Volume 1 Issue 2

ESONEWS

The Newsletter of the European Sea Observatory Network

CONTENTS

Fall 2007

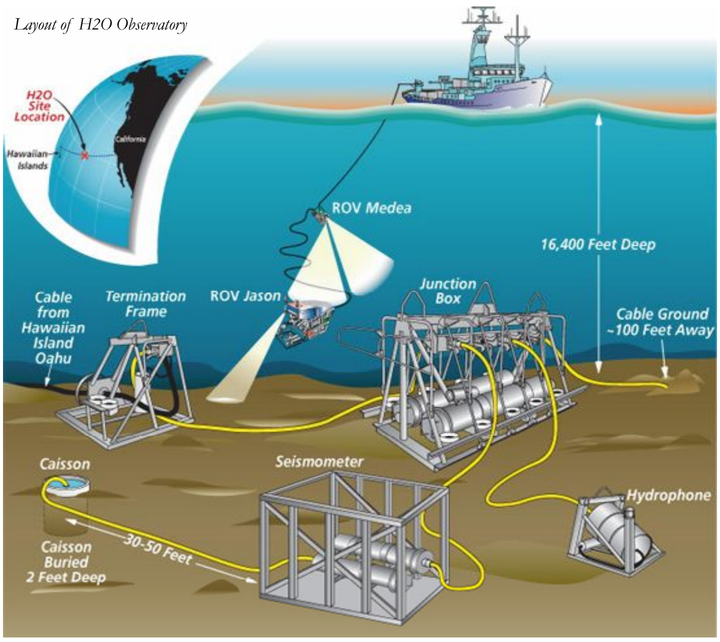
Industry Meets the Challenge of Ocean Observatory Implementation

A number of ocean observatories have been deployed worldwide (in the Mediterranean, offshore Japan and Hawaii) and more are due to be commissioned over the next few years (offshore Western Canada and the USA). Ocean observatory architecture is evolving with the changing needs of the scientific community and the advance into deeper water. Industry suppliers are meeting the new challenges presented by the move towards real-time cabled ocean observatories providing online data feeds from the deep ocean to the desktop of marine scientists and industry professionals. The established architecture involves a backbone submarine cable ring with science instrumentation located at regular nodes all connected back to a shore station.

The specifications for the science nodes that collect the data in the deep ocean observatories are now defined. The nodes will be housed in trawler resistant frames containing electrical power converters, pressure resistant housings with data communication equipment having capacities up to 8 Gb/s. The science instrument ports will incorporate wet mate connectors. The equipment will require higher reliability standards than onshore counterparts.

Operating Depth	Down to 8000 m
Supply Voltage	10000 VDC
Total Power Available	10000 W
Node Interna Power Load	<500 W
Shore to Node Data Communications	2.5 Gb/s or 1 Gb/s
Shore to Node Distance*	400 km or 100 km
Number of SIPs	8
SIP Voltage	48 VDC or 400 VDC
SIP Data Communications	Ethernet 10/100Mb/s
Input/Output SIP data	Serial or Ethernet
Extension Capabilities	100 km / 1 Gb/s
*Without multiple nodes or sub-sea amplification	

There are a number of challenges that ocean observatories present as they advance into deeper water and demand real-time, online data feeds. The technology challenges include the development of new sensors and the enhancement of remotely operated seafloor crawlers to explore the deep ocean floor using commercial off the shelf solutions that have a 25 year life expectancy and built in redundancy. The hostile physical environment provides a number of technological challenges including biofouling. There are also financial barriers such as proving the capacity of ocean observatories to generate revenue. There are organisational issues such as ownership of the infrastructure and the data generated, insurance, liability and indemnity issues between the partners operating the system and the clients receiving on-line data feeds.



Industry Meets the Challenge of Ocean Observatory Implementation

Biofouling creates a film of bacteria that inhibits sensors. Scraping is impractical for deep water sensors and TBT coatings have been phased out. Industry is addressing the issue by selecting surface material such as titanium which is immune to microbiologically influenced corrosion. Immunoglobulins are also proving useful because they provide a natural biocide for planktonic (floating) and sessile (attached) bacteria. Glasgow Marine Technology Centre (GMTC) in collaboration with Chelsea Technologies Group Ltd has developed an electrical method which substantially reduces biofouling on conducting surfaces. Ifremer developped and uses for some years a local electro-chlorination technic to protect against biofouling any kind of sensors and a specific method for optical devices which present very high integration caracteristics (equipment available at NKE company).

