Brussels, 4-05-2009
D/539824

INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER
155 rue Jean Jacques Rousseau
ISSY-LES-MOULINEAUX 92138
FRANCE

REGISTERED WITH ACKNOWLEDGEMENT OF RECEIPT

Subject: Amendment N° 3 to Contract N° GOCE-036851
Project "European Seas Observatory NETwork" (ESonet)
Your letter requesting amendment dated 01/02/2009
Reference: 07/121651/0/BF

Dear PERSON,

With reference to the above letter, this is to inform you that the Commission agrees to your request to modify the contract as follows:

Addition or removal of one or more special clauses

The special clause set out in Article 9 is modified as follows:

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<td>1. The contractor CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE represents also the following members of GEOSCIENCES AZUR UMR 6526 (referred to in this special clause as &quot;member(s)&quot;)</td>
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<td>- UNIVERSITE DE NICE SOPHIA ANTIPOLIS - UNIVERSITE PIERRE ET MARIE CURIE PARIS VI - INSTITUT DE RECHERCHE POUR LE DEVELOPPEMENT (IRD).</td>
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<td>- UNIVERSITE DE LA MEDITERRANEE AIX-MARSEILLE 2.</td>
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<td>The contractor CENTRE NATIONAL DE LA RECHERCHE</td>
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SCIENTIFIQUE represents also the following members of INSTITUT UNIVERSITAIRE EUROPEEN DE LA MER (IUEM) FR 2195 (referred to in this special clause as "member(s)")

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The contractor CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE represents also the following members of CENTRE EUROPEEN DE RECHERCHE ET D'ENSEIGNEMENT DE GEOSCIENCES DE L'ENVIRONNEMENT (CEREGE) UMR 6635 (referred to in this special clause as "member(s)")

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The contractor CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE represents also the following members of TECHNICAL DIVISION OF THE NATIONAL INSTITUTE OF UNIVERSE SCIENCES (DT INSU) UPS 855 (referred to in this special clause as "member(s)")

The contractor KONSORTIUM DEUTSCHE MEERESFORSCHUNG e.V. represents also its members (referred to in this special clause as "members")

The contractor CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS represents also its members (referred to in this special clause as "members")

2. The contractor may charge costs incurred by the members in carrying out the project, in accordance with the provisions of the contract. These costs shall not be considered as receipts of the project.

The members shall identify the costs to the project in accordance with the provisions of part B of the contract. Each member shall apply a cost reporting model in accordance with the principles established in articles II.19, II.20 and II.21. The contractor shall provide to the Commission:

- an individual financial statement from each member in the format specified in Form C. These costs shall not be included in the contractor's Form C
- an audit certificate from each member in accordance with the relevant provisions of this contract
- a summary financial report consolidating the sum of the eligible costs
borne by each member and the contractor, as stated in their individual financial statements, shall be appended to the contractor's Form C.

When submitting reports referred to in Article II.7, the consortium shall identify work performed and resources deployed by each member.

3. The eligibility of the member's costs charged by the contractor is subject to controls and audits of the members, in accordance with Article II.29.

4. The contractor shall retain sole responsibility toward the Community and the other contractors for its members. The contractor shall ensure that the members abide by the provisions of the contract.

as from 01/03/2007.

Modification of Annex I

The revised Annex I dated 1st February 2009 attached to your letter requesting the amendment referred to in the subject line replaces any former version.

All other provisions of the contract and its annexes remain unchanged.

The amendment comes into force upon the date of acceptance by the Commission of the modifications with effect from that date unless otherwise specified in each of the individual modification requested.

Please acknowledge receipt and inform your partners of the contents of this letter.

Yours sincerely,

[Signature]

M. Soares

Cc: Maria Di Francesco, CDMA 03/077; Pascal Legrand, CDMA 03/173
SIXTH FRAMEWORK PROGRAMME
PRIORITY 1.1.6.3
Global Change and Ecosystems

Contract for:

NETWORK OF EXCELLENCE

Annex I - “Description of Work”

Project acronym: ESONET
Project full title: European Seas Observatory Network
Proposal/Contract no.: 036851
Related to other Contract no.: (to be completed by Commission)

Date of preparation of Annex I: March 2007 revised the 1st February 2009

Start date of contract: 1st March 2007

1st February 2009
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APPENDIX C – REGIONAL OBSERVATORIES

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APPENDIX E - GLOSSARY
1. Project summary

The aim of the ESONET Network of Excellence is to create an organisation capable of implementing, operating and maintaining a network of multidisciplinary ocean observatories in deep waters around Europe from the Arctic Ocean to the Black Sea. The NoE will structure the resources of the participating institutes to create the necessary critical mass, remove barriers and through a joint programme of activities arrive at durable solutions for this future organisation.

Long-term observatories are crucial for European scientist to maintain world leadership that was developed through past and present framework programs. Only long-term observatories allow continuous observation of large numbers of parameters collected through power intensive sensors. This capability is crucial for observing natural processes that are either very episodic or statistically require long time series to detect because they are hidden by noise of higher frequency. The predecessors in the concerted action ESONET have identified such processes in all fields of marine sciences. The most important ones are: (1) the episodic release of methane from the seabed affecting climate change, (2) the relationship between earthquakes, tsunami generation and submarine slope failures, and (3) the short term biogeochemical processes affecting the marine ecosystem. These processes are of fundamental importance for European society, because we need to devise sensible climate change policies, protect our coastal population and infrastructure, and manage our marine resources. The establishment of long-term marine observatories is justified because they are the only means of acquiring continuously large amounts of different data, and being able to respond to them through interpretation task forces. The ESONET project has identified several of crucial scientific objectives.

The ESONET observatories will provide information on global change, warnings of natural hazards and a basis for sustainable management of the European Seas. They will be a sub-sea segment of the GMES and GEOSS initiatives and linked to the EU INSPIRE initiative.

A network of observatories around Europe will lead to unprecedented scientific advances in knowledge of submarine geology, the ecosystem of the seas and the environment around Europe. Very rapid advances in technical knowledge are anticipated. This will place European SMEs in an excellent competitive position for installation of such systems around the world. Our efforts will be part of a system extending around the world in co-operation with Japan, USA and Canada.

The NoE will work towards establishing sea floor and water column infrastructure which will provide power for instruments and real-time two-way data communications. Key areas around Europe have been identified from which specific targets are selected for relevant science programmes of potential hazards, geo hot spots and ecosystem processes. Sea floor infrastructure will provide platforms for instrumentation deployed throughout the water column and the geosphere below.

These ambitions are to be realized with new, advanced organisational structures linking scientific institutes, industries, governments and agencies throughout Europe and by initiating integration processes. The NoE will construct that framework.
Figure 1: Sites planned by ESONET NoE (detail in Appendix C)

Twelve permanent sites are initially identified, complemented by a mobile response observatory:

Figure 2:

Artic ocean: Arctic water exiting into the Atlantic ocean between Europe and Greenland is an important component of the global deep water circulation of the planet and its heat budget. Establishment of a long term station here is important for tracking global change as ice cover decreases but there are also important deep sea habitats such as mud volcanoes in the ‘Hausgarten’ region, off Svalbard.

Figure 3:

Norwegian margin: This region has shown slope instability with evidence of major slides which if repeated could result in catastrophic damage to offshore oil and gas installations as well as indirect effects of tsunamis striking the coasts of the British Isles and elsewhere. Special deep water habitats, such as coral reefs, are also an issue.

A major interest is on the Haakon Mosby Mud Volcano (HMMV)
Figure 4:

**Nordic Sea:** The MOEN (Meridional Overturning Exchange with the Nordic Seas) station uses the Faroes branch of the CANTAT-3 cable for measuring water column induced voltage. The recorded voltage is strongly influenced by the inflow of the North Atlantic Current. Long term monitoring of this current is of paramount importance in the understanding oceanic fluxes of heat, salt and freshwater at high northern latitudes and their effect on global ocean circulation and climate change in the arctic region.

Figure 5:

**Porcupine Seabight and Abyssal Plain:** This area has been an important area for biogeochemical flux studies in the past but is also a very productive fisheries and oil-gas exploration area. It is a stable margin with little evidence of seismicity, but does have important deep water habitats. This CELTNET site is used as a case study in the project ESONIM.

Figure 6:

**MOMAR** (Monitoring the Mid-Atlantic Ridge) is the site near the Azores. This area has special habitats associated with hydrothermal vents and sea floor morphology is distinct with recent crust spreading from the mid ocean ridge axis.
Figure 7:
Iberian sea observatory in the **Gulf of Cadiz**: It is a region of complexity with the junction of the Eurasian and African plates resulting in doming of the sea floor, mud volcanoes and other complex features. The interaction of the Mediterranean outflow with Atlantic waters is significant.

Figure 8:
**Ligurian sea**: Existing cables installed for the ANTARES neutrino detector experiment and long term data for the nearby Dyfamed site make it a practical early site for development. Slope instability processes, turbidites in the area of Var cañon, sea mammal sanctuary,… are criteria for a long term observatory.

Figure 9:
**East Sicily**: It is important offshore site close to Mount Etna, where the Italian SN-1 multidisciplinary observatory recently completed its first 6 month mission. The existing cable for NEMO neutrino experiment provides a focus for real-time data transfer and the integration of the seafloor observatory into land-based networks.
For tests and demonstrations, the **Koster Fjord area**, a coral site is situated only 500 m from the shore at a water depth of 90 m, will offer a Seafloor Observatory at this site with a cable connection to a shore station with power supply and real-time connection to the internet.

Maritime disasters happen mainly during a very bad weather in areas which are seldom monitored by permanent observatories. In a similar way, underwater seismic or volcano hazards may endanger inhabited zones in areas where no warning system has been yet implemented. Crisis management and risk evaluation are requiring to collect as soon as possible real time data on the environmental conditions of the area and the spill characteristics. ESONET will address the potentialities of scientific packages developed for permanent monitoring, implemented on subsea nodes that can be deployed under short notice. The standardisation and interoperability promoted by ESONET will make available the
complementarity of the most advanced equipments. They will be deployed from a security center in case of for instance pollution disaster at sea, in order to gather and transfer the in-situ data. The concept of this “Mobile response observatory” is based on an underwater networked observatory system deployed in the vicinity of the shipwreck or of the pollution source or of the unforeseen natural event at sea. The data will be transmitted to national environment authorities, coast guards and the European Marine Safety Agency.

The integration process of ESONET NoE, a permanent effort during the project, will be based on:

- building up active groups sharing their knowledge, methods and resources.
- acting as one body towards funding institutions (including EC), stakeholders, potential users and similar international projects,
- jointly acting for a strong cooperation with other networking efforts in ocean sciences, ocean technology, ocean data management (GEOSS, MERSEA, GMES, EUR-OCEANS, HERMES, ECOORD), and infrastructure (SEADATANET).
- Establishing functional relationships with the above (knowledge or data provider, cooperation, complementary scientific goals, complementary sea or subsea intervention means,…),
- Advancing the infrastructure policy of subsea observatories in Europe.
- On line monitoring to make the investment safer including quality control. This should not be underestimated (see COSTA project)
- Combination of oceanographic, geological, and biological themes at one station to enhance cost effectiveness compared to short term deployments

From the beginning of the project, lasting integration is in perspective through the construction of a permanent structure able to provide a set of ESONET CORE SERVICES, related to ESONET REGIONAL LEGAL ENTITIES. All of them will be linked for their implementation scheme as well as for a scientific and technical improvement process.

ESONET NoE will foster energies in Europe to constitute a permanent organisation before the end of the 4 years project duration. The European Seas Observatory Network promotes infrastructures that will operate for 10 to 30 years. ESONET NoE have to experimentally verify the initial idea that it is only feasible and cost efficient with a permanent structure, owner of the ESONET LABEL\(^1\) and offering “Core Services”: the NoE intends to give birth, if feasible, to such a structure.

The RLE (Regional Legal Entity) might be a research institute, a government agency, a company or a partnership or private organization depending of the size and circumstances of the project. The ESONET RLE would be responsible for providing the utility services to the observatories in the ocean and will report to the stakeholders and financing bodies. The ESONET RLE would be responsible for receipt of funds from international, national or regional sources and paying for installation and operation of the regional observatory. Since the ESONET RLE controls funds, it should be responsible for choice of technical solutions, deployment and operation of the system, provided it does not undermine the ESONET organisation (ESONET LABEL : interoperability, standards,…) and potential users.

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\(^1\) An ESONET LABEL will be attributed to deep sea observatory network legal entity in charge of one or more of the ESONET sites around Europe (Fig. 1) called REGIONAL LEGAL ENTITY if its meets all the conditions defined by the NOE.
Three work packages are in charge of integrating activities. WP1 is devoted to networking activities in the field of: integration of regional observatory initiatives and multidisciplinary efforts, data infrastructure, sharing facilities and link with international observatory programmes. WP2 builds up standardisation and interoperability in the field of sensor and scientific package, quality assurance and underwater intervention. The long term funding plan strategy will be issued from WP5 implementation strategy tasks on economical and legal models, site assessment and environmental constraint evaluation; the joint reply to infrastructure initiatives will be the occasion to practice.

Jointly executed research activities will consists in 2 WPs. In WP3, scientific objectives are specifying for the observatory design including generic and specific science modules. WP4 is devoted to demonstration missions chosen through calls for proposals. The excellence gained in ESONET will be spread by activities towards socio-economic users (WP6), education and the public (WP7).
2. Project objectives

2.1. Scientific Objectives

Oceans exert a pervasive influence on the Earth’s environment, most notably as a regulator of climate. Understanding the link between natural and anthropogenic processes and ocean circulation is essential for predicting the magnitude and impact of future changes in Earth’s climate. In this respect, the knowledge of deep water circulation close to the seafloor (i.e., water currents at the Benthic Boundary Layer) is a fundamental objective. More generally, understanding the interactions between ocean, biosphere and geosphere (lithosphere, and solid earth below), leading to natural hazards (e.g., tsunami, seismicity, submarine landslides) or environmental changes (e.g., sea-level, ecosystem changes, greenhouse gas budget) is one of the main scientific challenges for the next few decades.

To accomplish this goal, long time-series measurements of critical parameters, such as those collected using deep sea observatories and water column Eulerian observatories, are needed to supplement traditional seagoing investigations. These observatories will have power and communication capabilities and provide support for spatially distributed sensing systems and mobile platforms. Sensors and instruments will cover the whole water column, potentially extending the observation capabilities from below the seafloor up to the air-sea interface. Deep sea observatories will also be a powerful complement to satellite measurement systems by providing the ability to collect vertically distributed measurements within the water column for use with the spatial measurements acquired by satellites while also providing the capability to calibrate remotely sensed satellite measurements.

It is now clear that to answer many important questions in the ocean and Earth sciences, a coordinated research effort of long-term investigations is required. Experiments and research programmes, from the 1980s to the present, reflect the progressive enhancement of monitoring systems in the ocean basins. During this time we have witnessed the achievement and strengthening of the concept of “deep sea observatories” and the technical evolution of earlier, quite simple, stand-alone mono-disciplinary instrumented modules into more complex multi-parameter platforms with extended lifetime and performance. Much of deep sea observatory research is interdisciplinary in nature and has the potential to greatly advance the relevant sciences.

Observatories networked at seafloor level will offer Earth and ocean scientists new opportunities to study multiple, interrelated processes over time scales ranging from seconds to decades. These include: a) episodic processes; b) processes with periods from months to several years; c) global and long-term processes. Episodic processes include, for instance, eruptions at mid-ocean ridges and volcanic seamounts, deep-ocean convection at high latitudes, earthquakes, and biological, chemical and physical impacts of storm events. Category “b” includes processes like hydrothermal activity and biomass variability in vent communities. The establishment of an observatory network will be essential to investigate global processes, such as the dynamics of the oceanic lithosphere and the thermohaline circulation in the Ocean.

Such an increase in sampling capability will result in major advances across a range of scientific disciplines:
Global Change and Physical Oceanography:
- Deep water thermohaline ocean circulation,
- Physical oceanography processes,
- Upper ocean and climate change,
- CO₂ budget.

Earth sciences, geohazards and seafloor interface:
- Transfers from the Earth’s interior to the crust, hydrosphere and biosphere,
- Earthquake hazards,
- Tsunami hazards,
- Slope instability and sediment failures,
- Fluid flow and gas seepage through sediments and gas hydrates,
- Sediment transfer to the deep sea and climate change.

The Marine Ecosystem:
- Biogeography of European seas,
- The temporal ecology of photosynthetically and chemosynthetically driven benthic ecosystems,
- The dynamics of deep seafloor hydrothermal vents ecosystems,
- Pelagic (upper ocean) ecosystems,
- Coral reefs and Carbonate Mounds.

Non-Living resources:
- Energy (renewable resources and hydrocarbons, including CO₂ sequestration),
- Mining/deposition.

In order to solve key issues, such scientific fields are facing time and regional limitations that seafloor/water column observatories will overcome; these issues are presented in the Appendix B.

2.2. Environment and Security Operational Objectives

2.2.1. Seismic and Tsunami hazard operational networks
Deep sea observatories also have the potential to play a key role in the assessment and monitoring of geo-hazards, as many of Earth’s most seismogenic zones and most active volcanoes occur along continental margins plate boundaries like South Europe. Continuous measurements are required with the ability to react quickly to episodic events, such as earthquakes and volcanic eruptions. For geo-hazard mitigation, as the human population continues to grow, the potential social and economic dislocation provoked by natural hazards, such as earthquakes, volcanoes, submarine landslides and tsunamis, has increased. These impacts are especially detrimental to developing nations. The destructive earthquakes and related tsunamis that occurred at the end of 2004 in the Indian Ocean, and that strongly affected Sumatra, Malaysia, Indonesia, the Andaman Islands, Thailand, Myanmar, Bangladesh, Sri Lanka, India and the Maldives in terms of lives and economic impact, are only the most recent examples.
For estimating earthquake parameters and forecasting the expected height of the oncoming water wave, computer aided tsunami generation models are used. In all areas threatened by tsunami hazards, deep sea observatories developed within ESONET will be equipped with seismometers and high precision, low frequency pressure sensors. Each of these ESONET nodes will represent the base for the implementation of a tsunami early warning system covering the Eastern Atlantic and Mediterranean areas. The concept of “earthquake early warning systems” has been suggested by Hiroo Kanamori (2004) and others, in which the eventual size of an earthquake is estimated from the very beginning of the P-wave, so that an early warning of the damaging ground motion due to the S-wave can be issued. Because a seismic faulting is essentially a shear faulting, the first arriving P-wave is small and seldom causes damage.

Taking advantage of this special property of energy radiation from a seismic faulting, it is possible to develop early warning methods which will play an important role in modern societies with large and sophisticated structures. This concept is still in its infancy, but it is definitely worth progressing through ESONET and permanent seafloor monitoring.

Deep sea observatories need a real-time communication to on-shore, allowing the integration of their data in the already existing land-based seismic networks to advance a better understanding of plate-tectonic margin behaviour and of important seismogenic zones located at seas around Europe. ESONET NoE will benefit from already established links with organisations able to manage data and waveforms of terrestrial networks (like ORFEUS and CSEM) through the relationship with other approved EC projects [e.g., NERIES] in which some of the ESONET partners are involved. In relation to other geo-hazards like tsunamis, the actions of ESONET NoE will be in coordination with UNESCO-IOC, following in particular the recommendations of the “Intergovernmental Coordination Group for the Tsunami Early Warning System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)” launched at its 1st Session held in Rome (November, 2005).

Figure 13 : Historical seismic map during last 15 years, indicating at sea tsunami-genic sources in the area defined by the group of North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)
2.2.2. Physical Oceanography networks (water column)

Integrated operational monitoring and forecasting systems, such as the MERSEA system, are able to simulate and anticipate ocean conditions. The operational monitoring and forecasting of the ocean physics, bio-geochemistry and, to a certain extent ecosystem, will be completed within 2-3 years (objective of FP6 –MERSEA IP project); Satellite Remote sensing and in-situ Lagrangian data are providing most of the necessary assimilation input to the models, but Eulerian data are needed.

Indeed, the development of the algorithms for the models, the checking of these models during their development and their validation when operated (especially when forecasting is aimed at) are all needing time series. In-situ quantities in critical or representative locations need to be collected in a mode that delivers temporal variability on scales of hours to months.

ESONET NoE will provide data on key parameters from the subsurface down to the seafloor at representative locations and transmit them in real time to shore. The strategies of deployment, data sampling, technological development, standardisation and data management will be integrated with projects dealing with the spatial and near surface time series.

The contribution of ESONET will come through GMES for several key parameters of the water column. During the next 4 years, the target of GMES is clearly to prepare an operational phase in ocean physical oceanography. ESONET will contribute to “Initial Operational Phase of GMES Marine Core Services” (Figure 15) planned for 2008 as well as a regional policy on the Downstream Services. ESONET NoE regional development will take into account the geographical policies of GOOS regional task teams: Arctic, North-West Atlantic shelf NOOS, Mediterranean MedGOOS (reference projects MFSTEP, MOON), Iberia-Biscay-Ireland Shelf IBI-ROOS, Black SeaGOOS (Figure 14).

Figure 14 : Map of European regions envisaged by MERSEA project for their Downstream activities
Eulerian data in Operational Ocean Monitoring and Forecasting

No observing system can possibly capture a medium as vast and complex as the ocean, with all its diversity of processes and scales of variability. All knowledge and information available must be combined to describe it fully; the information is gained not only from all observations available, but also from the knowledge of the dynamics. The state of the art for the optimum combination of diverse data sets (in situ and remotely sensed) is through assimilation into numerical models, which take explicitly into account the physics and dynamics which control the temporal evolution of the ocean. Data assimilation allows not only nowcasts, i.e. best estimates of the present state, but also forecasts of its evolution, and re-analysis, which reconstitutes a coherent and consistent history of the evolution over an extended period of time. The MERSEA project, for instance, is developing an integrated system to monitor and forecast global ocean and European seas through routine assimilation of near-real-time satellite and in situ observations into 3D ocean models. The system expands and coordinates on-going national efforts in these fields (e.g. the global FOAM, MERCATOR, MFS and DIADEM/TOPAZ, and several national regional systems). The Global Ocean Data Assimilation Experiment (GODAE), is an international effort aiming to demonstrate the feasibility and the value of operational oceanography systems.

It is obvious that those systems cannot operate without the provision of comprehensive Eulerian in situ data set, which are the indispensable complement of Earth observing satellites.

Time series observatories occupy an indispensable niche in the vast temporal and spatial sampling that is required to monitor and forecast the ocean properly. They are essential to model validation. Progress in ocean model and assessment of system performance depends on rigorous validation against in situ data. For instance the validation of climate scenarios models is often made by considering their ability to reproduce past evolutions, where comprehensive data sets are the only objective reference. In the case of model development, in situ observations provide the necessary data for quantifying ocean processes and guide the tuning of their parametric representation (e.g. mixed layer depth, deep water formation, position of fronts, warm water pool, eddy kinetic energy, mixing, etc…). In the context of

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2 This is of course exactly the approach of numerical weather prediction systems for the atmosphere.

3 The MERSEA project is funded by the EC, under FP6, to develop Ocean and Marine Applications for GMES.
operational models, which assimilate observations, it is valuable either to estimate the misfits between model output and data -a measure of the ability of the model to account properly for the data -or to validate forecast skill by comparison of a previous forecast with data effectively collected at the target date.

According to MERSEA coordinator, the ESONET system can provide key in-situ model quantities in critical or representative locations need to be collected in a mode that delivers the temporal variability on scales of days to months, for:

- providing data on changes, processes, and events unobservable from satellites (like biogeochemical quantities),
- referencing, calibrating, validating satellite products (e.g. chlorophyll),
- estimating and tuning model parameters and process representations (e.g. primary production),
- validating assimilation and forecasting products (ecosystem changes),
- establishing meaningful statistics (high resolution spectra, extreme events, means, variance and covariance).

The biogeochemical models are in desperate need of data, since satellites cannot provide the required information and no observing system exists which delivers such variables. Timeseries observatories are at present the only method/technology to provide a complete suite of biogeochemical quantities, like chlorophyll, oxygen, CO₂, nutrients. The technology and infrastructure for this, including real-time data transmission, has been developed and implemented in the FP5 project ANIMATE.

Time series observatories from the ESONET network offer the advantage of relaxing the stringent constraints of power and data transmission limitations of autonomous surface moorings; they open the perspective of adaptive sampling strategies (burst sampling), high resolution measurements, and multi-parameter observations.
2.2.3. **Ecosystem management**

Monitoring of the ocean environment requires not only physical but also ecosystem models. Significant advances have been made in recent years in understanding and modelling the complex processes in ecosystems, ranging from the bio-geochemical processes governing the global carbon cycle (uptake, sequestration, and release) and other gas exchanges, to the coastal ecosystems describing water quality, primary production or algal blooms. The performance of ecosystem models is strongly predicated on the realism of the underlying physics, which in turn depend on good observations.

Well-managed seascapes are the basis of sustainable development and human security. They are critical to address underlying causes of biodiversity loss.

Ecosystem management requires a good knowledge of the structure and function of the communities of organisms inhabiting the pelagic and benthic environments of the deep ocean extending from the edge of the continental shelf to the depths of the deepest trenches. The paucity of sampling and monitoring of this vast area, combined with the increasing demands on open ocean resources require extensive study of this domain. Deep sea observatories are powerful instruments to approach some critical points:

- spatial and temporal variability in the deep ocean of organisms,
- seasonally and interannually variability of food supply,
- shifts in populations of megafauna,
- description of unknown species of organisms.

They will contribute to resolve questions essential to deep ecosystem management:

1) What are the dynamics of deep sea community structure in terms of species composition, abundance, biomass and diversity?
2) What processes produce/maintain diversity in deep sea communities?
3) What is the pattern of succession in deep sea communities and how is it regulated?
4) What is the influence of a spatially and temporally variable food supply on deep sea communities?
5) What are the vertical and lateral movements of deep sea animals?
6) What is the importance of vertical and lateral movements of deep sea animals in the transport of nutrients through the water column and across the continental margin?
7) What are the temporal and spatial influences of natural perturbations on deep sea communities?
8) How do anthropogenic inputs influence deep sea communities?
9) How do various scales of fluid release influence chemosynthetic communities?
10) How does the productivity of chemosynthetic systems influence surrounding deep sea communities?
11) What is the structure and productivity of the sub-seafloor biosphere?
12) What processes influence the formation, deposition, dissolution, or venting of gas hydrate deposits, and how do gas hydrate dynamics affect the subsea floor biosphere, deep communities, or climate system?
2.3. Technical Objectives

The technology of deep water scientific cabled observatories is still at its infancy. This situation is contrasted by the fact that deep sea exploration led by the hydrocarbon industry is now mature and industrial products and services are readily available. Taking advantage of the state of the art through cooperation with engineering underwater R&D actors and cooperation with leading companies in this field (e.g. Statoil, Alcatel, Fugro, Tecnomare) and SMEs, ESONET will provide the necessary steps to new cost effective developments and implementation of permanent observation capabilities with high priority for our society. This means that ESONET will facilitate the introduction and adoption of standards in the realm of scientific investigations to enable interoperability on the system and component level. Furthermore the project will enhance capacity building in the context of long term operation of observatory systems. This will result in an improved efficiency regarding scientific cooperation on the European level for instance in shared use of instrument and sensors on different platform-types.

The integration of leading European companies and SMEs into the anticipated Network of Excellence will be beneficial to both the industrial and the academic side. The scientific user will be able to adjust the requirement on the observatory system with respect to a technical and economic feasible solution while European companies will be enabled to adapt existing and develop new innovative methods for the prospective ocean observatory system. In this way, ESONET will stay abreast of future changes in the technological field.

The offshore oil and gas industry make great use of remotely operated vehicles (work class ROVs). Until recently, only a few scientific institutes in Europe (IFREMER, RCOM, NOCS) had deep water ROVs capable of servicing deep sea observatories. Major investment has now been made or is decided. These partly specialized ROVs or mobile dockers are able to deploy the diverse instrumentation of subsea experiments. SERPENT⁴, a collaborative project between oil companies, industrial companies and scientific institutions, shows the potential of use of work class ROVs for the deployment of scientific equipment. An objective of ESONET NoE is to provide common procedures based on experience within the offshore industry and standard interfaces to ease the interoperability of these subsea intervention means on the various European observatories.

2.4. Societal and Policy objectives

These will be achieved through the integrated research described in the Joint Programme of Activities (JPA). Through its JPA, ESONET will make a significant contribution to the development of a thematic strategy for the protection, conservation and sustainable use of the marine environment (Communication from the Commission to the Council and the European Parliament on “Towards a strategy to protect and conserve the marine environment”, 2 October 2002).

ESONET will spread scientific excellence and information resulting from its activities in three main directions: (1) to the socio-economic users of knowledge regarding the impacts of climate and anthropogenic forcing on continental margin ecosystems, (2) to the European industry including SMEs and (3) to governmental bodies. A complete WorkPackage, WP6, is dedicated to these objectives.

⁴ The SERPENT project (Scientific and Environmental ROV Partnership using Existing iNdustrial Tectnology) already involves leading European operators, it makes cutting-edge industrial ROV technology and data more accessible to the world's science community, sharing knowledge and progressing deep-sea research (http://www.serpentproject.com).
PESOS (an Association of SMEs from several member states, partner of ESONET- group of Providers of Equipment and Services for Observatory Systems) will initiate the building by ESONET of a SME organisation at European scale with SMEs interested in the monitoring of European continental margin ecosystems and seafloor processes. This association will play a major role into standardisation groups. More specifically, ESONET will indicate future environmental technology monitoring and innovation needs in the fields of continental margin exploration and exploitation. The ESONET observatory network will also improve the protection of European society against geohazards, by enhancing the capability to monitor, in real time, the dynamics of European margins.

The transfer of knowledge to users will allow the EU and governmental bodies to make significant contributions to the world effort to define mitigation strategies to confront global change, and to manage marine resources and ecosystems. The socio-economic users of ESONET knowledge include (a) assessment bodies, their scientists and policymakers, e.g. IPPC, (b) Intergovernmental organisations, e.g. UN / IOC, UN / FAO, ICES, (c) International agreements on exchange of data related to hazards such as global seismographic networks like GSN, FDSN and GEOSS related tasks (d) International Conventions, e.g. CBD, OSPAR Convention, (e) Non-governmental Organisations, (f) National fisheries assessment and climate change agencies, (g) Relevant European Commission directorates, e.g. Fisheries Directorate General.

The spreading of knowledge to the European public will be achieved through the use of centres of public outreach like aquaria and museums. Transfer of knowledge will specifically target the young age groups in order to favour general orientation towards science, foster scientific careers and most importantly shape an environmentally sensitive European society. The WP7 is dedicated to these objectives.

Overall, the ESONET approach answers Europe's strategic need to strengthen excellence on the major topic of hazard mitigation through environmental monitoring. This will further be achieved by restructuring the existing research capacities and the way research is carried out.

2.5. Objectives of long term governance

The ESONET NoE is a stepping stone on the way to creating an underwater ocean observatory network that will remain in place for decades, and that will be added to over time. The costs and practicalities of sustaining such a network require a concerted approach by the funding agencies of the European countries over a long time period. The costs will be more expensive than can be borne by a single country or the EU alone; the expertise required to create and manage the observatories lies in more than one country; and the ship time to service and install the equipment requires a combined effort. The benefits will be shared by all the maritime nations of Europe who will gain better knowledge of geophysical processes and risks (e.g. offshore earthquakes and tsunamis), knowledge of the seabed environment and natural change therein for better planning and regulation and better understanding of global change as it affects the oceans (e.g. ocean acidification, temperature change). The ESONIM project is in the process of establishing technical, legal and financial models for seafloor observatories, ESONET will add to this effort by directly engaging the funding agencies to alert them to the work in progress, future benefits and opportunities.

The actual structure of governance of the European Underseas Observatory Network that the NoE will build is not easy to determine at this stage. One of the objectives of ESONET NoE is to investigate the legal, economical and research policy feasibility of the organisation and in the same time build up the convincing elements for its successful achievement. ESONET partners are conscious of the time needed for planning financial commitments that will last...
Nevertheless, ESONET NoE has a preliminary plan for the construction of this organisation. The NoE will promote it, adapt it to research policy requirements, and issue the long term plans from the evaluation of the first results. This preliminary plan is to establish an interrelated structure (Figure 16) consisting of:

- a legal body at European scale, in charge of common responsibilities and tasks (dissemination, data management, standardisation, interoperability issues for maintenance, technology,…) providing CORE SERVICES and attributing ESONET LABEL. It might be an association, a foundation, a European Economic Interest Grouping or a mission devoted to an institute in Europe.
- a number of ESONET REGIONAL LEGAL ENTITY (RLE), owners and managers of the infrastructure and activities on one or more ESONET sites (Figure 1).

Figure 16: ESONET permanent structure
### 3. Participant list

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*CO = Coordinator  CR = Contractor

** Normally insert “month 1 (start of project)” and “month n (end of project)” These columns are needed for possible later contract revisions caused by joining/leaving participants

*** Core partnership is limited to institutes which can build, deploy, operate and maintain an European seas observatory Network.

OSI: Other Scientific Institutions are research institutes that will seek to use the data from the Network, own equipment, have a know-how, international relations, lobbying capabilities and are consequently actors of the programme of activities to build the Network

Partners from the commercial sector who will work towards the development and deployment of such a Network are either a large Company or a SME.
4. Relevance to the objectives of the specific programme and/or thematic

4.1. Appropriateness of using a NoE: generation of knowledge

Networking (i.e. sharing research facilities, using the same standards, international cooperation and mobility, efficient communication) and jointly executed research activities are paramount to the production of world-class science in deep sea observatory sciences (long term data series exploitation, risk assessment, geohazard, climate change). European research devoted to subsea observatories, although researchers, engineers, industrial companies are well recognized in Japan and North America, is not yet able to generate knowledge at the level of its expertise. EC funded projects and especially the ESONET CA started to bring confidence in the potential present in the EU and in the scientific appropriateness of developing observatories in European seas. The necessary next stage is to strengthen this community and orientate its skill towards solving key scientific problems in the field of deep sea environment and security. The cooperation of an integrated networked European consortium with North American and Japanese will then bring benefits to the global environment issues including third countries.

In addition to the scientific knowledge addressed in 2.1 and Appendix B, long term monitoring at sea is most probably a driver to a new branch of scientific and technological expertise. The analysis and management of long high frequency time series, the treatment of high definition TV images, the processing of optical and acoustic imaging are examples of some challenges.

4.2. Appropriateness of using a NoE: reduction of fragmentation, and creation of a progressive and durable integration of the EU research capacities

A major impediment to establishment of the proposed network of observatories is multiple fragmentations across boundaries that are: disciplinary, geographical, national, legal, institutional, technological, operational and micro economical.

4.2.1. Disciplinary boundaries

Participants in ESONET are unified by the requirement for continuous data acquisition on decadal time scales at fixed locations in the seas around Europe. This requirement brings together scientific disciplines that would otherwise have little contact with one another. Geo-sensors may be deployed in bore holes beneath the sea floor to monitor fluid flow with the earth’s crust. Ocean bottom seismometry is focussed on signal processing from arrays, rather than specific sampling of the seafloor. Within the water column, oceanographers study movements of water masses and their influence on the transfer of heat and matter across the planet with little reference to biology or solid Earth sciences. There has been little communication between remote sensing scientists and those specialising in development of sea floor instrumentation. A relatively recent positive development is the link to the astronomy community on neutrino networks as well as with hydrocarbon industry in joint use of sub-sea infrastructure. It is vital for ESONET to build links across these boundaries in order to build efficiently the scientific multidisciplinary monitoring objectives and a joint infrastructure. To overcome this fragmentation, WP3 is dedicated to a multidisciplinary scientific approach of subsea observatories.
4.2.2. **Geographical boundaries**

Europe is surrounded by 4 great marine basins, Arctic, Atlantic, Mediterranean and Black Sea with their subdivisions and connecting shallow seas such as the North Sea and Baltic. An important function of the NoE will be to co-ordinate work in these disparate areas so as to create a unified system with global relevance and common standards. The NoE will bring people to work together, to optimize efforts and investments. Two “All Regions Workshops” will be organized by WP1 Task a) during the project with the aim to build a subsea observatory community throughout Europe. Regional observatories will be awarded an ESONET LABEL, if they comply with a number of conditions establishing a durable integration at European level.

4.2.3. **National**

For the development of ESONET, problems of fragmentation within and across national boundaries will have to be overcome. The observatories may be located within the territorial sea of adjacent states or within international waters. They may be wholly or partly owned by organisations from states other than the local littoral states. In WP5, task c is aimed to support and develop co-operative efforts by all the nations represented in the project to develop common implementation projects. WP6 is dedicated to the spreading of excellence to socio-economic users in order to promote core services based on subsea observatories at European level.

4.2.4. **Legal**

Linked to the issues of national jurisdictions, there are legal barriers to the establishment of extensive infrastructure extending from land into the sea. The NoE will have to consider issues such as EEZ determination and ownership of sea floor, the intertidal zone and shore bases; the legal aspect of dissemination of information related to hazards and civil protection; and the implications of international and European legislation and agreements for the operation of a cabled deep sea observatory. Finally, the NoE will support the implementation of legislative initiatives for the protection and preservation of the marine environment (MPA and PSSA). WP5 Task b) will focus on solving potential legal constraints.

4.2.5. **Institutional**

Within or across member states, division of responsibilities between institutions can form artificial barriers to development of the ESONET observatory network. There are further differences in relation to private enterprise and the degree to which private enterprise can be responsible for public infrastructure in different countries. Different funding and employment models can be barriers to collaboration. It is important for ESONET to identify the correct organisations for implementation of different aspects of the work in different countries. In particular, on the side of geo hazard and early warning it will be of paramount importance to coordinate information and efficient data exchange among civil protection of different countries. Some ESONET partners are involved in EC projects (e.g. NEAREST) that need to manage this topic. WP6 is dedicated to the spreading of excellence to socio-economic users in order to promote core services based on subsea observatories. WP5 task c) and task d) will facilitate the creation of mechanisms to overcome institutional boundaries and develop integrated projects.
4.2.6. **Technological**

The building blocks of the proposed ESONET system are already in existence, like sub-sea sensors, observatory platforms, cables, junction boxes and data centres. However sensors in different disciplines have been developed independently and operate to different standards. This tends to require a certain amount of extra work by specialists for any inter-comparison of data collected by different teams. Furthermore, one could face a situation where additional data mining is necessary in the future when scientists will need the time series measured now. A lack of mutual exchange of good or bad experience usually comes from the use of very different technical choices. It is then difficult to promote European technology and foster SMEs or industrial growth on the market.

Such a situation must be prevented as early as possible before the major investments. The Network of Excellence will overcome this tendency for divergence.

The co-ordination of decision making by the observatory networks on the Western coast of North America is in contrast to the European situation where individual technical solutions are realised within the various existing regional underwater observatories. A targeted effort was initiated by EC projects to focus innovative underwater monitoring technology developments by involving SMEs. One can foresee a gap between providers in Europe and in North America once the latter starts to stimulate the market with large orders when major funding becomes available.

Competitiveness of European SMEs is threatened by the diversity of decision making in Europe and this will be specifically addressed by Task c) of WP6.

4.3. **Relevance to EU policy in this thematic**

ESONET is launched during the phase of consultation on the “Green Paper on a Future EU Maritime Policy”. The partners have been able to synthesise on the long term observatory issues through their exchanges in previous projects such as ESONET CA and during the preparation of this project. They are willing to participate to this step and the next steps of the establishment of the future EU Maritime policy.

Through its JPA, ESONET will make a significant contribution to the development of a thematic strategy for the protection, conservation and sustainable use of the marine environment (Communication from the Commission to the Council and the European Parliament on “Towards a strategy to protect and conserve the marine environment”, 2 October 2002). Our better understanding of the interactions between deep-water circulation, the biosphere and the geosphere will also contribute to the implementation of international commitments of European Union and Members States such as UN Framework Convention on Climate Change (UNFCC) and Group on Earth Observation (GEO).

ESONET research undertaken will enhance delivery of benefits to some of the areas defined in the GEO 2006 Workplan, as “Disasters”: develop our capacity to utilise deep water observation for prevention of natural disasters, “Climate”: understanding, assessing, predicting, and adapting to climate variability and change, “Ecosystems” : management and protection of deep-sea ecosystems and “Biodiversity”: understanding, monitoring, and conserving deep-sea biodiversity.

This European deep-sea observatory network will then contribute to the sub-sea segment of the GMES European initiative (Global Monitoring for Environment and Security) by its capacity to monitor physical, biological, geo-chemical, geological and geophysical processes.
occurring though out the sub-sea floor, sea floor interface and the water column. Data and information sharing will be developed between stakeholders to contribute to the understanding of key processes and protection of the marine environment.

The personal involvement of key partners (and all core partners) in infrastructure boards such as Marine Infrastructure Forum (MIF) of MARIN-ERA will enable direct linkage with ESONET. ESONET NoE will consider, link and build on existing and future initiatives in particular relevant ERA-net projects (MARINERA, BIODIVERSA and ECORD) aiming at stepping up the cooperation and coordination of research activities through networking of programmes, development and implementation of joint activities. Interactive participation in workshops organized by ESONET and ERA-net projects will be developed. For example ESONET NoE will be presented to MARINERA to identify common activities. In this regard, links will be built with the Deep Sea Frontier (DEEP-SF) Initiative, endorsed in Bonn in 8/9/2005, which has been the object of a recent expression of interest for EU funding for an Article 169.

ESONET will also consider on-going and future scientific research projects and will promote common use of infrastructure in the following initiatives:

- European Consortium for Ocean Research Drilling (ECORD-IODP);
- EMSO - European Multidisciplinary Deep sea observatory infrastructure for long term permanent monitoring of the ocean margin environment around Europe presented to ESFRI (European Scientific Forum for Research Infrastructures);
- European projects : EUROMargins, IMAGES, HERMES ;
- National Margins programmes.

The above EU initiatives or policies will be effectively addressed by ESONET. The Network will provide European policy makers with a predictive scientific basis for deep-sea observation and sustainable use of deep-sea resources.

It will also outline research perspectives with respect to the 2005 European marine Strategy and the future European Union maritime policy « a European vision for the oceans seas » (green paper published this year).
5. Potential Impact

5.1. Strategic impact

Step by step, taking into account the diversity of marine policies of Partner Nations, ESONET will create an organisation capable of implementing, operating and maintaining a network of multidisciplinary ocean observatories in deep waters around Europe.

- ESONET will alert the funding agencies of all Partner Nations to its activities with the intent to allow those who are willing to plan and commit expenditure over a long time period (tens of years) to sustain the observing networks. The mandate of «core partners» in ESONET is to promote European Subsea Observatory policy at national level. The strategic position envisaged is to act at the same level as Canada, Japan and USA in order to be able to establish equilibrated cooperation.

- Through the integrating activities of the first year, integrated plans of ESONET for a European Seas Observatory Network will be presented by groups in each field of expertise.

- ESONET will demonstrate European capabilities through demonstrations on sites of high scientific interest (second year).

- ESONET consortium will present jointly projects of underwater observatory infrastructure.

- As early as possible and before the third year ESONET will constitute a formal organisation.

At the end of the project (and preferably before):

- the construction of infrastructure of underwater observatories will be planned according to the budgets available at local, national or EC level;

- the methods and strategies of operation and maintenance will be established from common standards and incorporated in the ESONET LABEL;

- the body in charge of ESONET CORE SERVICES and all ESONET REGIONAL LEGAL ENTITIES will have technical and business plans towards permanent operations and are expected to have relevant legal basis; a number of Partner Nations will participate;

- Scientific objectives of European Seas Observatory Network will be updated, promoted by a wider, more multidisciplinary community, in close interaction with stakeholders.

5.2. Public interest for deep-sea processes

The outreach towards the public is one of the targets of ESONET in its strategy to spread excellence.

It is planned to start with an educational website showing the work in progress and to associate it with class material. The link with teachers is an excellent information conduit and will open the scope from schoolchildren up to undergraduate level. Next step is to build a web portal with real-time web interface. It will allow disseminating images from the seabed: natural events and remote operations. The capacity to produce films and outreach material is
one of the criteria for the experiments of ESONET (WP4). ESONET (WP7) will build up dissemination products from this raw material.

Consequently, ESONET outreach tools will be ready for major outreach actions towards the general public. The partnership with the Association for EUROCEANS Public Outreach through Oceanopolis will be a basis to develop exhibitions and lecture tours all around Europe. These exhibitions and the major scientific events of ESONET (All Regions Workshop for instance) will be occasions for TV, radio and press communication. ESONET outreach activities will take into account the policy of the Commission for information activities, including participation in the annual European Science Week.

5.3. Contributions to standards

Sea technology does not immediately lend itself to standardisation as highly specialised equipment for dedicated applications are developed and used. As a matter of fact, up to now there has been no real scientific or economic need to define standards in this realm of technology except for certain areas of offshore industry as for instance standards for operating ROV systems (e.g., ISO 13628-8, 2002). National standards do not address a sufficient market and independence of owners of sea equipments and seagoing personnel is not pushing for rules. The situation will certainly change within the very next future as permanent installations will be established in deeper waters be it for the oil industry or for scientific investigations and monitoring. Likewise to programs in space sciences an efficient management systems has to be erected and this immediately calls for standardisation on different levels starting from the mechanical adaptation up to mission assurance procedures.

At this point the key players in the field of ocean technology from industry and academia have to join forces and have to set up a sustainable information network by for instance setting up ad-hoc committees to address certain aspects of interoperability and standardisation. ESONET comes timely to be able to contribute to this subject offering an open forum to discuss all related issues. All sides can benefit from merging expertises as this will ensure higher reliability, better cost efficiency for the maintenance and operation of the installed infrastructure. Reliability and efficiency considerations led oil companies and Public oil Directorates to start using standards in the 70’s. Scientific subsea observatories will have to do the same, taking advantage of the previous experience of cable and gas and oil production infrastructures. ESONET will revert to existing infrastructure and will assist in defining the architecture of future observatory systems. This objective matches precisely the goals of other initiatives like GEOSS and NEAREST. An essential contribution of ESONET to GEOSS will come from the work package 2 on Standardisation. Work package 2 will help to build up a knowledge base on interoperability in cooperation with other national, European and international programs. Setting up links to existing standardisation initiatives and organisations or by direct involvement into the activities will be an efficient way to disseminate the collected results from ESONET.

By embedding and committing industry partners into the activities of the work package a major progress towards achieving interoperability of existing and future submodules and installations will be reached. The main contractors and associated partners from the industry also believe that it is a key issue for the future and that is why it is a major part of Integrating Activities. SMEs in the NoE will be gathered under a Group of Providers of Equipment and Services for Observatory Systems (PESOS). The objective of PESOS will be in particular to facilitate the
sharing of best practices and knowledge and the definition of standards for installing and operating observatory systems.

The first years of experiments in Japan and USA have shown the limits of using prototype technology in the context of cabled subsea observatories. The analysis of these practices (errors and success) will be shared with specialists from these countries and European engineers during a « Best Practice workshop » organized by ESONET NoE. The co-operation will continue in order to promote common procedures, interfaces and Quality Assurance at a world scale.

5.4. Contribution to policy developments

The concept of an observatory is one of the foundations of civilisation and in archaeology is often interpreted as early step in progress of societies. Subsequently adopted by specialised scientific culture observatories imply the conservation of data on parameters. Current observatory initiatives are often virtual systems based on information technology infrastructure from integrating of widely spaced scientific instrument to dissemination via interfaces such as “Google Earth”. Applying these concepts to the « deep sea frontier » of Europe is the objective of ESONET NoE, following previous initiatives and followed hopefully by permanent commitment of the European continent. ESONET NoE will build the structure able to launch the collection of time series of parameters, for decades. In WP1, the Task b) is dedicated to this objective. The management of data and their quality assessment is central to the project: ESONET NoE is related to the most experienced ocean data archiving teams and infrastructures in Europe.

The knowledge of the consortium, gained in the NoE will be disseminated through exchange of personnel, training and cooperation in international projects related to ocean observatory networks and to the international organizations in this field.

Exploitation of the marine environment is increasing rapidly via fishing and bottom trawling, offshore hydrocarbon extraction, laying of deep-sea cables, mining for minerals on the seabed etc. It is clear that these activities must be regulated so that the exploitation is sustainable and the environment is not destroyed in the process. However, the deep-sea environment remains poorly known, both in terms of what is there and in terms of natural change that affects this environment. A small number of long time-series monitoring activities have been carried out and some of these have shown significant levels of natural change, but over time periods of several years. To understand deep-sea environments more thoroughly we therefore need state-of-the-art monitoring over an extended number of years in a number of key sites. The most comprehensive data sets will be produced by deep-sea observatories, such as via ESONET. The data provided will be fundamental to understanding the ocean environment and will be fed directly to policy makers so that they can make informed decisions. This will not occur under this NoE but it is a crucial part of our long-term goal for the use of ocean observatories and the data generated therein.

Within this NoE we will bring the benefits of long term monitoring to the attention of the member states and show them how this can feed into policy development. This should set the scene for their future commitment to funding the observatories.
5.5. **Risk assessment and related communication strategy**

No potential risks for citizens or the society are associated to ESONET activities.

The ESONET project will adhere to the ethical rules described in the Guide for Proposers. The proposed research raises no sensitive ethical questions related to human beings, human biological samples, personal data and genetic information. The ESONET project will adhere to codes of conduct and national legislation concerning the use of test animals and genetically modified organisms. Experiment involvement with endangered and protected species will be avoided and will only be carried out in exceptional cases where there is no direct harmful effect on the plants or animals. Experiments involving invading species will only be performed under strictly controlled conditions, and the necessity of the experiment will be evaluated by an Experiments independent panel (Michel André is in charge of constituting this group during the first months of the project). Experiments performed by the project will only be launched when the risk of accidental release of specimens is zero. Possible of effects of scientific packages emitting, light (including lasers), or high energy acoustic will be evaluated for their impacts on marine organisms in accordance with the laws of littoral states, and international agreements. An ESONET policy on high energy emissions will be developed as part of the scientific package qualification process that is being pioneered by NEPTUNE.

The constraints on technologies acceptable or not in order to deploy environment friendly subsea observatories are a major concern of ESONET. They will be investigated inside WP5 as far as precise knowledge of permitting procedures. They will be major criteria to award the ESONET LABEL. Attention will be paid on the effect of acoustic devices on sea mammals and other organisms and effect of emf’s from power cables on certain species or fish.

The European Cetacean Society has created an ethical Committee in 2004. The president of this Committee, Michel André, is a participant to ESONET NoE partner dBscale (Spain). He will therefore act as an adviser to the project.

In all these cases, the rules and recommendations of international bodies such as IUCN and ICES will be strictly followed. During fieldwork the disturbance to species and habitats will be restricted to the minimum required. For marine protected areas, permission for fieldwork will be requested where necessary.
6. Outline Joint Programme of Activities (JPA) - for the full duration of the project

6.A – ACTIVITIES

The joint programme of activities will be a streamline of 7 interconnected Work Packages (WP) in three main areas in addition to WP8, which is concerned with management of the overall programme. ESONET will allocate funds to the 7 WPs for 2 successive periods, over the 48 months of the EC grant: two 18 months periods followed by one 12-month period. 3 WPs are related to the Integrating Activities (IA), 3 to the programme for Jointly Executed Research (JER) and 2 to the Activities to Spread Excellence (SE). The Jointly Executed Research (JER) will be conducted in sites of interest to the EU (see §1). This suite of observatory sites is of major relevance to the global change perspective, to the global environment and security monitoring including geohazards and to the biodiversity studies.

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<th>Table 1 – ESONET JPA : Work packages (WPs)</th>
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<td>M. Diepenbroek KDM (DE)</td>
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<td>I.a Integration of regional observatory infrastructure M. Cannat CNRS/IPGP (FR)</td>
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<td>I.b Data infrastructure M. Diepenbroek KDM (DE)</td>
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<td>I.c Sharing facilities move in II.d</td>
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<td>I.d Scientific integration J. Mienert UiT (NO)</td>
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<td><strong>WP2 Standardisation and interoperability</strong></td>
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<td>II.a Sensors and scientific packages C. Waldman KDM (DE)</td>
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<td>II.b Quality assurance, Quality control A. Holfford Univ. Aberdeen (GB)</td>
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<td>V.a Science, engineering and business plan for generic sites J. Piera CSIC (ES)</td>
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<td>IV.a Call for proposal M. Cannat IPGP (FR)</td>
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<td>IV.b Demonstrations E. Gracia CSIC (ES)</td>
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6.1. Integrating activities

6.1.1. WP1 - Networking

The implementation of a service oriented multi-purpose observatory network, generally available to different stakeholders as science, managing authorities (hazards) and public, encounters problems to be solved on both organisational and technical levels. At present, the different requirements are reflected in various approaches for the implementation and operation of observatory nodes. A concerted observatory system in the first place needs to compensate for the heterogeneity and dynamics of requirements and developments. The overall strategy is to adopt and foster globally accepted standards and concepts, to use generic approaches and multi-purpose setups where possible, and to find synergies both in new developments as well as in the usage of existing facilities.

WP1 will investigate the pre-requirements and identify the obstacles for the operation of a common network. It delivers the basic organisational and technical framework for a European seas observatory network. It will foster integration through promotion of multi-disciplinarity and transnational usage of regional observatories (task a). Linkage of regional observatories on a European and global scale through common data infrastructures and data management procedures allows for a general (location independent) and synoptic usage of newly generated and archived data (task b). Existing facilities will be identified, investigated, and tested to increase observing capacities and to ensure consistent and improved usage (task c). Finally, to foster integration and find synergies between observatories on a global scale - concepts and implementations have to be negotiated with international projects, programmes, and developments (task d). All concepts and activities will be reported to and agreed with the ESONET Test and Operation, Scientific, and Data Management Councils and coordinated with the other WPs, in particular WP 2 – Standardisation and interoperability.
Task a - Integration of regional observatory initiatives and multidisciplinary networking efforts

Objectives:
Multi-disciplinarity and transnationality are key to the success of ESONET, for scientific reasons (state of the art science requires active exchanges between teams and disciplines internationally), and for maximum use of the observatory infrastructure (additional sensors may be added at low cost to existing infrastructure).

Our objective in this task is to promote multi-disciplinarity and transnationality within each node of the ESONET sub-sea observatory network. This includes welcoming new users and refining regional observatory objectives with respect to the experience and achievements of other observatory initiatives worldwide, and to other European and international partners.

Our proposed approach for this task is to build upon the experience and achievements of existing European sub-sea observatory initiatives that have already reached a high degree of multi-disciplinarity and transnationality. For instance, the proposed MoMAR initiative is of particular relevance in this respect, with a high level of integration between biology and earth sciences objectives, and effective multinational cooperation. Other proposed ESONET nodes have developed complementary expertise.

Activities:
The exchange of personnel inside the ESONET consortium will be a major tool of integration for ESONET NoE. A call will be issued starting on month 2. It will be a permanent call.

The first “All Regions Workshop” (month 6 or month 2 with Kick off meeting if feasible) will schedule presentations of the experience and of the science and technology achievements of existing European sub-sea observatory initiatives, and of other subsea observatories worldwide. These presentations will emphasize multidisciplinary approaches, both in terms of scientific objectives, and in terms of observatory systems. They will be followed by thematic and regional parallel sessions aimed at refining the objectives of each regional observatory initiative, and at developing multidisciplinarity and transnationality in their implementation plans. Addressing such issues will serve as a basis for the establishment of regional observatory site implementation committees. These discussions will serve as a basis for the activities of WP3 (Scientific objectives and observatory design) and WP5 (Implementation strategies). Proposed plans for demonstration missions (WP4) will also be discussed and refined during this workshop.

As an outcome of this workshop, we also anticipate the formation of Regional Implementation Committee for each ESONET regional node (see Figures 1 and 16). The objective is to start from these Regional Implementation Committees to build permanent structures when and where possible. The perspective is to organize each regional observatory by a legally incorporated entity that could own property, hold bank accounts and enter into contracts nationally or internationally (Regional Legal Entity=RLE). The RLE might be a research institute, a government agency, a company or a partnership or private organization depending of the size and circumstances of the project. The ESONET RLE would be responsible for providing the utility services to the observatories in the ocean and will report to the stakeholders and financing bodies. The ESONET RLE would be responsible for receipt of funds from international, national or regional sources and paying for installation and operation of the regional observatory. Insofar as the ESONET RLE controls funds, it should be responsible for choice of technical solutions, deployment and operation of the system, provided it does not undermine the ESONET organisation (ESONET LABEL) and potential...
users. Each Regional implementation Committee would include:
   - scientists working in the area,
   - end users,
   - national navy delegates,
   - regional delegates,
   - funding organizations,
   - ESONET CORE SERVICES representative(s).

These Committees are a step of integration: on local projects building up subsea observatory projects, they will refer to ESONET and ESONET standards and methods.

This first “All Regions Workshop” should attract over 100 participants, mostly from the consortium. Registration will follow submission of a letter of intent, to insure that priority is given to active proponents of the various European subsea observatory initiatives. Using the outputs of the first 18 months work performed in all WPs, the content of the ESONET LABEL will be agreed on. It will be a condition for Regional Implementation Committee wishing to build an ESONET RLE to be integrated in the future ESONET permanent structure.

The European ESONET organization (to define in a perennial forms as soon as possible by the network) will specify standards and protocols defining both ends of the system (land and sub-sea systems) for interoperability and modularity but leave to each bid for tender the specification of technical details of cable engineering, power supplies or intermediate communications protocols. It should promote and seek funds for development of the network. It will also assume the links with the EU policy requirements in environment and security (GMES, GEO…) and large infrastructures (ESFRI).

We anticipate that a second “All Regions Workshop” (between month 24 and month 36 depending on Demonstrations and funding agencies policies) will build upon the results of 2 years of NoE’s activities, including funded Demonstration Missions. It will prepare for a coordinated response to relevant FP7 calls for proposals. WP1 will coordinate the organisation of the “All Regions Workshops”, the registration procedure, and the preparation of the workshops proceedings. This involves coordinating nominations for the organising committees for each event, with representatives for the ESONET observatory nodes, for the three Joint Research Activities WPs (WP 3 to 5), and for other international subsea observatory initiatives.

WP1 will examine proposals of new sites candidate to ESONET or improvements of already proposed ESONET sites.

WP1 will also provide coordination for the Regional Implementation Committees, and participate to the organisation of smaller Case Studies Seminars (organized by WP 3). WP1 will report to, and seek approval from the NoE’s Councils (Test and Operation, Scientific, and Data Management Councils) and Strategic Committee at each step of its activities.

Task b - Data infrastructure

Objectives:
An ocean observatory data management system must address several challenges:
Data products are generated from heterogeneous and regionally distributed observatory nodes in Europe and have different characteristics in format, metadata, resolution and validation of data.

Data archive centres exist for some data types but are not yet fully adapted for other parameters. Moreover, the responsibility for supporting each node may be divided among several different agencies.

In order to access data products from multiple sources, data need to be quality-controlled in a uniform manner. Data providers have to be coordinate with data users.

The network may be extended and has to be integrated with existing and future GEOSS related earth observation systems; especially, the thematic portal policy of GMES is under construction. ESONET will coordinate its schedule with GMES. Integration with other systems is hampered because present concepts and implementations of spatial data infrastructures (SDI) follow different architectures using different standards or de facto standards (INSPIRE).

Monitoring of environmental processes generates large amounts of data. Location independent usage of those data and related services require significant storage and compute capacities and appropriate network bandwidths. Current computing and storage capacities in European data centres as well as bandwidth in European networks are at least sufficient for the demonstration missions in WP 4. Depending on the data type and the capture frequency additional capacities might be needed for filtering, processing, evaluation, and visualization of data in productive implementations.

Long term preservation and publication of data has to be ensured.

**Activities:**

- Development of data management concepts for a networked system including organisational schemes for possible data flows. A fundamental underlying principle is the full and open exchange of data and information for scientific and educational purposes (GEOSS data sharing principles).
- Implementation and test of a hardware independent spatial data infrastructure (SDI) including a sensor registry. Interoperability will be largely based on the implementation of globally accepted information standards (Sensor ML, ISO19xxx family of standards, SOAP/WSDL, GRID standards) and existing Spatial Data Infrastructures (SDI). The activity will be carried out in close collaboration with WP2 (standardization).
- Organize data capture (also real time or near time and event based), long-term archiving, publication, and dissemination of observatory data, metadata, and data products using European and international data centres. For all these activities, ESONET will build on global and pan-European infrastructures for marine data management (SEADATANET/NODCs and ICSU-WDCs) and closely cooperate with EU initiative INSPIRE and other European projects like CarboOcean, MERSEA, and HERMES, SSA SEPRISE, or NoEs EUR-OCEANS and MARBEF. The integrative usage of European long term capacities in GRID like structures is not only the basis for the WP 4 demonstration missions but will also guarantee a sustainable operation of a possible productive observatory network in the FP 7.
- Conception of generally available ESONET services based on the common data infrastructure (e.g. data discovery and download, handling of extreme events).
Implement the above during ESONET NoE and treat data of demonstrations (WP4), tests (WP1 Task c, WP2, WP3) and site surveys (WP5).

The Data Management Committee will check the compatibility and consistence with relevant tasks of the project and the link with other European projects.

Task c - Sharing facilities

Objectives:

Subsea observatory networks require extensive and costly infrastructure, ranging from heavy-duty sea-going equipments to highly sophisticated analytical equipments. Collectively, the ESONET partners in Europe have a rich and diverse suite of relevant research facilities. This includes not only hardware, but also technical and methodological expertise.

The ESONET NOE will organize the sharing of European seagoing equipments and will open shared testing facilities, in order to ascertain and improve the long-term capabilities of sub-sea observatory components to launch common practices (oil and gas industry experience).

An integrated process will be started by the common management of simulated, shallow water or deep sea tests. It will organize calls similar to the METRI project. Negotiations to share other facilities, recorded in a catalogue, will be a major work for this task.

Activities:

Testing facilities in simulated environment and shallow water test beds:

Complementary to the above, many tests require sites in real marine conditions. Shallow water test beds equipped with a cable are cost efficient solutions. ESONET will use test sites that are available in Europe:

- Intereg 3c project Intermarec is initiating a cooperation between KERN region in Germany and Brittany in France on shallow water test sites with capabilities of running equipment connected to an underwater cable
- Koster Fjord area in Norway which is perfused by cold water from the Norwegian deep (2-4°C) can be used for testing equipment in low temperature conditions which influence operation of electronic or electro-mechanical devices, corrosion and bio-fouling development rates.

Those sites will be used for additional tests on anti-fouling, acoustic and optical sensors, crawler and AUVs.

Existing deep sea test sites and equipments

Antares, NEMO and NESTOR sites in the Mediterranean sea will open their infrastructure, already cabled, to ESONET NoE partners. They will be used for long-term tests of scientific packages, single instruments and underwater components.

ESONET partners operate most of the operational tools of this field in the world. The seagoing equipments will be shared in a number of occasions as part of the integration process. This will mainly tend to establish the interoperability between these major tools (see WP2).

Integration through a limited number of permanent deep sea test facilities

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5 METRI: The Marine Environment Tests and Research Infrastructure in as EC funded project proposing an infrastructure of 5 installations devoted to marine environment simulation to European companies or institutions.
The multiplication of test sites inevitably results in redundancies and unwanted dispersion of efforts, whereas Europe’s interest lies in the coordination and optimization of its resources. After the first 18 months, the NoE will select a small number of complementary test facilities to be used on an operational, permanent basis.

Initiate other fields of future integration

In many disciplines, the critical mass for scientific efficiency requires pooling together of national means. The NoE will promote the formation of European teams for the analysis of seismic data, the processing of images from seafloor cameras for biological monitoring, chemical and biological analysis, and spectrometry (see Task d). Projects integrating related infrastructures will be discussed and proposed inside ESONET NOE, following prescription by WP2 (Quality Assurance – Task b) or WP3 (Generic or specific science module).

Task d – Scientific Integration

Objectives:

The aim of this task is to define a perennial integration at European level of scientists of the numerous laboratories using data collected by deep sea observatories.

Scientific users of deep sea observatories will be not only members of large institutions but also members of small teams spread into various universities or small institutions. The objectives of this team will be to define and develop a structure allowing them to be integrated into a community that helps them to elaborate joined research projects.

Activities:

One way explored in details will be the creation of a Virtual Institute of scientific users of deep Sea Observatories (VISO). This institute would be organized into departments regrouping scientists from the same disciplines, but would have also to organize the multidisciplinary approach.

The Virtual Institute would:
- organize exchange of personal between its members,
- organize joined experiments on ESONET observatories,
- promote development of new scientific packages on the existing observatories,
- organize conferences on the ESONET observatories data exploitation,
- organize specialized workshops on data management, data dissemination, new sensors, new technologies, inter-comparison of results,…

The department will include laboratories not only scientists from all the initial partners (core partners and OSI) but also from other institutions interested by deep sea observatories data.

Task e - Links with international observatory programmes

The NoE will establish formal links with extra-European programmes addressed toward the establishment of seafloor observation networks. The links will be aimed at setting about the European experience, at stimulating the technological and scientific debate, compare adopted techniques/methodologies and trying to interface technical and scientific problems in the development of seafloor networks. Profitable links will be maintained with the principal
extra-European seafloor multiparameter real-time networks under development in the frame of ORION, NEPTUNE and ARENA.

In addition, the NoE Consortium will submit the request to have a NoE representative in the International Ocean Network commission, founded to take advantage of on-going efforts on seafloor monitoring in different countries and to foster synergies among different disciplines.

Both the ICDP and the IODP have shifted their attention towards long-term instrumentation of their boreholes. Depending on the scientific goals at the site, certain depth intervals are instrumented under “corks” with sensors, in some cases down to several kilometres and temperatures in excess of 100 °C. ESONET envisages teaming up with such programmes, and having instrumented boreholes near ESONET “nodes” in the Ligurian Sea and in the vicinity of Crete/Greece.

Activities:
NEPTUNE Canada (under construction), Monterey Bay project MARS (under construction), Neptune USA (funded according to a federal decision of February 2006), ARENA (networking of existing and new Japanese observatories) are in contact with ESONET NoE responsible persons and wish to sign agreements on several fields such as: scientific exchanges, technical evaluations, industrial specifications, standards, equipment tests… The task will deal with these promising exchanges.

An important element in development of observatories networks is the capability to design, implement and operate extension cabled observatories at distances of some kilometres from the junction box.

ESONET has been offered the opportunity to install such a system in the vicinity of one of the Canadian NEPTUNE Phase I observatories in the NE Pacific Ocean. In addition to scientific aims success would demonstrate ESONET capability to operate to international standards and create the know-how necessary for rapid roll-out of such systems in European waters.

