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ESONET European Seas Observatory Network

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Project Deliverable D58

Report on Selected test experiments on cabled sites

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CO	Confidential, only for members of the consortium (including the Commission Services)	

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Executive Summary

The ESONET NoE still suffers from insufficient access to online data. Most of demonstration missions are run with lander deployment / retrieval and subsequent data publication. ESONET needs a (near) real-time data flow from online observatories. The test sites will allow to launch the Web portal with real-time web interface and show to all users incoming data and underwater activities. This will enable ESONET partners as well as the general public to actively participate in ESONET research. As new technologies will be experimented, real time data connection will allow ESONET operators to immediately know how things are going on. Especially the coastal test sites will enable ESONET operators to send a maintenance ship and ROV to the study sites on short notice in case of eventual problems. Deep sea tests are also required to progress in deployment procedures.

Consequently, after decision in Steering Committee, a call for testing operation on cabled sites was officially opened the 28 April 2009.

The call was scheduled in several steps:

1- only a short proposal was requested, a kind of proposal intention description, to be sent before the 6th may 2009
2- selection of the priority proposals
3- coordination and merging of these priority proposals
4- assessment by external referees and final decision

The 7th of May 2009, nine proposals were received

-UGOT proposal: Koljo fjord site
-UPC-CSIC proposal: OBSEA site
-AWI proposal: Koster fjord
-CNRS/CPPM proposal: Ligurian Sea/ANTARES
-CNRS/LMGEM proposal: Ligurian Sea/ANTARES
-INFN/catania-NEMO proposal
-INFN/Antares proposal
-INGV/Antares proposal
-INGV/Catania-NEMO

Only three sites are ESONET sites: Antares, NEMO-East Sicily, Koster Fjord and three proposed sites are in shallow water: Koster Fjord, Koljo Fjord, OBSEA.
The proposals were not coordinated yet and a big integration effort was needed.

The coordination team made a first analysis of the received proposals.
Then a summary per site has been discussed with the Steering Committee.

After this first evaluation complementary information has been requested to the proponents the 29 June 2009 regarding:

- the test site
- the available infrastructure
- the calibration procedures to be tested and those already validated
- the sensors to be deployed, where and how?

- The underwater intervention procedure to be checked or not

In July 2009 the proposals were well documented and have been assessed a second time.

J. Marvaldi (IFREMER) analysisedthe completed proposals, highlighting the gap and complementary information to be requested. This second evaluation was synthesized and presented to the Steering Committee during the audio conference the 28th of July. The feedback was sent to the proponents by the coordination team in August 2009 to enquire complementary information focused on a more detailed budget, with a deadline to the 11th September.

The requested additional information was received with delay between September and October 2009. Considering the increasing delay incurred for this call, the steering committee in meeting the 7th October 2009 in Paris, decided to mandate the coordination team to prepare a proposal integrating a maximum of proposed tests in a coherent way.
The merging was processed in 3 steps:

- The proposal recommendations were discussed in a meeting during the 2nd Best practices Workshop in Brest, the 8th October 2009;
- The proposal was discussed in a meeting in Barcelona in November 2009
- Writing of the final proposal (January-February 2010)

Then this final version was sent to two external referees (USA and Canada) for assessment. The comments of the referees will be taken into account and notified to the test experiments responsibles without a need to modify the program.

1 Call for proposals

1.1 Rationale

The ESONET NoE still suffers from insufficient access to online data. Most of demonstration missions are run with lander deployment / retrieval and subsequent data publication. ESONET needs a (near) real-time data flow from online observatories. The LIDO demonstration mission is expected to go online soon, but more examples are needed. The test sites will allow to launch the Web portal with real-time web interface and show to all users (the ESONET community, public, industry and politicians) incoming data and underwater activities. This will enable ESONET partners as well as the general public (to a given extend) to actively participate in ESONET research.
As new technologies or sampling programs will be experimented, real time data connection will allow ESONET operators to immediately know how things are going on. Especially the coastal test sites will enable ESONET operators to send a maintenance ship and ROV to the study sites on short notice in case of eventual problems. There is no better place to try out new equipment for ESONET. But deep sea tests are also required to progress in deployment procedures.

1.2 Call organisation

After decision in Steering Committee, the call was officially opened the 28 April 2009 and posted on the ESONET web site. In addition an Email was sent to the ESONEWS mailing list.

The call included an announcement letter sent the 28th of April 2009 and a template. The scope of the call is clearly identified in the letter copied here below.
The call was scheduled in several steps:

1- only a short proposal was requested, a kind of proposal intention description, to be sent before the 6th may 2009
2- selection of the priority proposals
3- coordination and merging of these priority proposals
4- assessment by external referees and final decision

Unfortunately this schedule was long to manage because the received initial proposals were too heterogeneous, and a great integration effort was needed.

1.3 Announcement letter addressed to ESONET partners:

28 April 2009:

"*The Steering Committee of ESONET decided to organize tests of observatory equipments and sub systems on existing cabled ESONET sites. These test will have to be associated to training activities to teach and to demonstrate the use of equipments dedicated to long term immersion for real time measurements and the procedures of measurements, underwater interventions etc. This activity will involve WP2 for technological aspects (sensors, standardisation, interoperability…, WP9 for real time data acquisition and dissemination, WP7 for training*

purposes and outreach and WP1 in the framework of exchange of personnel. This will enhance the integration across ESONET sites.
Key issues that should be addressed are mainly:

1) *Integration of the defined generic sensor package into cabled observatories*
2) *Validation of calibration procedure of the generic sensor package*
3) *Standardisation and interoperability issues should be addressed by referring to procedures that have been described within relevant reports from WP2*
4) *Test of standard interfaces and Plug and Work Concepts*
5) *Integration into ESONET sensor registry activities*
6) *Test of recommended ROV instrument deployment procedures in particular for mate able connectors*
7) *Employing ESONET testing facilities*
8) *Evaluation of recommended quality management procedures*
9) *Integration into ESONET data management concepts as for instance in regard to metadata description, real time data access, free access to collected data etc.*
10) *Training of scientists and engineers to use and develop deep sea observatory sub systems.*

Potential sites these tests are:

- *Kosterfjord in shallow water near Goteborg*
- *OBSEA near Barcelona (Vilanova) in shallow water*
- *ANTARES in deep water near Toulon*
- *East Sicily (SN1) near Catania.*
-

These lists are not limitative.

There is no budget to buy sensors or instruments. The equipment that will be tested will have to be provided by partners or learned by industrial or other institution not ESONET members. Only costs for adaptation , installation or insurance are eligible to ESONET. The maximum available ESONET funds for these tests are about 500000€ including training.

The SC is expecting that all the tests will be coordinated by one partner which is meant to underline the integration process within ESONET NoE.

In a first step, we are asking you to fill in the attached questionnaire before Wednesday, May 6th. Received forms will be accessible on the website on May 7th.

A meeting will be organized in Bremen during Oceans between proponents. Then, the SC will select the coordinator and establish a list of the test to conduct by priority. Then, the coordinator will have to prepare a detailed description of the tests with the budget needed for each one."

1.4 Template for proposals

<table>
<tr><td colspan="5">Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites</td></tr>
<tr><td>Partner:</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Contact for these activities</td><td>Name:</td><td colspan="3"></td></tr>
<tr><td>Email:</td><td colspan="3"></td></tr>
<tr><td colspan="5">TEST SITES</td></tr>
<tr><td colspan="3">Do you propose a cable site for tests?</td><td>OUI ☐</td><td>NON ☐</td></tr>
<tr><td>Water depth?</td><td></td><td>Distance from the shore ?</td><td colspan="2"></td></tr>
<tr><td colspan="5">Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)</td></tr>
<tr><td colspan="5">TESTED EQUIPMENTS</td></tr>
<tr><td colspan="3">Do you propose any equipment to test</td><td>OUI ☐</td><td>NON ☐</td></tr>
<tr><td colspan="3">Do you know any industrial who could be interested to provide an equipment for tests</td><td>OUI ☐</td><td>NON ☐</td></tr>
<tr><td colspan="3">Do you know any not ESONET Institution who could be interested to provide an equipment for tests</td><td>OUI ☐</td><td>NON ☐</td></tr>
<tr><td></td><td>Model</td><td>Period</td><td colspan="2">Provider</td></tr>
<tr><td>CTD</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Oxygen</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Turbidity</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Fluorescence</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Chemical analyser</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Current meter</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>ADCP</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>PH probes</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Penetrometer</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Geophone</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Hydrophone</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Accelerometer</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Still camera</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Video camera</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Lights</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Temperature probes</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Samplers</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>….</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Underwater mate able connectors</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Acoustic modem</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>….</td><td></td><td></td><td colspan="2"></td></tr>
</table>

Qualification Tests				
Can you offer tests facilities at marginal costs?			OUI ☐	NON ☐
	Range	Used procedure use	Comments	
Pressure				
Temperature				
vibration				
…..				
SENSOR CALIBRATION				
Can you offer calibration facilities at marginal costs?			OUI ☐	NON ☐
	Range	Used procedure use	Comments	
Temperature				
Conductivity				
Pressure				
Oxygen				
Currentmeter				
OTHER COMPONENTS				
Do you provide other components for in-situ testing			OUI ☐	NON ☐
	Reference			
Bio fouling protection system				
TEST PROGRAM				
TEST 1 Description				
(5 lines)				
TEST 2 Description				
(5 lines)				
TEST 3 Description				
(5 lines)				

Comments:

2 Proposals initially received and first evaluation

The 7th of May 2009, nine proposals were received and are listed in annex 1

- -UGOT proposal
- -UPC-CSIC proposal
- -AWI proposal
- -CNRS/CPPM proposal
- -CNRS/LMGEM proposal
- -INFN/catania-NEMO proposal
- -INFN/Antares proposal
- -INGV/Antares proposal
- -INGV/Catania-NEMO

Only three sites are ESONET sites: Antares, NEMO-East Sicily, Koster Fjord and three proposed sites are in shallow water: Koster Fjord, Koljo Fjord, OBSEA.
The proposals were not coordinated yet and a big integration effort was needed.

The coordination team made a first analysis of the received proposals and a synthesis is presented here after.
In red : complementary actions to be performed in addition to the received proposals.
Then a summary per site has been discussed with the Steering Committee.

Synthesis of proposals : technical aspects

	Sensors	**Calibration** WP 2 d	**Qualification** WP 2 d	**Bio fouling**	**Connectors**	**Interfaces** **Junction Box** **Acoustics**	Subsea intervention **WP 2 c**	**- WP 9 : Data-management** **- WP7 : outreach**
ANTARES	CPPM : SISMO CPPM : IODA INGV : Radiometer LMGEM : MII	Contact WP2 d Testing group	Contact WP 2 d Testing group		ODI	CPPM INCV – INFN : ODI Acoustic Ifremer BJS	CPPM : Victor Ifremer INGV – INFN : PEGASO Support of WP 2 1c	Access to realtime data
KOSTER-FJORD	AWI : Timer C6 profiler sonar UGOT : CTD, oxygen, tourbility, fluorimeter, sonar, microelectrode	Generic instrumentation intercalibration - current meter - oxygen	WP 2 Testing group	Ifremer (leased)	GISMA	Ifremer Node for junction (leased)	ROV	GEOSS WP 9
NEMO – SN1	Hydrophone SeaBird SBE-37 WetLab Turbidity ADCP RDI Hydrophone	Acoustic calibration Calibration + generic instrumentation intercalibration	WP 2 Testing group		ODI Connector test	INGV – INFN : ODI	INGV – INFN : Pegaso Support of WP 2 1c	Access to realtime data
OBSEA	SBE37SMP VPC Camera Oceancom VPC Hydrophore Naxys VPC	Generic instrumentation intercalibration	VPC	To be adressed		Link-quest 1450 + PUCK		Standards

First remarks on proposals on tests on observatory methodologies on cabled Esonet observatories sites.

KOSTERFJORD	OBSEA	ANTARES	SN1
- Leader to be determined (Per Hall). - 1 CTD not compatible with generic instrumentation system. - Could you present a wider partnership (Jacobs University, SMEs). - Antifouling, proposed by Ifremer (leased). - Node for junction Ifremer SEAMON (leased). - C 6 Turner Design, must be long term. - Precise GISMA connector type. - Contact WP 2 of testing group. - Participation to WP 7 film to be included.	- Leader : Antoni Manuel. - See compatibility with generic instrumentation system. - Could you present a wider partnership (SMEs). - Choice of link. Quest not compatible with performance evaluation done for the preparation of deep sea Demonstration Missions. - What is the interest to deploy a camera without antifouling ? - Participation to WP 7 film to be included.	- Leader to be determined. - See compatibility with generic instrumentation system (turbidity, fluorescence, ADCP). - Wider partnership with Ifremer, SMEs. - Choice of Sercel or Evologics modems compatible with Demonstration Missions : precise ODI connector type ? - Propose a planning in order to fit with ROV schedules and BJS deployment. - Pegaso test after Victor test on SN 1. - Contact WP 2 d testing group. - Participation to WP 7 film to be included. - Access to realtime data for use by WP 9 and scientific community.	- Leader to be determined. - Please contact WP 2 testing group. - See compatibility with generic instrumentation system to be addressed (oxygen). - Could you present a wider partnership (SMEs, ROV operators,…). - Please contact WP 2 c group (Jean François Drogou) for procedure. - Pegaso test on SN1 before Antares. - Contact WP 2 d testing group. - Participation to WP 7 film to be included. - Access to realtime data for use by WP9 and scientific community.

After this first evaluation complementary information has been requested to the proponents the 29 June 2009 regarding:

- the test site
- the available infrastructure
- the calibration procedures to be tested and those already validated
- the sensors to be deployed, where and how?
- The underwater intervention procedure to be checked or not

The received complementary information is consolidated in ANNEX 2.
In July the proposals were well documented and have been assessed a second time.

3 Second Evaluation

J. Marvaldi (IFREMER) analysed the completed proposals, highlighting the gap and complementary information to be requested. This second evaluation is synthesized in the following table which has been presented to the Steering Committee during the audio conference the 28th of July.
The feedback was sent to the proponents in letters sent by the coordination team in August 2009 (see Annex 3) to enquire complementary information focused on a more detailed budget, with a deadline to the 11th September.

Evaluation table

	Partners	Sensors	Intervention tools	Comments
KOSTERFJORD	AWI	Scanning sonar: Kongsberg-Simrad EM 1000 /675 kHz (Zooplankton detection & tracking at ranges 50-100 m) Fluorometer and chlorophyll a sensors on Turner C6 platform 3D microprofiler device – 12 microelectrodes on 0.3 m2	Small ROV	ESONET test site in shallow water
	JUB	Oxygen Turbidity Fluorescence CTD (ADM) ADCP (Aanderaa RDCP- 600) Currentmeter Aanderaa		
KOLJOFJORD	UGOT	O2 optodes AADI Currentmeter Seaguard string logger 6 levels – Temperature probes 10 sensors included in Seaguard string	Small ROV	Not an ESONET test site; Avoid double funding with Hyppox Why not deploy these sensors on Kosterfjord Planning not clear ESOFLEX is designed for coastal use and easy access; not for deep seas.
	MARUM	Turbidity WET labs CTD Sea/Sun BHP 8 Video camera homemade + Lights halogen DSPL		
	AADI	ADCP RDCP-600 with sensors for Temperature, Oxygen (3835), Wave and Tide (4405),Conductivity (4019A) and Turbidity (3612A) Conductivity/Temperature sensors (4319A), Oxygen/Temperature sensors (4835), Tide/Pressure/Temperature sensor (4647C Fluorescence sensors (Turner C6),		Shallow water tests are not representatives for long term deployment in deep water; Would be more interesting to deploy Aanderaa sensors in deep water.

OBSEA	UPC	OceanCam OPT-06 from Ocean Presence Technologies CTD SBE 37 SMP Hydrophone Bjørge Naxys Ethernet 02345	Divers	Not an ESONET Site No biofouling protection. Possibility of testing at short time smart sensors in real condition. Could be a first step before deployment in deep water
NEMO		3C broad-band seismometer 100 Hz Guralp CMG-1T (0.0027-50 Hz) Differential Pressure Gauge (DPG) 10 Hz Prototype Univ. St. Diego Hydrophone (Geophysics) 200 Hz OAS E-2PD Hydrophone (Geophysics) 2000 Hz SMID (0.05-1000 Hz) 8 Hydrophones (Bio-acoustics) 96 kHz Reson TC4037 / SMID TR-401V1 Absolute Pressure Gauge (APG) 15 s Paroscientific 8CB4000-I 3-C Accelerometer + 3-C Gyro (IMU) 100 Hz Gladiator Technologies Landmark 10 Gravity meter 1 Hz Prototype IFSI-INAF CTD SeaBird SBE-37SM-24835 Turbidity meter Wet Lab ADCP 1 RDI Workhorse Monitor (600 kHz) Vectorial magnetometer 1 Hz Prototype INGV Scalar magnetometer 1 Hz Marine Magnetics Sentinel (3000 m) 3-C single point currentmeter 2 Hz Nobska MAVS-3	PEGASO	Deep sea cabled observatory; Opened to deployed other sensors Real time access to data collected
ANTARES	CNRS (CPPM-LOV-INSU) GEOSCIENCES AZUR IFREMER INGV	CTD (MicroCat C19 Oxygen probe (Aanderaa 4835) with an innovative biofouling protection ADCP (Norteck) Turbidity with a biofouling protection system Wideband ital Ethernet Hydrophone Oxygen consumption probe (IODA by CNRS) Marine radiometer Seismometer Gurlp CMG-1T Biofouling protection Radiometer	VICTOR and PEGASO	Deployment in June 2010 Interoperability test of VICTOR and PEGASO Deep sea cabled observatory Opened to deploy other sensors Real time access to data collected

4 Merged proposal

The requested additional information was received with delay between September and October 2009. Considering the increasing delay incurred for this call, the steering committee in meeting the 7th October 2009 in Paris, decided to mandate the coordination team to prepare a proposal integrating a maximum of proposed tests in a coherent way.
The merging was processed in 3 steps:

- The proposal recommendations were discussed in a meeting during the 2nd Best practices Workshop in Brest, the 8th October 2009.
- The proposal was discussed in a meeting in Barcelona in November 2009
- Writing of the final proposal

4.1 *Output from the Best practices Workshop, October 2009*

The test call was discussed during the 2nd Best Practices Meeting in Brest (08 October 2009). Main recommendations were issued from the discussions, according to the list of items considered for analysing the proposals:

PROPOSAL NAME	Merged Test Call
IDENTIFICATION	
Proposal leader	Unique
Proposal partners	Several countries
TECHNICAL	
Site localisation	Several sites accepted (range of salinity and temperature)
Site depth - m	One or more in deep water
Infrastructures	
Cable to shore	Mandatory
Sea bottom	Diversity is welcome - Open to wide range
Shore station	Existing
Land based premises	Existing
Intervention means	
Ships	Planned and co-financed (extra days)
ROV	Important for tests at sea
Divers	Additionally
Deployed equipment and sensors	Generic sensors of ESONET (See Deliverable D13)
	Additional sensors welcomed
Deployment planning	Compatible between the sites
	Check list to be reported
On shore equipment test programme	Environment resistance test for all equipments before deployment
Sensor calibration programme	Pre and post deployment for the sensors
	Parallel calibration by a reference equipment is an advantage during deployment
At sea equipment test programme	Functional testing
	Must be reported.