The Deutsches Zentrum für Luft- und Raumfahrt (DLR) has had plenty of opportunities in the past to gather experience in the development of wheels, both for planetary missions and for applications on Earth. One example is the deep-sea exploration vehicle MOVE (Moving Lander). In 2002/2003, on behalf of the University of Bremen, the Institute designed a set of flexible wheels that function up to a maximum depth of 6000 metres. This underwater vehicle with the 'wheels from space' has already proved itself in practice.

MOVE (Moving Lander) vehicle developed by DLR on behalf of the University of Bremen, shallow water test in the bay of Eckernfoerde

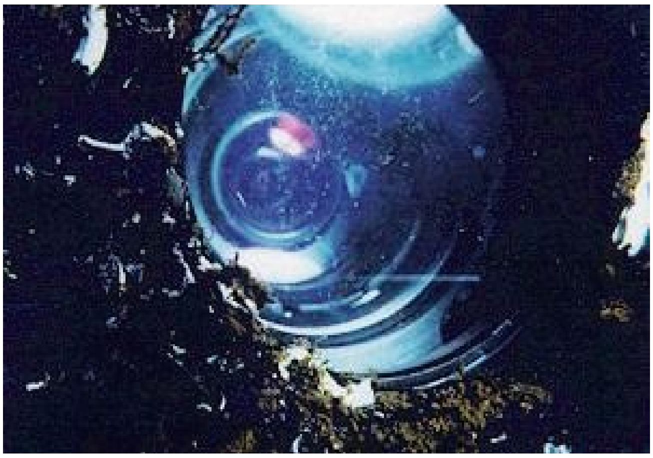
Industry is meeting the challenge of collecting environmental data in the deep ocean by designing innovative structures to host scientific instruments. BP's DELOS – Deep Ocean Long-term Observatory System situated off Angola, in the Atlantic Ocean in the oil and gas exploration region termed Block 18 at a depth of 1400m is just such an innovation. The DELOS system comprises two environmental monitoring platforms: - one in the far field (5 miles form sea floor infrastructure); and one in the near field (within 50metres of a sea floor well). Each platform comprises two parts: - the sea floor docking station that is deployed on the sea floor at the start of the monitoring program and remains for the 20 year project duration; and a number of observatory modules that are designed to perform specific environmental monitoring functions. A number of companies are involved providing equipment designed to operate under the rigorous specifications needed to operate in these unusual conditions:

- Sonardyne – location beacon
- McLane Parflux 78H-21 Sediment trap
- Kongsberg High Resolution mechanically scanned sonar head
- Aanderra current meter 3820R & other sensors
- Wet labs combination fluorometer and turbidity sensor (ECO FLNTU)
- Teledyne RDI 300kHz ADCP
- Module frames designed by 2H Offshore Ltd
- Glass fibre material and platform construction carried out by Fibreforce Ltd.
- Cameras – Kongsberg

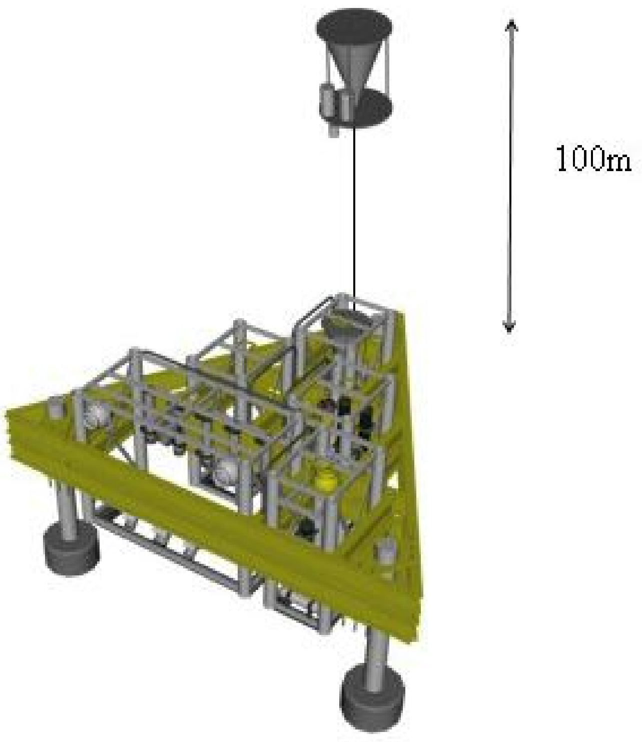
For the deep-sea environment (down to 6000m depth) technology companies like NKE Instrumentation have developed instrumented boards for the monitoring of the environment. Sensors and probes for measuring pH, oxygen, nitrate, hydrogen and sulphide are now available for deep water measurements.