This project will be implemented in the following stages:

1. International Workshop. This will prepare a concept design report for the extension cabled observatory including science package definition and appoint a group that will implement the project working jointly between Canada, USA, Japan and Europe. (In connection with the All Regions Workshop n°1, possibly month 6)

2. Compete for the call for demonstration mission of WP 4.

6.1.2. WP2 – Standardisation and interoperability

Objectives:
There are many good reasons to introduce standards for installing and operating ocean observatory systems. For instance standards allow for easy interchange of individual instruments between different installations and platforms. The depth and extent of the standardisation process depends on the needs of the users and the technical feasibility. The process should begin at the sensor level as this will ensure the seamless integration of the information flow originating from a multitude of sensor systems, in quantity and quality. In present observation systems with limited number of instruments it is always possible to individually integrate and match each instrument into the systems. With the future heterogeneous, dynamic changing ocean observatory systems in mind this is no longer a
A modular approach with each module possessing defined, standardised software and hardware interfaces has to be established.

In contrast to terrestrial systems underwater observatories are not easily accessible and servicing can prove difficult. A similar planning and logistic effort, as seen in space sciences, needs to be implemented for these observatories. This is the main reason for having standards, as instruments can be tested and integrated in a defined procedure before deployment. It lends itself to the concept of introducing quality management or mission assurance procedures.

Standards make interoperability possible which not only means interchange-ability of instruments but that the collected information is comprehensible for all subsequent data processing units. The sensor information must be accompanied with an exhaustive description of the data in the form of standardised metadata schemes. In other words the standards on a lower level should be translatable to a higher level as for instance has presently been put on track with Sensor ML and IEEE-1451. This will then provide a base to make the data available for automated information retrieval. On top of that schemes of sensor information metadata will facilitate the interoperability in particular under the aspect that information from different observatory sites have to be integrated into a common system.

Last but not least the standardisation processes are expected to generate added value and benefits in an economic context:
- Enhanced product quality and reliability
- Reduction in costs
- Increased efficiency and ease of maintenance
- Simplify and improve usability
- Greater compatibility and interoperability of goods and services
- Improved health, safety and environmental protection

In the industrial community, standardisation is a normal step, typically (almost inevitably) occurring when the industry has reached a sufficient level of growth and maturity. Therefore it will be essential for this work package to get European industrial players from the field and in particular SMEs involved in the standard definition process with the aim of reaching consensus between the major players from academia, government institutions and industry. SMEs in the NoE will be gathered under a Group of Providers of Equipment and Services for Observatory Systems (PESOS). The objective of PESOS will be in particular to facilitate the sharing of best practices and knowledge and the definition of standards for installing and operating observatory systems. PESOS will animate, in link with main European Technical Institutes, commissions of standardisation.

In the perspective of an increasing level of integration at European level (represented by initiatives like ESONET and KM3Net), and to explore the possibility of playing a decisive role in the worldwide global network initiatives either in the scientific field (NEPTUNE, MARS, ARENA) or motivated by government monitoring requirements (GEO), it is now necessary to take into account the issue of standardisation in an explicit and systematic way. This will form a base for sustainable progress in the establishment and reliable operation of the anticipated ocean observatory infrastructure in Europe.

**Activities:**

Reasons and opportunities to introduce standardisation issues in deep sea observatory science have been previously discussed. It must however be kept in mind that the standardisation
development is a process based on the principles of consensus; this means that the views of all interested parties are taken into account including but not limited to manufacturers, engineers, end users, marine operators etc. In the deep sea observatory community, consensus has to be achieved between parties with much diversified background (scientists, engineers, marine operators, environmentalists), interests (like scientific disciplines), methodologies, experiences (past internal developments, past projects etc).

At the same time the definition of any standard and regulation should not inhibit the use of the best available technology or the application of new technologies. It should also be remembered that standards and procedures evolve as technology evolves and will therefore need to be re-visited as and when required.

Keeping in mind these aspects, the most suitable approach proposed for this Work Package is to restrict its activities to the definition of a “roadmap” for the standardisation of deep sea observatories.

In other words, the activity shall not try to “solve” the problem of standardisation, but will more realistically represent the beginning of the process aimed at tackling the standardisation issue for the deep sea observatory community.

In the context of ESONET NoE, there are three main application domains requiring standardisation that have been identified:

a) sensors and scientific packages,
b) systems engineering and quality assurance/quality control procedures,
c) underwater intervention.

To each of these domains a specific activity shall be dedicated and organised according to the following workflow involving ESONET partners and PESOS.

1. Plan and set-up the standardisation project
   - Identify and analyse more in detail the standardisation needs and expected benefits;
   - Review experiences in standardisation gained in other fields (e.g. space projects);
   - Define objectives, scope, deliverables and planning of the standardisation effort.

2. Investigate existing standards with a view to applying them to the current situation
   - Inventory of existing observatory systems and platforms;
   - Inventory of existing standards regarding sensor integration and enabling interoperability;
   - Setting up links to other international standardisation initiatives like GEOSS, ORION and the offshore industry;
   - Evaluation of the collected information under the guideline of practicability in particular under the restrictions that apply for underwater systems and the possible integration on existing systems (cabled, relocatable (ASSEM), mobile (AUV));
   - Input from PESOS to the evaluation process regarding practicability and economic aspects.

3. Define standards
   - Definition of a roadmap for deep sea observatory standardisation in coordination with other international partners (Japan, USA, Canada) who are involved in the design of ocean observatories;
   - Building up a common information portal;
- Developing sustainable concepts for best practise and training aiming at defining quality assurance procedures.

4. Apply standards
- Plan and carry out a first implementation phase (e.g. through demonstration actions and pilot projects), including, but not necessarily limited to the following;
- Interoperability of sensor systems in existing cabled observatories (NEMO-SN-1 ANTARES, NESTOR);
- Integration of mobile (AUV, CRAWLER) or relocatable (GEOSTAR, ASSEM, ANIMATE) observation platforms into cabled systems.

**Task 2a - Sensor and scientific packages**

The goal of enabling interoperability of sensor systems on different infrastructures makes standardisation a necessity.

Aspects to be focused on include:
- interfaces (power, data, communication),
- mechanical layout and interfaces (for possible recovery by intervention systems),
- performance targets (e.g. measuring ranges, accuracy, long term stability etc.),
- design and manufacturing criteria (in close coordination with task 2b),
- qualification and acceptance tests (in close coordination with task 2b).

Based on this knowledge and under the guidelines of practicable and economic feasibility realisation, a roadmap for possible realisation schemes will be defined.

This task shall be carried out in close integration with SMEs involved in the production of instrumented packages suitable for application in deep sea observatories. SMEs have significant knowledge of practical solutions in highly specialised fields as is the case for ocean technology. The contribution SMEs to the ESONET NoE, via PESOS, will therefore aim at defining solutions for the standard implementation of instruments used in ocean observatories in an economically and technically appropriate way.

The interest of PESOS in such a project will originate from getting insight into future technical requirements based on the planned infrastructure. The definition of standardisation procedures is in the interest of European SMEs in particular and enables them to offer products on the global market.

The task of defining a possible architecture for achieving sensor interoperability will basically be split off into:
- Inventory of existing sensor systems and their corresponding operational characteristics and technical description.
- Inventory of integration procedures into current observatory infrastructures and platforms.
- Inventory of existing concepts in other fields (Ad-hoc sensor networks) as possible candidate solutions for future observatory systems.

**Task 2b - Quality assurance / quality control**
This task shall address the definition of a set of procedures/guidelines/recommendations applicable to the various subsystems constituting a deep sea observatory. Aspects covered shall be in the field of design, manufacturing, test and qualification, integration, operation and documentation related to ocean observatory equipment.

This task will contribute to accomplishing the following fundamental goals:

a) enable interoperability, by ensuring that the observatory components have been developed according to agreed and common procedures;
b) increase reliability, being confident that all components meet the particular requirements of the application (e.g. long life, continuous operation at seafloor, compatibility with the rest of the system etc.);
c) correctly address the work of the manufacturers and engineering companies involved;
d) help achieve a homogeneous level of quality in performances and obtained results (data etc.).

Test-beds will be created and associated with the shared infrastructure (WP1 Task c) to allow hardware-in-the-loop simulations of observatory elements that could be interconnected with their proper interfaces in order to validate power and data transfer prior to deployment. Such approaches are common in space projects to reduce the risk incurred in qualification programmes waiting for the complete system to be available.

Within this task, known concepts from the field of ocean sciences and other areas will be evaluated and a concept for ocean observatories will be defined. Quality assurance or mission assurance procedures are already quite common in certain fields of ocean sciences in particular where there is a strong need for inter-comparison of globally collected data. The proliferation of these quality assurance procedures shall allow the knowledge to be spread and enable all participating institutions in Europe to generate sensor data at the same level of quality.

- Building up a knowledge base of procedures which will be made accessible through a common information section of ESONET web site.
- Developing sustainable concepts for best practise and training aiming at defining quality assurance procedures.
- Realisation of concepts with existing instrumentation which may be demonstrated via NEMO-SN-1 ANTARES, NESTOR.
- Integration of mobile (AUV, CRAWLER) or relocatable (GEOSTAR, ASSEM, ANIMATE) observation platforms into cabled systems as part of the demonstration activities.

Task 2c – Underwater intervention

In view of the establishment of a permanent seafloor observation infrastructure around Europe, and cooperation at worldwide level with optimal use of the existing resources (ships, ROVs etc.), it is considered critical to define procedures and standards to correctly access observatories and related components (junction boxes, critical payload etc.), considering the problems that unregulated access may cause (risk of damage, inefficient work with associated time and cost increase, incorrect results etc.).

This task will therefore focus on the problem of underwater intervention on deep sea observatories, defining /

- criteria for a design of deep sea observatories taking into account the accessibility by a ROV or AUV or even a seafloor surface vehicle (working spaces for manipulation, docking points, visual aids for approach etc.),
- criteria to ensure the possibility of recovery and re-installation of specific observatory components (like sensor packages, battery packs etc) requiring substitution in case of failure or need for maintenance/recalibration by ROV, leaving the observatory in place,
- MOU to facilitate time exchanges of ROVs between European institutes for operations on the observatories that they will operate.

6.1.3. **WP5 Implementation strategies**

**Objectives:**

WP5 will utilise and build on the outputs of the ESONIM SSA and comprise of joint activities of ESONET NoE members in development and preparation of infrastructure projects, building from input from the NoE members. WP5 aims to analyse and integrate the activities and to assist in the preparation of applications to National and International funding agencies including input to proposals, if required.

WP5 addresses the most sensitive questions in the project. Business models, legal and permitting methods and reply to proposals are considered to be part of the common activities and will be shared according to rules included in the Consortium Agreement.

The economic, legal, technological and environmental impact aspects of implementation will be addressed. WP 5 will focus on creating structural linkages and strategies to enable establishment of significant Seas Observatory Network(s) in the areas prioritized through ESONET, or via evolving drivers such as GMES, GEOSS, seismological operational networks, ICG/NEAMTNS and the European Marine Strategy, etc. The NoE will also forge links with the owners and operators of existing structures, such as MARS, NEPTUNE and ARENA and assess the source of the experienced delays.

The agreement of military authorities is also addressed. Discussions will take place at the early stage of ESONET; on one hand at the Strategic Committee level and another hand at Regional Implementation Committees.

The NoE will contribute to the sub-sea segment of the GEO initiative and provide research data for GMES. Linkages with core marine operational services such as EUROGOOS and MERSEA will be supported. These linkages and strategies will be underpinned by the most up-to-date data and information.

Practically, the implementation strategy of actions within the NoE will be three fold:

1) The NoE will encourage its members to select a number of “hot spot” sites for long-term, permanent facilities;

2) The NoE will support preparatory phases to improve the scientific knowledge required to define the most valuable and environmentally friendly methods to enable implementation of operational systems in sensitive marine areas of Europe for long-term observation of the deep seafloor and water column. These will include, but not be limited to: mitigation measures for sea mammals and turtles, evaluation of emf fields to fish (e.g. magneto-sensitive) with particular reference to the COWRIE list of sensitive fish, vibration from cable freespan, installation sounds, wave disturbance, alterations to currents and circulation, water quality, scouring, sediment transport, shoreline erosion (landfall) and structural habitat alteration, including potential aggregation structure effects.
3) The NoE will also support decommissioning plans in accordance to the requirements of OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations, including recommended disposal: re-use of all or part of the installation; recycling of all or part of the installation; final disposal on land of all or part of the installation; other options for disposal at sea. WP 5 will also address technical and engineering aspects of disposal, timing, safety, marine environmental impacts and other consequences to the physical environment that may be expected to result.

As an initiative of the EU, GMES will be at the centre of a series of partnerships. These need to be defined at the EU level, including the role of agencies, Member States, value added services industry (including SMEs), user communities etc and WP 5 can contribute to this activity in the area of Seabed Observatory Networks. GAC (2005) 8 GMES Outline describes the areas for ‘fast track’ services to be implemented by 2008 including Marine Core Services delivered through Thematic Assembly Centres providing these core services, which are:

‘…particularly significant in the context of the implementation of the European Marine Strategy and the future development of a coordinated European Marine Policy, both requiring operational ocean monitoring and information systems. In the short to medium term, the objective is to provide general information, structured at the European level, on the state of the oceans, including:

…..operation, validation and maintenance of in situ observing networks….’

Tasks a and b are building-up a knowledge which will be used in Task c for the joint reply to proposals. Therefore, this Work Package will involve not only the scientists, economists, legal specialists and engineers but will also organize contacts with and between decision makers. It will frequently report to the Strategic Committee and seek advice from it. It is in the mandate of WP5 to prepare meetings at national research executive level, regional or national political level or Ministry levels (Task d).

Activities and Output – (Note: ESONIM project is still going on and the methodology of Task a and b will benefit from the experience of this project in 2006- this explains the rather short text hereunder)

Task a - Economical implementation models

The ESONIM Business Model will provide a basis to explore options (including Public-Private Partnerships) to establish and operate a deep sea observatory system. WP 5 will further advance these processes through:

a) Initial output after 9 months: Tutorial on developing network as a business building on models developed through ESONIM.

b) Developing the ESONIM implementation model to actual implementation plans for specific locations. This will be done through legal/business analysis by experienced commercial entities and definition of scientific and technical operational requirements by the Science and Technology Community. WP 5 will contribute seed funding to such activities, with main funding (as required) being sourced through potential implementation partners. Specific legal and business questions will also be addressed.

c) Developing and refining a High Level implementation structure/organization for ESONET. This structure will be flexible and adaptive to reflect the changing priorities of
the Commission, Member States and partners. The management structure will initially be
the Strategic Committee which will be a critical component of the Governance structure.

Task b - Site assessment, legal model and environmental constraints

The identification of legal risk is a key factor in developing an ESONET. Issues to be
addressed will include obligations of the ‘owner(s)’ of the network and obligations of
contractors.

The survey data of the selected sites will be collated by the NoE (survey costs are outside the
scope of the Network of Excellence). This will be an input for the environmental assessment
in sensitive areas. It will also contribute to the scientific assessment of WP3.

The legal model depends on the international, civilian and military constraints on the area,
including the type, scale of the involvement, timing and duration, e.g. NATO combined
exercises. The legal aspects will also explore responsibilities for damage to the installations,
by fishing, pollution or other anthropogenic disturbances. Permitting procedures, including
environmental assessments have to be prepared ahead of main funding decisions.

Task c - Joint reply to infrastructure initiatives.

The NoE will evaluate possible shared management structures and services, which could be
established under an Article 169, Deep Sea Frontier Initiative (ECORD ERA-net), ESFRI
(e.g. EMSO proposal on ESFRI list of opportunities) or other ERA-NET Initiatives
(MARINERA and BIODIVERSA). The first step in this work package will be to identify and
build on the regional (trans-national) consortia and seek complimentary structural funding.
This may also include the possibility of structured finance or loans via the European
Investment Bank.

Networking, quality and standardization will be contributing to the ESONET NoE integration.
From the beginning of the project, the aim is to achieve lasting integration on a set of
ESONET CORE SERVICES and ESONET RLEs linked through a common implementation
scheme and a shared scientific and technical approach. The Regional Implementation
Committees (see WP 1 task a) will have support from WP 5 in order to establish the legal
entities of ESONET RLEs.

Legal protection of ESONET LABEL will be studied by this task.

The seminars, tests, common negotiations and above all demonstration missions will
strengthen the integration process. Interaction with executives all over Europe will promote
the conviction of the need of European Seas Observatory Network. The constitution of groups
for integration in most Work Packages will prepare the ESONET partners for more
integration.

In parallel to this integration effort of the Consortium, the economic and legal research will
provide the basis for business plans of:

. each regional network, including its specific constraints and opportunities,
. Core services at the European scale.

During the last 16 months at the latest, it is planned to fully evolve the structure(s) to provide
structured co-ordination of ESONET in the long run.
The 4 levels of decisions required in such co-ordination are: regional, national, European and potential extension to third countries or regions (the Core services).

ESONET NoE Consortium through WP5 task will encourage the development of a co-ordinated governance, configured in a way that its integration in a European legal body (hosted by an institution or an autonomous association, a foundation, an EEIG,…) would be structurally facilitated.

After one year of ESONET, this task will lead the response by ESONET Consortium to infrastructure calls and will also prepare the legal and economic basis for the permanent structure(s) that will ensure the implementation, operation and maintenance in the long-term.

**Task d – Long term funding plan strategy**

Thanks to the Tasks a) and b) and to the experience of common work in task c), the funding plan strategy will be elaborated for the long term

The **Strategic Committee will be closely associated with this task and orientate the policy/institutional interfaces.**

The development of a network of underwater observatories will be a very expensive task that requires a large amount of co-operation at a number of levels, overcoming fragmentation. This co-operation will need to be sustained over a large number of years. The following teams will be brought together to develop these synergies and to plan the future developments.

- **Research teams**
  These organisations (from Core Partners and from Other Scientific Institutions) will need to work together to develop science programmes to exploit the data to its maximum. There is already a strong relationship between many of the scientists who work together in programmes such as HERMES, GEOSTAR 1-2-3, EXOCET/D, MERSEA and ASSEM. The scientific group constituted in WP3 Task 1 will be the core of cooperating activities. New links will need to be formed between these scientists and their North American and Japanese counterparts who are active in the development of seabed observatories (see WP1 Task e). The scientists will provide one of the vital links between the generation of data and its exploitation by the policy makers. We expect the scientists to interact with the policy makers to identify their needs, and then feed this back into scientific experiments to address the data gaps. Major meetings of ESONET will contain a session that will address how the scientists will work together and how they will interface with policy makers throughout the life of ESONET and into the longer-term future (see also WP1 Task d). In addition we expect each research organisation to orientate a component of its science in the direction of seafloor observatories. Data on the progress in this area will be monitored by the project so that there is a sound catalogue of expected research available to feed into the development plan beyond this project.

- **Technical teams**
  These teams (mainly from Core Partners) have a vital role to play in the development of technology to be used in the seafloor observatories. Firstly, they will need to decide how they will work together within Europe to share ideas and divide the workload (Groups issued from WP1 and WP2). Secondly, they will need to have strong connections to their North American
and Japanese counterparts so to exchange expertise and experience on the latest inventions and applications with mutual benefits. They will also need strong connections to the scientists who will drive the direction of the science to be achieved and thus the equipment that will need to be developed (WP3 Tasks b and c). A number of workshops (Best Practice Workshop for instance) and tutorials will establish working relationships. International cooperation (WP1 Task e), exchange of personnel and jointly executed experiments or tests will connect these teams.

- **Companies and SMEs**
  Commercial companies have a key role to play in laying and maintaining the seabed infrastructure (cables, nodes etc). It is vital to the success that these companies fully understand the objectives of ESONET and how usage of any infrastructure may be used and developed. Some of these aspects have been developed in ESONIM but they will need to be incorporated into the operational side of ESONET. This will be facilitated through a dialogue between the companies, WP6 participants and ESONET Steering Committee.

For ESONET to be successful, all of the teams mentioned above will need to work together, contributing to the **long term integration**. This will be achieved by the ESONET regularly updated website (WP7) where the development of each aspect of the project can be followed by all the participants. The newsletter (see WP6) will inform participants of progress and opportunities. We will encourage interchange of people from each group at each meeting (technologists, scientists, contractors, policy developers).

A document will be produced every year revealing how integration has been achieved between the different organisation and different groups within the project. The most complete version of the document, issued at the end of the project (or before) will be used as a blueprint for the operation of seafloor observatories beyond the ESONET project life.

This document, “Long Term strategy funding plan Year 200X”, should include the following items:

- Report on long-term planned research and co-operation between research organisations
- Document outlining agreement on co-operation between organisations involved in developing technology
- Report on meeting between commercial companies and ESONET WP leaders re working relationships and ESONET requirements (confidential aspects since open information is treated in WP6)
- Report of meetings to discuss long-term funding for seafloor observatories involving representatives from funding agencies
- Report on integration between respective teams (research teams, technical teams, companies and SMEs) and expected working relationships beyond the life of ESONET

And also according to the expected events and milestones:

- First year (2007). Synthesis on Integration Group constitution in the other WPs. Reporting on relations with funding agencies. First estimate of long term funding presented.
- Second year (2008). Integration achievements coming from ESONET LABEL, reporting on relations with funding agencies. ESONET defines the extent of Core Services. Long term funding estimation is updated.
. Third Year (2009). Report on national decisions about integration. Plan for launching the Legal integration bodies. Evaluation of the maturity of each Regional project (ESONET RLE or not). The part of the funding plan for core services in the long term and the part for Regional observatories operation are determined and hopefully decided.

6.2. Programme for jointly executed research activities

6.2.1. WP3 - Observatory design related to scientific objectives

Objectives

It is the objective of this work package to define the best methodology, scientific packages, instruments and underwater components to be applied in a long term cabled observatory.

The second and major objective is to contribute to further structuring and definition of the design of an underwater observatory system to collect long term (at least 20 years) real-time series measurements to allow monitoring of biological, geochemical, geological and geophysical key processes that document global change, and contribute in the detection and early warning of short and medium term potential hazardous events.

To achieve this, it is absolutely fundamental that key scientific objectives are continuously updated as new results become available, and that scientific objectives are further developed and clarified beyond the results of the preceding ESONET CA. Because long term ocean floor monitoring is in its infancy, there is a clear lack of scientific background to assess firmly the parameters to be measured. WP3 thus plays a central role in ESONET since the formulation of scientific questions is the basis for ESONET activities. We are at the beginning of a new era of continuous marine on line observation with new and exciting scientific perspectives rapidly evolving. These perspectives have to be disseminated to the broader scientific community and scientific objectives and methods have to be discussed and outlined with specialists. WP3 acts as an interface between scientific research goals from ESONET partners and from other stakeholders (EU- programmes, conservation organisations, governmental agencies, industry) with the ESONET technical related WPs. In essence, we will design a set of common tools for direct measurements to obtain real time recording. This will enable interactive experimental work on the seafloor during long term experiments. This enormous task can only be reached by durable integration and a serious commitment of all partners is needed towards building a common organizational and technical structure.

Activities

This joint research activity will take inputs from other work package activities to define the requirements for observatories in different areas. This will also be supported by input from other EU projects, e.g. MARBEF, HERMES, MERSEA, EUROCEANS, DAMOCLES and NEAREST.

An important justification for development of a cabled system of networked observatories as opposed to in-situ recording in stand-alone systems is that in the hostile environment of the open ocean, data, although successfully recorded, may subsequently be lost as a result of equipment failure or failure to recover the system. A cabled system provides security and
control that crucial data are recorded in real-time on land. However, this imposes severe constraints, in the sense that measurements are restricted to close to the position of the cable junction box or its extensions. The ESONET WP3 will address the development of the optimal means by which the various sensors will be associated with a cabled observatory to address the scientific objectives.

The initial phase in the establishment of an observatory network involves the (simultaneous) deployment of a range of sensors of increasing sophistication and scientific relevance to allow optimal instrument selection and modular design of a cabled observatory. Since some of the processes are temporary and localised, manoeuvrable instrument systems are crucial to monitor these events. Stationary systems will be adapted to movable applications and new developed web operated vehicles will be able to position a scientific payload or sensor at the desired spot. To align the technological specifications of future deep sea observatories with the scientific objectives, activities within WP3 will be closely coordinated with WP2 (for the generic technology package) and with WP4 (for the demonstrated disciplinary scientific packages):

➢ From a common Statement of Requirement document, the generic observatory modules that can be deployed at any site (such as connectors, certain sensors and structural elements) will be determined. In relation with WP2, a “Best practice workshop” will share the results of past experiments on these components, including failures. Underwater engineering research teams will analyze this state of the art, determine necessary improvements and integrate their efforts on ageing, biofouling protection and other long term related R&D issues. A reliability assessment will be performed.

➢ Disciplinary scientific packages that will be enhanced by ESONET are: ground-coupled seismometers (broadband or short period, according to the needs), piezometers for pore pressure measurements, pressure gauges (e.g. for tsunami detection), geodesy, borehole instrumentation, pore pressure, turbidity event monitoring, physical and chemical water column measurements, chemical analysis, seafloor imaging, monitoring of habitats, biological experiments under real time control, chambers and microprofilers for measurements water-sediment exchange rates of nutrients and oxygen, acoustic tomography, acoustic biomass and plankton detection, fish and marine mammal monitoring, monitoring of fluid flows and gas seepage, anthropogenic impact monitoring.

ESONET will support pilot experiments at sea and site surveys that help define the monitoring strategies and the most appropriate parameters to be measured in order to meet the scientific objectives. WP3 will thus be closely coordinated with WP4 which will launch a call for proposals for demonstration missions aiming at testing deep sea observatory components and infrastructures. Along with WP4 and WP5 (which will ensure site assessment), WP3 will contribute to:

. definition of criteria for proposal evaluation of the demonstration missions
. evaluation of proposals for demonstration missions by assessing their scientific relevance and technical feasibility.
TASKS

ESONET starts with fragmented disciplinary fields (ocean circulation, climate, biology, seismology, sedimentology, bio-acoustics, geophysics). Some occasional ad hoc experimented cooperations have been already developed. WP3 will enhance the integration process through promotion of multi-disciplinarity. This will be achieved by building bridges between the different actors (scientific and engineering) and between the different work packages (most particularly, WP2, WP3 and WP4 are intimately related), in order to eventually define the most adapted generic technology and scientific packages. WP3 will organize inter-disciplinary workshops which, by meeting scientific question and technical solutions, will lead to concrete and well-founded proposals for optimally designed observatories.

Task a - Science objectives

The main objective of this task is to align the technological specifications of future deep sea observatories with the scientific objectives. For this it is absolutely essential that the scientific objectives are continuously updated as new results become available, and that the scientific objectives are further developed and clarified beyond the results of the preceding ESONET projects.

Scientific objectives will be updated by a prominent group of expert scientists reporting to the Scientific Council and to the Strategic Committee. Results and updates will be disseminated to the scientific community in a number of ways: through the organization of workshops, by the regular update of the ESONET Web Site and by an ESONET Newsletter. One major effort of WP3 will be to make sure that everybody within ESONET NoE shares the same level of information regarding the latest technological and scientific developments.

At present, a number of regional networks sites have been proposed as prospective ESONET nodes. WP3 will clearly address the question of scientifically based priorities of the sites, in order to avoid dispersion of efforts for structuring the future European Observatory Network. Workshops and forums of discussion will be organized to examine the arguments (pro and contra) of each different site and define a long term strategy for site implementation.

New candidate sites will be evaluated in cooperation with WP 1.

Task b - Generic science modules

During the last decades, a continuous effort has been conducted by the academic research, the industry and the military to develop specific technologies for deep sea floor observations, including moorings, boreholes, seismic packages, cameras, optical devices and acoustic systems. Specific instrumentation systems have progressed tremendously and gained in reliability and modularity, paving the way for the development of generic technology. Good examples are: the establishment of standard MetOcean measurements on and in the water column in a number of sites will directly contribute to marine climate change monitoring and geohazard and tsunami warning systems.

The main objective of this task is to ascribe the development of generic technology to the scientific requirement and needs. This will be done in coordination with WP2 and WP4, through the production of specifications based on the scientific objectives organization of workshops and the dissemination of results.
The measurements throughout the water column (ADCP and moorings) will be inserted in the global observation networks. Seismic and tsunami monitoring constitute a major need due to the lack of data coming from large areas of the seafloor. Optical and acoustic imaging will open new perspectives for the understanding of biodiversity and natural processes. Opportunities provided by deployments well ahead of the European schedule through cooperation with Canada, US or Japan will be used to allow ESONET teams to train on real scale observatory modules.

**Task c - Specific science modules**

In addition to the generic science modules, some specific modules are needed for monitoring purposes. Their maturity must be evaluated.

The networking activities of ESONET NoE in Europe, the close relation with industrial companies and with underwater monitoring networks in North America and Japan (WP1), associated with standardisation activities and quality assessment of instruments (WP2) will indicate new solutions in term of methodology and technology. It will provide opportunities to benefit from specific equipments with limited costs. Some of them well suited for the scientific objectives of ESONET network, will be selected to be implemented on one or two sites (ESONET NoE is not allocated budget for development).

Examples:

- floats profiling along mooring lines or subsea winches,
- acoustic monitoring for mammals or fish echosounding from moorings,
- experiments with “CORK” instrumentation in ODP boreholes,
- new chemical monitoring using spectrometry (Laser Raman or Mass Spectrometry),
- high definition television,
- AUVs operating from docking stations,
- crawlers,
- pollution monitoring sensors,
- acoustic monitoring of seismic events in the SOFAR channel,
- new algorithms for Tsunami detection.

**Outputs:**

- Specify scientific questions and processes (physical, chemical, biological, geological) to be addressed.
- Define the set of parameters to be measured for each phenomenon of interest and parameters to assist a sustainable management of European seas.
- Demonstrate the scientific relevance of the collected dataset and the technical feasibility of the proposed methodology.
- Demonstrate the relevance of the site proposed for implementing the monitoring facility.
- Propose site and question adapted acquisition method and instrumentation.
- Disseminate results on the reliability of existing, enhanced or eventually new underwater monitoring components.
- Demonstration and inter comparison of existing modules on cabled test sites.
- Specify new generic and site specific scientific modules.
6.2.2. **WP4 - Demonstration missions**

**Objectives:**

WP4 will fund and coordinate sea tests for components of the observatory and observatory network designs, including data and energy transmission systems at cabled and non-cabled observatory sites, developed for ESONET nodes, as a basis for the forthcoming European Sea Observatory Network. WP4 will also coordinate joint research activities related to the preparation, and subsequent debriefing and data analysis of these demonstration missions.

The WP will focus on demonstration actions that bring at high level of excellence in the technology at different development phases, implementing the standardisation and interoperability of the different platforms from the consortium.

WP4 will benefit from the activities and results of WP2 (Standardisation: hard and soft, interoperability) and WP3 (Observatory design related to scientific objectives) and will constitute a feedback for them. The activities of WP4 also offer a frame to support WP8 (Education and outreach) giving the opportunity to participate to comprehensive interdisciplinary programme of research.

Demonstration missions will also acquire scientifically relevant scientific time-series data. They will be an input for integrated studies, common workshops and a raw material to demonstrate the integration of data management.

WP4 will be run in close cooperation with the Test and Operation, Scientific, and Data Management Councils for the prioritization and selection of test sites and management of demonstration missions. It will provide full scientific and technological reports to the NoE management structure. Designs and methods developed as part of WP4 will be made available for common use by the participants at ESONET observatory nodes.

**Activities:**

Demonstration missions will be planned at sites where existing infrastructures or/and facilities such as service with research vessels and ROVs allow for time and cost effective implementation and where demonstration missions can benefit of the synergy with other endorsed and funded initiatives. Tests of cabled observatory designs will be carried out at sites that have an existing cable connection to shore.

Demonstration missions will in most cases be planned at nodes of the planned ESONET key-sites, and contribute to the development of these nodes. It is envisaged, however, that specific operational needs may justify sea tests at sites that are not identified for long-term monitoring as part of the European Seas Observatory NETwork.

Demonstration missions will typically involve a pre-cruise phase of scientific and technological design and engineering (including equipment testing), a few days ship time for deployment of seafloor and/or water column observatory packages and devices recording of a set of time-series data over some months (typically 6 months) (via cable or acoustic transmission), recovery of the systems, followed by a post-cruise phase of data analysis, assessment of the technological aspects of the mission, design improvement, and reporting.
Demonstration missions, including their pre- and post-cruise phases, will involve at least three partner institutions from 3 countries, and will be carried out in close linkage with other WPs: particularly with WP2 (Standardization) and WP3 (Observatory Design).

Demonstration missions will be planned according to a selection procedure initiated by the issue of a ‘Call for proposals’. The first task of WP4 will be to issue this Call and promote it within the network (Announcement on the NoE web page, circulation of email and telephone interactions with other WP leaders, presentation of the Call at the first General Assembly on month 2). WP4 will then manage the evaluation process and moderate discussions of submitted projects at the “All Regions Workshop n° 1” (month 6).

Other demonstration cruises may be scheduled later through a second call if the budget allows it. Post cruise work and reporting will proceed into years 2, 3 and 4.

According to the Final Report of the ESONET CA, three sites identified as prospective ESONET nodes have an existing cable connection to shore and are operated and implemented in synergy with the ANTARES (Ligurian sea), NEMO (East Sicily) and NESTOR (South west Peloponissos) neutrino detectors. These sites are of multidisciplinary scientific interest with seismic activity near dense human habitation areas, slope instabilities with turbidity currents in canyons, past tsunamis, long term studies on biological and physical oceanography.

- The LIGURIAN SEA site (2300 m deep, 25 km off Nice) is a long term multidisciplinary monitoring area including water column up to the surface. The 685 IODP proposal plans to drill three holes there for tests of borehole instrumentation.
- The EAST SICILY site (2100 m deep, 25 km off Catania) presently includes two seafloor cabled stations monitoring seismological, oceanographic, environmental and acoustic (marine mammal) parameters in real-time.
- The PELOPONISSOS site (4000 m deep, 10 km off Pylos) is the deepest site for the monitoring of geological and environmental parameters.

The ESONET Report identified seven other sites, as yet non-cabled, as priority targets for future deep seafloor and water column observatories (see Appendix C):

- PORCUPINE ABYSSAL PLAIN (since 1989, SW off Ireland, 4900 m) lies well away from regions where physical gradients are strong and is a representative of the oceanic realm and an indicator of global climate change.
- AWI-Hausgarten (since 1999, west of Spitzbergen, depth range of 1000 to 5500 m) is located in the transition zone between the ARCT and SARC.
- NORDIC Seas active Haakon Mosby mud volcano located at 1000 m Water depth showing frequent outbursts and gas eruptions. Area of North Atlantic Deep Water formation of global significance (flow monitored intermittently with evolving technologies since 1948).
- AZORES - MoMAR site. The MoMAR area is in the NAST area and easily accessible from the Azores. The MoMAR sub-sea observatory project primarily addresses active seafloor spreading and life at deep sea hydrothermal vents MoMAR is an ongoing observatory project, with international support, and involvement of more than 14 institutions throughout Europe (http://www.momarnet.org). The MoMAR implementation plan calls for durable integration, over the next 5-10 years.
HELLENIC site: The Cretan Sea, the Rhodos Basin and the deep basin South of Crete are near shore MEDI areas where important hydrological conditions prevail. They are sensitive to climate change, geologically active and they constitute an important feeding ground for cetaceans.

CADIZ site: The Gulf of Cadiz / Iberian margin is a region of complexity with the junction of the Eurasian and African plates resulting in doming of the sea floor, mud volcanoes and other complex features. The interaction of the Mediterranean outflow with Atlantic waters is significant. Southwest Portugal, the Gulf of Cadiz and Morocco are prone to earthquakes and tsunami as testified by the great 1755 Lisbon earthquake and tsunami. NEAREST (Integrated observations from Near Shore Sources of Tsunamis: towards an early warning system) EC project, that involve ESONET partner, will develop and operate a prototype of Tsunami Detection and Early Warning System in the area of Gulf of Cadiz. The station will be contemporarily able to lodge a wide set of different geochemical, geophysical and oceanographic sensors. Esonet will support supplementary operations and demonstration of the deployed station as the establishment of a calibration point to be linked to remote sensing gravimeter, the measurement of sea bed current circulation and fault-fluid and gases releasing. On behalf ESONET a high resolution shallow water bathymetric stripe will be acquired during the observatory deploying campaign, devoted to tsunami modelling and inundation map production within the frame of resources and facilities optimization and data sharing.

BLACK SEA site.

In addition, we envisage that demonstration missions may also be planned at other sites that have not been identified in the ESONET CA report, yet offer the best answer to specific operational needs.

The KOSTERFJORD site (NE Skagerrak, Sweden) is situated in 90 m of water only 500 m from the shore and characterised by the presence of a cold water coral community. Although this is not a deep sea site, a joint international collaboration there offers an easy accessible Deep sea observatory facility with cable connection and real-time internet access open to the public (30 min. away from the EU supported Tjarnø Laboratories).

The MARMARA SEA is associated with large destructive earthquakes threatening the heavily populated Istanbul area (9 Millions inhabitants). Particularly destructive earthquakes that affected Istanbul occurred in 1509 and 1766. Another occurred in 1894. The recent earthquakes of Izmit and Duzce, in 1999, accelerated seismic activity in the Sea of Marmara and northwestern Aegean areas. ESONET NoE will determine to which extent a deep sea observatory could help improve earthquake hazards assessment and mitigation for the populations surrounding the Marmara Sea.

Another example of sites is the ESTOC site (since 1994, off the Canary Islands, 3618 m water depth) serves as reference station for studies of water column physical and biological processes in the open sea, as well as for instrumentation developments. It represents NAST conditions and variability.

According to the previous premise, the activities of the WP4 can be summarised as follows:

**Task a - Call for proposal (including preparation, planning and implementation)**
Preparation of the call for proposal for the demonstration missions and follow-up of the selection procedure by supporting the NoE Test and Operation, Scientific, and Data Management Councils.
Proposal evaluation: Submitted proposals will be evaluated by the members of the three network’s councils (Test and Operation, Scientific, and Data Management), using the criteria listed below, and discussed within the network at the “All regions workshop” on month 6. WP3 and WP4 leaders will also organize external scientific and technological reviews of the proposals. Based on these evaluations and workshop discussions, proposals will then be ranked, and a decision on funding made at the Steering Committee meeting immediately following the workshop.

Planning and implementation of the demo tests at selected site in close cooperation with NoE Tests and Operation Council, Observatory-site Leaders, proponent leaders and WP leaders (mainly WP2, WP3 and WP8).

Task b - Follow-up of demonstrations (including following-up of technical and scientific events as well as data flow and dissemination afterward) – Dissemination of the technological and scientific results of the demonstration tests in the NoE General Assemblies, internal and external workshops and conferences, internal and external reports. (most of Task b is outside the first 18 month period).

6.3. Spreading of excellence activities

6.3.1. WP 6 Socio economic users

Objectives:

The work package aims at promoting the need of subsea observatories, disseminating the results of ESONET NoE and establishing permanent links to socio economic users. The ESONET CA Report contains considerable data and analysis of potential user category, user area of interest and policy issues as summarized below:

<table>
<thead>
<tr>
<th>User Category</th>
<th>User Interest</th>
<th>Policy Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>National and Regional Administration Bodies, Public Departments, Civil Protection Authorities, Military Authorities Research Institutions, Universities, Private Consultancy, Industry, Non-Governmental Organisations, Public</td>
<td>Climate change monitoring, Geohazard Assessment, Education and Training, Ecosystems Study and Biodiversity assessment, Environmental protection and conservation, Pollution, waste prevention, Regulation policy, Civil security, Defense, Offshore oil industry, mineral extraction, Biotechnology, Industrial accidents, Renewable energy, Tourism</td>
<td>climate change, biodiversity, decline/habitat destruction, environmental security, geo-hazards, oil pollution/ hazardous substances, noise pollution, water quality, pollution, waste, recreation.</td>
</tr>
</tbody>
</table>

This WP will identify:

a) direct clients for data, information and/or infrastructure;
b) indirect users of information (education or outreach within WP7)

c) possibilities for integration within decision support tools

WP6 will expand on initial contacts (from other work packages such as WP5 and from previous projects) building the case for ocean observatory implementation based on socio-economic issues beyond the marine sector. Discussion will be held with the military to explore possible synergies. WP6 will initiate communications with the wider public through the “ESONET News – Europeans observe the deep sea” explaining the scientific issues and defining the socio-economic implications of ocean observatory findings. The socio-economic issues include for example, security of coastal communities, bio-prospecting and human health, fiscal mechanisms for GHG abatement, food from the sea, the safety of shipping, waste management, future energy supply, etc.

This WorkPackage 6 deals with dissemination of open type of information while WP5 is in charge of sensitive studies and integrated strategic negotiations and WP7 deals with outreach for non specialists. A restriction in data exchanged will be nevertheless applied in some cases, especially:

- In Task b, the military sector will be investigated as a potential stakeholder. But the contact will explore possible synergies with military equipments existing or planned; this will be done under the necessary level of confidentiality. The restriction of use of some areas of military interest will be treated in WP5 Task b.
- The dissemination must ensure a fair competition between private companies, especially SMEs. The Task c will take care of the necessary contracts or agreements needed. Some data might be restricted due to such contracts. The procedures of the Consortium Agreement will be followed in case of dispute.

Activities and Output:

Task a - Core services stakeholders and Task b) Regional services stakeholders

- Building on ESONET CA and ESONIM SSA outputs, WP6 will identify a detailed list of potential clients, their specific requirements and ability to pay for services or data produced by the European Seas Observatory Network,

- Development of systematic contacts with identified potential customers, towards formal arrangements evaluating also their impact in the implementation process;

- Development of models for evaluation of the benefits of the European Seas Observatory Network to its customers, either using current or to-be-developed networks and technologies.

Task c - Promotion and SME policy

- Assessment of the impact of ESONET on European Society as a whole.

- Organization of workshops held which can be in conjunction with Workshops under WP5 to promote business plans needed for the implementation phase.

- Identification of limitations of available observation technology, to foster development by the European private sector (and among them SMEs via PESOS) of new tools for the submarine monitoring of the Earth, either sensors, data browsers or value added services.

- Ensure a fair competition between SMEs.
Promote on the political and societal levels the perception that the European Union must monitor physical, chemical and biological processes occurring from beneath the deep sea floor to the sea surface and be competitive as a global player in this area of R&D.

### 6.3.2. WP 7 - Education and outreach

**Objectives:**

The main objective of outreach and training is the development and support of comprehensive interdisciplinary programs for research, education and public outreach on deep waters around Europe. ESONET will strengthen educational possibilities for students of all ages. This WP is intended to integrate vertically and laterally at all educational levels: for teachers to mentor scientists about how to teach kids, for data librarians to mentor teachers in the use of data archives, for engineers to introduce students and teachers into their instrument design.

ESONET’s envisioned internet technologies will merge research portfolios and establish a shared and mutually accessible research resource. The joint public relations can provide a wide range of new opportunities to explore and investigate the dynamics of the marine world using real-time data flow to classrooms and living rooms coupled with cutting-edge visualization techniques. Collaborators within the informal educational community will include museums, science centers, aquariums, media, and youth programs.

**Training:**

The training of graduates and post graduates in multidisciplinary environmental sciences is an important part of ESONET. The NoE is seriously committed to accomplishing two complementary goals: professional development of scientists/engineers and marine policy experts, and assistance to the ESONET full-time staff. Opportunities for training of full time staff through personnel exchanges among involved institutions will be promoted. ESONET NoE dedicates a significant part of the budget for these exchanges. The program will provide interns with an opportunity to work on projects relevant to their research, area of concentration, or degree. A collaboration with existing undergraduate programs will improve and restructure undergraduate curricula. The partners will be identified through the first ESONET workshop that focuses on undergraduate/graduate formal education offering incorporation of real-time data into undergraduate and graduate coursework and research. Partners from industry are committed to join these workshops. Trained postdocs and postgraduates who are funded by ESONET will disseminate the ideas developed within the NoE. Recruitment activities will be used to promote gender-balance. Thus one objective is to offer fellowships which will be 50 % granted to female applicants. Joint training programs will encourage postgraduates and staff to move or even relocate between the partners.

The core group will be supported by assistant partners and will invite partners from the new EU member states for the integrated activities. All these restructuring activities will lead to higher scientific excellence of the new generation of scientists and engineers of the EU. International cooperation: close links with other long term observatory projects in both US, Canada and Asia will allow cross fertilization of ideas and technological approaches.

**Implementation:**

**Task a - Educational tools**

Build an educational website showing work and create class material.
Link with teachers and produce teaching aids and resources for a wide audience, ranging from schoolchildren up to undergraduate level.

**Task b - Build a Web portal with a real-time web interface**

Show to all users metadata as well as the study sites using web-cams and underwater activities of internet operated vehicles, Service-ROVs.

**Task c - Communicate results and new developments**

1) Outreach at an appropriate level to the general public through TV, radio and press. Lecture tours by ESONET scientists around Europe at scientific and popular levels will be undertaken. An agreement is made with NoE EUR-OCEANS to cooperate with aquaria through the membership in ESONET NoE of Oceanopolis and link with the Association for EUR-OCEANS Public Outreach which comprises 14 Aquaria. An agreement will establish a link with HERMES.

2) Thematic maps.
Novel thematic maps (thematic maps and 4D visualization of ecosystems) on paper, dynamic electronic versions in GIS technology and real time data transfer will be presented at international conferences, and distributed to universities, research centres, museums, schools, societies, private foundations, NGOs and companies.

3) Organize a series of workshops, seminars and meetings.
Training for post-graduates and engineers involved in deep-sea research, especially from partners of the project ESONET and including participants from developing countries. These meetings will be organized as much as possible jointly with ESONET NoE internal workshops.

4) Take stock of all the European degrees and masters associated to marine technologies and sciences, introduce ESONET to those universities and related libraries and open discussion with ESONET.
6.4. Management of the Consortium activities

6.4.1. WP8 Management and governance structure.

The Coordinator makes sure that the organisational, management and governance structure of ESONET NoE aims at ensuring:

- Balanced participation in the network of the different types of members: large institutions, university laboratories, major industrial groups, SMEs.
- Efficient decision making.
- High quality management of the network’s resources.

The ESONET NoE structure (Figure 17) consists of:

- **3 Governing Bodies:**
  - General Assembly (GA),
  - Strategic Committee (STRAC),
  - Steering Committee (SC).

- **3 Advisory Councils:**
  - Scientific Council,
  - Test and Operation Council,
  - Data Management Council.

7 work packages (WPs) and an additional management work package (WP8).

The precise description of the governance system can be found in the Consortium Agreement and in paragraph 8.

The *Coordinator* implements the administrative and financial decisions of the General Assembly, the Strategic Committee and Steering Committee, within the framework set by the European Commission and under the authority of the Strategic Committee. The NoE is advised by the Scientific Council, Test and operation Council and Data management Council.

The *Coordinator* will:

- act as the intermediary between ESONET NoE and the EC,
- transmit all necessary information to the EC,
- receive payments made by the EC,
- administer the EC funds,
- make payments to Member organisations,
- keep accounts,
- inform the EC of the distribution of the funds.
The **Strategic Committee** (STRAC), brings together representatives of the **Core partners** at high level of responsibility, including when possible representatives of funding agencies (with a direct access to the national research funding decisions).

The **General Assembly** approves the major decisions concerning the general, political and financial orientations of the Network as proposed by the Steering Committee and the Network’s Strategic Committee. It is informed of statements, reports etc... by the Steering Committee. It can ask for explanations from the Steering Committee and deals with matters of membership.

The **Steering Committee** deals with current affairs under the leadership of the coordinator and the advice of Council chairperson. Meetings of the **Steering Committee** shall take place every 3 months or upon request by any of its members. The meetings can be either physical meetings or audio- or video- or email-conferences.

**The Scientific Council, the Test and Operational Council and Data Management Council** consists of experts proposed by the Strategic Committee. Its composition will be approved by the General Assembly. The three councils evaluate proposals to internal calls for offer and give their recommendations to the Steering Committee (The NoE will issue internal calls in order to optimize the budget allocation towards integrating activities - permanent call for exchange of personnel and call for demonstration actions).

The above description of ESONET NoE demonstrates that the organisational structure provides a secure and efficient framework for any necessary decisions to be taken.
6.B - PLANS

6.5. Plan for using and disseminating knowledge

The common knowledge acquired in ESONET NoE is coming more specifically from:

- Previous projects (especially from EC funded projects) as synthesised during workshop “Updating state of the art from previous EC projects” on month 2,
- International cooperation (WP1 Task e),
- Best practice workshop on month 8,
- Integrating activities in WP1,
- Specification reports from WP2.

It will be used as input and specifications for:

- the Joint research Activities in WP3 and WP4,
- the Tests in WP1,
- the demonstrations of interoperability in WP2.

Their dissemination will be ensured by:

- Exchange of personnel from WP1,
- First education and training workshop (WP7 – month 12),
- WP6 to socio-economic users,
- WP7 to the public and education bodies.

The time series and images from the seafloor and water column will be accessible according to the data management policy. The general principle is a wide dissemination of these results enabling treatment, interpretation, comparisons between data spatially and timely and assimilation in models. Data for operational need (seismics, Tsunami warning, physical oceanography) will be made available within requested delay. The use of the validated and/or treated data will be done by the scientists of the ESONET partnership but also open to the whole research community.

Promoting the use of this new highlight on the poorly known deep sea areas is a major concern for the project. ESONET will discuss with all the potential stakeholders (WP6) in order to collect the needs and tailor the subsea observatories accordingly.

Following the researchers, through the medium of educational programs, TV professionals, Aquariums and museums, the public will access to the time dimension in the deep seas around Europe. WP7 is dedicated to this outreach activity.

The plan is to initialize the dissemination organization of ESONET first with data acquired in previous projects or during the tests taking place during the first months of the project. Data management system will be prototyped (WP1). The education website and other education materials will be tested and launched (WP7). The user groups and regional stakeholders will be contacted and their requirements taken into account (WP6). The scientific group in ESONET will work on the scientific objectives and the priorities (WP3). It means that a first
benchmarking of the disseminations capabilities of the NoE will be done with sufficient input during the first year.

Everything will be ready then to prepare the dissemination of the Demonstration Missions. The plan of the Dissemination Missions competing in the call issued by ESONET will be strong criteria in the selection process. The advice of the Data Management Council on the multidisciplinary scope of the acquired data will be taken into account. During the second year of the project, ESONET WPs will all be active in the promotion of the results of the Demonstration missions. The quantitative and qualitative indicators of the project will reflect this effort and help to improve the impact of the ESONET activities.

Subsea observatories are a field of oceanography involving a large number of disciplines. ESONET is already presented to more than 10 conferences and seminars each year. The dissemination of results of the NoE will include:

- Participation to marine conferences: Oceans, Oceanology International, Suboptic, SeaTechweek,
- Participation to disciplinary conferences: EGU, AGU, IODP, ION,…
- Organisation of dedicated panels in the above,
- Involvement in the participation of conferences with a major concern on subsea observatories: ISSC, ORION, ….
- Organization of two European “All Regions Workshops”, tutorials, seminars and specialized workshops.

6.6. **Gender Action Plan**

The proportion of women in marine science decreases rapidly from more junior to more senior levels. In light of this, the ESONET partners will ensure that there are no barriers to leadership roles for female participants within the network. Initially, within the ESONET network, female scientists have already been appointed as:

- 6 out of 26 in the responsibility of regional sites,
- 7 out of 27 as Work Package responsible or “task team”,
- 7 out of 34 members of Councils,
- a woman is Chairperson of the Data Management Council.

Actions to ensure gender equality will include:

- consider the scope for women to give high profile presentations (e.g. keynote talks at conferences) on project results etc. to raise their profile and develop career and networking opportunities;
- identifying other training and development opportunities;
- ensure that access to employment and training opportunities within the scope of the project are open, transparent and non-discriminatory. The employment opportunities and directly related to the project will be advertised as widely as possible, and the appointment panels should be of mixed sex;
- ensuring that outreach and education activities promote the role of women in science and the opportunities that exist for women to get involved in ocean research. All outreach and education activities should provide positive role models for female students;
- preventing inappropriate use of language and concepts regarding gender bias. The reports and outreach activities will be screened for use of language and concepts that can lead to gender bias, or fail to take account of gender.
ESONET cannot control the employment practices of partners that are governed by larger organisations. However, awareness of best practice in gender equality can be shared and may instigate longer-term changes, taking into account regional and cultural differences. Examples are:

- promotion schemes allowing self-nomination and based on published criteria recognizing a variety of outputs (this has increased promotion of women in UK-NERC);
- annual staff appraisals emphasising development needs for the individual;
- maternity and paternity leave, part-time and flexible-hours working, job sharing, career breaks, childcare support, home working, special leave, sabbaticals.

To guide these actions, the ESONET project coordinator will gather disaggregated statistics to show the role of women in the project and their participation in events such as training and project conferences. This will be used as a yearly reported indicator of gender actions. The project also undertakes to contribute this data to surveys and investigations instigated by the EC.

6.7. **Raising public participation and awareness**

*see WP6 and WP7 and Paragraph 5.2.*
6.C - MILESTONES

6.8. Major Milestones over full duration of the action

The ESFRI roadmap published on 19th October 2006 points EMSO (European Multidisciplinary Sea Observatory) as the first large scale infrastructure to fund under the FP7. Generally speaking, major milestones of ESONET will depend on the calls for infrastructure. ESONET will anticipate in order to follow the roadmap of the European Commission FP7 and the schedules of calls by the member states.

- Before the beginning of the project or month 0.
The constitution of the Councils and Committees is agreed and they are ready to work on the basis of e-mail forum. The first “ESONET News- Europeans observe the deep seas” is issued. The website is ready with statutory texts and Esonet CA documents available. The scheme of the calls for proposals (WP1-Exchange of personnel and WP4-Demonstration Missions) are ready, allowing partners to apply for ship time outside ESONET budget. Invitations for the first workshop are sent.

Note: The “All Regions Workshop n°1” will take place at the same time as the Kick Off Meeting or in parallel to training events of month 6-8 if possible in order to diminish the number of meetings.

Figure 18: Overall planning of Joint Program of Activities
• Month 2 – KICK OFF MEETING and ALL REGIONS WORKSHOP N°1.
The General Assembly and statutory meetings are followed by a Workshop (possibly held on month 6) presenting the scientific interests of each of the regional observatories networks of ESONET (APPENDIX C). The same workshop is used to share the information about recent or ongoing EC projects in the field of underwater observatories (ESONIM, ORION, EXOCET/D, COBO, ASSEM, ANIMATE, MERSEA, SEADATANET, HERMES, KM3Net…). ERANet key actors and coordinators will be invited to the “ALL REGIONS WORKSHOPS”

• Month 2 and 3 – Issue of the Calls for proposals (WP1-Exchange of personnel and WP4-Demonstration Missions).

• Month 6 to 8 – Training workshops and tutorials (Best practice seminar) – Decision on successful proposals for demonstration missions.

• Month 12 – ALL INTEGRATION GROUPS ARE CONSTITUTED
This is the first major step of integration. Groups are constituted before this date on all the fields of expertise of subsea observatories. From an initial group of core partners, a group of specialists is constituted and signs a MOU or a contract in the following fields:
  - Regional Implementation Committees for a number of sites among the 12 ESONET sites (WP1),
  - Data management group(WP1),
  - Core group of institutes and companies testing equipments(WP1),
  - Sensor standardisation group(WP2),
  - Quality assurance group(WP2),
  - Underwater intervention group(WP2),
  - Group of scientific experts (starting month 1)(WP3),
  - Economical and legal expertise group (WP5),
  - SME group, constituting a formal association PESOS(WP6 and WP2).
Contracts or MOU are signed for the international cooperation with at least one networked observatory (Neptune, ARENA, Mars) (WP1).

These groups are preparing the elements of ESONET LABEL in their field.

• Month 12 – First Education Workshop.

• Month 13 – ESONET consortium is ready to apply for infrastructure budget.
The economical and legal models are available, standards are issued and integration groups are active.

• Month 14 – Reports on the first 12 months are issued.

• Month 18 – Beginning of the second phase.
Demonstration missions are running

• Month 18 – Coordination with GMES plans on Core Services.

• Month 24 – Definition of ESONET LABEL and its protection at European level.

• Month 26 – Reports on the second 12 months are issued.
• **Month 28 – Reports on the demonstration missions.**
Scientific work will continue using this data. Outreach events will promote the results to a wide community, including socio-economic actors and the public.

• **From month 28 (latest month 36) – National decisions about integration.**
The elements will be collected in order to present a permanent ESONET organisation to the EC and to each member state.

• **Month 32 – ALL REGIONS WORKSHOP N°2.**
Key decision makers and scientists will be invited to this overview of all the work achieved to better define the regional observatory networks around Europe. A complete business plan, the first results of demonstration observatories and a plan of further deployment of infrastructure will be presented. The ESONET LABEL will be delivered for the ESONET nodes to the groups issued from the Regional Implementation Committees which is building up the corresponding ESONET RLE.

• **Month 36 (or before) – LAUNCHING LEGAL INTEGRATION BODIES.**
As far as we can anticipate it, the legal integration body(ies) able to implement, operate and maintain the network of multidisciplinary ocean observatories in deep waters are launched after all signatures.
They would ensure ESONET CORE SERVICES and ESONET RLEs

• **Month 42 – ESONET CORE SERVICE WORKSHOP.**
This workshop is held in order to complete the information on operation and maintenance issues and to promote services. Outreach activities are associated.

• **Month 48 – Final Report.**
7. **Quality of integration and performance indicators**

- In order to promote integration, the Joint Programme of Activities is designed to:
  - continue the networking process started with ESONET CA, OMARC, ASSEM/ORION and other clustering efforts of the European Commission;
  - constitute integrative groups within the first year (Regional Implementation Committees for a number of sites among the 12 ESONET sites (WP1), Data management group(WP1), Core group of institutes and companies testing equipments(WP1), Sensor standardisation group(WP2), Quality assurance group(WP2), Underwater intervention group(WP2), Group of scientific experts (starting month 1)(WP3), economical and legal expertise group (WP5), SME group, constituting a formal association PESOS(WP6 and WP2)).
  - include in the NoE management structure three Councils (Scientific, Test and Operation, Data Management) guiding the integration in all three fields;
  - plan all activities in order to reach national decisions on integration at European level before month 36;
  - use the Spreading of Excellence activities to mobilise interest of socio-economic actors (WP6) and train the staff of the ESONET NoE partners to share a common scientific and technological culture (WP7);
  - dedicate a part of Joint Research Programme, WP5, to develop common economic and legal approach and apply for funding as one structure.

- The ultimate objective of the NoE is not only the commitment of the participants but the involvement of their respective member states. The integration of underwater observatory network policies requires that national groups are constituted to act in the name of the member state. This process has already been initiated by the constitution of national groups that will be represented by one contractor of ESONET NoE called “core partner”.

- The principle of exchanging and sharing means and personnel by the Network of Excellence is supported by the directors of the partners either represented at national level or still participating separately.

- A formal letter was sent to the coordinator by the director of the partners during the phase 2 of the proposal. These letters are available under request. They acknowledge that a draft of the Consortium agreement has already been transmitted to the partners during the submission phase. A new version has been circulating among core partners in September 2006. It circulates among all the partners in October 2006.

The integration at European level is of most importance for the Network of Excellence in order to bring the infrastructure projects to success. Particular attention will consequently be paid to the evolution of restructuring European Observatory initiatives through performance indicators.

These indicators will be checked on a yearly basis during independent reviews regarding the progress towards integration and will be a permanent concern of the Steering Committee reported to Strategic Committee and at every General Assembly.
List of indicators

ESONET performance indicators.
Indicators are classified in 2 ways:

i) Type of indicators: statutory, qualitative or quantitative performance indicators.

ii) Type of Integration Activity. Classification:
1. Development of a coherent management framework;
2. Interoperability of data and other systems;
3. Common approaches to science and society issues;
4. Co-ordinated programming and execution of research;
5. Strengthening of complementarity and mutual specialization;
6. Staff mobility;
7. Sharing of research infrastructures and facilities;
8. Use of common electronic and communication networks;
9. Joint training programs;
10. Management of knowledge and intellectual property.

Integration Objective I1: Integration of European Research in the observatory field.

<table>
<thead>
<tr>
<th>Integration Objective I1: Integration of European Research in the observatory field.</th>
<th>Work package</th>
<th>Activity type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statutory</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1.1 Contracts, MOUs or formal agreements signed between ESONET partners (including other active or supporting bodies is positive).</td>
<td>WP5</td>
<td>1</td>
</tr>
<tr>
<td>I1.2 Development of joint calls for research proposals.</td>
<td>WP1,3</td>
<td>2,3,4</td>
</tr>
<tr>
<td>I1.3 Contracts or MOU on the common use of monitoring equipment.</td>
<td>WP2,4</td>
<td>4,5</td>
</tr>
<tr>
<td>I1.4 New R&amp;D projects launched in common.</td>
<td>WP3</td>
<td>4,5</td>
</tr>
<tr>
<td>I1.5 New infrastructure projects launched in common</td>
<td>WP5</td>
<td>2,5,7</td>
</tr>
<tr>
<td>I1.6 Use of common communication tools.</td>
<td>WP1,7</td>
<td>8,9</td>
</tr>
<tr>
<td>I1.7 Use of common methodologies.</td>
<td>WP2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Quantitative Performance Indicators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1.8 Days of common cruises.</td>
<td>WP4</td>
<td>4</td>
</tr>
<tr>
<td>I1.9 Days of joint training seminars.</td>
<td>WP3,7</td>
<td>9</td>
</tr>
<tr>
<td>I1.10 Number of joint proposals.</td>
<td>WP1,5</td>
<td>3,4</td>
</tr>
<tr>
<td>I1.11 Person-months of exchanged personnel.</td>
<td>WP1</td>
<td>6</td>
</tr>
<tr>
<td>I1.12 Number of joint publications.</td>
<td>WP3,4</td>
<td>3,4</td>
</tr>
<tr>
<td>I1.13 Number of joint Ph.D. supervisions.</td>
<td>WP1</td>
<td>3,4</td>
</tr>
<tr>
<td>I1.14 Number of shared facilities, equipment.</td>
<td>WP1</td>
<td>5,7</td>
</tr>
<tr>
<td>I1.15 Number of invitations as experts, teachers or conference speakers by United Nations, USA, Japan, Canada or other ocean monitoring organisations.</td>
<td>WP1</td>
<td>9,10</td>
</tr>
<tr>
<td>I1.16 Mbyte of time series exchanged or jointly collected and analyzed.</td>
<td>WP1</td>
<td>7,8</td>
</tr>
<tr>
<td>I1.17 Mbyte of time series validated by models or experts.</td>
<td>WP1</td>
<td>7,8</td>
</tr>
<tr>
<td>I1.18 Hours of video exchanged or jointly collected and analyzed.</td>
<td>WP1,7</td>
<td>7,8</td>
</tr>
<tr>
<td>I1.19 Number of new components or sensors issued from ESONET NoE cooperation.</td>
<td>WP2</td>
<td>4</td>
</tr>
<tr>
<td>I1.20 Number of satisfactory years of deployment of new components or sensors issued from ESONET NoE cooperation.</td>
<td>WP2</td>
<td>5,7</td>
</tr>
<tr>
<td>I1.21 Number of science centres utilising and contributing to the web-based initiatives (Education and outreach).</td>
<td>WP7</td>
<td>10</td>
</tr>
<tr>
<td><strong>Qualitative Performance Indicators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I1.22 Implementation of inter-disciplinary evaluation and quality control tools.</td>
<td>WP2,5</td>
<td>2,3,10</td>
</tr>
<tr>
<td>I1.23 Established agreements on data access protocols.</td>
<td>WP1</td>
<td>8</td>
</tr>
<tr>
<td>I1.24 Statistics of gender actions.</td>
<td>WP8</td>
<td>1</td>
</tr>
</tbody>
</table>
**Integration Objective I2: Toward a permanent ESONET structure**

<table>
<thead>
<tr>
<th><strong>Statutory</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I2.1 Number of regional consortia constituted by the project and leading to formal agreements.</td>
<td>WP5</td>
<td>1</td>
</tr>
<tr>
<td>I2.2 Number of countries whose ministries have signed their involvements in ESONET legal integration body(ies).</td>
<td>WP5</td>
<td>1,2,7</td>
</tr>
<tr>
<td>I2.3 Number of signature of public authorities and stakeholders for their participation in ESONET CORE SERVICES and/or ESONET RLES.</td>
<td>WP5</td>
<td>1,2,7</td>
</tr>
<tr>
<td>I2.4 Number of contracts or MOUs signed by ESONET as a legal body under constitution.</td>
<td>WP5</td>
<td>1,4</td>
</tr>
<tr>
<td>I2.5 Number of contracts or MOUs signed by ESONET as legal body (when constituted).</td>
<td>WP5</td>
<td>1,4</td>
</tr>
<tr>
<td>I2.6 Number of laboratories candidate to integrate a Virtual Institute of deep Sea Observatory (VISO).</td>
<td>WP1</td>
<td>3,4</td>
</tr>
</tbody>
</table>

**Quantitative Performance Indicators**

| I2.7 Number of standards adopted by PESOS members. | WP2, 6 | 5 |
| I2.8 Number of new PESOS members, non partners of initial ESONET NoE. | WP6  | 5 |
| I2.9 Number of participation of PESOS to international exhibitions. | WP6  | 5,10 |
| I2.10 Number of ESONET LABEL attributed to RLE. | WP5  | 1,4 |
| I2.11 Number of research groups that apply ESONET recommendations. | WP6  | 7,8 |
| I2.12 Number of inter-disciplinary seminars. | WP3  | 9,10 |

**Qualitative Performance Indicators**

| I2.13 Support at European level for infrastructure decisions. | WP5  | 5,7 |
| I2.14 Support received at regional, national or international level, private or public. | WP5, 6 | 5,7 |
8. **Project organisation, management and governance structure**

8.1. **Organisational, management and governance structure and decision-making mechanisms**

The organisational, management and governance structure of ESONET NoE aims at ensuring:

- Balanced participation in the network of the different types of members: large institutions, university laboratories, major industrial groups, SMEs.
- Efficient decision making.
- High quality management of the network’s resources.

The ESONET NoE structure consists of:

- **3 governing bodies**:
  - General Assembly (GA),
  - Strategic Committee (STRAC),
  - Steering Committee (SC)

- **3 Advisory Councils**:
  - Scientific Council
  - Test and operation Council
  - Data management Council

- **7 work packages** (WPs) and an additional management work package (WP8)

The seven work packages will be conducted in 11 regional observatories or more.

The precise description of the governance system can be found in the Consortium Agreement.