PROPOSAL NAME	Merged Test Call
	Feed back of proper operation before leaving the site unattended.
At sea measurement programme	Biofouling to be addressed in various conditions (sensors and cameras)
	Frequencies of measurement: high frequency possible for technology tests.
	Reference scientist for each sensor.
Data management	Refers to WP9 - Periodical checking of the data quality.
Site access to others	Mandatory according to liability and access rules.
Data access to others	Mandatory
FINANCIAL	Maximum budget should be 550 000 k€ for the total

4.2 Output from Barcelona meeting, November 2009

A work meeting was held in Barcelona on 21 November 2009, where the following statements were agreed and a site partner was charged of writing each item:

- As concerns the thematic addressed by the proposal:
    - Sensor qualification: UGOT

Measuring protocol: measure, calibration ... / Generic packages / Quality control. Drift check.. Bio fouling prevention. / Long term behaviour. Inter calibration (different kinds of sensors for the same parameter)

    - . Standardization: UPC

Interoperable data management / Instrument control / Plug and play concepts. Sensor registry.

    - ROV operations: INFN with INSU / Ifremer

Interoperability: deployment procedures for ROV and vessels / Connector mating / Maintenance.

    - Public outreach: JUB, Jacobs University Bremen

Access to data in real time. / Taking into account mammals.

- As concerns the contribution of each site:

For Antares - NEMO- SN1, East Sicily – OBSEA - Koljo Fjord - Koster Fjord, the proposal should describe:
existing infrastructure, what instrumentation will be deployed within the frame of the proposal, what instrumentation is already in place and will be accessible to ESONET, availability of plugging point to test other instruments not provided by the site proponent (plugs, electrical characteristics, mechanical constraints, acquisition constraints…).

- As concerns the amount and sharing of ESONET financial contribution:

The budget of the test call will be limited to total 550 000 € shared as:

Antares:	208 000 €
NEMO:	180 000 €
OBSEA:	100 000 €
Koljo Fjord:	60 000 €
Koster Fjord:	2 000 €

A complementary proposal will be submitted to Exchange of personnel for total 90 000€ shared as:

Antares:	12 000 €
NEMO:	20 000 €
OBSEA:	20 000 €
Koljo Fjord:	20 000 €
Koster Fjord:	18 000 €

Jacobs University Bremen (JUB) prepared the KOSTOBS observatory (Koster Fjord) as test facility and contacted Norwegian authorities to get permissions to deploy ESONET equipment in a Norwegian cold-water coral reef.
However, finally the infrastructure at KOSTOBS will not be maintained in the Merged Proposal and supported by ESONET. KOSTOBS will thus become an EU HERMIONE facility.

Final discussions on budget repartition between each site partners were pursued early 2010, with final agreement reached early February.

4.3 *Final merged proposal*

The final merged proposal is 99 pages long, please refer to the annex 4.

5 External review process and final decision

Two external referees have been chosen by the coordination team,
The introduction letter sent, with the proposal and financial information attached are in Annex 5

<u>Comments received:</u>

Reviewer 1:

As requested by Roland Person, I have reviewed the material sent regarding the "ESONET-Cabled sites-Merged tests proposal". From the cover letter, there is clearly some urgency to begin to generate a flow of real-time data from one or more ocean observatories, ideally cabled observatories, and to have the scientific community develop the necessary web portal and thereafter an understanding and ability to use the data and data archive through multidisciplinary teams. This research will benefit from the power to receive complex multivariate data from several locations/depths/environments and bring together the European and international partners to analyse the data and imagery in near-real-time and to interpret and differentiate short and longer term Earth/ocean processes and events.

I note that you list six projects but refer to them as five projects (in the letter; with the rejection of the Koster Fjord proposal). I also note that three are ESONET related and the other two are shallow water/coastal (fjord) in nature, but that most of the budget is devoted to the deep water sites. I am uncertain how the latter three are included in the ESONET program that was designed more for deeper water sites since shallow water ones were accommodated in other EU or national programs. You have now, through detailed discussions, been able to merge the proposals into five that are now in this present proposal and appendices under review. Your letter invited comments to be structured as shown below, so I have followed this arrangement although I find it rather different from the structure of the proposal and the list of 10 key issues.

1- Quality and effectiveness of integration

Using the coastal Koljo Fjord site for sensor testing makes good sense and reduces shiptime and intervention costs and avoids weather delays as much as possible. However, the marine environments represented are limited and so it may not be the best location for testing all sensors. Likewise, the OBSEA observatory is to be used to test science nodes, which again is sensible being nearshore and in relatively shallow water and so reduce costs for that particular testing. It is not clear how much such testing of sensors or nodes will, or can, be undertaken using salt-water tanks on land at least initially to avoid shiptime costs and logistic challenges.

2- Interoperability

Issues of interoperability appear to have been considered well. They are covered in the consideration given to instruments, data management, ROV and intervention methods, etc. The crucial interoperability will only be fully tested when the real-time data flows and from more than one site, and by then demonstrating the ability of scientists to actually work effectively and concurrently with the multidisciplinary experiments.

3- Standardisation

There is adequate review of the issues and options involved in the important process of standardization for sensors and for data management. It would have helped to design and include a diagram showing the specific issues, the possible/optional technologies/solutions, the major pros and cons, and the preferred solution or testing procedure to arrive at the preferred solution. In other sections of the proposal (e.g. 3.3 Data Management), there is no text but just a table. Some reference is made to developments at other non-European observatories (e.g. the MBARI PUCK), but there are others not mentioned so it is difficult to determine if a full comparative review has been or will be made, and where such collaborations could reduce costs or avoid reinventing various wheels. Standardization should not just be within the ESONET observatories, but should include important ones that have been developed elsewhere.

4- Data management

This is divided into the deep sea and shallow sea sites and arranged in tabular form with specifications for each observatory project. Of particular concern is the statement that data within particular projects (e.g. ANTARES; under Data Management and under Data Access to Others, p. 20/99) will be held for 3 months and it would be only shared with the international community after two years. Most major observatories have passed through the internal debate about controlling data to allow their participating scientists to have a period of exclusive access (and hence publishing priority). However, we rejected this approach since it makes a mockery of all the efforts and costs of achieving a real-time observatory with international collaboration, which can examine the effects of Earth/ocean processes well beyond the geographic limits of a particular observatory and comparing instrument reliability/sensitivity, data sets, events and processes between different observatories. I hope I have misinterpreted the table in this regard since it would be a fundamental issue/problem that I would identify. Funding agencies will need to see that data are being used and results derived rapidly, not confined and not widely shared with slower dissemination of results.

5- Relevance of the technological advancements and methodologies

The appendices provide detailed proposals for the main projects. The opportunities and plans for technological advances are identified as are the methodologies for ensuring success.

6- Feasibility and cost effectiveness

There has clearly been a considerable amount of planning with detailed budget justification and prioritising. The actual proposed projects certainly seem to be entirely feasible. The main challenge/question is whether there are sufficient funds for the proposed work; certainly, the participating, experienced institutions and their staff are providing significant in-kind and logistic support. The amount of funding available (550,000 Euros) is not a large amount when spread among the five geographic areas/projects and when dealing with the latest marine instrumentation and significant deployment challenges. The balance in apportioning the funds amongst the two deep-water sites versus the two shallow-water sites seems reasonable. Unless I overlooked some information, I could not see a significant amount for contingency in the budget tables, to cover unexpected delays, weather problems during deployment, uncertain costs or deployment issues with the instruments, etc. Placing complex oceanographic equipment at depth with ROV interventions is notoriously tricky and some degree of failure is to be expected. In particular, the technology is plagued most by the lack of reliability of connectors and by the skill in undertaking the actual connections underwater by the ROVs. I note that much thought and experience has and will be gained in ROV deployment and that a new ROV will be introduced, which is highly commended.

7- Potential impact through the development, dissemination and application of project results

This proposal will lay the groundwork for these five projects, and especially for other emerging projects within ESONET, for the new generation of ocean observatories, particularly those that are cabled and able to generate a large flow of real-time data and imagery. These developments will undoubtedly lead to major new breakthroughs in the basic understanding of Earth/ocean processes, but also in a host of regional and local processes, relationships, and events. There will be many significant socio-economic spin-offs that will more than justify the investment. Importantly, ESONET and related ocean observatories will serve to bind and coordinate oceanographic research in the European Union and forge strong and effective relationships with the developing ocean observatories in other countries (e.g. Canada, USA, Japan, Taiwan, China, etc). This will transform ocean sciences and lead to a wiring of the oceans with an impact comparable to, or greater than, the satellites introduced above the Earth.

Reviewer 2

Upon reading the "Review of ESONET cabled sites – Merged Test Proposal," the reviewer determined that the scope of the proposal required a broad range of expertise to provide evaluation. A panel Engineers and Marine Operations staff assembled to provide the following response.

1- General Comments:

The ESONET cabled sites – Merged Test Proposal provides an **overview** of a comprehensive plan to address the following objectives:

1) Integration of the defined generic sensor package into cabled observatories
2) Validate calibration procedures of the generic sensor package
3) Standardization and interoperability issues
4) Tests of standard interfaces and Plug and Work Concepts
5) Integration into ESONET sensor registry activities
6) Tests of recommended ROV instrument deployment procedures in particular for wet mateable
7) Employing ESONET testing facilities
8) Evaluation of recommended quality management procedures
9) Integration into ESONET data management concepts such as metadata description, real time data access, and free access to collected data
10) Training of scientists and engineers to use and develop deep-sea observatory sub systems.

- **Each of the ten goals** listed above is **important** to the success of an integrated ocean observing network.
- This plan outlines an aggressive program that relies on **significant** levels of **support** from member intuitions.
- This plan shows real **progress** in the **levels of cooperation** between member institutions and is a **testament** to the **value of ESONET**.

The Merged Test Proposal does not provide sufficient detail to comment in depth on procedures or the cost effectiveness of the plans. However, we have provided comments below that we hope will be helpful during the implementation of this proposal.

2- Specific comments:

Standardization and interoperability issues

We believe these issues are being handled well by the ESONET standardization committee and within the framework of the Best Practices workshops. ESONET members also participate in efforts such as the OGC PUCK standard working group, OGC Ocean Science Interoperability Experiments, and IEEE 1451 standardization committees. We think there is still the need to refine which standards to adopt and how best to use them. For example, some ESONET prototypes and architectural diagrams include elements of both OGC Sensor Web Enablement (SWE) and IEEE-1451 in the same system. However, these two standards in some ways compete with one another, and using both of them may introduce unneeded complexity. ESONET teams should try to simplify these architectures where possible.

Test of standard interfaces and Plug and Work Concepts

We believe the teams at UPC SARTI and Kiel are doing a good job of evaluating the available standards, e.g. PUCK and IEEE-1451, and that work should be completed. The ESONET standardization committee is represented on the OGC PUCK standard working group as well as the IEEE-1451.2 standardization committee. Note that the PUCK working group is considering extending PUCK protocol to Ethernet interfaced instruments, based on suggestions from IFREMER Smart Sensor project and other ESONET members, and collaboration and evaluation should continue in this area.

Best Practices

We have included a "best practices" outline of requirements and procedures for Ocean Observatories. Although we are sure that many, or perhaps most, of these practices are probably already used, perhaps this outline will provide some ideas that should be considered. A brief outline is included below:

1) <u>System design</u>:
   a) Design for built-in test for communications and electrical integrity such as loopback connectors, ground fault monitoring of electrical circuits, etc.
   b) Provide high-resolution fault monitoring for each element of the system so that operators can diagnose a problem to a replaceable component from the remote control station.
   c) Include fault tolerance in the design through automatic circuit breaker functions, redundant or spare connection ports and complete galvanic isolation of de-energized circuits.
   d) Plan and budget for spare units for all system components that can fail during installation or operation. These spares must be immediately available during installation and maintenance.
   e) Design the observatory so that any component can be replaced using locally available resources in case of installation or operational failure.
2) <u>Component design:</u>
   a) Experiences with ROV laid cable, both successful and unsuccessful.
   b) Qualification testing in an environment equivalent to deployment target.
3) <u>Systems integration</u>:
   a) Provide a full resolution, hardware test bed, for software development early in the project.
   b) Maintain a complete duplicate system for development and qualification test during development and after deployment of the Ocean Observatory.
   c) Require qualification testing for Ocean Observatory components and third party instruments prior to installation. This procedure must be completed on an identical interface to the target system and exercise all of the required functions. This includes data quality verification for both engineering monitoring instruments and scientific payload instruments.
4) <u>Installation and operational considerations</u>:
   a) Plan the operational installation so that verification testing is conducted during installation at each step. If a failure occurs during any step in the installation it must be possible to "unwind" that step and resume the installation process with a spare unit, a spare connector port, etc.

3- Areas of Concern:

Please understand that we have absolute respect for our marine operations colleagues in Europe and offer these comments as lessons we have learned (often at a considerable cost).

4- Light work class ROVs

We have concern that the proposed light work class ROVs may have serious difficulty in some aspects of observatory support outlined in the test proposal.

Light work class ROVs

Cherokee

Limited power and payload may hinder operations during installation and subsea assembly of science nodes. The indicated manipulator, Hydrolek EH5, may not have enough power and reach. Dexterity may be an issue with only five functions and no feedback.

Cougar XT/XTi /PEGASO ROV

This ROV is also limited in power. This ROV may not be able to provide mate/de-mate force sufficient for large power connectors. Payload appears to be twice that of the Cherokee, but is still marginal. Indicated manipulators may not have sufficient force or dexterity to manipulate delicate fiber optic connectors and heavy main electrical connectors.

Connector cleaning

From the VENUS experience some method of cleaning silted connectors is required especially if the connectors are deployed in areas with heavy silt or sedimentation. The ODI connectors can be very difficult to disconnect if installed with silted surfaces.

ROV Operations

Training in the mate/de-mate of underwater mateable connectors is critical for ROV operations prior to the operation. Are trials in a test tank with a mock up of connector positions possible prior to the naval mission?

Interconnection of nodes has been completed successfully via ROV laid cables up to 4 km long at MBARI and with heavy armored cables deployed via ROV i.e. “ROCLES” the system used on Neptune Canada network.

5- Lessons Learned for Operations on Subsea Observatories:

1) A ROV camera must have both direct line of sight to the mating connector receptacle and be able to position the manipulator to connect at the same time. Being able to see latching mechanisms, alignment guides, docking cones or any number of devices employed to make under water connections and place instruments is a paramount consideration. Ideally, specifying the ROV used to interact with a subsea installation makes designing the system easier. This is not always possible or in many cases practical, therefore creating as much visual access as possible with out compromising structural integrity is the next best solution.

2) Underwater mateable connectors are robust but have limits. Training operators in their use and installation is required. It is also required to train the stakeholders, offshore representatives, system managers and researchers in their use and installation as well. This will add another level of checks and balances on the process, which will reduce damage and mishandling. A stakeholder can stop an operation if it is felt that it is being conducted improperly. At a minimum, the use of a 7-function spatially correspondent manipulator is required to make up these connectors. An alternative to manipulator-mated connections may be a dedicated tool that takes an unmated connector pair, aligns them and presses them together; eliminating the operator's "forcing" of the mate/ de-mates. Careful consideration to routing of cabling to a connector is also important. The cable can add forces (torque) onto the connector that will inhibit the mating process or make alignment at best difficult.
   2A) In situations where the particulate matter is constantly suspended in the water mass, river out falls, shallow water seafloor etc, it is recommended that connectors be modified by the manufacturer to accept some form of flushing tool to remove any sediment that could hinder operation of the connector. At least two instances of this occurring are noted, one requiring the use of a pry bar to de-mate the connector pair, the other rendering the connector inoperable.

3) Pre-deployment testing; a facility to test both in a dry and wet environment a prospective user's equipment needs to be in place. This tool will eliminate or reduce the failures caused by improperly designed equipment or equipment that does not meet the design requirements of the observatory system. A standard procedure for the MARS system is to evaluate power requirements as stated to those measured, check in-rush specifications and check for system operation, connectivity and faults (grounds, shorts and open circuit)

4) Instrument deployments and methods should be discussed with the operations group, preferably those who will deploy the equipment. This should happen during the design stage of the equipment to avoid late term re-design of interface equipment or deployment equipment. The operations team can also assist in the design of techniques to launch and recover complex equipment.

6- Conclusion:

We recommend that the "ESONET cabled sites – Merged Test Proposal" be approved for implementation. This project will provide an important step forward in developing an integrated ocean observing system for Europe.

Further, we suggest that efforts to develop a formal structure to support the **international technical and scientific exchange of information for ocean observatories** be considered.