Scientific researchers have paved the way in the design and deploy

Unprotected camera lens



Hydrophilic-coate d camera lens



ment of ocean observatories beginning in shallow water and now operating in the deep ocean around the world. Commercial off the shelf solutions are now required to meet the challenges of operating under high pressure and strong current conditions in deep water.

For operational and economic reasons ocean observatories are expected to operate for over twenty years. Therefore careful physical design, with built in redundancy, stringent component selection and assembly, high standards in construction & qualification are now required. Now that the private sector is deploying ocean observatories for commercial purposes industry standard certification has become even more important.

Your company may have a solution to some of the challenges currently identified. Interact with the research community through PESOS (Providers of Equipment & Services to Ocean Observatories) to understand the needs of the ocean observatory community.

The objective of PESOS is to provide a means for the marine technology sector to:

- Interact with ESONET partners on matters of interest to industry
- Learn about the other industry participants
- Develop synergies between industry partners for mutual benefit

How? PESOS published this quarterly newsletter which provides companies an opportunity to advertise their technological advances by publishes short articles on successful deployment of instrumentation. PESOS also organises informal meetings at oceanographic conferences designed to keep industry informed of ocean observatory developments and the technological challenges being faced by the scientific community gathering data in the deep ocean.

MOVE (Moving Lander) vehicle developed by DLR on behalf of the University of Bremen, shallow water test in the bay of Eckernfoerde

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New comers into ESONET NoE

Ingrid Puillat, deputy coodinator of the ESONET Network of Excellence
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Ingrid is a marine scientist with particular interests in mesoscale and submesoscale hydrodynamics and its coupling with the biogeochemistry in open sea and coastal areas. Just arrived at IFREMER Brest, she's coming from the Institute for Environment and Sustainability of the Joint Research Centre (JRC/European Commission) at Ispra (Italy) where she worked as researcher in fate modelisation of Persistent Organic Pollutants in coastal aquatic ecosystems for a FP6 European integrated project.

After completing her PhD in oceanography at Marseille University with C. Millot and I. Taupier-Letage in the Oceanography and Biogeochemistry Laboratory (LOB), she moved to several institutes as experimental oceanographer: the IFREMER Institute at Brest (France), the International Marine Centre at Oristano (Italy), the LODyC/IRD at Paris and Lima (France and Peru). She also worked as assistant Professor at Toulon University (France). Usually involved in experimental programs and in European context she's managing the ESONET network of Excellence as Deputy coordinator with Roland Person at IFREMER Brest.

Fiona Grant, Marine Institute, IMI, Ireland
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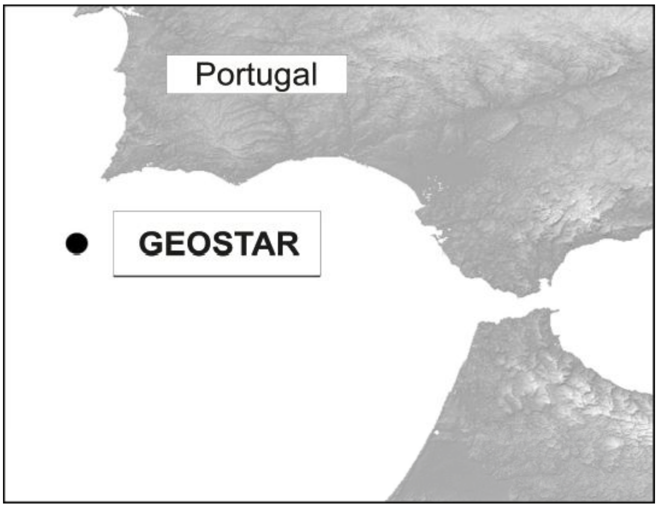
Fiona is a marine geologist and geophysicist with a background in gravity and magnetic modelling and sedimentary basin formation. She has also some experience in habitat mapping of freshwater environments. She joined the Marine Institute on 4th September 2007. Prior to that, she was the National Protection and Conservation Coordinator for wild salmon and sea trout in the Central Fisheries Board. Her qualifications include a B.Sc. in Earth Sciences & an M.Sc. in Applied Geophysics from NUI, Galway and a Ph.D. in Marine Geology and Geophysics from NUI, Galway and the University of Oxford.