The *coordinator* implements the administrative and financial decisions of the General Assembly, the Strategic Committee and Steering Committee, within the framework set by the European Commission and under the authority of the Strategic Committee.
Figure 19: Organisational, management and governance structure of ESONET
The coordinator will:

- act as the intermediary between ESONET NoE and the EC,
- transmit all necessary information to the EC,
- receive payments made by the EC,
- administer the EC funds,
- make payments to Member organisations,
- keep accounts,
- inform the EC of the distribution of the funds.

The coordinator will hire a project team of three full time equivalent people for the duration of the Network. The project team will be located at the Centre Ifremer of Brest and will, in complementing to the above tasks, archive the documents and reports produced by the Network, manage its programme (provisional agendas, date and place of meetings, convening members, etc…) and disseminate information relevant administrative and financial matters. The permanent staff of the coordinator (coordination groups, secretaries) will assist the project teams as necessary. The coordinator takes care to limit expenses involved by meetings. It will organise video internet conferences for most of the Network’s meetings. It will also host Network’s meeting when appropriate in Brest (meeting rooms for 20 to 200 people), Paris or Toulon (meeting rooms for 40 people).

The coordinator is responsible of the implementation of the JPA. He works closely with the council chairpersons and WP leaders.

The Scientific Council, the Test and Operational Council and Data Management Council consist of experts proposed by the Strategic Committee. Its composition will be approved by the General Assembly. The proposed composition is given in Appendix D.

The Scientific Council (SC) advises the Assembly, the Strategic Committee (through the Steering Committee), the Steering Committee and the coordinator on the Network’s scientific orientations and the implementation of the JPA’s, especially of WP1, WP3 and WP4.

The Test and Operation Council (TOC) advises the Assembly, the Strategic Committee (through the Steering Committee), the Steering Committee and the coordinator on the test and operational aspects of the JPA’s, especially of WP2, WP4 and WP5.

The Data Management Council (DMC) advises the Assembly, the Strategic Committee (through the Steering Committee), the Steering Committee and the coordinator on the data management policy of the JPA’s, especially of WP1, WP6 and WP7.
The chairpersons of the councils are:

<table>
<thead>
<tr>
<th>Scientific Council</th>
<th>Test and Operation Council</th>
<th>Data Management Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chairperson</td>
<td>Chairperson</td>
<td>Chairperson</td>
</tr>
<tr>
<td>Imants G. Priede</td>
<td>Univ. Aberdeen (GB)</td>
<td>Paolo Favali</td>
</tr>
<tr>
<td></td>
<td></td>
<td>INGV (IT)</td>
</tr>
<tr>
<td></td>
<td>Sylvie Pouliquen</td>
<td>IFREMER (FR)</td>
</tr>
</tbody>
</table>

The proposed members of the three councils for the beginning of the project and at least to the first General Assembly are presented in Appendix D:

The three councils evaluate proposals to internal calls for offer and give their recommendations to the Steering Committee.

The **Strategic Committee** (STRAC), brings together representatives of the Core partners at high level of responsibility, including representatives of funding agencies (with a direct access to the national research funding decisions).

*The Strategic Committee* consists if possible of one representative of Ministry or Funding Agency chosen per Core partner (see table §3 for the list of Core Partners). A deputy from the management of each Core Partner is also appointed.

The Co-ordinator or his delegate is in charge of the secretary function.

The **Strategic Committee** gives recommendations to the **Steering Committee** to implement tools for lasting integration of the European research on deep sea observatories: MoU between Core partners, virtual labs, permanent structures, European technical committees,…

*The Strategic Committees* members will report from contacts with national decision makers about their involvement into deep sea observatory network development and associated European research integration.

The **Strategic Committee** will approve proposals from the **Steering Committee** contribution to a lasting integration of the European research on deep sea observatories and will promote them to decision makers at European and national level to support long term observatory development and implementation.

The **General Assembly** approves the major decisions concerning the general, political and financial orientations of the Network as proposed by the Steering Committee and the Network’s Strategic Committee. It is informed of statements, reports etc… by the Steering Committee. It can ask for explanations from the Steering Committee and deals with matters of membership.

To this end, each Partner shall appoint an authorised representative to the Assembly by notice in writing sent to the Co-ordinator. Substitutes for representatives shall also be appointed. Replacements of representatives as well as substitutes shall be possible. In meetings of the Assembly the representatives may be accompanied by advisors.
In the Assembly, the Partners shall approve those major decisions concerning the general political, strategic and financial orientations of the Network, as proposed by the Steering Committee:

- with respect to the Partners obligations under the Contract and their relation with the Community, information on the current Joint Programme of Activities and adoption of any new Joint Programme of Activities;
- on a yearly basis, information on the Network Budget;
- initial approval of the Work Packages leaders, upon proposition by the Co-ordinator;
- approval of the members of the Scientific Council, the Test and Operation Council, the Data Management Council;
- in a manner not unduly obstructing the timely delivery of such reports, information on any annual reports to be delivered under the Contract;
- acceptance of new partners to the Consortium Agreement;
- proposals to the Partners regarding the acceptance of new partners to the Contract, in consideration of the respective steps to be taken in such case in accordance with the Contract including the modalities of the accession process;
- proposals to the Partners for the conclusion of Additional Agreements for Integration Purposes;
- proposals to the Partners for the approval of any amendment of terms of the Consortium Agreement;
- proposals to the Partners’ approval for the review and/or for amendments of terms of the Contract, to be transmitted to the Commission by the Co-ordinator;
- any decision to instruct the Co-ordinator to ask the Commission on behalf of the Consortium to terminate the participation of one or more Partners.

The Assembly is informed of the project by the Steering Committee. Any decision of the Assembly shall require the majority of present members.

The Assembly shall appoint three of its members as delegates to the Steering Committee, taking into consideration a balance between countries and different kind of partners (OSI, SME).

The Steering Committee deals with current affairs under the leadership of the coordinator and the advice of Council chairperson.

The Steering Committee consists of the Co-ordinator, the Chairman of the Scientific Council, the Chairperson of the Test and Operation Council, the Chairperson of the Data Management Council, Work Package leaders, the three delegates elected by the Assembly, and additional delegates of Core partners whose country is not represented by the previous persons. It will be avoided to have more than three members per core partner in the Steering Committee.

The Steering Committee is responsible for the overall direction of the Network. It shall in particular be in charge of coordinating the activities within the Network and take most of the decisions of the Partners and prepares the decisions to be taken by the Assembly. In particular it shall be responsible for the following:

- the overall follow-up of the performance of the tasks and activities and deliverables to be provided by the Partners under the Contract and the current Joint Programme of
Activities as well as information of the representatives of the other Partners on any non-performance;

- compiling the reports and deliverables received from the Work Packages, to be delivered by the Consortium to the Commission;

- supporting the Co-ordinator in the preparation of meetings with the Commission and in the compilation of related data;

- preparing proposals to the Strategic Committee for:
  - suggestion of MoU between Core partners,
  - installation of Committees at European level,
  - projects at multinational level,
  - integration of European research in the observatory field.

- preparing proposals to the Assembly for:
  - the acceptance of new parties to the Consortium Agreement and the accession of new parties to the Contract, including in case of a positive decision by the Assembly on conducting a competitive call,
  - the review and/or amendment of terms of the Contract, and the review and/or amendment of terms of the Consortium Agreement,
  - additional Agreements,
  - actions to be taken against a Defaulting Party, after reviewing the documentation and compiling a report on the Default of such Party,
  - the decision to suspend all or part of the Project or to terminate all or part of the Contract, including the modalities of such termination with respect to ongoing activities; or a decision regarding a request by the Co-ordinator to the Commission to terminate the participation of one or more Parties in the Contract,
  - the establishment of any advisory committees, including the appointment of its members.

- propose comments on Intellectual Property on additional procedures and policies on management of Knowledge and submit the proposals and its comments to the Assembly for approval;

- proposing modalities for any additional rules for the financial management of funds;

- co-ordinating agreements or activities on publications or press releases by Partners or by the Commission and co-ordinating the required actions and agreements on planned press releases or publications in accordance with the Consortium Agreement;

- Organize the Work Packages and modifications of partnership:
  
  (a) appoint, and when needed decide the revocation of the appointment of the respective Work Packages' leaders, as well as the Councils' chairpersons,
  (b) provide regular information to the Partners on the overall Network activities, distribute any documents and exchange information with respect to the Network activities to and between the Work Packages and the Partners concerned,
  (c) gather and consolidate all reports and deliverables from the Work Packages,
  (d)) validate the work and budget plans received from the Work Packages leaders, and prepare the Joint Programme of Activities for the following period,
  (e) prepare the acceptance of new parties to the Consortium Agreement and the accession of new parties to the Contract.
(f) alert and prepare actions to be taken against a defaulting party in accordance with the Consortium Agreement, after reviewing the documentation and compiling a report on the Default of such Party.

The Steering Committee shall be chaired by the Co-ordinator, the Chairperson of the Scientific Council shall be the vice-chair. The chairperson of the Steering Committee shall usually be responsible for the transmission and presentation of the proposals of the Steering Committee to the Assembly. Anyway, depending on the Agenda, another member may be appointed.

Meetings of the Steering Committee shall take place every 3 months or upon request by any of its members. The meetings can be either physical meetings or audio- or video- or email-conferences.

All resolutions taken during meetings of the Steering Committee, including those based on non-personal meetings, shall be recorded by the Coordinator and agreed upon by the members who attended that meeting. The record shall be sent to all members. The record shall be considered as accepted, if no member or attendee has objected against the record towards the Co-ordinator after a pre determined delay. Thereafter, the chairperson of the Steering Committee shall sign the record. The original records of resolutions thus compiled and signed shall be kept by the Co-ordinator and serve as prima facie evidence for the decisions taken. The Co-ordinator shall distribute copies to all members and attendees.

Neither the Steering Committee nor its chairperson or any of its members, shall be entitled to act or to make legally binding declarations on behalf of the Partners of the NoE altogether or on behalf of a single one nor shall a member enlarge its role beyond the one described in the Consortium Agreement.

Task team: The Work Package leader is assisted by task leaders and other specialists for the coordination of the WP activities (see Table 1 in §6). They constitute a Task team for each WP. The Steering Committee approves the initial composition and changes in the task teams.

Partnership evolution: the initial partnership of ESONET NoE groups all the European institutions involved in deep sea observatory studies. Provision will be made at the coordination level to be able to invite non partner organisations to participate in the Network activities on Strategic committee recommendations. The invited organisation can become a new partner by decision of the General Assembly on Strategic Committee recommendation transmitted by the Steering Committee.

The above description of ESONET NoE demonstrates that the organisational structure provides a secure and efficient framework for any necessary decisions to be taken.

Internal calls
The Network of Excellence will issue internal calls in order to optimize the budget allocation towards integrating activities:

- A permanent call for exchange of personnel (issued on month 2 to start with, reviewed at every Steering Committee meeting). The procedure is: Advice of Scientific Committee, Advice of Test and Operation Committee, Advice of Data Management Committee, Decision of Steering Committee. It is organized by WP1.
The criteria are: quality of the activity inside a work package, integration in a team, gender equilibrium, potential of joint research, potential of joint know-how for the future Core Services of the NoE.

- Call for demonstration actions. At least one during the project duration.

  First call on month 2. Decision on month 6. Cruises from month 16. The procedure is: Advice of Scientific Committee, Advice of Test and Operation Committee, Decision of Steering Committee, presentation to the general assembly. These demonstration actions will concentrate the full spectrum of infrastructure provided by ESONET partners (research vessels, ROVs, AUVs, IOVs, observatory test sites). The actions will allow to test new technologies, data handling as well as to harmonize the team-work between all partners from the different EU institutions.

  **Criteria are presented on paragraph 9.1.4.** The call and follow up are organized by WP4.

- A permanent call for established scientist-teacher and scientist-museum/aquarium partnerships to support ESONET education and outreach (issued on month 2 to start with, reviewed at every Strategic Committee meeting). These partnership programs will allow developing and constantly improving new curricula in science education and outreach.

  Internal calls will follow stringent rules to be issued before the beginning of the project. They will deal with:

  - the confidentiality of all the council or decision meetings relating to these calls,
  - the deontology rules such as the abstention of a person who is involved in a proposal to the evaluation of this proposal,
  - allowed iterations (questions to the proposers).

### 8.2. Adequation and necessity to the NoE objectives of researchers to be integrated

The 249 researchers in oceanography disciplines or marine technology cover a complete scope of the potential to be integrated in order to fulfil the multidisciplinary objectives of ESONET NoE. All the specialities of marine biology, marine geology, biogeochemistry, physical oceanography are joined to specialists of sensors, underwater cables, boreholes, moorings, underwater intervention, benthic stations, electronic architecture, underwater mechanical design, material ageing at sea, fibre optic networks, energy management underwater, data management, quality assurance, metrology, etc. This covers the objectives presented in §2 *Scientific objectives* and *Technical objectives*. Experienced researchers in operational networks are also involved (objectives *Environment and Security Operational Objectives*). Economy, teaching and law of the sea are also among the competence in the network, they will participate in the objectives of *Societal and Policy objectives*.

The equilibrium of disciplines is presented in §10.5. A Network of Excellence is needed to be able to monitor the European margins, it must have the critical scale for this ambition. Japan and West coast of North America are building the future of subsea observatories on large scale networking too.

### 8.3. Management of knowledge

The *Consortium Agreement draft*, already circulated among partners entails the guiding principles for the ownership and protection of the knowledge (owned by the Member Organisations at the beginning of the project, or acquired in parallel to it or generated by the project), as well as for the granting of access rights to this knowledge. The NoE partners and
especially Core Partners will pay attention to build a common knowledge that may potentially start services and constitute Core Services of ESONET in the future. « They will act together to protect jointly owned knowledge. A co-ownership agreement will be established between those partners who share rights ». In case of discussion or conflict, the reference will be in first instance the Strategic Committee. Consultation in two meetings at least will be attempted to first attempt to settle eventual dispute. Special attention is paid within WP6 Socio-economic users to the transfer of knowledge to SMEs or larger industrial partners. The way to cope with the knowledge acquired on sites with potential laying of cable for scientific subsea observation is not completely defined yet. It is a task of WP5 Implementation strategies to address the legal aspect of regional projects. It will result in procedures and methods depending on the countries and EEZ. They will be proposed during the second part of ESONET NoE as internal rules for his specific management of knowledge.

8.4. Adequacy of the requested grant

See 10.

8.5. Decision making process

The ESONET NoE decision making process is illustrated in Figure 19 (although all the arrows are not drawn). The complete definition is proposed in the Consortium Agreement. If we look at common processes:

- New ideas are initiated from Task teams or from General Assembly members through questions or from Strategic Committee on strategic matters. They are transmitted to the Steering Committee who can ask further investigation to the WPs or to any partner or ask advice from Councils. The Steering Committee have a general view on the decisions; they are taken according to the importance.

- Daily decisions are taken by the Task teams under the control of Work Package leader, and with reporting to the Steering Committee,

- Short term decisions are taken by the Steering Committee

- Major decisions (as defined above in the paragraph “General Assembly” of §8.1) are prepared by the Steering Committee and approved by the General Assembly

- Integration decisions are taken by the Strategic Committee. They are prepared by WPs, mainly WP5, on feasibility and budgeting. They are instructed by the Steering Committee with possible advisory by Councils and then presented to the Strategic Committee.

- Funding and budgeting is from the European Commission to the Coordinator, the Coordinator to Partners and Members according to responsibilities and WP leaders estimates (initial budget) and Partners and Members activities afterward.

- Reporting on task: from Task team to WP leader to Steering Committee on regular reporting

- Administrative reporting is from the Coordinator to the EC.

- Archiving is the coordinator’s responsibility, delegated to Task teams for scientific and technical matters, unless confidential.

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6 Consortium Agreement draft of Esonet NoE
8.6. Evolution of partnership
No partnership expansion will take place during the first 18 months on the NoE, since ESONET has to organize itself efficiently towards integration. The entry of a new partner is a decision of the General Assembly following an invitation by the Coordinator under recommendation of the Steering Committee. Access to the contract will have to be negotiated by the Coordinator with the EC. The withdrawal of a partner is possible according to the draft Consortium Agreement; this right is nevertheless restricted by the liabilities and obligations of the partner.

8.7. Progress made in establishing a Consortium Agreement
A draft Consortium Agreement was written before the Phase 1 of the submission. It has circulated among partners who all received an electronic copy of this draft. They all acknowledged receipt of this copy in their letter of participation signed by a Chief Executive or Director in their institution or company. These letters are available under request to the coordinator. Core partners are reviewing a complete version of the Consortium Agreement in September 2006 in its managerial and legal aspects. It is submitted end of September to the other partners.
## 9. Detailed joint programme of activities (JPA) – months 13-30

### 9.1. Introduction - general description and milestones

The first 18 months were planned in order to ensure maximum integration: constitution of all active groups, synthesis of state of the art, activities raising the level of knowledge in the European consortium to the highest level, tools for staff training and dissemination, launching of demonstration activities.

### 9.1.1. Summary of main Achievements

#### List of deliverables

<table>
<thead>
<tr>
<th>Deliverable no</th>
<th>Deliverable name</th>
<th>WP n°</th>
<th>Lead participant</th>
<th>Nature⁷</th>
<th>Dissemination level⁸</th>
<th>Date due</th>
<th>Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Define preliminary scientific priorities; Text of the call for proposal.</td>
<td>WP3, WP4</td>
<td>NOCS INGV</td>
<td>R</td>
<td>PU</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>D2</td>
<td>Report on regional observatory stakeholders.</td>
<td>WP6</td>
<td>FFCUL</td>
<td>R</td>
<td>CO</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>D3</td>
<td>Esonet class material on science background</td>
<td>WP7</td>
<td>KDM</td>
<td>PU</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>Report on First educational and training workshops.</td>
<td>WP7</td>
<td>KDM</td>
<td>R</td>
<td>PU</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>D6</td>
<td>Proceeding of best practice workshop: sensor interface, quality insurance and specification for demonstration actions.</td>
<td>WP2</td>
<td>KDM</td>
<td>R</td>
<td>PP</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>D7</td>
<td>Report on constitution of integration groups; Proceedings of All Regions workshop. Report on potential creation of virtual institute.</td>
<td>WP1</td>
<td>KDM</td>
<td>R</td>
<td>PU</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>D9</td>
<td>Data management plan.</td>
<td>WP1</td>
<td>KDM</td>
<td>R</td>
<td>PU</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>D15</td>
<td>Esonet News “ESONET News – Europeans observe the deep sea”</td>
<td>WP6</td>
<td>IFREMER</td>
<td>R</td>
<td>PU</td>
<td>N°1 - 5 N°2 - 8 N°3 - 11</td>
<td>3 8 10</td>
</tr>
<tr>
<td>D20</td>
<td>Report on long-term planned research and co-operation between research organisations.</td>
<td>WP5</td>
<td>IFREMER</td>
<td>R</td>
<td>PU</td>
<td>12</td>
<td>12</td>
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<tr>
<td>D21</td>
<td>Document outlining agreement on co-operation between organisations involved in developing technology.</td>
<td>WP5</td>
<td>IFREMER</td>
<td>R</td>
<td>PU</td>
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<td>12</td>
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<tr>
<td>D22</td>
<td>Report on confidential meetings between</td>
<td>WP5</td>
<td>Marine</td>
<td>R</td>
<td>CO</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

⁷ Nature of the deliverable using one of the following codes: R=report / P = prototype / D = demonstrator / O = other

⁸ Dissemination level using one the following codes: PU = public / PP = restricted to other program participants (including the Commission Services) / RE = restricted to a group specified by the consortium (including the Commissions Services) / CO = confidential, only for members of the consortium (including the Commission Services)
<table>
<thead>
<tr>
<th>Deliverable n°</th>
<th>Deliverable name</th>
<th>WP n°</th>
<th>Lead participant</th>
<th>Nature</th>
<th>Dissemination level</th>
<th>Date due</th>
<th>Delivery</th>
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<tbody>
<tr>
<td>commercial companies and ESONET WP leaders working relationships and ESONET requirements.</td>
<td></td>
<td></td>
<td>Institute</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>D23</td>
<td>Report of meeting to discuss long-term funding for seafloor observatories involving representatives from funding agencies.</td>
<td>WP5</td>
<td>IFREMER</td>
<td>R</td>
<td>CO</td>
<td>12</td>
<td>12</td>
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<tr>
<td>D24</td>
<td>Report on integration between respective teams (research teams, technical teams, companies and SMEs) and working relationships beyond the life of ESONET.</td>
<td>WP5</td>
<td>IFREMER</td>
<td>R</td>
<td>PU</td>
<td>12</td>
<td>12</td>
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</table>

**List of milestones**

<table>
<thead>
<tr>
<th>Milestone e no.</th>
<th>Milestone name</th>
<th>Work package no.</th>
<th>Date due</th>
<th>Actual / Forecast delivery date</th>
<th>Lead contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a1</td>
<td>Call for exchange of personnel</td>
<td>WP1</td>
<td>Month 2</td>
<td>D10 - Month 18</td>
<td>IPGP</td>
</tr>
<tr>
<td>1a2</td>
<td>Follow-up of the exchange of personnel</td>
<td>WP1</td>
<td>Month 2 - last year of project</td>
<td>Done throughout the project</td>
<td>IPGP</td>
</tr>
<tr>
<td>1a3</td>
<td>All Regions Workshop n°1 and proceedings</td>
<td>WP1</td>
<td>Month 6 (month 8 for proceedings)</td>
<td>Month 6 D7 - Done</td>
<td>CSIC IFREMER IPGP</td>
</tr>
<tr>
<td>1a4</td>
<td>Constitution of Regional Implementation Groups</td>
<td>WP1</td>
<td>Month 12</td>
<td>Done and still in process</td>
<td>IPGP</td>
</tr>
<tr>
<td>1b1</td>
<td>Data management plan</td>
<td>WP1</td>
<td>Month 6</td>
<td>–month 9 (D9)</td>
<td>KDM</td>
</tr>
<tr>
<td>1b2</td>
<td>Topology of existing regional observatories available</td>
<td>WP1</td>
<td>Month 12</td>
<td>Month 12</td>
<td>KDM</td>
</tr>
<tr>
<td>1b3</td>
<td>Test of prototype of data infrastructure</td>
<td>WP1</td>
<td>Month 9-12</td>
<td>D19 - Month 18</td>
<td>KDM</td>
</tr>
<tr>
<td>1b4</td>
<td>Constitution of the data management group</td>
<td>WP1</td>
<td>Month 12</td>
<td>Month 12</td>
<td>KDM</td>
</tr>
<tr>
<td>1c1</td>
<td>Database of the infrastructure accessible in European area</td>
<td>WP1</td>
<td>Month 2</td>
<td>Month 16</td>
<td>IFREMER</td>
</tr>
<tr>
<td>1c2</td>
<td>Best Practices on shallow water and deep water test sites</td>
<td>WP1</td>
<td>month 8</td>
<td>Month 16</td>
<td>IFREMER</td>
</tr>
<tr>
<td>1c3</td>
<td>Core group of institutes and companies testing equipment</td>
<td>WP1</td>
<td>month 12</td>
<td>Month 18</td>
<td>IFREMER</td>
</tr>
<tr>
<td>1e1</td>
<td>International panel in the “All Regions Workshop 1”</td>
<td>WP1</td>
<td>Month 7</td>
<td>Month 7</td>
<td>Univ. Aberdeen</td>
</tr>
<tr>
<td>1e2</td>
<td>Membership of ESONET NoE in international boards relating to the subsea observatories</td>
<td>WP1</td>
<td>Month 12</td>
<td>Month 12</td>
<td>Univ. Aberdeen</td>
</tr>
<tr>
<td>Milestone no.</td>
<td>Milestone name</td>
<td>Work package no.</td>
<td>Date due</td>
<td>Actual / Forecast delivery date</td>
<td>Lead contractor</td>
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</tr>
<tr>
<td>1&amp;3</td>
<td>Signature of MOU or contracts at international level</td>
<td>WP1</td>
<td>Month 12</td>
<td>Month 24</td>
<td>Univ. Aberdeen</td>
</tr>
<tr>
<td></td>
<td>First signature of an agreement for testing of a prototype on NEPTUNE Canada (or ARENA Japan or MARS) (see WP 3)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2.1</td>
<td>Standardization project plan.</td>
<td>WP2</td>
<td>Month 6</td>
<td>Month 6</td>
<td>KDM</td>
</tr>
<tr>
<td>2.2</td>
<td>Best Practices workshop.</td>
<td>WP2</td>
<td>Month 8</td>
<td>Month 11</td>
<td>KDM</td>
</tr>
<tr>
<td>2.3</td>
<td>Report on existing standardization concepts.</td>
<td>WP2</td>
<td>Month 11</td>
<td>Month 12</td>
<td>Univ Aberdeen</td>
</tr>
<tr>
<td>2.4</td>
<td>Sensor interface – Group is constituted.</td>
<td>WP2a</td>
<td>Month 12</td>
<td>Month 12</td>
<td>KDM</td>
</tr>
<tr>
<td>2.5</td>
<td>Quality assurance – Group is constituted.</td>
<td>WP2b</td>
<td>Month 12</td>
<td>Month 12</td>
<td>Univ Aberdeen</td>
</tr>
<tr>
<td>2.6</td>
<td>Subsea intervention – Group is constituted.</td>
<td>WP2c</td>
<td>Month 12</td>
<td>Month 12</td>
<td>IFREMER</td>
</tr>
<tr>
<td>3.1</td>
<td>Establish group of experts</td>
<td>WP3</td>
<td>Month 1</td>
<td>Month 6</td>
<td>NOCS</td>
</tr>
<tr>
<td>3.2</td>
<td>Define preliminary scientific priorities</td>
<td>WP3</td>
<td>Month 2</td>
<td>Month 6</td>
<td>NOCS</td>
</tr>
<tr>
<td>3.3</td>
<td>Call for proposals</td>
<td>WP3+4</td>
<td>Month 3</td>
<td>Month 3</td>
<td>NOCS and INGV</td>
</tr>
<tr>
<td>3.4</td>
<td>Establish proposal review committee</td>
<td>Steering Committee</td>
<td>Month 3</td>
<td>Month 7</td>
<td>Steering Committee</td>
</tr>
<tr>
<td>3.5</td>
<td>Review proposals</td>
<td>Science committee and Technology committee</td>
<td>Month 7</td>
<td>Month 8-10</td>
<td>Steering Committee</td>
</tr>
<tr>
<td>4.1</td>
<td>Text of the call approved by SC</td>
<td>WP4</td>
<td>Month 2</td>
<td>Month 2</td>
<td>INGV, IPGP, CSIC</td>
</tr>
<tr>
<td>4.2</td>
<td>Demo mission planning submitted to TOC</td>
<td>WP4</td>
<td>Month 4</td>
<td>Month 6</td>
<td>INGV</td>
</tr>
<tr>
<td>4.3</td>
<td>Selection of successful proposals</td>
<td>WP4</td>
<td>Month 6</td>
<td>Month 11</td>
<td>Steering Committee</td>
</tr>
<tr>
<td>5.1</td>
<td>Tutorials on developing cabled networks as a business are ready</td>
<td>WP5</td>
<td>Month 8</td>
<td>Month 14</td>
<td>IMI</td>
</tr>
<tr>
<td>5.2</td>
<td>Meeting on individual implementation plans for specific cabled observatory sites</td>
<td>WP5</td>
<td>Month 12</td>
<td>Month 14</td>
<td>IMI</td>
</tr>
<tr>
<td>Milestone no.</td>
<td>Milestone name</td>
<td>Work package no.</td>
<td>Date due</td>
<td>Actual / Forecast delivery date</td>
<td>Lead contractor</td>
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<tr>
<td>6.1</td>
<td>ESONEWS</td>
<td>WP6</td>
<td>Every 3 months from month 2</td>
<td>Done</td>
<td>IFREMER/FFCUL</td>
</tr>
<tr>
<td>6.2</td>
<td>Contribution to All Regions Workshop</td>
<td>WP6</td>
<td>Month 6</td>
<td>Month 7</td>
<td>FFCUL</td>
</tr>
<tr>
<td>6.3</td>
<td>SME group constituted</td>
<td>WP6</td>
<td>Month 12</td>
<td>Month 7 improved on month 13</td>
<td>IFREMER/ SME representative (Alcatel elected for the first year)</td>
</tr>
<tr>
<td>7.1</td>
<td>Update of ESONET website</td>
<td>WP7</td>
<td>Month 1</td>
<td>Done</td>
<td>KDM</td>
</tr>
<tr>
<td>7.2</td>
<td>Installation of ESONET Educational website</td>
<td>WP7</td>
<td>Month 6</td>
<td>Done</td>
<td>KDM</td>
</tr>
<tr>
<td>7.3</td>
<td>Preliminary educational website for the introduction of ESONET to the general public</td>
<td>WP7</td>
<td>Month 6</td>
<td>Month 7</td>
<td>KDM</td>
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<tr>
<td>7.4</td>
<td>ESONET class material on science background</td>
<td>WP7</td>
<td>Month 9</td>
<td>Month 10</td>
<td>KDM</td>
</tr>
<tr>
<td>7.5</td>
<td>Preliminary class material on science background to be sent to schools</td>
<td>WP7</td>
<td>Month 12</td>
<td>Month 12</td>
<td>KDM</td>
</tr>
<tr>
<td>7.6</td>
<td>First educational and training workshop</td>
<td>WP7</td>
<td>Month 12</td>
<td>Month 12</td>
<td>KDM</td>
</tr>
<tr>
<td>7.7</td>
<td>Train postgraduates and engineers including ESONET staff on science background in the first educational workshop</td>
<td>WP7</td>
<td>Month 12</td>
<td>Month 12</td>
<td>KDM</td>
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<tr>
<td>8.1</td>
<td>Steering Committee meeting</td>
<td>WP8</td>
<td>-</td>
<td>-</td>
<td>IFREMER</td>
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</tbody>
</table>

**9.1.2. Reminder: main milestones to the end of the project**

- **Month 18 – Beginning of the second phase.**
  Demonstration missions are running
- **Month 18 – Coordination with GMES plans on Core Services.**
- **Month 24 – Definition of ESONET LABEL and its protection at European level.**
- **Month 26 – Reports on the second 12 months are issued.**
- **Month 28 – Reports on the demonstration missions.**
  Scientific work will continue using this data. Outreach events will promote the results to a wide community, including socio-economic actors and the public.
• **From month 28 (at latest month 36) – National decisions about integration.**
  The elements will be collected in order to present a permanent ESONET organisation to the EC and to each member state.

• **Month 32 – ALL REGIONS WORKSHOP Nº2.**
  Key decision makers and scientists will be invited to this overview of all the work achieved to better define the regional observatory networks around Europe. A complete business plan, the first results of demonstration observatories and a plan for further deployment of infrastructure will be presented. The ESONET LABEL will be delivered for the ESONET nodes to the groups deriving from the Regional Implementation Committees, building up the corresponding ESONET RLE.

• **Month 36 (or before) – LAUNCHING LEGAL INTEGRATION BODIES.**
  As far as can be anticipated, the legal integration body(ies) able to implement, operate and maintain the network of multidisciplinary ocean observatories in deep waters are launched following all signatures.
  They would ensure ESONET CORE SERVICES and ESONET RLEs

• **Month 42 – ESONET CORE SERVICE WORKSHOP.**
  This workshop is held in order to complete the information on operation and maintenance issues and to promote services. Outreach activities are associated.

• **Month 48 – Final Report.**

### 9.1.3. WP1 Networking – months 13-30

**Task 1a - Integration of regional observatory initiatives and multidisciplinary networking efforts**
*(Led by M. Cannat, IPGP)*

- **Activities 1a1 & 2: Exchange of personnel**
  A new call for exchange of personnel will be issued in July 08 and a fair evaluation system is being organised. The call will particularly emphasise exchanges around the implementation of the funded Demo Missions.

- **Activity 1a3: Issues of the All Regions Workshop:**
  Following the organisation of the first All Regions Workshop, groups working on each ESONET site as well as their scientific specificity have been well identified. To facilitate scientific and technology exchanges between the partners, around the WPs 2, 3, 4 and 5 objectives, in the coming month we will for example coordinate the dissemination of a questionnaire to gather information on existing site survey data, and on infrastructure requirements for the observatory plans at each node. This will contribute to structuring the groups of each node and to preparing the organisation of the second All Regions Workshop that should take place in month 32.

- **Activity 1a4: Constitution of Regional Implementation Groups**
  Contact persons have been identified for each site. We plan to pursue the constitution of these groups, keeping base with the activities of the different work packages toward the
implementation of the node observatories (science, technology, law, etc.). This activity will be continued with WP6 task 6b.

**Task 1b Data infrastructure (led by M Diepenbroek, KDM)**

- **Activity 1b1: Data management plan**
  During the next phase of the project WP 1b) will continue to improve and update the data and information management plan to meet the ongoing technical and infrastructural development of the observatories and demo missions. A meeting with partners of SeaDataNet and EuroSites will allow to establish common issues (expected to take place during the General Assembly meeting in October 2008). The constituted data management group will organise data flows from a selected set of observatories (incl. EUROSITES observatories) and elaborate the corresponding updates for the data management plan. It will work closely with the Data Management Council. The data management group consists of representatives from ESONET demonstration sites, Ifremer, WDC-MARE, EUROSITES and SeaDataNet.

- **Activity 1b2: ESONET knowledge base (extension of topology of existing regional observatories)**
  Topology, data and information management plan, sensor registry, feature catalogue, and QA/QC methodologies (WP2) will be comprised in a Wiki based structure, the ESONET knowledge base, which can be extended by possible information inventories from further tasks and by data mining, providing additional knowledge, in particular site surveying information on the different sites (link to activity 1a3).

- **Activity 1b3: Data infrastructure prototype**
  The SDI is being designed and developed and will be tested before month 18 in order to be used by the demonstration activities (WP 4). The prototype corresponds to D-19. Beyond month 18 a sensor registry with a corresponding feature catalogue (instrument types, parameters, etc.) will be developed and finally included in the ESONET Spatial Data Infrastructure (SDI). Interoperability will be largely based on the implementation of globally accepted information standards and existing SDIs. For these activities, close ongoing collaboration with WP 2 will continue. The productive version of the SDI will consist of a network of selected demonstration sites, a data service from the MARS testbed observatory, selected data repositories (initially WDC-MARE and Ifremer), the registry, and the data portal as frontend service on the ESONET website. In a later phase the SDI will be contributing to GMES and GEOSS. The Sensor registry will be registered for GEOSS as a generally available component (common activity with WP2 task d). A specific meeting with representatives of the GMES Marine core service “MyOcean” is planned during the General Assembly of ESONET in Portugal. In addition, IFREMER is involved in MyOcean and internal collaborations are underway to enhance the link with MyOcean.

**Task 1c Sharing facilities (led by J. Marvaldi, IFREMER)**

We are requesting to move this task to WP2 task 2d because it deals with the sharing of facilities for testing operations involving standardisation and interoperability of these facilities.
Task 1d – Scientific integration (led by J. Mienert, UiT)

One way to be explored in detail will be the creation of a Virtual Institute of scientific users of deep Sea Observatories (VISO). According to the model of the virtual institute involving Ifremer and AWI on deep sea operation, ESONET will evaluate the solutions of one or several virtual Institutes involving scientific users of observatories or engineering groups.

The Virtual Institute would:
- organise exchange of personal between its members,
- organise joint experiments on ESONET observatories,
- promote the development of new scientific packages on the existing observatories,
- organise conferences on the ESONET observatories’ data exploitation,
- organise specialised workshops on data management, data dissemination, new sensors, new technologies, intercomparison of results,…

The department will include laboratories with scientists not only related to all initial partners (core partners and OSI) but also to other institutions interested in deep sea observatories data.

According to the model of the virtual institute involving Ifremer and AWI on deep sea operation, ESONET will evaluate the solutions of one or several virtual Institutes involving scientific users of observatories or engineering groups.

VISO concepts are to be developed by a core group of engineers and marine scientists. These concepts should address the following points in order to set up the durability of the Esonet implemented services:
- Standards for all eleven nodes regarding basic deep-sea parameter assessments
- Evaluating and Assessing gateways at each of the nodes for providing requested data transfer
- Assessing large observatory data sets that can accommodate the full range of observational techniques for specified types of real time deep-ocean data
- Providing a publicly viewable web-based tool for reviewing deep-oceans’ changes
- Evaluating the collaborative portal for ocean observatories that enables data distributions similar to what has been achieved by the Global Seismic Network (http://www.iris.edu/about/GSN/), which also expands to the deep ocean, or the Northern Light Observatories (http://en.wikipedia.org/wiki/EISCAT) hosted in Norway.

Activity 1d1: Workshop preparation

An important next step in exploring the VISO development is to be implemented now. Indeed, the VISO Development and Operational workshop includes GSN, and EISCAT representatives will be prepared. These representatives will provide a realistic showcase for our VISO development showing a range of potential utilities.

This workshop will help to propose the VISO structure: its potential departments and units by bringing together the Scientific communities in research and engineering fields.

An application for this workshop will be submitted to the given ESONET structure for financing and approval. It will be prepared and organised in Tromsø in autumn
2008/spring 2009, Norway, where we envision attracting partners from the industry as well. A synthesis of the information concerning the virtual institute is being done. A synthesis of the preparation will be done in month 23 (Jan 2009).

- **Activity Id2: Workshop conclusions**
  A report of the workshop will be delivered in month 30.

**Task 1e – International cooperation (led by M. Priede, UniABDN)**

- **Activity 1e1: International panel**
  Activity ended

- **Activity 1e2: International boards membership**
  Strong links were established during the first years with NEPTUNE Canada, MBARI, OOI, JAMSTEC (DONET project) and MACHO (Taiwan), an international network for development from the ION initiative. A first meeting was held in Tokyo in March 2008, a second one in Vienna in April 2008. A draft agreement on the constitution of an International Association of Sub Sea Observatory Operators (IASSO) is circulating (Neptune, DONET, OOI). ESONET standardisation working groups could be opened to the international community.

- **Activity 1e3: Plan for MOU signature**
  Discussions are in progress and practical agreements for the testing of prototypes on NEPTUNE Canada and MARS Monterey have been settled by ESONET partners.

  Implementation of high-level agreements is delayed due to pending consolidation of observatory organisations in Europe and elsewhere. This activity is postponed to month 24.
### Activities

<table>
<thead>
<tr>
<th>Activities</th>
<th>Name</th>
<th>Activity period and/or del. Report date. (month)</th>
</tr>
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<tbody>
<tr>
<td>1a 1&amp;2</td>
<td>Call preparation and evaluation of exchange of personnel</td>
<td>16-18 (Jun- Sept 08) report in M19= D10</td>
</tr>
<tr>
<td>1a 3&amp;4</td>
<td>Constitution of all RLE</td>
<td>16-18 (Jun- Sept 08)</td>
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<tr>
<td>1b 1&amp;4</td>
<td>First report of the data management group</td>
<td>14-20 (Apr-Oct 08) report M21 (Nov 08)</td>
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<td>1b3</td>
<td>Data infrastructure prototype</td>
<td>report in M18 = D19</td>
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<tr>
<td>1b3</td>
<td>Data infrastructure productive version</td>
<td>30 (Sept 09)</td>
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<tr>
<td>1b 5&amp;6</td>
<td>Concept service structure and Esonet knowledge base</td>
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<td>1d1</td>
<td>Evaluation of virtual institutes</td>
<td>23 (Jan 09)</td>
</tr>
<tr>
<td>1d2</td>
<td>VISO Workshop report</td>
<td>27 (Jun 09)</td>
</tr>
<tr>
<td>1e3</td>
<td>Plan for signature of MOU or contracts at international level. First signature of an agreement for testing of a prototype on NEPTUNE Canada (or ARENA Japan or MARS)</td>
<td>23 (Jan. 09)</td>
</tr>
</tbody>
</table>

### 9.1.4. WP2 Standardisation and interoperability –months 13-30

Working groups have been constituted during the ESONET Best Practices Workshop that will address standard and interoperability related issues in regard to the list of tasks. Within the next 18 months there will be a continuation of the ongoing work where specific topics from the broad spectrum of standardisation have been selected to come up with demonstration cases.

**Task 2a – Sensors and Scientific packages (Lead: C. Waldmann, UniHB)**

- **Activity 2a1: Specification report for demonstration action-sensor interface**
  Following the group constitution, a report synthesising recommendations on sensor interface will be delivered (deliverable 25).

- **Activity 2a2: contribution to Esonet sensor registry: standardised hardware implementation concepts**
  As a contribution to the ongoing implementation of the sensor registry, the topic of interface descriptions and their possible integration into existent content standards will be investigated. This will be done taking standardised hardware implementation concepts into account, like IEEE 1451. This will also imply the active participation in workshops and working groups within GEOSS, OGC and international ocean observatory initiatives. The PESOS group will be directly involved in this process by linking the information flow with interested companies and asking for their advice and possible contribution.
**Activity 2a3: contribution to Esonet sensor registry: metadata description**

In regard to the metadata description of instruments and the measuring process the evaluation and introduction of concepts derived from the Guide on Uncertainty in Measurements (GUM) and the International Vocabulary on Metrology (VIM) both released by the International Standards Organisation ISO in ocean sciences will be carried out. As this activity may have an impact on other European projects as SEADATANET and EUROSITES it is planned to set up close links between people in charge of relevant topics.

Within this framework the translation of the description of the measuring process into a workflow document (UML) for selected cases will be of importance to help formalising each step of the integration process of an instrument into an observatory.

All the above-mentioned activities will be conducted in close cooperation with connected tasks in WP1.

**Activity 2a4: generic functional diagram of an ocean observatory**

In cooperation with WP1 and WP3 a generic functional diagram of an ocean observatory including the definition of the basic terms will be developed as a base for a targeted discussion on observatory system implementation issues. This activity will leverage existing links to other observatory programs as for instance NEPTUNE Canada, Ocean Observatory Initiative in the US and the DONET program in Japan.

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**Task 2b - quality assurance / quality control (Lead: A. Holford, UniAbdn)**

The necessity of quality management for ocean observatories is obvious. However, the implementation has to be displayed through certain examples describing the according procedures.

**Activity 2b1: Identification of important quality aspects for generic sensor packages**

Simple types of instruments always included in deep sea observatories (e.g. current meter, temperature sensor, oxygen sensor, ADCP, etc.) will be selected and important aspects to ensure quality and reliability will be identified, as for instance:

- a standard interface control document format
- a standard test procedure for each individual instrument or instrument type in cooperation with task 2d
- a standard method of recording and archiving the results of these tests and
- a standard procedure for logging and accessing all maintenance performed on a given sensor (i.e. all historical data).

**Activity 2b2: Publication of draft reports for approval during the 2nd Best Practices Workshop.**

The next steps in this process will be to select instrument types and generate draft versions of the above-mentioned documents for these instruments and distribute them for approval. These will then be used where possible on the demonstration missions of the ESONET project, which are built up as prototype observatories. Where possible, existing test bed facilities for validating test procedures will be identified. Feedback from end users will be sought and where necessary the procedures will be reviewed and improved as required.
During the second Best Practices Workshop, these quality management aspects will be presented and discussed.

- **Activity 2b3: Specification report for demonstration action –Quality assurance**
  Following the group constitution, a report synthesising recommendations on quality assurance will be delivered (deliverable 26).

**Task c - Underwater intervention (Lead: J.F. Drogou, IFREMER)**
Facilitating instrument exchange between European institutions has been identified as a main challenge by the Ocean Facilities Exchange Group (OFEG) organisation, in the Ocean Research Fleets Working Group (OFWG) Report. The report underlined many issues which have to be taken into account: Interoperability, Technical support, Annual programming, Cooperation outside Europe, Insurance, Transport, etc. Among these issues, which will be mainly piloted by the OFEG initiative, the definition and implementation of technical conditions for interoperability in underwater intervention on future observatories were specified as a main goal in this Work Package.

The following activities will be conducted as part of this task:

- **Activity 2c1: facilitation of the exchange of underwater facilities**
  - Precise technical conditions for enlarging/increasing the number and flexibility of welcoming vessels
  - Facilitates exchange of sensors, equipments, payloads on the different vehicles, through “standard” interfaces.

- **Activity 2c2: qualification of procedures and recommendations:**
  - Provides scientific users and operators with standard qualified procedures or recommended practices to operate equipment in a safe and productive way
  - Provides recommendations for training (crew) and testing (procedures)

The activities will be implemented through the review of existing experiences on different compatibility levels:

- Compatibility for sharing platforms and ships
- Compatibility between ROVs (tooling and payloads)
- Compatible procedures

Due to the complexity of operations as part of the construction of ocean observatories, training, simulation and testing of according procedures are necessary.

A training facility would allow the dedicated setup of training courses for the following tasks:

- Manipulation training
- Virtual operations training and testing
- Scientists’ operational training
- Existing Infrastructure
Activity 2c3: Specification report for demonstration action –underwater interventions

A report synthesising recommendations on underwater intervention assurance will be delivered (deliverable 27).

Task 2d - Sharing testing facilities (Lead: J. Marvaldi, IFREMER)

A rich and diverse suite of relevant research facilities exists among Esonet partners. Items of interest include not only hardware but also technical and methodological expertise.

In order to ascertain and improve the long-term capabilities of sub-sea observatory components, the objectives are:

- To organise the sharing of sea going equipments and testing facilities
- To launch common practices

The steps towards these objectives comprise:

- To record simulation testing land-based facilities and promote their shared use
- To promote the constitution of teams on specific subjects for sharing technical and methodological expertise in view of developing common practices
- To select a small number of complementary shallow and deep sea testing facilities and to start an integrated process of common management through calls for proposals

The activities will include:

- **Activity 2d1**: A first version of the testing facilities database will be made available on the Esonet website (Month 18)

- **Activity 2d2**: Information on Metri-2 will be integrated to the Esonet website (Month 14). The constitution of the “Core group for testing” will be set up (Month 18)

- **Activity 2d3**: The guidelines for developing a common test schedule and methodology will be set up (Month 22)

- **Activity 2d4**: A first version of a registry of relevant testing and calibration best practices and procedures will be made available on the Esonet website (Month 28)

Close cooperation will be maintained with tasks 2a / Sensor and scientific packages and 2b/ Quality assurance-quality control.

A secondary junction box developed and built by Ifremer and IN2P3 will be available to Esonet partners to connect equipment for tests or demonstration on Antares main cable, with case to case agreement by Antares cooperation (Month 30). This secondary junction box will provide compatibility with NEPTUNE Canada. In addition, KOSTOBS should be prepared as a test site.

- **Activity 2d5**: The items related to “Sharing facilities” will be presented for discussion and recommendations at the “Second Best Practice Workshop” (Month 30)
  - Survey of existing facilities
  - Intercomparison of calibration methods and preparation procedures
- Existing calibration standards
- Exchange of personnel

- **Activity 2d6**: Intercomparison of different underwater acoustic modem systems will be organised and carried out as part of 2 cruises in the Ligurian Basin in August 2008 and 2009. The cruises’ proposals have already been evaluated and accepted. Different partners from the ESONET consortium will be involved in the campaign. This test will be an opportunity to demonstrate the effectiveness of standard procedures to test backbone components of the observatory system, as will be developed within this task.

**Task 2e - Contribution to GEOSS standardisation and implementation activities (Lead: E. Delory, dBScale)**

In order to support the growing effort of the European Union (EU) to consolidate the GEOSS (demonstrated through the GMES initiative and the INSPIRE directive), ESONET will build and accommodate its observation platforms and spatial data infrastructure (SDI) including recommendations from the Group on Earth Observations activities, with special focus on architecture and data interoperability issues. As a result, this task will also help identify the level of standardisation at which ESONET nodes and SDI need to be perennially and globally accessible.

Would the implementation of GEOSS standards in ESONET be counterproductive or merely not technically or financially feasible, this task will also advise on the registration of special arrangements in concert with the GEO Standards and Interoperability Forum (SIF). Standards that are used within the ESONET infrastructure, which may not be registered as GEOSS standards, will be identified and proposed to the SIF for evaluation. This task will be the contact point between the GEOSS component registry, service registry and standards registry leads and committees.

Particular attention will be paid to the policies and rules developed within GEOSS that describe the steps to follow to make ESONET a globally important ocean data gateway and component of the GEOSS. While task 2a merely addresses technical implementation aspects this task’s orientation will be more strategic. As a first step, it will be necessary to make the GEOSS community aware of ongoing activities within ESONET and other ocean-related projects to foster the role of ocean-related monitoring in earth observation programs. A strategy on how to supply the collected data in computer-readable format has to be developed so that ESONET can register its data holdings and web services in GEOSS. Regular visits to GEOSS workshops (STC, ADC and workshops organised according to relevant tasks) and presentation of concepts and achievements of the ESONET project will ensure that deep ocean environmental data and the derived information collected within the ESONET NoE and follow-up projects can be made available in a timely fashion and following the policies and rules recommended by GEO.

The following activities will be pursued:

- **Activity 2e1**: Evaluation of GEO task in regard to standardisation and interoperability aspects
- **Activity 2e2**: Participation in GEOSS workshops and contribution to working groups created by GEOSS supporting organisations
- **Activity 2e3:** Dissemination of GEOSS concepts within ESONET and other workshops (Best Practices Workshop). Invitation to designate technical and/or strategic representatives from each ESONET node

- **Activity 2e4:** Creation of an ESONET/GEO forum in order to discuss GEOSS architecture and data interoperability issues. Organisation of periodic/side teleconferences to discuss generic/technical aspects

- **Activity 2e5:** Surveying ESONET node software/hardware architects on standards and GEOSS

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**Task 2f - Organisation of the second Best Practices Workshop (IFREMER)**

In month 30 the Best Practices Workshop will be organised by WP2 and the synthesis of the activities will be presented for approval. This workshop is planned to be held at IFREMER.

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**9.1.5. WP3 Scientific objectives and observatory design – months 13-30**

The objective of this work package is to define the best methodology, scientific packages, instruments and underwater components to be applied in a long-term cabled observatory.

The second and major objective is to contribute to further structuring and defining of the design of an underwater observatory system to collect long-term (at least 20 years) real-time series measurements to allow monitoring of biological, geochemical, geological and geophysical key processes that document global change, and contribute to the detection and early warning of short and medium-term potential hazardous events.

To achieve this, it is absolutely fundamental that key scientific objectives be continuously updated as new results become available, and that scientific objectives be further developed and clarified.

Because long-term ocean floor monitoring is in its infancy, there is a clear lack of scientific background to firmly assess the parameters to be measured. WP3 thus plays a central role in ESONET since the formulation of scientific questions is the basis to ESONET activities. We are at the beginning of a new era of continuous marine online observation with new and exciting scientific perspectives rapidly evolving. These perspectives have to be disseminated to the broader scientific community and scientific objectives and methods have to be discussed and outlined with specialists. WP3 acts as an interface between scientific research goals of ESONET partners and other stakeholders (EU-programs, conservation organisations, governmental agencies, industry) with the ESONET technical-related WPs. In essence, we will design a set of common tools for direct measurements to obtain real time recordings. This will enable interactive experimental work on the seafloor during long-term experiments. This enormous task can only be achieved through durable integration and a serious commitment of all partners is needed towards building a common organisational and technical structure.
Task 3a - Science objectives

The main objective of this task is to align the technological specifications of future deep sea observatories with the scientific objectives. Toward this, it is absolutely essential that the scientific objectives be continuously updated as new results become available, and that the scientific objectives be further developed and clarified beyond the results of the preceding ESONET projects.

- Activity 3.a.1 – Update of scientific objectives
  The group of scientific experts is constituted. Scientific objectives will be updated by this group reporting to the Scientific Council and to the NoE Strategic Committee.

At present, a number of regional network sites have been proposed as prospective ESONET nodes. WP3 will clearly address the question of the sites’ scientifically-based priorities, in order to avoid dispersion of efforts for structuring the future European Observatory Network.

Scientific priorities for demonstration will be revised before the second call (June-July 2008).

- Activity 3.a.2 - Workshop with HERMES, MERSEA/MyOcean, EUROCEANS
  This joint research activity will use inputs from other EU projects. A workshop with representatives from other European projects (HERMES, MERSEA/MyOcean, EUROCEANS, NEAREST, …) will be organised, at the time of the second General Assembly.

Results of activities 3a1 and 3a2 will be synthesised in Deliverable D11 in month 18

Task 3b - Generic science modules

Over the last decades, a continuous effort has been conducted by the academic research, the industry and the military to develop specific technologies for deep sea observations, including moorings, boreholes, seismic packages, cameras, optical devices and acoustic systems. Specific instrumentation systems have tremendously progressed and gained in reliability and modularity, paving the way for the development of generic technology. Good examples are: the establishment of standard MetOcean measurements on and in the water column in a number of sites will directly contribute to marine climate change monitoring and geohazard and tsunami warning systems.

- Activity 3.b.1 – Updating the generic parameters list
  Some generic parameters (commonly measured) have already been recognised during the first year of activity. For the next 18 months we will update this list according to the demonstration missions’ process.

- Activity 3.b.2 - Link between generic technology and scientific needs
  The main objective of this activity is to assign the development of generic technology to the scientific requirements and needs. This will be done in coordination with WP2 and WP4, through the production of specifications based on the scientific objectives, organisation of workshops and dissemination of results.
The results of this task will be synthesised in a preliminary report in month 18 and it will be part of deliverable D13 expected in month 24.

Task 3c - Specific science modules
In addition to the generic science modules, some specific modules are needed for monitoring purposes. Their maturity must be evaluated.

These specific science modules will be defined in relation to scientists involved in demonstration missions.

The results of this task will be part of deliverable D13 expected in month 24.

9.1.6. WP4 Demonstration Missions –months 13-30

Objectives:
WP4 is funding and coordinating sea tests for components of the observatory and observatory network designs, including data and energy transmission systems at cabled and non-cabled observatory sites, developed for ESONET nodes, as a basis for the forthcoming European Sea Observatory Network. WP4 will also coordinate joint research activities related to the preparation, and subsequent debriefing and data analysis of these demonstration missions.

Task 4a – call for proposal
A second call for proposal for the demonstration missions will be issued at the end of 2008.

- Activity 4.a.1 – Revision of call text
  This activity includes:
  - A second call for proposal for the demonstration missions will be issued in the second half of 2008: management of the proposal submission, evaluation, and selection procedures according to the scheme adopted in the 1st Call. Scientific priorities and “technical areas” will be revised in collaboration with WP3.
  - Evaluation criteria will be reviewed according to the analysis of the balance sheet of the 1st year, in relation to work package 3.
  - The text of the call will be revised to take in account the conclusions of the first annual review and the remarks from the Commission. A priority for measurement in the water column related to the seafloor will be displayed.

- Activity 4.a.2 – Update of reviewer list
  The international reviewer list will be completed.

- Activity 4.a.3 – Selection process
  Proposals will be collected by WP4 and evaluated similarly to the first call in relation to the NoE Test and Operation, Scientific, and Data Management Councils.
  WP4 will be responsible of the follow-up of the reviewing process.
Task 4b – Demonstrations

- **Activity 4.b.1 – Follow-up of the selected demonstration missions (First call)**

Four proposals were selected in the first call: LIDO, MARMAR-D, MOMAR-D and LOOME.

This activity includes:
- Acquisition of the implementation plans of the Demonstration Missions selected in the 1st Call (months 13-14)
- Monitoring of the selected Demonstration missions and of their deliverables (see list of deliverables in appendix hereafter). Preparation and circulation of DM status 6-month report to provide inputs to the other ESONET WPs (months 13-30);

- **Activity 4.b.2 – Reporting**

Reports on these demo missions will be issued on a 6-month basis and are expected in months 18, 24 and 30. WP4 will indicate any deviation from the implementation plan. WP4 is accountable for gathering the reports sent by DM leaders to write a synthesis.

WP4 will also collect the Demonstration Missions’ Deliverables expected in each implementation plan.

WP 4 will set up a general report for Demonstration Missions by month 30.
### ANNEX WP4: DEMO MISSIONS – 1st Call

#### List of Deliverables

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<thead>
<tr>
<th>Deliverable No.</th>
<th>Deliverable Name</th>
<th>Institution in Charge</th>
<th>Deliv. Month</th>
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<tbody>
<tr>
<td>D1.1</td>
<td>Sea operations procedures: recovery and deployment of SN-1 and Ovde stations (East Sicily)</td>
<td>INFN</td>
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<td>Status of the SN-1 and Ovde stations, new requirements and technical specifications of the enhancements</td>
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<td>Sea operations procedures for recovery and deployment of GEOSTAR (Gulf of Cadiz) and refurbishment</td>
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<td>New requirements and technical specifications of the enhancements of the GEOSTAR surface buoy</td>
<td>UPC</td>
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<td>D1.6</td>
<td>Demo mission planning, development and follow-up</td>
<td>INGV</td>
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<td>Software of real-time detection of biological sounds (whales and dolphins) and anthropogenic noise</td>
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<td>Software of automatic classification of biological sounds (whales and dolphins) and anthropogenic noise</td>
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<td>Software of marine mammal localisation and tracking</td>
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<td>Report on the implementation of prototype SWE concepts</td>
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<td>Report on the sensor registry</td>
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<tr>
<td>D3.1</td>
<td>Website with real-time transmission of marine mammal acoustic signals and acoustic images from seafloor cabled observatory to public institutions</td>
<td>FFCUL/UPC</td>
<td>12</td>
</tr>
<tr>
<td>D4.1.</td>
<td>Report on functioning/mis-functioning parts and subsystems of the recovered instrumentation</td>
<td>TEC</td>
<td>3</td>
</tr>
<tr>
<td>D4.2.</td>
<td>TDR of new hydrophone arrays; TDR of data acquisition, power and data transmission systems, sea operations</td>
<td>INFN</td>
<td>5</td>
</tr>
<tr>
<td>D4.3.</td>
<td>Reports on testing activity</td>
<td>TEC</td>
<td>12</td>
</tr>
<tr>
<td>D4.4.</td>
<td>Reports on integration activity</td>
<td>INFN</td>
<td>15</td>
</tr>
<tr>
<td>D4.5.</td>
<td>Final report on station tests after integration.</td>
<td>INGV</td>
<td>18</td>
</tr>
<tr>
<td>D4.6.</td>
<td>Periodic reports of underwater stations, on-shore and offshore systems in activity.</td>
<td>INGV</td>
<td>9,12,15,18,18,21</td>
</tr>
<tr>
<td>D4.7.</td>
<td>Report on feasibility of a low low-cost solution to bearing estimation in acoustic monitoring of whales on the basis of signals acquired in LIDO</td>
<td>DBSCALE</td>
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<tr>
<td>D4.8.</td>
<td>Report on technological conclusions from test activities.</td>
<td>INFN</td>
<td>22</td>
</tr>
<tr>
<td>D4.9.</td>
<td>Report on possible standardisation and spreading of acoustic sensors and tsunami detectors</td>
<td>UNIHIB</td>
<td>22</td>
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<tr>
<td>D5.1.</td>
<td>Six-month based reports</td>
<td>UPC</td>
<td>6,12,18,24</td>
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<tr>
<td>D5.2.</td>
<td>Final report</td>
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## 2. LOOME

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<thead>
<tr>
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<th>Institution in Charge</th>
<th>Deliv. Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Long-term seismometer</td>
<td>UiT</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Long-term chemical sensors (pH, O2, sulfide, redoX)</td>
<td>MPI-MM/Ifremer</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Long-term temperature sensors on surface. Temperature and pore pressure in the subsurface seabed</td>
<td>IFREMER/IFM-GEOMAR</td>
<td>6</td>
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<tr>
<td>4</td>
<td>Scanning sonar for gas flares detection</td>
<td>UNIHB</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Design of sensor network and operation platform</td>
<td>UNIHB</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Deployment and recovery procedures for instruments and data</td>
<td>Marum</td>
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<tr>
<td>7</td>
<td>Design of underwater communication</td>
<td>UNIHB/Ifremer/UiT</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Documentation of inter-operability and standardization</td>
<td>UNIHB</td>
<td>24</td>
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<tr>
<td>9</td>
<td>Cruise report Polarstern 2009Jan Mayen 2008</td>
<td>MPIMM/UiT/Ifremer</td>
<td>24</td>
</tr>
<tr>
<td>10</td>
<td>Scientific reports</td>
<td>all partners</td>
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## 3. MARMARA

<table>
<thead>
<tr>
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<th>Deliverable Name</th>
<th>Institution in Charge</th>
<th>Deliv. Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1.1</td>
<td>Paper on piezometer and OBS results</td>
<td>Ifremer</td>
<td>12</td>
</tr>
<tr>
<td>D1.2</td>
<td>Paper on flowmeters and osmo-samplers</td>
<td>ITU/Scripps</td>
<td>14</td>
</tr>
<tr>
<td>D1.3</td>
<td>Paper on fluid analysis</td>
<td>CNRS</td>
<td>12</td>
</tr>
<tr>
<td>D1.4</td>
<td>Paper synthesitizing Marnaut results</td>
<td>CNRS</td>
<td>12</td>
</tr>
<tr>
<td>D2.1</td>
<td>Reports on the cruises completed by DEU (DEU1 and DUE2 cruises)</td>
<td>DEU</td>
<td>14</td>
</tr>
<tr>
<td>D2.2</td>
<td>Report on the cruise completed by Ifremer (MarmesoNet)</td>
<td>Ifremer</td>
<td>14</td>
</tr>
<tr>
<td>D2.3</td>
<td>1-year time series at 3 sites</td>
<td>INGV</td>
<td>23</td>
</tr>
<tr>
<td>D3.1</td>
<td>Report (including integrated database) combining marine and land seismological data in the Marmara Sea</td>
<td>ITU/Tubitak</td>
<td>26</td>
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<tr>
<td>D3.2</td>
<td>Report on the ambient noise in the MS and recommendation for the implementation of permanent seabottom stations</td>
<td>INGV</td>
<td>26</td>
</tr>
<tr>
<td>D3.3</td>
<td>High Res Seismic Images at the 3 sites</td>
<td>DEU</td>
<td>18</td>
</tr>
<tr>
<td>D4.1</td>
<td>Integration of all available data (including sedimentology)</td>
<td>ISMAR</td>
<td>24</td>
</tr>
<tr>
<td>D4.2</td>
<td>GIS including all available data</td>
<td>CNRS</td>
<td>24</td>
</tr>
</tbody>
</table>
D4.3 Report to test working hypothesis and validate concept of seafloor observatories  CNRS  24
D4.4 Report on best site selection  ISMAR  28
D5.1 Recommendation Report on the preferred option  Ifremer  28
D5.2 Cost estimation report  Ifremer  28
D5.3 Implementation plan  INGV  28
D6.1 Support agreement contract with Turkish authorities  ITU  30
D6.2 Website  ITU  18
D6.3 Training course  ITU  24

*CAUTION: The planning indicated here above is based on a start in April 2008, and on the hypothesis that the cruises will actually take place in May 2008. The exact dates of the Ifremer cruise (with Le Suroît) will be known in June 2008.

3Osmo-samplers and flowmeters deployed during the marNaut cruise (June 2007) were recovered in May 2008. Scientific papers are expected in June 2008.

4.  MOMAR-D

<table>
<thead>
<tr>
<th>Deliverable No.</th>
<th>Deliverable Name</th>
<th>Institution in Charge</th>
<th>Deliv. Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Cruise proposal submission</td>
<td>IPGP/Ifremer</td>
<td>1</td>
</tr>
<tr>
<td>D2</td>
<td>Report Description of the operational system: interface specifications, sensors, localisation</td>
<td>Ifremer</td>
<td>3</td>
</tr>
<tr>
<td>D3</td>
<td>Signed agreement on Data management policy</td>
<td>Ifremer</td>
<td>3</td>
</tr>
<tr>
<td>D4</td>
<td>Communication plan</td>
<td>Ifremer</td>
<td>3</td>
</tr>
<tr>
<td>D5</td>
<td>On-shore integration and test report</td>
<td>Ifremer</td>
<td>12</td>
</tr>
<tr>
<td>D6</td>
<td>Cruise preparation file</td>
<td>IPGP/Ifremer</td>
<td>15</td>
</tr>
<tr>
<td>D7</td>
<td>Deployment of the system during the cruise</td>
<td>IPGP/Ifremer</td>
<td>20</td>
</tr>
<tr>
<td>D8</td>
<td>1-month data file</td>
<td>IPGP/Ifremer</td>
<td>21</td>
</tr>
<tr>
<td>D9</td>
<td>Report on dissemination activities</td>
<td>Ifremer</td>
<td>21</td>
</tr>
</tbody>
</table>
9.1.7. WP5 Implementation strategies – months 13-30

On 19th & 20th March 2008, WP5 participants attended a workshop in CSIC Barcelona to begin work on the development of implementation plans as set out in the ESONET NoE Description of Work.

Tutorials on the financial model were held and the outputs from the ESONIM project were presented to participants as a background to the work which will be conducted in WP5. The initial plan was to develop a series of implementation plans for three generic sites – namely an Atlantic, a Mediterranean and a standalone site.

Extensive discussions took place in relation to the definition of what constituted an Atlantic, a Mediterranean and a standalone site. Participants were strongly of the opinion that it would be more fruitful and relevant to compare a generic cabled observatory and a generic standalone site from a scientific, engineering, financial, legal, ethical and environmental perspective.

The definition of a standalone site within the ESONET context has been reaffirmed for the purposes of WP5 – it is not a standalone mooring but is an infrastructure which offers a near real-time data transfer and communications capability.

To this end, two working groups were established to develop implementation plans for:

2. Standalone Site WG – led by Olaf Pfannkuche. Participants: Fiona Grant, Jean Francois Rolin, Jerome Blandin & others from ESONET & EuroSITES community.

Each WG leader is responsible for the co-opting of ESONET members (and in the case of the Standalone Site WG, EuroSITES members) into each of the tasks set out in the terms of reference. WP5 leaders (Fiona Grant and Mick Gillooly) will input to the work plan as appropriate.

Draft terms of reference as set out in the table below were drafted for each of the working groups. The terms of reference are based on the template provided by the ESONIM project to facilitate the inter-comparability and compatibility of both sets of evaluations; they lead to the definition of Tasks a, b, c. Other activities as defined in the DoW have now to be done in cooperation with EMSO; they are included in Task d.