6 Conclusions

The process of merging the proposals to the test call as one project has been time consuming. Nevertheless it appears to be successfull in several respects. It reflects on integration effort of 11 Esonet partners, well in line with the network objectives.
It leads to a good technological and scientific level of experiments as ascertained by the non-european reviewers.
It will allow to present a reasonably good experience of cabled observatory operation in Europe at the end of ESONET.

Annex 1

UGOT proposal

Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites				
Partner:	UGOT			
Contact for these activities	**Name:**	Per Hall		
	Email:	perhall@chem.gu.se		
TEST SITES				
Do you propose a cable site for tests?			Yes X	NO ☐
Water depth?	45 m	Distance from the shore ?	100 m	
Please join a description of the infrastructure: junction, connectors, interfaces, existing sensors and instruments; servicing operations (availability of ROV, cost by day…)				
TESTED EQUIPMENTS				
Do you propose any equipment to test			Yes X	NO ☐
Do you know of any European company who could be interested to provide equipment for tests			Yes X	NO ☐
Do you know of any not ESONET Institution who could be interested to provide equipment for tests			Yes X	NO ☐
	Model	Deployment time	Provider	
CTD	Sea/ Sun BHP 8	1 year	MARUM, Bremen	
Oxygen	AADI optodes/temp	1 year	UGOT	
Turbidity	WETLABS	1 year	MARUM, Bremen	
Fluorescence				
Chemical analyser				
Current meter	Seaguard string logger 6 levels	3-6 months	UGOT	
ADCP	RDCP-600	3-6 months	AADI (a SME)	
PH probes				
Penetrometer				
Geophone				
Hydrophone				
Accelerometer				
Still camera				
Video camera	Homemade	1 year	MARUM, Bremen	
Lights	DSPL, Halogen	1 year	MARUM, Bremen	
Temperature probes	About 10 sensors included on Seaguard	1 year	UGOT	

Samplers			
….			
Underwater mate able connectors	GISMA	1 year	MARUM, Bremen
Acoustic modem			
….			
Qualification Tests			
Can you offer testing facilities at your institution?			Yes X NO ☐
	Range	procedure reference	Comments
Pressure	0-730 bar		Procedure will be adjusted between part. institutions
Temperature			
vibration			
…..			
SENSOR CALIBRATION			
Can you offer calibration facilities at your institution?			Yes X NO ☐
	Range	procedure reference	Comments
Temperature			
Conductivity			
Pressure			
Oxygen	0-200 saturation	Winkler titration	
Current meter	0-300 cm/s	Doppler test unit	
OTHER COMPONENTS			
Are you planning to provide other devices/components for in-situ testing			Yes ☐ NO X
	Reference		
Bio fouling protection system			
TEST PROGRAM			
TEST 1 Description (5 lines)	- Test of long- term behaviour of different sensor systems It is planned to compare the performance of different sensor system by evaluating the collected data. Correlation methods will be used to extract common information from different parameters.		
TEST 2 Description (5 lines)	- Real- time data access This will allow operating the sensor systems like for instance an ADCP interactively. Through that strategies for future long- term deployments of current meters can be derived.		

TEST 3 Description (5 lines)	- Implementation of Interoperability concepts and GEOSS principles With the given bandwidth of the cabled system particular standardisation concepts can be realised that are otherwise only found in for instance remote sensing. Based on GEOSS principles certain services will be defined that allow for easy retrieval of data.		

Comments:

The tests in Koljo fjord will also contribute to the EC funded project HYPOX that started April 1st, 2009. One of the main objectives of HYPOX is to make the collected data according to GEOSS principles available to the ocean science community. This is also in the interest of ESONET so that synergies can be established between ESONET and HYPOX.
The planned deployment will allow testing a combination of a fixed sensor array with an additional node to accommodate other sensors.

UPC-CSIC proposal

Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites				
Partner:	UPC – CSIC			
Contact for these activities	**Name:**	Antoni Mànuel, Juanjo Dañobeitia		
	Email:	antoni.manuel@upc.edu jjdanobeitia@cmima.csic.es		
TEST SITES				
Do you propose a cable site for tests?			**Yes** ☐	NO ☐
Water depth?	20 m	Distance from the shore ?	4 km	

Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)

The OBSEA site offers the opportunity to test the equipment and network components with a low cost.

The OBSEA is one initiative, funded by the Spanish Ministry of Science and Innovation, consisting in an expandable cabled submarine observatory that will be installed mid May 2009 as the Spanish pioneer submarine laboratory. It will be accessible for ESONET and EMSO groups for technological testing and scientific long-term monitoring of physical variables. This is a joint research venture between the Technical University of Catalonia (UPC) and the Marine Technological Unit (UTM) from the CSIC.
The main goal of the OBSEA is to provide a relatively low cost infrastructure for easy technological test bed and development of new sensor with the aim to extend it with more nodes to a regional deep sea observatory, and alongside real time monitoring of some physical parameters.
The OBSEA platform will be installed 4km offshore the Vilanova coast at 20 meters depth (diving depth or using small ROVs) within a protected area and easily reachable with small boats. The Instrument Platform for housing the instrument is a 4.6 square meters stainless steel structure with three legs designed for stabilization and to protect the oceanographic sensor from unlikable operation. The main components of the underwater station have been designed to stand up to 300 meters (30 bars) of water pressure and have been tested at 20 bars in our hyperbaric chamber. The system is powered from the shore station with a 3.6kW power supply delivering up to 320V and 11 Amps of direct current, but is planned to incorporate a 1000V power supply in the near future allowing longer cables. The trunk line to the shore is a 1+1 optical fiber connection at 1Gbps. The current design is supporting 6 wet mateable external instruments powered with to 3 amps at 12 or 48V and with a 10/100Mbps Ethernet connection.

The submarine connectors have been manufactured by GISMA, the hybrid connector for 6 optical fibers and 2 electrical pins is the series 40 size 4 and the 6 electrical wet-mateable connectors with 7 pins are series 10 size 3.

The interface provided to the instruments is using 3 pins for power (GND, VCC, and power measurement return) and 4 pins for the 10/100Mbps ethernet data connection

In this first phase two sensors and a camera will be installed at the OBSEA. The underwater camera will provide real time images for security surveillances and to control the performance of the installation. A broadband hydrophone (7 Hz 100 kHz) is installed to acoustically characterize the ambient noise and to record coherent signal. A CTD will measure variations of temperature, conductivity and pressure, providing useful information for seasonal flows and mixing variations. We are planning to incorporate other sensors, thus we have some available free ports. All the instruments will be accessible to the users through a TCP/IP connection, maintaining a database with the real time historic values.

TESTED EQUIPMENTS			
Do you propose any equipment to test		**Yes** X	NO □
Do you know of any European company who could be interested to provide equipment for tests		**Yes** X	NO □
Do you know of any not ESONET Institution who could be interested to provide equipment for tests		**Yes** X	NO □
	Model	Deployment time	Provider
CTD	SBE 37 SMP	Permanent	Seabird
Oxygen			
Turbidity			
Fluorescence			
Chemical analyser			
Current meter			
ADCP			
PH probes			
Penetrometer			
Geophone			
Hydrophone	Ethernet 02345	Permanent	Bjørge (Naxys)
Accelerometer			
Still camera			
Video camera	OceanCam OPT-06	Permanent	Ocean Presence technologies
Lights			
Temperature probes			
Samplers			
….			
Underwater mate able connectors	Series 10 size 3		GISMA
Acoustic modem	UWM2000		Link-Quest
….			
Qualification Tests			
Can you offer testing facilities at your institution?		**Yes** X	NO □
	Range	procedure reference	Comments
Pressure	On air Pressure 0 to 1030 kPa – 0 to 100kPa Underwater preasure (0 – 20 atm) up to 200m	Intern ICP-01 and Iberco IB-80 Invest	Fluke 744 and Modules 700P9 – 700P24 -700PD6 1800x800 mm hyperbaric chamber
Temperature	-40 ºC to 180 ºC and humidity from 10%Hr to 98 %Hr	Votsch VC 4060	Climatic Chamber
vibration	0 to 200Hz 158mm 1,1g	Beran Instruments Limited APS, Model 129	Vibration Table Horizontal Shaker

…..				
SENSOR CALIBRATION				
Can you offer calibration facilities at your institution?			**Yes** X	NO □
	Range	procedure reference	Comments	
Temperature	-40 ºC to 180 ºC and humidity from 10%Hr to 98 %Hr	Votsch VC 4060	Climatic Chamber	
Conductivity				
Pressure	On air Preasure 0 to 1030 kPa – 0 to 100kPa Underwater preasure (0 – 20 atm) up to 200m	Intern ICP-01 and Iberco IB-80 Invest	Fluke 744 and Modules 700P9 – 700P24 -700PD6 1800x800 mm hyperbaric chamber	
Oxygen				
Currentmeter				
Electrical Parameters (V, I, Z)	Fluke 5520A	Intern ICE-03		
OTHER COMPONENTS				
Are you planning to provide other devices/components for in-situ testing			Yes □	**NO** X
	Reference			
Bio fouling protection system				
TEST PROGRAM				
TEST 1 Description (5 lines)	Automated retrieval and installation of IEEE-1451 and/or SWE components for instruments that implement PUCK protocol. Retrieved components may include IEEE1451 TEDS, SensorML document, and instrument "driver" software to be installed on the instrument "host" computer or Network Capable Application Processor or "NCAP". Standards to test: PUCK protocol, IEEE 1451, STWS, OGC			
TEST 2 Description (5 lines)	TEDS (Trandsducer Electronic DataSheet) integration with MixedMode Sensor as Hidrophones. Automated installation of a 1451.4 MixedMode Hidrophone has to be developed and tested in real conditions with an integration of this type of sensors with SWE (SensorWebEnable) standard.			
TEST 3 Description	Evaluation the video data analysis system that it has been developed at the UTM in collaboration with researchers			

(5 lines)	
TEST PROGRAM	
TEST 4 Description	An broadband hydrophone will be connected to the node to test the real-time analysis management tools developed in LIDO.
(5 lines)	
TEST 5 Description	Underwater communication tests. An acoustic modem will be installed at the OBSEA observatory in order establish underwater acoustic link with other acoustic modems for performance evaluation. Furthermore, implementation of the IEEE 1588 clock synchronization protocol through the water column can be evaluated.
(5 lines)	
TEST 6 Description	IEEE1588 evaluation for synchronized acquisition in Ethernet Cabled underwater observatories. Evaluation of the real conditions in a marine sensor network (MSN) where IEEE1588 is used to synchronize the time triggering and time stamping of the different acquisition nodes.
(5 lines)	

Comments:

AWI proposal

Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites			
Partner:	Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI)		
Contact for these activities	**Name:**	Michael Klages & Thomas Soltwedel	
	Email:	Michael.Klages@awi.de Thomas.Soltwedel@awi.de	
TEST SITES			
Do you propose a cable site for tests?		Yes ☐	NO
Water depth?		Distance from the shore ?	
Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)			
TESTED EQUIPMENTS			
Do you propose any equipment to test		Yes	NO ☐
Do you know of any European company who could be interested to provide equipment for tests		Yes	NO ☐
Do you know of any not ESONET Institution who could be interested to provide equipment for tests		Yes	NO ☐
	Model	Deployment time	Provider
CTD			
Oxygen			
Turbidity			
Fluorescence	Turner C6	Several days (≤ 6)	AWI
Chemical analyser			
Current meter			
ADCP			
PH probes			
Penetrometer			
Geophone			
Hydrophone			
Accelerometer			
Still camera			
Video camera			
Lights			
Temperature probes			
Samplers			
….			
Underwater mate cable connectors			
Acoustic modem			

Scanning Sonar	Kongsberg-Simrad EM 1000	Several days (≤ 6)	AWI	
3D -Profiler	In house development	Several days (≤ 6)	AWI	
Qualification Tests				
Can you offer testing facilities at your institution?			Yes	NO ☐
	Range	procedure reference	Comments	
Pressure	0 – 600 bar		13 l volume, temperature constant between 2 and 25°C	
Temperature				
vibration				
SENSOR CALIBRATION				
Can you offer calibration facilities at your institution?			Yes ☐	NO
	Range	procedure reference	Comments	
Temperature				
Conductivity				
Pressure				
Oxygen				
Currentmeter				
OTHER COMPONENTS				
Are you planning to provide other devices/components for in-situ testing			Yes ☐	NO
	Reference			
Bio fouling protection system				
TEST PROGRAM				
TEST 1 Description (5 lines)	The Kongsberg-Simrad EM 1000 Scanning Sonar system operates at 675 KHz frequency and enables us to track and detect zooplankton of size classes larger than 1 cm at distances of 50 -100 m. The **Kosterfjord observatory** shall be used to operate this energy consuming sonar system for a period of 5-6 days in continuous mode of operation.			
TEST 2 Description (5 lines)	A Turner C6 platform (with fluorometer and chlrophyll a sensor) will be used to investigate the relationship between physical mixing processes and phytoplankton dynamics at high temporal and spatial resolution at **Kosterfjord cabled observatory**.			

TEST 3 Description	A 3D-Microprofiler device carrying an array of up to 12 microelectrodes (pH, O_2, resistivity etc) has been developed for autonomous mode of operation to sample the seafloor at pre-programmed positions within a given frame of ca. 0.3 m^2. Using the **cabled Kosterfjord observatory** we intent to test the option to position the microlectrode array manually (tele-operated assisted by a video-camera attached to the frame).		
(5 lines)			

Comments:

If feasible, we intent to assemble a multi-sensor array consisting out of the three above listed instruments to be used simultaneously at Kosterfjord observatory.

CNRS proposal

<table>
<tr><td colspan="6">Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites</td></tr>
<tr><td>Partner:</td><td colspan="5">CNRS</td></tr>
<tr><td rowspan="2">Contact for these activities</td><td>Name:</td><td colspan="4">Jean-Jacques DESTELLE</td></tr>
<tr><td>Email:</td><td colspan="4">destelle@cppm.in2p3.fr</td></tr>
<tr><td colspan="6">TEST SITES</td></tr>
<tr><td colspan="3">Do you propose a cable site for tests?</td><td>Yes X</td><td colspan="2">NO</td></tr>
<tr><td>Water depth?</td><td>2475m</td><td>Distance from the shore ?</td><td colspan="3">42km</td></tr>
<tr><td colspan="6">Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)</td></tr>
<tr><td colspan="6">TESTED EQUIPMENTS</td></tr>
<tr><td colspan="3">Do you propose any equipment to test</td><td>Yes X</td><td colspan="2">NO ☐</td></tr>
<tr><td colspan="3">Do you know of any European company who could be interested to provide equipment for tests</td><td>Yes X</td><td colspan="2">NO ☐</td></tr>
<tr><td colspan="3">Do you know of any not ESONET Institution who could be interested to provide equipment for tests</td><td>Yes X</td><td colspan="2">NO ☐</td></tr>
<tr><td></td><td>Model</td><td>Deployment time</td><td colspan="3">Provider</td></tr>
<tr><td>CTD</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Oxygen</td><td>IODA</td><td>3 years</td><td colspan="3">CPPM/COM</td></tr>
<tr><td>Turbidity</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Fluorescence</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Chemical analyser</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>3-C single-point current meter</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>ADCP</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>PH probes</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Penetrometer</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Geophone</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Hydrophones</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Accelerometer</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Still camera</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Video camera</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Lights</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Temperature probes</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Samplers</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>3-C Broad-band seismometer</td><td>GURALP</td><td>3 years</td><td colspan="3">Geo-science Azur</td></tr>
<tr><td>Scalar magnetometer</td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>Vectorial magnetometer</td><td></td><td></td><td colspan="3"></td></tr>
</table>

Gravity meter				
Absolute pressure sensor				
Differential pressure gauge				
Marine radiometer				
Underwater mateable connectors	ODI electro optical ROV wet mateable connectors	2005, 2006, 2007, 2008, 2009	CNRS/IFREMER	
Acoustic modem				
Power and real time data transmission systems				
Qualification Tests				
Can you offer testing facilities at your institution?			Yes X	NO ☐
	Range	procedure reference	Comments	
Temperature				
vibration				
…..				
SENSOR CALIBRATION				
Can you offer calibration facilities at your institution?			Yes ☐	NO ☐
	Range	procedure reference	Comments	
Temperature				
Conductivity				
Pressure				
Oxygen				
Currentmeter				
OTHER COMPONENTS				
Are you planning to provide other devices/components for in-situ testing			Yes ☐	NO ☐
	Reference			
Bio fouling protection system				
Deep sea acoustic transmitter for calibration				
TEST PROGRAM				
TEST 1 Description (5 lines)	Installation of Sesmograph and IODA on the ANTARES infrastructure.			
TEST 2 Description (5 lines)	Adaptation of junction box output wet mateable connector for dedicated use			

	of earth and sea sciences.		
TEST 3 Description (5 lines)	Tests of connections/disconnections of modules/platforms by ROVs in the ANTARES site.		

Comments: The proposed tests will be in cooperation with IFREMER, INGV and the NEMO collaboration
Description of the infrastructure

The international collaboration ANTARES (Astronomy with a neutrino Telescope and Abyss environmental RESearch) aims to detect and study the production of high-energy neutrinos in the universe. The ANTARES infrastructure is also a permanent marine observatory providing high-bandwidth real-time data transmission from the deep sea.

ANTARES is located in the Mediterranean Sea, 42km from La Seyne-sur-Mer (Var), France (42° 48'N 6° 10' E). The detector comprises a grid of about one thousand photomultipliers (PMTs), sensitive to the Cerenkov light emitted by high energy neutrinos interacting close to the detector. The PMTs are distributed over 12 detector lines, each nearly 500m high and installed on the seabed at a depth of 2500m. The outputs from up to 16 lines are connected to a passive junction box, via interlink cables. A 48 fibre electro-optical submarine cable, the Main Electro-Optical Cable (MEOC), connects the detector to the shore station. The submarine cable supplies ~4400VAC, 10A to a transformer in the junction box. The sixteen independent secondary outputs of the junction box provide ~500VAC, 4A. Each ODI wet-mateable connector provides 2 optical fibres for data communication. ROV intervention is necessary for connection of any equipment.