She is working with the Director of Ocean Science Services, Mick Gillooly, as coordinator for ESONET NoE, EMSO, EURO-ARGO and other observatory programmes. Under the Marine Institute's new Integrated Marine Exploration Programme, she will act as an innovator and contact point for internal, national and international research scientists interested in deepwater research initiatives and will input into the development of the Deep Sea Frontier Initiative and other deep sea RTDI.

Tsunami: installed an abyssal monitoring observatory in the Gulf of Cadiz at 3200 m depth by the EU Project NEAREST

During the night between the 25th and the 26th August 2007 an abyssal observatory was installed to survey tsunami waves of Gulf of Cadiz at water depth of about 3200 m in Portuguese water. This area is in fact tsunami prone as testified by the 1st November 1755 earthquake events. On that day the coast line that extend West of Gibraltar was invested by a devastating wave of tsunami. This wave was generated by the strongest earthquake, of which we have memory, ever happened in Western Europe. Lisbon, and with it all cities located along the coast of Portugal, Atlantic Spain and North-western Morocco, were first hit by a seismic wave and few minutes after, 45 minutes after in Lisbon, by a tsunami wave. Witness statements from that time report descriptions of a wave high up to 12 meter in the southern point of Portugal (Capo San Vincente).
All the lowest part of Lisbon, Royal Palace included, was destroyed by the combined effect of the shock and the tsunami. The coast line along this length of sea has been newly urbanized and it is now densely populated. If now a tsunami ever generate in this area it would bring much more devastating consequences.
Different studies and detailed survey, carried out in the past years by the Istituto di Scienze Marine (ISMAR-CNR) of Bologna in collaboration with numerous others european scientific team, have showed that the tectonic structures responsible for these big events are very close to the coast line arising the difficult problem of alerting the population in short time. The problem to have short time between the moment in which a tsunami is generated and the moment of the destructive wave arrival is common to the entire Mediterranean basin. The monitoring techniques up to now developed by those countries at risk of tsunami, such as Japan and United States, are not directly applicable on these areas. The Japanese have developed a network of sensors put in front of their coast, the U.S.A. have deployed sensors in the middle of the Pacific able to detect tsunami known as "teletsunami", those phenomena that happening at big distances give hours for their determination and monitoring.
Unfortunately at the actual state of our knowledge, we are not able to predict if after a big earthquake happened at sea a tsunami would be generated or not. That is for instance even demonstrated in the big earthquake that few days ago hit Peru, which although the strong magnitude did not produce any tsunami.
Thanks to a series of geological and geophysical studies conducted in the past 10 years which made possible to individuate the principal seismotectonic structures that could cause tsunami events, in the Gulf of Cadiz new technologies and new methodologies to overtake the problem related to nearby seismic source are being experimented. Spotting the potential tsunami sources is an important result; in the Pacific, for example, these sources have not yet been spotted with the necessary detail. On the slipstream of these results NEAREST (Integrated observations from NEAR shorE Sources of Tsunamis: towards an early warning system) project was born. This project is funded by the European Commission within the "Global Change and Ecosystems" framework. Its Italian co-ordination (ISMAR-CNR) involves researchers and technicians from Italy, France, Germany, Spain and Morocco. NEAREST proposes itself to collocate the sensors directly on the tectonic source to be able to monitoring the movements and to immediately recognise a tsunami.
In the Gulf of Cadiz the time that elapses between the propagation of a tsunami and its impact on the coast closer to the Algarve it is of only 15 minutes and the alert, to be effective, must be emitted within few minutes from the occurrence of the seismic event. To obtain this result it has been used GEOSTAR underwater observatory equipped with a new tsunameter developed in collabotation with Istituto di Radioastronomia of Bologna, branch of Istituto Nazionale di Astrofisica (IRA-INAF). GEOSTAR is a multidisciplinary abyssal station, developed by Istituto Nazionale di Geofisica e Vulcanologia (INGV) and Tecnomare (marine engineering company of Italian Eni group) in the framework of previous European projects and qualified in four scientific missions. INGV and Tecnomare are both involved in NEAREST.