<table>
<thead>
<tr>
<th>Task 5a</th>
<th>Generic Cable Site WG</th>
<th>Standalone Site WG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science</strong></td>
<td><strong>Activity 5a1:</strong> Update Scientific Report on Network Functions and Customers from ESONIM project.&lt;br&gt;The objective is to update the overarching specification of user needs and update the justification for the establishment of a European Seafloor Observatory Network.</td>
<td><strong>Activity 5a2:</strong> Develop Scientific Report on Network Functions and Customers using the ESONIM template as appropriate.&lt;br&gt;The objective is to provide the overarching specification of user needs and scientific justification for the establishment of a standalone site.</td>
</tr>
<tr>
<td><strong>Engineering</strong></td>
<td><strong>Activity 5a3:</strong> Update Engineering Report on Observatory Architecture Manual from ESONIM project.&lt;br&gt;The objective is to review the</td>
<td><strong>Activity 5a4:</strong> Develop Engineering Report on the technical architecture of a Standalone Site.&lt;br&gt;The objective is to develop an</td>
</tr>
</tbody>
</table>
Task 5a

<table>
<thead>
<tr>
<th>Generic Cable Site WG</th>
<th>Standalone Site WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaume Piera</td>
<td>Olaf Pfannkuche</td>
</tr>
</tbody>
</table>

outputs from the ESONIM model, update the technical specifications of the observatory components as appropriate for a generic cabled observatory and to provide updated cost estimates which can be used in the Financial task.

Engineering solution for the design, development, construction and deployment of a standalone system that will deliver the best technical solution and to provide cost estimates which can be used in the Financial task.

Business Plan & Financial Model

**Activity 5a5: Update Business Model and cash flow forecast from ESONIM project.**

The objective is to review the business plan and financial model from ESONIM and produce an overall estimate with uncertainties and identify more difficult items where specific work is needed within EMSO.

**Activity 5a6: Develop Business Model and cash flow forecast using the ESONIM financial model as a template.**

The objective is to develop a business plan and financial model for a standalone observatory and produce an overall estimate with uncertainties.

Task 5b – Legal, Ethical and Environmental (LEE)

<table>
<thead>
<tr>
<th>Task 5b</th>
<th>Generic Cable Site WG</th>
<th>Standalone Site WG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Michel André</td>
<td>Michel André</td>
</tr>
</tbody>
</table>

Legal, Ethical & Environmental

Assemble synthesis of relevant legal and best practice documents (International, EU, national, local).

Provide a homogeneous atlas describing the ESONET sites on all parameters needed for environmental assessment and permits.

Michel André (see ESONET NoE DoW - §11 – Ethical issues) is to develop terms of reference/working plan incorporating mammal and environmental components and circulate it among attendees of this meeting over next few weeks for agreement. All partners will input material relevant to national legal requirements and update legal practices relevant to ongoing programmes (e.g. Antares, Nemo etc). In relation to mammals, impacted species will be identified for each site, recommendation frequency and levels will be defined and a monitoring system to assess the impact on cetaceans at each site will be devised.

A 3D-model could be developed to assess the acoustic signature of the observatories, to measure ambient noise and to assess the sound propagation of activities from anthropogenic sources such as fishing.

Objectives:
The generic objective of WP5 Task b) for the next 18-month period will be on the one hand the gathering of information on the legal and institutional conditions on which the observatories were/are/will be developed and implemented, regarding the structure, functions, faculties, competences and intern governability, in order to elaborate, at the end of Phase 4, a report where, based on the analysis of the assembled information, best practice will be recommended for each site and for the Network in general. In all phases, all national legal aspects will be taken into account as well as European legal and political guidelines. The second objective is to conduct a survey of the presence and distribution of marine mammal species at each site, identify sound/anthropogenic sources from the observatories’ activities,
define sustainable acoustic/anthropogenic parameters and detect potential negative effects on local populations.

The information from the two objectives will be analysed and introduced in a dynamic online database that all ESONET and external partners will be able to access.

**Activities Description:**

- **Activity 5b1: Building-up Methodology**
  The differences between the legal, ethical and environmental nature/conditions of the observatories imply to adapt the work methodology, based on information exchange, to each site’s specificity including its objectives, organic structure, dependence, functions and autonomy. Once the information is gathered, the work team will be constituted to cover the existing Generic Cable and Standalone Sites. The Phase 1 deliverable will be a report on the chosen criteria and the methodology to be followed, including the information and deadlines to be provided and followed by ESONET partners.

- **Activity 5b2: Information Assembling**
  During Phase 2, an online database will be built allowing the information to be stored and easily retrieved by users. This information will be gathered from external sources and directly from partners through the posting of available documents or answering to a questionnaire designed in Phase 1. This should considerably simplify the process. In parallel, a survey of the presence and distribution (migrating or resident) of marine mammal populations at each site will be conducted as well as the identification of sound/anthropogenic sources produced or associated to the observatories’ activities.

- **Activity 5b3: Analysis of Content**
  Once all the LEE available information is gathered, it will be profiled, commented or completed by other sources and processed. At that stage, the output format will be simple to allow each site to comment, add or modify the information introduced in the database. Finally, the LEE gaps will be identified and tagged in the database to allow its completing in further activities, placing them in a hypothetical model of European legal and institutional framework. Regarding marine mammals, the possible interactions between the observatories’ activities and their populations will be specifically analysed at each site and a general definition of sustainable acoustic parameters will be provided.

- **Activity 5b4: Best Practice and Guidelines**
  This phase will allow for the building of a final report on suggested best practices and guidelines that will previously circulate among all partners for comments. At that stage, the database will be complete and accessible online.
**Task 5c - Comparative Work**

(Both Working Groups of Task 5a)

<table>
<thead>
<tr>
<th>Generic Cable Site WG</th>
<th>Standalone Site WG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Update the implementation model for a generic cabled observatory using the outputs from the ESONIM project as a template. The implementation model should include an assessment of all ESONET sites and identify whether a cabled observatory or standalone site is most appropriate given the outputs from all the tasks within WP5.</td>
<td>Develop an implementation model for a generic standalone site using the outputs from the ESONIM project as a template. The implementation model should include an assessment of all ESONET sites and identify whether a cabled observatory or standalone site is most appropriate given the outputs from all the tasks within WP5.</td>
</tr>
</tbody>
</table>

**Task 5d - Reporting to EMSO and mobilising the network of excellence on long term strategy funding plan**

A report will be prepared for EMSO PP on the Implementation Model being developed in WP5 of ESONET NoE. Given that the projects will run concurrently, it is important that the scope of work in each project does not overlap and that the deliverables contribute to the overall development of both bodies of work.

It will be important to monitor the funding developments throughout the lifetime of the ESONET NoE project. The Strategic Committee will be closely associated with this task as it will require very high-level co-operation between institutions and countries. A number of deliverables (D20 – D24) will be forwarded on an annual basis as an update for this important area.

**Note**

This new organisation of the work package 5 is not disconnected from the structure expected in the first version of the Description of Work (March 2007). Indeed it helps to better distribute the tasks among partners and to better manage the activities.
The correspondence between the old structure and the new one is explained hereafter.

<table>
<thead>
<tr>
<th>Reference in the DoW § 6.1.3</th>
<th>Title</th>
<th>Reference in Chapter 9, Months 13 to 30</th>
<th>Title</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>Task a –</td>
<td>Economical implementation models</td>
<td>Task a -</td>
<td>Science, engineering and business plan for generic sites</td>
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<tr>
<td>Task b -</td>
<td>Site assessment, legal model and environmental constraints</td>
<td>Task b -</td>
<td>Legal, Ethical and Environmental (LEE)</td>
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<td>Task c -</td>
<td>Joint reply to infrastructure initiatives</td>
<td>Task d -</td>
<td>Reporting to EMSO and mobilising the network of excellence on a long-term funding plan strategy</td>
<td>The joint replies to infrastructures initiatives need to be agreed on by EMSO PP</td>
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<td>Task d -</td>
<td>Long-term funding plan strategies</td>
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<td>Long-term funding plan strategies are reported on a yearly basis</td>
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</table>

9.1.8. WP6 Socioeconomic users – months 13-30

Task 6a: Core services stakeholders

- Activity 6a1: Core services and contribution to GMES
  
  Core services will be stabilised in report D16 in month 18.

  A meeting with the stakeholders of the core services will be organised.

  The contribution of ESONET will come through GMES for several key parameters of the water column. Indeed, links with the European Project PREVIEW will be initiated via INGV and FFCUL to check how seismology data can serve a suitable GMES core service (“Emergency” core service). As explained in WP1, activities linked to Marine core services of MyOcean project will also be enhanced.

  A specific chapter will be included in deliverable 43 “Data infrastructure productive version” expected in month 30. It will address common objectives and a decision will be made defining the contents of the ESONET contribution to GMES.

Task 6b: Regional services stakeholders

- Activity 6b1: Meetings of all ESONET nodes stakeholders
Following D17, formal meetings of all ESONET nodes stakeholders will be organised based on the preliminary MoU concerning infrastructure and basic scientific plans and/or the regional legal entities designed within WP1.

- **Activity 6b2: Cooperation with WP5**
  Regarding the financial aspects of each regional node, cooperation with WP5 will be established, to stabilise a coherent economic approach.

**Task 6c: Promotion and SME policy**
The involvement of SMEs will be fostered by:

- **Activity 6c1: Information circulation**
  Better circulation of information concerning their role as suppliers/value-added services in Demo missions;

- **Activity 6c2: Yellow Pages**
  “Yellow Pages” to be linked with ESONET webpage. Deliverable D17 will report the actions undertaken and the conclusions of the task named ESONEWS (month 18).

New industrial partners are interested in PESOS activities associated to ESONET. Discussion on the form to give to PESOS will be continued.

**Task 6d: ESONEWS**
"ESONET News, Europeans observe the deep sea" will be produced every 3 months (Deliverable D15). As during the first year of Esonet, it will be prepared in digital form and distributed to a large mailing list provided by ESONET central office. Each 8-page issue is also printed, to be distributed in international meetings. A layout upgrade is planned.

Each issue will focus on a main topic. One SME will be presented in each issue.

9.1.9. **WP7 Education and outreach – months 13-30**

**Objectives:**
The main objective of outreach and training is the development and support of comprehensive interdisciplinary programs for research, education and public outreach on deep waters around Europe. ESONET will strengthen educational possibilities for students of all ages. This WP is intended to vertically and laterally integrate at all educational levels: for teachers to mentor scientists about how to teach kids, for data librarians to mentor teachers on the use of data archives, for engineers to introduce students and teachers to their instrument design.

ESONET’s envisioned internet technologies will merge research portfolios and establish a shared and mutually accessible research resource. The joint public relations can provide a wide range of new opportunities to explore and investigate the dynamics of the marine world using real-time data flow for classrooms and living rooms coupled with cutting-edge visualisation techniques. Collaborators within the informal educational community will include museums, science centers, aquariums, media, and youth programs.
Task a - Education tools

- **Activity 7a1: Education website**
The educational website is open and will be maintained.

- **Activity 7a2: Class material**
More class material will be added and games and quizzes will be developed.

Task b – Web portal with real-time web interface

- **Activity 7b1: Web portal**
A public Web Portal is in operation. Video-footage of test deployments will be added. The webpage will introduce the public to the ESONET demo sites.

Task c – Communication of results.

- **Activity 7c1: Second training workshop**
WP7 will hold a second training workshop to introduce ESONET to postgraduates and engineers, especially related to ESONET partners. The goal is to create an environment and mix of participants that will inspire a diversity of discussions and cross-fertilisation of ideas.

  It will offer the incorporation of real-time data into undergraduate and graduate coursework and research. *Industry partners are committed* to join this workshop.

- **Activity 7c2: General public outreach**
The computer terminals will be shipped to three EU aquaria and will give access to the public webpage. Azores university is implementing a video camera in an aquarium.

- **Activity 7c3: Introductory ESONET poster**
An introductory poster on ESONET will be prepared and published in the aquaria and some fact sheets will be distributed.

9.1.10. **WP 8 Management activity – months 13-30**

Management activities will be improved, taking into account the experience of the first year. The coordination team is getting more and more structured.

Indeed, Ingrid Puillat is working full-time on Esonet coordination with Roland Person (almost full-time).

In addition, IFREMER is hiring an administrative person, Ms degree in financial management, working at halftime on Esonet financial management with our financial officer (also part-time on Esonet).

An executive secretary, with over 15 years of experience, is involved on a part-time basis.

Our head of department is in charge of the follow-up of 3 WPs.
And we have the support of IFREMER’s juridical staff (2 persons) to manage contract amendments and all juridical aspects (grant agreements for Demonstration Missions, data policy, etc.). IFREMER’s Communication Direction is also involved now.

**Task 8a: General Assembly**
The General Assembly will be organised by FFCUL in Portugal in month 18/19. The management team will coordinate this meeting with participants and will produce the report.

**Task 8b: Meeting organisation**
This WP is also in charge of organising the Steering Committee meetings. When possible, these meetings will be organised by email or Visio conference, otherwise physical meetings will be arranged in a convenient location. The financial decision of the Steering Committee will be implemented by the management team with the support of Ifremer’s administrative officers.

The coordination team will organise the 2nd meeting of the Strategy Committee between month 18 and 21.

This meeting will take place at the same location and date as the strategic board of Esonet.

**Task 8c: Information management and yearly reporting**
Information will be disseminated to the partners through the internal Webpages and by Email. The implementation of a reporting tool will facilitate and speed up the generation of contractual documents and inter-WP syntheses. An online system will be opened to partners to input their activity reports and financial statements.

The reporting process is expected to start in February 2009 with the partners’ individual activity reports per WP that should be sent to WPs’ leaders around mid-February. WP leaders will thereby get all input from partners for their WP and will easily write the WP activity report.

Financial reporting will start for partners on 01 March. An information meeting for administrative staff is planned in February 2009.

**Task 8d: Link with European Commission**
The management is also in charge of the links with the European Commission on all contractual aspects. Amendments to the contract will be prepared according to the evolution of the partnership (administrative modifications, new partner, selected partner, etc.).

**Task 8e: Link with European projects**
The management team will promote links with other European projects (EUROSITES, HERMES/HERMIONE, EUROCEANS, MyOcean, PREVIEW and S@ny). It will support WP3 in the organisation of a joint meeting with them at the time of the General Assembly.

**Task 8f: Esonet label**
The coordination team will initiate the definition of the Esonet label and its protection following month 18.
## 9.2. Planning and timetable

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st February 2009</td>
<td>9.2. Planning and timetable</td>
</tr>
</tbody>
</table>
### 9.3. Work package list Joint programme of activities (months 13-30)

<table>
<thead>
<tr>
<th>Work-package No(^9)</th>
<th>Work package title</th>
<th>Lead contractor No(^{10})</th>
<th>Start month(^{11})</th>
<th>End month(^{12})</th>
<th>Deliverable No(^{13})</th>
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<tr>
<td>1</td>
<td>Networking</td>
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<td>D-10  D-19  D-23  D-34  D-37  D-42  D-43  D-44</td>
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<td>4</td>
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<td>INGV</td>
<td>1</td>
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<td>D-12  D-45</td>
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<td>D-15  D-16  D-17</td>
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</table>

\(^9\) Work package number: WP 1 – WP n.

\(^{10}\) Number of the contractor leading the work in this work package.

\(^{11}\) Relative start date for the work in the specific work packages, month 1 marking the first month of the project (March 07), and all other start dates being relative to this start date.

\(^{12}\) Relative end date, month 1 marking the first month of the project, and all end dates being relative to this start date.

\(^{13}\) Deliverable number: Number for the deliverable(s)/result(s) mentioned in the work package: D1 - Dn.
<table>
<thead>
<tr>
<th>Work-package No</th>
<th>Work package title</th>
<th>Lead contractor</th>
<th>Start month</th>
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<th>Deliverable no</th>
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<tbody>
<tr>
<td>7</td>
<td>Education and outreach</td>
<td>KDM</td>
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<td>48 (30)</td>
<td>D-18 D-30 D-32 D-38 D-40 D-49</td>
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<td>8</td>
<td>Management activities</td>
<td>IFREMER</td>
<td>1</td>
<td>48 (30)</td>
<td>D-29 D-30</td>
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9.4. Deliverables list Joint programme of activities (months 13 – 30: March 2008-September 2009)

<table>
<thead>
<tr>
<th>Deliverable n°</th>
<th>Deliverable name</th>
<th>WP n°</th>
<th>WP n°</th>
<th>Lead participant</th>
<th>Estimated indicative person months</th>
<th>Nature</th>
<th>Dissemination n level</th>
<th>NEW</th>
<th>Delivery date (proj.month)</th>
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<tr>
<td>D5</td>
<td>First elements of individual implementation plans for specific cabled observatory sites.</td>
<td>WP5</td>
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<td>Marine Institute</td>
<td>22</td>
<td>R</td>
<td>PP</td>
<td>24</td>
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<td>D8</td>
<td>Prototype implementation of example standardised sensor system.</td>
<td>WP2</td>
<td></td>
<td>KDM</td>
<td>65</td>
<td>R</td>
<td>PP</td>
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<td>Report: exchange of personnel; common schedule and methodology of tests.</td>
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<td>110</td>
<td>R</td>
<td>PP</td>
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<td>D12</td>
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<td>WP4</td>
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<td>INGV</td>
<td>278.5</td>
<td>R</td>
<td>PP</td>
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<td>Report on science modules.</td>
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<td>D14</td>
<td>Report on workshops to facilitate and broker partnership, Tutorials/Meetings on Implementation plans and replies to infrastructure proposals; on site assessment, legal model, environmental constraints and their associated ethical issues.</td>
<td>WP5</td>
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<td>41</td>
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<td>14, 17, 20, 23, 26, 29</td>
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<td>Publish draft ESONET web portal.</td>
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<td>KDM</td>
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<td>D20-2009</td>
<td>Report on long term planned research and cooperation between research organisations.</td>
<td>WP5</td>
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<td>D22-2009</td>
<td>Report on confidential meetings between commercial companies and ESONET WP leaders re working relationships and ESONET requirements.</td>
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<td>Report of on meetings to discussing long-term funding for seafloor observatories involving representatives from funding agencies.</td>
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<td>Report on integration between respective teams (research teams, technical reams, companies and SMEs) and working relationships beyond the life of ESONET</td>
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<td>Nature</td>
<td>Dissemination n level</td>
<td>NEW Delivery date (proj.month)</td>
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<td>Specification report for demonstration actions – quality assurance.</td>
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<td>D27</td>
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<td>24th month activity report</td>
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<td>Installation of computer terminals</td>
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<td>WP1</td>
<td>UNIAB DN</td>
<td>2</td>
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<td>D34</td>
<td>Plan for signature of MOU and contracts at international level. First signature of an agreement for testing of a prototype on NEPTUNE Canada (or Arena Japan or Mars USA)</td>
<td>WP1</td>
<td>UNIAB DN</td>
<td>1</td>
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<td>CO</td>
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<td>D35</td>
<td>Recommendations for ESONET registration in GEOSS</td>
<td>WP2</td>
<td>DBScal e</td>
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<td>R</td>
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<td>D36</td>
<td>Report of testing facilities survey</td>
<td>WP2</td>
<td>IFREM ER</td>
<td></td>
<td>P</td>
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<td>D37</td>
<td>VISO Workshop preparation report</td>
<td>WP1</td>
<td>UiT</td>
<td>1</td>
<td>R</td>
<td>PU</td>
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<td>WP2</td>
<td>UniABDN</td>
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<td>60</td>
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<tr>
<td>D42</td>
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<td>WP1</td>
<td>KDM</td>
<td>60</td>
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<td>PU</td>
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<tr>
<td>D43</td>
<td>Data infrastructure productive version.</td>
<td>WP1</td>
<td>KDM</td>
<td>18</td>
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<tr>
<td>D44</td>
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<td>WP1</td>
<td>KDM</td>
<td>12</td>
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<td>D45</td>
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<td>278.5</td>
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<td>PP</td>
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<td>D46</td>
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<td>IMI</td>
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<td>R</td>
<td>PP</td>
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<td>D47</td>
<td>Online database to include local, national and European legal, ethical and environmental (LEE) documents</td>
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<td>UPC</td>
<td>23</td>
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<td>CO</td>
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<td>UPC</td>
<td>24</td>
<td>R</td>
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<td>D50</td>
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<td>KDM</td>
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<td>PU</td>
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<td>D51</td>
<td>Training and simulation manual</td>
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<td>IFREM ER</td>
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<tr>
<td>D52</td>
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<td>KDM</td>
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<td>PU</td>
<td>32</td>
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</table>
Del. no.: Deliverable numbers in order of delivery dates: D1 - Dn
Nature: Please indicate the nature of the deliverable using one of the following codes:
  R = Report, P = Prototype, D = Demonstrator, O = Other
Dissemination level: Please indicate the dissemination level using one of the following codes:
  PU = Public
  PP = Restricted to other programme participants (including the Commission Services)
  RE = Restricted to a group specified by the consortium (including the Commission Services)
  CO = Confidential, only for members of the consortium (including the Commission Services)
Delivery date (proj.month): Month in which the deliverables will be available.
  Month 1 marking the start of the project, and all delivery dates being relative to this start date
9.5. Work package descriptions

9.5.1. WP1: Networking

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<th>Start date or starting event:</th>
<th>Month 1</th>
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<tr>
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<td></td>
<td>Month 1</td>
</tr>
</tbody>
</table>

**Work package title**

NETWORKING

**Participant id**

KDM IFREMER IPGP UNIABDN And other partners (see DoW §10.2)

**Objectives**

Task 1a) – Develop strong links between regional nodes of a European network of subsea observatories, and to promote multi-disciplinarity and transnationality within each node.

Task 1b) – Standardized data flow and services in a commonly usable network.

Task 1c) – Increased capabilities and shared usage of existing facilities.

Task 1d) – Integration of ESONET into the international earth observation framework.

Task 1e) – International cooperation

**Description of works**

**Task a) Integration of regional observatory infrastructure**

Activity 1a1&2: Exchange of personnel. A fair evaluation of the staff exchange of personnel request is being organised for the next 6 months.

Activity 1a3: Issues of the All Regions Workshop. Coordinate the dissemination of a questionnaire to gather information on existing site survey data, and on infrastructure requirements for the observatory plans at each node.

Activity 1a4: Constitution of Regional Implementation Groups. Pursue the constitution of the Regional Implementation Groups, keeping base with the activities of the different work packages toward the implementation of the node observatories.

**Task 1b) Data infrastructure**

Activity 1b1: Data management plan. Update and extension of the general data and information management plan. A meeting with partners of SeaDataNet and EuroSites will allow to establish common issues to organise the data flows and infrastructure.

Activity 1b2: ESONET knowledge base. Completion of the topology of existing regional observatories.

Activity 1b3: The ESONET Spatial Data Infrastructure. Development of the ESONET Sensor registry (common deliverable with WP2). The data infrastructure prototype will be designed and developed. It will be tested before month 18 in order to be used by the demonstration activities (WP 4). This prototype corresponds to D-19.

**Task 1d) Scientific integration**

Activity 1d1 & 2: Organisation of Virtual Institute (VISO) workshop and its reporting.

**Task 1e) International cooperation**

Activity 1e2 & 3: Follow-up of the international network for observatory development from the ION initiative. MoU signatures will be followed up.
## Deliverables

<table>
<thead>
<tr>
<th>Deliverable n°</th>
<th>Deliverable name</th>
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<td>D10</td>
<td>Report: exchange; common schedule and methodology of tests.</td>
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<tr>
<td>D19</td>
<td>Data infrastructure prototype</td>
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<td>D23</td>
<td>Agreement on an International network</td>
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<td>D34</td>
<td>Plan for signature of MOU and contracts at international level. First signature of an agreement for testing of a prototype on NEPTUNE Canada (or Arena Japan or Mars USA)</td>
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<td>VISO Workshop preparation report</td>
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<td>D42</td>
<td>Sensor registry (with WP2)</td>
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<td>Data infrastructure productive version</td>
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<th>Nature</th>
<th>Dissemination level</th>
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## Milestones and expected results

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<td>Constitution of all RLE</td>
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<td>Portal for Data infrastructure prototype on ESONET website</td>
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<td>Evaluation of virtual institutes</td>
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<tr>
<td>24</td>
<td>Plan for signature of MOU or contracts at international level. First signature of an agreement for testing of a prototype on NEPTUNE Canada (or ARENA Japan or MARS)</td>
<td>1e3</td>
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<tr>
<td>24</td>
<td>Agreement on an International network</td>
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### 9.5.2. WP2: standardisation and interoperability

<table>
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<tr>
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<tr>
<td><strong>Work package title:</strong></td>
<td>STANDARDISATION AND INTEROPERABILITY</td>
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<tr>
<td><strong>Participant id</strong></td>
<td>KDM /UNIHB</td>
<td>UNIABDN</td>
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</table>

#### Objectives

Define roadmap and carry out a first implementation phase of standardisation projects focused on the following application domains in the framework of ocean observatory systems (seafloor and water column).

- Task a) sensors and scientific packages.
- Task b) quality assurance / quality control.
- Task c) underwater intervention.
- Task d) Sharing testing facilities
- Task e) Contribution to GEOSS standardisation and implementation activities
- Task f) Organisation of the second Best Practices Workshop

#### Description of works

**Task a) sensors and scientific packages**
- Activity 2a1: Specification report for demonstration action-sensor interface
- Activity 2a2: contribution to Esonet sensor registry: standardised hardware implementation concepts
- Activity 2a3: contribution to Esonet sensor registry: metadata description
- Activity 2a4: generic functional diagram of an ocean observatory

**Task b) quality assurance / quality control** (A. Holford, UniAbdn)
- Activity 2b1: Identification of important quality aspects for generic sensor packages
- Activity 2b2: Publication of draft reports for approval during the 2nd Best Practices
- Activity 2b3: Specification report for demonstration action –Quality assurance

**Task c) Underwater intervention** (Lead: J.F. Drogou, IFREMER)
- Activity 2c1: facilitation of the exchange of underwater facilities -
- Activity 2c2: qualification of procedures and recommendations
- Activity 2c3: Specification report for demonstration action –underwater interventions

**Task d): Sharing testing facilities** (Lead: J. Marvaldi, IFREMER)
- Activity 2d1: First version of the testing facilities database will be made available
- Activity 2d2: Constitution of the “Core group for testing”
- Activity 2d3: Guidelines for developing common schedule and methodology of tests
- Activity 2d4: Registry of relevant testing and calibration of best practices and procedures
- Activity 2d5: Presentation of “Sharing facilities” during the “Second Best Practices Workshop”
- Activity 2d6: Intercomparison of different underwater acoustic modem systems

**Task e) Contribution to GEOSS standardisation and implementation activities** (Lead: E. Delory, dBScale)
- Activity 2e1: Evaluation of GEO task
- Activity 2e2: Participation in GEOSS workshops
- Activity 2e3: Dissemination of GEOSS concepts within ESONET
- Activity 2e4: Creation of an ESONET/GEO forum
### Deliverables

<table>
<thead>
<tr>
<th>Deliverable n°</th>
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### Milestones and expected results

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<td>Common test procedures</td>
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<td>Sensor standardisation group: preliminary report</td>
<td>2a</td>
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<td>24</td>
<td>Quality assurance group: preliminary report</td>
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<td>Underwater intervention group: preliminary report</td>
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<td>29</td>
<td>Link with GEO committees and OGC</td>
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<td>Second Best Practices Workshop</td>
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1st February 2009
9.5.3. **WP3: Observatory design related to scientific objectives**

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<td>OBSERVATORY DESIGN RELATED TO SCIENTIFIC OBJECTIVES</td>
</tr>
<tr>
<td><strong>Participant id</strong></td>
<td>NOCS, IFREMER, KDM, NIOZ, INGV, And other partners (see DoW §10.2)</td>
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**Objectives**

The main objective of this work package is to provide the NoE scientific needs related to the make use of a long-term observatory. column).

**Task a) Science objectives**

The main objective of this task is to align the technological specifications of future deep sea observatories with the scientific objectives

**Task b) Generic science modules**

Scientific generic packages have to be defined in order to address the best methodology, scientific packages, instruments and underwater components to be applied in long-term cabled observatories.

**Task c) Specific science modules**

In parallel to the definition of the generic science modules commonly used in the observatory network, some science modules will be more specific to a site or a research field. We will define these modules. This work package thus contributes to further structuring and definition of the design of an underwater observatory system to collect long-term (at least 20 years) real-time series measurements.

**Description of works**

**Task a) Science objectives**

Activity 3a1: Update of scientific objectives
Activity 3a2: Workshop with HERMES, MERSEA EUROCEANS

**Task b) Generic science modules**

Activity 3a1: Update of the generic parameters list
Activity 3a2: Link between generic technology and scientific needs

**Task c) Specific science modules**

Activity 3c1: Definition of specific science modules and link with technology.

**Deliverables**

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<td>Report on scientific background and objectives</td>
<td>WP3</td>
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<td>Report on science modules</td>
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<td>Preliminary report on generic science modules</td>
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<td>Preliminary report on specific science modules</td>
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9.5.4. WP4: Demonstration Missions

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<td>DEMONSTRATION MISSIONS</td>
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<tr>
<td><strong>Participant id</strong></td>
<td>INGV</td>
<td>IPGP</td>
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**Objectives**

To deploy and manage long-term complex experiments at sea, aimed at testing seafloor observatory components and infrastructures and demonstrating the network’s capability to establish and maintain marine observatory infrastructures as the base for the forthcoming European Sea Observatory Network, and to address the scientific, geohazard, and technology objectives of ESONET.

Tasks of this work package are:
- Task a: Call for proposal
- Task b: Demonstrations

**Description of works**

After the first call issue (month 3) and the selection of the proposal (month 11), the period of months 12-30 will be devoted to:

**Task a) Call for proposal**

Activity 4a1: Issue of the 2nd Call and management of the proposal submission, evaluation, and selection procedures according to the scheme adopted in the 1st Call (month 16). Evaluation criteria will be seen again according to the analysis of the balance sheet of the 1st year, in relation to work package 3;

Activity 4a2: The international reviewer list will be completed

Activity 4a3: Proposals will be collected by WP4 and evaluated similarly to the first call in relation to the NoE Test and Operation, Scientific, and Data Management Councils.

**Task b) Demonstrations**

Activity 4b1: Acquisition of the implementation plans of the Demonstration Missions selected in the 1st Call (months 13-14);

Activity 4b2: Monitoring of the selected (Demonstration Missions) activities, Preparation and circulation of DM status 6-month report to provide inputs to the other ESONET WPs (months 13-30); WP4 will also collect the Demonstration Missions’ Deliverables expected in each implementation plan. Set-up of a general Report for Demonstration Missions for month 30.

**Deliverables**

<table>
<thead>
<tr>
<th>Deliverable no.</th>
<th>Deliverable name</th>
<th>WP no.</th>
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<td>WP4</td>
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<td>278.5</td>
<td>R</td>
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<tr>
<td>D45</td>
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### Milestones and expected results

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<tr>
<td>18, 23, 30</td>
<td>Status report on demonstration missions</td>
<td>4b</td>
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9.5.5. WP5: Implementation strategies

<table>
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<tr>
<td>Participant id</td>
<td>IMI</td>
<td>INGV</td>
<td>IFREMER</td>
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Objectives

Task a) Science, engineering and business plan for generic sites

Activity 5a1 - Science - Generic Cable Site WG: The objective is to update the over-arching specification of user needs and update the justification for the establishment of a European Seafloor Observatory Network.

Activity 5a2 - Science - Standalone Site WG: The objective is to provide the over-arching specification of user needs and scientific justification for the establishment of a standalone site.

Activity 5a3 - Engineering - Generic Cable Site WG: The objective is to review the outputs from the ESONIM model, update the technical specifications of the observatory components as appropriate for a generic cabled observatory and provide updated cost estimates which can be used in the Financial task.

Activity 5a4 - Engineering - Standalone Site WG: The objective is to develop an engineering solution for the design, development, construction and deployment of a standalone system that will deliver the best technical solution and to provide cost estimates which can be used in the Financial task.

Activity 5a5 - Business Plan & Financial Model - Generic Cable Site WG: The objective is to review the business plan and financial model from ESONIM and produce an overall estimate with uncertainties and identify more difficult items where specific work is needed within EMSO.

Activity 5a6 - Business Plan & Financial Model - Standalone Site WG: The objective is to develop a business plan and financial model for a standalone observatory and produce an overall estimate with uncertainties.

Task b) Legal, Ethical & Environmental: Assemble synthesis of relevant legal and best practice documents (International, EU, national, local)

Task c) Comparison cabled vs non-cabled: The implementation model should include an assessment of all ESONET sites and identify whether a cabled observatory or standalone site is most appropriate given the outputs from all the tasks within WP5.

Task d) Reporting to EMSO and mobilize the network of excellence on long term strategy funding plan.

Description of works

Task a) Science, engineering and business plan for generic sites

Activity5a1: Science - Generic Cable Site WG: Update Scientific Report on Network Functions and Customers from ESONIM project.

Activity5a2: Science - Standalone Site WG: Develop Scientific Report on Network Functions and Customers using the ESONIM template as appropriate.


Activity5a4: Engineering - Standalone Site WG: Develop Engineering Report on the technical architecture of a Standalone Site.

Activity5a5: Business Plan & Financial Model - Generic Cable Site WG: Update Business Model and cash flow forecast from ESONIM project.

Activity5a6: Business Plan & Financial Model - Standalone Site WG: Develop Business Model and cash flow forecast using the ESONIM financial model as a template.

Task b) Develop online database with relevant legal, ethical and environmental legislation from EU countries.
which will be available for open access. A report on Best Practise and Guidelines for LEE issues will be prepared.

**Task c) Comparative Work – Both Working Groups:** Update the implementation model for a generic cabled and standalone observatory using the outputs from the ESONIM project as a template. Compare the overarching specification of user needs and the scientific justification for the establishment of a cabled observatory versus a standalone site.

**Task d) Reporting to EMSO**
Report to EMSO on the relevant issues of ESONET WP5.
Organise open panels in addition to the core partners (EMSO partners) meetings.

### Deliverables

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<tr>
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<th>Deliverable name</th>
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<td>D14</td>
<td>Report on workshops to facilitate and broker partnership. Tutorials/Meetings on Implementation plans and replies to infrastructure proposals; on site assessment, legal model, environmental constraints and their associated ethical issues</td>
<td>WP5</td>
<td>Marine Institute</td>
<td>22.5</td>
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<td>WP5</td>
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<td>Report on confidential meetings between commercial companies and ESONET WP5 leaders re working relationships and ESONET requirements.</td>
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### Milestones and expected results

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<td>Meeting on ESONET core services</td>
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### 9.5.6. WP6: Socioeconomic users

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#### Objectives

This WP will determine/outline (i) direct clients for data, information and/or infrastructure; (ii) indirect information users of information as in education or outreach programs; (iii) possibilities for integration within decision support tools. This meaning:

- Development of systematic contacts with identified potential users.
- Development of models for evaluation of the benefits of the European Seas Observatory Network to its users.
- Assessment of the impact of ESONET on European Society as a whole.
- Discussion with the military and the industry to explore possible synergy.
- Identification of limitations of available observation technology, to foster development by the European private sector (SME) of new tools for the submarine monitoring of the Earth, either sensors, data browsers or value-added services.

#### Description of works

**Task 6a) Core services stakeholders**

Activity6a1: Core service will be stabilised in report D16 in month 18. A meeting with the stakeholders of the core services will be organised in order to define the milestones for the next years.

**Task 6b) Regional services stakeholders**

Activity6b1: Following D17, formal meetings of all ESONET nodes stakeholders will be organised based on the preliminary MoU concerning infrastructure and basic scientific plans and/or the regional legal entities designed within WP1.

Activity6b2: Regarding financial aspects of each regional node, cooperation with WP5 will be established, to stabilise a coherent economic approach.

**Task 6c) Promotion and SME policy**

Activity6c1: Better circulation of information concerning their role as suppliers/value-added services in Demo missions.

Activity6c2: “Yellow Pages” to be linked with ESONET Webpages (Deliverable D17).

**Task 6d) ESONEWS**

"ESONET News, Europeans observe the deep sea" will be produced every 3 months (Deliverable D15). It will be prepared in digital form and provided to a large mailing list prepared by ESONET central office. Each 8-page issue is also printed, to be distributed in international meetings. A layout upgrade is planned. Each issue will focus on a main topic. One SME will be presented in each issue.

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1st February 2009
### Work package number

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<td>ESONET News “ESONET News – Europeans observe the deep sea”</td>
<td>WP6</td>
<td>IFREMER</td>
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<td>Pu</td>
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### Milestones and expected results

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9.5.7.  WP7: Education and outreach

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Objectives

- Task a: Build educational tools.
- Task b: Build a web portal with real-time web interface.
- Task c: Communicate results.

Description of works

After the ESONET Outreach webpage is online and the workshop is held, the period of months 12-30 will be devoted to:

**Task a) Educational tool**
Activity 7a1: The educational website is open and will be maintained.
Activity 7a2: More class material will be added and games and quizzes will be developed.

**Task b) Web portal with real-time web interface**
Activity 7b1: A public Web Portal is in operation. Video-footage of test deployments will be added. The webpage will introduce the public to the ESONET demo sites.

**Task c) Communication of results**
Activity 7c1: Second training workshop to introduce ESONET to postgraduates and engineers, especially related to ESONET partners.
Activity 7c2: The computer terminals will be shipped to three EU aquaria and will give access to the public webpage.
Activity 7c3: An introductory poster on ESONET will be prepared and published in the aquaria and some fact sheets will be distributed.

Deliverables

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**Objectives**

- Task a: Organisation of the General Assembly.
- Task b: Meeting organisation.
- Task c: Information management and reporting.
- Task d: Link with European Commission.
- Task e: Link with European projects.
- Task f: Esonet label.

**Description of works**

**Task a) General Assembly**
Coordination of the General Assembly organised by FFCUL in Portugal

**Task b) Meeting organisation**
Organisation of Consortium meeting (Steering Com., Strategic Com. …)

**Task c) Information management and yearly reporting**
The implementation of a reporting tool and information exchange.

**Task d) Link with European Commission**
Contract amendment and reporting, legal aspects

**Task e) Link with European projects**
Promotion of links with other European projects (EUROSITES, HERMES, EUROCEANS …).

**Task f) Esonet label**
Coordination, after month 18, of the definition of the Esonet label and its protection.

**Deliverables**

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10. Project resources and estimation of incurred eligible costs
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1st February 2009
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**TOTAL** 381 353 264,1 288,5 129,5 75,5 113 67 1671,6

*For the distribution of tasks and resources of KDM members within ESONET, please refer to table in Appendix A page 15.*
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Estimated breakdown of the requested EC contribution per reporting period

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<th>Total</th>
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Estimated costs of the joint Programme of Activities

| Estimated costs for the full duration | 13 990 529,00 |
| Estimated costs for the first 18 month | 5 059 200,00 |
Contract no 036851 ESONET NoE – Annex I – Description of Work

1

Ifremer

2

IPGP

4

CNRS

5

SOPAB

6

KDM

12

INGV

13

ISMAR

14

INFN

15

TECNOMARE

16

NERC-NOCS

17

HCMR

18

FORTH

19

NIOZ

20

IMI

21

UAç

22

UALG

23

FFCUL

24

CSIC

25

UiT

26

NGI

27

NERSC

28

ULB

29

UGOT

30

SU

31

TFH Berlin

32

IO-BAS

33

ITU

34

B.U.,KOERI

35

DEU-IMST

36

ALCATEL

37

FUGRO

38

CSA

39

SERCEL

40

nke

41

GURALP

42

ALTRAN

43

SIS

44

UNIABDN

45

NSW

47

TESEO

48

SEND

49

DBSCALE

50

CINTAL

1st February 2009

3 000 000
1 040 000
1 150 000
60 000
2 910 000
4 038 000
1 357 000
2 500 000
1 500 000
137 373
200 000
220 000
202 000
287 483
387 500
110 000
432 000
715 000
240 000
70 000
80 000
110 000
630 000
159 000
150 000
75 000
220 000
205 000
100 000
50 000
70 000
220 000
80 000
70 000
30 000
30 000
30 000
213 750
30 000
18 000
50 000
30 000
100 000

1 600 000
500 000
1 000 000
10 000
4 242 000
810 000
0
8 500 000
750 000
0
0
0
0
3 000
50 000
15 000
60 000
50 000
20 000
200 000
20 000
20 000
70 000
9 800
10 000
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10 000
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10 000
10 000
10 000
5 000
0
0
0
195 000
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0
0
10 000

Travel

Other costs

200 000
60 000
120 000
5 000
79 500
150 000
90 000
300 000
10 000
20 000
0
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0
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40 000
5 000
75 000
70 000
30 000
10 000
10 000
8 000
49 000
32 000
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1 650 000
1 000 000
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100 000
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0
0
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14 500
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13 875
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0
0

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634 400
701 500
36 600
1 446 300
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0
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1 470 000
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122 000
134 200
155 540
13 709
236 375
67 100
263 520
436 150
146 400
42 700
48 800
67 100
249 100
40 800
91 500
45 750
134 200
125 050
61 000
30 500
42 700
134 200
48 800
42 700
18 300
18 300
18 300
89 625
18 300
4 600
30 500
18 300
61 000

Requested
contributio
n

Equipment
and
consumables

Total costs

Personnel

Subcontracting

Direct costs

Indirect
costs

Participant
short name

Participant
number

10.4. Project management level description of resources and grant

500 000 10 130 000
0 2 234 400
100 000 3 071 500
10 000
121 600
60 000 8 737 800
750 000 7 390 000
0 3 097 000
0 13 500 000
100 000 3 830 000
0
320 783
0
322 000
0
354 200
0
357 540
15 000
354 192
0
743 875
0
197 100
0
830 520
0 1 371 150
0
436 400
0
322 700
0
158 800
0
205 100
8 000 1 020 600
4 000
245 600
0
256 500
0
125 750
0
399 200
0
350 050
0
181 000
0
90 500
0
132 700
0
374 200
0
148 800
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122 700
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53 300
0
53 300
0
53 300
0
538 500
0
48 300
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27 600
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85 500
0
53 300
0
181 000

138

275 000
50 000
86 000
25 000
395 000
275 000
60 000
35 000
30 000
105 000
100 000
10 000
60 000
120 000
50 000
10 000
95 000
90 000
55 000
10 000
10 000
10 000
30 000
20 000
30 000
15 000
30 000
15 000
15 000
20 000
20 000
35 000
10 500
5 500
5 500
5 500
5 500
120 000
10 500
5 500
5 500
5 500
10 500


Table 10.4.a – Total description of resources

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<td></td>
<td>25 007 106</td>
<td>18 949 800</td>
<td>2 144 750</td>
<td>7 666 675</td>
<td>11 447 029</td>
<td>1 547 000</td>
<td>66 762 360</td>
<td>7 000 000</td>
</tr>
</tbody>
</table>

Table 10.4.b – Eligible costs Full period (core partners)

<table>
<thead>
<tr>
<th>Participant short name</th>
<th>Direct costs</th>
<th>Indirect costs</th>
<th>Sub-contracting</th>
<th>Total costs</th>
<th>Requested contribution</th>
</tr>
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<tbody>
<tr>
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<td>Travel</td>
<td>Other costs</td>
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<tr>
<td>Ifremer</td>
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<td>60 000</td>
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<tr>
<td>KDM</td>
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<td>140 000</td>
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<td>300 000</td>
</tr>
<tr>
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<td>150 000</td>
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</tr>
<tr>
<td>NERC-NOCS</td>
<td>48 605</td>
<td>12 300</td>
<td>53 465</td>
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<td>0</td>
</tr>
<tr>
<td>HCMR</td>
<td>150 000</td>
<td>10 000</td>
<td>40 000</td>
<td>20 000</td>
<td>64 000</td>
</tr>
<tr>
<td>NIOZ</td>
<td>93 000</td>
<td>20 000</td>
<td>0</td>
<td>0</td>
<td>61 000</td>
</tr>
<tr>
<td>IMI</td>
<td>180 000</td>
<td>35 000</td>
<td>13 709</td>
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</tr>
<tr>
<td>FFCUL</td>
<td>210 000</td>
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<td>40 000</td>
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<td>121 870</td>
</tr>
<tr>
<td>CSIC</td>
<td>350 000</td>
<td>25 000</td>
<td>40 000</td>
<td>30 000</td>
<td>215 000</td>
</tr>
<tr>
<td>Other partners</td>
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<td>180 000</td>
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<td>121 870</td>
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<tr>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Internal Calls</td>
<td>1 700 000</td>
<td>760 000</td>
<td>204 000</td>
<td>920 000</td>
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<tr>
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<td>6 427 605</td>
<td>1 312 000</td>
<td>1 601 300</td>
<td>3 012 174</td>
<td>195 000</td>
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### Table 10.4.c – Eligible costs 18 first months (core partners)

<table>
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<th>Participant short name</th>
<th>Direct costs</th>
<th>Indirect costs</th>
<th>Sub-contracting</th>
<th>Total costs</th>
<th>Requested contribution</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Personnel</td>
<td>Equipment and consumables</td>
<td>Travel</td>
<td>Other costs</td>
<td>Sub-contracting</td>
</tr>
<tr>
<td>Ifremer</td>
<td>260000</td>
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<td>56000</td>
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<td>100000</td>
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</tr>
<tr>
<td>INGV</td>
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</tr>
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<tr>
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<td>16000</td>
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</tr>
<tr>
<td>NIOZ</td>
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<td>0</td>
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<td>70000</td>
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<tr>
<td>IMI</td>
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<td>1000</td>
<td>14000</td>
<td>14000</td>
<td>60000</td>
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<tr>
<td>UAç</td>
<td>84000</td>
<td>12000</td>
<td>16000</td>
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</tr>
<tr>
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<td>14000</td>
<td>10000</td>
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<tr>
<td>other partners</td>
<td>660000</td>
<td>48000</td>
<td>16000</td>
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<tr>
<td>coordination</td>
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<tr>
<td>Attributed</td>
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<td></td>
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</tr>
<tr>
<td>internal calls</td>
<td>680000</td>
<td>450000</td>
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<td>599000</td>
<td>607000</td>
<td>519000</td>
<td>832000</td>
</tr>
</tbody>
</table>
10.5. Involvement of researcher

The involvement of researchers tends to promote interdisciplinarity and improve the level of expertise in Europe. Researchers from Japan, Canada and USA will be associated and invited for seminars and common activities such as standardisation. The ESONET NoE events will be widely advertised and it is anticipated that researchers from third countries will also join some activities.

![Breakdown per scientific disciplinary]

The equilibrium between scientific disciplines and marine technology is evident on the above figure. The aim is to cover all the necessary knowledge scope and experience. The gender balance, reflecting the existing stage will be followed as a management indicator.

![Gender issue]

Figure 21: Gender balance in the number of researchers
11. Ethical Issues

The ESONET project will adhere to the ethical rules described in the Guide for Proposers. The proposed research raises no sensitive ethical questions related to human beings, human biological samples, personal data and genetic information. The ESONET project will adhere to codes of conduct and national legislation concerning the use of test animals and genetically modified organisms. Experiment involvement with endangered and protected species will be avoided and will only be carried out in exceptional cases where there is no direct harmful effect on the plants or animals. Experiments involving invading species will only be performed under strictly controlled conditions, and the necessity of the experiment will be evaluated by an Experiments independent panel (Michel André is in charge of constituting this group during the first months of the project). Experiments performed by the project will only be launched when the risk of accidental release of specimens is zero. Possible of effects of scientific packages emitting, light (including lasers), or high energy acoustic will be evaluated for their impacts on marine organisms in accordance with the laws of littoral states, and international agreements. An ESONET policy on high energy emissions will be developed as part of the scientific package qualification process that is being pioneered by NEPTUNE.

The constraints on technologies acceptable or not in order to deploy environment friendly subsea observatories are a major concern of ESONET. They will be investigated inside WP5 as far as precise knowledge of permitting procedures. They will be major criteria to award the ESONET LABEL. Attention will be paid on the effect of acoustic devices on sea mammals and other organisms and effect of emf’s from power cables on certain species or fish. The European Cetacean Society has created an ethical Committee in 2004. The president of this Committee, Michel André, is a participant to ESONET NoE partner CSIC/UPC (Spain). He will therefore act as an adviser to the project.

In all these cases, the rules and recommendations of international bodies such as IUCN and ICES will be strictly followed. During fieldwork the disturbance to species and habitats will be restricted to the minimum required. For marine protected areas, permission for fieldwork will be requested where necessary.
SIXTH FRAMEWORK PROGRAMME
PRIORITY 1.1.6.3
Global Change and Ecosystems

Contract for:

NETWORK OF EXCELLENCE

Annex I - “Description of Work” - APPENDIXES

Project acronym: ESONET
Project full title: European Seas Observatory Network
Proposal/Contract no.: 036851
Related to other Contract no.: (to be completed by Commission)

Date of preparation of Annex I: March 2007 revised the 1st February 2009

Start date of contract: 1st March 2007
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Appendix A - Consortium description

A.1 - Participants and Consortium

<table>
<thead>
<tr>
<th>Participant n° 1</th>
<th>Ifremer</th>
<th>France</th>
</tr>
</thead>
</table>

**Ifremer** (the French Research Institute for Exploitation of the Sea) is a public research body, entirely devoted to a maritime purpose. With an annual budget of approximately 150 Million Euros, 1,385 executives, researchers, engineers, sailors, technicians and administrative staff, 72 laboratories or research departments along the mainland coast and in the French Overseas Territories, 7 research vessels, 2 manned submersibles, 1 ROV 6000 (Remotely Operated Vehicle) and testing facilities, Ifremer is involved in all the marine science and technology fields. Its missions are: Ensure better knowledge, assessment, value enhancement and streamlining in the exploitation of marine resources, improve knowledge and means to protect and restore the marine environment, enhance the socio-economic development of the maritime world, provide assistance to the government, public authorities and organisations concerned with scientific, technical or economic research, create and manage facilities of national interest (fleet), gather, disseminate and enhance national and international oceanographic information, and finally contribute to implementing of agreements and conventions for international cooperation in the marine field.

Ifremer has a long past in the development and exploitation of long term deep sea observatories, with a need shared by several research laboratories including marine geology, marine chemistry, physical oceanography and deep sea biology. Its capabilities in the development of benthic stations, the method for their deployment, the standardisation of interfaces, the communication to the continent, the data management and dissemination have been demonstrated in several EU funded projects: MAST ALIPOR and GEOSTAR, FP5 ASSEM and ORION, ESONET CA and presently KM3Net and ESONIM.

**Key participants:**

**Roland Person** is graduated from an Engineering School in Electronics and Computer Sciences (Ecole Supérieure d'Electricité - Paris) and Doctor in Physical Oceanography (University of Paris VI). Engineer at CNEXO and IFREMER in charge of development of many instrumentation devices: Oceano-meteorological buoys using VHF, HF and satellite links (Nimbus, Argos, Meteosat…); deep tow system RAIE2 Miscellaneous bottom landers (OBS, MAP,…); acoustic systems (Digital echo integrator, side scan looking sonar, synthetic aperture sonar,…). Director of the Acoustic department of IFREMER (Brest and Toulon) up to 2000, he is now in charge of the Ocean Bottom observatory project at Ifremer. Partner of many European projects (ISUSAT, AUV, BIOMAS, GEOSTAR, COSMOS, ASSEM, ESONET…). He was in charge of the work packages architecture design and Data management in ESONET CA. He was President of the organization committee of the workshop on standardization in ocean bottom observatories in Paris (1 and 2 February 2005), member of the NEPTUNE Canada Community Science Experiments Review Committee.

**Jean-François Rolin**, design engineer, is the head of the Department for Technology of Instrumental Systems. He is a graduate from CESTI engineer school (1976). After an experience in the structural assessment of offshore platform in a classification society in France and Norway, he joined Ifremer as a head of the mechanical design team. He participated in the development of ten different landers or benthic stations and two bore-hole instrumentation systems. He co-ordinates the design of monitoring systems for coastal environment and deep sea. He has performed several studies on reliability of deep sea systems and coordinated a national standard on quality tests of oceanographic instruments. He co-ordinated the ASSEM project.
Pierre Cochonat, 24 years experience in the study of sedimentary processes and physical properties of slope and basin sediments and more recently in scientific programme management. He is presently working at the Ifremer headquarters in the “Programs and Strategy Division” in charge of "Exploration and Exploitation of the Deep Ocean Floor and its Biodiversity" including scientific and financial management of Ifremer activities in geosciences, biology, biotechnology and related technologies.

Participant n°2 IPGP France
IPGP currently has over 420 members including 150 students (50 PhD). The institute has an active post graduate program and is divided into 14 teams studying six major themes: Earth physics, earth chemistry, geology, materials, earthquakes and volcanism. IPGP researchers play a leading role in the field of geophysical seafloor observatories, with particular expertise in the fields of seismology, geodesy, and mid-ocean ridge hydrothermalism. IPGP coordinates the EC MoMARnet RTN devoted to the implementation of the Azores MoMAR observatory project. IPGP is also involved in the NERIES EC project to deploy broadband ocean bottom seismographs around the European continent.

Key participant:
Mathilde Cannat has worked as a full time researcher for CNRS for near to 20 years, first at the Université de Brest, then in Paris. She is a specialist of geological processes at mid-ocean ridges, has authored and co-authored 68 papers in international journals, has convened sessions at international meetings (AGU, EGS, and at topical workshops), she frequently reviews proposals for national and international (NSF, NERC) programs, and papers for the main journals in Earth Sciences (JGR, EPSL, Nature, G3, Terra NovaS. She has been co-chief scientist of one ODP leg (leg 153), and of three cruises on French vessels. She has served in many committees, at national (Steering committee of the Dorsale program), and international level (ODP Lithosphere panel ; Steering committee of the French American Ridge Atlantic (FARA) program ; Steering committee of the InterRidge program; ESF-Euromargins review committee; ODP-Strategic Committee). In 2001-2003, she worked part time as « chargée de mission » for CNRS-INSU. In this position, she participated in the management of the Marine Geosciences programs run by CNRS (Dorsale program, Adhoc Oceans program, and GDR Marges). She also represented CNRS-INSU in a number of committees and managed cruise-related expenses for French academic researchers. She currently coordinates the MoMARnet MCRTN (www.momarnet.org), and chairs the French Steering Committee for the MoMAR Program. She is also a member of the Geosciences Marines committee of IFREMER (2003-), of the Comité National du CNRS (2004-), and of IPGP Administrative Committee (2004-).

Participant n°4 CNRS France
This partner represents six laboratories:
CNRS Member n° A- The CEREGE, Centre Européen de la Recherche et de l’Enseignement des Géosciences de l’Environnement (permanent staff : 144). The research team involved in ESONET is the Geodynamics Team, lead by Xavier Le Pichon, Endowed Professor of Geodynamics at College de France. Within the field of geodynamics, main interests are: the surface response to deep tectonic processes, fault zone initiation and localization processes, fluid-deformation coupling from the seafloor to the seismogenic zone. Objects studied are subductions, large scale strike-slip faults, seismogenic faults, continental slope instabilities and fluid expulsion sites on the seafloor (water, gas and gas hydrates). Methods used are geomorphic and structural analysis at various scales (using
MCS, HR and THR seismics, multibeam bathymetry, reflectivity imagery and visual observations), kinematics, numerical modelling, measurements in boreholes and on cores. Areas of work are Marmara Sea, Sunda trench, Nankai Trough, Gulf of Mexico, Provence and Mediterranean Sea.

**Key participant:**

**Pierre Henry** – Senior researcher at CEREGE/Collège de France.
Teaching, education and outreach
Conferences in schools and exhibits on active faults, earthquakes and tsunamis (2005-).
Graduate and undergraduate courses in plate kinematics and geodynamics (1995-2003)
Advisor (or supervisor) of 6 doctoral thesis.

**CNRS Member n° B - GEOSCIENCES Azur** a combined University/CNRS research Institute working under the auspices of the CNRS, the IRD, the University of Nice-Sophia Antipolis and Paris VI, with links with the Oceanology Observatory of Villefrance-sur-mer (OOV).

**CNRS Member n° C - IUEM** : The European Institute for Marine Studies (IUEM, www.univ-brest.fr/IUEM), located in Brest (France), is a research institute and an Earth observatory of the University of Western Brittany (UBO, www.univ-brest.fr) and of the National Center for Scientific Research (CNRS, www.cnrs.fr). Founded in 1997, the IUEM plays a major role in marine sciences in the fields of physical oceanography, chemistry, biology, geosciences, geography, law and economy, at national, European and international levels. The Institute has a staff of 250 people and 300 enrolled students (Master and PhD levels). The physical oceanography, chemistry, biology, and geosciences labs are particularly interested by the ESONET goal of implementing and networking permanent sub-marine observatories for monitoring various processes on the deep ocean floor and in the water-column.

**Key participant:**

**Dr. Jean-Yves Royer** – Senior Research Scientist at CNRS.
Head of Laboratory « Domaines Océaniques »
joint laboratory of CNRS and Université de Bretagne Occidentale in Brest

**CNRS Member n° D - The LOV** groups mainly physician and biologist researchers interested also by Ligurian sea studies.

**Key participant:**

**Gabriel Gorsky** – Senior Research Scientist at CNRS (LOV).

**Areas of professional expertise /**
Biological oceanography, zooplankton ecology. Trophic interactions, population dynamics, and behaviour of gelatinous zooplankton. Zooplankton sampling technology and data treatment (especially imaging technologies).

**CNRS Member n° E - CPPM-IN2P3** is a division of CNRS operating more than 20 laboratories around France charged with research in particle, astro-particle and nuclear physics. Of these, the Centre de Physique des Particules de Marseille (CPPM) and the Institut de Recherches Subatomiques (IReS) in Strasbourg are involved in the ANTARES pilot project, where CPPM has coordinated the design studies for the ANTARES pilot project and developed the deep sea acoustic positioning system. CPPM and IReS will contribute to the scientific and technical aspects of the Design Study and coordinate the Astro-particle Physics work package.
CNRS Member n° F – LMGEM -
The Laboratoire de Microbiologie, Géochimie et Ecologie Marines (LMGEM) has about 50 scientists (including PhDs and postdocs) carry out scientific research work on questions concerning biotic and abiotic organic matter recycling in coastal and open ocean, throughout the water column (from the epipelagic to the bathypelagic domains) and in the sediment. The LMGEM was the leader participant of the EMPS (European Microbiology of Particulate Systems) project included in the Mediterranean Targeted Project and was involved in WP4 MATER project and leader of the WP4 BioDeep (FP5). The current development of the In situ Dynamic Auto-Sampler (namely IODA6000) in collaboration with the CPPM, in the framework of the ANR project POTES, will be validate and valorized in the framework of EuroSITES (FP7).

Key Participant
Dr Christian Tamburini is a research scientist (CR2) of the CNRS (since 2003, http://www.com.univ-mrs.fr/~tamburini/ctambu_us/index.php3). His scientific interests are in the areas of microbial ecology of mesopelagic and bathypelagic waters. He is deeply implied into developing innovative instruments and devices to collect and incubate deep-sea samples without decompression and to simulate particle flow throughout the water column. He has participated to several cruises in the Mediterranean Sea and is coordinating the French program ANR POTES – Pressure effects On marine prokaryotes, http://www.com.univ-mrs.fr/LMGEM/potes/). He is one of Deep-Sea Task force coordinators at the CIESM (Int. Commission of the Scientific Exploration of the Mediterranean Sea). He is representing the Centre d'Océanologie de Marseille into the ANTARES Collaboration since 2003, is involved into the Instrument Line of ANTARES (CTD, camera, O₂ probe), into the study of the bioluminescence in deep-sea waters for ANTARES and involved into the development of the IODA6000. He is one of the Pi in the EuroSITES projects (FP7, http://www.eurosites.info/) devoted to integration and enhancement of key existing European deep-ocean observatories.

Dr Dominique Lefèvre is a research scientist (CR1) of the CNRS (since 1996). Between 1993 and 1996, he was a postdoctoral fellow at School of Ocean Sciences, University of Wales, Bangor, Menai Bridge, UK, working on marine microbial processes (transfer of organic matter, respiration, photosynthesis). Currently working in the biological CO2 fluxes in the whole water column at different time scale (day to year) using in situ field observations, chemical (O₂, TCO₂) or enzymatic (ETS) approaches and automated sensors (Seabird, Ysi, Aanderaa). He is also involved into the development of the IODA6000s, in the EuroSITES projects (FP7) and in ANTARES program.

CNRS Member n° G – LMTG
The “Laboratoire des Mécanismes et Transferts en Géologie” (LMTG; University Mixed of Research UMR5563) is a French research laboratory which works in the field of Earth and Environmental Sciences (http://www.lmg.obs-mip.fr). It hosts about 150 permanent members (faculty, researcher, technician) from 4 different institutions of the French research system (CNRS, University, IRD (Research and Development Institute) and CNAP (National Committee of Astronomers and Physicists)) plus about 70 post-docs and graduate students. The LMTG is part of a larger institute of 8 research laboratories (900 staffs), the “Observatoire Midi-Pyrénées” (OMP; http://www.obs-mip.fr), both scientifically and geographically. Their missions are dedicated to fundamental research, to support developing countries, to train and educate students at all levels, and to collect long-term observations of the natural environment through a network of observatories. Research at the LMTG is based on various approaches: the study of global element cycles, which demands many high-quality chemical, physical and isotopic analyses, the determination of the mechanisms at the microscopic scale (diffusion, chemical reaction, etc…), which requires extended experimental facilities, the observation of the natural environment, which is effective only by systematic and detailed observations on building observatory sites. This is supported by numerical
modelling enabling the global integration of all scientific data. The LMTG scientists involved in the ESONET program are part of the team HYMEDIA (Hydrothermalism-Metallogeny-Diagenesis), whose name summarizes very well its scientific activity. They are engaged in oceanic hydrothermalism studies via observation of the natural environment, characterisation of the chemical and isotopic composition of hydrothermal fluids and quantification of chemical element fluxes.

**Key Participants**

*V. Chavagnac* has a proven track-record in isotope geochemistry, which she has successfully applied in recent years to trace marine hydrothermal circulation. She also has developed at several times of her career, new analytical technique.

*C. Monnin* is a theoretician of fluid-rock interaction using thermodynamic models that he applies on natural waters, for example to assess element and heat transfer from the oceanic crust and chemical equilibrium between minerals and natural waters.

**CNRS Member n° H – DT-INSU**

The Technical Division (DT) of the National Institute of Universe Sciences (INSU) is a Service Unit (UPS 855) of the CNRS. It brings together 45 people level engineer, technician or administrative, and 62 sailors. Its main tasks are:

- The operational management, maintenance and implementation of national resources.
- The DT participates in the construction or acquisition of some of these equipment.
- The support laboratories for tasks of general interest.
- Aid to engineering projects for laboratories under the department Sciences of the Universe (SDU) of CNRS.

The DT provides many tasks at the national level, including:

- Implementation of a fleet of coastal vessels
- The provision of a park instrumentation oceanographic
- The use of test facilities in geophysics
- The development and maintenance of many other national instruments.

**Key Participants**

*Etienne Ruellan* is head of the Technical Division of INSU; he is researcher in geosciences specialized in marine tectonics in subduction areas, back-arc basins and continental margins.

*Carl Gojak* is in charge of the installation of scientific instruments on networks submarines. He installed a seismometer on the telescope ANTARES. Telescope which he was partially responsible for its construction.

**Participant n° 5 SOPAB France**

*Oceanopolis*

After a vast extension programme launched in 1999 until the Grand re-opening of May 2000, Océanopolis has become a very unique Ocean Discovery Park, combining scientific approach with spectacular settings in its three thematic pavilions: Polar, Temperate and Tropical. With an average number of 450,000 visitors per year including 50,000 pupils and students Océanopolis is a major facility that belongs to the City of Brest. Being supported by Europe, The State, The Région of Brittany, the Department of Finistère and the Brest Community, Océanopolis has two main functions:

- Presenting to the general public the activities of oceanographical research (Brest is the French “capital” of Oceanography).
Generating is significant flow of tourism to western Brittany using the theme of oceanography.

Océanopolis is managed by the Sopab, on behalf of the city of Brest. The Sopab is a semi-public Company with a capital of 1.400.000 €, a staff of 250 employees and a turnover of 24,4 millions euros.

**Key participants**


**Participant n° 6 KDM-Konsortium Deutsche Meeresforschung Germany**

This partner represents 5 member institutions, namely UniHB, IFM-GEOMAR, AWI, JUB and MPI-MM. For a short description of these institutions please see below. KDM is a registered German association with legal capacity founded in 2005

- to promote collaboration within German marine science and research and also
- to support international cooperation in planning and operating big infrastructure.

One aim of KDM mentioned in the articles of association is to intensify the cooperation of German, European and International marine research with respect to binding cooperation to plan operate and use large infrastructure. The specific tasks include the continuous execution of joint research, developing long-term investment programmes and coordinating the use and further development of large infrastructure for marine research. One other important aim is the joint presentation of the German marine research community, represented by its members, towards decision makers and the media. Within FP6, KDM members contribute to 74 projects, with 56 WP leaders and 5 coordinators.

Membership fees fund KDM, currently 11 institutions have joined KDM of which 5 are ESONET members. KDM is in the process of hiring staff that will be responsible for the project management of ESONET and other projects. In the meantime KDM has hired Dr. Johanna Wesnigk from the small owner-manager company EMPA as a sub-contractor to help with the negotiation phase and to train the new personnel.

**KDM Member n° A: UniHB Germany**

DFG Research Center Ocean Margins and Centre for Marine Environmental
Sciences, RCOM-MARUM at the University Bremen
The Research Center Ocean Margins at the University of Bremen aims to investigate geoscientifically the ocean margins, the transitional zones between the oceans and the continents. The region of the ocean margins extends from the coastal zone across the shelf and the continental slope to the continental rise. More than 60% of all Earth's people live in the adjacent coastal land areas, and they have intensively exploited coastal waters for the extraction of raw materials and food over a long period. In recent times, human activity has spread farther out into the oceans as the margins gain increasing attention as potential centres for hydrocarbon exploration, industrial fisheries and other exploitations by man. Thus, especially in recent years the increasing need to investigate the ocean margins has become clear - a task to which the Research Center Ocean Margins will contribute significantly. The research themes span from environmental changes in the Tertiary to the impact of recent coastal constructions, and from microbial degradation in the sediment to large scale sediment mass wasting along continental margins.