The ANTARES infrastructure already incorporates an instrumentation line (IL07) designed for multi-disciplinary studies comprising a number of oceanographic sensors, allowing numerous studies in the fields of Sea, Earth and Environmental Sciences.

The sensors currently providing data are:
- ADCP current meters ;
- temperature and salinity sensors ;
- sound velocity meters ;
- light transmission meters ;
- bioluminescence detectors (optical cameras and photomultiplier tubes) ;
- acoustic sensors.

In the near future, a secondary junction box, will be connected to one of the ANTARES junction box outputs. This new facility, provided and managed by IFREMER, will allow simultaneous real-time readout of a number of additional earth & sea science sensors via the ANTARES infrastructure.

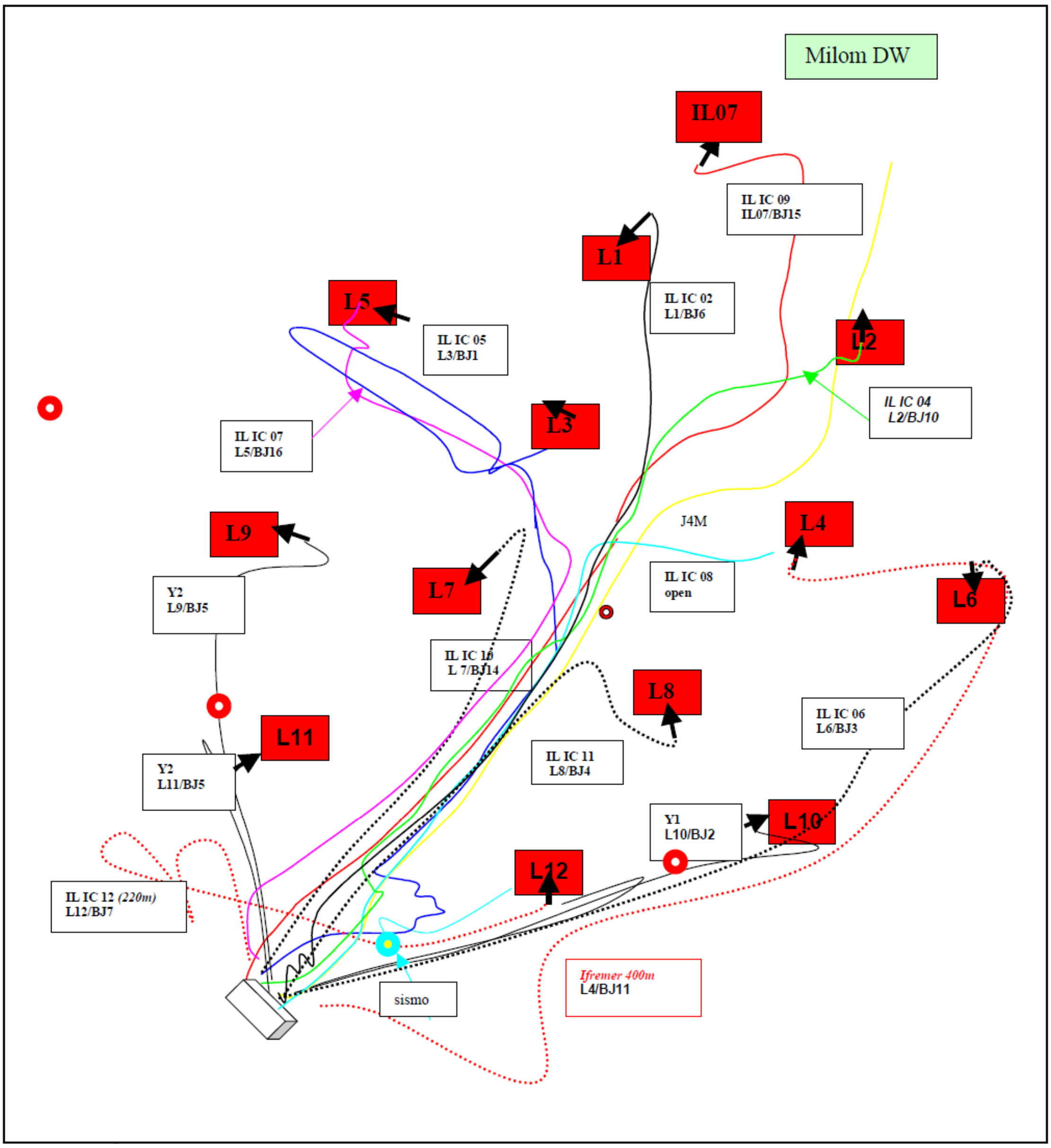
The successful construction and operation of ANTARES is a major step towards the construction of future second-generation deep-sea observatories in the Mediterranean Sea, aiming to instrument a km^3-scale volume.

Status 30 mai 2008

Légende :

orientation BSS

touret vide



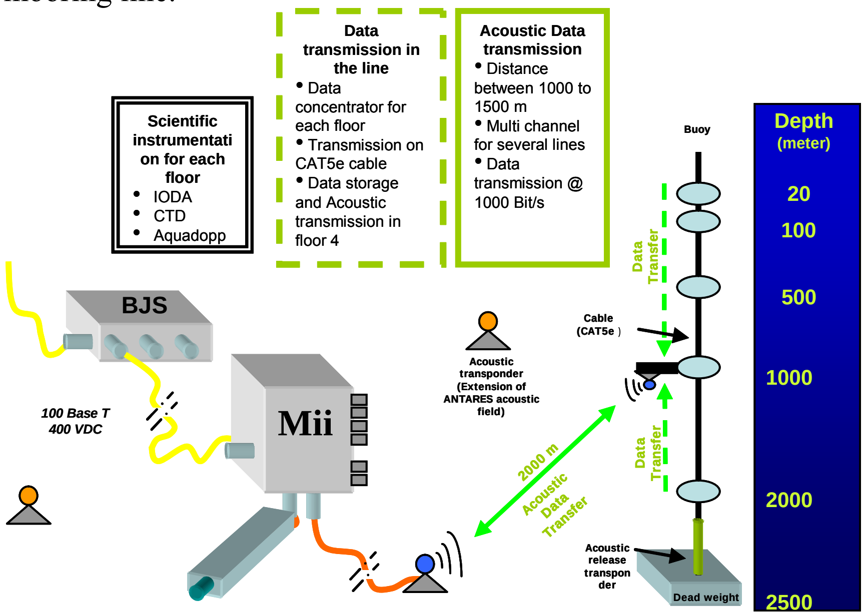
CNRS/LMGEM proposal

Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites				
Partner:	CNRS LMGEM			
Contact for these activities	**Name:**	LEFEVRE		
	Email:	Dominique.lefevre@univmed.fr		
TEST SITES				
Do you propose a cable site for tests?			Yes ☒	No ☐
Water depth?	2470 m	Distance from the shore ?	20 km	
Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…) Description Antares + BJS dependence… ROV dependance …				
TESTED EQUIPMENTS				
Do you propose any equipment to test			Yes ☒	No ☐
Do you know of any European company who could be interested to provide equipment for tests Sarcell moden / evologics modem			Yes ☒	No ☐
Do you know of any not ESONET Institution who could be interested to provide equipment for tests			Yes ☐	No ☒
	Model	Deployment time	Provider	
CTD	Microcat SBE 27	1 year	LMGEM + INSU	
Oxygen	Aanderaa	1 year	LMGEM + INSU	
Turbidity				
Fluorescence				
Chemical analyser				
Current meter	Norteck	1 year	LMGEM + INSU	
ADCP				
PH probes				
Penetrometer				
Geophone				
Hydrophone				
Accelerometer				
Still camera				
Video camera				
Lights				
Temperature probes				
Samplers				
….				
Underwater mate able connectors				

Acoustic modem				
….IODA	CNRS	1 year	LMGEM	
Qualification Tests				
Can you offer testing facilities at your institution?			Yes ☐	No ☒
	Range	procedure reference	Comments	
Pressure				
Temperature				
vibration				
…..				
SENSOR CALIBRATION				
Can you offer calibration facilities at your institution?			Yes ☐	No ☒
	Range	procedure reference	Comments	
Temperature				
Conductivity				
Pressure				
Oxygen				
Currentmeter				
OTHER COMPONENTS				
Are you planning to provide other devices/components for in-situ testing			Yes ☐	No ☒
	Reference			
Bio fouling protection system				
TEST PROGRAM				
TEST 1 Description (5 lines)	Acoustic test in pool. Addressing the acoustic compatibility with the Antares Hydrophones.			
TEST 2 Description (5 lines)	In situ test for acoustic data transmission on the RV Antedon or RV Tethys II.			
TEST 3 Description (5 lines)	Instrumental Interface module (MII) pressure tests. Individual components and whole setup in pressure chamber and in situ at 2500 m depth.			

Comments:

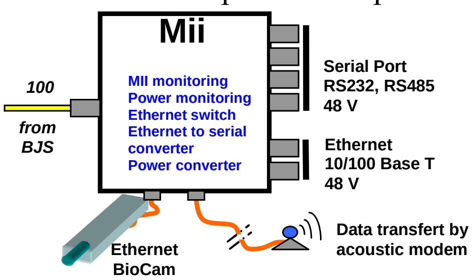
The infrastructure of ANTARES neutrino detector and the realisation of secondary junction box (BJS) are a great opportunity to install scientific instruments with real time data acquisition on this site. The aim of this test is to develop an interface module dedicated to scientific sub-marine instrumentation and real time data acquisition system use in autonomous instrumented mooring line.



As shown on the above drawing the test objective is to deploy along the BJS an interface module for instrumentation (MII), allowing a later wireless connection for autonomous instrumented lines (BIO and PRO). Some scientific instrument directly will be connected to MII (as BioCam) and an acoustic transmission system which allow to take data in real time from several instrumented lines in a 2 Km area around the MII.

Description of MII

This module allows to provide to users several communication protocols and the electrical power required to connect scientific instruments. Two types of port will be available, either a serial link RS232 or Ethernet link 10/100 Mbps on copper. For these two types of interconnection, the available voltage will be 48-Volt. The power available for each connector will depend of the power allocated to the MII by the BJS.



The electronic system will be embedded inside a container attached to a framework structure. This structure will also host the wet-mateable connectors (for ROV operation) and the release system.

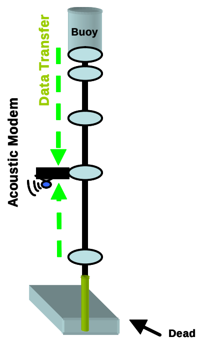
This module will host instruments which are directly integrated on it such as BioCam. The connection will be performed with dry-mateable connectors before deployment.
An acoustic modem integration for data transmission will be integrated in MII. This type of transmission will allow scientists who install autonomous moorings lines (with data-taking at low flow rate) for short time period the benefit of real-time without the cost of submarine
Acoustic data transmission :

The proposed system consists of:
- A modem at sea bottom (container modem with head attached) to equip the MII. It will be powered by the hub and managed by cable for data exchange, the operator is located in the ANTARES shore station. The connection is type RS 232. This modem can communicate with several systems installed on other autonomous equipments on the Antares site.
- A modem installed (container modem and remote head) in the middle of the line, at a depth of about 1,000 m. The modem must be powered by a block suitable for energy independence want (lifting every month). It will be connected to the acquisition system nearby. The acquisition system allows to collect data from sensors of each floors trough the main cable. These sensors are mainly physical and chemical sensors. The amount of data to be sent to each issue remains to be defined, but is not very important for this kind of sensor.

The horizontal distance between the line and the MII is about 2000 m. The link between modems will be a link oblique (angle of about 45 degrees).
The modem should work in the band of 12 kHz. The frequency band to be avoid is 40-60 kHz, which is used for the positioning of Antares's lines. Tests should be performed to verify that the running of the detector is not disturbed. The communication system will allow speeds of 100 bit/s (coding included) to 7000 bit/s (coding not included). The speed depends on propagation conditions and environment. The modem will be programmed by the operator, through the liaison: radiated power, speed, coding.

Autonomous instrumented mooring line :

BIO mooring



This line consists of five instrumented storey connected by a supporting wire allowing induction data transfer using an inductive modem. The cable allows to maintain the structure, enable the transmission of data between floors and facilitate the deployment of the line. The bottom is constituted of dead weight attached to the line by acoustic release transponder for the recovering. At the top, there is a buoy for keeping up the line.
Each floor hosts a CTD, an UVP and an IODA6000. A camera and an ADCP are planned in the line. A modification of the electronic embedded in the IODA6000 will allow to use it as a data concentrator.
Data are send to a data management unit located on the storey 4 (@ 1000 meter depth). Transmission is made using an inductive modem. Data are stored and transmitted to the MII by the acoustic modem integrated in the same storey.

INFN/Catania

INFN Proposal/Nemo site

Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites

Partner:	INFN		
Contact for these activities	**Name:**	Giorgio RICCOBENE	
	Email:	riccobene@lns.infn.it	
TEST SITES			
Do you propose a cable site for tests?			Yes X / NO ☐
Water depth?	2100 m	Distance from the shore ?	25 km
Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)			
TESTED EQUIPMENTS			
Do you propose any equipment to test			Yes X / NO ☐
Do you know of any European company who could be interested to provide equipment for tests			Yes X / NO ☐
Do you know of any not ESONET Institution who could be interested to provide equipment for tests			Yes ☐ / NO X
	Model	Deployment time	Provider
CTD			
Oxygen			
Turbidity			
Fluorescence			
Chemical analyser			
Current meter			
ADCP			
PH probes			
Penetrometer			
Geophone			
Hydrophone	SMID TVR 401 V(1) RESON TC 4037	2009	INFN
Accelerometer			
Still camera			
Video camera			
Lights			
Temperature probes			
Samplers			
….			
Underwater mate able connectors	ODI electro optical ROV mateable connectors	2005, 2006, 2009	INFN
Acoustic modem			
Power and real time data transmission systems	Custom		INFN INGV
Qualification Tests			
Can you offer testing facilities at your institution?			Yes X / NO ☐
	Range	procedure reference	Comments

07may2009 1

Pressure	0 – 600 bar 0-400 bar		Cylindrical pressure tank 900 mm x phi 200 mm oil filled. 9 electrical pin connector. Available at INFN-LNS Spherical pressure tank 6000 mm radius water filled. 9 electrical pin connector. Available at Shore Laboratory.
Temperature			
vibration			
…..			
SENSOR CALIBRATION			
Can you offer calibration facilities at your institution?		Yes ☐	NO ☐
	Range	procedure reference	Comments
Temperature			
Conductivity			
Pressure			
Oxygen			
Currentmeter			
OTHER COMPONENTS			
Are you planning to provide other devices/components for in-situ testing		Yes ☐	NO ☐
	Reference		
Bio fouling protection system			
Deep sea acoustic transmitter for calibration	Sea Surface and/or deep sea beacons developed and realized by INFN (see Test 3)		
TEST PROGRAM			
TEST 1 Description (5 lines)	We want to perform maintenance, connection/disconnection and recovery operations on ROV e.o. mateable connectors installed at the Test Site in different times (2005, 2006). Once recovered the mechanical and electrical status of ROV connectors will be studied. During the ROV dive structures made of different materials, installed in the site, will be recovered and studied.		
TEST 2 Description (5 lines)	Two different power and data transmission systems will be tested: the direct "shore-to-deep sea frame" link on TSN and the link on TSS. The latter is realised by the use of a deep sea Junction Box (see description of the infrastructure) installed in year 2006. This will allow also a test of the power and data transmission systems installed on the Junction Box.		
TEST 3 Description (5 lines)	We will perform real-time tests of acoustic sensors, installing a calibrated acoustic transducer on the ROV. The acoustic transmitter will be, in fact, linked to the GPS time with the aim of performing a time-and-amplitude calibration of hydrophones.		

Comments: The test will be performed in collaboration with INGV

DESCRIPTION OF THE INFRASTRUCTURE

The Eastern Sicily infrastructure consists of a shore laboratory, a 28 km long electro-optical (hereafter e.o.) cable connecting the shore lab to the deep-sea lab. The shore laboratory hosts the land termination of the cable, the on-shore data acquisition system and power supply for underwater instrumentation. The shore laboratory has also a radio link (maximum speed 56 Mbps) to LNS-INFN that allows link (100 Mbps/1Gbps) to the internet. The underwater cable is an umbilical underwater e.o. cable, armoured with an external steel wired layer, containing 10 optical single-mode fibres (standard ITU-T G-652) and 6 electrical conductors (4 mm^2 area). At about 20 km E from the shore, the cable is divided into two branches, roughly 5 km long each, that reach two different sites namely Test Site North (TSN, latitude 37°±30'810 N, longitude 015°±06'819 E depth 2100 m) and Test Site South (TSS, latitude 37°±30'008 N, longitude 015°±23'034 E, depth 2050 m). The TSN cable branch has 2 conductors and 4 fibres directly connected to shore. The TSS branch has 4 conductors and 6 fibres.

In January 2005 INFN and INGV performed a sea operation onboard the Pertinacia-Elettra C/L vessel to recover the underwater cable terminations TSN and TSS and to install, on them, two underwater frames. Each frame, made of grade 2 titanium, is equipped with a pair of e.o. connectors. The two frames were deployed on the seabed. The e.o. connectors are made to be handled by ROV to allow plugging and unplugging of underwater experimental apparatuses, avoiding further recovery operations of the main cable. During the same naval campaign two experimental apparatuses were deployed, plugged and put in operation. The seismic and environmental monitoring station Submarine Network 1 (SN1), designed and operated by the INGV (Istituto Nazionale di Geofisica e Vulcanologia) was connected to the TSN termination and the O*v*DE (Ocean Noise Detection Experiment) station was deployed and connected to the TSS termination.