Location of the NEAREST Observatory

The peculiar characteristic of the abyssal station is to be able to overstay on the seafloor for more than a year. GEOSTAR is equipped with geophysical instruments (seismometer, hydrophone, and gravimeter) and oceanographic instruments; and in this occasion it is equipped with a new conception tsunameter. This tool has been appositely designed to operate in areas that generate tsunami waves in order to send automated alert messages. The tsunameter is based on a double check of seismic and pressure signals and keeps into account the seafloor movements. The study of the relation between the motion of the seafloor and the perturbation of the water column could be the key to comprehend the unsolved scientific problem of the tsunami generation after strong earthquakes. Other peculiar characteristic of the tsunameter is that it can receive inputs from land and it can reprogrammed during the mission.
GEOSTAR observatory has other characteristics which put it spearhead in this type of studies. It does not only detect, measure and register the changes that happen on the seafloor, but it is also able to elaborate data to recognise variation of the order of a centimetre within the water column. At the end of the mission the observatory will be recovered restocked and reequipped to continue the experiment.
The recovery takes place thanks to the auxiliary of the MODUS (MObile Docker for Underwater Sciences), a vehicle appositely developed by our German colleagues from the Polytechnic and the

The figures illustrate GEOSTAR observatory (on top), the surface buoy (in the middle) and the deployment site of the observatory in the Gulf of Cadiz (in the bottom) by CNR research vessel URANIA.

Technical University of Berlin during previous "Geostar" projects. MODUS is controlled from the ship through a telemetric cable and it guarantees the deployment and the recovery of the observatory to and from the seafloor. This might seem a simple operation but at sea all become extremely complicated. The lightning at depth of 3000 meters is absent and even a very powerful spotlight guarantees only few meters of visibility. In water then it is not possible to transmit radio waves and all positioning systems must make use of acoustic transmissions, just like whales do to communicate among themselves.

In NEAREST, GEOSTAR has been positioned by URANIA oceanographic ship owned by CNR, on to a gigantic geological structure, large around 50 km and long around 100 that, acting like a sort of rock plunger, can transfer big quantity of energy to the water column generating tsunamis.

In case of tsunami an alert must be sent to land in short time. To do so the abyssal observatory is on acoustic link with the buoy equipped with a meteorological station, acoustic modems, GPS positioning system, satellite link and solar panels for powering.

The signals coming from the abyssal station are sent to shore stations installed at INGV (Rome), Tecnomare (Venice), ISMAR (Bologna), and also to the Data Centre of the Istituto Metereologico (Lisbon), that is linked also to the Geophysical Centre of Granada, and to the Rabat Centre of National Council for the Scientific Research (Morocco). These institutes manage the national seismic network and they are in charge to validate the data received from the station and of the integration of the data in the local seismic and oceanographic network and they are also in charge to forward the alert to the national authority.

The importance of this experiment resides in the feasibility study of a "Tsunami Early Warning System" usable in the Mediterranean areas or in other part of the planet exposed to a risk of tsunami originated near the coasts.

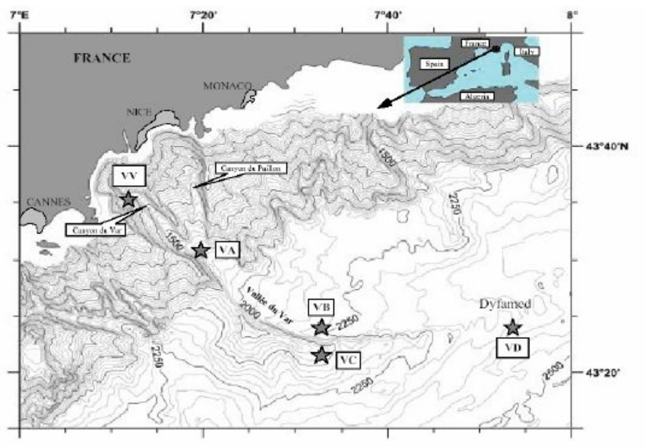
NEAREST experiment is a first step towards the installation of a permanent observatory in the Gulf of Cadiz, node of the future underwater network which will be integrated in real time with the monitoring terrestrial networks that the European Community intend to develop in the European Seas, from the Arctic to the Black Sea passing through the Mediterranean. Such network, called EMSO (European Multidisciplinary Seafloor Observatory) was recently declared by the European Commission one of the 35 infrastructures important for the development of the European scientific research area.