The Centre for Marine Environmental Sciences (MARUM), University of Bremen
MARUM is a cooperative facility at the University of Bremen offering a number of technical and scientific services and developing innovative technology in support for scientific operations. Within the last decade MARUM became one of the leading groups in Germany and Europe to develop and operate sophisticated equipment for marine science applications. (www.marum.de). Different technology projects with the aim of data transmission (underwater acoustics and satellite communication) and sensor developments (buoyancy driven carrier systems, optical sensors, camera systems) were carried out during the last decade. All major equipment for open ocean field work and technological development is available at the location, such as specialised mechanical workshops and electronic laboratories. Special test facilities like a test basin and a large high pressure chamber for instrument testing under in-situ pressure are owned by the Department of Geosciences. Within the framework of the newly established DFG Research Centre on Ocean Margins new, additional infrastructure will be established within the technological oriented working group MARUM. A deep sea ROV system QUEST (ALSTHOM-Schilling) with a maximum deployment depth of 4000 m has been acquired and will allow for scientific oriented missions as well as servicing and recovery of deep sea equipment in situ. This system is a core vehicle where additional scientific payload will be implemented according to the scientific demands in the next future. A deep sea going AUV (4000 m) equipped with high resolution sonar mapping systems is in the procurement stage and will complement the operation of the deep sea ROV system QUEST within the very next future. One of the permanent tasks of MARUM lies in the maintenance of the scientific information system PANGAEA (Network for Geological and Environmental Data –www.pangaea.de), which is a system for acquisition, processing, long term storage, and publication of georeferenced data related to earth science fields. Essential services supplied by PANGAEA are project data management and the distribution of visualization and analysing software. In 2001 the PANGAEA group founded the ICSU World Data Center for Marine Environmental Sciences (WDC-MARE), which uses PANGAEA as operating platform. Organization of data management includes quality check and publication of data and the dissemination of metadata according to international standards. With its comprehensive graphical user interfaces and the built in functionality for import, export, and maintenance of information PANGAEA is a highly efficient system for scientific data management and data publication. The institutional frame is supplied by MARUM in cooperation with the Alfred Wegener Institute (AWI), Bremerhaven. The main contributions of UniHB to the ESONET NoE will be to lead work packages 1 and 2, both dealing with Integration: Dr. Michael Diepenbroek is the leader of WP1 and has been suggested as a member of the data management council which is responsible for advice on the data management policy of the JPA’s, especially for WP1, WP6 and WP7. Dr. Christoph Waldmann is leader of WP 2 Standardisation and interoperability and has been suggested as a member of the Test and Operation
Council (TOC) which gives advice on the testing and operational aspects of the Network, especially of WP4 and WP5.

**Key participants:**

**Prof. Dr. Gerold Wefer,** born in 1944, is a Professor of Marine Geology at Bremen University, Germany. After studying and working in the Geology Department at Kiel University and Scripps Institution of Oceanography he moved to Bremen in 1985. His main areas of research include: Sedimentation processes in shallow water; Ecology of benthic foraminifera; Carbonate production in boreal and tropical seas; Distribution of stable isotopes in calcareous organisms; Particle flux (carbon and associated elements) in high latitudes and in the South Atlantic; Paleoclimate in the South Atlantic. Dr. Wefer has participated in over 30 major research cruises, many of which as chief scientist. Since 2001 he is head of the DFG Research Center on OCEAN Margins.

**Dr. Christoph Waldmann,** born in 1956, is a Research Associate at the University of Bremen, MARUM in Germany. After studying and working in the Physics Department at Kiel University and a one year stay at the Woods Hole Oceanographic Institution he started working in Bremen in 1996 in the technology group of MARUM. His field of expertise lies in sensor and underwater platform development in particular for deep sea applications. He has been involved in several EU-projects like ANIMATE, EXOCET/D and CARBO-OCEAN.

**Dr. Michael Diepenbroek,** born in 1955, Research Associate, University of Bremen, MARUM, Geologist and Computer Scientist. In 1990 he obtained a Master in Geology and in 1992 a PhD in Geology at the Free University of Berlin. Research fields in geology included sediment transport processes, statistics, and image analysis of sediment particles. 1992-94 in the computer center of the Alfred Wegener Institute for Polar and Marine Research (AWI), Bremerhaven. 1994-97 conception and implementation of the scientific information system PANGAEA (Network for Geological and Environmental Data). He took a leading role in the initiation of the ISCU World Data Center for Marine Environmental Sciences (WDC-MARE), founded in 2001. Since 1998 at MARUM, where he is responsible for the operation of WDCMARE and PANGAEA. 9 publications in international journals.

**KDM member n° B: IFM-GEOMAR Germany**

The Leibniz Institute of Marine Sciences at the University of Kiel (IFM-GEOMAR) was founded in 2004 through the merger of the Institute for Marine Science (IfM) and the Research Centre for Marine Geosciences (GEOMAR). IFM-GEOMAR’s mission is to understand the physical, chemical, biological, and geological processes in the ocean and their interaction with the seafloor and the atmosphere. The expertise of four major divisions covers a wide range of topics from all aspects of marine science. The institute is involved in worldwide operations covering all major ocean basins. More than 400 employees are funded by the Federal Ministry of Education and Research and the Federal State of Schleswig-Holstein within the Leibniz research community, by other national and international funding agencies and the industry. IFM-GEOMAR as an institution at the University of Kiel offers arguably the most comprehensive marine education in Germany. Issues on the future ocean are of main concern to IFM-GEOMAR research including: better prediction of the consequences of human impact on atmospheric and oceanic changes, such as climate and sea-level change, ocean acidification, marine resources and natural hazards. IFM-GEOMAR closely cooperates with a variety of regional SMEs specialized in the development of marine instrumentation. The institute has an outstanding expertise in the construction and operation of long-term oceanographic moorings, tsunami alert systems, autonomous oceanographic vehicles (gliders, floats), benthic landers and ocean bottom seismometers. A 6000m rated work class ROV is presently purchased by IFM-GEOMAR and will be available in early 2008. Dr. Pfannkuche is Co-leader of WP 3 Scientific objectives and observatory design (III.a Sciences objectives). Dr. Peter Linke has
been suggested as a member of the Test and Operation Council (TOC) which gives advice on the testing and operational aspects of the Network, especially of WP4 and WP5.

**Key participants:**

**Prof. Peter Herzig**
Peter M. Herzig (born 1954) received his Ph.D. in Geology from the Aachen University of Technology in 1986 for his research carried out on ancient seafloor in the Troodos Ophiolite on Cyprus. Following an Alexander von Humboldt Post-Doctoral Fellowship at the University of Toronto, he obtained a Research Associate and Assistant Professorship at Aachen and was a Visiting Professor at the Geological Survey of Canada. From 1993-2003, Peter Herzig was Full Professor and Chair of Economic Geology and Petrology as well as Head of the Leibniz Laboratory for Applied Marine Research at Freiberg University of Mining and Technology. He served as Dean of the Faculty for Geosciences, Geoenigineering and Mining from 1997-1999. Following a Visiting Professorship at the Southampton Oceanography Centre in the United Kingdom, Peter Herzig became Full Professor at the University of Kiel in 2003 and Director of the Leibniz Institute of Marine Sciences IFM-GEOMAR in 2004. Since January 2004 he is also Chair of the German Marine Research Consortium (KDM). In November 2004 Peter Herzig was appointed Maritime Coordinator for the State of Schleswig-Holstein at the Office of the Prime Minister. Since 2005 he is President of the International Marine Minerals Society, USA. Peter Herzig has participated in more than 20 oceanographic expeditions in all oceans, several as Chief Scientist. He has experience with deep diving and remotely operated vehicles and also sailed as petrologist and Chief Scientist for the Ocean Drilling Program. In 2000, he has received the prestigious Leibniz-Award of the German Research Foundation for his work on seafloor hydrothermal systems.

**Dr. Olaf Pfannkuche** is a biological oceanographer and has a record of 25 years of scientific work on benthic boundary layer processes in the deep sea. He participated in more than 60 ship expeditions all around the world of which more than 30 were organized and led by him. He coordinated several large multidisciplinary German cooperative research programmes on deep-sea processes and carbon turn over in the NE Atlantic and Indian Ocean. He has a long experience in international cooperation both on the European level and with countries outside Europe from his participation in the JGOFS Programme. He regularly reviews research proposal and manuscripts submitted to international scientific journals. His recent research activities focus on geosphere/biosphere coupled processes (gas hydrates, cold seeps) and long-term sea floor observation (e.g. cold water coral ecosystems) His working group together with Dr. Linke (IFM-GEOMAR) has an outstanding expertise on deep-sea instrumentation, particularly lander technologies. He worked as principal investigator in several EU-projects (OMEX I, BENGAL, ALIPOR, ESONET) and at present in ESONIM and HERMES. His research interests include deep-sea biogeochemistry, benthic ecology, geosphere-biosphere coupling, gas hydrates, anthropogenic impact on deep-sea, sea floor observation with long-term observatories.

**Prof. Martin Visbeck**
born in 1963, is a physical oceanographer with extensive experience in experimental oceanography. He research is aimed to understand the ocean’s role in the climate system with an emphasis on the investigation of key processes and long time series observations in the ocean. He received his degree from the University of Kiel, spent two year at MIT, Cambridge USA and then 10 years at LDEO, Columbia University NY USA. Since 2004 he is the head of the Physical Oceanography division at IFM-GEOMAR. His group has extensive expertise in long term observations of circulation and water mass changes using shipboard and moored observatories. They are the leaders of the German profiling float (Argo) consortium and the first European group who has successfully used ocean gliders.

**Dr. Peter Linke** is a marine biologist and has a record of more than 20 years of scientific work on deep-sea benthos starting in the Sonderforschungsbereich 313 with investigations on benthico-pelagic
coupling. In 1993 he joined the department of Environmental Geology at GEOMAR where fluid circulation at active margins and the quantification of the input of gases and fluids into the hydrosphere is a major objective. Within this group, he gained expertise in the investigation of biogeochemical processes associated with fluid flow phenomena at various subduction zone (Aleutean, Cascadia, Makran, Peru margin) and hydrothermal vent (Aegean Sea) settings. This includes process-oriented investigations by combining geological, geochemical and biological approaches and by using modern in-situ techniques, in particular Lander technologies. He worked as principal investigator and coordinator in various multidisciplinary DFG-, BMBF- and EU-funded projects and was chief scientist of several major cruises. At present he coordinates the COMET project within the special program GEOTECHNOLOGIEN by BMBF and DFG.

KDM Member n° C: AWI Germany
The Alfred Wegener Institute Foundation for Polar and Marine Research (AWI) was established in 1980 as a public-law foundation. The institute is one of the sixteen national research centres in Germany. All major scientific disciplines are represented thus interdisciplinary research approaches are a main element in its research strategy. Actually, the Alfred Wegener Institute Foundation for Polar and Marine Research comprises the following research establishments: the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven, the AWI Research Unit in Potsdam, the Helgoland Biological Institute (BAH), the Marine Research Station on Helgoland and the Wadden Sea Station in List/Sylt. In 2006, the Foundation has 780 employees including a large number of students. The research mission of the Alfred Wegener Institute is to improve our understanding of the complex relations between the oceans, ice, atmosphere, the sea floor and the plant and animal kingdoms. AWI promotes polar and marine research through its own research work in the Arctic, Antarctic and temperate latitudes. It coordinates polar research in Germany and provides the equipment and logistics necessary for polar expeditions. AWI operates the ice breaking research vessel "Polarstern", the RV "Heincke" and, among some other small boats, RV "Uthörn", one Dornier 228 aircraft used for remote sensing as well as for meteorological and oceanographic surveys, the permanently manned German Antarctic and Arctic research stations "Neumayer" and "Koldewey", respectively. A close cooperation between AWI and IFREMER exists through the virtual institute “Underwater Systems and Technologies” which links the deep-sea technology branches of both institutes closely together (exchange of personnel, expertise, soft- and hardware). AWI is since 1999 operating a long-term deep-sea observatory, the AWI-Hausgarten (79°N west off Svalbard) where at frequent intervals ROV operation takes place down to the maximum depth of “Hausgarten” at 5500 m. Michael Klages has been suggested as a member of the data management council which is responsible for advice on the data management policy of the JPA’s, especially for WP1, WP6 and WP7.

Key participants:
Dr. Michael Klages is a marine biologist with experience in field and laboratory investigations on benthos organisms of both Polar Regions since 1987. His main research interests focuses on biodiversity of benthic ecosystems and crustacean ecology. Among his participation in about 15 cruise legs into either the Antarctic or Arctic he was chief scientist onboard the French RV "L'Atalante" in 2001 and 2005 and onboard RV "Polarstern" in 2003. During these expeditions the French ROV "Victor 6000" was used. The results of his investigations are published in more than 40 peer-reviewed journals or books. He is head of an interdisciplinary research group which is working on Arctic deep-sea biodiversity but at the same time responsible for underwater vehicles and deep-sea technology. The department is responsible for the operation of several free falling landers and a 3000 m depth rated Autonomous Underwater Vehicle (AUV).
Dr. Thomas Soltwedel is a marine ecologist working on causes and effects of physical, chemical and biological gradients on the biodiversity of benthic assemblages. Since 1991, he participated in five EU projects within the MAST and ENRICH programs (e.g. OMEX, ALIPOR, ADEPD, COBO). Dr. Soltwedel is now working in the AWI deep-sea department, focussing on research projects in the deep Arctic Ocean. In 1999, he co-ordinated the first deployment of IFREMER's deep-diving ROV "Victor 6000" from board a non-French ship, i.e. the German RV "Polarstern". At the same time, he started working with autonomous free-falling devices carrying a wide range of instruments, incl. respiration chambers, cameras, current meters, etc.

KDM member n° D: JUB Germany
Jacobs University Bremen, a private, independent research university founded in 1999, brings many of the aspects of American higher education to Europe. Two schools (Science and Engineering, Humanities and Social Sciences) as well as a Centre for Lifelong Learning provide undergraduate and graduate programs in a total of 25 different areas. Currently 750 students coming from 80 different countries, and about 95 graduate students live on Campus. The faculty of Earth Science and Engineering at JUB (currently 60 professors) is developing a geoscience research centre and coordinates of a science/industry consortium of European research facilities concentrating on continental margin studies. JUB’s intention is to strengthen electronic management of geoscience data, the numerical simulation of geological processes and to build up a new facility of internet controlled oceanography. Its faculty has additional expertise in marine technology, operation of deep sea instrumentation and electronic engineering. A science park adjacent to the JUB campus is under consideration to facilitate technology transfer from campus research activities and provide internship and employment opportunities. JUB builds up strong relationships with industry. For more information please contact http://www.jacobs-university.de/. A main contribution of will be that Prof. Thomsen is leader of WP 7 on education and outreach.

Key participants:

Prof. Dr. Laurenz Thomsen
Interests: boundary layer particle and solute transport, biological modification of near bottom fluxes of particulate and dissolved matter. Cabled observatories with internet operated vehicles.
Educational outreach and training.
Experience: has a record of 16 years of scientific work on laboratory and in-situ studies on benthic boundary processes at continental margins. He is specialised in flow dynamics and instrument development. Participation in RTD projects ALIPOR, OMEX-I, OMEX-II, EUROSTRATAFORM, ESONET, BIOFLOW and HERMES. Responsible for HERMES training. Member of Neptune US, Neptune Canada and MARS. 26 cruises to continental margins. His research group developed the first mobile internet operated deep-sea vehicles with different sensor packages (www.deepseacam.com). Strong links to industry and remote controlled operations.

Prof. Dr. Vikram Unnithan is an assistant professor of Geoscience at the Jacobs University Bremen. His main research interests and expertise lie in the field of marine and applied geophysics with particular focus on hydrocarbon systems modelling, fluid flow processes, gas hydrates, seismic modelling, marine geology, process sedimentology, GIS, geodatamanagement and geoscience visualisation. He is currently involved in a number of international programs such as HERMES, IRCCM and maintains and seeks to promote links to industry. His position at the JUB is partially funded by Statoil.

Dr. Volker Karpen is a research associate (Oceanography) at the JUB. Since 2003 he is working for the ESONET initiative. His main research interest is the investigation of cold seeps in respect to
fluid and gaseous fluxes. During the last two years he established a shallow water cabled observatory in the Eckernförde Bay, which delivers online video
and sensor data. The network is also used as a test bed for international projects like ESONET and NEPTUNE. Three newly developed crawlers are connected to the observatory for test and research purposes before they will be used in deeper waters.

KDM Member n° E: MPIMM Germany
The task of the Max-Planck-Institute for Marine Microbiology (MPIMM) is to perform fundamental research on the mechanisms of element cycling in the sea, especially the benthos, and how the cycling is controlled by microorganisms. The research projects include many international cooperations and several European research projects like HERMES (Hotspot Ecosystem Research on the Margins of European Seas), EXOCET (Extreme ecosystem studies in the deep ocean: technological developments) and the Networks of Excellence MARBEF, (Marine Biodiversity and Ecosystem Functioning) and MARINE GENOMICS. Although it is mainly a research institute, education on pre- and postgraduate level is important and well-structured (e.g. through the MarMic school).
Approximately 8 scientists will be involved in ESONET. Our role in the project will be the use of sensoric units (microprofilers, benthic chambers and in situ incubators) on underwater vehicles (crawlers and ROV’s). We plan to perform long-term in situ microbial activity measurements at the sea floor. The main contributions of MPIMM are being planned in WP 2, Standardisation and Interoperability and WWP 3 Jointly Executed Research. Antje Boetius has been suggested as a member of the scientific council which is responsible for giving advice on the network’s scientific orientation including a strong role in the selection of the demonstration missions.

Key participants:
Prof. Antje Boetius is leader of the group “Microbial habitats” in the department of Biogeochemistry of the MPI and Associate Professor of Microbiology at JUB. Her group “Microbial Habitats” deals with in situ studies of physical, chemical, geological, and biological factors structuring microbial habitats and regulating occurrence and distribution of microbial populations in coastal, ocean margin and deep water benthic ecosystems. Boetius’ research focuses on cold seep ecosystems, on the methane turnover in marine sediments and on deep-sea microbial ecology. Main working areas are the Eastern Mediterranean Sea, the Norwegian margin, the North Sea and the Black Sea. Boetius is a collaborator in many national and international research programs on gas hydrates and early diagenesis in deep-sea sediments and participated in over 20 research expeditions. Her experience with international projects includes coordination of work packages of the FP5 OMARC project METROL and of the FP6 IP HERMES, member of steering committee of “ChEss” and scientific advisory board of ICoMM (Census of Marine Life projects), P.I. in the ESF projects MEDIFLUX, MicroSystems and the GDRE “DiWoods”. Also she coordinates the research project MUMM – Methane in the GeoBioSystem: Methane Turnover, Microorganisms, Metabolism” of the German Geotechnologies program and is involved in networks for the development of technologies for ocean observation (e.g. MarTech).

Dr. Dirk de Beer is leader of the Microsensor Research group in the Max-Planck-Institute for Marine Microbiology. He is a microbial ecologist, interested in how transport regulates the distribution and rates of benthic conversions. Educated as microbiologist and engineer, he has first studied N, O and C-cycling and mass transfer phenomena in industrial biofilms. Since 1994 he joined the MPI and studied microbial processes in microbial mats and marine sediments. He is specialized in the use of microsensors for high spatial resolution, both for in situ and laboratory studies, and has 93 peer-reviewed publications mostly on physicoecological studies, and on method
innovation. He has several international cooperations within Europe, in bilateral projects in the Middle-East and with institutes in the US.

**Dr. Frank Wenzhoefer** is a Scientist of the Microbial Habitat group at the Max Planck Institute for Marine Microbiology (MPI), Bremen. He is a biogeochemist and microbial ecologist, interested in benthic processes and mass transfer, and the development of in situ technologies. Since 1996 he joined the MPI, with a three year break in Denmark at the Marine Biological Laboratory, and investigates benthic processes form shallow waters to the deep sea. He has a documented record of extensive research within the field of biogeochemistry, carbon cycling and benthic marine ecology. He is specialist in *in situ* technologies (e.g. Microprofiler, 2-D imaging, Benthic Chambers) for benthic process and ecology studies and is involved in networks for the development of technologies for ocean observation (e.g. Virtual Institute MarTech, MBL-MPI-JAMSTEC collaboration). He has experience in international cooperation at the European level (e.g. EU-projects COSA, EXOCET/D, HERMES) and participated in more than 16 cruises.

**KDM Subcontractor: EMPA, Environmental & Marine Project Management Agency**

**Dr. Johanna B. Wesnigk**

EMPA is a project management agency for European RTD projects for scientific organisations and SMEs. The thematic focus is on environmental and marine research, incl. energy and transport topics. EMPA offers a full service by providing strategic advice, high quality proposal- and project management as well as training. EMPA has been commissioned by KDM to help KDM and its member institutes to facilitate the contract negotiations, to organise KDM as the sole ESONET EU partner, to clarify the role of its members within ESONET and ensure their full information and participation, to ensure that KDM represents all five member institutes in a joint strategic manner. EMPA will also educate and train the new project management staff that is being hired by KDM in order to achieve optimum synergies and integration among KDM members, projects and programmes.
# Tasks and (or) Resources of KDM members within ESONET in the first 18 months

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<tr>
<th>IFM-Geomar</th>
<th>Uni HB</th>
<th>AWI</th>
<th>JUB</th>
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X – Stands for contribution to at least one task within this workpackage.
Participant n° 12 INGV Italy

The Istituto Nazionale di Geofisica e Vulcanologia (INGV) is the main Italian research institution in Earth Sciences operating in the field of Geophysics and Volcanology. The main subjects developed at INGV relate to the Physics of the Earth, and include Geomagnetism, Geology, Geodesy, Paleomagnetism, Seismology, Geodynamics, Geochemistry, Rheology, Marine Geophysics, Physics of the High Atmosphere, Dynamic Climatology. The activities related to marine geophysics started in early ‘90s within scientific and technological projects funded by the European Commission for the development of seafloor multidisciplinary observatories (co-ordinator of GEOSTAR [MAS3-CT95-0007], GEOSTAR-2 [MAS3-CT98-0183] and ORION-GEOSTAR-3 [EVK3-2001-00022]) able to perform autonomous and long-term monitoring down to 4000 m. INGV also participated to the ASSEM project [EVK3-CT-2001-00051], and to the ESONET project [EVK3-CT-2002-80008]) the former addressed to the development operation of the shallow water of the Corinth Gulf array of sensors for geo-hazards and the latter as support action to the future development of a seafloor network all around Europe from the Norwegian margin to the Black Sea. INGV manages the first European seafloor observatory in real-time deployed offshore Eastern Sicily at 2060 m w.d. (SN-1) funded by Italian governmental entities, which is also the first operative site of the future European seafloor observatory network. In the framework of the above projects INGV has gained experience in the setting-up of seafloor observation systems and in the multidisciplinary analysis of geophysical, geochemical and environmental long-term time series. The experience in marine geophysics also include the participation since early ‘90s to sea cruise and the elaboration of acquired data in collaboration with other Italian and European institutions (e.g., ISMAR-CNR, ConISMa, Alfred Wegener Institute, Ifremer, IFM/GEOMAR, University of Hamburg) in the frame of EC projects (e.g., TYDE, ) and national project funded by the Italian Education, University and Research Ministry (APALBES, MABEL).

Key participant:

Paolo Favali. He is Research Director at INGV. He has 30 years of experience with main fields of interest in Natural Hazards, Seismotectonics, Geodynamics, Applied Geophysics and Environmental Sciences. He cooperates in research and technological projects with many Italian/International Universities, Scientific Institutions and Industries. He has been teaching “Physics of Solid Earth” and “Earth Physics” in Italian Universities since 1994. Member (1999-2003) for the European Science Foundation of the Detailed Programme Group SEIZE (Seismogenic Zone Experiment) of Ocean Drilling Programme. Co-ordinator of the following projects GEOSTAR, GEOSTAR 2, TYDE, ORION-GEOSTAR-3 funded by EC; MABEL funded by PNRA. He is Expert Evaluator of projects European Commission. Since 1995 he represents INGV in the International Ocean Network (ION) of the IUGG. From 2001 head of the Marine Unit of INGV, which was and is presently involved in many national and international projects (e.g., EC-ASSEM, SN-1, EC-ESONET, APLABES, EC-MOMARNET, EC-KM3NET).

Participant n° 13 ISMAR Italy

Consiglio Nazionale delle Ricerche, Istituto Scienze Marine, Department of Bologna, Italy, ISMAR

The National Research Council (CNR) is a public organisation; its duty is to carry out, promote, spread, transfer and improve research activities in the main sectors of knowledge growth and of its applications for the scientific, technological, economic and social development of the Country. To this end, the activities of the organisation are divided into macro areas of interdisciplinary scientific
and technological research, concerning several sectors: biotechnology, medicine, materials, environment and land, information and communications, advanced systems of production, judicial and socio-economic sciences, classical studies and arts. CNR is distributed all over Italy through a network of institutes aiming at promoting a wide diffusion of its competences throughout the national territory and at facilitating contacts and cooperation with local firms and organisations.

ISMAR is the reference institution of the Italian National Research Council for marine geological studies. The institute was founded in 1968 and its institutional duties include the systematic exploration and geological and environmental understanding of the Italian territorial Seas. Furthermore, the Institute is involved in scientific research in extra-territorial Mediterranean areas in the Atlantic Ocean, Red Sea and Antarctic Seas. ISMAR is based in Bologna and has a workshop in the Ravenna harbour, where assemblage, testing and storage of instruments is possible easing the logistics of the marine campaigns. IGM employs some 45 persons of which more than 50% have completed graduate or post-graduate studies. The staff of the institute are trained and experienced in a broad range of technical and scientific disciplines and are capable of working in a wide variety of international projects.

The majority of the ISMAR research projects are funded by national initiatives and from EC Framework Programmes. In particular, the institute was involved in the EC projects GEOSTAR 1/2, BIGSETS, ESONET, EUROSTRATAFORM. The institute has an extensive database consisting of multibeam bathymetry and seafloor reflectivity, magnetometric and gravimetric data, multichannel and high-resolution seismic lines, and seabed sampling.

Key participant:

**Nevio Zitellini.** Born in 1952, Dr. in Geology from University of Bologna in 1977 and Master in Marine Geophysics from Columbia University N.Y. Research Scientist at I.G.M (Istituto di Geologia Marina del C.N.R, now ISMAR) on 1982; Senior Researcher on 1996, and since 1998, Research Director in the same Institution. He has a long standing research interest in Marine Geology and Geophysics ranging from Magnetometric and Gravimetric researches, Multichannel Seismic Reflection data interpretation and elaboration to structural and tectonic studies. Leader of several scientific cruises and participant in many others. Past projects include regional studies on the Thyrenian Sea, Sardinia and Sicily Channels, Adriatic Sea, Red Sea, Scotia Arc, Bouvet Triple Junction and SW African Continental Margin. Recent projects include: Gulf of Cadiz, NW African and Portuguese continental margins. He has been active in national and international programs. Recently, P.I of the EC project BIGSETS and presently co-ordinator of the ESF project SWIM. Other activities included: Member of the Steering Committee of the Antarctic National Research program, Member of the editorial Board of the scientific review Terra Antarctica, Member of Cartography Committee of C.N.R, Member of Grandi Apparecchiature Committee of C.N.R, Member of I.G.M Scientific Committee. Author of over 50 refereed publications.

Participant n° 14 INFN Italy

The INFN - the National Institute of Nuclear Physics - is an organization dedicated to the study of the fundamental constituents of matter, and conducts theoretical and experimental research in the fields of sub nuclear, nuclear, and astroparticle physics. Fundamental research in these areas requires the use of cutting-edge technologies and instrumentation, which the INFN develops both in its own laboratories and in collaboration with the world of industry. Moreover, the INFN promotes the application of the skills, methods, and experimental techniques developed to research in other fields, such as medicine, artistic preservation, and environmental protection. These activities are conducted in close collaboration with the academic world. INFN
researchers make important contributions to research not only in various European laboratories, but also in numerous research centres worldwide.

Research activity at the INFN is carried out at two complementary types of facilities: the Divisions (Sezioni) and the National Laboratories.

Each of the 19 Divisions is located at a university physics department. The Divisions thus provide a direct connection between the Institute and the academic world. The four Laboratories—in Catania, Frascati, Legnaro, and at Gran Sasso—are home to major facilities which are available to the national and international scientific community.

The INFN workforce includes about 2000 of its own employees, almost 2000 university employees involved in research conducted by the Institute, and 1300 young researchers, including undergraduate and graduate students and research fellows. The organization of the INFN represents an effective balance between centralized and decentralized management and is the product of customs established and strengthened over the years.

The INFN and in particular the NEMO (NEutrino Mediterranean Observatory) Collaboration is conducting, since many years, an intense activity to develop technical solutions and to select an optimal marine site for the construction of a km³ scale neutrino telescope in the Mediterranean.

The realization of a km³ scale detector for astrophysical neutrinos is considered today one of the most important aims of the next decade. Up to now only smaller scale detectors have been realized or are under way, demonstrating the feasibility of the technique of Cherenkov detection of the secondary muons in deep waters or ice. However, the realization of a km³ scale detector needs a further improvement of the technologies by means of appropriate R&D studies. The Mediterranean Sea offers optimal conditions, on a worldwide scale, to locate the telescope and several sites have been proposed by the European collaborations active in the field. Moreover, it has full complementarities, in terms of sky coverage, with the ICECUBE detector is under construction at the South Pole. The NEMO Collaboration aims to carry out the necessary R&D towards the km³ neutrino detector. The activity has been mainly focused on:

1. search and characterization of an optimal site for the km³ installation;
2. development of a feasibility study of the detector;
3. developments of prototype of the km³ detector elements.

The NEMO Collaboration has performed, since 1998, a long term research program to select and characterize an optimal deep-sea site. This activity has demonstrated that the abyssal plateau in the Ionian Sea close to the southernmost cape of the coast of Sicily (Capo Passero) shows excellent characteristics to host the km³ underwater neutrino detector. More than 20 sea campaigns have been performed, aiming at studying the seasonal and long term behaviour of water optical characteristics and oceanographic properties (like currents, sedimentation and seabed geology) [6]. The location of Capo Passero site, at about 80 km from the coast and about 50 km from the shelf break, was chosen to ensure the best condition of stability in time of the water parameters and avoid any perturbation coming from the presence of the shelf break. A geological survey of the area verified the flatness and the absence of any evidence of recent turbidity events. The nature and structure of the seabed was studied in detail in order to design the mooring structures of the neutrino detector.

In 2001, INFN has started to fund the realization of a test site infrastructure at 2100 m depth, in front of Catania coast at a distance of 25 km, in view of the realization of a small scale technological demonstrator, the so called NEMO Phase 1 project.

In 2003 INFN started a program (funded by EU by means of Italian PON 2000-2006) called LAMS for the realization of a multidisciplinary underwater laboratory, that will be deployed in June 2006. In 2004 the INFN started with the Project SIRENA (funded by Italian Research Minister), which foreseen the realization of prototype structures for the underwater NEMO tower, that will be one of the main component of the underwater km³ detector.

INFN is partner of the KM3NET project, a “Design Study”, funded by EU inside the FP6.
Moreover, the INFN has funded the realization of a main underwater infrastructure in Capo Passero Site composed by a shore station, a main electro optical cable (20 fiber optic, DC power supply, length 1000 km, final site depth 3500 m). The installation will be completed by the end of 2007.

**Key participant:**

**Emilio Migneco.** He is Director of Laboratori Nazionali del Sud (INFN). He is full professor at Catania University since 1976. He was Director of Laboratori Nazionali del Sud (1979-1985; 1989-1994). Co-ordinator of Cristal Ball project, Member of Scientific Committee of Ganil (1985-1994), Member of NuPECC (since 1994), member of “PAC for low and intermediate energy physics” (INIR – Russia). Vice President of INFN Executive Board (1994-2000). He is the spokesperson of the NEMO project.

**Participant n° 15 Tecnomare S.p.A.**

Tecnomare, founded in 1971, is an Industrial Company of the Eni group, specialised in providing a complete range of offshore design and engineering services for international Oil and Gas Companies, supporting them in their core business developments. Tecnomare covers all phases of upstream development from feasibility studies, conceptual, basic, FEED (front-end engineering design) and detailed engineering, project management, procurement services, field supervision, marine operations design, right through to global maintenance engineering. Tecnomare can also provide turn-key supply of equipment and systems.

Tecnomare fields of activity include:
- upstream oil and gas development: focuses on projects relative to infrastructures and systems for the development of onshore and offshore hydrocarbon fields, including the new frontier of deep and very deep water;
- operations and maintenance: concentrates on operations and maintenance activities for infrastructures, plants and systems;
- robotics and space: deals with projects regarding the development of robotic technologies and components relating to control, supervision and tele-manipulation systems, both in the marine and space environments.

Tecnomare is actively committed to a Health, Safety and Environment policy assuring safety to people and environment in all its activities and operates within a Quality System conforming to ISO 9001 and BS 5750 which has been certified by Det Norske Veritas. Tecnomare offices are in Venice and Milan. There are also branch offices in Matera, Cairo (Egypt) and Aksai (Kazakhstan) and subsidiaries in London (Tecnomare UK) and Pisa (STI). For fabrication and testing operations, Tecnomare has a workshop in Venice Scientific and Technological Park, equipped with laboratories, assembly/system integration areas and storage areas.

Tecnomare employs about 250 people, more than 85% of them being graduate. These people, trained and experienced in a broad range of technical and scientific disciplines, are capable of working in a wide variety of International projects. This has allowed, during Tecnomare 30 years of life, the development of a large number of research project, most of them obtaining financial support either from national initiatives or from different EC Framework Programmes for RTD activities. On this regard, Tecnomare was and is presently involved in some of the most important initiatives related to the development and demonstration of innovative technologies for long-term deep-sea monitoring and observation.

In particular, Tecnomare is in the forefront of the technical development of seafloor observatories. In 2003 carried out a technical and economical feasibility study for an Abyssal Benthic Laboratory,
awarded by the DG-XIII in the framework of MAST-2 programme. The study assessed feasibility of a network of co-operating stations capable of operating both under controlled and autonomous mode for periods of several months to over one year at depths up to 6000 m. Following this study, the company was involved as responsible for the design and development of GEOSTAR, the first European deep-sea multidisciplinary benthic observatory (EU projects GEOSTAR 1 1995-98 and GEOSTAR 2 1999-2001); ORION, the first network of seafloor observatories (EU ORION project 2002-2005); SN-1 the first European cables seafloor observatory and first node of the Italian seafloor seismological network (GNDT project 2001-2003 and subsequent upgrade in 2004-2005); MABEL, the first seafloor observatory for Antarctica (2002-2005).

Other significant participations in EU-sponsored projects: BIODEEP, MFSTEP.

In ESONET NoE Tecnomare will provide qualified offshore engineering competences and experiences to the various tasks of the project. Number of persons involved in ESONET activities: 8.

**Key participant:**

*Francesco Gasparoni*

Position: Project Manager in the Robotics and Subsea Division of Tecnomare (Venice, Italy)

Reference discipline: University Degree in Electronic Engineering (Padova) in 1981.

Experience in national, European or international activities: F. Gasparoni joined Tecnomare in 1982 and since then, he has been involved with growing degree of responsibility in the design and development of automated systems for marine applications. In this field he had the responsibility for the design, development, test and commissioning of complex meteo-oceanographic and structural data acquisition systems for oil and gas platforms. Between 1989 and 1991 he worked in Roma (ENEA-Casaccia) as Tecnomare representative for the Italian Antarctic Research Programme. At European level, he has been responsible for the technical and economical feasibility study of an innovative concept of Abyssal Benthic Laboratory, awarded by EC DG-XII in the framework of MAST-2 programme. Local Project Manager for Tecnomare in the EU projects GEOSTAR, GEOSTAR 2, BIODEEP, MFSTEP, ORION, ESONET. At national level he has been responsible for the development of innovative seafloor observatories in the framework of national projects GNDT and MABEL (phase 1 and 2). Participation to more than 10 scientific cruises onboard research (R/V Urania) and cable lay (P/C Pertinacia) vessels; several weeks of work at sea onboard Offshore Support Vessels and oil&gas platforms in Mediterranean Sea and North Sea. Author or co-author of more than 50 papers.

**Participant n° 16 NERC - NOCS United Kingdom**

The Southampton Oceanography Centre (SOC) is one of Europe’s leading centres for oceanographic science. It is a joint venture between the Natural Environment Research Council and the University of Southampton. It has some 450 research scientists, lecturing and support staff as well as 480 undergraduate and postgraduate students. The scientific mission of SOC is to understand the functioning of the earth and its oceans as a physical, biological, geological and chemical system on a global scale. SOC is made up of the University’s School of Ocean and Earth Science and 4 NERC Research Divisions working closely together and providing a unique blend of teaching and research opportunities. The NERC Divisions are organised in multidisciplinary groups with expertise in observation, modelling and technical development. There is a strong information technology support. SOC is home to Research Vessel Services which manages and operates NERC’s fleet of research ships.
Key participants:

Dr. Christian Berndt was a research associate with the University of Tromsoe. He has published in the fields of rifted margin tectonics, break-up volcanism, natural gas hydrates, slope stability, seismic processing, and potential field studies. He is involved in EC-funded projects. He worked on the relationship between natural gas hydrates and continental slope stability. Within the COSTA project he took a lead role in the development of the long-term seismicity and pore-pressure observatory. Presently, he is senior geophysicist, challenger Division for Seafloor Processes at National Oceanographic Centre, involved in different research programmes: Seafloor Processes, Dynamics, Variability and Disturbance; fluid flow,…

Dr Richard Lampitt
A marine scientist of 30 years experience with particular interest in the downward flux of material and factors that affect this flux. This focuses particularly on the biogeochemical changes in the upper water column and as such has been a key member of the ANIMATE consortium. This has established an array of three multidisciplinary upper ocean observatories in the Northeast Atlantic (CIS, PAP and ESTOC). He is responsible for the PAP observatory which also has a major benthic component and which is now widely recognized as a major international site.

He has been a member of several national and international scientific steering committees and working groups including chairman of the JGOFS North Atlantic planning group for three years. His publications which include over 30 peer reviewed papers reflect a wide range of interests. He has been involved with six previous EU funded projects.

Participant n° 17  HCMR  Greece
The Hellenic Centre for Marine Research (HCMR) is the major national research centre responsible for carrying out oceanographic research for the Ministry of Development. HCMR comprises five institutes with 180 research staff, 200 technicians and 60 administrative and secretarial staff. The Centre is fully equipped with state of art laboratory and field equipment, and has participated in more than 40 EU-funded RTD projects. It is currently running 2 large scale aquaria which can be used as ideal public outreach standpoints. HCMR has major field research facilities and equipment, including 2 multipurpose research vessels (AEGAE and PHILIA), a manned submersible (THETIS), 3 ROV's and a wide range of water column and seabed monitoring and surveying instrumentation. These resources are supported by well-equipped laboratories, analytical facilities and trained staff.

The Institute of Oceanography of HCMR has extensive research facilities in Anavissos as well as in the islands of Crete and Rhodos. It is by far the largest Institute within HCMR and is capable of undertaking a variety of oceanographic tasks mainly within the Mediterranean basin.

Key participants:

Dr. Anastasios Tselepides
Position:  Research Director.
Interests:  Deep-sea research, pelagic-benthic coupling mechanisms, determination and quantification of the various modes of energy flux to the benthic communities in the oligotrophic E. Mediterranean Sea, benthic response to organic falls, benthic community structure and energetic requirements, productivity of marine ecosystems, structure and function of oligotrophic ecosystems, development of deep-sea benthic platforms

Experience:  Co-ordinator of CINCS. Co-ordinator of the E. Mediterranean biology WP’s in MATER and PI in numerous EU projects (CINCS, SEEPS, ALIPOR, MATER, CYCLOPS, DESEAS, BIODEEP, INTERPOL, ADIOS, ANREC, ESONET, HERMES). 50 papers and 90 scientific publications.
**Dr. Vasilis Lykousis**

**Position:** Research director.

**Interests:** Downslope sedimentological processes, biogeochemical cycles, slope stability, sediment mass gravity processes, quaternary sediment sequences and sedimentary facies.

**Experience:** Co-ordinator of INTERPOL (EVK3–CT-2000-00526) project. Former co-ordinator of the E. Mediterranean WP of the MTP-II-MATER (MAS3-PL 950401). PI in CINCS, ASSEM (EVK3-2001-00038), EURODELTA (EVK3-2001-00023), ANAXIMANDER (EVK3-2001-00123) EURODOM (RTN) EU projects. Co-ordinator of EU large-scale offshore facilities projects i.e. submersible THETIS. 140 scientific publications.

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**Participant n° 18**

**FORTH/IACM**

**Greece**

The Institute of Applied and Computational Mathematics (IACM) of FORTH was founded in 1985. Its mission is to conduct basic and applied research in the general area of Applied and Computational Mathematics. It has good computing facilities and a wide range of research activities, a large part of which is funded by competitive research grants. Through its research programs the Institute has developed many collaborative projects and relations with other research groups in Universities, Research Centers and Organizations in Greece and abroad. The successful research activity of IACM is documented by the quality and number of research publications of its members, by the number of international scientific meetings and conferences they have organized, and the excellent results of its two past evaluations by the General Secretariat of Research and Technology. The Wave Propagation Group of the Institute will be involved in the ESONET project.

The original scope of the group was the study of underwater acoustics, and its applications to oceanography and geophysics. Activity areas in this respect include forward propagation modelling and inverse problems, in particular, ocean acoustic tomography, sea-bed reconstruction, and inverse scattering.

In 2000 a hydroacoustic measurement facility was established at IACM which enables the conduction of scaled propagation experiments, the calibration of acoustic transducers, and the performance of acoustic field measurements in the audible and ultrasound regime.

The range of objectives of the group has expanded over the years. Today, besides underwater acoustics, it includes the theory of elastic wave propagation, water waves, and the theoretical and numerical study of non-linear wave phenomena in fluid dynamics, kinetic theory of gases and models from material science.

The group has participated in many European and National Projects on Underwater Acoustics and Acoustical Oceanography. In particular it has contributed in the design of large scale experiments for the validation of the ocean acoustic tomography as a tool for Ocean observation, involving the development of ocean observatories in the Western Mediterranean Basin and in the analysis of the data acoustical data for ocean observation purposes from various sites in the globe. Also, the group has long experience in the development of acoustical methods for bottom classification.

In addition the group offers training services to students and young scientists working in the field of Wave Propagation and Underwater Acoustics.
Key participant:

Michael Taroudakis is Associate Professor at the Department of Mathematics of the University of Crete and member of the research staff of the Institute of Applied and Computational Mathematics of the Foundation for Research and Technology-HELLAS. He obtained his PhD in Underwater Acoustics from the Technical University of Athens in 1988.

His main research areas include Acoustical Oceanography, Underwater Acoustics, Bioacoustics, Sound and Vibration Control, and Wave Propagation.

He has taught in the Technical University of Athens and the University of Crete numerous undergraduate and graduate lectures in various topics of Computational Mathematics and Mathematical Modelling.

He has co-ordinated several European and National research projects dealing with Acoustical Oceanography (mainly related to Ocean Observation Methods using Acoustics) and Underwater Acoustics (acoustic propagation). He has also participated as Scientific Responsible or Principal Scientist in many other projects on subjects related to his research fields.

He has organized several International Conferences, Workshops or Special Sessions related to Underwater Acoustics and Acoustical Oceanography.

He is Editor of the Journal of Computational Acoustics and Associate Editor of the ACTA ACUSTICA united with ACUSTICA.

He is a Fellow of the Acoustical Society of America and General Secretary of the Hellenic Institute of Acoustics.

Participant n° 19 Royal NIOZ Netherlands

The Royal Netherlands Institute for Sea Research (Royal NIOZ) is an independent research institute primarily funded by the Netherlands Organisation for Scientific Research (NWO). NIOZ is one of the major European oceanographic institutes, directed towards execution of fundamental and applied multidisciplinary and integrated marine research. Its research covers coastal and shelf seas as well as the continental margin and open ocean and involves close multidisciplinary studies in collaboration between physicists, chemists, geologists and biologists.

The institute also contains a highly qualified division of marine engineering and construction, and has extensive technical support services which, in combination with the scientists develop and construct novel and advanced high quality sea-going equipment. Especially in the field of long term benthic lander design and employment NIOZ has an excellent reputation. NIOZ aspires to perform top level curiosity driven and society inspired research of marine systems that integrates the natural sciences of relevance to oceanography. NIOZ supports high-quality marine research and education at universities by initiating and facilitating multidisciplinary and sea-going research embedded in national and international programmes. Over the last decade NIOZ has been coordinator or sub-coordinator of a considerable number of international (EU/ESF, IGBP, WCRP) and national (NWO) funded projects, in addition to being partner in a large number of EU funded projects.

At present NIOZ employs 230 staff, 145 of them in permanent positions. It has close contacts with universities and other marine institutes, and participates in the training of young scientists in physical and chemical oceanography, marine geology and geochemistry, biology and biogeochemistry, ecotoxicology and marine biodiversity.
NIOZ has performed marine research for well over a hundred years, both at sea and in the lab. It operates its own research vessels, of which RV "Pelagia" (66m long), recently equipped with multibeam facilities (2006), has been instrumental in a number of major international and European, large scale sea-going research projects and will be made available for application within the ESONET project.

NIOZ, as the National Institute of Oceanography in the Netherlands maintains close links to Dutch universities, for an important part by participation in the Research Schools for Sedimentary Geology (NSG), Functional Ecology (FE), Environmental Chemistry and Toxicology, Biodiversity, and Atmospheric and Oceanographic Sciences (SAMOS).

**Key participant:**

**Prof. Dr. T.J.C.E. van Weering**

Dr van Weering is an experienced marine geologist. His main interests focus on Continental Margin Sediments, Sedimentary Processes and Sedimentation. A second field of interest is the presence, role and forcing of gas in marine sediments, gas hydrates, formation of mud volcanoes, and cold water carbonate mounds. In addition there is a strong interest in (Paleo)-oceanographic variability and climatic change. He is liaised with the Jacobs University Bremen as adjunct-Professor Marine Geosciences and is Professor in Paleo-Oceanography at the Free University of Amsterdam, the Netherlands.

Dr. Van Weering has been and is involved in organisation and execution of seagoing scientific research programs, as well as in participation in industry related, applied scientific projects. He was assistant-coordinator of the Indonesian –Dutch Snellius II Theme "Geology and Gephysics of the Banda Arc" and also participated in the Dutch/Indonesian coastal studies program “Teluk Banten” as well as in the Dutch/Vietnamese “Red River Delta and Coastal Zone” project. He is also a member of the joint Netherlands /Indonesian WOTRO/KNAW commission for the East Kalimantan Coastal Zone Research program.

Over the last decade he has been project coordinator and member of the steering committee of the (EUfunded) OMEX(Ocean margin Exchange) I and II (93-2000) Benthic Studies project, which aimed at establishing a carbon budget for the European continental margin and at definition of the carbon exchange between the coastal seas and the open ocean. He further participated in and was member of the Steering Committee of the EU funded ENAM I (93-96) (Eastern North Atlantic margin Sedimentary processes), ENAM II (96-99) and STRATAGEM projects and developed benthic landers for long term deployment in the early nineties. As such, he was involved in the EU ALIPOR I project to further develop seabed observatories for long term deployments and is currently involved in the EU-programme ESONET which aims at creating on-line networks of seabed observatories for (environmental) monitoring in areas of seabed exploitation. Seabed observatories have been and will be applied and adapted in the future (especially in the framework of continental margin studies) towards studies of fluid flow and variability of benthic boundary layer conditions.

His group participated and participates in a number of EU ( Stratagem, Geomound, ECOMound, ACES, EU-STRATAFORM) and other international, projects, such as HERMES (Hotspot Ecosystem Research on Margins of European Seas. Within Hermes and also in ACES and ECOMOUND a series of long term (one year) deployments of seabed observatories were done. This program deals with changes in margin ecosystems in response to global and ocean changes and to define the driving forces of the changes encountered. He has been and is involved in seabed data interpretation projects jointly with industry and is member of the editorial board of four international journals.
Dr. G. Duineveld is an experienced marine biologist with an outstanding career in benthic system studies. He participated in EU programs such as Mater, OMEX I and II, ACES and presently is involved in HERMES. He was at the start of the development of benthic landers for benthic sampling and time series observations of oxygen consumption and fluorescence measurements and his group was involved in the program ALIPOR for benthic laboratories. His group contains the widest expertise in deep sea marine benthic biology of the Netherlands.

Dr. E. Epping is a microbiologist with a strong interest in exchange processes at the sediment-water interface and in the application and development of sensors to measure exchange coefficients and related parameters. He has been a fellow at the MPI in Bremen, and was instrumental in developing and realisation of the Benthic Mobile Vehicle for long term deployment MOVE! (cooperation project between Jacobs University Bremen and Royal NIOZ) which will be made available for application in the ESONET project. He further was involved in the ALIPOR project and has made numerous deployments with the benthic lander TROL for measurement of oxygen consumption and geochemical parameters above and directly beneath the seabed. He is involved in instrumental designs and sensor development at Royal NIOZ and participated in the OMEX I and II benthic studies project.

Ing B. Koster is head of the division of electronic engineering at NIOZ and has a long term history of instrument development and design, especially in benthic landers and related fields. His group is an expert group in construction of seagoing equipment as well as in software development to enable instrument manipulation and handling in long term deployed benthic observatories.

Ing M. Laan is software engineer and data handling electronician, working in close cooperation with B. Koster in the design, development, testing and realisation of benthic observatories and related equipment.

Participant n° 20 IMI Ireland

The Marine Institute is Ireland's national agency whose role is twofold:
1 - To support existing marine businesses and related activities through the provision of key scientific services and advice and through the results of research to provide for wise management decisions to guide the on-going sustainable development of the marine resource.
2 - To support RTDI (research, technology, development and innovation) activity to create further employment and to underpin future innovation, growth and wealth creation in the marine area.

The Marine Institute, established under statute in 1992 has grown rapidly in the intervening period. In 2002, the Institute has a staff of 140 people, located in 11 facilities around the country.

The Ocean Science Services team within the Marine Institute will act as coordinator for the ESONIM project. The team brings diverse expertise to the consortium being charged with responsibility for major Irish marine infrastructure (including Ireland’s two research vessels), the Irish national seabed survey (jointly with Geological Survey of Ireland), the marine equipment pool and real-time operational networks of marine weather buoys and coastal tide gauge stations. Ocean Science Services bring both a data producer and end-user perspective to the project and provides the overall management for the project. Input will also be forthcoming from the Strategic Planning and Development Services Group who have managed major national IT infrastructure projects and marine technology funding programmes. Members of the co-ordination team have significant experience of managing large projects with multiple partners. Michael Gillooly and Glenn Nolan who have considerable combined experience will act the co-ordinator contacts.
Key participants:

**Michael Gillooly** (BSc, MSc) currently Director of Ocean Science Services in the Marine Institute, Michael has extensive management experience in major marine infrastructures having personally overseen the build of both the RV Celtic Voyager (1997) and the RV Celtic Explorer (2002) on behalf of the Marine Institute. Michael also has some management responsibility for the Irish National Seabed Survey (now renamed INFOMAR).

**Caroline Hepburn (ACCA Certified Accountant):** Caroline is currently director of corporate services at the Marine Institute having previously held senior management positions in the private sector and will bring considerable financial management and planning expertise to the coordinating role.

**Glenn Nolan** (B.A., M.Sc., and Ph.D.) manages the oceanographic services programme for the Marine Institute having responsibility for the day-to-day running of the Irish weather buoy network of five operational platforms around the Irish coast and the Irish Tide gauge network currently being developed. Glenn also has responsibility for ocean modelling, remote sensing and provision of oceanographic data from vessels and other platforms to marine data end users.

**Fiona Fitzpatrick** (Ph.D.) manages the Advanced Mapping Services Section within the Ocean Science Services Group and is responsible for managing the operational aspects of seabed mapping programmes including INFOMAR and associated ancillary activities.

**Participant nº 21 UAç Portugal**

The UAÇ/DOP (Department of Oceanography and Fisheries from the University of the Azores) is an interdisciplinary department, involved in marine science research. Main research programs deal with the description, experiment and modelling of oceanic ecosystems, within the areas of Ecology, Marine Biology, Physical and Chemical Oceanography, and Fisheries. There are 11 permanent PhD members of staff, 1 emeritus researcher, 10 post-docs, and 9 registered PhD students. 3 higher technicians, 21 non-permanent research assistants, a total of 44 people. **FACILITIES:** The main analytical facilities of UAÇ/DOP/DOP are the EC-LabHorta aquaria and laboratory. LabHorta is a laboratory to conduct experiments with organisms of deep-sea hydrothermal vents (namely molluscs), which are kept under controlled conditions. It was created to support and expand the capacity of research cruises and the experimental studies of the biology, physiology and behaviour of deep-sea hydrothermal vent fauna and taxa from other deep-sea environments. The Genetics and Histology Laboratory and the Ecotoxicology Laboratory are part of the LabHorta facility. The main equipments in the Genetics and Histology Laboratory include refrigerated ultra-centrifuge, ultra-freezer, PCR mini-cycler and other protein and DNA electrophoresis equipment. The Ecotoxicology Laboratory is equipped with a HPLC, molecular absorption spectrophotometer, atomic absorption spectrophotometer, spectrofluorometer and diverse auxiliary equipment (e.g. precision balances, conductimeters). UAÇ/DOP also includes the Oceanographic instrumentation and Calibration Laboratory, dedicated to insure the operationality and precision of several types of oceanographic equipment. It maintains current meters, acoustic releases, temperature recorder and thermistor chains, sub-surface floats, CTDs, OPCs, Multiple Water Sampler (Rosette), Fluorometers, ADCP, APT Weather Satellite System, SEASOAR. **INFRASTRUCTURES:** The Infrastructures include the R/V “Arquipélago” – a 25 meters research vessel prepared to operate in all Macaronesian islands, the R/L “Águas-Vivas” – an 11 meters research launch prepared to operate within Azores archipelago. **DATABASES:** ImagDOP- conducts development, management, promotion and distribution of imagery within the DOP/UAç and with cooperating entities. Imagery data is either gathered among contributors and/or directly collected by DOP/UAç staff. ImagDOP has a total of sixty hours of underwater films, 10 thousand slides and scientific illustrations of all
marine species known in the Azores. Seven thousand of these slides were obtained underwater, while the remaining three thousand were taken above water and in near shore regions. This database probably constitutes the largest marine slide collection available for the Azores.

**Key participants:**

**Ricardo Serrão Santos**, Doctor in Biology and Animal Ecology is Principal Investigator at the University of the Azores, Director of the Department of Oceanography and Fisheries and Vice-Chair of IMAR-Institute of Marine Research. RSS is dedicated to the study of marine biodiversity and ocean ecosystems, with more than 200 hundred published works of which around 60 papers in scientific refereed journals and books. RSS is member of several international Steering Committees among which the MarBEF (European Network of Excellence on Marine Biodiversity), and two Census of Marine Life programs: MAR-ECO and ChESS. RSS is member of the Scientific Council for Marine Sciences and Environment (MCTES/FCT-Portugal), Portuguese Delegate at the Committee of Research Infrastructures at the European Commission. RSS is also member of ICES WGMHM, co-chair of the WG Monitoring and Observatories of InterRidge and co-chair of the WG on Deep Sea Research (COI-Lisbon). He is member of the Intersectorial Oceanographic Commission (Lisbon). He is co-ordinator and/or partner of several national, European and international scientific projects (e.g. MARMAC, OGAMP, MARE, MAREFISH, FISIOVENT, CETAMARH, ASIMOV, VENTOX, OASIS, MoMARNET, MarBEF, EMPAFISH, etc). Actual main interests and activities include marine conservation of habitats and biodiversity of both shallow and deep-sea ecosystems of the Azores Triple Junction and MAR, implementation of MPAs and experimental evaluation of their benefits, but also experimental studies of deepsea organism under controlled conditions at LabHorta.

**Ana Colaço** (PhD) is a marine biologist, research fellow at the UAZ/DOP- Centro da Universidade dos Açores. During his carrier, she has been involved in several R & D projects, all related to the deep-sea environment. She first worked on the trophic ecology of deep-sea fishes. Since 1997 she is focused on ecology of deep-sea hydrothermal ecosystems. She is part of the MoMAR steering committee. She is expert on trophic ecology. She has a long experience in international cooperation both at the European level (MAST III, FP5; FP6 and bilateral cooperations.)

**Participant nº 22 UALG Portugal**

CIMA centre was created in 1998 and integrates scientists from the Marine and Environmental Sciences Faculty of the University of Algarve. Its activity embraces advanced training at MSc and Ph.D levels, development of research projects and supplying analytical and consulting services to the community. The scientific rationale of the Centre is organised into 5 thematic groups (TG). The intrinsic multidisciplinary of the staff allows the cross-fertilisation and exchange of complementary methodologies to be the basic assumption of the functioning of the unit. The long-term commitment of the University of Algarve to promote high level teaching and research in marine & environmental science led to the formation of CIMA. The fundamental idea behind the foundation of this R&D unit was to integrate researchers from various fields of pure and applied science with two common denominators: the environment and the sea;

- TG1. Sedimentary Dynamics;
- TG2. Biogeochemical Cycles, Natural and Anthropogenic Alterations of the Environment;
- TG3. Structure of the Earth’s Crust;
- TG4. Dynamics and Energy Transfers in the Ocean;
- TG5. Technologies in Environmental Rehabilitation;
Key participant:

Joaquim Manuel Freire Luis
Professor at the University of Algarve
Geophysicist PhD in Geophysics
J F Luis is a geophysicist, Professor at the University of Algarve and member of the Marine and Environmental Research Center of the Portuguese Science and Technological Foundation. During his carrier, he worked on potential field data analysis and code development. Since 1992 he has focused his activity in the past and present day cinematic of the North Atlantic, isostasy studies of the Azores Plateau, hydrophone seismicity of the MAR north of Azores and tsunami modelling including programming.

Participant n° 23

FFCUL
Portugal

The CGUL is the leading geophysical research center in Portugal, having participated in a significant number of projects financed by EU, like IAM and STREAMERS in the program JOULE, DETWS, GITEC and GITEC-TWO, in the ENVIRONMENT program or MARFLUX/ATJ and ISO-3D in the MASTII/III. Among recent EU initiatives with direct involvement of CGUL we must emphasize ESONET, a project devoted to the establishment of a network of deep sea observatories around the European seas, ESF initiatives like SWIM, MOMARNET, and the new NERIES and GO projects, where Marine Geophysics is the central topic addressed by CGUL.

CGUL has got 20 permanent researchers and about 25 research students in Geophysics and Meteorology.

Key participants:

Jorge Miguel Alberto de Miranda
Associate Professor of the University of Lisbon
Nationality: Portuguese; Work address: CGUL, Campo Grande, Edificio C8, 6º, 1700 Lisboa
Academic Qualifications: Ph.D. – 1991, University of Lisbon
Participation in EU project: Marflux/ATJ (Mast II); ISO 3D (Mast III. Technology); IAM (Joule).
Member of the steering committee of Interridge.

Luis Miguel Henriques Marques Matias
Professor at the University of Lisbon
Researcher of CGUL-IDL
Seismologist PhD and Aggregation in Physics/Geophysics
L M Matias is a seismologist, Professor at the University of Lisbon. During his carrier he devoted himself to the study of marine geophysics, combining reflection and refraction data. Since 1998 he is been focusing his activity in the SW Iberian margins, where he developed in cooperation with Italian, French and Spanish groups the systematic research of the main seismogenic and tsunamigenic sources combining geophysical and geological information. He coordinated a significant number of national and European funded research projects in the areas of seismology and seismic risk.

Participant n° 24

CSIC
Spain

CSIC – Member n° A - The National Council for Scientific Research (CSIC) is a public organization of research established in all the autonomous communities over de country. The main task of the CSIC is formulates national science and technology policy, supporting and conducting scientific research programmes and activities in Spain. It advises the Government on all science and technology issues, through the state secretary of Science & Technology. The CSIC conducts research through its specialised centres which totalized 123 research centres directly administrated and another 84 associated with different national institutions having an impact on the socio-economic development of the country. In the field the proposal enters, which is the Natural Resources, the CSIC has 17 Institutes that mobilizes more than 1800 people between researchers, and administrative employees. The UTM from Barcelona carries out activities on the logistic,
operating oceanographic vessels and polar stations, and research & technological development in marine science. The **ICM** from Barcelona contributes to marine science research in the domain of physical oceanography, marine geology and biology. The **ICMAN** from Cádiz contributes to the knowledge of the local oceanography in the areas of southern Spain, which includes activities related to the environmental and living resources management in this region, using remote sensing techniques, *in situ* measurements through oceanographic cruises and mooring facilities.

**Key participants:**


**Eulàlia Gràcia.** Geologist (PhD). Scientist of the Spanish National Research Council (CSIC) working in the Marine Technology Unit in Barcelona (Spain). She has 15 years of experience in marine acoustics (swath bathymetry, sidescan sonar) and seismic reflection applied to neotectonics in oceanic and margin environments including: processes of oceanic crust genesis, continental margin deformation and control on geomorphology and geological hazards (earthquakes, tsunamis, submarine landslides), and marine paleoseismology. Principal Investigator of the European and National projects HITS, IMPULS, ESF EuroMargins SWIM in the South Iberian Margins (Gulf of Cadiz and Alboran Sea). She has also participated in ODP (Ocean Drilling Program) drilling gas hydrates at Hydrate Ridge (Cascadia Margin).

**CSIC – Member n° B – UPC - The Technical University of Catalonia (UPC: Vilanova Working Group)** is one of the most important universities in Spain, with clear leadership in transfer of technology to academic, research and innovation industries and centres.

**Oceanographic Instrumentation**

The new Technology Transfer Centre in Vilanova, supported by the University, provides the group with some freedom to decide on its activities, and this will improve the oceanographic instrumentation research: UTM & ICM. Among common projects, the development of a new release of 10 OBSs (Ocean Bottom Seismometers) should be included.
Key participants:

Michel André - Professor at the Technical University of Catalonia (UPC) Director of the Laboratory of Applied Bioacoustics (LAB)
Michel André is an Engineer in Biotechnologies graduated from the Institut National des Sciences Appliquées, INSA, Toulouse, France; He holds a Master degree in Biochemistry and Animal Physiology from the Université Paul Sabatier de Toulouse, France; His PhD Dissertation that he defended at the Universidad de Las Palmas de Gran Canaria was on sperm whale acoustics and noise pollution. He was a research assistant at the San Francisco State University, California, an intern scientist at The Marine Mammal Centre, California and an associate professor at the Universidad de Las Palmas de Gran Canaria, España. His research involves the development of acoustic technologies for the control of noise pollution in the marine environment; the study of the biological and pathological impact of noise pollution on cetacean acoustic pathways; the mathematical, physical, morpho- and electro-fisiological mechanisms of the cetacean bio-sonar as well as the extraction of the information from their acoustic signals.

Antoni Mànuel-Làzaro Ph.D. in Telecommunication engineering from Technical University of Catalonia (1996). Since 1988, he has been an Associate Professor in the Department of Electronic Engineering at the Catalonia Technical University. Director of the research group “Remote acquisition systems and data processing (SARTI)” of the Technical University of Catalonia made of 9 researchers, within the Technological Innovation Centre network of Catalonia government (march 2001), and he is the Coordinator of the Tecnoterra associated unit of the Scientific Research Council through Institute Marine Science Institute and Marine Technology Unit. His current research interests are in applications of automatic measurement systems based on the concept of virtual instrumentation and oceanic environment. He is the author and co-author of several papers in international journals, two patents, six books in instrumentation and numerous communications in international congresses, in the area of electronic instrumentation and power electronics. Now he is involved in more than ten projects with the industry and seven funded public research projects. He is a member of the following societies: IEEE Oceanic Engineering Society; IEEE Signal Processing Society; IEEE Instrumentation and Measurement Society; IEEE Education Society; IEEE Power Electronics Society; IEEE Computer Society; IEEE Communications Society.

Participant n° 25  UIT  Norway
The University of Tromsoe comprises 6 faculties, 39 departments and 4 research centres. It has 1600 employees of which half are scientists. The population of students is ca. 7000 of whom 15 % are foreign students. Marine Geology and Geophysics comprise the activities of the Department of Exogene Geology that has a core group of four faculty members (Prof. Juergen Mienert, Prof. Tore Vorren (faculty dean), Prof. Morten Hald, and Assoc. Prof. Karin Andreassen). Three other faculty members and several doctoral and postdoctoral students are participating in marine geological and geophysical research at the Department. The marine geology and geophysics group has broad experience, covering complementary fields in geohazards, gas hydrate research, applied geophysics, and paleoceanography. The work of the group is related to the development of ocean margins in the north, where easy access and possession of an ice-breaking research vessel (RV Jan Mayen)) give us a considerable advantage, nationally and internationally. The University’s research vessels and high quality seismic equipment and coring equipment as well as front-line industry processing software (Landmark ProMAX) and 3-D interpretation software (GeoQuest Charisma) represent a substantial resource. The group collaborates with colleagues from national and international institutions on cruises and research projects, and hosts scientists from other countries on our own cruises. The continental margin research of this group has lead to appreciable international co-operation with the
International Ocean Drilling Programme, research centres all over Europe, and with the hydrocarbon industry. State-of-the-art seismic data, processing software and high-speed workstations have been made available to us by the industry.

**Key participant:**

**Juergen Mienert**, professor in marine geology and applied geophysics at the Department of Geology at the University of Tromso, Norway, is the coordinator of the Ocean Margin Research Consortium (OMARC) funded by the European Union, and the EUROMARGIN program under EUROCORES of the European Science Foundation. He is co-leader of the UNESCO IGCP511 project submarine mass movements and their consequences. His main interests are the response of passive continental margin gas hydrate systems to climate change, submarine slides, and geodynamics based on high resolution 3D, 2D and ocean bottom seismic research. He has participated in many international collaborative projects with European and American institutions and was coordinator of: 1. European North Atlantic Margins (ENAM I and II) sedimentary processes; 2. Continental slope stability (COSTA), and he participated as leader in more than 10 projects such as the US/EU Strataform, the European Sea Floor Observatory Network (ESONET) and Hot Spot Ecosystems of European Seas (HERMES). He was leading gas hydrate assessments in one of the largest deep-water gas fields “ORMEN LANGE”. The project was an integrated study for safe field development in the Storegga submarine slide area at the mid Norwegian margin. These projects involved large parts of the European research fleet, and multidisciplinary marine surveys for geohazard assessments.

**Participant n° 26 NGI Norway**

NGI, is a Norwegian private foundation performing research and services in geotechnics. NGI is providing services to the oil industry companies and advice to the Norwegian authorities in charge of public safety.

NGI has a strong experience in instrumentation design qualification and operation. It is the reason why it will lead WP2. This experience includes land slide hazard monitoring in mountains, distance measurement in offshore contracting (task 2.2) and pore pressure geotechnical survey instrumentation (task 2.1). NGI is collecting data for Norsk-Hydro and Statoil in an attempt to monitor a seabed slope, the data is up to now retrieved during ship cruises.

NGI is involved in the geotechnic assessment of the Ormen Lange field situated in the area of the Storegga Slide. It is a major area for risk evaluation in the European margins and will be the place for the WP4 experiment with NGI as a leader. NGI brings its scientific expertise, its experience in reliable instruments compatible with the offshore industry rules and its commitments with local authorities in Norway (WP6).