The NEMO Phase-1 project was realised in order to validate the technological solutions proposed by INFN for the construction of the so called *km^3 high energy neutrino detector*. NEMO Phase-1 consisted in the deployment and operation of prototypes of the critical elements of the km^3 detector: a junction box (JB) and a tower hosting optical sensors and data acquisition/transmission electronics. The JB provides connection between the main electro-optical cable and the detector structures. It has been designed to host and protect from the effects of corrosion and pressure, the opto-electronic boards dedicated to the distribution and the control of the power supply and digitized signals. The JB is working and is fully usable for deep-sea experiments. The JB offers optical several fibre links and power connection (380 VAC 3 phase, 3 kW in total) to several end users. Connections to end users are realised through four e.o. ROV mateable connectors.

The Eastern Sicily infrastructure includes underwater handling capability to manage experiments, such a capability consists of a deep-sea light-class ROV with 2 manipulators (SeaEye Cougar, 4000-m operative depth) and a deep-sea shuttle able to deploy and recover on the seafloor heavy systems (40 kN, the systems have to be equipped with a compatible mechanical interface).

INFN Toulon

Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites

Partner:	INFN			
Contact for these activities	**Name:**	Paolo PIATTELLI		
	Email:	paolo.piattelli@lns.infn.it		
TEST SITES				
Do you propose a cable site for tests?			Yes X	NO ☐
Water depth?	2475 m	Distance from the shore ?	42 km	
Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)				
TESTED EQUIPMENTS				
Do you propose any equipment to test			Yes X	NO ☐
Do you know of any European company who could be interested to provide equipment for tests			Yes X	NO ☐
Do you know of any not ESONET Institution who could be interested to provide equipment for tests			Yes ☐	NO **X**
	Model	Deployment time	Provider	
CTD				
Oxygen				
Turbidity				
Fluorescence				
Chemical analyser				
Current meter				
ADCP				
PH probes				
Penetrometer				
Geophone				
Hydrophone				
Accelerometer				
Still camera				
Video camera				
Lights				
Temperature probes				
Samplers				
….				
Underwater mateable connectors				
Acoustic modem				
Qualification Tests				
Can you offer testing facilities at your institution?			Yes	NO X
	Range	procedure reference	Comments	
Pressure				
Temperature				
vibration				
…..				
SENSOR CALIBRATION				

Can you offer calibration facilities at your institution?			Yes ☐	NO ☐
	Range	procedure reference	Comments	
Temperature				
Conductivity				
Pressure				
Oxygen				
Currentmeter				
OTHER COMPONENTS				
Are you planning to provide other devices/components for in-situ testing			Yes ☐	NO ☐
	Reference			
Bio fouling protection system				
TEST PROGRAM				
TEST 1 Description (5 lines)	Tests of deployment/recovery of underwater systems and accurate positioning on the seabed of modules cabled to the ANTARES observatory by means of a new underwater vehicle (deep-sea shuttle) in an area where seafloor monitoring modules and devices are presently operating. Test of deep sea ROV dive, operation and connection/disconnection of ROV mateable e.o. connectors.			
TEST 2 Description (5 lines)				
TEST 3 Description (5 lines)				

Comments: The test will be performed in Collaboration with INGV, ANTARES and IFREMER

DESCRIPTION OF THE INFRASTRUCTURE

INGV and INFN own a deep-sea light-class ROV with 2 manipulators (SeaEye Cougar, 4000-m operative depth) and a deep-sea shuttle able to deploy and recover on the seafloor heavy systems (40 kN, the systems have to be equipped with a compatible mechanical interface) capable to perform the operation described in Test 1.

INGV/Antares

<table>
<tr><td colspan="5">Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites</td></tr>
<tr><td>Partner:</td><td colspan="4">INGV</td></tr>
<tr><td rowspan="2">Contact for these activities</td><td>Name:</td><td colspan="3">Laura BERANZOLI</td></tr>
<tr><td>Email:</td><td colspan="3">beranzoli@ingv.it</td></tr>
<tr><td colspan="5">TEST SITES</td></tr>
<tr><td colspan="3">Do you propose a cable site for tests?</td><td>Yes X</td><td>NO</td></tr>
<tr><td>Water depth?</td><td>2475</td><td>Distance from the shore ?</td><td colspan="2">42 km</td></tr>
<tr><td colspan="5">Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)</td></tr>
<tr><td colspan="5">TESTED EQUIPMENTS</td></tr>
<tr><td colspan="3">Do you propose any equipment to test</td><td>Yes X</td><td>NO ☐</td></tr>
<tr><td colspan="3">Do you know of any European company who could be interested to provide equipment for tests</td><td>Yes X</td><td>NO ☐</td></tr>
<tr><td colspan="3">Do you know of any not ESONET Institution who could be interested to provide equipment for tests</td><td>Yes X</td><td>NO ☐</td></tr>
<tr><td></td><td>Model</td><td>Deployment time</td><td colspan="2">Provider</td></tr>
<tr><td>CTD</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Oxygen</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Turbidity</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Fluorescence</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Chemical analyser</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>3-C single-point current meter</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>ADCP</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>PH probes</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Penetrometer</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Geophone</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Hydrophones</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Accelerometer</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Still camera</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Video camera</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Lights</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Temperature probes</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Samplers</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>3-C Broad-band seismometer</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Scalar magnetometer</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Vectorial magnetometer</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Gravity meter</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Absolute pressure sensor</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Differential pressure gauge</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Marine radiometer</td><td>INGV prototype</td><td>2009</td><td colspan="2">INGV</td></tr>
<tr><td>Underwater mateable connectors</td><td>ODI electro optical ROV mateable connectors</td><td>2005, 2006, 2007, 2008, 2009</td><td colspan="2">INGV
INFN</td></tr>
<tr><td>Acoustic modem</td><td></td><td></td><td colspan="2"></td></tr>
</table>

Power and real time data transmission systems			
Qualification Tests			
Can you offer testing facilities at your institution?			Yes X NO ☐
	Range	procedure reference	Comments
Temperature			
vibration			
…..			
SENSOR CALIBRATION			
Can you offer calibration facilities at your institution?			Yes ☐ NO ☐
	Range	procedure reference	Comments
Temperature			
Conductivity			
Pressure			
Oxygen			
Currentmeter			
OTHER COMPONENTS			
Are you planning to provide other devices/components for in-situ testing			Yes ☐ NO ☐
	Reference		
Bio fouling protection system			
Deep sea acoustic transmitter for calibration			
TEST PROGRAM			
TEST 1 Description (5 lines)	Tests of deployment/recovery of underwater systems and accurate positioning on the seabed of modules cabled to the ANTARES observatory by means of a new underwater vehicle (deep-sea shuttle) in an area where seafloor monitoring modules and devices are presently operating.. Test of deep sea ROV dive, operation and connection/disconnection of ROV mateable e.o. connectors.		
TEST 2 Description (5 lines)	Deployment and recovery of underwater radiometer by means of ROV, and long-term operation in the ANTARES site.		
TEST 3 Description (5 lines)			

Comments: The test will be performed in Collaboration with INFN, ANTARES and IFREMER

Description of the infrastructure

INGV and INFN own a deep-sea light-class ROV with 2 manipulators (SeaEye Cougar, 4000-m operative depth) and a deep-sea shuttle able to deploy and recover on the seafloor heavy systems (40 kN, the systems have to be equipped with a compatible mechanical interface) capable to perform the operation described in Test 1.

INGV/Nemo

Organisation of TESTS on observatory methodologies on cabled ESONET observatory sites				
Partner:	INGV			
Contact for these activities	**Name:**	Paolo FAVALI		
	Email:	paolofa@ingv.it		
TEST SITES				
Do you propose a cable site for tests?			Yes X	NO ☐
Water depth?	2100 m	Distance from the shore ?	25 km	
Please join a description of the infrastructure : junction, connectors, interfaces , existing sensors and instruments; servicing operations (availability of ROV, cost by day…)				
TESTED EQUIPMENTS				
Do you propose any equipment to test			Yes X	NO ☐
Do you know of any European company who could be interested to provide equipment for tests			Yes X	NO ☐
Do you know of any not ESONET Institution who could be interested to provide equipment for tests			Yes X	NO ☐
	Model	Deployment time	Provider	
CTD	SeaBird SBE-37	2009	INGV	
Oxygen				
Turbidity	WetLab			
Fluorescence				
Chemical analyser				
3-C single-point current meter	Nobska MAVS-3	2009	INGV	
ADCP	RDI Workhorse 600kHz	2009	INGV	
PH probes				
Penetrometer				
Geophone				
Hydrophones	OAS E-2PD SMID prototype	2009	INGV	
Accelerometer	IMU Gladiator	2009	INGV	
Still camera				
Video camera				
Lights				
Temperature probes				
Samplers				
3-C Broad -band seismometer	Guralp CMG 1T	2009	INGV	
Scalar magnetometer	GEM Overhauser Sentinel	2009	INGV	
Vectorial magnetometer	INGV prototype	2009	INGV	
Gravity meter	IFSI-INAF prototype	2009	INGV	
Absolute pressure sensor	Paroscientific 8CB4000-I	2009	INGV	
Differential pressure gauge	University San Diego	2009	INGV	
Underwater mateable connectors	ODI electro optical ROV mateable connectors	2005, 2006, 2007, 2008, 2009	INGV INFN	

Acoustic modem				
Power and real time data transmission systems	Custom		INFN INGV	
Qualification Tests				
Can you offer testing facilities at your institution?			Yes X	NO ☐
	Range	procedure reference	Comments	
Temperature				
vibration				
…..				
SENSOR CALIBRATION				
Can you offer calibration facilities at your institution?			Yes ☐	NO ☐
	Range	procedure reference	Comments	
Temperature				
Conductivity				
Pressure				
Oxygen				
Currentmeter				
OTHER COMPONENTS				
Are you planning to provide other devices/components for in-situ testing			Yes ☐	NO ☐
	Reference			
Bio fouling protection system				
Deep sea acoustic transmitter for calibration				
TEST PROGRAM				
TEST 1 Description (5 lines)	Tests on deployment/recovery of underwater systems and accurate positioning on the seabed of modules cabled to the NEMO-SN1 observatory by means of a new underwater vehicle (deep-sea shuttle) and ROV in an area where seafloor monitoring modules and devices are presently operating.			
TEST 2 Description (5 lines)	Tests of connections/disconnections of modules/platforms by ROVs to JB and tests of functioning and data transfer to shore.			
TEST 3 Description (5 lines)				

Comments: The tests will be performed in cooperation with INFN

Description of the infrastructure

The Eastern Sicily infrastructure consists of a shore laboratory, a 28 km long electro-optical (hereafter e.o.) cable connecting the shore lab to the deep-sea lab. The shore laboratory hosts the land termination of the cable, the on-shore data acquisition system and power supply for underwater instrumentation. The shore laboratory has also a radio link (maximum speed 56 Mbps) to LNS-INFN that allows link (100 Mbps/1Gbps) to the internet. The underwater cable is an umbilical underwater e.o. cable, armoured with an external steel wired layer, containing 10 optical single-mode fibres (standard ITU-T G-652) and 6 electrical conductors (4 mm^2 area). At about 20 km E from the shore, the cable is divided into two branches, roughly 5 km long each, that reach two different sites namely Test Site North (TSN, latitude 37°±30'810 N, longitude 015°±06'819 E depth 2100 m) and Test Site South (TSS, latitude 37°±30'008 N, longitude 015°±23'034 E, depth 2050 m). The TSN cable branch has 2 conductors and 4 fibres directly connected to shore. The TSS branch has 4 conductors and 6 fibres.
In January 2005 INFN and INGV performed a sea operation onboard the Pertinacia-Elettra C/L vessel to recover the underwater cable terminations TSN and TSS and to install, on them, two underwater frames. Each frame, made of grade 2 titanium, is equipped with a pair of e.o. connectors. The two frames were deployed on the seabed. The e.o. connectors are made to be handled by ROV to allow plugging and unplugging of underwater experimental apparatuses, avoiding further recovery operations of the main cable. During the same naval campaign two experimental apparatuses were deployed, plugged and put in operation. The seismic and environmental monitoring station Submarine Network 1 (SN1), designed and operated by the INGV (Istituto Nazionale di Geofisica e Vulcanologia) was connected to the TSN termination and the O*v*DE (Ocean Noise Detection Experiment) station was deployed and connected to the TSS termination.
The NEMO Phase-1 project [was realised in order to validate the technological solutions proposed by INFN for the construction of the so called *km^3 high energy neutrino detector*. NEMO Phase-1 consisted in the deployment and operation of prototypes of the critical elements of the km^3 detector: a junction box (JB) and a tower hosting optical sensors and data acquisition/transmission electronics. The JB provides connection between the main electro-optical cable and the detector structures. It has been designed to host and protect from the effects of corrosion and pressure, the opto-electronic boards dedicated to the distribution and the control of the power supply and digitized signals. The JB is working and is fully usable for deep-sea experiments. The JB offers optical several fibre links and power connection (380 VAC 3 phase, 3 kW in total) to several end users. Connections to end users are realised through four e.o. ROV mateable connectors.
The Eastern Sicily infrastructure includes underwater handling capability to manage experiments, such a capability consists of a deep-sea light-class ROV with 2 manipulators (SeaEye Cougar, 4000-m operative depth) and a deep-sea shuttle able to deploy and recover on the seafloor heavy systems (40 kN, the systems have to be equipped with a compatible mechanical interface).

Annex 2: Revised proposals on each site

TESTS ON CABLED SITES

Description and access conditions of the Test Sites

Site: ANTARES

ALBATROSS
Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences

Responsible for the site: Dominique LEFEVRE
Email: Dominique.lefevre@univmed.fr

<u>Foreword:</u>

The international ANTARES collaboration (Astronomy with a Neutrino Telescope and Abyss environmental RESearch) aims to detect and study the production of high energy neutrinos in the Universe. The ANTARES infrastructure is also a permanent marine observatory providing high-bandwidth real-time data transmission from the deep-sea for geosciences and marine environmental sciences..

The aim of this proposal is to develop an autonomous instrumented line to provide real-time high-frequency time series of a variety of hydrological and biogeochemical variables. This line will be equipped with standard sensors as well as a number of new innovative sensors. The project is based on implementing an acoustic data transmission between the autonomous line and the ANTARES cabled infrastructure. This project is pursued within the framework of national and international project (MOOSE, Mediterranean project, EuroSITES, NEPTUNE,...) and would represent an important step forward in the development of autonomous sensor technology interfaced to deep-sea cabled infrastructures.
This proposal also intends to demonstrate the necessity of well defined calibration procedures, with the aim of finalising a common protocol for measurements on different existing ESONET sites.

Calibration procedures:
Today a variety of calibration procedures are available for oceanographic sensors. These, calibration procedures are designed either for static devices (mooring line) or dynamic devices (water column profiles) and are performed either by the manufacturer or by the scientific teams.

Thus, a crucial issue concerns the field of the standardisation. On the one hand, this is related to the inter-calibration of various sensors between themselves, such as two instruments from two different manufacturers which should provide the same results. This step could be done either at sea or in the laboratory in controlled condition.
On the other hand, it concerns the calibration procedures themselves, in other words if a same instrument could give same results depending on its calibration procedure. Both topics are essential for the future in order to compare oceanographic measurements across worldwide sea observatories.
Another crucial issue is to define the procedure for in situ calibration of existing instrument during their mooring time. Based on existing procedure (i.e. European project Animate) we will define procedure for generic sensors such as CTD and O2.

I - Location of Test Site and main features

- ANTARES is located in the Mediterranean Sea at 42°48’N - 6°10’E.
- Water depth: 2500 m
- Bottom topography and soil conditions: see Figure 1
- Distance to coast / Distance to port of operation: 42 km from La Seyne-sur-Mer (Var, France)

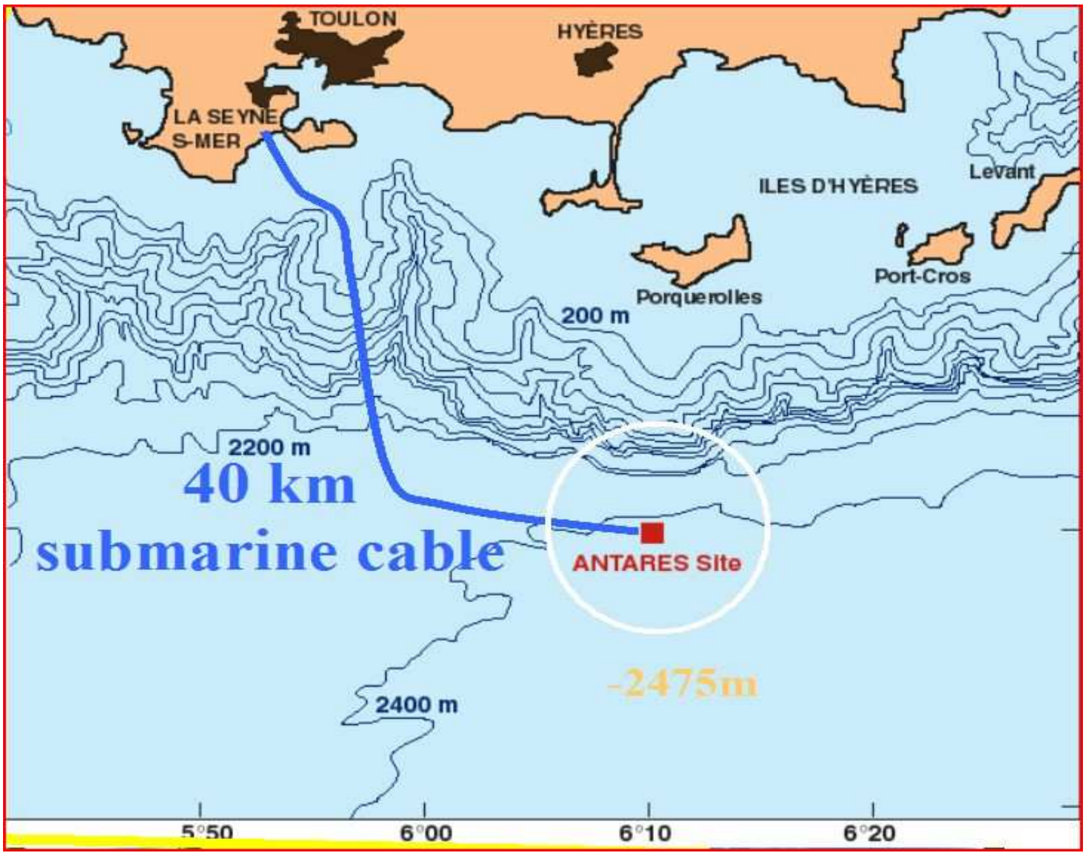


Fig.1: ANTARES site location

II - Existing infrastructure

General architecture and main characteristics:

- Sea bottom test area infrastructures
- Main cable to shore
- Shore station

The detector comprises a grid of about one thousand photomultipliers (PMT), sensitive to the Cherenkov light emitted by high energy neutrinos interacting close to the detector. The PMTs are distributed over 12 detector lines, each nearly 500m high and installed on the seabed at a depth of 2500m. The outputs from up to 16 lines are connected to a passive Junction Box via interlink cables. A 48 fibre electro-optical submarine cable, the Main Electro-Optical Cable (MEOC) connects the detector to the shore station. The submarine cable supplies ~4400 VAC, 10 A to a transformer in the Junction Box. The sixteen independent secondary outputs of the Junction Box provide ~500 VAC, 4A. Each ODI wet mateable connector provides 2 optical fibres for data communication. ROV intervention is necessary for connection of any equipment.