EMSO underwater network will be used by the scientific and technological community, today co-ordinated within ESONET European project, to extend the capability to better comprehend the fundamental processes that regulate climate and life of our Planet. Thanks to the research carried-out in the area up to now, the Gulf of Cadiz has already obtained approval to become one of EMSO nodes from the European scientific community.

A recent monitoring experiment with a non cabled observatory:

Real time transmission of current and turbidity data from the near bottom Var canyon system

Under the umbrella of the EU-FP6 HERMES program, Ifremer is committed in the monitoring of the particle dynamics in the Var canyon. For this purpose, a set of current measurement devices and particule traps were installed on several mooring lines and seabed stations along the Var Valley. Two of them were fitted with a near-real time link to shore, thanks to the SEAMON-BOREL system, developed at Ifremer. The system was installed and maintained during two years at a depth of 2000 m, enabling the current and turbidity monitoring from Brest. The technical status of the equipment was also watched from Brest. What are the lessons learnt from this two-year experiment ?

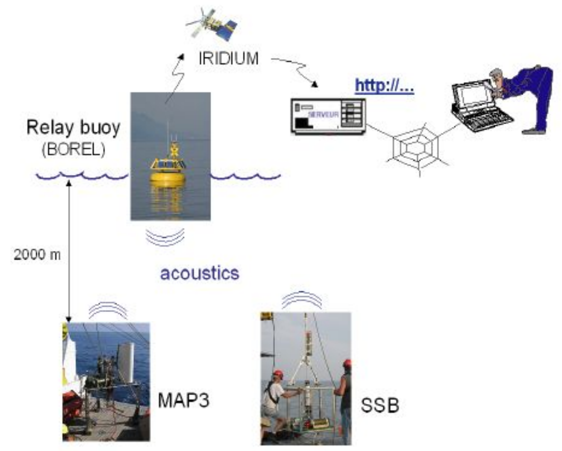


The Var valley and ENVAR instrument locations

The SEAMON (Sea Monitoring) system enables the measurement data from various local deep sea sensors to be collected as and when generated, then periodically forwarded to a data base on shore. MAP3 (currentmeter, fluorometer and turbidity sensor near the seabed) and SSB (currentmeter) stations were installed at the levee of the valley and benefited from this service. They sampled measurements every 15 mn, stored and forwarded them every 6 hours to shore. The near real-time link comprised one acoustic segment between each seafloor station and a relay-buoy (BOREL), followed by an Iridium satellite segment joining the buoy to a shore server. The link was bi-directional, allowing the modification of the measurement parameters at any time, by an operator on shore. The functioning parameters of the stations were also monitored, for a proper preparation of the maintenance interventions scheduled at each periodic cruise over the Var Valley.
Although the seabed measurement system worked perfectly during the two years, the monitoring service from shore was interrupted several times. It allowed, however, to display interesting features of the current system such as the inertial oscillations encountered in these areas, in addition to monitoring the functioning status of the equipment. The reasons for near real time service interruptions were diverse:

Three acoustic modem failures obliged to recover the stations. The origin of these failures is now known and fixed. We also had two unexpected successive Iridium modem failures, that occurred during maintenance operations and exhausted the available spare parts set. Last but not least, the buoy twice escaped from its swinging radius. The first time, the mooring line was found cut clean through, 300 m below the surface. The second time was an incidental removal by a coast guard, that could have easily been avoided.

As a conclusion, this two year operation showed that it is possible to monitor deep sea phenomena in real time, at a relatively modest cost. Although the system reliability was significantly enhanced during the experiment, the necessary effort for keeping a such sytem operational should not be underestimated. That means shiptime together with skilled technical teams can be made available and afforded during the entire operation. Furthermore, a significant increase of the acoustic data rates is now required to open that type of observatories to sensors generating larger data volumes.