**Participant n° 27 NERSC Norway**

Nansen Environmental and Remote Sensing Center (NERSC) is an independent non-profit research institute affiliated with the University of Bergen, Norway. The Nansen Center conducts basic and applied environmental research funded by national and international governmental agencies, research councils and industry.

NERSC’s vision is to make a significant contribution to the understanding, monitoring and forecasting of the world’s environment and climate on regional and global scales. This is done through coordination and participation in national and international research programs focusing on:

- Studies of global and regional climate processes using numerical models together with observations from earth-monitoring satellites and field experiments.
. Modelling of the global and regional marine ecosystem and carbon cycle combined with use of satellite ocean color observations.

. Studies of ocean disposal of the greenhouse gas CO2 as an option for reducing the rapid increase in atmospheric CO2 concentration.

. Studies of coastal zone processes and ecosystem dynamics by integrated use of high resolution ocean circulation models and observations through advanced data assimilation systems.

. Studies of sea ice processes using coupled numerical models and observations from satellite.

. Operational monitoring and forecasting of the coastal zone as a tool for management and risk assessment.

. Operational monitoring and forecasting of ice conditions as a service to offshore industry, ship traffic and fishing industry.

**NERSC's research strategy** is to integrate the use of remote sensing and field observations with numerical modelling through the use of advanced data assimilation techniques. The center teaches university courses and hosts graduate students and postdoctoral fellows from several nations. In 2002 the Nansen Group hosts 10 PhD candidates in Bergen and 15 PhD candidates in St. Petersburg. Cooperation in research and education are established with several universities world-wide.

NERSC will contribute to ESONET by the expertise and research activities related to acoustic tomography and physical oceanography, in particular in the Arctic Ocean and other high latitudes seas. NERSC has resources such as oceanographical data, modelling and data assimilation systems which will be included in ESONET. NERSC will build and deploy an acoustic tomography array in the Fram Strait area as part of the DAMOCLES IP project in the period 2006 – 2009. This acoustic tomography experiment will be conducted in cooperation with an industry partner in Norway (NAXYS) and IACM FORTH in Greece.

**Key participants:**

**Stein Sandven** (born 1952) is physical oceanographer with Cand real degree from University of Bergen 1979. His position is research director at Nansen Environmental and Remote Sensing Center and Professor II at UNIS in satellite remote sensing.

In the last 25 years he has been leader and participant in several national and international research and application studies, remote sensing application development projects, and operational ice/ocean monitoring projects. Main field of expertise: Marine and polar remote sensing, polar oceanography, sea ice research with emphasis on remote sensing methodology. Coordinator of many projects funded by EU, ESA, Norwegian Space center, Norwegian Research Council and industry. Lecturer in university courses and special training courses. Supervisor for M. Sc. and Ph. D. students. Published more than 50 papers in international refereed journal and books. Supervisor for 3 completed Ph D/Dr. and 5 Cand. Sc. Candidates.

**Dr. Hanne Sagen** (born 1961), Ph D in applied Mathematics from the Department of Mathematics, University of Bergen, Norway in 1987. Current position is PhD Researcher, Nansen Environmental Remote Sensing Center, Thormehlensgate 47, 5006 Bergen. She is specialised in underwater acoustics including ambient noise and acoustic propagation in the Arctic regions. Expertise in acoustic modelling, data analysis, data assimilation systems, ice coupled surface wave propagation into the Arctic, polar science, remote sensing and under water technologies. Participated in acoustic field experiments in sub-Arctic regions.
Environmental hydroacoustics laboratory, Université libre de Bruxelles (ULB-EHL) is presently being supported by a number of international and national research programmes including a 4-year integrated project of the 6th EU RTD framework programme (contract no. 505428-GOCE). The lab is specialized in the characterization of hydrosystems by acoustic means, covering a wide range of applications such as assessment of a shallow water environment using sparse arrays of acoustic-oceanographic sensors (water column and sediment), study of sediment dynamics in an estuary, monitoring of photosynthesis in a sea grass bed, very-high resolution sub bottom profiling, etc. EHL staff and collaborators include specializations in physics, geophysics, marine biology, signal processing and applied mathematics. The lab designs experimental techniques and hardware for in-situ acoustic remote sensing of ocean to very shallow freshwater environments, and develops software for data inversion and assimilation based on metaheuristics and variational approaches.

Key participant:
Jean-Pierre Hermand is a physicist specialized in underwater acoustics and inverse problems, professor at the University of Brussels (ULB), and head of the Environmental hydroacoustics lab, Optics and acoustics dept. His main research interests lie in the integrated use of acoustics to remotely sense and characterise ocean and shallow marine or freshwater environments. He has a long experience in international collaboration and multidisciplinary research and has been the scientist-in-charge of many cruises in the Mediterranean. As principal scientist with the Environmental research division at Saclant Undersea Research Centre, Italy, he leads the research and development of geoaoustic inversion methods for the estimation of seabed and sub bottom properties. He now co-ordinates research in the field of environmental assessment in collaboration with European and international institutions. He is a member of the technical committees on acoustical oceanography, underwater acoustics and signal processing of Acoustical Society of America, is a senior member of IEEE and co-chair of IEEE Ocean Engineering Society, and represents Belgium in the scientific committee of the European conference on underwater acoustics. The ongoing international projects include: 1. AQUATERRA “Integrated modelling of the river sediment-soil-groundwater system” Integrated project of the 6th EU RTD Framework Programme, Research Priority 1.1.6.3 Global Change and Ecosystems (European Commission, Contract No. 505428-GOCE), 2. AO-BUOY Acoustic-oceanographic buoy for rapid environmental assessment (NATO Undersea Research Centre, Royal Netherlands Navy, Netherlands Hydrographic Office, Univ. of Algarve), 3. SIGMAA Système d’Inversion Géoaoustique par Modélisation Adjointe Automatisée (Univ. Pierre et Marie Curie à Paris VI, Service Hydrographique de la Marine Française).

Key participant:

Goteborg University (UGOT). Number of researchers to be integrated into ESONET: 3 PI’s (Prof. Per Hall, Dr. Tomas Lundalv and Dr. Anders Tengberg; all males), and 8 Ph.D. students or postdocs (six females and two males). The affiliation of these persons is Dept. of Chemistry or Dept. of Marine Ecology at Tjarno Marine Biological Laboratory. Role of UGOT in the project: Run and have responsibility for the Koster Fjord demonstration observatory. Participate in the activities associated with the Porcupine Observatory and the Arctic (Hausgarten) Observatory.
Per Hall (born 1954) is a marine biogeochemist, Professor at Goteborg University (UGOT), Sweden since 1999, and deputy Director of the Marine Research Centre of UGOT since 2004. He has worked on the biogeochemical cycles of carbon, nitrogen, silica and phosphorus in coastal, margin and deep-sea sediments of most oceans and below aquaculture installations. Since 1991 he uses advanced autonomous instrumentation such as benthic landers in his biogeochemical research, and since 2002 stable sensors in long-term oceanographic measurements. Hall’s main field of expertise is the role of sediments in oceanic biogeochemical cycles. He has a long experience in international cooperation both at the European level (co-coordinator, steering committee member and/or work package leader of eight EU and ESF projects since 1991; EPOS II, ALIPOR, BENGAL, KEYCOP, COBO, ESONIM, two projects on the White Sea, and one on the Gulf of Finland), and with the USA (collaboration with Prof. Robert Aller at Stony Brook University; Alvin dives in the Panama Basin, Pacific Ocean).

Participant n° 30 SU Sweden

The Department of Meteorology/Physical Oceanography at Stockholm University was founded by Carl-Gustav Rossby in 1947. Initially its research and teaching was devoted solely to dynamic meteorology, but the department has gradually expanded and presently also comprises Chemical Meteorology, Atmospheric Physics and Physical Oceanography. The department has 7 full professors, 9 associate professors, and 5 research scientists/assistant professors as well as around 20 doctoral students. The department has chemical and technical laboratories as well as a fully equipped workshop.

Key participant:

Peter Sigray is a physical oceanographer/geomagnetic researcher with long experience in theoretical studies as well as field-work. He defended his PhD thesis on experimental atomic and molecular physics in 1989, where after he spent a year as postdoc at the Max-Planck Institute in Heidelberg. After some years as a research associate at the Manne Siegbahn Institute in Stockholm, he assumed a research position at the Swedish Defence Research Agency, where he in 1999 became research director at the Section for Applied Marine Research. He is an adjoint professor at the Department of Meteorology/Physical Oceanography at Stockholm University since 2005. His main interest is in ocean methodologies related to cabled-based integrated flow studies. The focus of his research is on the general circulation of the Baltic Sea and the North Atlantic inflow. The latter related to the thermohaline circulation.

Participant n° 31 TFH Berlin Germany

Technological research Institution - TFH, in co-operation with Technical Universität Berlin, designed and developed a thrustered tool for deep sea interventions - MODUS. Responsible for the design of deep sea handling system. Participant definition of the requirements, manufacturing and integration phase, technical test and operative mission.

The Technische Fachhochschule Berlin (University of Applied Sciences) was founded in 1972 as joined institution of several former polytechnic institutions. Activities are widespread in the field of engineering research. Research at the Department VIII – “Mechanical, chemical and environmental engineering” is most often related with companies to develop new technologies in the field of engineering design using CAE-technologies e.g. CAD, FEM. Several laboratories for production, manufacturing and material research support this work.

Key participant:
**Hans Gerber**
Mechanical Engineer, Professor at the TFH. He has over 16 years of experience in the field of mechanical research and development, and interdisciplinary engineering projects. Graduated in Chemical and Environmental Engineering in 1986. Scientific Assistant at the Institute for Design and Mechanical Engineering at the Technische Universität. 1991 Ph.D. in Mechanical Engineering. 1991-1997 Manager of the Department “Technical Operation and Development” at VWS in Berlin, responsible for technical test operations and related equipment development. More than 25 papers. He participated as Local Project Manager of TFH in GEOSTAR (MAS3-CT95-0007) and participates now in the ongoing project GEOSTAR 2 (MAS3-CT98-0183), BIODEEP and other projects as the bi-national projects GNDT and MABEL (Italy-Germany) also as LPM. Lecturing in the field of mechanical engineering and design (TFH) and deep-sea systems (TUB).

**Participant no 32 IO-BAS Bulgaria**
The Institute of Oceanology, BAS, Varna is affiliated to the Bulgarian Academy of Sciences. The main research activities are focused on the field of coastal dynamics, marine physics, chemistry, geology, biology, ecology, ocean technique and technology, data management and underwater investigations. The Institute hosted Bulgarian National Oceanographic Data Centre (BGODC). Traditionally involved in all aspects of marine research it also offers consulting and expert services, environmental impact assessment studies, education and training. The total scientific stuff is 53 scientists (3 senior scientists - Professors, 14 senior scientists - Assoc. Professors, 34 scientists - Assoc. Researchers, DSci.-3, PhD- 24). IO-BAS is the Regional Activity Centre and Focal Point of BSEP. The Institute participated in NATO SIF TU-fisheries and TU-Black Sea projects and is actively participating in NATO SIP ODBMS project. Institute participated in almost all GEF and Black Sea EU programmes implemented in the region. During last five years IO-BAS actively participate in a large number of FP5 and FP6 among which, Sea-Search, CESUM-BS, CRIMEA, EUROSEISMIC etc. The institute coordinates two of Black Sea GOOS projects ARENA and ASCABOS. The Institutes’ experts are involved in consulting decision and policy makers for elaboration of environmental friendly regulations and standards for sustainable management of Black Sea living resources at governmental and local authorities’ level. The scientific staffs are qualified in environmental impact assessment expertise. Human resources of IO-BAS is adequate for the implementation of its role in the ESONET Project and for its implementation it will be integrated 4 Assoc. Professors, 4 to 6 Researchers and necessary number of technicians.

**Key participant:**

**Dr. Hristo Slabakov** is a Director of the Institute of Oceanology- Bulgarian Academy of Sciences. He takes MSc (1969) and PhD (1982) degree in Technical University of Varna. Since 1986, he is Associated Professor at the Institute of Oceanology and a lecturer in the Naval Academy in Varna. He is also a licensed expert of the Bulgarian Ministry of Environment, a Member of Steering Committee of Black Sea GOOS and President of the National Oceanographic Commission. As a Coordinator of the ARENA and ASCABOS EC Projects (18 partners) he is well experienced in international cooperation both at the regional and European level. His areas of research activities are: marine explorations, oceanographic devices and instrumentation, laboratory calibration systems, operational oceanography, monitoring.

**Participant no 33 ITU Turkey**
ITU-EMCOL is presently being supported by a 3-year FP6-2004-ACC-SSA-2 project (Contract No. 17490). The Centre is specialized in marine and lake studies related to natural hazards and...
environmental changes, covering a wide range the fields such as submarine earthquake geology, tsunamis, submarine land slides, floods, climate change and environmental pollution. EMCOL scientists include specializations in marine geology and geophysics, seismology, tectonics, paleolimnology and paleoceanography. EMCOL has the field and laboratory equipment for mapping of active faults by high resolution seismic reflection method in marine and lake basins, and sampling and analyses of marine and lake sediments, and water columns.

**Key participant:**

**Namık Çağatay** is a marine geologist, professor at Istanbul Technical University (ITU), and is the Coordinator of ITU-EMCOL (Eastern Mediterranean Centre for Oceanography and Limnology). His chief interests are palaeoceanography using multi proxy methods and earthquake related sedimentation. He has participated in many international collaborative projects with European and American institutions as a co-chief scientist, and in the ODP-Leg 172 as an inorganic geochemist. The recent international projects include: 1. Submarine Earthquake Geology in the Marmara Sea. (CRN-ISMAR, ITU, MTA, LDEO Project). 2. MARMACORE (ITU, MTA, CNRS-CEREGE, CNRS-Gif-Sur-Yvette, College De France, IPG Paris), 3. MARMARASCARPS Project (IPG Paris, Ifremer, ITU), 4. MARMARA VT Project (College de France, ITU, FUB, GEOMAR, PEPS, CEREGE, IFREMER). 5. Earthquake Risk Assessment in the Marmara Sea (CNR-ISMAR and ITU-EMCOL), 6. EMCOL (Eastern Mediterranean Centre for Oceanography and Limnology; EC FP-6 SSA no. 17690) Project. Most of these projects have involved marine multidisciplinary marine surveys for earthquake risk assessment in the Marmara Sea, a natural laboratory for submarine seismotectonic activity.

**Participant n° 34 B.U., KOERI Turkey**

Bogazici University, Kandilli Observatory and Earthquake Research Institute. It has laboratories and departments. It offers M.Sc. and Ph.D. degrees in geophysics, geodesy and earthquake engineering. One laboratory called National Earthquake Monitoring Centers (NEMC), operates Turkish National Earthquake Network and it became national Tsunami Early Warning Center in 2006. There are also meteorological astrophysical laboratories. Magnetic laboratory is connected to Department of Geophysics. In addition to the NEMC, there are two other centers; Iznik Earthquake Prediction center and Belbasi Nuclear Explosion Monitoring Center in Ankara.

**Key participant:**

**Cemil Gürbüz** is a geophysicist, deputy director of the Institute, Professor at the University of Bogazici, Kandilli Observatory and Earthquake Research Institute, and lecturer at the Department of Geophysics. During his carrier, he worked on the in-seam seismic for the Turkish Coal Company, Seismicity projects of Sinop and Akkuyu Nuclear power plant sites, Turkish - German Earthquake Prediction Project, Turkish - Japanese Earthquake Prediction Project, Bursa Area Seismicity project as a part of Marmara Polyproject, Seismotectonics of the Marmara Region, Eastern Turkey Seismic Experiment : Lithospheric Structure in an Active Continental Collision Zone, Improvement in Detecting, Location and Identification of Small events through joint data analysis by seismic observatories in the Middle East/Eastern Mediterranean Region, Calibration of Regional Seismic Stations in the Middle East with shots in Turkey, Investigation of the mechanics of the North Anatolian Fault and related seismic risk. He is expert in Investigation of crustal structure of earth’s crust by geophysical methods, Processing of earthquake and explosion seismic data, Investigation of shallow structures for engineering studies, Establishment of micro earthquake networks. He has long experience in international cooperation at the European level (Poly Projects with Germany, England, France, Switzerland), Japan and the USA as a PI and Co-PI of NSF programmes (three projects).
Participant n° 35  

DEU-IMST  

Turkey

The scientists in the Institute of Marine Sciences and Technology (IMST) of Dokuz Eylül University (DEU) are organized into interdepartmental and inter-institutional faculties and research institutions. The main activities of IMST address a broad range of marine sciences, including geological, geophysical, biological, chemical and technological disciplines.

The major instructional and research facilities of the IMST include R/V “K. Piri Reis” and boats equipped with the latest facilities required for modern oceanography. A remote sensing station to receive and analyse AVHRR data has been operational since October 1994. Seismic laboratory (SEISLAB) has been active in early 2005 to acquisition, process, interpret and store the seismic reflection data collected using R/V K. Piri Reis research vessel. Additionally, the Lab also has necessary hardware and software to collect, process and interpret the multibeam echosounder and side scan sonar data.

Key Participant:

Günay Çifçi is a marine geophysicist, Professor at Dokuz Eylül University (DEU) and the coordinator of the SEISLAB for the gas hydrate research project in the Institute of Marine Sciences and Technology, and lecturer at the Department of Geophysics. His main interests are collecting the seismic data, processing and interpretation, gas-hydrate studies, marine pipe line investigations and strong involvement in TTR in Black Sea and Mediterranean Sea using sonar and multibeam data. The current international projects are Hotspot Ecosystem Research on the Margins of European Seas (HERMES), High resolution seismic survey at Bosphorus outlet of Black Sea with IFREMER.

Participant n° 36  

ALCATEL  

France

Alcatel Submarine Networks (ASN) a world leader in the engineering design, implementation and maintenance of underwater telecommunication cable systems having supplied more than 500,000km of cable. ASN provides turnkey solutions which include the design and manufacture of submarine optical and power cables, submerged optical amplifiers and power switching branching units, shore based power feeding and optical DWDM transmission equipment with the associated network management tools.

ASN is a European based company with headquarters and systems engineering teams in Paris France supported by Alcatel’s Central Research Centres in France, Germany and Spain. Equipment manufacturing is in London, UK and Trieste Italy, with submarine cable design and manufacturing in Calais, France. Marine installation and maintenance is based in London.

Since 1999, ASN has been working with several institutes on the specialist engineering design of cabled ocean observatories, with the aim to assist with the transition from short term pure research to long term fully operational networks. These relatively new system utilise many standard telecommunication products and services, and require the development of a number of customised products and solutions.

ASN has developed an in depth understanding of both the science and operational challenges that face these new systems, having closely collaborated with institutes worldwide on projects such as, NEPTUNE, MARS and NEMO.

1st February 2009
**Key participant:**

**Gary Waterworth BSc(Hons) CEng MIMechE**
1979 - Present Alcatel Submarine Networks.
Experience includes design, manufacture and installation of submarine cabled systems and projects. Part of the NEPTUNE and MARS projects teams working with the University of Washington, MBARI and WHOI. Worked on the initial concepts for the 800km, 35MUSD NEPTUNE Canada system for the University of Victoria. Currently collaborating with institutes on cabled observatory projects off the coasts of Ireland, France, Japan and Taiwan. Member of the Scientific Submarine Cable Technical Committee and Vice Chair of the IEEE OES Technical Committee on Submarine Cables.

**Participant n° 37 FUGRO Netherlands**

**Fugro** collects and interprets data related to the earth’s surface and the soil and rocks beneath. On the basis of this the Company provides advice, generally for purposes related to the oil and gas industry, the mining industry and the construction industry, including infrastructure projects.

Fugro operates around the world at sea, on land and from the air, using professional, highly specialised staff supported by advanced technologies and systems, many of which have been developed in-house. The equipment Fugro uses to carry out its work includes over thirty vessels, several hundred CPT (Cone Penetration Test) and drilling units and approximately forty aeroplanes and helicopters as well as some sixty ROVs (Remotely Operated Vehicles).

Fugro’s objective is to hold a leading market position due to its technological developments and quality. This requires a strong international or regional market presence.

Fugro was founded in 1962, has been listed on Euronext N.V. in Amsterdam since 1992 and has been included in the Amsterdam Midkap Index since March 2002. Fugro has approximately 9,000 staff permanently stationed in over 50 countries.

Organisationally Fugro comprises three divisions: Geotechnical Services, Survey Services, and Geoscience Services.

**GEOTECHNICAL DIVISION** - Investigation of and advice regarding the physical, characteristics of the soil, foundation design and construction materials. **Fugro Engineers BV** operates in this division.

**SURVEY DIVISION** – Precise positioning services, geological advice, topographic, hydrographic and geological mapping and support services for offshore and onshore construction projects, as well as data management Fugro Global Environmental & Ocean Sciences business line including **Fugro GEOS** and **Fugro Oceanor** operate in this division.

**Fugro OCEANOR** is a high technology company specialising in the design, manufacture, technological development, installation and support of ocean observing and forecasting systems. The Company has over 20 years of international experience and a staff with multi-disciplinary backgrounds within marine technology and instrumentation including engineering, electronics,
marine surveying and operations, applied meteorology, oceanography, mathematics, software
development, marine biology and hydrology.

Systems and services are provided and supported globally through the network of Fugro and Fugro
GEOS offices. Fugro OCEANOR and Fugro GEOS are certified in accordance with the

**Fugro GEOS** provides a range of oceanographic and marine meteorological systems and services:
- Oceanographic measurement services
- Oceanographic consultancy
- Metocean monitoring systems for oil and gas industry applications
- Specialist offshore forecasting services.

The Fugro OCEANOR SEAWATCH system incorporates moored buoys, sensors, data processing,
software, communication interfaces, simulation models and modules for training and institutional
capacity building. The system or modules of the system can be used to support national, regional or
local marine environmental monitoring in deep and shallow water.

SEAWATCH systems can include the following components:
- Moored multi-parameter oceanographic buoys (‘WAVESCAN’, ‘SEAWATCH’, ‘SEAWATCH
MINI II’ – all based on SEAWATCH technology).
- Real time, two-way communication system.
- Integration of data from other sources.
- Databases and presentation software including GIS.
- Numerical forecast models.
- Training and institutional capacity building modules.

SEAWATCH can serve as the basis for a complete regional environmental monitoring and
forecasting system, or can be easily integrated into a pre-existing infrastructure. SEAWATCH is
designed to comply with international metadata standards. Thus, the system can act as an interface
for the exchange of oceanographic and meteorological environmental data between nations and
government agencies.

Of particular recent interest is our experience in the Indian Ocean region where we have provided
national observing systems for many of the countries affected by the 2004 tsunami. Since the
tsunami we have delivered tsunami monitoring system components to Malaysia, India and Greece.

Fugro OCEANOR is presently researching and testing deep sea acoustic communications techniques
with a number of Norwegian research institutes and companies

Further detailed information about the systems and services provided by these companies can be
found at [www.oceanor.no](http://www.oceanor.no), [www.geos.com](http://www.geos.com) and [www.oceannumerics.com](http://www.oceannumerics.com).

**GEOSCIENCE DIVISION** - Acquisition, processing and interpretation of seismic and geological
data, reservoir modeling and estimation of oil, gas, mineral and water resources and the optimisation
of their exploration, development and production.
Fugro has recently been involved with PROMESS, where we provided geotechnical drillship services and ASSEM where we provided industrial market guidance. Fugro provided geotechnical services for the 4th Framework MAST III ISAC project (Ref: MAS3950046).

**Key participant**

**Robert Hawkins**, MSc, DIC, CGeol, FGS. Graduated from Oxford Brookes with a degree in Earth Sciences in 1988 and then went on to read an MSc in Mineral Exploration at the Royal School of Mines, Imperial College, London. He then joined Fugro in 1989 as an engineering geologist and spent the first seven years working on a variety of offshore geotechnical projects both in the North Sea and overseas. Since then he has held a number of positions in the organisation including Contracts Manager, Operations Manager of Fugro Limited and General Manager for Alluvial Mining Limited. He is currently Business Development Manager for Fugro Offshore Geotechnics Europe. Robert Hawkins was the Fugro Project Manager for the MAST III ISAC project.

**Dr Svein Erik Aasen** is the Technical Manager of Fugro OCEANOR, Trondheim, Norway. He has eleven years experience of the development of sensors and real time systems. This includes deep sea instrumentation and ocean surface observation systems. Most of these systems send data in real time and are often used as multi hazard warning systems. The latest versions also include a tsunami monitoring subsystem. This is a seabed based system which includes acoustic communications to the surface buoy. It can be deployed in water depths of up to approximately 6000m. Dr. Aasen obtained his PhD from the University of Trondheim in 1995 on the construction of an advanced real time measurement station and advanced applications of meteorological data. He is a member of the Norwegian Society of Chartered Engineers. He also has extensive experience of lecturing and training personnel from universities and client institutions and companies.

**Participant n° 38 CSA Ireland**

The CSA Group was established in 1984 and comprises a team of world-class geoscience professionals, providing technical and project management services to the international marine, mining, hydrocarbon and construction industries. CSA are partners in ESONET and reviewed the data requirements and evaluated site locations for the seafloor observatory network. CSA has project management experience with the Irish National Seabed Survey and the Irish Petroleum Infrastructure Programme and will assist the co-ordinator of the project, the Irish Marine Institute, in consortium management activities including legal, contractual, ethical, financial and administrative management. CSA has experience in tendering for marine vessel and seabed sampling services in NW Europe. With this experience and that gained on the ESONET project, CSA can provide input to the other partners in providing OPEX options and costings for the cash flow forecast (WP4). The experience will contribute to the ESONIM legal partner in developing the legal framework (WP5) for a Seafloor Observatory Network site. CSA was involved in evaluating sites for selection in the ESONET project and the understanding of the issues will contribute to the timely delivery of results for WP6. CSA’s experience in managing the Irish Petroleum Infrastructure joint industry programme will contribute to defining partner relationships (WP6). CSA has planned, organised and managed numerous conferences and published several articles on marine related subjects in the last 12 months and will continue to work with ESONIM partners to disseminate and present the results of the project (WP7). CSA’s participation will be focused and managed by Nick O’Neill (Director) and assisted by Ed Slowey (Project Manager), both are graduate geologists with over 30 years professional experience in project management between them.

**Key participant:**
Nick O'Neill (BSc, MSc) 1994 - Present CSA Oil & Gas Services Ltd. Experience includes project/contract management for the Petroleum Infrastructure Programme, a group of 16 international oil companies and the Irish government carrying out a 7-year research programme in the Rockall Trough. Management consultant to the €32m Irish National Seabed Survey since 1999 to the present. Member of the ESONET team. Pre- 1994 Geological Consultant. Worked as operations geologist with several international oil companies. Presented training course at Shell International Training School in the Netherlands and Nigeria. Lecturer in drilling and production technology at University College Dublin MSc course in Petroleum Geology.

Participant n° 39 SERCEL France

Sercel has been a leading player in the seismic acquisition industry for over forty years, supplying the geophysical industry with a full range of high-tech integrated equipment to meet the requirements of current oil exploration projects.

With its technological prowess and in-depth knowledge of client needs, SERCEL has over the years built up its reputation on equipment which offer an intrinsic combination of high-quality, reliability and flexibility.

From its facilities in Nantes, Saint-Gaudens, Toulon, Brest, Massy, Houston, Calgary, Alfreton, Moscow, Surgut, Singapore, Dehradun, Xian, Xushui, Beijing, Sydney and Dubai, SERCEL is confident that it can satisfy all equipment, support and training requirements, wherever there are seismic survey projects in the world. Whatever the field conditions, whether on land, at sea, in open country, in the mountains, in the jungle or in the desert, SERCEL engineers and technicians apply the skills they have acquired through long-standing R&D work and experience in the field to constantly push back the limits of seismic acquisition.

The Underwater Acoustics Division located in Brest (France) is specializing in the development of products and systems based on Underwater Acoustics: acoustic modems, acoustic data transmission systems, acoustic networks, location systems, sensors and much other equipment matched to specific requests.

The competences of its people in low power consumption electronic circuits, marine Mechanics, transducers, Software and systems integration can be valorised in Esonet project. Its facilities include an acoustic tank and testing equipment.

Sercel Underwater Acoustics Division can cooperate with other Sercel Divisions to satisfy customers and to comply with specifications of project.

Sercel has been an active partner in several European Projects within FP 2 to 6. Many of these projects were dealing with the design, the implementation and the operation of underwater stations and associated surface equipment. Its Personnel is then used to cooperate with Universities, Institutes and private companies. Several Esonet partners were partners of Sercel in these projects.

Key Participants

Gérard AYELA Engineer in Electronics. After 15 years with Ifremer, he created ORCA Instrumentation in1988, a SME specializing in Marine Instrumentation and Underwater Acoustics. He is now Product Development Manager at the Sercel's Division in Brest (France).

Pascal COINCE Engineer in Electronics. He also worked at ORCA and has become a specialist in Acoustic Modems and associated equipment.
Alain PRIOU  Mechanical Engineer in charge of all development dealing with Marine Mechanics

Participant n° 40 nke France
MICREL was created in 1984 with specialisation in electronics. It became nke in July 2005. The company employs 72 people and its annual turnover is 6.1 M€. nke is ISO 9001 certified. nke is targeted on application of high-tech electronic measuring devices for new and special purposes. There are four fields of activity: oceanographic instrumentation, marine electronics, regulation of domestic heating, and custom design, dealing with development and manufacture of speciality electronic products for individual customers.

Since 1993, nke has been developing autonomous loggers for measurement of physical and chemical parameters of seawater. There are used in shallow or deep water up to 6000m. These loggers are working independently during several years without maintenance. PC software allows programming these loggers using a portable inductive link connected to a serial port.

In 2004, nke developed new applications of automatic station using GSM distant control link. In 2005, nke developed an autonomous ultra deep messenger for submarine observatory (ROSE). In 2006 nke launched an operational multiparameter probe (SMATCH) including: GPRS link (TCP-IP protocol), multi sensors (C, T, D, pH, DO, turbidity, fluorimeter), local chlorination for biofouling protection (under Ifremer license).

The nke's engineering group (22 people) has specialists with knowledge and deep experience to develop loggers and instrumentation for the project in electronic (embedded systems, radio link, design of printed circuits, production of testing systems), informatics (development of PC software for industrial applications), mechanics (conception of atmospheric and sea water housing dedicated to shallow or deep water, small and large series).

Nke takes part in several groupings or trade associations (Pôle Mer Bretagne et PACA, Technopôle Brest-Iroise, G2RA, Haliod, MEITO, ...), and member of a European Groupment of Economic Interest (Littoralis).

Key participant(s):

Yves DEGRES: Engineer - Ecole Nationale d'Ingénieurs de Brest (France) 1985
He developed oceanographic products at nke since 1993, and now he is Instrumentation manager since 2001, in charge of scientific collaboration and marketing development.

Olivier GUILLERME: Engineer - Oceanographic Instrumentation Product Manager
He integrated R&D nke electronical dpt. in 1996 and developed hardware, software (embedded and PC) for oceanographic products since 1998.

Michel JOUANNIC: Oceanographic Instrumentation Project Engineer
He integrated R&D nke electronical dpt. in 2000 and he participated to several projects in oceanographic field (scientific echosounders, automated systems and instrumented buoy for coastal measurement...).


Participant n° 41 GURALP United Kingdom
Güralp Systems Ltd is a leading designer and manufacturer of broadband seismic instrumentation.

1st February 2009
The company, based in Berkshire in southern England, designs, manufactures and provides support for a wide range of seismic devices, including land-based, ocean-bottom and borehole instrumentation. Founded by Dr. Cansun M. Güralp in 1985 to produce high quality research and monitoring systems, the firm has grown steadily as a result of its excellent reputation within the industry, and to date employs over 60 people in its 10,200 sq. ft. factory.

Güralp Systems boasts an international clientele, particularly in eminent areas of seismological research such as the USA and Japan, and GSL was presented with the Queen's Award for Export Achievement in 1999 in recognition of this attainment. GSL has provided equipment for many major projects worldwide, including the US Seismograph Network (USGS), IRIS PASSCAL, USARRAY, EARTHSCOPE, the Canadian Seismic Network (GS Canada), the Southern Californian Cooperative Network (CALTECH and USGS). Guralp Systems has provided a wide variety of Ocean Bottom systems for many projects worldwide and has experience from individual Sensor designs through to full COTS based Ocean bottom systems.

Key participant:

Dr Cansun Guralp (PhD in Instrument Physics and Cybernetics, PhD Thesis, University of Reading, title: “Design of borehole broadband seismometers”)

Present founder and managing director of Guralp Systems Limited. Several key Patents and publications including:

- Seismometer lock, patent number gb 9509089.0, 4th May, 1995

Awards received
Guralp systems limited awarded Queens Award for Export, 1999.

Participant n° 42 ALTRAN Technologies S.A. – ALTRAN OUEST France
(Atlantide S.A.S. was held by Altran Technologies S.A.)

ALTRAN Ouest is an Engineering and Consultancy company in new innovating technology, created in 1984. Based in Brest (29-France), the ALTRAN Ouest team brings together 50 consultants, engineers and doctors in information technology, telecoms, information systems, instrumentation, embedded systems, and marine sciences.

ALTRAN Ouest developed its competences on the two following main fields:
- Environment sciences and technologies,
- Communication and information technologies.

These competences are structured more precisely around five essential topics:
- Underwater acoustics,
- Oceanography,
- Numerical data management,
- Multimedia services,
- Systems integration.

ALTRAN Ouest intervenes mainly within the framework of provisions of services. Those relate to for a significant part the system development or software, but include also missions of scientific or
technical study, integration, exploitation, or of assistance to project management processes, council and technological surveying. They can take an embodiment of technical aid or the fixed price contracts.

Beyond the provisions of services, ALTRAN Ouest develops its own activity of R&D around emerging technologies. This activity has an ambition to develop a centre of competences and innovation, resulting in particular in:
- capacity to build industrialise (or) draft studies upstream in partnership with laboratories and the realization of research tasks. This original approach allows us, thanks to the capitalization of competences, to be force of proposal within the framework of our services.

ALTRAN Ouest is an actor of regional economy, through several groupings or trade associations (Technopôle Brest-Iroise, G2RA, Haliod, AFEIT, MEITO, ...).

**Key participant(s):**

**Geosciences : Laurent RICHIER (MSc) –**
Ecole et Observatoire de Physique du Globe 1994 – Strasbourg (France)

After his initial formation in geophysics, Laurent Richier got strong experience as regards acquisition and data processing (geophysical, seismic, satellite, magnetism, gravimetry...). He controls the techniques of signal processing, and algorithmic development. He also acquired an experience in acoustic underwater data acquisition.

**Information technologies : Philippe KERVELLA (Ing) –**
ESME-Sudria 1989 – Paris (France)

Engineer with great experience as regards information systems, Philippe Kervella drives the projects in this field. In particular, it treated problems related to the complex contents data management (cartography, scientific data, collaborative work, knowledge management...) in the fields of the telecoms and the marine sciences.


**Participant n° 43 SIS Germany**

SiS is a company founded in 1984 with the emphasis on the field of sensors, instruments and systems in marine sciences, meteorology, environment, calibration equipment and engineering services. Besides own products a number of well-known manufacturers are represented. Since 1997 SiS resides in Klausdorf/Schwentine near Kiel.

The R&D staff consists of applied physicists, computer scientists, engineers, technicians and craftsmen. Fields of interest are sensor development, precision analog electronics, high resolution fast data acquisition systems, µ-controller hard- and software. Autonomous battery powered systems. Metrologic grade standards and instruments. Software development for technical and scientific applications. IEEE-bus controlled measuring systems. Optical remote sensing, satellite telemetry.

Pressure test vessel up to 1000 bar. Pressure calibration with relative accuracy of 3x10⁻⁴. Temperature calibration laboratory according to ITS-90 with metrological standards in the range of -5 °C to 40 °C. Resolution, reproducibility and absolute accuracy of 10 µK, 100 µK and 200 µK respectively. Our test facilities and R&D capabilities are offered to customers for commercial services or user-specific developments (CLS Argos Services. Software tools. Consulting).
Aberdeen is an International university built on serving one of the most dynamic regions in Europe with a major activity in offshore and sub sea technology. The Oceanlab opened in September 2001 is a unique facility designed for development, testing and servicing of deep ocean autonomous vehicles and other instrumentation. The oceanlab team has been responsible for over 500 deployments of autonomous platforms at depths of 500m to 5800m in the Atlantic and Pacific Oceans and in the Mediterranean Sea.

**Key participants:**

**Professor I. G. (Monty) Priede** is head of the Deep Ocean Research group and has co-ordinated several EU research programmes in the Fisheries and Marine Science and Technology Sector including ALIPOR (Autonomous Lander Instrument Packages for Oceanographic Research). He has extensive experience of sea-going research and was principal scientist on two cruises of the RRS Discovery during which up to 15 landers were deployed from the research vessel. Professor Priede graduated in marine sciences from the University of Wales in Bangor has a PhD from the University of Stirling and DSc from University of Aberdeen.

**Prof. Ursula Witte** formerly at the Max Planck Institute for Marine Microbiology, Bremen, Germany, has taken up post as Professor of Biological Oceanography at the University of Aberdeen on 1 May 2005. She has experience in marine benthic ecology and biogeochemistry and in the development of in situ technology. Research has focused on carbon turnover in shelf, slope and deep-sea sediments and has considerably advanced understanding of the driving forces of carbon turnover in cohesive deep-sea sediments and permeable shelf sands. Research has been funded by the German Science Foundation, Ministry of Research and Education, Germany, the Max Planck Society and the EU and has transferred from Germany an EU-funded project on development of a coastal ocean benthic observatory and a complete deep-sea chamber lander system.

**Dr. Philip M. Bagley** is an engineer, senior research fellow at the University of Aberdeen, and Technical Director of the Oceanlab deep ocean research institute. He is a Chartered Engineer, a Member of the Institute of Electrical Engineers, and the Society for Underwater Technology. With a background in engineering research and development in the commercial and defence industries he moved to the University of Aberdeen in 1989. Since then he has focused on deep ocean Lander technology, acoustics, and robust long-term data logging and control systems. He was instrumental in setting up the successful Oceanlab commercial unit currently with over 80 oil and defence related customers. He is experienced in very long term deep ocean monitoring systems and is the lead on a BP funded project to provide 20year environmental monitoring sub sea systems. He has collaborated on major European (ALIPOR) and US (DELOS Deep Ocean Long term Environmental Observatory System) research grants and is on the organising committee of Oceans 2007.

**Dr. Martin Solan** is a marine benthic ecologist, Lecturer at the University of Aberdeen, and leads a benthic biodiversity research group. During his career, he first was appointed as a NERC funded Research Fellow (Biodiversity and Marine Ecosystem function) before becoming the Project manager (2002) for ESONET (European Seafloor Observatory Network). Since 2004 he is focused on the development of in situ technologies and coastal ocean benthic observatories. He is expert in the use of imaging technology to evaluate invertebrate activity and behaviour and the development of concepts of biodiversity and ecosystem function in marine sediment systems. He has a long experience in international cooperation both at European (ESONET, COBO, MarBEF, Corepoint), US (as an active contributor to NSF programmes dealing with biodiversity change, including BioMerge), and at the international level (international biodiversity programmes including Diversitas and deep ocean technology development in Japan).
Anne Holford is a software engineer currently working at Aberdeen University’s Oceanlab. She specialises in embedded applications for small autonomous devices. She has spent 25 years in the aerospace industry working on large projects such as Air Traffic Control System and commercial aircraft simulators to small ones developing, building and supporting the launch of mini technology satellites used to carry experimental payloads. She spent several years working on projects from the European Space Agency (ESA) working closely to their CCSDS standards for documentation, telemetry and telecommand. She has long experience in international cooperation both at the European level through Plessey’s Air Traffic Control System for the Austrian government, ESA’s Multi Satellite Support System (MSSS), Thales on the European Geo-stationary Navigation Overlay Service (EGNOS) and with the US through the Defence Evaluation and Research Agency on programmes such as Space Technology Research Vehicle (STRV) programs and the Medium Wave Infra-Red imager (MWIR).

Dr. Alan Jamieson began in Oceanlab as the mechanical technician after completing an honours degree in industrial design from the Robert Gordon University. He later completed a part-time PhD in lander related technology entitled ‘Autonomous lander technology for biological research at mid-water, abyssal and hadal depths’. Alan is now a research fellow through the European frame-work 6 project ‘COBO’ (Coastal and Ocean Benthic Observatories), contracted to design a new sediment profile imaging camera (SPI). Alan is principally involved in the design of mechanical lander systems and sub-sytems including regular sea going support.

Dr. Camila Henriques graduated in 1999 with a B. Sc. (Hons) in Zoology (Marine and Fisheries Biology) at The University of Aberdeen, writing a review of the classification of the species Stauroteuthis syrtensis (Octopoda: Cirrata). Completed her PhD at Oceanlab in September of 2004, looking at latitudinal and bathymetric patterns of the distribution and behaviour of deep-sea scavenging fishes based on in-situ lander observations from four locations in the Eastern Atlantic Ocean. After spending one year at the Centre for Coastal Studies in Mexico as the Lecturer of Ecology Camila returned to Oceanlab in September 2005 and is now employed as a Research Assistant helping to coordinate Oceanlab's contribution to various long term observatory projects.

**Participant n° 45 NSW Germany**

In its over 100-year history, NSW has established itself as a world leader in fiber-optic submarine cable systems, in special cables for the offshore industry and other underwater and terrestrial applications and as a supplier of customized plastic products. From its global headquarters in Nordenham, Germany, and its regional sales offices in the U.S., the U.K. and Malaysia, NSW serves the needs of customers throughout the world.

A member of the Corning Incorporated (NYSE: GLW) group of companies, NSW is committed to Corning's rigorous, uncompromising standards of service and quality. Quality and quality assurance have always been and will continue to be key elements of NSW's activities. For us, total quality performance means understanding who the customer is, what the requirements are, and meeting those requirements without error, on time, every time. Our vision is to grow NSW by pursuing profitable business opportunities, providing products and services that meet the changing needs of our customers competently and efficiently, and continually elevating the level of service and value we provide to them.

NSW's research and development teams work in close cooperation with Corning's optical fiber and cable experts to create state-of-the-art all-optical submarine cable solutions for many of the world's leading network operators. NSW manufactures its cables in full compliance with the requirements of recognized international quality accreditors such as Lloyds, DNV, GL and ABS. Its internal quality
system is comprehensive and covers all aspects of its manufacturing and business operations. NSW performs all required mechanical, chemical, electrical, optical and performance tests, and specialist in-house staff monitor and test all components at both pre-selected and random stages of the manufacturing process.

NSW is committed to extending the frontiers of technology in all of its core businesses. Its mission is to be the most innovative, competitive and customer-oriented supplier of repeaterless fiber-optic submarine cable systems, underwater cables and specialized plastic products worldwide.

**Participant n° 47 TESEO Italy**

Involved in emerging market sectors since 1998, TESEO S.r.l. is today a consolidated realty thanks to its offer of GIS application systems and Facility Management (FM) supporting software. Certified ISO 9001:2000 for the design, development and supply of specialised software and for the related activities, TESEO can rely on an excellent staff specialised in the aforementioned sectors.

As Solution Maker, TESEO is a software house able to solve integration problems of complex information systems, conjugating CAD/GIS technologies with the FM ones. Starting from the development of a specialised platform (MGCI – Modular Global Concurrent Interface), able to share, integrate and make more accessible data and documents, TESEO S.r.l. has engineered a suite of products that wants to reply to public bodies’ and private companies’ needs.

In particular TESEO’s products portfolio is formed by:

- MGCI-eFM: Facility Management integrated solution (buildings, industrial plants and utilities).
- MGCI-eGIS: GIS solution to support all programming, planning and territorial control of technical and management activities.

Strong of the experience developed in deep collaborations with local universities and research centres, TESEO is now able to carry out, as an RTD (Research and Technological Developer), performing wider research projects together with national and European big companies and Universities. At the moment TESEO is involved in the following national and international project: the Italian “SEALSPAW - Advanced services for tourist and cultural heritage localisation using multi-channel wireless platforms” and “DEDALO – Ontology based Communication System”; the EC FP6 Network of Excellence “ESONET – European Seas Observatory Network”.

**Key participant:**

**Ruggero Nicotra**

He is the Manager of the Software Development Division of TESEO. He started software development activities since 1983. In 1986 he got the University Degree in Physics with praise. Since then he has been involved in the development and as team leader and manager of team of work developing software solutions for industrial application. He is responsible of the solution to be developed in SEALSPAW and DEDALO research projects.
Participant n° 48  SEND  Germany
SEND Signal Elektronik GmbH is specialized in signal recording, data pre-processing and data storing. One highlight of our expertise is the processing of weak sensor signals in environments that are difficult to access.

In addition to development tasks, we also offer a range of products for marine seismology and seismic:
- data loggers and recorders
- cable telemetry
- GPS for time synchronization
- Hydrophone pre-amplifiers

Participant n° 49  DBSCALE  Spain
Medicion Ambiental SNLE offers technical and scientific services, supplies and develops customised technologies for terrestrial and marine environmental monitoring. We provide data post-processing services, from data management to statistical analysis, classification, pattern recognition and modelling.

We perform measurements in the following fields: Acoustics and Vibrations, Radiations, Seismics, Climatology, Air and water pollutants.
dBscale is an active member of the Standards Working Group for the GEOSS, an activity that has built expertise in the modern issues of standardisation of environmental sensing and data exchange on a global scale.

Key participant:

Eric Delory (Ingénieur ENSEA, DEA en Bioingénierie du Signal) 1994 - worked at the Institute of Biomechanics of Valencia (Universidad Politécnica de Valencia, Spain) from 1995 to 1997 on the design of a real-time portable system to monitor the human heart rate in high-level swimming. Then he flew to S.E. Asia, Singapore, where he worked as a research fellow at the Acoustic Research Laboratory, National University of Singapore, for four years, on the design of underwater acoustic instrumentation and the application of wavelets and pattern recognition to non-stationary underwater acoustic signals, focusing on whale acoustics. Back to Europe in 2001, he has been since then an associate scientist at the Laboratory of Applied Bioacoustics, Technical University of Catalonia, developing underwater acoustic monitoring solutions (he’s chief engineer on the award winning Whale Anti-Collision System project) and investigating cetacean audition through auditory evoked potentials. He founded dBscale (Pte Ltd) in 2005, a company dedicated to environmental sensing services and technologies. He’s an active member of the IEEE Committee on Earth Observation Standards Working Group for GEOSS.

Participant n° 50  CINTAL  Portugal
The Centro de Investigacao Tecnologica do Algarve (CINTAL) is a no-profit research organization, located in the University of Algarve, Faro, Portugal. CINTAL is formed by three laboratories, among which, the Signal Processing Laboratory - SiPLAB, which emphasis is underwater acoustic signal processing, ocean acoustic tomography and underwater communications. SiPLAB has approximately 10 researchers: 3 professors, 3 PhD students and 4 engineers. The contribution of CINTAL to ESONET is, in conjunction with other underwater acoustic related partners, to provide
the knowledge, practical expertise and technical assistance in setting up a local acoustic network for data transmission, ocean monitoring and marine mammal detection and tracking.

**Key participant:**

*Sergio M. Jesus*, has received a PhD in engineering sciences in 1986 from the Université de Nice (France). From 1986 to 1992 he was a staff scientist at the SACLANT Undersea Research Centre, La Spezia, Italy, where he was involved with underwater acoustic field noise directionality and early studies on target detection using matched field processing. In 1992 he joined the Electrical Engineering and Computer Department at the University of Algarve, Faro, Portugal where he is currently associate professor. He is the general director of the Center for Research and Technology (CINTAL) and coordinates the Signal Processing Lab. He has extensive sea going experience having participated and coordinated over 15 sea experiments at national, European and international level in the Mediterranean, Atlantic and Pacific (Hawai). He also participated/coordinated over 20 projects both at national and European level. His interests are underwater acoustics signal processing, model-based inversion, ocean and seafloor tomography and underwater communications.
Appendix B – Scientific objectives for ocean research disciplines

Scientific Objectives for the following:

- **Global Change and Physical Oceanography**: ocean circulation, water masses, global CO₂ budget, ice cover, climatology
- **Earth sciences, geohazards and seafloor interface**: earthquakes, slope stabilities, tsunamis, sedimentary and hydrothermal processes, fluids seeps and vents, plate tectonics
- **The Marine Ecosystem**: biogeography, biomarkers of global change, ocean productivity, living resources, biodiversity, Hot Spots
- **Non-Living resources**: energy (renewable resources and hydrocarbons, including CO₂ sequestration), mining/deposition

**B.1. Global Change and Physical Oceanography**

Our climate is changing rapidly. Higher global temperatures will come at a huge expense to society. Sea level changes will require substantial investments in coastal protection and coastal infrastructure from harbours to roads. Severe weather incidents such as flooding or hurricanes are also predicted as a result of higher atmospheric energy. As the burning of fossil fuels increases and carbon dioxide (CO₂) is presently considered the most important driving agent for climate change, it is important to better understand the carbon cycle and carbon exchange between the atmosphere and the oceans, especially its variability over time on a range of timescales, to provide the information necessary to devise the appropriate policies. Studying the role of the ocean and geosphere as carbon sources and sinks is also of critical importance to assess the effects of their variability on the marine ecosystem.

Seafloor observatories will play a key role to study a variety of phenomena that control the Earth’s climate:

- **Deep water thermohaline ocean circulation.**

The portion of ocean flow that is driven by density (called the thermohaline circulation) can be conceptualized as a great ocean conveyor belt - with warm, less dense waters flowing in one direction (northward in the Atlantic) at the sea surface and cold, dense waters flowing in the opposite direction in the deep ocean. Critical points of this "conveyor belt" are where the surface waters sink into the deep ocean. In the northern North Atlantic this happens only in a few places - in the Labrador Sea and in the Nordic Seas. On these two North Atlantic sites, as the ocean loses its heat to the atmosphere, the surface waters become cold and dense, and consequently sink downward into the deep ocean and then flow toward the equator. This overturning circulation thus transports significant amounts of heat to high northern latitudes resulting in the present, relatively mild climatic conditions in Europe.

A number of attempts have been made over the last years to observe the anticipated variability of the conveyor belt using arrays of deep moorings deployed in critical areas of the thermohaline current system (through for instance the CLIVAR, RAPID, ASOF and other Programmes). Other networks of observatories have been placed within the centre of large ocean gyres (e.g. the ANIMATE
project), to document long term changes in the temperature, salinity and density evolution. Together with data assimilative models this will allow a quantitative assessment of changes and variability in the large scale ocean circulation and related subsurface ocean properties.

Within ESONET we will build on the experience of these efforts with localized Eulerian stations for expending these systems systematically and for allowing real time data transfer. The long term goal is to increase the capabilities of the subsurface moored systems to become more modular in design and to provide communication between the mooring and shore based laboratories. Such systems are will not only be useful for documenting long term changes in the ocean, but also be utilized as means of communication for regional cabled observatories lacking cable connection to shore.

- Physical oceanography processes.

Research on the ocean circulation is now a complementary exercise of modelling, interpretation of satellite remote sensing and assimilation of in-situ data. The representation of oceanographic phenomena is now efficient enough to have originated operational oceanography (see 2.2.2). Ocean circulation connects all basins around Europe. There are several locations of global significance within the ESONET (for instance neighbouring of straights or reference sites for satellite sensor calibration) where in situ observations need to be sustained. Monitoring changes in water mass properties in terms for example of temperature, salinity, oxygen, carbon and major nutrients and changes in large scale circulation in terms of transport of heat and matter, are important for marine resources around Europe and for regional and global climate.

The steep slopes of European margins constitute a difficult area to modelise and to understand. Eulerian measurements through moorings are in operation on several sites around Europe. Their maintenance is costly and they lack energy and communication bandwidth to transmit in real time all the data potentially acquired with the underwater acoustic technology (complete ADCP output for instance). The link between small scale and mesoscale processes in the circulation will be potentially unveiled thanks to the permanent monitoring throughout the water column at some well chosen sites. Boundary conditions for ocean circulation models on the one hand and coastal models on the other, need to be based on reliable time-series. ESONET provide that time series at several sites.

- Upper ocean and climate change.

In addition to the requirement to quantify the time varying concentration of CO₂ and of CH₄, a variety of other aspects of the marine environment are changing as a result of enhanced atmospheric CO₂ and these have the potential to change the oceans functioning in a major and fundamental way. These changes may in fact reduce the capacity of the oceans to sequester carbon from the atmosphere and thus will increase the rate of global warming. In this context changes in the acidity of the oceans which will reduce the viability of certain classes of phytoplankton, as well as enhancement of the input of dust into the oceans (which in places provides essential micronutrients or increased stability of the water column resulting in reduced supply of macronutrients to the euphotic zone) must be named as potentially having a strong effect on the marine ecosystem, influencing biodiversity and the possible use of living resources.

To obtain the observational capabilities to record the variability of properties of climatically critical components or proxies over a range of time scales, the present observing systems must be radically upgraded. Central to this upgrading of facilities is the development, design and construction of an array of cabled, multidisciplinary long-term observatories.
B.2. Earth sciences, geohazards and seafloor interface

B.2.1. Transfers from the Earth’s interior to the crust, hydrosphere and biosphere

Geoscience research in the oceans is moving beyond the exploration and mapping of the seafloor and is now focusing on the dynamics of the solid Earth system and the interaction of geological, chemical and biological processes through time. Many of Earth’s tectonic systems will be difficult to fully understand without continuous observation provided by the establishment of seafloor observatories. These include the complex magmatic and tectonic systems at ridge crests and submarine volcanoes; the genesis of destructive earthquakes and their relationships to large-scale plate motions, strain accumulation, fault evolution and sub-surface fluid flow; the geodynamics of Earth’s interior and the origin of Earth’s magnetic field; and the motion and internal deformation of lithospheric plates.

Geophysical observatories are an integral component of Earth science research on land; advances in technology and our understanding of the oceans now makes it feasible to establish long-term observatories on the seafloor or in boreholes. ESONET will help study fundamental processes that impact the transfer of energy and matter from the interior of the Earth to the crust, hydrosphere and biosphere. Long-term observations will provide crucial information to address fundamental questions such as: i) the feed-backs between volcanism, deformation, seismicity and hydrothermalism; ii) coupling between the ecosystem and sub-surface processes (including deep processes involving the lower crust and mantle); iii) the mass and energy fluxes at hydrothermal vent fields, and their impact on biological fluxes. Understanding the causal links among magmatic, tectonic, hydrothermal and biological processes at mid-ocean ridges represents a particularly compelling challenge in this respect. Seafloor magmatic and volcanic activity creates new ocean crust and transfers thermal energy from the mantle to the oceans, leading to the creation of seafloor hydrothermal systems, and to the existence of chemosynthetic ecosystems. In addition, the recent discovery of subsurface microbial populations in ocean crust adds yet another dimension to mid-ocean ridge processes and has far-reaching implications, ranging from speculation about the origins of life to the biogeochemistry of the oceans. The interactions between these processes are likely to be temporally variable, and dominated by episodic events that our current expedition-mode of research has little chance of observing and sampling. Understanding the links and feedback mechanisms among geological, chemical, and biological processes in these very dynamic environments can be achieved only by the observatory capabilities envisaged by ESONET.

B.2.2. Earthquake hazards

The seismic activity resulting from the convergence of the European and African plates represents a major hazard for the populated, southern margins of Europe. Seismicity and tsunami hazards can affect mainly the belt from the Azores through the Mediterranean area, to the Black Sea. According to the Red Cross - Red Crescent report on world disasters, earthquakes have proven the deadliest of all Europe’s disasters over the past decade, and cost the continent 25 billions € in damage alone for that decade. It is recognised that earthquakes such as those that occurred in the recent past in Europe [e.g., Catania, 1693; Lisbon, 1755; Messina, 1908] would result in tens or hundreds of thousands of victims and billions of Euros in damage.

Seismology has an important role in reducing the impact of earthquakes in our society, primarily by detecting the presence of active faults. To improve the seismo-tectonic mapping of the active faults in coastal areas, it is necessary to conduct offshore surveys with seismometers deployed on the
The 2003 earthquake of Boumerdes (Mw= 6.8), which killed more than 2000 victims and left more than 200 000 people homeless dramatically illustrates this necessity: the fault that ruptured was located offshore, and there are good reasons to think that Algiers is also probably located on the westward continuation of a near-by active submarine fault. The identification and monitoring of offshore active faults is therefore a critical issue for densely populated coastal areas.

The nucleation and rupture processes of earthquakes are complex and chaotic, so that it is difficult—if not impossible—to make accurate predictions of earthquakes, even if the physics of earthquakes is now rather well understood. Kanamori (2004) and other first order seismologists have proposed that a practical way to use seismology for effective mitigation is in earthquake and tsunami “early warning”: after the occurrence of an earthquake, the severity of ground shaking can be rapidly estimated; then the information is sent to the users at some distance away, before damaging ground shaking. This approach needs considerable efforts before it can be considered operational. Deploying seismometers in tectonically active coastal areas within ESONET will represent a major advance toward that goal.

New perspectives specific to submarine faults are presently emerging. Seismological and geodetic work conducted on land (most particularly on the San Andreas and on the North Anatolian Faults) show the existence of highly permeable, low velocity, damaged fault zones. In submarine environments, such damaged fault zones are likely to offer a path for water to penetrate massively into the crust. On the other hand, Pacific Ocean transform faults have been shown to have a low number of aftershocks and high foreshocks rates compared to continental strike-slip faults. Fluid pressure changes could thus be good candidates to explain the physical linkage that is proposed to exist between foreshocks and mainshocks prior to large earthquakes at these oceanic transform faults. The presence of fluids hence appears to be a major specificity of submarine environments (compared to land) that could be of major importance to detect earthquake nucleation processes. Deep seafloor observatories with adapted instrumentation will help study the relationship between fluids and seismicity during the seismic cycle, a question of fundamental interest for the mitigation of earthquake hazards in tectonically active, near shore areas. Towards this goal, as a complementary acquisition of data, the geoscience community has started deploying networks of autonomous hydrophone, moored in the water column, for long term (several years) monitoring of the seismic activity in the deep ocean.

**B.2.3. Tsunami hazards**

Tsunami hazards have been dramatically brought to the awareness of the public after the December 26th, 2004, Sumatra earthquake. However, the potential danger of tsunami in Southern Europe (West Portugal and Mediterranean areas) is a reality long known by specialists and historians: the great earthquakes of Lisbon (1755) and Messina caused devastating tsunamis, killing tens of thousands of people. Aware of this potential danger, the European Community has funded a number of programmes to assess tsunami hazards in Europe and propose solutions for tsunami hazards mitigation. ESONET will provide the means to implement these solutions practically and operationally.

Tsunamis are gravity waves that propagate in the ocean in response to sudden shifts of the ocean floor generated by earthquakes, but also by landslides and volcanoes. Tsunamis waves have different characteristics (in terms of period, wavelength and velocities) that oceanic waves and swells. They can be easily recognized using ad hoc pressure sensors moored on the seafloor. Hence, tsunami waves can be predicted in a deterministic manner after the occurrence of a potentially dangerous earthquake, provided that near seabed low frequency pressure variations and seismic
events are permanently monitored and transmitted in real time, from the seafloor to onshore facilities. Each ESONET node from areas exposed to tsunami hazards will contribute to the implementation of European Tsunami early warning systems TWS.

**B.2.4. Slope instability and sediment failures**

Slope instabilities and sediment failure represent a significant danger to populated coastal areas (slope failure is a major cause of tsunami). Submarine slope instabilities can also cause substantial damage to offshore infrastructures (cables, offshore platforms, pipelines…), at great societal cost. In the last four decades, significant efforts have been made by academy in order to understand and identify the triggering mechanisms of slope instability processes and sediment failure on continental margins and on the flanks of submarine volcanoes. Numerous studies and projects in relation with submarine slope instability regarding design of marine constructions, offshore structures, and pipelines have also been initiated by the oil industry in the Norwegian Margin, the Gulf of Guinea and the Gulf of Mexico. Recognised triggering mechanisms include: i) oversteepening, ii) seismic loading, iii) storm-wave loading, iv) rapid sediment accumulation and under-consolidation, v) gas charging, vi) gas hydrate dissociation, vii) low tides and viii) fluid seepage. To predict potentially dangerous landslides, long-term monitoring of slope movement is essential.

In areas of high seismic activity, important progress can be achieved by monitoring the pore pressure, the shear wave velocity and the propagation of the seismic waves. Indeed, during an earthquake, the sediment dynamic behaviour is influenced by the intensity and duration of the cyclic loading, which may affect the sediment stiffness shear strength and increase the fluid pore pressure. Areas of high sedimentation rate are generally associated with under-consolidated sediment. The increase of sediment loading is transferred in part from the sediment matrix to the water. In a normal hydrostatically pressured geological formation, the sediment is permeable and the fluid can communicate through the different layers. The pore water is free to escape during consolidation and fluid pressure is hydrostatic. However, for over-pressurized layers, where the permeability of the sediment prevents the fluid circulation, the pore water partially supports the overburden pressure. Failure occurs when the forces caused by fluid pressure gradients exceed the confining stress. In areas characterized by high sedimentation rate long-term seabed pore pressure monitoring is therefore essential for slope stability assessment.

The formation and breakdown of gas hydrates is known to influence the occurrence and location of submarine landslides. The detection of gas hydrates is therefore also essential to evaluate the risk of slope failure and sediment deformation. Gas hydrates cement the sediment, modifying its strength. The upper limit of the gas hydrate stability zone (pinch-out), where expulsion of free gas is expected is therefore a critical interval in terms of sediment rheology and potential sediment failure. ESONET will contribute to the understanding and prediction of the risk associated with the dissociation of the gas hydrates with instrumented sites for continuous monitoring of temperature, pore pressure, gas chemistry, and pore-water salinity.
B.2.5. Fluid flow and gas seepage through sediments and gas hydrates

Recent evidence suggests the existence of an intense, previously unsuspected, fluid circulation and gas seepage through seafloor sediments:

1) Millions of pockmarks cover the present seafloor (Judd et al., 2002). These are considered to be the result of carbon-rich (a.o. containing a significant amount of CH₄) fluid flow from the subsurface of the seabed into the water column, and related chemosynthetic seep fauna, seep carbonates and other geological observations are found around pockmarks. However these might be substantial on a global scale given the worldwide abundance of pockmarks on continental margins and the fact that they are intermittently active.

2) Gas hydrates, ice-like crystals of water containing predominantly methane gas in their pore spaces occur along all continental margins (at suitable P, T conditions). Recent estimates of the amount of carbon bound in gas hydrates and the free gas underneath the gas hydrates are 2500-5000 GT - half the amount of carbon that potentially can affect climate -, but new discoveries within a few years are likely to increase significantly this estimate. Therefore, it is of crucial importance to quantify the mobility of this carbon reservoir. Structures such as chimney’s acoustic blanking effects, subsurface sediment mobilization, and landslides close to the outcrop of the gas hydrate stability zone indicate the episodic release of fluids from the gas hydrate reservoir to the seabed and into the water column (Berndt et al., 2003, Berndt et al., 2005, Booth et al., 2000, Mienert et al., 2004, Wood et al., 2004). The likely timing of carbon release from gas hydrates is most likely to occur during times of bottom water warming when the pressure and temperature dependent gas hydrate stability field conditions are changed. Recent research in
the Black Sea, Mediterranean an Gulf of Cadiz has shown that gas escape and fluid flow from deeper lying reservoirs (Blinova et al, 2005; Bohrmann et al, Stadnitskaya et al, 2006; Woodside et al, 2006) give way to the formation of large chimneys (Diaz del Rio et al, 2004), the presence of large pockmarks and the presence of hotspots of specific benthic fauna (Cunha et al, 2006; Sibuet and Olu-Le Roy, 2003). The amount of carbon that is released during episodes of fluid flow and gas escape into the water column and development of such structures is completely unknown on local as well as global scale.

The above observations suggest that the geosphere can release large amounts of carbon during short time spans, bypassing the biological buffers and offsetting ocean atmosphere carbon equilibrium. It is important to quantify the involved carbon and methane fluxes, to establish their relationship with biodiversity hotspot and ecosystem development and to implement them into climate models.

It will be one of the major goals for the first five years of a long-term observatory deployment to quantify the short term variations in carbon fluxes, in response to different forcings (e.g. storms, bottom water temperature changes, landslides, turbidity flows, etc). Measuring fluid flow through sediments and subtle carbon flux variation from the seabed requires long-term cabled observatories for several reasons: i) Long time series are needed to pick up episodic fluid flow or gas events; ii) A cable on the seafloor allows the deployment of a number of sensors along the line, maximizing chances to pick up fluid expulsion events; iii) continuous monitoring allows rapid response with a research vessel after a fluid expulsion event; iv) long time series are crucial to filter out short period variations.

B.2.6. Sediment transfer to the deep sea and climate change

The European NE Atlantic Ocean and Mediterranean continental slope and shelf edge are strongly dissected by canyons. Canyons are mainly found in the former non-glaciated section of the NE Atlantic margin south of 54°N, and are rare in the North. In particular the steep and narrow Mediterranean margin of Spain, France, Italy and Greece is incised by numerous canyons.

Incidentally canyons are directly connected to major river outflow systems and have been incised deeply into the shelf. These canyons then may act as a sediment trap for particles produced on the shelf, and as a conduit for transport thereof to the deep sea. Multiple (up to 1 year) deployments of benthic landers recording near-bed properties allow the identification of the main processes for sediment particle transport and dispersal. Between 100 and 2700 m in the canyon, tidal currents frequently exceeding 30 cm.s⁻¹ resuspend the muddy sediment from the seabed and subsequently transport suspended sediment and organic matter along the axis of the canyon. Beyond this depth, measured bottom currents of 5-10 cm.s⁻¹ appear to be insufficient to resuspend and transport sediments further down the canyon, and interaction with along-slope directed ocean currents becomes more important. Particulate matter transport through the canyon is thus an active and relatively fast process, but a considerable part of the metabolizable organic material is degraded during transit through the upper half of the canyon.

Transported particles include anthropogenic matter associated with river runoff, as was recently observed in canyons of the Gulf of Lions (Mediterranean) and in the Nazaré Canyon. The amounts of transfer of anthropogenic matter to the deeper canyon system and the deep sea, potentially affecting biodiversity and ecosystem development are virtually unknown and budgets do not exist. Neither is it known in how far the upwelling system at the mouth of canyons such as Nazaré, where fisheries are very extensive, is affected by anthropogenic inputs. Similarly, intermediate and bottom nepheloid layers may develop where the along slope current system interacts with topography and where internal waves affect the margin. As a result large amounts of material may become
resuspended and transported parallel to the continental slope and eventually influence ecosystem development.