The ANTARES infrastructure already incorporates an instrumentation line (IL07), situated between 2000 and 2350m-depth and designed for multi-disciplinary studies comprising a variety of oceanographic sensors. It allows numerous studies in the fields of Sea, Earth and Environmental Sciences.
(Description of existing sensors on IL07 and the access to these data is given below)

A secondary junction box (SJB) is planned to be installed on ANTARES in 2010, using one of the 16 connexion lines (at the same level as a neutrino detector line).

Sensors could be either connected directly to the Secondary Junction Box or to the Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS). This autonomous line does not require an external power supply, since all sensors will have their own supply through battery. However, it could transmit samples of data to the SJB via acoustic transmission. The aim of the autonomous line is to deploy sensors throughout the water column (surface to the deep ocean) and to add new sensors or replace existing ones without requiring a ROV intervention

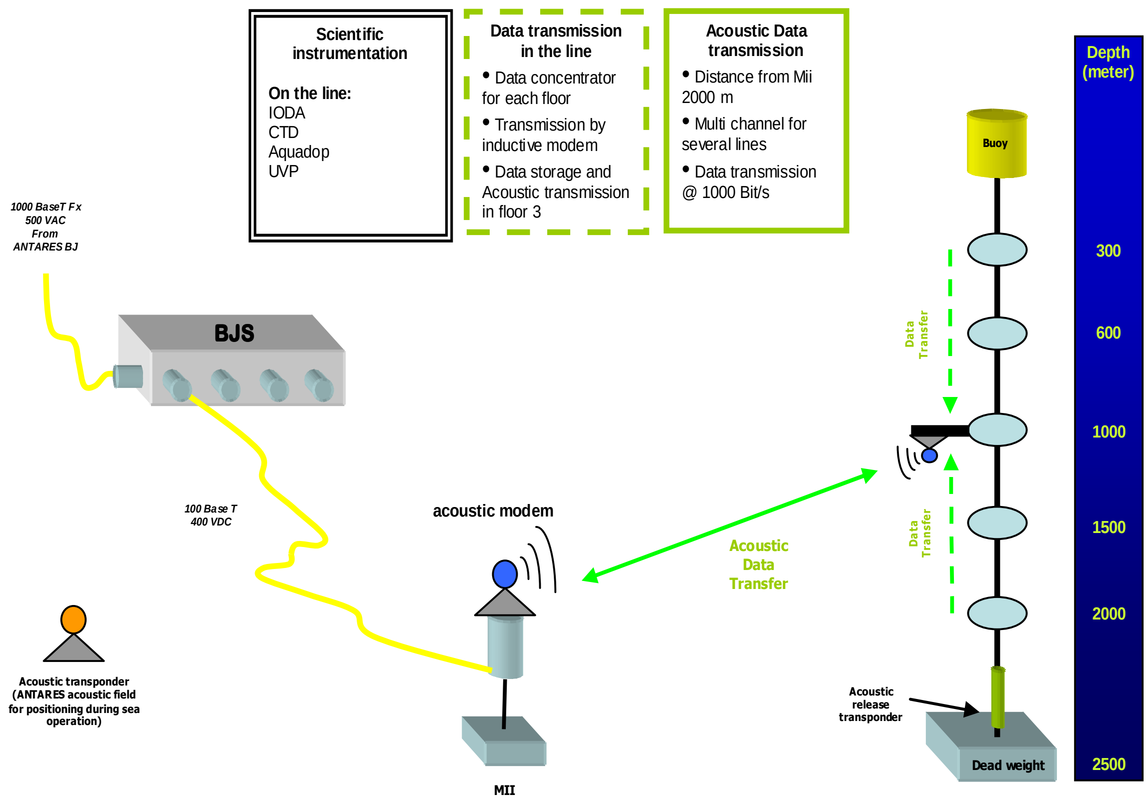


Figure 2: Schematic view of the data transmission between the Secondary Junction Box (BJS), the acoustic modem and the Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS). The BJS will be directly connected to the ANTARES Junction Box (JB).

Precise description of existing structures on test area for housing instruments or pieces of equipment in test:
- Mechanical interfaces
- Power and data interfaces and connector references

The main junction box provides a supply of 500 VAC with a power around 1.5 KW. The data transmission will be done by one optical fibre by bidirectional CWDM with a bandwidth of 4 x 1.2 Gbit/s.

The BJ is equipped by ODI Wet Mateable connectors.

Secondary junction box (SJB) description

A cable of around 400 m length will link the SJB with the main existing ANTARES junction box. This secondary junction box will offer between 4 and 6 general purpose sockets for the connection of equipments under conditions of shared time, power and bandwidth.

Each socket provides a supply of 400 VDC with a maximal power of 1 KW (shared with all outputs). The data transmission will be via Ethernet at 100Mbit/s.
The BJS is equipped by ODI Wet Meatable connectors (ROV-161-01-12-4).

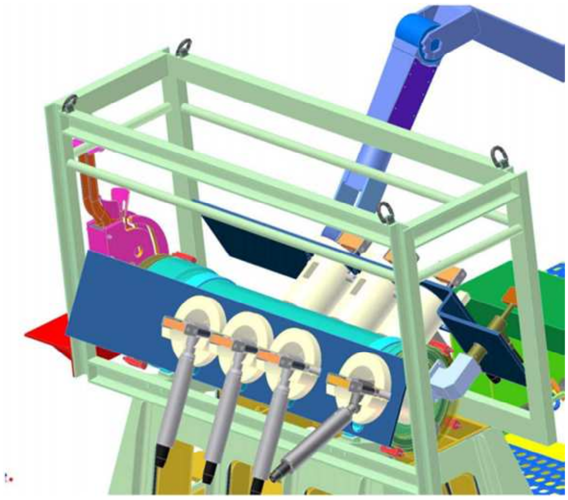


Figure 3: Schematic view of the Secondary Junction Box system, with a ROV arm behind the device in the process of making a cable connection.

Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS)

This line consists of five instrumented storeys connected by a supporting wire allowing induction data transfer using an inductive modem. The cable maintains the structure, enables the data transmission between floors and facilitates the deployment of the line. The bottom is constituted of a dead weight attached to the line by acoustic release transponder for the recovery. At the top, there is a buoy to maintain the line vertical. The line will be deployed at least 2500 m away from the SJB and the ANTARES infrastructure.

Each floor hosts a CTD, an UVP and an IODA6000. An ADCP is also planned in the line. A modification of the electronic embedded in the IODA6000 will allow to use it as a data concentrator. Instruments will be connected to the IODA6000 by RS232. It is possible to integrate instruments with inductive modem interface.
Data are sent to a data management unit located on the storey 4 (at 1000 meter depth). Transmission is made using an inductive modem. Data are stored and transmitted to the SJB by the acoustic modem integrated in the same storey.

Each floor can receive any new instrumentation if made compatible with the data flow and ANTARES telescope.

Existing procedure to access to the infrastructure:

- Conditions of access

Existing procedure:

Principles, techniques and procedures ***to access to the infrastructure*** for users are defined by the GUASA document (User Guide refers to the Access to ANTARES), and are updated by the head of the SAI (access service infrastructure, in charge of managing the ANTARES access by Users, for the ANTARES Collaboration). The SAI is in charge to define and develop the technical requirements and procedures to access to ANTARES infrastructure, investigate requests from user, and manage the implementation of the activities on behalf of the ANTARES Collaboration in order to be sure that the ANTARES experiment is not disturbed by the implementation of the users' experiments. The function of SAI is presently assumed by the CPPM of the CNRS/IN2P3, who appoints the chairperson.
Any project has to be reviewed by a CTA (Technical Access Committee to ANTARES) specifically created for each request and responsible of investigation and compliance of the experiment implementation with the GUASA rules.

The Institution Board of ANTARES gives its final agreement for access to ANTARES.

Person to contact for more details on infrastructure:

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Phone number	+33 685 901 884
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III - Underwater intervention

Available means for underwater intervention (Ships, ROV…):

Underwater interventions on the SJB are managed by IFREMER.
The VICTOR(IFREMER) and/or the COUGAR (INFN/INGV) are possible ROVs that could be made use of.
Such operations could be performed in conjunction with maintenance operations on the ANTARES neutrino telescope.

The ALBATROSS autonomous line does not require support from a ROV. Periodical recoveries are planned every 3 months.

Existing procedures for intervention and work on the infrastructure:

Deployment and underwater intervention procedures are already defined for operations on the ANTARES site. These include operations concerning detection lines of the neutrino telescope as well as operations on the Junction Box.
All procedures have to ensure that there will not disturbance for the ANTARES neutrino telescope and have to make sure that operations will be performed in safety.

Planned interventions on the site 2009-2010-2011:

For the test campaign proposed in the framework of ESONET, deployments concern the Secondary Junction Box (SJB), the acoustic modem with its interface module and the ALBATROSS autonomous line.
Underwater interventions will concern connection between the Junction Box and the SJB, and possibly some other interventions such as the deployment and burying of the seismometer, (connected on the line 12 of the ANTARES detector), the deployment of the Radiometer, the connection of the ratcom etc.

• Sea deployment interventions:
Objects:
Deployment of the SJB and the Acoustic Modem

Dates:
Autumn 2010

• VICTOR ROV interventions:
Objects:
Underwater connection between the BJ and the SJB with the Victor ROV

Dates:
Autumn 2010

Possibilities of added works:
Underwater inspections and interventions

• Sea deployment interventions:
Objects:
Deployment / recovery of the ALBATROSS autonomous line

Dates:
From Autumn 2010 to Winter 2011, once every three-months

• VICTOR/COUGAR ROV interventions:
Objects:
Underwater inspections and interventions (seismometer deployment/burying, deployment/connection of instrumentation on the SJB or in the vicinity,…)

Dates:
2011

Possibilities of added works:
Connection or interventions on SJB or instrumented lines, including ALBATROSS, IL07 or ANTARES line 12, if intervention concerns multidisciplinary purposes.

Possibility of extra operation (in addition to planned interventions):
Extra funds have to be found to cover ROV operations costs during other periods

Person to contact for more details on underwater intervention:

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IV - Instruments already installed or planned

Detailed reference of instruments installed on the Instrumentation Line IL07, already connected to the main junction box:

Storey	Height above seabed	Device type	Manufacturer	Model	Measured parameters
6	305m	6 hydrophones	HTI	HTI-90-U	sound level, transients
		CTD	SEABIRD	SBE 37-SMP	conductivity, temperature
5	290m	Optical Module	ANTARES	Custom	light level
		ADCP	Teledyne RD	Workhorse	sea current
		Camera	AXIS	AXIS221	images
4	210m	C-Star	WETLABS		water transparency
		SV	GENISEA/ECA	QUUX-3A(A)	sound velocity
		CT	SEABIRD	SBE SI	conductivity, temperature
3	195m	6 hydrophones	Erlangen	Custom	sound level, transients
		O_2 probe	AANDERAA	Optode 3830	oxygen level
2	180m	6 hydrophones	HTI	HTI-90-U	sound level, transients
		C-Star	WETLABS		water transparency
1	100m	Optical Module	ANTARES	Custom	light level
		ADCP	Teledyne RD	Workhorse	sea current
		Camera	AXIS	AXIS221	images
BSS	0	Pressure sensor	GENISEA/ECA		Pressure
		Transponder	IXSEA	RT661B2T	acoustic positioning

Table 1. Details of the instruments on the line IL07.

Summary of sensors planned to be installed on the autonomous line ALBATROSS:

Except for the $IODA_{6000}$, recently technologically approved on the line 12 of ANTARES, all other sensors/instruments are regularly deployed on mooring lines or during oceanographic cruises.

IODA

The $IODA_{6000}$ consists of an equi-pressure system which aims to measure the oxygen concentration and the oxygen dynamics in shallow or deep waters, up to 6000 m depth. $IODA_{6000}$ consists of a 5L-chamber in polycarbonate equipped with an internal Aanderaa® Optode that samples the seawater by a slow rotation. The seawater sample is enclosed between two Versilic® mats during a period of time (from few hours to few days).

Optode

Oxygen Optode model 3830 from AANDERAA which is an optical sensor based on dynamic fluorescence quenching. In this device, a specially designed chemical complex is illuminated with a blue LED and emits in return a red luminescent light with a lifetime that directly depends on the oxygen concentration of the medium.

UVP

Under water Video Profiler is a video camera which allows to measure:
- Particles size spectrum above 60µm and less than 5cm.
- Particles biovolume and their respective sedimentation rates.
- to determine meso and macroplankton (from 1 mm to 5 cm)

The UVP is interfaced with other sensor and a CTD

Aquadopp

The Aquadopp® profiler measures the current profile in water using acoustic Doppler technology. It is designed for stationary applications and can be deployed on the bottom, on a mooring rig, on a buoy or on any other fixed structure. The Aquadopp® profiler uses three acoustic beams slanted at 25° to accurately measure the current profile in a user selectable number of cells. The internal tilt and compass sensors tell the current direction and the high-resolution pressure sensor gives the depth—and the tidal elevation if the system is fixed mounted.

Water Velocity Measurement :

Range ±5 m/s (inquire for higher ranges), *Accuracy* 1% of measured value ±0.5 cm/s
Maximum sampling : rate (output) 1 Hz. 4 Hz on request, *Internal sampling rate* 23 Hz

Measurement area

Measurement cell size 0.75 m, *Measurement cell position, (user selectable)* 0.35–5.0 m, *Default position (along beam)* 0.35–1.8 m

Doppler uncertainty (noise)

Typical uncertainty for default configurations 0.5–1.0 cm/s, *Uncertainty in U,V a 1Hz sampling rate* 1.5 cm/s

Echo Intensity

Acoustic frequency 2 MHz, *Resolution* 0.45 dB, *Dynamic range* 90 dB

Sensors

Temperature Thermistor embedded in head, *Range* –4°C to 40°C, *Accuracy/Resolution* 0.1°C/0.01°C, T*ime response* 10min
Compass Flux-gate with liquid tilt, *Maximum tilt* 30°, *Accuracy/Resolution* 2°/0.1° for tilt < 20°
Tilt Liquid level, *Accuracy/Resolution* 0.2°/0.1° for tilt < 20°, *Up or down* Automatic detect
Pressure Piezoresistive, *Range* 0–200 m (standard), *Accuracy/Resolution* 0.5% / Better than 0.005%

<u>Microcat CTD</u>

Conductivity-Temperature-Depth (CTD) probes from Sea-Bird Electronics, SBE 37-SMP.
Temperature is acquired by applying an AC excitation to a hermetically sealed, VISHAY reference resistor and an ultra-stable aged thermistor with a drift rate of less than 0.002°C per year. A 24-bit A/D converter digitizes the outputs of the reference resistor and thermistor and pressure sensor.
Conductivity is acquired using an ultra-precision Wien Bridge oscillator to generate a frequency output in response to changes in conductivity.
The MicroCAT pressure sensor, developed by Druck, Inc employs a micro-machined *silicon diaphragm* into which the strain elements are implanted using semiconductor fabrication techniques, free of pressure hysteresis. Compensation of the temperature influence on pressure offset and scale is performed by the MicroCAT's CPU.
Real Time clock: To minimize power and improve clock accuracy, a temperature-compensated crystal oscillator (TCXO) is used as the real-time-clock frequency source. The TCXO is accurate to ± 1 minute per year (0 ºC to 40 ºC).

Accuracy with conductivity resolution 13.10^{-4} S/m for a measurement range 0-7 S/m , with a resolution of 10^{-5}.Temperature accuracy of 0.002 with a resolution of 10^{-4} °C for a measurement range –5 to +35°C. Pressure accuracy is 0.1% of full scale range with a resolution of 0.002% of full scale range.

<u>Hydrophone :</u>

Hydrophones sensors are based on piezo-electrical ceramics that convert pressure waves into voltage signals, which are then amplified for readout. The ceramics and amplifiers are coated in polymer plastics. The hydrophane sensors are tuned to be sensitive over the whole frequency range of interest from 1 to 50 kHz with a typical sensitivity around −145 dB ref. 1V/μPa or 0.05V/Pa (including preamplifier) and to have a low noise level.