Data transmission chain between seafloor and user on shore

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COMPANY PROFILE

SEND Signal Elektronik GmbH

SEND is a German company specialisig in handling scientific data which are often not reproducible and therefore highly valuable. SEND's signal integrity know-how is based on more than 10 years of experience in signal acquisition, data pre-processing and data storage for geophysics and nuclear physics. Due to co-operations with business partners, SEND can also organise and manage the development and manufacturing of complete OBS/OBH or deep towed streamer systems.

SEND has developed and manufactures its own data loggers for seismological applications which - by means of low noise preamplifiers and filters - digitise, compress, classify, verify and store the signals coming from your sensors. Afterwards the data can be played-back and processed on your PC or work station, and they can be converted into standard data formats. Due to the uniqueness of these data loggers, SEND is calling them SEISMOCORDER. Due to consequent application of the Mono-Oscillator technology (all control signals are derived from a single oscillator), the Seismocorder of SEND offer exceptionally low noise figures.

Furthermore, SEND launched the "Full Tilt" Geophone on the basis of modified standard geophones and a gimbal electronics.

As service, SEND offers the development of electronic devices reaching the technological limits with respect to

- Signal to noise ratio
- Energy consumption
- Time-base precision

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Product Portfolio

- Electronic Contract Development
- Data Logger
- GPS for time synchronisation
- Deep Sea Cable Telemetry
- Electronically Gimballed Geophone
- SLA- Ocean Bottom Seismic units
- Tsunami Early Warning units

Our production is organized and documented strictly according to the principles of the DIN ISO 9001 quality management system. Every piece of equipment leaving our house has been registered completely. All components can be traced back to the place and exact date of manufacturing. Comprehensive assembly instructions and testing protocols assure a consistent quality of the manufacturing process and very reliable products.

ESONET NoE
FIRST ALL REGIONS WORKSHOP
BARCELONA 5-7th OF SEPTEMBER 2007

Roland Person
Coordinator of ESONET NoE

In the framework of the ESONET NoE, the first All Regions Workshop took place at Barcelona, the 5-7th of September 2007. This meeting introduced presentations of experience, achievements and plans of science and technology of European and worldwide sub-sea observatory initiatives.
A first plenary session outlined observatory worldwide experiences presented by our colleagues from Canada (Neptune-Canada observatory: C. Barnes from Victoria University), USA (J. Delaney from Washington University, S. Walker from NFS, Mars observatory: S. Etchemendy from MBARI) and Japan (Donet observatory; Y. Kaneda from JAMSTEC), bringing their expertise to the NoE and an external point of view on the European regional plenary sessions that followed. The Hermes project presented by P. Weaver from the NOC (U.K.) gave an overview of the scientific interest for long term investigation on margins of European seas.
The organisation of regional plenary sessions enabled to refine the objectives of each regional observatory initiative and to reinforce the multidisciplinary aspect and the internationality in the implementation plans. During the thematic parallel sessions round tables focused on the new insights that continuous monitoring and long time series experiments will brought. A special attention was drawn on how existing nodes can be used to build upon what has been achieved so far, in Europe and elsewhere. Four technical parallel sessions addressed problems of interoperability & communication, standardisations, data management, observatory servicing & maintenance operations.
The available reports of parallel sessions can be found with the authorized presentations of plenary sessions, on the "Partners only area" of ESONET-EMSO web site www.esonet-emso.org, by selecting the "Minutes of meetings" tab.
We thank, the hundred of scientists for their participation and especially for the ~30 oral presentations, the chairpersons for their work, without forgetting the CSIC Team for the logistic organisation.

Flashes/short news

Strategic Committee of ESONET and EMSO

During the Barcelona Strategic Committee (STRAC) meeting, it has been decided to merge the EMSO STRAC and the ESONET one. We are pleased to announce the arrival of Dr. Dan Holtstam from the Swedish Research Council (VR) as Swedish representative in the ESONET-EMSO STRAC.

ESONET-EMSO website: www.esonet-emso.org

The web site has been recently updated. Now you can find an agenda of conferences and of internal meetings. More details can also be read in the partners only area. On the demonstration missions web page (partners only area) you can check the selection process.

EUROPE FOR GEO

The Esonet Network has been selected by the European commission to be present during the booth "Europe for GEO" that will take place during the GEO international meeting and ministerial summit at Cape Town in South Africa the 27-30th of November 2007.

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