Long term deployment of seabed observatories in selected canyons and margin sites will allow estimation of magnitudes and frequencies of forcing conditions and their spatial and temporal variability as induced by climate change on a range of time scales, as well as allow budget calculations of mass fluxes of anthropogenic and organic matter transported to the deep sea. This will contribute significantly towards better understanding of ecosystem development and sustainable and safe use of resources.

B.3. The Marine Ecosystem

B.3.1. Biogeography of European seas

Europe is surrounded by **five contrasting oceanic biogeographic zones** as defined by satellite remote sensing of sea surface chlorophyll distribution:

- **ARCT** with non-permanent ice cover;
- **SARC** influenced by surface warm water from the Atlantic including the highly productive Barents sea fishery area;
- **NADR** with the biggest seasonal change in chlorophyll concentration anywhere in the world’s oceans and dominating the climate of western Europe;
- **NAST** with lower productivity;
- **MEDI** – resembles the subtropical Atlantic in its pattern of productivity whereas the Black Sea is strongly influenced by freshwater inflow from rivers and is anoxic below 80-200m depth.

![Figure 2: Oceanic biogeographic zones and plate boundaries around Europe](image)

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Studies at the sea floor interface have become multi-disciplinary as the interaction between venting of fluids and specialised biological communities living on the sea floor has been elucidated. Oceanic areas around Europe comprise a remarkable variety of such vent habitats, from mud volcanoes, pock marks, seeps, and carbonate mounds, to hydrothermal hot vents at the mid-ocean ridge. It is thought that the biodiversity of related ecosystems and of the deep waters around Europe, still being discovered (e.g. HERMES), exceeds that of the total European land mass. ESONET will allow for decadal monitoring of these biodiversity hotspots, setting up for groundbreaking discoveries on issues such as microbial biodiversity, life in extreme environments, and the importance and role of the subsurface biosphere.

B.3.2. The temporal ecology of photosynthetically and chemosynthetically driven benthic ecosystems

There have been very few long-term observations of deep-sea benthic ecosystems. Only two major studies have been reported to date, that undertaken on the Porcupine Abyssal Plain (Bett et al., 2001; Lampitt et al., 2001) and that in the deep northeast Pacific (Ruhl and Smith, 2004). Both of these studies demonstrated a very close linkage between surface ocean processes and the ecology of the benthos, providing a route through which climate change may impact even the abyss. These studies also showed the scope for dramatic regime shifts in the benthic fauna in response to changes in the quantity, quality and dynamics of sedimenting photosynthetically derived organic matter (Wigham et al., 2003). These two long-term studies have revolutionized our understanding of deep-sea biodiversity and biogeochemistry. Their results also indicate the critical importance of long-term observations.

Although photosynthetically derived organic matter primarily fuels the majority of deep-sea benthic communities there are a number of important chemosynthetically driven, cold seep systems. The “exotic” faunas of hydrothermal vents are comparatively well known but there are many other cold seep systems (Sibuet and Olu-Le Roy, 2003, Cunha et al, 2006). There is now a clear need to better understand these systems, e.g. they are thought to have conservation value (Baker et al., 2001) and may be significant in the carbon cycle and climate change. The fluids that fuel these systems may vary in composition and flow rate, consequently it is to be expected that the associated benthic communities will react in response to these changes (see also section on fluid flow above). Even comparatively subtle changes in organic matter supply can result in major changes in the benthos (Billett et al., 2001).

To establish observatories in both photosynthetically and chemosynthetically driven benthic ecosystems and initiate continuous long-term monitoring of the benthos, these observations of the benthos have to be supported by measurements of incoming organic matter and fluid flow. Note that these measurements may be non-trivial and require new technology development. A highly desirable additional measurement would be “sediment community oxygen consumption”; again this is a non-trivial matter to implement. Ideally the observatories should be located in close proximity to one another to enable the influence of photosynthetically derived organic matter on chemosynthetic systems to be assessed.

This type of monitoring has been carried out using conventional moorings (e.g. Bett et al., 2001; Ruhl & Smith, 2004), but inevitably the observations become disrupted and discontinuous. Long-term visual (photographic and video recording) observations of the benthos do have a significant power and data-rate requirement. The ability to increase sampling and observation rates in response to variations in incoming organic matter and fluid flow would also be valuable.
New insights will be gained into the temporal dynamics of deep-sea benthic communities, particularly how they are linked to variations in organic matter supply. Clearly the proposed monitoring would benefit from integration with other benthic studies in the vicinity of the observatories. Studies of any other environmental parameters may be useful in interpreting the observed benthic responses.

B.3.3. The dynamics of deep seafloor hydrothermal vents ecosystems

Hydrothermal fluids act as the linkage between the geological/geophysical processes and biological activity at mid-ocean ridges and submarine volcanoes. Virtually all hydrothermal vent systems studied to date at mid-ocean ridges undergo a period of phase separation after input of new magma, the extent and duration of which appears variable. The initial period of intense phase separation after a magmatic event can result in mass fluxes that are as great in the first few months following the event as in the next year or two after the event. Diffuse hydrothermal fluids generally represent hydrothermal fluids that have been mixed extensively with seawater, and it is these environments that are likely to be the most important for deep sea vents biogeochemical processes.

Understanding these biogeochemical processes, and the resulting ecosystems, requires an observatory approach, and has crucial implications for frontier fundamental research, most notably on the evolution of life in the early Earth, or on the diversity and the adaptation of organisms to life in extreme environments. These studies have led to major discoveries in the applied field of biotechnology. Coupled monitoring of ridge and seamounts hydrothermal environments, as envisioned for the ESONET Azores network, also has significant potential for the durable management of fishing resources in the area. pH and key redox species dissolved in hydrothermal vent fluids and coexisting diffuse flow fluid can provide critical constraints on the feedback between inorganic systems, microbi ally regulated processes, and the macrofauna at mid-ocean ridges. Our goal is therefore to continuously monitor critical physical and chemical parameters in both focused and diffuse fluid flow, to track microbial evolution using colonization devices and developing new in-situ microbiological tools, and to relate these time series data to changes observed in the vents benthic organisms. The principal questions that stand out are the following:

- How does microbial community composition change over time, and how does it relate to geological and geochemical processes? pH and key redox species dissolved in hydrothermal vent fluids and coexisting diffuse flow fluid can provide critical constraints on the feedback between inorganic systems and microbi ally regulated processes at mid-ocean ridges. Recent data point to the existence of an extensive, yet uncharacterized subsurface microbial biosphere at the Azores vent fields, making them an ideal site for studying the subsurface microbial biosphere.
- What are the temporal and spatial scales of the biological response to perturbations caused by magmatic and tectonic events? A main goal of benthic community studies at mid-ocean ridge vents is to understand the relationships between changes in community structure and distribution, and concurrent changes in vent fluid flux, temperature and chemistry (in relationship to tectonic and volcanic events), and to understand biological interactions among species competing for limited habitat space. Time-series studies will provide a means of studying organism growth, faunal succession, biological interactions, and the response of species and communities to environmental changes.
- What are the major mechanisms for larval dispersal and recruitment? Vents are distributed as discrete patches on the ridge and are transient on time scales of decades. Since most species in the communities are endemic to vents, their persistence depends on their ability to disperse away from senescent vents and to colonize newly-opened ones. The mechanisms of dispersal...
and their influence on population dynamics and community structure remain an open question. Getting answers on this first order question requires continuous monitoring of the water column around the vents, with a network of instrumented moorings.

- What is the contribution of subsurface chemosynthesis to overall primary productivity? The fluxes of geochemical tracers, particles and biota released into the water column near the vent field have yet to be assessed, and their variability through time is not known. These will be addressed, together with larval dispersal, with instrumented moorings surrounding the vents.

B.3.4. Pelagic (upper ocean) ecosystems

There are at least three main drivers that demand close attention to pelagic ecosystems: i) In its simplest sense pelagic ecosystems are a resource and provide food for a substantial proportion of the world population; ii) In addition these ecosystems provide the mechanism for the removal of about 20% of the anthropogenic carbon introduced into the atmosphere. This so called “biological pump” will undoubtedly be affected by the climatic changes that are currently taking place in terms of the increase in acidity of the oceans, its warming and the predicted increase in stratification and enhanced dust supply from the continents; iii) the diversity of the oceanic system is still being realized and without doubt it will provide an increasing range of substances for use in such areas as pharmaceuticals. It is the high diversity of the system that provides such opportunities and without clear knowledge of the ways in which such systems are structured and how they function, the diversity will not be realized and the effects of climatic change on such diversity cannot be predicted.

The ways in which the ecosystem will respond to climate change are unknown and this is largely as a result of insufficient observational data. This deficiency in data is not only in the quality of the data but also and most importantly because the duration of observation is frequently too short to determine the natural variability of the system and hence the nature of any signal. This is particularly important in cases where the function of the system is affected to a large degree by episodic events such as blooms. In order to obtain this observational ability the present observing systems must be radically upgraded and a central part of this will be the construction of an array of cabled multidisciplinary long-term observatories. A variety of instruments are currently available with which to make in situ measurements. These range in complexity from those that simply measure the concentration of a substance in the water (e.g. Fluorescence as a proxy for phytoplankton concentration) to those that manipulate a sample in some way before making a measurement (e.g. Primary production after 14C inoculation and a 24 hour incubation). Development of such instruments is progressing in several centres across Europe but in many cases their application can only be realized if there is an adequate power and data stream supply route. The first phase of this development will involve a significant degree of technical development of appropriate sensors so that they can be linked to the cabled network. However from a scientific perspective the main objective will be to make high quality and high frequency observations on a variety of indicators of ecosystem structure and function. This will involve for instance the use of visual imaging systems to characterise the microbial and macrobiotic components of the community. The measurement of rate processes such as on primary production will also be a key component. Acoustic devices to determine the distribution and behaviour of marine mammals are in their infancy but nevertheless provide a means to examine these elusive components of the marine biosphere. These various observations can at present only be carried out from research ships due to the high power requirements of the sensors and the large data streams that come from them. There is a variety of sensors currently available but for many of them, the power requirements are too large for them to be deployed for significant periods of time in remote locations at a reasonable rate of sampling.
Furthermore the quantities of data are frequently too large for conventional data storage systems and the data rates too high for satellite transmission. This is particularly true for optical and acoustic sensors. As stated above the issue of data security is one of increasing concern and it is only when the data have been archived on land that they can be considered as secure. Near real time data transmission is essential if this is to be achieved. From the perspective of the protection of marine ecosystems, the crucial results which will arise will be an understanding of the time varying properties of a number of key ecosystems. This will be in terms of both variations in their instantaneous characteristics (e.g. abundance of Mesozooplankton) and also variations in the rates of key processes (e.g. Primary production or migration rate of whales).

The specification of the precise variables which must be measured will be developed during the ESONET NoE and clearly this will affect fundamentally the type of sensors which are required and the ways in which they will be integrated into the cable system. At present most pelagic observatories comprise a mooring line with sensors attached at various depths. However, there are some current developments which will provide the capability to profile large sections of the water column with a single set of sensors. One such development is the “SeaCycler” in the EU FP6 program CarboOceans. There are various advantages to this such as the use of only one suite of sensors having one set of calibrations (re-zeroed for instance at a deep water location). Such profilers may very well be included in the technology required in the cabled system but once again the availability of enhanced power and data transmission will enable such systems to be used in a much more powerful manner than if reliance has to be made on batteries and on board data storage or satellite transmission.

In the context of protection of pelagic ecosystems, the water column should not be seen in isolation and the processes and ecosystem properties of the benthos should without doubt be studied at the same place and time. In order to interpret the observations adequately, there are a number of other observations that are also required (e.g. nutrients and physical structure of the water column) and a modelling framework in which to provide the final integration. Such interdisciplinary observations are a highly advantageous aspect of an integrated observing system. In addition to interdisciplinary observations mentioned above which are highly advantageous, multidisciplinary observations can and should be carried out wherever possible. One does not suggest for instance that the short term variations in primary production have a direct effect on borehole properties. However where such observations can be co-located there are substantial logistical advantages. In the case of a cabled observatory array such logistical advantages must be explored in great detail and sites will be selected where such multidisciplinary studies are desirable.

**B.3.5. Coral reefs and Carbonate Mounds**

Within the last decade, a great number of cold water corals and coral covered carbonate mound structures have been discovered at the European continental margin. These mounds are suggested to represent modern carbonate knolls, made up of active bioherms or living carbonate reefs, possibly developed through seepage of dissociated gas hydrates and/or other hydrocarbons from below through faults and fissures. Cold seepage in turn leads to a higher than normal concentration of bacteria and micro-organisms at the seabed and in the water immediately above, having a significant influence on local benthic community development.

The continental margin around Europe offers the unique opportunity to study processes in an extremely diverse habitat structure and biodiversity in combination with all major geomorphological structures in a relatively confined area. Recent scientific exploration along the European ocean margin showed the existence of a deep-water coral ecosystem belt stretching from...
northern Norway to NW Africa and extending into the western Mediterranean Sea. Two colony forming stone, cold-water coral species, *Lophelia pertusa* and *Madrepora oculata*, have the potential to construct impressive reef frameworks similar to their tropical cousins and with an as rich biodiversity. Aside from these structural aspects, deep-water coral ecosystems attract a yet unknown number of associated species that live there permanently or temporarily there. Many of them and especially fish are of economic importance. Microbes seem to be ‘key players’ in mound-building processes. Prokaryotic organisms have played this role since the Archaean. The mounds of the Porcupine Basin and Rockall Trough seem therefore to be a possible recent link to microbial carbonate formation in earth history. However, though the formation of such carbonates is common even in the cold and deep waters of the NE Atlantic, the mechanisms and environmental factors that control this diagenetic process are currently unknown.

We are just beginning to understand the functional role and the dynamics of the key species in carbonate mound-coral ecosystems. Most intense occurrences are concentrated in areas where a complex seabed topography such as banks, ridges, seamounts, canyon systems and fjords exert a physical control on the deep current flow. Main questions to be addressed are: what is the influence of the ambient biogeochemical conditions on the biodiversity, functioning and dynamics of the coral-carbonate mound ecosystem thriving under this trophic situation at present and in the past? What is reaction of marine ecosystems to global change?

Last but not least, cold water corals represent an important biological resource, which is in many places severely exploited and under threat. Among a suite of human impacts to the deep coral ecosystems, demersal trawling is by far the most destructive. These facts and the great significance coral-carbonate mound ecosystem at the Irish Atlantic Frontier in combination with an existing data base from previous EU-programmes (OMARC Cluster) led to the planning of a optical cable based net work of observatories.

**B.4. Non-living resources: investigating and monitoring the effect of deep-water exploitation on the biosphere and geosphere**

The ‘thematic strategy on the protection and the conservation of the marine environment’ aims to ensure that all EU marine waters are environmentally healthy by 2021. On the other hand, hydrocarbon production is a vital driver both in the EU energy demand discussion as well as in the non governmental organization dialogue. The integration of science and economics to promote sustainable development of non-living deep-sea resources is still in its infancy and the EU’s current sector by sector approach to environmental protection of the seas is too fractured. Major economic issues exist relating to the positive and negative aspects of hydrocarbon extraction. However the development of valuation systems for the deep-sea lags behind studies conducted in terrestrial environments.

Offshore ocean exploration and monitoring is a major task for oil and gas industry. Since fossil hydrocarbon resources will last for at least fifty more years, the industry will invest much into infrastructure and new techniques for optimized exploitation. This will lead consequently to enhance underwater developments. In the future, huge production platforms will be replaced by smaller subsea solutions, deployed directly on the seabed. This goal demands build up of a new network of power- and data-cables at the affected continental margins. Underwater platforms, wells, and pipelines will be equipped with sensors for continuous data transmission. There will be less need for oversized ships and man power at sea. The risk of platform hazards or pollution due to hydrocarbon
leakage should be minimized. Main operation and control is possible from land. Several systems are already in operation or in the planning phase.

These integrated operations are currently a hot topic in the petroleum industry. Most operators have built onshore operation support centers for real-time optimization of drilling operations and production. Real-time onshore monitoring and control of wells and offshore processing are likely ingredients of the subsea-to-shore concepts in the future. These developments now open up for a new perspective on cooperation between the petroleum industry and ecology R&D. A subsea-to-shore production concept includes data and power cables from shore to offshore subsea facilities located some hundred kilometers offshore. One idea is to integrate a subsea field development with a marine subsea cabled observatory. As petroleum industry moves to deeper waters and higher latitudes, online monitoring around underwater platforms and pipelines, using state-of-the-art sensor and instrument systems is urgently required. This can be achieved in close collaboration between the petroleum industry and the EU science community.
Monitoring of the ocean margin is, in itself, not a trivial task and will need to foster energies from all EU member states in a variety of disciplines, including engineering, telecommunications, information technology, biology, ecology, geology, geophysics, oceanography and socio-economics. A multi-faceted approach is required. In order to be effective, however, the placement of fixed observatories cannot be random or limited to locations that offer cheap alternatives. Instead, the division of the European ocean margins into representative zones, each with an observatory capacity, is a more fruitful way of maximising environmental monitoring capacity. Indeed, the main innovation of ESONET is to co-ordinate the use of existing European infrastructure. It is not necessary to complete a cabled network around Europe from the outset, rather a phased introduction of appropriate technology in key provinces is more realistic. Many potential sites have already been identified as being operable to some degree and provide promising opportunities in terms of their scientific contribution to the network, geographical location and adaptability. Some of these sites are already being evaluated with regard to forming the principle strategic nodes of an ESONET, and plans are being put in place for future integration. The sites so far proposed include, but are not limited to, eleven initial locations.

The European ESONET organization (to define in a perennial forms as soon as possible by the network) will specify standards and protocols defining both ends of the system (land and sub-sea systems) for interoperability and modularity but leave to each bid for tender the specification of technical details of cable engineering, power supplies or intermediate communications protocols. It should promote and seek funds for development of the network. It will also assume the links with the EU policy requirements in environment and security (GMES, GEO,…) 

One objective of ESONET NoE is to organize each regional observatory by a legally incorporated entity that could own property, hold bank accounts and enter into contracts nationally or internationally (regional legal person=RLP). This might be a research institute, a government agency, a company or a partnership or private organization depending of the size and circumstances of the project. The regional legal person (RLP) would be responsible for providing the utility services to the observatories in the ocean and will report to the stakeholders and financing bodies.
The RLP will responsible for receipt of funds from international, national or regional sources and paying for installation and operation of the regional observatory. Since the RLP controls funds, it should be responsible for choice of technical solutions, deployment and operation of the system, albeit with constraints from the ESONET organisation and potential users.

**ESONET permanent structure linked to Regional Legal Entities**

![ESONET federation diagram]

In the case of a small system, not cabled for instance, it may be possible for a large RLP to own, install, operate and service the observatory using its own technical resources including ships and remotely operated vehicles. It is already the case for example for Ifremer which operates an acoustically controlled autonomous observatory in the canyon of Var for three years (demonstration included into EC Hermes project). This scheme would generally not possible for cabled observatories which include complex sub systems.

### C.1. Arctic – Arctic Ocean

Arctic water exiting into the Atlantic ocean between Europe and Greenland is an important component of the global deep water circulation of the planet and its heat budget. Establishment of a long term station here is important for tracking global change as ice cover decreases but there are also important deep sea habitats such as mud volcanoes in the ‘Hausgarten’ region, off Svalbard.
C.1.1. Scientific context and relevance
Arctic ecosystems are adapted to extreme environmental conditions with large seasonal forcing and the increasingly rapid rate of recent climate change poses new challenges to the resilience of arctic life. The entire system is faced by fast changing ice and water conditions, varying primary production and food availability to faunal communities, an increase in contaminants, and possibly increased UV radiance. The adaptive capacity of a number of arctic populations and ecosystems is probably not strong enough to withstand the sum of these factors that might lead to a collapse of subsystems.

C.1.2. Scientific objectives
To detect and track environmental changes in the transition zone between the northern North Atlantic and the central Arctic Ocean, and to determine experimentally key factors controlling deep-sea biodiversity, the German Alfred Wegener Institute for Polar and Marine Research (AWI) established the deep-sea long-term observatory HAUSGARTEN. This observatory is located in Fram Strait, the only deep connection between the central Arctic Ocean and the Nordic Seas, where exchanges of intermediate and deep waters take place. Circulation patterns in Fram Strait result in a variable sea-ice cover, with permanent ice-covered areas in the west, permanent ice-free areas in the south-east, and seasonal varying ice conditions in central and north-eastern parts, i.e. in the wider HAUSGARTEN area. The dramatic decrease in sea-ice extent observed over the last decades causes an ongoing northward shift of the ice-edge related primary production.

C.1.3. Existing national and international programmes on the site
Multidisciplinary research activities at HAUSGARTEN are carried out in close co-operation with national and international colleagues, and cover almost all compartments of the marine ecosystem.
from the pelagic zone to the benthic realm, with some focus on benthic processes. Some aspects of the research activities carried out at HAUSGARTEN are embedded in the institutional research programme “MARCOPOLI” of the AWI. This concerns benthic biodiversity studies, particle flux studies, and geochemical studies on exchange processes across the sediment-water interface. Other intended research efforts such as habitat mapping and classification, automation of underwater image analysis are pending.

C.1.4. Preliminary design of the implementation and possible schedule

Phase 1: autonomous nodes
Phase 2: cable and first nodes
Phase 3: cabled observatory

In its actual design HAUSGARTEN (Phase 1) is an autonomous observatory consisting out of 15 permanent sampling sites along a depth transect from Vestnesa Ridge to the Molloy Deep (1000-5500 m) and along a latitudinal transect following the 2500 m isobath crossing the central HAUSGARTEN station. The central station serves as an experimental area for long-term experiments at the deep seafloor. Repeated sampling and the deployment of moorings, different long-term lander systems, which act as local observation platforms, and the installation of other long-term in situ instruments has taken place since the beginning of the station in summer 1999. Frequent visual observations with towed photo/video systems allow the assessment of large-scale distribution patterns of larger epibenthic organisms. At regular intervals, a working-class Remotely Operated Vehicle is used for targeted sampling, the positioning and servicing of autonomous measuring instruments, and the performance of in situ experiments and geo-referenced video-footage. A 3000 m depth rated Autonomous Underwater Vehicle (AUV) extends our sensing and sampling programs of the near future.

Phase 2 (2007-2009) will include the installation of a junction box (free-falling device) with local energy supply for short- and medium-term observations, measurements, and experiments. The intention is not only to acquire experiences with this kind of technology, e.g. the handling of underwater plugs by an ROV, but also to prepare for event-driven activation of, for example, sediment traps, water sampler, crawler surveys.

Phase 3 (from 2010) includes the cable connection of HAUSGARTEN observatory to a land base. Koldewey Station, a permanent station of the Alfred Wegener Institute for Polar and Marine Research in Ny Alesund, Spitsbergen, is only about 200 km away from HAUSGARTEN and could be considered to be such a base.

C.1.5. Regional consortium of users and financing institutions

The observatory is at present predominantly maintained and used by the deep-sea research group of the Alfred Wegener Institute. However, each year scientists from other German and European institutes are participating in either our field work or the later analysis of samples in the laboratory. The planning reliability in access on the station offers good opportunities for other users to share their expertise and infrastructure at HAUSGARTEN. Close cooperation links exists, for example, to the Institute for Polar Ecology (Kiel), the Max-Planck Institute for marine Microbiology (Bremen), the University Ghent (Belgium), Institute of Oceanology in Sopot (Poland), and the PP Shirshov Institute of Oceanology Moscow (Russia). At present the observatory is maintained by institutional funds of the AWI.
C.1.6. Participants
AWI, IPÖ/Kiel, IOPAR/Sopot, University Ghent, IORAS/Moscow, etc.

References


C.2. Norwegian margin - Atlantic Ocean
The Norwegian margin region has shown slope instability with evidence of major slides which if repeated could result in catastrophic damage to offshore oil and gas installations as well as indirect effects of tsunamis striking the coasts of the British Isles and elsewhere. Special deep water habitats, such as coral reefs, are also an issue.

C.2.1. Scientific context and relevance
Although there is a wide range of evidence indicating that global warming is taking place we are not well prepared to detect rapid as well as long term thermohaline circulation changes on a human time scale. How rapid and at what amplitude do changes in thermohaline circulation in the Nordic Seas occur? If there is a response of the Nordic climate to rapid changes in ocean circulation what are the potential temperature amplitudes? Fluid flow from gas hydrates and geohazards may be a significant process within continental margins. The flow and gas emission at the seabed system that operates within them is not understood, even at the most fundamental level. Fluid flow is also potentially an important influence on the local distribution of benthic biota on continental margins and on biota in the sediments beneath them. We need to understand flow systems at a range of time and scales from that operating through the whole margin to those acting through a single seep. Do potential areas of deep-sea methane release have impacts on geohazards or climate? What are fluid flow episodes and how do they relate to ocean temperature changes?

Did you know that the seabed of ocean margins functions like a great bioreactor which harbours a vast diversity of microorganisms? There is ample evidence indicating that gas production, degradation of hydrocarbons, precipitation of minerals, transformation of metals and much more are all microbial processes shaping ocean margin ecosystems. However, we are only beginning to identify the key microorganisms in these processes.

Two sites of major interest relate to both the very important northern high latitude thermohaline circulation loop and gas hydrates. The thermohaline circulation to the Norwegian Sea manifested in the northward directed warm-water flow of the Norwegian current – determines climate and living conditions above the Arctic Circle. Its warm water masses reach down approx. 700m, bathing the
upper slope of the Norwegian continental margin. It is known that “switched on/off” scenarios existed for the Norwegian current and those changes occurred during global climate change. It is deemed important to understand its short and long term development for predicting rapid and/or drastic changes which may, in turn, influence resources such as fish stocks in the ocean or societal living conditions on land.

Second, gas hydrates consist of ice-like crystals and store huge amount of methane, which is a potent greenhouse gas. Gas hydrate melting and methane release may have elevated the planet out of ice ages, but they also may contribute to a future increase in global warming. The stability of this cold ice stored in sediments of the continental margins depends on both temperature and pressure. Thus the ocean bottom temperature is to be monitored in order to decipher potential environmental impacts. Two observatory stations with cable transects, one on the Mid-Norwegian margin close to one of the largest deep-water gas fields in Europe (Ormen Lange at Storegga), and one on the Barents Sea continental margin at a submarine mud volcano (HMMV), are envisioned. The sites range from approximately 900 and 1200 m water depth to the shallow water depth of the Norwegian current.

C.3. Nordic Seas – Atlantic Ocean

The MOEN (Meridional Overturning Exchange with the Nordic Seas) station uses the Faroes branch of the CANTAT-3 cable for measuring water column induced voltage. The recorded voltage is strongly influenced by the inflow of the North Atlantic Current. Long term monitoring of this current is of paramount importance in the understanding oceanic fluxes of heat, salt and freshwater at high northern latitudes and their effect on global ocean circulation and climate change in the arctic region.

C.3.1. Scientific context and relevance

The relative pleasant climate of the Nordic Countries is to a large extent the result of the warm saline water that enters the Nordic Seas. This flow has not only scientific but also social economic impacts. Even a small disturbance, anthropogenic or naturally, will most probably induce strength on the European community. The reason for the present climate is the large amount of warm water that flows northwards eventually passing the Faroe Islands. The current system responsible for the heat transport has its origin in the Gulf Stream. At higher latitudes a northern branch develops flowing northwards. This water is characterised as warm, saline and buoyant. At northern latitudes about 8 million cubic meters per second enters the Nordic Seas by passing over the submarine ridge that lays between Greenland and Scotland. Here the currents release their heat to the atmosphere and as a result become cold and saline. This transformation makes the buoyant water dense and as a consequence sinks. The submarine ridge acts as wall arresting the descending water north of the ridge. This process has been on going for a long time and a steady state has developed where the sinking water eventually escapes through the deepest channel in the ridge, which is located south of the Faroes. The surface inflow, the sinking followed by the escape acts as a thermal pump; the process has therefore been named the thermohaline circulation (THC).

From the simplified picture, outlined above, it becomes evident that the climate is dependent on the strength of the thermohaline pump. It is thought that a slight raise in average temperature will increase the melting of the Greenland ice sheets. The added fresh water will slowly dilute the saline surface waters in the Nordic Seas and eventually, create a lid of buoyant water that will become strong enough to resist the force of the north flowing water, as a consequence the warm water will be hindered from reaching the higher latitudes. This picture is however painted with a course brush and there could be compensating effects that will keep the lid at bay. Recently there was a report on
an observed freshening of the Nordic Seas. The forecast, suggested that the inflow could cease in about 100 years timescale (Curry and Mauritzen Nature 2005). Shortly afterwards a new report was released presenting results that show that the freshening could to some degree be balanced by an increasing salinity of the inflow induced by lateral displacements of the subpolar gyre (Hátún et al. Nature 2005).

More and more studies suggest that the THC cannot be regarded as a simple heat pump. Small-scale phenomena are strongly linked to the dynamics of the THC. Unfortunately there is a lack of long-term observations covering the North Atlantic. The reason for this is that monitoring with traditional instruments is costly. Higher instrumental density and introduction of alternative measuring techniques are to large extent excluded by the pertinent financial situation. The social-economical importance related to the inflow strongly suggests that this region by necessity is developed into a Nordic Node as a part of a European observatory strategy. The Atlantic water inflow is the key parameter for the wealth and stability of the European Community.

C.3.2. Scientific objectives

First-hand objective is to establish a continuous monitoring of the inflow of the Faroe Branch (north of the Faroese) and the Shetland branch (southeast of the Faroese) and the overflow of dense water (south of the Faroese). The ultimate goal is to use the Nordic Node for now-casting and fore-casting of the thermohaline circulation, hereby making it the “warning bell” of a changing climate. The observatory approach will allow the measurement to become more versatile then what the case is today, thus a backbone of sensors will easily be complimented by other instrumentations tailored for special studies, e.g. oceanographic, chemical and biological investigations. An extraordinary benefit is that data from several sensor systems become synchronized and stored coherently. The scientific objectives are to continuously observe the flows in and out of the Nordic Seas at the Faroese region and to relate these to the dynamics of the North Atlantic and the Nordic Seas. Studies of the inflow related to temperature changes of the arctic are of interest as well as influence of salinity dilution of the circulation. The meteorological influence on the circulation is also of interest, especially the redistribution of water due to wind forcing. Combination of flow with meteorological observations will improve the understanding of the wind driven dynamics. Finally to develop a forecasting system based on data from the node is a challenge that will include the merging of frontier research in meteorology, climatology, oceanography and technology.

C.3.3. Existing national and international programmes on the site

Since 1994 there has been an observational program in the region based on bottom mounted ADCPs combined with standard hydrographical sections. This has been to a large degree dependent on financing from the European Community, e.g. Veins and MOEN projects. During, temporarily lack of EC support, the program has been kept alive by local initiatives. The latter has to a large degree excluded joint use of data and sometimes resulted in reduction of sensors. By tradition the flows have been monitored by the scientists from Faroese, Norway, Scotland, Germany, Iceland and Sweden. Stockholm University has been working on the inflows and overflow for several years both theoretically and experimentally. In the EC financed project MOEN, a cable-based measurement was developed as fore runner for a future observatory. This instrument makes use of a 100 km sub-sea cable and produces near-real-time data of the integrated flow north of the Faroese.
C.3.4. Preliminary plan for the Nordic Node:

1) The forming of both a central consortium and a peripheral interest group (the former connected to ESONET and the latter constituting the scientific user group)
2) Investigation of techniques, liability and costs to serve as basis for proposals
3) Pan-European proposal for the Nordic Node
4) Establishment of regional ESONET-committee
5) Deployment of first leg of Node
6) Evaluation of the Node-success (lessons learned, improvements)
7) Extension of the second leg of the cabled node
8) Extension to the third leg

C.3.5. Participants:

Sweden: Stockholm University, Peter Sigray
Sweden: Stockholm University, Peter Lundberg
Sweden: Stockholm University, Johan Nilsson
Faroese: Faroese Fishery Laboratory, Bogi Hansen
Norway: Bjerknes Center, Svein Østerhus

Selected References for Node description and participants:


C.4. Porcupine/Celtic –Atlantic Ocean

The Porcupine Seabight and Abyssal Plain area has been an important area for biogeochemical flux studies in the past but is also a very productive fisheries and oil-gas exploration area. It is a stable margin with little evidence of seismicity, but does have important deep water habitats.

C.4.1. Scientific context and relevance

The area of the Celtic Sea shelf into the Porcupine Seabight and out to the Porcupine Abyssal Plain (Fig 3) is the most intensively studied part of the European NE-Atlantic margin.

![Figure 6](image1.png)  
**Figure 6**: The NW-European continental Margin in the vicinity of the Porcupine Seabight. In the last 25 years intensive time series studies have been carried out at Station PSB (UK & EU-programmes), PAP (UK & EU-programmes), BIOTRANS (German & international JGOFS programmes) and on the slopes and at Goban Spur, OMEX-Transect (EU-Projects).

![Figure 7](image2.png)  
**Figure 7**: The Porcupine/CeltNet area southwest of Ireland covers two biogeochemical provinces: NADR and NECS. Very high seasonal phytoplankton blooms occur in these provinces.
C.4.2. Scientific objectives

Recent scientific exploration (FP 5 OMARC) along the European ocean margin proofed the existence of a deep-water coral ecosystem belt stretching from northern Norway to NW Africa extending into the Mediterranean Sea. The two colony forming stone coral species, *Lophelia pertusa* and *Madrepora oculata*, have the potential to construct impressive reef frameworks similar to their tropical cousins. They are essentially involved in the formation of the spectacular carbonate mounds off Ireland. Aside these structural aspects, deep-water coral ecosystems attract a yet unknown number of associated species that live permanently or temporarily there. Many of them are of economic importance. This important biological resource, however, is in many places severely exploited and under threat. Amongst a suite of human impacts to the deep coral ecosystems, demersal trawling creates by far the strongest destruction. We are just at the beginning to understand the functional role and the dynamics of the key species. Most intense occurrences are concentrated in areas where a complex seabed topography such as banks, ridges, seamounts, canyon systems exert a physical control on the deep current flow such as by the generation of topographically-guided filaments, current acceleration and density-driven convection. In this respect, the coral ecosystem acts as a benthic recorder of ocean circulation, nutrients and carbon flow. Therefore distribution of deep-water coral/ carbonate mound ecosystems at the Irish Atlantic frontier can be applied to understand the structure, functioning and dynamics under the particular trophic system of the NADR (North Atlantic Drift, Fig. 4).

The trophic state of the upper mixed ocean layer in the NADR is seasonally eutrophic with significantly pulsed particle exports from the upper mixed layer in spring and late summer. Of particular interest is the question: What is the influence of the NADR biogeochemical conditions on the biodiversity, functioning and dynamics of the coral/carbonate mound and other benthic ecosystems thriving under this trophic situation at present and in the past? Global change and the reaction of marine ecosystems can be addressed by investigating the change of biodiversity which occurred in deep-water coral ecosystems during the last glacial-interglacial cycle. While the now vigorously growing coral reefs in Scandinavian waters started to develop in a formerly glaciated environment just at the end of the Termination IB, the geologic history of the coral-capped carbonate mounds off Ireland probably extends back over the past 2 Million years.

Coral-covered carbonate mounds of the Belgica Mound Province (BMP), north-eastern Porcupine Seabight are main targets for proposed long-term seafloor observatories. The BMP consists of about 25 exposed and 20 buried carbonate mounds that structure the continental margin in a confined depth limit between 600 and 900m (Figs 5, 6). Exposed mounds arise 50 to 200m above the adjacent seabed, thus forming topographic obstacles in the local current regime. While the shallower mounds are covered by early Holocene coral debris, flourishing coral ecosystems thrive along the summits and flanks of the deeper exposed mounds. Here dense thickets of colonial coral frameworks, produced by *Lophelia pertusa*, *Madrepora oculata*, and locally by stylasterids provide a complex 3-dimensional habitat for a species rich community of benthic and demersal organisms. was influenced by global change, i.e. the peaked Northern Hemisphere glacial-interglacial cycles.
Adjacent to the Irish continental margin extends the Porcupine Abyssal Plain (PAP). Surface water layer winter condition at PAP is of a mixed layer as deep as 500-800m driven by thermally convective overturning and wind forcing supplying nutrients into the upper mixed layer. With warming and reduced storm frequencies in spring the water column becomes more stable and a thermocline of about 50m thickness is established leading to major phytoplankton blooms (Figs 7, 8). PAP lies south of the main stream of the North Atlantic Current and is subject to return flows from this coming from the west and northwest. An intermittent stream of cyclonic and anticyclonic mesoscale eddies occurs across the area extending sometimes several thousand meters into the water column. During the past decade the intention has been to observe changes in rate and state variables within the entire water column and benthos for a wide range of biogeochemically significant features in the centre of the PAP (BENGAL Station). The site appears to satisfy many of the conditions for simplicity as it lies well apart from the continental margin where physical gradients are strong. It is situated in the middle of the biogeochemical province of the North Atlantic Drift and there is no evidence of significant advective supply of material. Processes at the seabed are dynamically coupled to upper mixed layer processes geared by atmospheric forcing. The downward flux of particulate matter from the upper part of the water column has a profound effect on ocean biogeochemistry and hence on the global climate. As the material sinks it is subject to remineralisation and with increasing depth, the chemical components such as the greenhouse gas CO₂ become more and more isolated from the atmosphere. Export below the winter mixed layer may isolate it from the upper ocean for decades or centuries. In deeper part of the water column (>1000m) long-term moored sediment traps have shown that there are strong regional variations in magnitude and seasonal variation in downward particle flux, controlled to a large extent by upper
ocean biogeochemistry and plankton community structure (biological pump). Plankton dynamics produce strong seasonal signals as well as significant interannual variations both in the timing and magnitude and composition of the organic matter flux to the sea bed.

Life in the deep sea is almost entirely dependent on the fall out of organic matter from the surface layers. Therefore the abundance, biomass and composition of deep sea life are influenced by the patterns of surface productivity. The abundance of deep sea fishes is clearly influenced by surface production. Furthermore the flux from the surface varies both seasonally and from year to year in quantity and biochemical composition. In the NADR province on the Porcupine Abyssal Plain a strong seasonal deposition of phytoplankton has been repeatedly observed between late May and late summer at 4800m depth (Figs 9,10). Over time the composition of the deep sea fauna has changed possibly associated with change in fluxes to the deep sea influenced by the North Atlantic Oscillation. During 1997-2000 a sudden infestation of the Northeast Atlantic Ocean abyssal plain by sea cucumbers *Amperima rosea* (6457 ha⁻¹) and brittle stars *Ophiocten hastatum* (54,000 ha⁻¹) was detected. If such events had occurred following some human intervention, such as deep sea waste disposal, it is likely that the anthropogenic effect would have been held responsible. It is evident that the deep waters around Europe function as coupled systems and it cannot be assumed that the deep sea is uniform and stable but is in dynamic equilibrium with the upper ocean. Large scale changes occur that are very poorly understood. The central Porcupine Abyssal Plain location (PAP) in the NADR is the best monitored deep sea abyssal location in Europe. However monitoring only began in 1989 and a number of years are missing from the time series. There is an urgent need to establish continuous monitoring at this and other sites in order to track changes over time in the oceans around Europe. Simple exploration during single visits to locations is no longer adequate.
The continental margin and the Celtic Sea southwest of Ireland offers the unique opportunity to study processes in an extremely diverse habitat structure and biodiversity in combination with all major geo-morphological structures in a relatively confined area. These facts and the already existing data base led to the planning of a glass fibre optical based network of observatories – **CeltNet** -in the Porcupine Region (Figs. 11, 12) within the FP-5 ESONET Project because:

- It encompasses all important deep-water habitats (except seeps) in a confined area.
- It contains large habitat diversity and biodiversity and thus an enormous genetic and natural product potential.
- It is located in a region, where global changes will manifest rapidly (changes in atmospheric forcing, currents, productivity, plankton and benthic biota, fish stocks).
- It contains ecosystems with high indicator potential, dynamically responding to either natural or anthropogenic environmental changes (e.g. aphotic corals)
- It is impacted by economic interests (fishing, oil and gas prospection) and a high anthropogenic disturbance potential (shipping accidents).
- There is a strong demand for environmental protection (foundations of MPAs) by nature conservation stakeholder.

Some major objectives addressed by CeltNet are to make long-term systematic observations of marine abiotic and biotic processes and key parameters in the Porcupine region such as: Climate change depicted by:
- coral biota response,
- other key biota response (e.g. sponge belt and abyssal megafauna)
- biodiversity and habitat changes
- productivity changes,
- biogeochemical changes (proxies),
- changes in the quantity and composition of deep water masses (salinity, temperature, current speed & direction),
- variation in surface water masses (integrity of the North Atlantic Current),
- changes in atmospheric forcing (e.g. NAO impact),
Anthropogenic impact depicted by:
- coral and other biota response,
- biodiversity and habitat changes
- occurrence and distribution of pollutants

Transport processes at different margin morphologies:
- slope failures and sediment transport,
- canyons as conduits between the deep-sea and the upper slope,
- physical processes (e.g. tidal waves, internal waves, vertical mixing, upwelling, convection, filament formation).

C.4.3. Existing national and international programmes on the site

The extraordinary concentration of oceanographic research to the vicinity of the PSB and the repeated examination of the time series stations PSB, PAP and BIOTRANS led to a series of fundamental new insights and partly changes in paradigms on the functioning of deep water ecosystems: biodiversity, benthic-pelagic coupling, and long-term changes (global change) in deep-sea ecosystems. The spread of new surveying technologies in oceanography in the last decade (e.g. swath bathymetry, deep towed side scan sonars, ROVs, AUVs) resulted in the finding of geological structures and ecosystems of special interests such as carbonate mounds and deep-water coral reefs which have been lately intensively studied by programmes of the EU-OMARC cluster (ACES, GEOMOND, ECOMOUND). The Goban Spur continental margin transect investigations (OMEX) represents one of the few studies on the role and functioning of continental margins in the exchange of materials between continent and ocean as a basis for the development of predictive models of global environmental change.

The Celtic shelf and slope is a key area of industrial exploitation on the European continental margin with intensive fisheries down to about 2000m water depth and oil and gas prospecting. It is one of the main gate ways of global transport (shipping) with a high risk of environmental impacts by ship accidents with hazardous cargo. There is sound evidence of severe damage to ecosystems of special protectional need such as deep water coral reefs by trawling activity. The high biodiversity of the PSB and Porcupine Abyssal Plain (habitats, species) prompted international organisation (OSPAR) and natural conservation stakeholders (WWF) to demand the establishment of marine protected
areas (MPAs) in the Porcupine Seabight/ Porcupine Abyssal Plain proper extending to BIOTRANS (Fig 3).

The western European continental margin southwest of Ireland is a focal locality of colliding interests between the conservation of an unique biodiversity (habitats, communities, species) and industrial exploitation (fisheries, oil, gas) with high risks of large area contaminations by hazardous ship cargos (e.g. oil spills in 2002 “Prestige”, “Sea Empress”). To keep a balance between the health of the environment and human exploitation a sustainable management is needed. This can only be achieved with a monitoring strategy which includes the long-term observation of natural processes in combination with the monitoring of environmental impact parameters (physical, chemical, meteorological and climatological). A continuous observation should provide the data base for a series of forecasting models on the development of biological communities esp. fishable stocks, accidental pollution scenarios (alarms) and global climatological impacts.

C.4.4. Preliminary plan for the Porcupine Node:

A feasibility study for CeltNet is presently carried out within FP-6. The ESONIM Project identifies the best technical solution, provides the economic justification and suggests the appropriate legal structures to establish a seafloor observatory that conforms to the model defined by ESONET. ESONIM provides convincing reasons and the methodology required for national governments to implement seafloor observatories offshore Europe. ESONIM selected CeltNet as a model to demonstrate a transferable methodology to implement any of the ten proposed ESONET sites. A guide to scientific justification for a seafloor observatory site and a process for assessing revenue generation will be established, by inviting submissions from ESONET partners and interviewing end users of the proposed CELTNET site. The observatory architecture proposed by ESONET will be tested by an engineering design team who will select the best technical implementation solution for CeltNet. Using data provided by the engineering design team a business development team of financial and legal consultants will calculate the capital cost of installation, the running costs, the potential revenues, sources of funding and the cost of financing. Legal consultants will address insurance and indemnity issues, propose model contracts and suggest partnership agreements. Public private partnerships will be considered. The business development team will present a business model with a projected ten year cash flow forecast for the CELTNET site. The deliverables from ESONIM will be used by ESONET-NoE partners to petition their respective governments for support to establish seafloor observatories. ESONIM will promote and facilitate the take up of the results of ESONET and will contribute to the implementation of observing and forecasting systems to make long-term systematic observations of marine parameters necessary for global change research and management strategies.

C.4.5. Participants:

Marine Institute of Ireland
KDM/Geomar
Ifremer
University of Aberdeen
C.5. Azores – Atlantic Ocean

The Azores and Mid-Atlantic Ridge area has special habitats associated with hydrothermal vents and sea floor morphology is distinct with recent crust spreading from the mid ocean ridge axis.

C.5.1. Scientific context and relevance

The MOMAR (“Monitoring the Mid-Atlantic Ridge”) project was initiated by the international InterRidge Programme, to study active mid-ocean ridge processes along a slow-spreading ridge segment (Lisbon, 1998). The goal is to promote and establish a coordinated and multidisciplinary long-term study of hydrothermal environments at the Mid-Atlantic Ridge (MAR) near the Azores (35°N to 40°N).

Hydrothermal circulation at mid-ocean ridges is a fundamental process that impacts the transfer of energy and matter from the interior of the Earth to the crust, hydrosphere and biosphere. Seawater circulates through the permeable upper oceanic crust at mid-ocean ridges, exchanges chemicals with the surrounding rocks, and is heated up to temperatures of a few hundred degrees Celsius. This hot fluid flows up and is expelled at hydrothermal sites, in the form of black smokers, or diffuse vents. The unique faunal communities that develop near these vents are sustained by chemosynthetic microbes that use the chemicals in the hot fluids as a source of energy.

C.5.2. Scientific objectives

The objective of the MOMAR project is to study the temporal variability in active processes such as hydrothermalism, ecosystem dynamics, volcanism, seismicity and ground deformation, in order to constrain the dynamics of mid-ocean ridge hydrothermal ecosystems:

- What are the feedbacks between volcanism, deformation, seismicity, and hydrothermalism?
- How does the ecosystem couple with sub-surface processes?
- What are the mass, energy and biological fluxes at hydrothermal vent fields?

The implementation plan includes a multi-scale approach, ranging from the regional (>100 km) scale for seismicity, oceanography, and biological dispersion, to local (1 km) and very local (<1m) scales for the vent field and its ecosystem. The regional scale approach addresses fundamental issues such as:

- the relation between intermediate depth hydrothermal fields, seamount ecosystems, and the evolution of fishing resources in the Azores area,
- seismic and volcanic risks to populated areas in the Azores Islands,
- and the movement of deep water masses and the consequences of changing thermohaline circulation in the North Atlantic on climate and on biodiversity.

The planned regional seafloor system of geophysical observing sites will also be an important European contribution to the global network of seismic and magnetic observatories that is currently implemented to study the physics and chemistry of the Earth’s deep interior. The MAR near the Azores is ideally located for this marine multidisciplinary observatory project: it is near port (Horta on Faial Island; Figure 2), allowing for short transit times for the deployment and retrieval of tools, and making cable connection to shore an option for later stages of implementation of the project.
The MAR near the Azores comprises 4 known hydrothermal vent fields, each with its own specific geological, chemical, hydrothermal, volcanic and biological characteristics (Lucky Strike, Rainbow, Menez Gwen, and Saldanha). It has been the focus of a great number of cruises in the past few years, as part of the FARA program (French-American Ridge Atlantic), the MARFLUX (MAST II EC program), AMORES and ASIMOV (MAST III EC program) and VENTOX (Framework V), EXOCET/D (Sarradin et al, 2005) and MoMARNET (Framework VI; Cannat et al., 2006) European projects. The geological-geophysical background of this region is well constrained, as are the general characteristics of the known hydrothermal vents, and the broad diversity of the associated ecosystems.

The II and III MoMAR Workshops that took place in Horta, Azores (June 2002) (Santos et al, 2002), and in Lisbon (April 2005) provided an implementation plan for integrated studies and long-term observations in the MoMAR area. A list of critical experiments and an adequate order for implementation were established (all MOMAR workshop reports are available at www.momar.org). Following the II Workshop, the European scientific community coordinated several cruise proposals, and two EC proposals that have since been funded, one for development of observatory sensors (EXOCET/D; Sarradin et al., 2005), and the other a research and training EC network (MoMARNet; Cannat et al., 2006). A more recently funded FP6 project, NERIES, also includes MoMAR as one of its target sites for the long-term installation of a broad band Ocean Bottom Seismometer.

C.5.3. The MoMAR ESONET node. Outline of the implementation plan

Inside the MoMAR area, the Lucky Strike hydrothermal field (~37°37'N / 32°17'W) is the main target of the MoMAR ESONET node. Discovered in the nineties (Langmuir et al., 1997) this field has since been the object of many cruises, addressing its geological and geophysical characteristics (Detric et al., 1995; Cannat et al., 1999; Escartin et al., 2001; Miranda et al., 2005; Fouquet et al., 1995; Ondreas et al., 1997), as well as fluid chemistry and vent field biology (Desbruyères et al, 2001). Over 100 hydrothermal vents are distributed on the summit of a large axial volcano. Vent fluid temperatures range from the 330º C of black smokers, to low (200-212ºC), and very low (<20ºC) temperature fluids (Von Damm et al., 1998; Cooper et al., 2000). Fluid temperatures at some vents appear to be very stable over a time scale of a few years (i.e., Tour Eiffel, 324±1°C), while others show variability of >10°C (Statue of Liberty, 202-185°C; Sintra, 176-215°C; Charlou et al., personal communication). A recent seismic exploration (SISMOMAR cruise; PI W Crawford) was able to identify the seismic signature of the axial magma chamber below the hydrothermal field, which is most likely the heat source for the Lucky Strike hydrothermal system.

Long-term acoustic monitoring of the seismic activity (since 1999) of the Mid-Atlantic Ridge by networks of autonomous hydrophones moored in the SOFAR channel has demonstrated the usefulness of acoustic monitoring sensors deployed in the water column (e.g. Smith et al. 2002, Goslin et al. 2004). On average, due to the low attenuation of acoustic waves along their paths in the SOFAR channel, hydrophones are able detect 20 to 50 times more earthquakes than land-based networks (Figure 13) and provide better accuracy on their location (1-2 km error for events located within an hydrophone array). In July 2005, a network of 4 hydrophones has been specially deployed for a continuous monitoring of the low-magnitude seismic activity in the MoMAR sector at a regional scale (from 32ºN to 39ºN). This array will be turned-over in April 2006 for another year of monitoring (MARCHE cruises, PI J. Goslin). This hydroacoustic monitoring effort will provide the first long time-series of observation from the MoMAR observatory. Beyond 2007, real-time seismoaoustic monitoring will be a key issue for assessing the tectonic/magmatic/hydrothermal potential of future earthquake activity.
The objective for the Lucky Strike MoMAR node is to set up a permanent seafloor observatory to record and relate seismicity, seafloor deformation, fluid flow, temperature and composition, with the dynamics of vent communities (including microbes).

Implementation of the Lucky Strike MoMAR observatory has begun in 2005-2006 for seafloor deformation, near vents faunal communities monitoring, vent fluid temperature, and seismicity, with cruises funded primarily through the French system, with additional support from the EC FP6 EXOCET/D, and NERIES projects.

In a first stage, sensors will be autonomous or linked acoustically to an ASSEM junction box equipped with messengers for periodic satellite data transmission to shore (Stage 1). Observatory experiments are presently planned for periods of 2 to 5 years, but decadal monitoring is aimed at, as it is the most adapted to the time scale of active processes in this ridge environment.

![Figure 16: Earthquake epicenters identified along the Mid-Atlantic Ridge north and south of the Azores Plateau between June 1, 2002 and March 15, 2003. Black dots are the 1906 events recorded by the networks of autonomous hydrophones (deployment sites are the yellow stars and circles); white triangles are the 40 events recorded by land-based networks during the same period (NEIC catalog). As part of the MoMAR observatory, a network of 4 hydrophones was deployed around the MoMAR site (37N, 32W) in July 2005 for a period of two years (MARCHÉ cruises, PI J. Goslin).](image)

The longer term objective (>2008) is to implement an integrated monitoring infrastructure with real time data satellite transmission (stage 2), followed (>2012) by cable energy supply and data transmission (stage 3). It is envisioned that these later phases of the project should see an extension of real time monitoring to volcanic, hydrothermal and biological processes on the Azores Platform. This extension to nearer to shore active volcanic domains and biological hot spots will address the
issues of volcanic and seismic hazard to the densely populated areas of the Azores Islands, and assist the Azores region for the durable management of its fishing resources.

C.5.4. Existing national and international programs on the site

Teams involved in the MOMAR project belong to 32 leading institutions corresponding to 9 European countries. Most have long experiences in seagoing operations, deep-sea experimentation and scientific and technological development. For many, the MoMAR project represents the exciting continuation of ongoing research efforts in the MAR - Azores Triple Junction region, with significant support through FP3, FP4 and FP5 programs, and from national funding agencies particularly in Germany, France, UK and Portugal. A few US colleagues are also involved in the planning, through the InterRidge Program. Although no US proposal has been funded so far, the involvement of these colleagues could lead to a formal EC-NSF agreement for the funding of the project in the years to come.

Two EC-FP6 projects directly concern the MoMAR project: one for development of observatory sensors (EXOCET/D; Sarradin et al., 2005), and the other a research and training EC network (MoMARnet; Cannat et al., 2006). A more recently funded FP6 project, NERIES, also includes MoMAR as one of its target sites for the long-term installation of a broad band Ocean Bottom Seismometer.

A land-based laboratory, LabHorta, is installed at DOP-UAç (Colaço et al, 2002), at close proximity to the MoMAR area and the active deep-sea vent sites. LabHorta was conceived in view to keep with live vent animals recovered from acoustically-retrievable cages, developed during VENTOX project, at the deep-vents of the area. LabHorta is currently being equipped with resident pressure vessels among other improvements funded through the Portuguese and Azorean research councils.

MoMAR has been identified as a priority project both by Ifremer and by CNRS-INSU in France, and a french MoMAR steering committee (chaired by M. Cannat) has been nominated in July 2004 to coordinate national initiatives and to link with European and international observatory programs. Five MoMAR-related french cruises are funded for the 2005-2007 period. Substantial funding for MoMAR cruises and experiments in France also comes from the newly created Agence Nationale de la Recherche (ANR).

The MoMAR approach follows the recommendations of the recent Quality Status Report on ecosystems of the oceanic north Atlantic, issued by the OSPAR`2000, that calls for a coordinated program of species identification and distribution mapping, all set in the context of a full suite of environmental and habitat parameterization.

Last but not least, the Regional government of the Azores sponsors an International workshop involving leading scientists and stakeholders regarding aspects of the hydrothermal vent field conservation (Santos et al, 2003). In October 2006 the OSPAR WG on Marine Protected Areas Species and Habitats (MASH) adopted the proposal made by Portugal/Azores in view to include the deep vent sites Rainbow, Lucky Strike and Menez Gwen (MAR) in the OSPAR network of MPAs. The sites were proposed “with the aim of promoting knowledge, monitoring and conservation of an area that best represents species, habitats and ecological processes in deep-sea hydrothermal vents in the OSPAR area, while enabling sustainable scientific research and promoting education and environmental public awareness and interest”. This situation creates a unique opportunity to link science, education and environment protection.
The proposed research and development effort brings together teams with complementary expertise in the fields of marine earth, ocean and life sciences, and of marine technology. As such, this project mobilizes a community that is larger than the forces of any one country within Europe. It takes advantage of the great opportunities offered by the Azores MAR region and builds upon many years of research led by European teams in the area. The ESONET NoE will represent a great opportunity to integrate more fully the wide range of marine scientific and technological expertise that exists within Europe, and to coordinate the MoMAR initiative with actions planned at other European subsea observatory nodes for a greater scientific and societal impact.

C.5.5. Participants:
University of Azores
University of Lisboa
Ifremer
KDM/University of Bremem

Selected References for Node description and participants:


C.6. Iberian Margin – Atlantic Ocean

The Gulf of Cadiz / Iberian margin is a region of complexity with the junction of the Eurasian and African plates resulting in doming of the sea floor, mud volcanoes and other complex features. The interaction of the Mediterranean outflow with Atlantic waters is significant.

C.6.1. Scientific context and relevance

On November 1, 1755 the coastal cities of Southwest Iberia, and North Africa were struck by the most destructive earthquake and tsunami ever recorded in Western Europe. The earthquake’s epicenter is known to have been offshore. The occurrence of other historical strong earthquakes and tsunamis in SW Iberia goes back at least to 60 B.C and demonstrates the potential threat of the area.

The seismicity of this area is the result of the tectonic activity along the Europe-Africa plate boundary (inset of fig.2), which trends roughly E-W connecting the Azores-Triple Junction to the Gibraltar Strait with mainly NNW-SSE trending compressive stresses nearby Cape San Vincente and a convergence rate of 4 mm yr.-1 in the last three million years. Between the Gorringe Bank and Gibraltar the plate boundary consists of diffuse, active compressive deformation, distributed over a 200-300 km wide area. The seismicity pattern reflects this kind of plate interaction with presence of
scattered hypocenters spanning from shallow to intermediate depth. Focal mechanisms show a mixture of thrust and strike slip motion (Fig.14).

Investigation based on multi channel seismic surveys, carried out during the nineties showed the presence of several active, compressive, tectonic structures of regional significance (Fig.14): the Horseshoe fault (HSF), the Guadalquivir Bank (GB) and a large hill of tectonic origin, located at 37N 10W, about 100 km offshore Cape San Vincente, named "Marques de Pombal" (Fig.15, MP in Fig.14). All these structures share active tectonic up-lift due to contraction and relevant lateral continuity. Among these tectonic structures the Marques the Pombal potentially satisfies the requirements needed to be the 1755 generator. The Marques the Pombal is a relevant, active, tectonic feature and is located in an area compatible with the numerical modelling; the constraints derived from the Multi-channel seismics (MCS) allow to infer a true fault plane dip of about 24 degrees in the first 11 km.

From an oceanographic point of view the Gulf of Cadiz is of paramount importance for the study of the Mediterranean Outflow Water (MOW) because it affects the deep-water circulation on global scale.
Models point to the importance of Mediterranean water flows in regulating the meridional overturning and the heat transport in North Atlantic hence influencing the climate system. Modelling studies suggest also that the ocean may undergoes to multiple equilibria states. If this is the case very rapid transition from one equilibrium state to another may happen.

The warm and saline Mediterranean water flowing into the Atlantic at Gibraltar is an important factor influencing the North Atlantic deep water formation and meridional overturning. One of the branches of the Mediterranean Outflows Water intersects the ocean surface within the Labrador and Norwegian-Greenland seas, rapidly loosing its heat content by cooling at the surface, but retaining its salinity and reducing the stability of the water column in this region of deep water formation.

Salt transport into Atlantic Ocean from Mediterranean Sea may strongly affect the ocean circulation and stability. Ocean circulation is sensitive to the nature of that input and the climatic consequence of changes in salt transport can be very large over time scale of one century. Important quantities as northward heat transports in the Atlantic sector of the global ocean could be drastically modified by rather small changes in the interaction between the Mediterranean and the Atlantic.

Extensive mud volcanism, pockmarks, mud diapirism and carbonate chimneys related to hydrocarbon rich fluid venting are observed throughout the Gulf of Cadiz. Up to now 18 mud volcanoes, occurring at water depths between 700 and 3500 m, have been confirmed in this area by coring. The sediments from the mud volcanoes show obvious indications of gas-saturation: degassing structures, a strong H2S smell, chemosynthetic fauna (such as Pogonophora tube worms) and authigenic carbonates. Gas hydrates were recovered from the top of two active mud volcanoes: Ginsburg (910 m wd) and Bonjardim (3060 m wd). The gas released from the hydrates is essentially hydrocarbonic with a high content of methane homologues, indicating its thermogenic nature and suggesting the existence of hydrocarbons and gas rich over pressured sediments at depth, and the upward migration of these fluids and fluidised sediments along faults to the seafloor. Pore-water composition studies suggest that gas hydrates are likely to be present in other mud volcanoes in the area, as well.

C.6.2. Scientific Objectives

C.6.2.1. Main tasks of the deep-sea observatory in the Gulf of Cadiz

The fact that most of the seismic activity occurs at sea, along the continental margin of SW Iberia and in the Gulf of Cadiz. Due to lack of permanent seismic stations at sea the seismic activity is not properly monitored. This fact prevents either the early detection of the eventual tsunami waves, either the precise location of low magnitude earthquakes, which are key data to understand the present stress behaviour of the margin.

The main aim of the project is the set-up and operation of a monitoring seismic network in the Gulf of Cadiz for the evaluation and mitigation of these hazards. This network must be able to provide an in-depth knowledge of the seismic activity in the area coupled with the capability of an early detection of tsunami generation. This proposal follows the path of several projects, funded by the European Commission during the last years, for the earthquake/tsunami risk assessments of the area as BIGSETS (Big Sources of Earthquake and Tsunami in SW Iberia) and GITEC.

In addition to the above-mentioned task, we plan to monitor the temporal variation of the warm (13°) and saline (>37 g/l) Mediterranean Outflow Water (MOW). The MOW flows out from the
strait of Gibraltar and spreads in the Gulf of Cadiz at depth of 800-1200 m with two main branches. One branch diverge northward, toward the Bay of Biscay, the other crosses the whole North Atlantic reaching the Labrador and Norwegian – Greenland seas after 20-30 years. Since the MWO is affecting the deep-water circulation on global scale its variations, measured in the Gulf of Cadiz, may anticipate climate change at the scale of tens of years.

The deep-sea observatory and deep-sea instruments management systems will be based on the GOSTAR system (Geophysical and Oceanographic Station for Abyssal Research). Outstanding characteristics of the project shall be the integration of traditional seismic monitoring systems and methods like shore seismic networks, Ocean Bottom Seismometer (OBS) and Ocean Bottom Hydrophone (OBH) with innovative systems such as multidisciplinary deep-sea observatories, near-real time seafloor communication systems and dedicated tools for the accurate and safe management of deep-sea instruments.

The planned deep sea observatory will be starting point for both a near real time warning network and long term seismic observation to recover important measurements of the tsunami generation critical parameters outlined above.
C.6.2.2. Additional tasks: mechanism of tsunami generation

One of the most important issues regarding tsunami mitigation and warning is the likelihood of the generation of destructive water waves after the onshore recording of a strong earthquake occurring at sea. Unfortunately, tsunami warning is presently still poorly reliable: for example only 25% of warning alarms emitted in the Hawaiian area is effectively followed by a tsunami event (Milburn, 1996). This poor reliability, producing fatalities, economic losses and a progressive dangerous erosion of credibility in the involved population (Milburn, 1996), is also due to the scarce field knowledge of tsunami phenomena. Presently, tsunami warning is based mostly on earthquake energy threshold criteria as measured by seismic networks located mainly on land, and from an early stage monitoring of sea water disturbance.

Recent investigations (Zitellini et al., 2001) showed that the most probable location of the "1755 Lisbon Earthquake" corresponds to a single, at least 100 km wide, well defined, active structure with total a dip-slip displacement of up to 1100 m ("Marques de Pombal" thrust). The study of geometrically well constrained tsunamiogenic sources showing well defined geological and geophysical characteristics (such as shape, extension, decollement surface position, depth and length etc.) offers the opportunity to tackle tsunami generation from a novel perspective using the structure as a "field laboratory" to infer the most critical parameters for the coupling between sea bottom and water column during an earthquake and to test numerical models and theoretical assumptions in the frame of low magnitude events.

C.6.2.3. Additional tasks: gas hydrates in the Gulf of Cadiz

Methane is a well-known and powerful greenhouse gas and its release from the destabilization of gas hydrates in the shallow sea floor is considered as one of the main causes for climatic changes in the past and it is a natural hazard for the future. Slope instabilities related to hydrate dissociation might represent a serious hazard for seafloor activities like oil exploration, pipelines and communication cables. The study of the ecosystems associated with gas seepage is particularly important, because of the similarities with conditions of life formation in the Earth. In the Gulf of Cadiz, the widespread shallow fluid venting on the seafloor can be attributed in part to the destabilization of gas hydrate rich sediments in contact with the Mediterranean Outflow.

One target of this Observatory is to investigate the relative role of climate-controlled oceanographic variability and tectonic activity in the episodic formation and activity of fluid venting structures. Particular emphasis will be put into unravelling the effect of the periodic variability of the Mediterranean Outflow Water (MOW) on the dissociation of gas hydrates, particularly in the northern sector of the Gulf of Cadiz, and to study the related potential release of methane stored in oceanic sediments in the considered region.

C.6.3. Existing national and international program on the site

On behalf the Sixth Framework Programme, Call: FP6-2005-Global-4, Sustainable Development, Global Change and Ecosystem, Priority 6.3.IV.2.2: Assessment and reduction of tsunami risk in Europe, it has been recently approved the Research Project “Integrated Observations from Near Shore Sources of Tsunamis: towards an early warning system (acronym NEAREST)”. The project is presently under negotiation and it is planned to start on Oct.1, 2006, for a length of three years. One of major topic addressed by NEAREST is the early detection of the near shore tsunamis for effective early warning by the set-up and operation of a deep sea, long-term, observatory, in the Gulf of
Cadiz. In future NEAREST method may be extended to other near-shore potential tsunamigenic sources, as for instance the Central Mediterranean (Western Ionian Sea), Aegean Arc and Marmara Sea.

C.6.4. Preliminary design of the implementation and possible schedule:

C.6.4.1. Site location:

The location for the permanent deep-sea long-term observatory is at about 100 Km SW Cape San Vicente (fig.1) at water depth of 3000-4000 meters. The conclusive best site selection will be carried out on behalf the project NEAREST. The installation of the station is planned in two steps.

The first step regards the set up of an un-cabled operational prototype, with minimal configuration based on the near real time GEOSTAR technology. It will be devoted mainly to the recording of the natural seismicity and the detection of low magnitude tsunamis. During the first step the equipment will be tested as well the ground parameters for optimal recording. This step will be carried out by the project NEAREST.

During step two we plan to cable the observatory to allow a real time monitoring. In step two we plan to install along the cable pathway additional sensor for the measurements of the MOW which main branches turns just South of Cape San Vicente at water depth 800-1000 m.

The selected site owns the following characteristics: a) it is easily and rapidly reachable in any season; b) it presents key features for the scientific/monitoring targets c) it is suitable for investigations on various scientific/monitoring targets; d) it offers safe operating conditions for the deployed instrumentation.