<u>Radiometer:</u>

GEMS (Gamma Energy Marine Spectrometer) INGV is a sensor for underwater radioactivity measurement.
A new Radiometer/Gamma-spectrometer for ^{40}K and other radionuclides in the ocean. A prototype of radioactivity sensor (radiometer and nuclear spectrometer) for underwater measurement was developed by INGV in collaboration with Minsk University and Tecnomare ENI SpA. The sensor, named GEMS (Gamma Energy Marine Spectrometer) is sensitive to gamma detection of ^{40}K but suitable to detect also other natural (e.g., U, Th) and man caused radionuclides (e.g., ^{137}Cs, etc.) occurring in the ocean seawater. The ^{40}K isotope contained in sea salt, particulate and sediments yields a flux of photons generating a background noise for

photo-multiplier tubes used for the detection of neutrinos, as planned in the KM3NET project experiments; It is therefore important to monitor eventual variations over time of this background (e.g., due to benthic sediment mobilization, water currents). The radiometer consists of a gamma-sensor - NaI crystal (Fig.1), with PMT, high voltage supply, shaping amplifier, compact digital module for data acquisition, accumulation, processing and transmission to the control unit via digital interface. The radiometer can be installed in a benthic observatory, mooring or hosted in a multi-sensor probe for casts and profiles from a ship.
After several tests in laboratory, GEMS performed successfully a first long-term monitoring (6 months, Nov. 2008 – May 2009) in deep sea in the Mediterranean Sea (data not shown).

RATCOM:
Experimental setup for a tsunami warning system for the Mediterranean,
by a private company ACRI, 260 route du pin montard 06904 SOPHIA ANTIPOLIS.
Contact person: Philippe Barbey

Added instrumentation

Where	Height above seabed	Device type	Manufacturer	Model	Measured parameters
Line	500	CTD	Seabird	SMP37P	Conductivity, temperature, pressure
		Oxygen optode	Aanderaa	3830	Dissolved oxygen concentration, temperature
		IODA	CPPM/LMGEM		Dissolved Oxygen dynamics
		UVP	LOV		Video of particles
		ADCP	Nortek	Aquadopp	sea current
		Camera			Images
		Inductive Modem			(Data transmission)
		Acosutic modem			
		Radiometer	INFN		Radioactivity
BJS	0	Camera			Bioluminescent organisms
		Ratcom	ACRI		Tsunamis
BSS	0	Acoustic Transponder	IXSEA	RT661B2T	acoustic positioning

Table 2. Detailed description of instruments laid out on the Autonomous Line ALBATROSS.

Accessibility to the data from these sensors:

Data are available from the ANTARES database.

A website is in under development through WP7 Esonet resources. The aim is to carry out a functional database, bringing all the necessary information to the validation and the valorisations of the data taking in the ALBATROSS project framework, associated with the data taken by the ANTARES detector.

1) Validation of data set :

The database will be built around three types of tables corresponding to three life stages of a data set:

a) Before the data acquisition: Tables will gather the whole of the metadatas recalling the configuration of the various probes, calibration information, condition of the water, the exact positions of the probes on the site, the parameters used during the calculation of a data, etc…
b) During the data acquisition: The raw data will be stored in “RAWData” table. Then distributed in real-time in the various tables corresponding to the various probes. A first automatic validation will be carried out to check the absence of aberrant values. If it is not the case, an alarm could be sent to the person responsible for this probe.
c) After the data acquisition: The data set will be checked by the person responsible for a probe or a type of probe. The table of data will be updated: information concerning the recalibration of probes and possible special events will be traced in specific tables.
d) For long-term: All the data will be archived and saved regularly.

2) Valorisation of data set :

a) A particular strain is brought to the compatibility of the data formats and metadata in order to be able to, in an automatic or quasi-automatic way, abound the global databases which are under development.
b) A WEB portal, for data consultation and data management, is under construction. It will be designed as user friendly, from which the use of the data and the analysis will be easy for the international scientific community (Mercator and Coriolis database for example). This work will be done in close collaboration with people involved in the WP6.

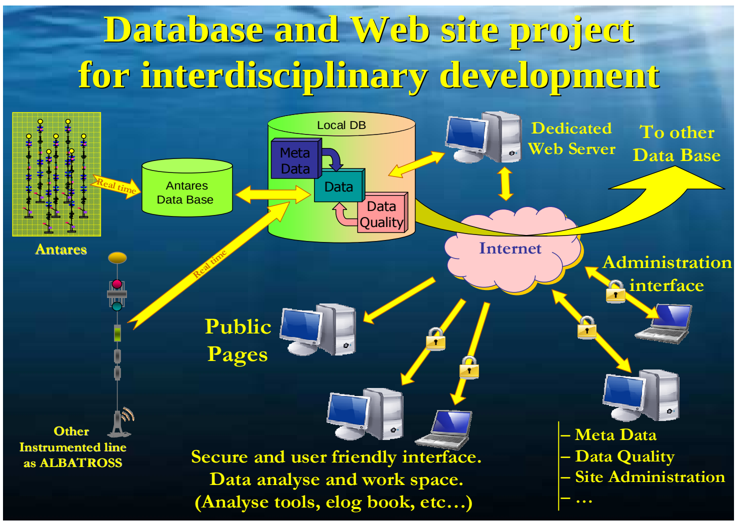

Figure 4: *Overview of the Data management for ANTARES data, SJB sensors and the Autonomous Line sensors*

Person to contact for more details on sensors already installed:

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V – Deployment possibilities of additional instruments

Deployment conditions:

Housing on seafloor structure and power and data connection
The Acoustic Modem (and its interface module) deployment will be performed at the same time as the SJB is deployed. Any equipment fitted to either of these two interfaces will have to deploy at that point in time.
The autonomous mooring line will be equipped with inductive data transfer. Any equipment can be added to the line as long it is meeting the requirement specified for the inductive modem. The line will be recovered after 3 months thus facilitating the addition of new sensors. The evolution of the sensor to be made compatible with the communication system will be at the cost of the sensor's owner responsibility.

Access conditions to data collected:

Once the data will be validated by their identified owner/responsible, the data will be made available within 3 months to the Esonet community and within 2 years to the international community.

Person to contact for more details on deployment conditions of additional instruments:

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This proposal intends to demonstrate the necessity of well defined calibration procedures. The final goal of the methodology is to be able to compare measurements on different existing ESONET sites.

TESTS on Cabled Sites

Description of the Test Sites

Site: Koljo Fjord, Sweden

Responsible for the site: Per Hall
Email: perhall@chem.gu.se

I - Location of the infrastructure, bathymetry:
In the Koljo Fjord on the Swedish west coast about 100 km north of Gothenburg.
See attached map.

II - Existing infrastructure:

Precise description:
The Koljö Fjord is situated on the Swedish west coast approximately 100 km north of Gothenburg. Data exist in a data base (hosted by the Swedish Meteorological and Hydrological Institute (SMHI) in Gothenburg) on water column depth distributions of salinity (S), temperature (T), oxygen, hydrogen sulfide, nutrients, total N, total P, chlorophyll, Secchi depth, pH, alkalinity, etc. at the central deepest site (40-45 m). Most of these parameters (and certainly S, T and O_2) have been measured on a monthly basis since 1986, on a bimonthly or quarterly basis during 1958-1985, and (at least) annually during 1934-37. There are no measurements for the period 1938-57. The monitoring program in the Koljö Fjord is ongoing and presently run by SMHI.

Interfaces:
We propose a flexible, movable, self contained coastal observatory ESOFLEX (see attached drawing) that will have a single hub for connection of up to 5 nodes through serial interfaces (selectable Rs422 or Rs232). One of the existing nodes (provided by the HYPOX project) is a Seaguard string logger (from www.aadi.no). In addition to the sensors that are already connected to this instrument it has the capacity of accepting more than 10 sensors using AICAP (open AADI modified CAN bus standard for environmental sensors) and 4 analogue sensors. Consequently the combination of the ESOFLEX hub and the Seaguard node will provide power (max 100 W) and communication with the following specifications:
- RS 232
- RS 422
- AICAP (AADI modified CAN bus)
- Analogue

In regard to the implementation of IEEE 1451, in particular making use of the MBARI PUCK system, which is one of the major activities within WP2 of ESONET, an application will run on the shore side that implements an IEEE 1451.0 server. This will allow to use this infrastructure for demonstration experiments as planned for instance for OGC Interoperability Experiment 2. In addition commercially available software for data collection from nodes, instruments and separate sensors and for storage and on-line presentation of the collected data will be operated (more information on drawing).

Available connectors (detailed reference):

Underwater matable connectors from SubConn (Microseries 8 pin) or GISMA (series 80, 7 pin). For more information see attached drawing. In the present configuration the Seaguard string is equipped with AADI adapted LEMO connectors for plug and play connection of sensors using the AICAP format. These connectors are not underwater mat able but if necessary the existing 7 free outlets could be equipped with a SubConn underwater matable adaptors.

Existing procedure to access to the infrastructure:
ESOFLEX is designed for coastal use and easy access. The Hub and the so far proposed nodes can be lifted, recovered and modified within in 1-2 hours. The shore container for data transfer and power can be lifted on-board by the crane of R/V Skagerak (research ship of Göteborg Univeristy) and transferred to a different location if desired. It is planned to transfer all data from the shore station to Gothenburg University, which will play the role of central mission control centre. From there the data will be collected and presented with existing commercially available software (from www.aadi.no). The data will also be made accessible by the PANGAEA data system, through the IEEE 1451 server, that will provide the procedures to make the data available in a standard format (i.e. NetCFD) that allows users to freely access and process the data.

Person to contact for more detailed information on infrastructure:

Name	Anders Tengberg
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and

Name	Christoph Waldmann
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III - Underwater intervention:

Available tools for underwater intervention (Ships, ROV…):
Several ships like Skagerak, Oscar von Sydow and Alice. ROVs, benthic lander platforms, moorings, etc. are available. Steaming time from home location to the observatory is around 1 hour.

Existing procedure to work on the infrastructure:

Planning:
The infrastructure will be deployed in the Koljö Fjord starting in October 2010 and will among other things comprise of a fixed string of instruments covering the water column and a seafloor node (40-45 m depth) for payload experiments. For more information see attached drawing.

Possibility of extra operation:
The infrastructure is planned as a platform to not just provide data transfer from deployed instruments but also to train for deep-sea operations. For instance, the observatory will allow for ROV operations for instance checking the plugging process of underwater mateable connectors. It is also planned to get students involved as part of training activities within ESONET. The intention is to use the observatory as an easily accessible test bed for commercially available or newly developed (e.g. within EU project SENSNET) instruments

and sensors. A major advantage with the proposed design is its flexibility and the ease to lift and connect new sensors without the need for costly and time consuming ROV operations.

Rules to apply for a specific intervention operation:

Specific intervention operations will be made possible. A description of the planned activities and to be deployed instruments has to be provided to the observatory operators. They will check whether the planned mission will follow all guidelines of the infrastructure that has been provided as a reference document. In case of any technical issues further information about how to adjust the deployment scenario will be provided.

Person to contact for more detailed on underwater intervention:

Name	Christoph Waldmann
Phone number	+49-421- 218 65606
Email	waldmann@marum.de

IV - Access to data collected by an instrument connected for test:

The basic instrument tests can be conducted on site to assure proper function of the payload sensors. The access to the online stream will then be accessible through the IEEE 1451 server running at the University of Kiel, which allows direct access to all sensor relevant characteristics or through the PANGAEA data system. For other data centres the data stream will be made available as well as the formats, and protocols will follow standard formats according to the guidelines of the OGC Sensor Web Enablement recommendations.

Person to contact for more detailed on data management problem:

Name	Christoph Waldmann
Phone number	+49-421- 218 65606
Email	waldmann@marum.de

V – Sensors already installed or planned

In the included ESOFLEX drawing we have presented some of the equipment that we have/will have access to for this project. In addition we also have other equipment available that could be connected and utilised including: CTD's (Sea and Sun BHP 8), Turbidity sensors (Wetlab), Fluorescence sensors (Turner C6), Video Cameras, Lights, Scanning Sonar (Kongsberg-Simrad EM1000), 3-D profiler (in-house development) and Planar Optode (in-house development)

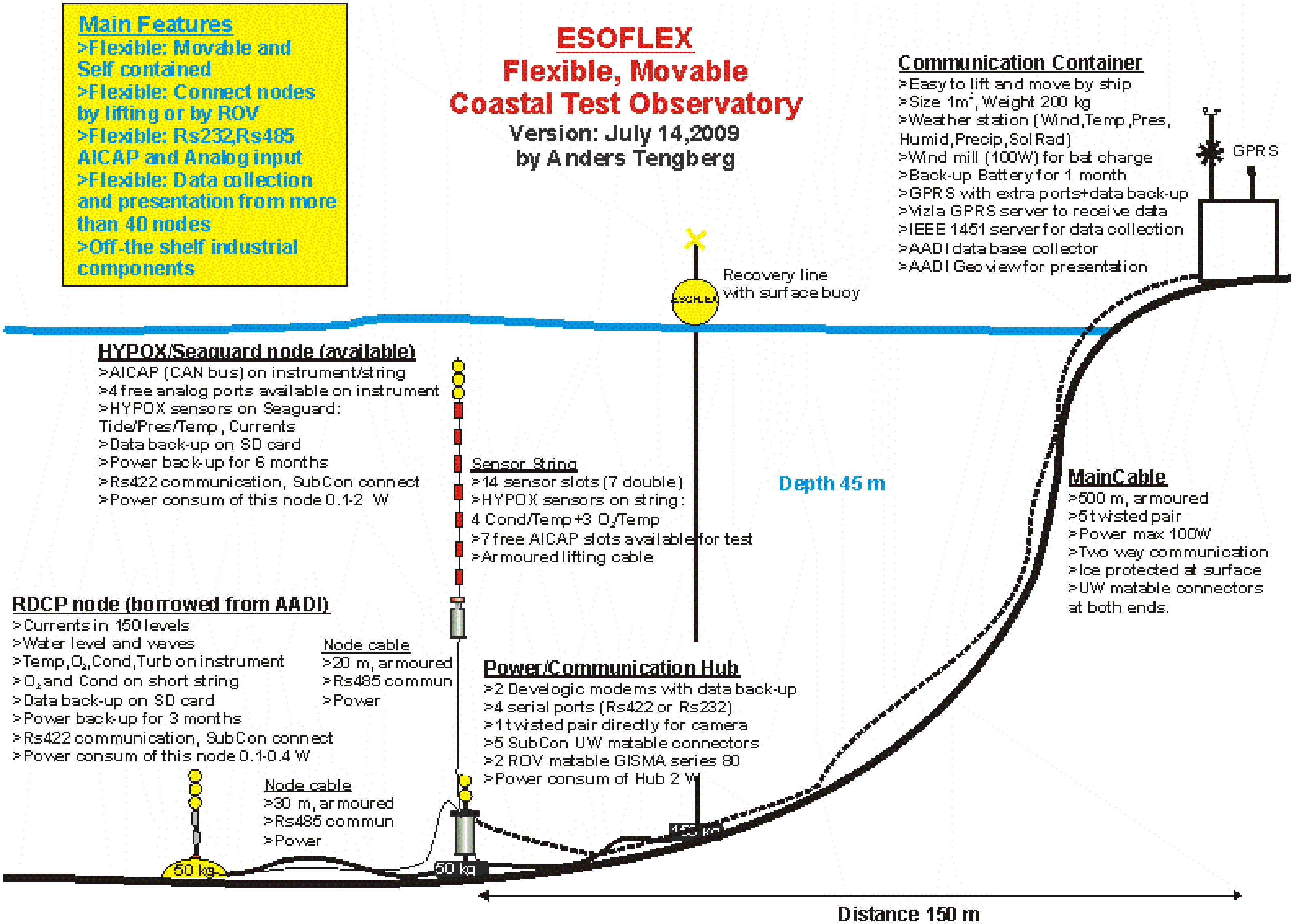
Detailed reference of the sensors:

All main components, instruments and sensors suggested to be used for this observatory (see drawing) are commercially available off the shelf standard products. Detailed information about the modems for the communication hub is available at http://www.develogic.de/ (see HAM.NODE). The Seaguard string logger (single point current meter with sensor string), the Conductivity/Temperature sensors (4319A), the Oxygen/Temperature sensors (4835), the Tide/Pressure/Temperature sensor (4647C) and the RDCP-600 (Acoustic Doppler Profiling Current meter) with sensors for Temperature, Oxygen (3835), Wave and Tide (4405), Conductivity (4019A) and Turbidity (3612A) are all produced by Aanderaa Data Instruments. For detailed information and data sheets see www.aadi.no.

Accessibility to the data from these sensors:
All data will be fully available to the whole ESONET community using existing solutions for transfer, collection and presentation of data. We envisage streaming of data to the IEEE 1451 server running at the University of Kiel for incorporation of data into the Pangea data base and for direct access to all sensor relevant characteristics. For data presentation on the Internet in graphs we plan to use dedicated available software (Geoview, www.aadi.no).