During step two the observatory will be integrated with the network made up by the seismic stations already operating in cape San Vicente (Fig.14)

C.6.4.2. Step One, Sensor and Configuration:

We list the minimal experimental configuration for un-cabled operational prototype based on GEOSTAR station:

a) Capability of near real time data return, via acoustic bidirectional link with a buoy or via messengers, like ARGOS.

b) Ability of an accurate estimation of instrument positioning.

c) Broad band seismometers (0.001 Hz – 100 Hz), equipped for long term measurements (more than 8 month).

d) On site battery recharging ability in the case of cable connection between the buoy and the bottom station.

e) Control on seismometer tilt and orientation.

f) Pressure transducer allowing 100 Hz sampling rate. The equipment must be able to record a few millimeter sea water disturbances at the typical tsunami wavelengths range (from few up to hundred kilometers). As known pressure can be measured through piezoelectric transducers that present an accuracy proportional to the measurements range. Depending on the depth and the sampling rate the transducer is operated, it can acquire data on sea waves.
(near to the surface) or data concerning hydrostatic variations related to tides, wind effects, long waves related to regional atmospheric phenomena and tsunamis.

Present day pressure tide gauge are able to reach accuracies about 1 part in one hundred million, and sampling rate of about 100 Hz with acceptable power consumption.

In general it is not possible to distinguish height variations from density variations in a water column by using only a pressure sensor, so these two effects can be separated according to their typical time scales, if different in the studied phenomena.

g) The sampling rate requested to monitor tsunami waves depends on the minimum wavelength we want acquire and from the depth where the transducer is located.

h) Buoy equipped with a barometer and sensor for the water temperature.

i) The upgrade of the GEOSTAR near real time buoy to allow real time monitoring is highly recommended to enhance the accuracy of the pressure transducers data processing and real time tsunami warning.

j) Oceanographic mooring with acoustic current meters, transmission-meters and T/P sensors

Additional requirements:

a) High resolution bathymetric data collection is needed for the precise selection of the deep-sea observatory

b) New acquisition of bathymetric data in shallow water and enhance tsunami modeling both for scientific and warning purposes. A detailed bathymetry is needed at least in a stripe connecting deep water and shallow water pressure transducer both to allow the application of coincidence method in a time window to improve the reliability of tsunami warning and for tsunami modeling.

c) Testing or development of fast algorithms for rapid earthquake magnitude evaluation and epicenter localization and for anomalous sea water disturbance recognition.

C.6.4.3. Step One, Schedule


C.6.4.4. Step two: general consideration

Local seismicity studies and reliable epicenter location of marine earthquake require the integration of onshore seismic network and ocean bottom seismometers with deployment/acquisition times ranging from few months to years. The deployed instruments capability must match few Gbyte of data storing and typically 3-4 components broad band measurement.

Present day ocean bottom seismometers allow semi broad band data acquisition (from some Hz to 100 s) but they can be tuned for specific seismic targets: unfortunately they suffer of both a poor coupling with the sea floor that push up the noise level and a poor estimation of position. Moreover they are not in general capable of real time or quasi real time data return. The restriction presented by GEOSTAR, if not cable connected, with respect to real time capability is the low data transfer rate of the acoustic modem.

Presently acoustic modem (2400 kbit /sec) suffers a low data rate transferring capability, allowing only a few wave form transmission, that should be enhanced in the near time. Cable connection with satellite linked buoy might be better, but present more complicated ROV aided deployments
operation. ARGOS messengers, due to their ascent speed (1-1.2 m/sec) do not allow near real time data transferring (for near field tsunami warning) in deep water.

For testing purpose on the reliability of a future near real time / real time tsunami warning station GEOSTAR, complemented with the above mentioned instruments is a good monitoring station. Nevertheless, due to our site location, it should be relatively easy and not too expensive to connect a cable to the GEOSTAR station.

The present working depth of GEOSTAR ranges from 0 to 4000 m.

The same problem of low data rate transferring capability may affects the deep water pressure transducer but the same consideration for testing purpose before mentioned can be applied.

The power consumption of the barometric station upgrading must be checked.

**C.6.4.5. Output:**

The arguments we face in this task, like seismic and tsunami hazard, tsunami risk and warning, global change are completely in the main stream of European community scientific policy. The data output of the task could be directly oriented to the national Portuguese, Spanish and Maroccan institutions for disaster prevention and warning. Real time alarm needs the design of a computer network here not discussed, but that should be discussed, standardized both in data format and protocols among the various groups of ESONET.

**C.6.5. Regional consortium of users and financing institution**

Sixth Framework Programme, Call: FP6-2005-Global-4, Sustainable Development, Global Change and Ecosystem, Priority 6.3.IV.2.2: Assessment and reduction of tsunami risk in Europe, Research Project “Integrated Observations from Near Shore Sources of Tsunamis: towards an early warning system (NEAREST)”. The project is presently under negotiation.

**C.6.6. Participants at the Gulf of Cadiz Regional Node**

The participation may be based on NEAREST partnership:

1) Consiglio Nazionale delle Ricerche, Istituto Scienze Marine, Dipartimento di Bologna, Italy
2) Fundação da Faculdade de Ciências da Universidade de Lisboa - Centro de Geofísica da Universidade de Lisboa, Portugal
3) Consejo Superior de Investigaciones Científicas – Unitat de Tecnologia Marina - Centre Mediterrani d’Investigacions Marines i Ambientals, Barcelona, Spain
4) Alfred-Wegener-Institute fur Polar-und Meeresforschung, Geophysics section, Germany
5) Université de Bretagne Occidentale, UMR 6358 Domaines Océaniques, France
6) Istituto Nazionale Geofisica e Vulcanologia, Roma 2 section, Roma, Italy
7) Technische Fachhochschule Berlin - FB VIII - Maschinenbau, Verfahrens- und Umwelttechnik AG Tiefseesysteme, Germany
8) Instituto Andaluz de Geofísica - Universidad De Granada, Spain
9) Instituto de Meteorologia, Divisão de Sismologia, Lisbon, Portugal
10) Centre National pour la Recherche Scientifique et Technique, Morocco
11) XISTOS Développement S.A, Paris, France

Selected References for Node description and participants:


C.7. Ligurian – Mediterranean Sea

This area is monitoring for a long time with conventional cruise. Long term series get with various tools and various sampling times are already available (SOMLIT, DYFAMED). Existing cables installed for the ANTARES neutrino detector experiment make this practical early site for development: perpetuating presently measurement with higher sampling rate and interactivity, testing of new instruments, in link with IODP.

C.7.1. Scientific context and relevance

The Ligurian Sea is a large multidisciplinary area of interest with many technical advantages for a demonstration observatory. It would play in ESONET a similar role to the Monterey Accelerated Research System (MARS) in the American NEPTUNE development. Many subsystems are already available such as the land fall station, the cable landing and one junction box from the Antares neutrino observatory project. All the technology and subsea intervention know-how is mastered by the partners. Moreover, the site is in deep water not far from important harbours and sea state conditions are well known and favourable for tests and sea operations.

Almost all scientific packages within ESONET will have a scientific interest at the Ligurian region. Long term series of data exist in many fields and scientists now require real time high frequency sampling rates to understand processes and develop predictive modelling.

The Ligurian sea is a seismic area not far from an inhabited region. The active fault in deep water cannot be monitored from shore due to propagation anomalies induced by the geologic structure.

Slopes instabilities are located on the continental slope. The last catastrophic event occurred at Nice airport (16 October 1979). One effect of this land slide was the rupture of telecommunication cables 100 km from Nice, in 2 500 m water depth.

Hyperpycnal and turbidity currents appear at the Var river mouth during overflow events and their effect is propagated down the Var canyon. The same phenomenon, at large scale, appears in major river systems like Zaire. The site is convenient to develop a scientific knowledge of this process.

In Ligurian sea, the offshore area is completely isolated from coastal influence by the “Liguro-Provençal” current. It is representative of large areas of the world ocean. Dynamics of fluxes in this region have been monitoring since 1988, participating to JGOFS programs.
More than 20 parameters are collected on a monthly basis at DYFAMED location. Since 2003, the area is used as a calibration point (BOUSSOLE buoy) for water colour satellite sensors.

Dynamics of oceanographic processes can be studied: wind driven coastal upwelling, particle plumes, nutrient benthic exchange, bottom boundary layer processes, mesoscale variabilities,.....

Figure 19: Oceanographic processes which can be studied on the Ligurian sea observatory.

The 685 IODP proposal seeks to establish a test bed for offshore borehole observations and borehole-to-cable technologies. It proposes drilling at four sites to study microseismicity, the seaward extend of seismicity, noise level testing against OBS and the precursors and mechanism of landslides with hydrological experiments. Temperature, pore pressure, electrical conductivity, fluid chemistry and strain will be also monitor.

**C.7.2. Scientific objectives**

This site gives an opportunity to test technological development in a place of high scientific interests. Long time series measurement, with low sample rates time exists. It will be possible to compare these data with those acquired at high sample cote time by a cable observatory.

The availability of ROVs and submersibles in this area will allow a “low cost” maintenance of the observatory and the deployment for testing of new instrumentation.

All scientific disciplines can find interest to use data collected by such a network.
C.7.3. Existing national and international programmes on the site

The Joint Global Ocean Flux Study (JGOFS) is an international and multi-disciplinary program launched in 1987 under the auspices of the Scientific Committee of Oceanic Research (SCOR). The Ligurian Sea is one of the site monitored by this programme (DYFAMED mooring).

The ANTARES collaboration is constructing a large area water Cherenkov detector in the deep Mediterranean Sea, optimized for the detection of means from high-energy astrophysical neutrinos. The test site is implemented in deep water in the landing station of Toulon. A telecommunication cable was installed at La Seyne and joins a deep water site (2500 m depth) south of Porquerolles Island.

The ROSMARIN network (funded by INSU, PACA and EC through Interreg DEVINE project) monitors the deep sea seismic activity by deploying a semi-permanent OBS network.

C.7.4. Preliminary design of the implementation and possible schedule

The Ligurian sea observatory will comprise:

- Three stations with at least broadband seismometer, biogeochemical sensors and physical sensors (currentmeters), CTD, turbidity,… [blue square].

- A local array with acoustic networking to monitor canyon of Var and slope stability events (piezometer, geodesic, turbidity, turbidity currents,… [yellow area].

- Water column measurements on DYFAMED by vertical moorings monitoring the dynamic fluxes (particle samplers, fluorimeter, chemical analyses,…)[red square].

- Four instrumented boreholes (IODP program), two in deep water to develop seismic instrumentation in borehole and two on the continental slope to study mechanism of land slides with hydrological experiments [pink point].

In a first step, a cable will be deployed in deep water from Antares site, to raise its landing station. Two junctions would be deployed, with a secondary one on station A and on DYFAMED area.

In a second step, a dedicated landing station would be installed (Saint Jean Cap Ferrat?), the ANTARES being used again to increase reliability of the system.
Figure 20: Preliminary design of the Ligurian sea observatory.

C.7.5. Regional consortium of users and financing institutions

The observatory is at present predominantly supported by GEOAZUR, INSU/CNRS and Ifremer. PACA regions supporting this project. A cooperation with Italy is running about monitoring of the Ligurian Sea. European scientists (Germany, Spain) and international scientists (US, Japan) are supporting the IODP project.

A regional implementation committee will be constituted in the first months of 2007.

C.7.6. Participants

Ifremer, CNRS (GEOAZUR, CEREGE, LOV, IUEM), IPGP, INGV, CSIC, UniHB Germany, WHOI.
C.8. East Sicily – Mediterranean Sea

An important offshore site close to Mount Etna, where the Italian SN-1 multidisciplinary observatory recently completed its first 6 month mission. The existing cable for NEMO neutrino experiment provides a focus for real-time data transfer and the integration of the seafloor observatory into land-based networks.

The Easter Sicily Test Site (NEMO – SN1), developed by the Italian INFN (Istituto Nazionale di Fisica Nucleare), and managed by its internal branch Laboratori Nazionali del Sud, is located at a distance of 25 km from the Eastern Sicily Coast off-shore Catania, at an operative depth of 2100 m.

The facility is composed by:

1. A Shore Station for the data acquisition, the power supply of an underwater laboratory, a mechanical and electrical workshop. Moreover the shore station is connected in real time with the Laboratori Nazionali del Sud, permitting to have a complete remote control of the underwater facility.

2. An electro optical cable, produced by NEXANS company, composed by 2.330 m of double shield cable, 20.595 m of single shield cable, a branching unit (or splitting branching unit) that split the main cable in two branches cables, called TSS (Test Site Sud – 5000 m) and TSN (Test Site Nord – 5220 m). The characteristics of the cable are: 6 electrical conductors (diameter 4 mm²), maximum power on-shore 3 kW, 10 optical fibres standard ITU-T G-652

Presently, the SN1 seafloor observatory, managed by INGV, is connected to the Shore Station by means of an electro optical cable. The station SN1, equipped with a wide set of geophysical and oceanographic sensors, represents the first operative node of ESONET, and it is now transmitting data in real time to the National Seismological Service Centre, in Rome, managed by INGV.

In addition the Southern Branch (TSS) of the cable hosts an acoustic station, operating since January 2005 (like SN1) equipped with hydrophones aimed at characterising the acoustic environmental noise and recording “voices” of marine mammals (this last activity in cooperation with Pavia University).

These stations represent a first operative step in the direction of a multidisciplinary laboratory.

A further improvement of the NEMO-SN1 Test Site will include a multidisciplinary underwater laboratory (LAMS Project co-funded by EC by means of national structural funds [PON 2000-2006]), that will be deployed in June 2006. The underwater laboratory will be connected in real time with the termination frame of the TSS and will include a Junction Box (JB), with 4 electro-optical connectors devoted to underwater scientific experiments. It has been designed to host and protect from corrosion and pressure, the opto-electronic boards dedicated to the distribution and the control of the power supply and the digitized signal. One of the four underwater plugs of the junction box will be used by INFN for the connection of the prototype of the tower of the neutrino underwater telescope of the NEMO Pilot experiment. The other 3 plugs will be free in order to permit the installation of underwater scientific experiments.

The 3 plugs have the following characteristics:
- Standard ROV wet-mateable connectors;
- 3-phases power supply system with a max voltage of 380 V;
- 1 fiber optic (single mode) for the data transmission system, using SDH (SONET) worldwide standard.
An additional project, PEGASO, co-funded by EC by means of national structural funds, has started in December 2005 and is mainly devoted to enhance the Test-site logistics and service capability to operate and maintain the NEMO Pilot Experiment and the seafloor stations presently at seafloor. As a secondary development task, PEGASO foresees the design and construction of seafloor multiparameter modules to extend the area monitoring in the NEMO-SN1 site and provide portable modules for specific applications (e.g., marine earthquake sequences, marine degassing processes, slope instability).

The peculiarity of the NEMO-SN1 test site because of availability of marine and land infrastructures and for motivations pertaining to geo-hazards (see below), makes the site suitable to host for validation prototypes of Tsunamis Early Warning Systems.

**Background**

In the last decades, Eastern Sicily area has experienced, differently from most of the other Sicilian regions, a remarkable socio-economical, industrial and tourism development, accompanied by an extreme urbanisation along the coasts. In the area important industrial plants for oil/petroleum/gas refinement, storage and production of derivative reside. Logistics for product transportation are located at major harbours and port docks. Moreover for its geographic location, near the Messina strait, the sea of the Eastern Sicily is continuously crossed by main cargo-boat routes. The impact of all the mentioned activities on the environment as a whole is scarcely controlled with severe consequences for the population in term of pollution of the waters, sea and air.

Fishery and fishing industry, another important portion of the economy of Sicily, can largely suffer for environmental degradation with dramatic consequence for those coastal regions having this single resource.

The tourism industry of Sicily has grown significantly from ’70s on. Tourists visit the area for a variety of reasons including unrivalled natural beauty. Revenue derived from tourism now ranks as one of the most important resources in Sicily and a sustainable economic development is necessary in order to preserve the environment.

*Geo-hazards* - Important factors supporting the need for a ‘real-time’ monitoring like the one presently performed by SN1, pertain to geo-hazard. Eastern Sicily has experienced in the past disastrous seismic events, some of them accompanied by tsunamis, mostly generated by seismogenic structures lying at sea.

![Figure 21: Historical seismicity of Eastern Sicily (1000-1992)](image1)

![Figure 22: ING Instrumental Catalogne (1975-2001)](image2)

![Figure 23: Map of the Maximum Felt Intensity in Eastern Sicily](image3)
The 1693 and 1908 earthquakes, both reaching an intensity of XI in MCS scale, completely destroyed the city of Catania and Messina respectively and produced destructions all over the southeastern Sicily. Damages were observed in a large area, from the southern Calabria to Malta. Both shocks were followed by large tsunamis involving the whole eastern Sicily coast, the Messina Straits and, probably, the Aeolian Islands. According to some sources, the 1693 shock gave rise to an inundation about one mile long occurred along the whole Eastern Sicily coast.

In recent times Eastern Sicily was interested by events of minor intensity, some of which originated by off-shore tectonic structures, causing serious damage along the coast. An example is the December 13, 1990 earthquake, with intensity VIII MCS, provoking severe damage south of Catania in the town of Augusta, and victims in the small town of Carlentini (Catania). This shock was accompanied by anomalous sea behaviour along the Augusta coast. Figure 16 presents the distribution of the seismicity in the periods 1000-1992. From the 70’s, the coming of new generation of sensors and the parallel improvement of the seismological networks in the area, has also revealed a spread and moderate seismicity in the marine zone between Sicily and Calabria (Fig. 17) to be related to marine structures. The historical and instrumental seismicity are the base of hazard studies that has stressed the high exposition of the Eastern Sicily (Fig. 18).

In the frame of the global dynamics of the Mediterranean basin, characterised by the collision processes between the African and the European plates, Sicily represents the natural connection between the Apennine and the North-African chains. The region is interested either by an intense volcanic basaltic activity, probably connected to extensional tectonics responsible for the Iblean volcanism and the formation of the Etna edifice, or by frequent and strong seismic events. In particular, Eastern Sicily region is characterised by two main structural units, the Northern chain and the Iblean plateau: Mt. Etna is located just between these two units. The northern chain is a structure formed by a sequence of sediments superimposed from Eocene to Quaternary, with a progressive movement of the compressive front towards the eastern area. The Iblean plateau, that represents an emerged part of the foreland, is formed by thick Meso-Cenozoic carbonatic sequences with frequent volcanic elements (older than Etna products). The adjacent Ionian region is characterised by the presence of a large submerged structure, namely the Malta escarpment. According to some hypothesis, the genesis of this structure is related to the evolution of the southern Tyrrhenian slab, whose southern border has been recognised in correspondence of Eastern Sicily. Many Authors attribute to the Malta escarpment a prolonged tectonic activity in time. In spite of its regional extension and kinematics, the temporal intervals of activity and the geometry are still not well defined. The continuation of this structure seems to directly involve the roots of the Etna volcanic edifice, as it has been proposed by some authors.

The existence of other important submerged seismic structures is confirmed by off-shore bathymetric and seismic prospecting investigations; nevertheless, medium-low magnitude marine seismicity, which could provide useful information on the characteristics of the area, is neither well detected nor localised.

In the Etna region and in the Eastern Sicily an integrated monitoring network, namely the POSEIDON system, is operating on land since late ‘90s for the surveillance of Eastern Sicily volcanic and tectonic structures. The POSEIDON monitoring network (see red symbols in Fig. 4), presently managed by INGV is constituted by around 30 analogue seismic stations, 3 components and short period, and by 13 digital seismic stations wide band, to be increased up to 40 units, and to be integrated in the INGV national seismic network. The signals of the seismological network all converge in the POSEIDON centre of Catania. Figure 4 shows the locations of the monitoring stations of POSEIDON and INGV national network, these latter including stations of the former ING and the former Istituto Internazionale di Vulcanologia-CNR.

Due to the very high tsunamigenic potential of Eastern Sicily, a prototype of multiparameter station is working in the area of Augusta (south of Catania) since 1998 for immediate detection and early warning in case of tsunamis generated by local earthquakes. The station is based on the integration
of seismic and mareographic data. The seismic data are provided by the INGV digital station of Monte Tauro while a tide gauge has been installed off the Augusta harbour at a water depth of 4 m for the recording of mareographic data. An automatic control centre in the nearby of the seismological station, simultaneously acquires via radio the sea level data sent by the acquisition system of the mareographic sensor and the seismic data. The signals are simultaneously analysed and processed: an automatic procedure is available to check the occurrence of anomalies on both mareographic and seismic signals and eventually send an alert message to specific unit of Civil Protection.

Oceanography - The Mediterranean is a particularly suitable region both because can be considered a laboratory basin for fundamental ocean processes and because its outflow influences the Atlantic circulation. While climate changes are usually thought to develop over centuries or millennia, recent investigations are evidencing that significant changes in the thermohaline condition might take place over shorter (decadal) period. This finding is particularly remarkable for the Mediterranean Sea, where space and time scales are one order of magnitude lower than in the oceans and where, starting from the second half of 80’s, a sudden and amazing change in the thermohaline cell of the Eastern Basin was observed. The Sicily region is particularly suitable to detect these changes, because westward the Sicily channel controls fluxes between the Eastern Basin and the western basin and, subsequently, the Atlantic Ocean. Furthermore, eastward (Ionian side), the deep circulation provides an excellent signature of the deep water that every year flows both from the Adriatic and/or Aegean seas. Modulations of deep Ionian circulation or changes in the deep hydrographic conditions permit to follow the interannual variability of the deep water formation and finally of the thermohaline circulation of the Eastern Basin.

The oceanographic monitoring in the Sicily region aims also to provide experimental evidences to climatic models and to improve their ability to predict future change in climate, especially at regional (Mediterranean) scale.

The figure reports the location of the NEMO-SN1 seafloor multiparameter cabled observatory off-shore Eastern Sicily (Central Mediterranean). NEMO-SN1 is the first operational ESONET key-site from January 2005 and is managed by INFN and INGV. The site proposed by INFN for the deployment of the NEMO KM3 neutrino telescope deployment is also indicated.
C.9. Hellenic – Mediterranean Sea

The eastern Mediterranean is characterized by significant seismicity, special habitats in deep basins and a very steep drop off in depth from the coastlines.

C.9.1. Scientific context and relevance

The international geophysics and oceanographical scientific community has recently defined as a priority the acquisition of data in those areas of the globe, like the ocean depths, for which at the moment we have few or no data at all. The monitoring of the water column parameters that can be performed by a deep-sea laboratory will provide very useful data for the study of the global circulation of waters in the Mediterranean. Earthquakes generated by offshore seismicity have, in the past, caused great damage to coastal regions, both from earthquakes and the resulting tsunamis. Events originating at sea can only be precisely located by using on-land and underwater seismic stations together. A permanent network of underwater stations will complement the existing land network, enhancing its performance. A further advantage of underwater stations is that, if suitably located, they suffer from a much lower background noise than land stations.

Deep-sea regions have been generally considered as stable environments, not subjected to the strong and rapid modifications related to human influence that characterize the coastal regions. More recent studies have demonstrated, however, that deep-sea regions are subject to strong variations of the trophic and sedimentation rate, even on a seasonal scale. An observatory able to monitor the deep-sea environment by measuring in situ biological, chemical and physical parameters will be able to:

- Monitor seismic activities for geo-hazard prevention;
- Measure benthic-pelagic interchange and turnover;
- Measure oxygen consumption;
- Detect fluid fluxes from the seabed into the ambient bottom-water;
- Project images of the benthic and pelagic fauna.

The Hellenic region comprises of four distinct networks: NESTOR (existing neutrino observatory cable), BUTT-1 (IODP – site of proposed deep borehole), the Cretan basin and the Rhodos basin. The overall aim of these stations is for the long term investigation of seafloor processes. The objectives are:

- to quantify slow versus fast fluid flow and carbon/methane fluxes;
- to develop long term monitoring observatories for oil/gas industry;
- to create a science platform capable of offering a totally new approach to public outreach and awareness of ocean processes;
- to develop an enhanced 3D visualization of multi parameter datasets;
- to carry out hydroacoustic studies on fluid flow pathways and mineral crusts in upper sediment layers;
- to link fluid, methane flow with tectonic movement and seismic activity monitor the biology and ecology of these deep areas.

An internet operated vehicle (IOV) has been built with the capability to move along the seafloor by video control and to carry out detailed investigations on fluid and particle fluxes in the benthic boundary layer. The IOV should be connected to the internet via a junction box (node) within an underwater network. Once connected the system should remain on the seafloor for extended periods of several months to study the temporal and spatial variations at a given location in the deep sea. For the NESTOR-ESONET deep sea observatory three crawlers will be built, each equipped with different sensor systems. All crawlers will be connected to one central instrument system (lander),
which is located up to 100 m away from the node, carries additional sensors and transfers the data of the IOVs to the land-based data centre or offshore installation.

C.10. Marmara Sea

The Marmara Sea is an intra-continental marine basin between the Aegean and Black seas. It is in a tectonically very active region located on the North Anatolian Fault (NAF) zone (Şengör, 1979; Barka, 1992; Straub et al., 1997; Okay et al., 1999, 2000; Le Pichon et al., 2001; Şengör et al., 2004). The NAF is a major transform-plate boundary that has produced devastating historical earthquakes along its 1600 km length (Ambroseys and Finkel, 1995). The most active northern branch of the NAF cuts across the Marmara in an E-W direction and continues westward into the NE Aegean Sea (Fig. 19).

The Marmara Sea has three ~1250 m-deep strike-slip basins between 10-20 km-wide northern shelf and a 40 km-wide southern shelf. The deep basins are separated by -450 to -600 m deep, NE-trending transpressional ridges. The shelf break is at about -100 m water depth. The slopes leading to the deep basins are steep (>18º) and carry the scars of many paleo-landslides and submarine canyons (Fig.1). They also have some unstable areas near the shelf break and in the upper slope that may slide during future seismic events.

The earthquake events along the NAF have a westward progression with a sixty year sequence of rupturing toward Istanbul, in which one event promoting the next. After the 1999 İzmit and Düzce earthquakes, the next large (Mw> 7) earthquake is expected in the Marmara Sea close to Istanbul, an important cultural centre and a mega-metropole with 15 million inhabitants (Parsons et al., 2000). There are also large faults with dip-slip component in the south, near the edge of the southern shelf and İmralı submarine platform which in the event of their rupture, would cause tsunamis in the Marmara Sea. The earthquake activity in the Marmara Sea has produced more than 30 tsunami events in the past two millennium, with heights up to about 6 m in the coastal areas (Yalçın et al., 2002). Most of these tsunamis have probably been caused by submarine land slides.

The coastal areas and freshwater reservoirs providing Istanbul with water are under tsunami risk. The Büyük Çekmece Lake on the northern coast of the Marmara Sea is in location particularly prone to tsunamis. This lake provides more than 15% of Istanbul’s drinking water.

ROV video surveys of the sea floor during the R/V Meteor Leg M44-1 (Halbach et al., 2000) and R/V Le Atalante (Armijo et al., 2005) have proven active venting of methane-rich fluids from the fault on the Western Ridge and the SE corner of the Tekirdağ Basin (Fig. 20). These sites are also characterized by black bacterial mats, chemosynthesis-dependent fauna consisting of mainly bivalves (abundant mytilids), echinids and crustacea and carbonate crusts (Fig. 20). The ROV video observations show that the deep basin floors are commonly marked with very densely distributed burrows, indicating a high benthic faunal activity.

The Marmara Sea is also interesting in terms of its oceanographic setting. It is connected to the low salinity (S=18‰) Black Sea via the İstanbul (Bosphorus) Strait and to the normal marine (S=38.5‰) Aegean Sea via the Canakkale (Dardanelles) Strait; the two straits have sill depths of -65 and -35 m, respectively. There is a permanent two-layer flow in the straits and the Marmara Sea with the halocline located at -25 m (Ünlüata et al., 1990; Besiktepe et al., 2004). The Black Sea waters enters the Marmara Sea as a jet through the İstanbul Strait and forms the upper layer (Besiktepe et al., 1994). The upper layer water circulates in the Marmara Sea as an anticyclonic gyre at velocities of 20-50 cm/s Marmara Sea as an anticyclonic gyre at velocities of 20-50 cm/s and flows out through the
Çanakkale Strait as the surface current. The Mediterranean water enters the Marmara Sea as an undercurrent and dips into the Tekirdağ Basin and forms the lower water layer with a potential temperature of 14.5°C (Ünlüata et al., 1990; Beşiktepe et al., 1993). Its eastward flow towards the Istanbul Strait is somewhat hindered by the pressure ridges. The slow circulation, coupled with the microbial degradation of the organic matter, results in a gradual depletion of oxygen in the lower-layer to 2-3 mg O2/l in the Çınarcık Basin. The renewal time of surface and the deep waters is estimated to be 4-5 months and 6-7 years, respectively (Ünlüata et al., 1990, Beşiktepe et al., 1993). The Sea of Marmara region is densely populated and industrialized with more than Turkey's 20% population and 50% industry located in its drainage basin. The municipal and industrial inputs from its drainage basin, together with nutrient and contaminant inputs from the Black Sea, have polluted the Marmara Sea in the last 40 years (Orhon et al., 1994; Polat and Turgut, 1995).

Its high tectonic activity with catastrophic earthquakes, submarine landslides and resulting tsunamis, as well as its special oceanographic setting as a gateway between the Mediterranean and Black Seas, makes the Marmara Sea a natural laboratory for multidisciplinary scientific research and training area for young scientists.

**The significance of the Marmara Sea seismic gap for earthquake risk assessment and mitigation**

The westward progression of major ruptures along the NAF (Barka, 1996), culminating with the 1999 destructive earthquake events, leaves a 170 km long seismic gap along the Sea of Marmara capable of generating large earthquakes (Reilinger et al., 2000; Hubert-Ferrari et al., 2000). The last destructive earthquakes occurred at the western and eastern edges of the Marmara basin (i.e., 1912 Ganos and 1999 İzmit and Düzce earthquakes). It is likely that fault ruptures will fill this gap in the next decades (Toksöz et al., 1999; Pinar et al., 2001; Öncel and Wyss, 2000; Parsons et al., 2000; Atakan et al., 2002).

The hazard facing Istanbul and adjacent areas varies widely depending on where and how the predicted Marmara seismic rupture will take place. This region of the North Anatolian Fault is thus critical to our understanding of fault interactions, stress build-up during seismic cycle and seismic hazard in the Istanbul area. Estimates of the slip rate, distribution of motion, microseismicity along the strands of the NAF, detection of fluid outflow and the analysis of how it relates to the seismic activity can help reach a realistic assessment of seismic hazards for this densely populated area of Turkey.

Seafloor observatories would offer earth scientists and oceanographers working in this region unique new opportunities:
- to study multiple, interrelated processes over time scales ranging from seconds to decades;
- to conduct comparative studies of regional processes and spatial characteristics;
- to map basin-scale structures using time-series measurements.

**C.10.1. Scientific objectives**

The overall objectives of the proposed activity in the Marmara region are mainly focused to conduct comparative studies of multiple, interrelated processes driven by fault movement. These studies should be carried out giving high priority to those areas which are more prone to seismic hazard.
The lack of extensive, more-or-less continuous time-series measurements is probably one of the most serious limits to understanding of long-term trends and cyclic changes of fault behaviour, as well as episodic events such as major earthquakes or submarine landslides. The key point to address these issues will be obtaining time-series observations at different locations along the North
Anatolian fault system. The results of these observations could be integrated in theoretical models that will be used to predict fault behaviour and to guide new experiments.

The science topics and themes that can be tackled using ocean observatory capabilities, span a wide range of studies. The following outlines a set of scientific issues and a selection of questions for which ocean observatories could enable major breakthroughs by using new technology and innovative experimental approaches:

1) Earthquake processes: As fault blocks move, they can lock and accumulate stress that can be released quickly in the form of earthquakes (seismic deformation) or as creeping motion (aseismic deformation). Monitoring the seismic and aseismic deformation over an extended period of time will enable scientists to understand how and when strain is released along the NAF system. These data will be used to assess and mitigate the geological risk. Observatories can facilitate contemporaneous measurements of different parameters over long time scales, which is essential to their characterization and understanding.

2) Sedimentation and sediment transport: normal hemi-pelagic sedimentation, and sedimentation triggered by storm events, floods, and earthquakes;

3) Water column studies;

4) Fluids, chemistry, and ecological characterization;

5) How often, and in what pattern and quantity, is fluid delivered from the fault to the sea?

6) What are the primary heat transfers, chemical and biological consequences of fluid outflow along the fault system?

7) To what degree does fluid venting influence the physical, chemical and biological character of the overlying water column? What is the relative importance of episodic vs. steady state outputs?

Each question is an important research focus in its own right; taken together they encompass the major interactive processes operative along the global fault system.

C.10.2. Significant observatory sites

1) Eastern edge of the Çınarcık Basin: the 1999 earthquake rupture extends up to here. The next earthquake rupture is expected to involve the fault segment in this basin and its westward extension at least all the way to the Central Basin (Le Pichon et al., 2001). This basin is also prone to submarine landslides and tsunamies. It is also the location where the deep waters Mediterranean origin move towards the Istanbul Strait on their way to the Black Sea, and where the pollutants and nutrients from the Istanbul Metropolitan area and the Black Sea begin affecting the deep basinal areas of the Marmara Sea.

2) Tekirdağ Basin: Tekirdağ Basin and the Western Ridge is intersected by the main Marmara fault with fresh scarps and a prominent deep furrow, where fluid escape, bacterial mats, mineral crusts and associated benthic life have been observed (Fig. 20) The western extension of the main Marmara fault in the Tekirdağ Basin connects with the onshore Ganos Fault, which ruptured during 1912 earthquake. The Tekirdağ Basin is also the first location where the waters of Mediterranean origin from the Çanakkale Strait (Dardanelles) descend into the deep Marmara basinal areas.
3) The Eastern Ridge: this ridge separates the Çınarcık and Central Basins and constitutes a part of the seismic gap in the Marmara Sea. Here, it is important to monitor micro-seismic activity, with a view to determine if the fault segment is locked or creeping.

The main objectives in these locations are to monitor:

1) micro-seismic activity,
2) fluid escape and its relation to seismic activity, benthic organic activity and ecology,
3) sedimentary processes related to seismic activity, submarine landslides, resulting tsunamis and turbidity currents, and
4) to obtain time-series oceanographic data (T, salinity, dip currents, turbidity, oxygen content), which are important for understanding the deep circulation dynamics and for monitoring ecological changes and effects of pollution in the deep Marmara Sea.

C.10.3. Existing national and international programs on the Marmara Sea

There are no sea-floor observatory programmes presently being carried out in the Marmara Sea. However, there are several ongoing collaborative international research projects, related to mainly the earthquake geology and geophysics.

6) MARNAUT (investigation of cold seeps and potential landslide areas with Nautil submersible) CNRS (CEREGE, PEPS), College de France, ITU, MAM, IFREMER, FUB, GEOMAR, 2007.
7) Sediment Geochemistry Atlas of the Marmara Sea, ITU supported by TUBITAK, Project no.103Y053.

C.10.4. Participants

ITU-EMCOL (Turkey)
ISMAR (Italy)
COLLEGE DE FRANCE
C.10.5. Financial support

Financial support from the City Council of Istanbul and Istanbul Metropolitan Municipality is possible.
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<th>Regional consortium of users</th>
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Selected References for Node description and participants:


Reilinger R., N. Toksoz, S. McLusky, A. Barka, 1999 Izmit , Turkey earthquake was no surprise, GSA Today, 10 (2000) 1-6.


C.11. Black Sea

(Boetius A., Bohrmann, G., Dimitrov P., Lericolais G., Linke P., Unnithan V.)

With anoxic conditions in the deep, problems with invasive species and high sediment loads delivered to the system, this area has unique problems requiring long term stations.

The Black Sea is one of the largest regional seas of the Eurasian continent and unique in many of its geographical, geological, biological, hydrographical and socio-political characteristics. Its total shoreline is 4340 km, and it is bordered by Romania, Bulgaria, Turkey, Georgia, Russia and Ukraine, with more than 160 million people inhabiting the greater Black Sea basin. The coastal zone of the Black Sea region has maritime temperate climate. The Black Sea is the world's most isolated sea, connected to the world’s oceans only via the Bosporus to the Mediterranean Sea, and with the Sea of Azov in the northeast through the Kerch Strait. It has a surface area of 432000 square kilometers and contains 550000 cubic kilometers of water. Through the Bosporus Strait about 300 cubic kilometers of seawater flows from the Mediterranean to the Black Sea along the bottom, returning a mixture of seawater and freshwater of about 600 cubic kilometers. The Black Sea is highly impacted by riverine discharge of some of the largest European rivers, the Danube, Dniepr and Don. Its salinity ranges between 18-22‰. It receives the drainage from a 2 million square kilometer basin, covering about one third of the area of continental Europe and delivering about 350 cubic kilometers of river water. The shelf occupies a large area in the north-western part of the Black Sea, where it is over 200 km wide and has depths of 150 meters. In eastern and southern parts of the sea the shelf has a depth of less than 100 m and a width of only 2.2 to 15 km. The smallest stretches of shelf are found near the Caucasian and Anatolian coasts. The Black Sea also comprises deep-water habitats, reaching > 2200 meters in the central area. A unique characteristic of the Black Sea Basin is its anoxia below 150 m water depth, and the consequent effect on biological and biogeochemical processes, including a limited zone populated by animal life defined by oxygen availability, a distinct chemocline, an extensive sulfidic zone, high methanogenesis rates and a high microbial diversity. The most unique type of life in the Black Sea are the reef- and crust-forming methanotrophic archaea (Michaelis et al. 2002). The total methane inventory in Black Sea waters has been estimated as 6x10^{12} mmol (Reeburgh et al., 1991). Furthermore, because of its hydrological isolation, the Black Sea has experienced extreme variations of salinity in the past 2 million years. Different from most marine sediments those of the Black Sea were formed under changes between limnic, marine and hypersaline settings, and oxic/anoxic phases in the water column. This has made the Black Sea one of the most fascinating areas to study sedimentary deposits and geological as well as hydrographical and climatic history of the region.
The eutrophication of the Black Sea due to the excessive loads of nutrients via the rivers and
directly from the coastal countries has led to radical changes in the ecosystem since the
1960es. This had a major impact on biological diversity and human use of the sea, including
fisheries and recreation. One of the regions of intensive radioactive precipitation during the
Chernobyl disaster was the northwestern Black Sea region. To release environmental
pressure from the Black Sea, a variety of political and non-governmental actions have been
taken. A co-operation for the protection of the Black Sea environment takes place in the
framework of the Convention on the Protection of the Black Sea against Pollution (Black
Sea Convention), to which the European Union has been granted official observer status.
Other partnerships include the Black Sea - Danube Strategic Partnership (BSDSP). One of
its main partners, the Black Sea Ecosystem Recovery Project (BSERP) has been developed
under the auspices of the Global Environmental Facility (GEF) International Waters (IW)
Program, and is implemented by the United Nations Development Program (UNDP). Main
efforts in ecosystem recovery started in 2002 and included the Black Sea Nutrient Reduction
Facility (World Bank) amongst a variety of activities. The BSERP ensures the provision of a
suite of harmonized legal and policy instruments for tackling the problem of eutrophication,
and release of certain hazardous substances, and to facilitate. Other important activities
include the Danube Regional Project harmonized with the EU Water Framework Directive
and GEF requirements, the EU-Russia-Ukraine GMES net-working on pipeline and oil spill
monitoring and the DABLAS Task Force with the aim of providing a platform for co-
operation for the protection of water and water related ecosystems of the wider Black Sea
region, including the Danube basin. A summary of environmental projects concerned with
the Black Sea region is given on http://www.blackseaweb.net. A first Black Sea Global
Ocean Observing System (GOOS) sponsored by the IOC implemented basic elements of an
operational network for observation, oceanographic data exchange, assimilation, forecasting,
and issues of products for marine ecological applications.
Major topics of Black Sea GOOS are coastal observations, sea level measurements, remote sensing, buoy measurements of basin circulation, regional weather forecasting and improved ecosystem modelling. The first EU funded Black Sea GOOS Project ARENA has been launched in 2003. ARENA is a regional capacity building and networking program to upgrade monitoring and forecasting activity in the Black Sea basin. ARENA aims a networking and capacity building for the development of the regional GOOS.

An important topic for the wider Black Sea area is potential impacts from earthquakes, landslides and floods. There is still controversial evidence for the biblical Black Sea flooding event 7000 years ago, but certainly did floods play an important role in the history of human settlements around the Black Sea. Northern Turkey lies on the Anatolian Fault, where earthquakes have been reshaping the land for millions of years. Other regions of seismotectonic concern are the Kaliakra or Shabla seismic zones. The seismic and differentiating character of earthquakes in this region is closely related to the deep fracture and the block construction of the crust. Some of the coastal mountains rise to over 3000 m altitude within 50 km from the sea. Steep slopes, agricultural land use and heavy rainfalls contribute to an increasing risk of landslides in the coastal areas of the Black Sea. The role of seafloor instabilities in the Black Sea is not well known. It hosts steep canyon systems, where bottom sediments of the shelf zone are removed to the continental slope region and finally to the abyssal part of the sea. Benthic turbidity storms due to bottom erosion, landslides and local submarine earthquakes have been observed occasionally. Furthermore, the recently recognized widespread occurrence of subsurface fluid flow, gas seeps, mud volcanism and gas hydrate deposits indicates an important role of these phenomena in seafloor stability, and a potential for catastrophic interactions between gas release and earthquakes and landslides.

Many of the important discoveries regarding gas seepage and mud volcanism in the Black Sea were made during the Training-through-Research (TTR) program of UNESCO in operation since 1990 based on a major initiative of Moscow State University (MSU), which puts together the advantages of the formal training of undergraduate and postgraduate students and young scientists with the experiences gained in advanced research. Its main operational field is marine geology and geophysics combined in with studies in benthic biology and physical oceanography, studying processes of geosphere-biosphere coupling in high-seas (http://ioc.unesco.org/ttr/geninfo.html). In the period 1991-2004, fourteen major TTR cruises were conducted in the Mediterranean and Black Seas and in the northeastern Atlantic.

In the 5th and 6th EC framework programs several major research projects have been funded within the OMARC (Ocean Margin Research Deep Water Consortium) to further increase knowledge on the Black Sea deep-water areas especially with regard to gas seepage. A brief summary of the results and study areas of interest is given in the next paragraphs. Several of the members of these OMARC projects in the Black Sea are also participants in ESONET and will help integrating previous knowledge into the planning of seafloor observatories.

The 5th FP project ASSEMBLAGE (http://www.ifremer.fr/assemblage/) has focused on the assessment of the Black Sea sedimentary system since the last glacial extreme. Main questions were the history of the connection between Mediterranean and Black Sea area, the growth of the sedimentary system in the Northwestern Black Sea, including the Danube and Dniepr-Dniestr deep-sea fans, the sedimentary records of the past global climate and sea
level changes as well as the distribution of gas seeps and gas hydrates (Popescu et al. 2003). The fieldwork within ASSEMBLAGE has provided long sediments cores for the study of climatic proxies and age determination, and bottom-simulating reflectors were investigated as potential indicators of paleo-environmental conditions. Heat flow measurements were made on specific target points on the BSRs, and 3D high-resolution seismic mapping was carried out in an area bearing gas hydrates. ASSEMBLAGE has concentrated on the area 43-44°N and 30-31°E and could provide high-resolution information of sedimentary environments, hydrate settings, and BSRs.

Another 5th FP project fully dedicated to methane seepage was CRIMEA ("Contribution of high-intensity gas seeps in the Black Sea to methane emission to the atmosphere"). This project focused on the transfer of methane from the seafloor through the water column and into the atmosphere from submarine high-intensity methane seeps and outbursts in the Black Sea (http://www.crimea-info.org) using a combination of modern geophysical, geological and biogeochemical methods. An important finding was that some shelf areas release large amounts of methane to the seawater, where it is partly oxidized and consumed by bacterial activity. CRIMEA concentrated mainly on the Dnepr paleo-delta area (water depth 100-700 m) and Sorokin Trough. Intense seepage areas have been identified particularly on the western and northwestern shelf and slope, as well as on the northern and north-eastern slope (Klerkx 2002, Klaucke et al. 2005). Moreover, high-intensity seeps were detected that vigorously eject methane into the water column and also to the atmosphere (Schmale et al. 2005). Sediments, which underlay the shelf and slope of the Western Black Sea, contain source rocks with significant oil and gas potential of several million tons of hydrocarbons km-3. For the Bulgarian continental shelf, the gas flux at the seabed is estimated at 147,000,000 to 737,000,000 m3 / year (Dimitrov, 2002). High estimates were also obtained for the north-western shelf, and the coast of Georgia. Furthermore, the annual gas flux from mud volcanoes in the Black Sea is inferred at 0.5 - 3Tg. Gas hydrates have been recovered in submarine fans, in fractured zones and within mud volcanoes. Theoretically, methane hydrates can form in the Black Sea at water depths exceeding 580 to 700 meters. Hence, the area of the Black Sea that is suitable for gas hydrate formation is evaluated at 288 100 km2, representing about 68% of the total Black Sea. So far, the volume of gas hydrates in the Black Sea has been estimated at 4.8 km3 corresponding to 0.1-1x 1012 m3 of methane gas.
Another EC 5th FP project was METROL “Methane flux control in ocean margin sediments” which dealt with gas distribution in shelf sediments and microbial processes controlling gas fluxes. Methane seeps were mapped through extensive acoustic surveys by the partners GeoEcoMar and IBSS. Anaerobic methane oxidation as the main sink for methane in the ocean was found to take place in the subsurface and at the seafloor at gas vents. Within METROL three working areas were chosen according to existing information on gas seeps distribution, accumulations of free gas in the sediment, and sediment geochemistry. The Danube Canyon (also known as Viteaz Canyon) is a large shelf-indenting canyon that has developed seaward of the late Pleistocene paleo–Danube Valley. It is located on the outer northwestern Black Sea shelf and stretches for 26 km from ca. 44°05’N, 30°10’E to the shelf break at ca. 43°55’N, 30°20’E. The canyon is up to 110 m deep and represents the proximal end of the paleo-Danube delta system. Aggregations of methane seeps have been mapped along the canyon slope and adjacent areas, especially along the shelf break edge to both sides of the canyon and along the landward prolongation of the paleo-Danube system. Subsurface gas plumes have been mapped in sediments in the canyon and along its prolongation (Popescu et al. 2004); further information on subsurface gas distribution is available by sub-bottom profiles from METROL project partner GeoEcoMar. A number of gas seeps have been mapped in water depths between 100 and 300 m along the entire north western shelf break between the Danube Canyon and the paleo-Dniepr delta area (Egorov et al. 1998). Dense accumulations of seep positions are known from the area around 44°35’N 31°10’E. This area mainly served for the search for gas seeps and associated carbonate precipitating microbial mats. Also, the paleo-Dniepr area has been intensively mapped by METROL for gas seep positions (Egorov et al. 2003). Data on the distribution of shallow gas have been made available by the METROL project partner GeoEcoMar and by the EU project CRIMEA.

Additional information about deep water gas seeps becomes available through the German national Geotechnologies program METRO (http://www.rcom-bremen.de/Page1908.html)
supported by DFG and BMBF as well as by the national research programs of the riparian countries. Highly active deep-water mud volcanoes were detected in the western basin and especially in the Sorokin Trough southeast of the Krim peninsula in water depths of 800-2000 m (Greinert et al. in press). The Sorokin Trough has been investigated in detail by METEOR-expedition M52/1 (Bohrmann et al., 2003; Krastel et al. 2003), focusing on gas hydrate structure, composition and distribution as well as association with fluid migration.

Another main focus of current EC research projects in the Black Sea is on deep-water hot spot ecosystems. The 6th EC FP project HERMES “Hot spot ecosystem research on margins of European seas” operates one of its regional work packages in the Black Sea, which is concerned with the biodiversity of microorganisms in slope and fluid flow impacted systems (http://www.eu-hermes.net/). Several European research cruises are planned together with riparian partner countries between 2007 and 2009 with a focus on in situ geophysical, geological, biogeochemical and biological measurements, and use of state of the art equipment for non-stationary benthic observation tools (including swath bathymetry, deep towed side scan sonars, ROVs, AUVs, benthic lander systems, in situ chemical sensors, camera deployments, colonization experiments etc). This work will provide a good baseline for selection of deep-water sites of interest for long-term observation, and will considerably improve the use of in situ analytical technology. All information collected during HERMES Black Sea activities will become available in the PANGAEA database for long term data storage. The WebGIS portals of the HERMES GIS (http://gis-web.iub-bremen.de/website/hermes/) will continue to provide facilities for online data analysis and visualisation. Close co-operation and collaboration with MARUM will insure direct access to the Pangaea database and maintenance of data standards. The HERMES partners will support ESONET by providing access to this information for accurate planning of activities in the Black Sea. The GIS tool will be available to ESONET and it is planned to develop an integration of observatory data into a GIS scheme.
ESONET plans to prepare and establish networks for the establishment of benthic observatories targeted to several objectives of the Global Change and Ecosystems sub-Priority, which could be realized in the Black Sea. Deep water long term observatories in areas of particle entrainment from the Danube and/or other discharging rivers could help detecting patterns related to global change, physical oceanography and anthropogenic impact. Furthermore, knowledge is available to plan observatories detecting geohazards including submarine earthquakes, slope instabilities, tsunamis, as well as fluid flow and gas seepage. This will also contribute to the knowledge on non-living resources especially with regard to hydrocarbons and CO2 sequestration. Last but not least, the deep water systems represent unique marine ecosystems with highly interesting biogeography, and biodiversity. Major objectives addressed by the Black Sea regional team are to prepare and plan long-term systematic observations of marine abiotic and biotic processes and key parameters such as:

- physical processes (e.g. tidal waves, eddies)
- river discharge
- changes in the quantity and composition of surface and deep water masses (salinity, temperature, current speed & direction)
- changes in atmospheric forcing
- distribution and high resolution analysis of the chemocline
- slope stabilities and failures
- sediment transport
- canyons as conduits between the deep-sea and the upper slope
- occurrence and distribution of pollutants
- productivity changes
- biodiversity and habitat changes

Today no concrete technology plans are available to install glass fiber cables or other types of submarine infrastructure. The main task for ESONET will be to help structuring the resources of the participating institutes to create the necessary critical mass, remove barriers and fragmentation of ideas, technologies and infrastructure, improve teaching, education and outreach, and - through joint program of activities – to arrive at durable solutions for the future organization of benthic observatories.

As main objective will be the planning of the investigation of long-term patterns in fluid flow and gas seepage through sediments and gas hydrates. This is of high interest to society because structures such as gas chimney’s acoustic blanking effects, subsurface sediment mobilization, and landslides close to the outcrop of the gas hydrate stability zone may indicate the episodic release of fluids from the gas hydrate reservoir to the seabed and into the water column (Kessler et al. 2006, Naudts et al. 2006, Schmale et al. 2005, Greinert et al. in press). Currently an initiative from various members of European programs, including partners of ESONET, proposes a new deep drilling program in the Black Sea to investigate both climatic and hydrological change in the basin as well as fluid and gas migration and hydrate distribution. A collaboration regarding site choices and possible linkage to benthic observatories is foreseen. To understand hydrocarbon release from gas hydrates in times of bottom water warming, when pressure and temperature dependent gas hydrate stability field conditions are changing, and in relation to seismic activities is of high importance. Previous observations in the Black Sea suggest that the geosphere can release large amounts of carbon during short time spans, bypassing the biological buffers and offsetting ocean atmosphere carbon equilibrium. It is important to quantify the involved carbon and methane
fluxes, to establish their relationship with biodiversity hotspot and ecosystem development and to implement them into climate models. Measuring fluid flow through sediments and subtle carbon flux variation in fluid and gaseous phases from the seabed requires long-term cabled observatories.

One first proposal for a long-term observatory to combine gas flux analysis with earthquake warnings has been put forward to ESONET (Dimitrov P.S., Institute of Oceanology – Varna, Bulgarian Academy of Sciences). This project for constructing a geodynamic polygon in the immediate vicinity of the Black Sea region has been developed in relation to rapidly increased seismic activities during last years. The main objective for this polygon is the registration of changes in gas-methane rates in permanently active gas springs related to tectonic infractions, to allow for warnings several hours before the occurrence of an earthquake. The idea for such a construction is based on previously described phenomenas of increased gas emission from the bottom several hours before an earthquake. An example is the Crimea earthquake on 12.09.1927: In front of terrestrial observing points in Lukuk, Eupatoria and Sevastopol fires were watched. The reason for the observed "fires" in the sea may be explained with release of gas (methane) from the seafloor, which could have ignited spontaneously and locally in the atmosphere. The main element of the geodynamic polygon is an installation for the capturing of gas expelled from natural seepage, to measure gas fluxes. It is proposed to exploit the emitted gas.

An ideal region for the construction of the polygon is the "Zelenka" area because the region is in the center of the Kaliakra earthquake zone, because gas emission occurs along predictable patterns (faults) and because the gas sources are very close to the coast, which allows for cheaper construction and service costs. The installation would consist of a semi-sphere fitted to the underwater gas sources, as well as a built-in pipe equipped with a line pipe with a valve, and a hermetic cable-pipe with a muffle and branch box for the cable. The muffle is connected with valve and outlet tube. Seismic sensors on the sphere and in the center, as well as the sensors for pressure, sea-water temperature and salinity are to be included in the branch box by hermetic couplings. Gas sources connected to deep faults exist in the Black Sea near Georgia, the Ukraine, and in other areas. Therefore, similar polygons could be constructed on the margins of all Black Sea countries. It would be a favourable long-term goal to achieve a complete regional observation of seismic and gas flux activities by connecting the data flow from the separate polygons. Today, only one such gas flux observation and collection construction has been installed at the famous Coal Oil Point Seep Field close to Santa Barbara, California (http://www.bubbleology.com/). Since the late 1990s, scientists have mapped the seeps in the area using sonar and quantified seepage flux from sonar and direct gas capture using a flux buoy (Washburn et al., 2001). In this area, most seepage is also located along linear trends above faults or fractured anticlines (Hornafius et al. 1999). The availability of such a submarine observatory and gas collection site has been very important for understanding long term changes in gas emission in relation to geological processes.

Selected references


Hornafius, J.S., D.C. Quigley, and B.P. Luyendyk, 1999. The world's most spectacular marine hydrocarbons seeps (Coal Oil Point, Santa Barbara Channel, California): Quantification of emissions, Journal Geophysical Research - Oceans 104 C9, 20703-20711


C.12. Koster Fjord demonstration observatory, western Sweden

C.12.1. Scientific context and relevance
Tjarno Marine Biological Laboratory (TMBL) has studied deep-water coral occurrences in the Koster Fjord area (NE Skagerrak, Sweden) over a long period of time. One of the studied coral sites is situated only 500 m from the shore at a water depth of 90 m. Deep water, originating from the Norwegian Trench, is here pumped over sill in a system of coastal deep-water channels by forcing of tidal and internal movements. A joint collaboration between the Jacobs University Bremen (JUB; L. Thomsen, T. Viergutz) and Goteborg University (UGOT; T. Lundalv, P. Hall, A. Tengberg) will offer a Seafloor Observatory at this site with a cable connection to a shore station with power supply and real-time connection to the internet, permitting access to data for a broad public as well as control of many functions on the Observatory. TMBL and UGOT have direct and immediate access to several ROVs and ships that will permit installation and service of the Observatory. The observatory is only 30 minutes of ship time away from TMBL.

C.12.2. Scientific objectives
The main purpose of this demonstration site is to test individual technological components developed in ESONET or related programs, both at a prototype phase and at an integration and compatibility phase. The activities at the site will focus on demonstration and test actions that will help validate the technology at different developmental phases of the project. The observatory serves to gain better insights into the dynamics of cold water coral systems like recruitment and feeding behaviour, hydrodynamics around cold water corals and monitoring of fishing activities in the area. Observations at the site can be expected to yield unique data on faunal behaviour and functioning at a biodiversity hotspot, as well as valuable data on the hydrographic regime.

C.12.3. Existing national and international program on the site
Activities within the EU HERMES 6FP-IP and within the national Research Program MARBIPPP (Marine Biodiversity, Patterns and Processes – Swedish EPA) are taking place at this site. In addition, an international research consortium on continental margin research uses the Koster site to test deep-sea equipment and monitoring devices for hydrocarbon industry.
Figure 30: Map of the Koster Fjord Demonstration site, with locations of the Observatory site and Tjarno Marine Biological Laboratory indicated.

Figure 31: Bathymetry of the Sacken Observatory site, with live coral patches marked.
C.12.4. Preliminary design of the implementation

Autonomous nodes
Planned sensors and parameters include an Internet Operated vehicle with video camera, temperature, salinity, turbidity, oxygen (optodes), horizontal and vertical current speed and direction throughout the water column (RDCP), wave height and spectrum, zooplankton migration, hydrophone, respiration chambers, and autonomous planar optode for 2-dimensional imaging of oxygen in water and sediment. Measured physical and chemical parameters will be related to observed biological behaviour and functions.

C.12.5. Extension

Many other sensors can be installed for demonstration and testing purposes after infrastructure for an additional underwater node has been provided by ESONET partners.

![Detailed bathymetry of the Sacken Observatory site. Inset: Photograph of a small Lophelia pertusa colony with associated fauna.](image)

C.12.6. Regional consortium of users and financing institutions

The Koster observatory will be in operation during the lifetime of the NoE and will thus offer unique opportunities for use in all WP’s. It is anticipated that the Koster observatory will play a central role in the joint activities of all participants.

The regional consortium consists of:
Jacobs University Bremen (JUB), Goteborg University (UGOT), Stockholm University (USTOCK) and Tjarno Marine Biological Laboratory (TMBL). TMBL has received strategic support from the EU.

C.12.7. Participants

JUB, UGOT, USTOCK
Selected References


## Appendix D - First composition of councils and committees

### Steering Committee

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<th>Role</th>
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<td>IFREMER</td>
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<tr>
<td>Scientific Council Chair Person</td>
<td>Imants G. Priede</td>
<td>Univ. Aberdeen (UK)</td>
</tr>
<tr>
<td>Test and Operation Council Chair Person</td>
<td>Paolo Favali</td>
<td>INGV (IT)</td>
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<tr>
<td>Data Management Council Chair Person</td>
<td>Sylvie Poulquen</td>
<td>IFREMER (FR)</td>
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<td>WP1 Networking</td>
<td>M. Diepenbroek</td>
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<td>WP2 Standardisation and interoperability</td>
<td>C. Waldman</td>
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<td>WP3 Scientific observatory design related to scientific objectives</td>
<td>H. Ruhl</td>
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<td>WP4 Demonstration missions</td>
<td>L. Beranzoli</td>
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<td>WP5 Implementation strategies</td>
<td>M. Gillooly</td>
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<td>WP6 Socio economic users</td>
<td>J.M. Miranda</td>
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<td>WP7 Education and outreach</td>
<td>L. Thomsen</td>
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<td>3 elected delegates from General Assembly</td>
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<tr>
<td>Core Partner – HCMR – Greece</td>
<td>A. Tselepides</td>
<td>HCMR (GR)</td>
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<tr>
<td>Core Partner – CSIC – Spain</td>
<td>J.J. Dañobeitia</td>
<td>CSIC (ES)</td>
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### Scientific Council

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<tr>
<td>Antje Boetius</td>
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<td>Louis Geli</td>
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<td>Pierre Henri</td>
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<td>Richard Lampitt</td>
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<td>Domenico Giardini</td>
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### TEST AND OPERATION COUNCIL

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**TOC Members**

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<td>Laura Beranzoli</td>
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<td>Mathilde Cannat</td>
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<td>Per Hall</td>
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<td>Glen Nolan</td>
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<td>Phil Bagley</td>
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<td>Hans Gerber</td>
<td>TFH Berlin (DE)</td>
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### DATA MANAGEMENT COUNCIL

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**DMC Members**

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<td>Andrea Morelli</td>
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APPENDIX E – Glossary

ANIMATE  Atlantic Network of Interdisciplinary Moorings And Time-series for Europe

ANTARES  Astronomy with a Neutrino Telescope and Abyss environmental RESearch

ARCT  Atlantic ARCTic Province

ARENA  Advanced Real-time Earth monitoring Network in the Area

ASSEM  Array of Sensors for Seabed Monitoring of geohazards

AUV  Autonomous Underwater Vehicle

AWI  Alfred Wegener Institut (DE)

BSERP  Black Sea Ecosystem Recovery Project

CA  Concerted Action

CBD  Convention on Biological Diversity

CINTAL  Centro de Investigação Tecnológica do Algarve (PT)

CLIVAR  Climate Variability and Predictability program

CNRS  Centre National de la Recherche Scientifique (FR)

cork  circulation obviation retrofit kit
(Instrumentation and packer systems inserted in some deep sea boreholes for subsequent monitoring. The device includes a cover of the drill hole, allowing mastering of fluid related experiments)

CRIMEA  Contribution of high-density gas seeps in the Black Sea to methane emission to the atmosphere

CSIC  Consejo Superior de Investigaciones Científicas (SP)

DAMOCLES  Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies

ECOOP  European COastal-shelf sea OPerationnal monitoring and forecasting system

ECORD  European Consortium for Ocean Research Drilling

EEZ  Exclusive Economic Zone

EMSO  European Multidisciplinary Seafloor Observation infrastructure

ERA-NET  European Research Area Network

ESFRI  European Strategy Forum on Research Infrastructures

ESONIM  European Seaﬂoor Observatory Network Implementation Model

ESTOC  European Station for Time-series in the Ocean, Canary Islands

EUROCEANS  EURopean network of excellence for Ocean Ecosystems ANalySiS

EUROGOOS  European - Global Ocean Observing System

EXOCET/D  Extreme ecosystem studies in the deep ocean -Technological Developments

FAO  Food and Agriculture Organisation
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<tr>
<td>FDSN</td>
<td>Federation of Digital Broad-Band Seismographic Networks</td>
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<tr>
<td>FORTH</td>
<td>Foundation for Research and Technology Hellas (GR)</td>
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<tr>
<td>GAC</td>
<td>GMES Advisory Council</td>
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<tr>
<td>GEO</td>
<td>Group on Earth Observation</td>
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<tr>
<td>GEOSS</td>
<td>Global Earth Observations System of Systems</td>
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<tr>
<td>GEOSTAR</td>
<td>GEophysical and Oceanographic STation for Abyssal Research</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<td>GMES</td>
<td>Global Monitoring for Environment and Security</td>
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<td>GOOS</td>
<td>Global Ocean Observing System</td>
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<td>GSN</td>
<td>Global Seismographic Network</td>
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<td>HCMR</td>
<td>Hellenic Center of Marine Research (GR)</td>
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<tr>
<td>HERMES</td>
<td>Hotspot Ecosystem Research on the Margins of European Seas</td>
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<td>HOV</td>
<td>Human Operated Vehicle</td>
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<tr>
<td>IACM</td>
<td>Institute of Applied and Computational Mathematics</td>
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<td>ICDP</td>
<td>International Continental Scientific Drilling Program</td>
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<td>ICES</td>
<td>International Council for the Exploration of the Sea</td>
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<td>IFREMER</td>
<td>Institut Français de Recherche pour l’Exploitation de la Mer (FR)</td>
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<td>INFN</td>
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<td>INGV</td>
<td>Istituto Nazionale di Geofisica e Vulcanologia (IT)</td>
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<td>INSPIRE</td>
<td>Infrastructure for Spatial Information in Europe</td>
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<td>IOC</td>
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<td>IODP</td>
<td>Integrated Ocean Drilling Program</td>
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<td>IP</td>
<td>Integrated Project</td>
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<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>JUB</td>
<td>Jacobs University Bremen (DE)</td>
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<tr>
<td>IUUEM</td>
<td>Institut Européen de la Mer (FR)</td>
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<tr>
<td>JGOFS</td>
<td>Joint Global Ocean Flux Study</td>
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<td>JPA</td>
<td>Joint Programme of Activities</td>
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<td>KDM</td>
<td>Konsortium Deutsche Meeresforschung (DE)</td>
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MARBEF  Marine Biodiversity and Ecosystem Functioning
MEDI   MEDITerranean Sea
MERSEA Marine Environment and Security for the European Area
METRI  Marine Environment Test and Research Infrastructure
METROL Methane flux control in ocean margin sediments
MISU   Dept. of Meteorology at Stockholm University (SE)
MoMAR  Monitoring the Mid-Atlantic Ridge
MPA    Marine Protected Areas
MPI    Max-Planck Institute (DE)
NADR   North Atlantic DRift Province
NAST   North Atlantic SubTropical Gyre Province
NEAREST Integrated Observations from Near Shore Sources of Tsunamis
NEMO   NEutrino Mediterranean Observatory
NEPTUNE North East Pacific Time-series Undersea Networked Experiments
NERIES Network of Research Infrastructures for European Seismology
NERSC  Nansen Environmental and Remote Sensing Center (NO)
NESTOR Neutrino Extended Submarine Telescope with Oceanographic Research
NGO    Non-Governmental Organizations
NIOZ   Netherlands Institute for Sea Research (NL)
NOCS   National Oceanography Center Southampton (UK)
NoE    Network of Excellence
OAT    Ocean Acoustic Tomography
OBH    Ocean Bottom Hydrophone
OBS    Ocean Bottom Seismometer
OMARC  Ocean Margin Research Consortium
ORION (EC Project) Ocean Research by Integrated Observation Networks
ORION (US Programme) Ocean Research Interactive Observatory Networks
PAP    Porcupine Abyssal Plain
PSSA   Particularly Sensitive Sea Area
RLE    Regional Legal Entity
ROSMARIN Réseau d’observation sismologique marin
ROV    Remotely Operated Vehicle
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<td>SARC</td>
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<td>SCOR</td>
<td>Scientific Committee of Oceanic Research</td>
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<tr>
<td>SDI</td>
<td>Spatial Data Infrastructures</td>
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<tr>
<td>SensorML</td>
<td>Sensor Model Language (XML-based Sensor Model Language)</td>
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<tr>
<td>SERPENT</td>
<td>Scientific and Environmental ROV Partnership using Existing Industrial Technology</td>
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<td>SMEs</td>
<td>Small and Medium-Sized Enterprises</td>
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<td>SOAP</td>
<td>Simple Object Access Protocol</td>
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<td>SOFAR</td>
<td>Sound Fixing and Ranging</td>
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<tr>
<td>SSA</td>
<td>Specific Support Action</td>
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<td>THC</td>
<td>Thermohaline Circulation</td>
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<td>United Nations</td>
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<td>UNDP</td>
<td>United Nations Development Program</td>
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<td>WRCP</td>
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