Person to contact for more detailed on sensors already installed:

Name	Anders Tengberg
Phone number	+46-703-466372
Email	anderste@chem.gu.se


Main Features
>Flexible: Movable and Self contained
>Flexible: Connect nodes by lifting or by ROV
>Flexible: Rs232,Rs485 AICAP and Analog input
>Flexible: Data collection and presentation from more than 40 nodes
>Off-the shelf industrial components
ESOFLEX
Flexible, Movable
Coastal Test Observatory
Version: July 14,2009
by Anders Tengberg
Communication Container
>Easy to lift and move by ship
>Size 1m³, Weight 200 kg
>Weather station (Wind,Temp,Pres, Humid,Precip,Sol Rad)
>Wind mill (100W) for bat charge
>Back-up Battery for 1 month
>GPRS with extra ports+data back-up
>Vizla GPRS server to receive data
>IEEE 1451 server for data collection
>AADI data base collector
>AADI Geoview for presentation
GPRS
Recovery line with surface buoy
HYPOX/Seaguard node (available)
>AICAP (CAN bus) on instrument/string
>4 free analog ports available on instrument
>HYPOX sensors on Seaguard: Tide/Pres/Temp, Currents
>Data back-up on SD card
>Power back-up for 6 months
>Rs422 communication, SubCon connect
>Power consum of this node 0.1-2 W
Sensor String
>14 sensor slots (7 double)
>HYPOX sensors on string:
4 Cond/Temp+3 O2/Temp
>7 free AICAP slots available for test
>Armoured lifting cable
Depth 45 m
MainCable
>500 m, armoured
>5 twisted pair
>Power max 100W
>Two way communication
>Ice protected at surface
>UW matable connectors at both ends.
RDCP node (borrowed from AADI)
>Currents in 150 levels
>Water level and waves
>Temp,O2,Cond,Turb on instrument
>O2 and Cond on short string
>Data back-up on SD card
>Power back-up for 3 months
>Rs422 communication, SubCon connect
>Power consum of this node 0.1-0.4 W
Node cable
>20 m, armoured
>Rs485 commun
>Power
Power/Communication Hub
>2 Develogic modems with data back-up
>4 serial ports (Rs422 or Rs232)
>1 twisted pair directly for camera
>5 SubCon UW matable connectors
>2 ROV matable GISMA series 80
>Power consum of Hub 2 W
Node cable
>30 m, armoured
>Rs485 commun
>Power
50 kg
50 kg
Distance 150 m

TESTS ON CABLED SITES

Description and access conditions of the Test Sites

Site: NEMO-SN1

Responsible for the site: Giorgio Riccobene
Email: riccobene@lns.infn.it

I - Location of Test Site and main features

- Geographical situation and coordinates
- Water depth / Bottom topography and soil conditions
- Distance to coast / Distance to port of operation

The Eastern Sicily infrastructure consists of a shore laboratory located in Catania harbour (Sicily, Italy) and a 28 km long electro-optical (hereafter e.o.) cable connecting the shore lab to the deep-sea infrastructure. Two underwater cable terminations are available, namely: Test Site North (TSN) and Test Site South (TSS).

- Water depth: TSN 2100 – TSS 2050 m
- **TSN**: regular physiographic profile; maximum slope 0.5°. Volcanic soil. Sediment layer < 1.5 m.
  TSS: steep slopes and flat areas (slope 1°). Volcanic soil. Sediment layer < 1.5 m. Further details available on request
- Distance to coast / Distance to port of operation: about 25 km to Catania harbour

The harbour of Catania is the logistic base of Elettra Tlc., owner of the Certamen C/L and of the Teliri C/L vessels. Elettra Tlc. is member of the MECMA Consortium.

II - Existing infrastructure

General architecture and main characteristics:

- Shore station
- Main cable to shore
- Sea bottom test area infrastructures

The shore laboratory (Fig. 1, left panel) hosts the land termination of the cable, the on-shore data acquisition system and power supply for underwater instrumentation. It is equipped with a large hall (20 m x 6 m x 6 m height) for large structure mounting and integration, an electronics workshop, climatic rooms for computing and data acquisition devices. A GPS antenna and receiver is installed in the lab. The shore laboratory has also a radio link (maximum speed 56 Mbps) to LNS-INFN that allows fast Ethernet link (1 Gbps) to the internet. An hyperbaric vessel is also available for high pressure tests. Characteristics are reported in Table 1.

Table 1

Internal diameter	80 cm
Filling medium	Fresh water
Max pressure	400 bar
Electrical contacts	9
Max V	100 V
Max A	5 A

The underwater cable (Fig. 1, right panel) is an umbilical underwater e.o. cable, armoured with an external steel wired layer, containing 10 optical single-mode fibres (standard ITU-T G-652) and 6 electrical conductors (4 mm^2 area). At about 20 km E from the shore (22.925 m of cable), the cable is divided into two branches, roughly 5 km long each (5220 m and 5000 m respectively), that reach two different sites:
- Test Site North (**TSN**, latitude 37°30'810 N, longitude 015° 06'819 E depth 2100 m)
- Test Site South (**TSS**, latitude 37°30'008 N, longitude 015° 23'034 E, depth 2050 m).

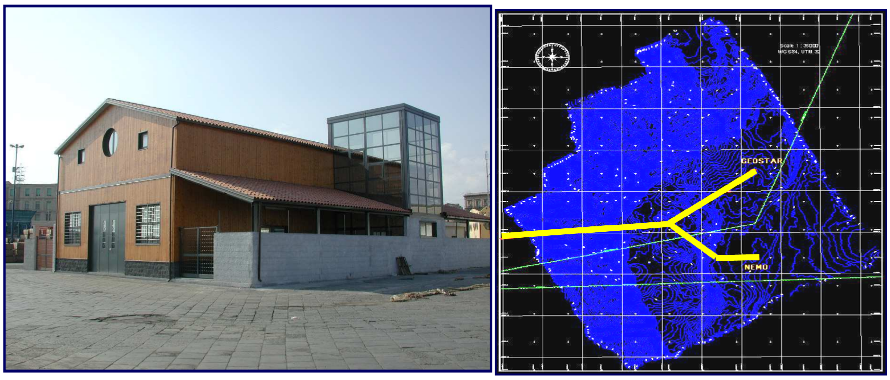


Figure 1. Left: The Shore Lab in the port of Catania. Right: Test site bathymetric chart and path of the main electro optical cable.

The TSN cable branch has 2 conductors and 4 fibres directly connected to shore. The TSS branch has 4 conductors and 6 fibres. The scheme of optical and electrical connections is shown in Fig. 2, the numbering in the sea infrastructures side refers to the pin number of the ODI Rolling Seal hybrid connector 8 ways (see Annex 1) used for the installation and shown in Fig. 3. The Cable characteristics are summarised in Table 2, the connectors characteristics are summarised in Table 3.

Table 2

Electrical Characteristics	
DC resistance (max)	4.9 Ohm / km
Insulation resistance (min)	1000 MOhm · km
Impedance	0.75 mH / km
Capacity	75 nF / km
Optical Characteristics	
Attenuation @ 1310 nm (max)	0.40 dB / km
Attenuation @ 1550 nm (max)	0.25 dB / km
Dispersion for 1288 nm – 1339 nm (max)	3.5 ps / nm· km
Dispersion for 1550 nm (max)	18 ps / nm· km

Table 3	
Number of Circuits:	4 electrical 4 optical
Electrical Characteristics	
Max Operational Current:	7 Amps
Max Operational AC Voltage	700 VAC Phase-to-Ground (mated)
Max Operational DC Voltage	1000 VDC mated
Insulation Resistance	>10 GOhm @ 1000 VDC
Contact Resistance	<10 mOhm
Optical Characteristics	
Insertion Loss: 1310/1550 nm	<0.5 dB
Mated back reflection: 1310/1550 nm	<-30 dB

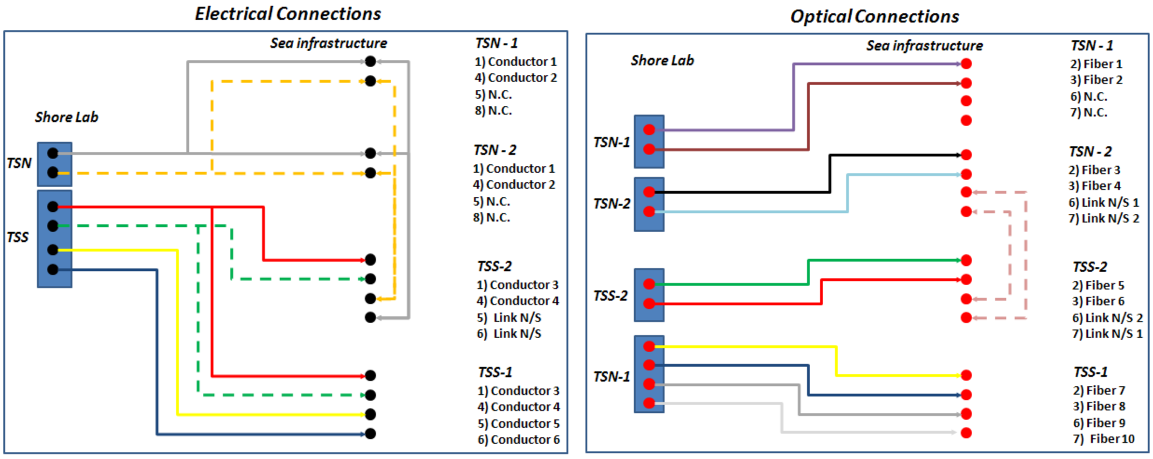


Figure 2. Scheme of conductors (left) and optical fibres (right) available at the Catania Test Site.

In January 2005 INFN and INGV performed a sea operation onboard the Pertinacia -Elettra C/L vessel to recover the underwater cable terminations TSN and TSS and to install, on them, two underwater frames. Each frame, made of grade 2 titanium (see Fig. 4, left panel), is equipped with a pair of ODI Rolling Seal hybrid connector 8 ways. The two frames were deployed on the seabed. The e.o. connectors are made to be handled by ROV to allow plugging and unplugging of underwater experimental apparatuses, avoiding further recovery operations of the main cable.

During the same naval campaign two experimental apparatuses were deployed, plugged and put in operation:

1) the multidisciplinary seafloor observatory Submarine Network 1 (SN1) for the geophysical and environmental monitoring, a GEOSTAR-class observatory designed and operated by the INGV (Istituto Nazionale di Geofisica e Vulcanologia), was connected to the TSN termination (Fig.4, right panel). Details on the sensors installed can be found in Annex 2.
2) the O*ν*DE (Ocean Noise Detection Experiment) station was deployed and connected to the TSS termination (Fig.5, left panel). Details on the sensors installed can be found in Annex 3.

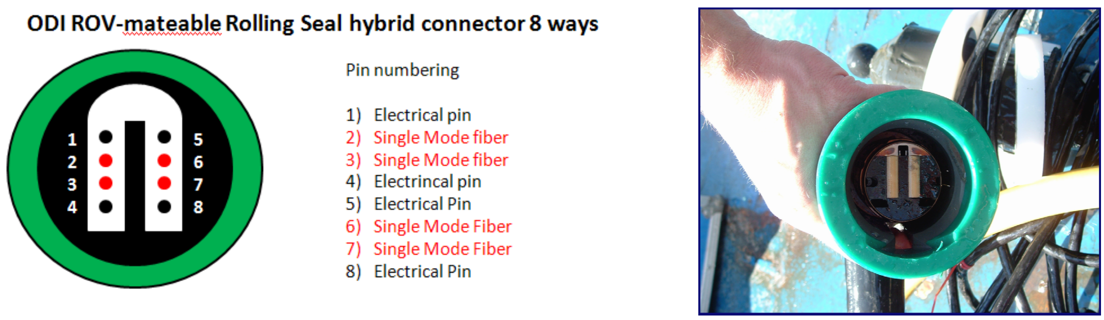


Figure 3. Pin numbering valid for all the ODI ROV mateable connectors installed on TSS and TSN frames.

Another operation in the Site was performed on January 2006, in the framework of the NEMO Phase-1 project. The NEMO Phase-1 project was realised in order to validate the technological solutions proposed by INFN for the construction of the so called *km3 high energy neutrino detector*. NEMO Phase-1 consisted in the deployment and operation of prototypes of the critical elements of the km^3 detector: a junction box (JB) and a tower hosting optical sensors and data acquisition/transmission electronics. In Fig.5, right panel, the photo of the JB is shown. The NEMO Phase-1 experiment is described in Annex 4.

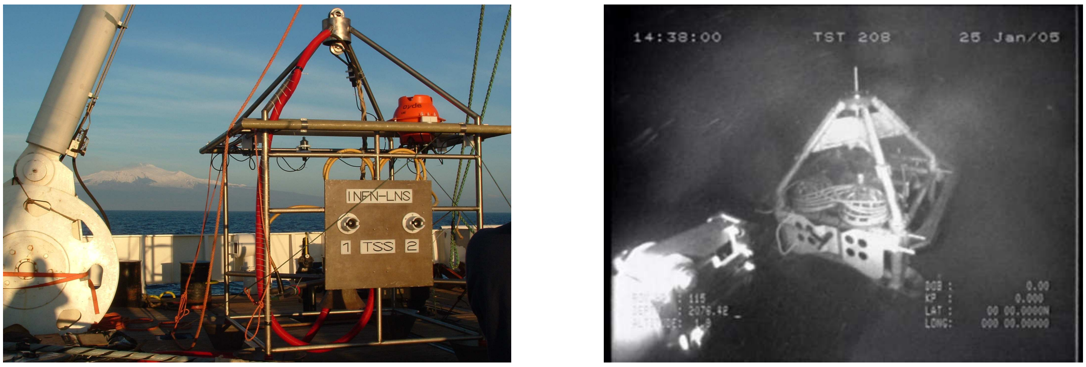


Figure 4. Left: The titanium frame installed on TSS, hosting the e.o. ODI connectors. Two identical frames are installed on TSN and TSS. Right: the SN1 seafloor observatory deployed on the seafloor (2100 m w.d.) in January 2005.

The JB provides connection between the main electro-optical cable and the detector structures. The JB has been designed to host and protect from the effects of corrosion and pressure, the opto-electronic boards dedicated to the distribution and the control of the power supply and digitized signals.
The JB is working and it is fully usable for deep-sea experiments. The JB offers optical several fibre links and power connection (380 VAC 3-phase, 3 kW in total) to several end users. Connections to end users are realised through four e.o. ROV mateable connectors.

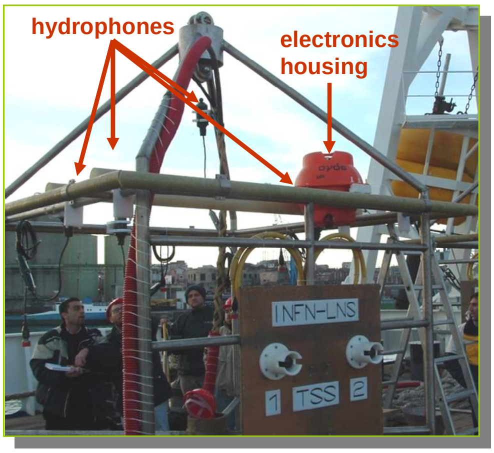


Figure 5. Left: the OνDE station installed on the top of TSS. Right: the NEMO Phase JB installed on TSS.

In April 2008 SN1 and OνDE were recovered after 3 years and 3 months, within the activities planned in the frame of the PEGASO project (PotEnziamento di reti Geofisiche e Ambientali SOttomarine = enhancement of underwater geophysical and environmental networks), funded by "Regione Siciliana" (2005-2008). Details on the project can be found in Annex 5. PEGASO covered also the resources for the refurbishment and the enhancement of both SN1 and OνDE. Their deployment is planned within the end of 2009 as part of the activities of the LIDO (LIstening to the Deep Ocean) ESONET Demo Mission (DM) (see LIDO-DM full proposal in Annex 6). The new complete list of sensors installed is shown in Table 4.

Table 4

Sensor	Rate	Model
3-C broad-band seismometer	100 Hz	Guralp CMG-1T (0.0027-50 Hz)
Differential Pressure Gauge (DPG)	10 Hz	Prototype Univ. St. Diego
Hydrophone (Geophysics)	200 Hz	OAS E-2PD
Hydrophone (Geophysics)	2000 Hz	SMID (0.05-1000 Hz)
8 Hydrophones (Bio-acoustics)	96 kHz	Reson TC4037 / SMID TR-401 V1
Absolute Pressure Gauge (APG)	15 s	Paroscientific 8CB4000-I
3-C Accelerometer + 3-C Gyro (IMU)	100 Hz	Gladiator Technologies Landmark 10
Gravity meter	1 Hz	Prototype IFSI-INAF
CTD + Turbidity meter	1 s/h	SeaBird SBE-37SM-24835 + Wet Lab
ADCP	1 profile/h	RDI Workhorse Monitor (600 kHz)
Vectorial magnetometer	1 Hz	Prototype INGV
Scalar magnetometer	1 Hz	Marine Magnetics Sentinel (3000 m)
3-C single point currentmeter	2 Hz	Nobska MAVS-3

Precise description of existing structures on test area for housing instruments or pieces of equipment in test:

Test Site North (TSN)
Underwater frame made of grade 2 titanium deployed on the seabed and equipped with a pair of ODI e.o. Rolling Seal 8 ways hybrid connectors. The frame dimensions are 200 x 200 x 300 (h) cm. The connection scheme is shown in Fig. 2 and Fig. 3.

AC and DC Power transmission is feasible using connectors TSN-1 and TSN-2.

At present a 500 VAC (1-phase) 10 kVA power supply is installed on-shore.
Power link is available on both ODI connectors.
TSN-1 - Pin 1 neutral; Pin 4 phase.
TSN-2 - Pin 1 neutral; Pin 4 phase.

The power supply and electrical pin-out can be changed according to cable and connector specs given in Tables 2 and 3.

Test Site South (TSS)
Underwater frame made of grade 2 titanium deployed on the seabed and equipped with a pair of ODI e.o. Rolling Seal 8 ways hybrid connectors. The frame dimensions are 200 x 200 x 300 (h) cm. The connection scheme is shown in Fig. 2 and Fig. 3.

AC and DC Power transmission is feasible using connectors TSS-1 and TSS-2.
At present a 700 VAC (3-phase) 10 kVA power supply is installed on-shore.
Power link is available on both ODI connectors.
TSS-2 - Pin 1 phase-R; Pin 4 phase-S.
TSS-1 - Pin 1 phase-R; Pin 4 phase-S; Pin 5 phase T; Pin 8 neutral.
The connector TSS-1 is connected at present to the NEMO Phase-1 Junction Box.
The connector TSS-2 is used as backup link for the Junction Box.
The JB offers to end-users two outputs on two ODI Rolling Seal Connectors. The maximum power load per each connector is 1.5 kVA with 380 VAC (3-phase). Optical fibre link is affordable using DWDM (optional CWDM) laser transmission.
The Connection Scheme is shown in Table 5

Table 5

JB-Output 1			***JB-Output 2***		
	Electrical	***Optical***		***Electrical***	***Optical***
Pin 1	Phase R		Pin 1	Phase R	
Pin 2		1540 - 1545 nm	Pin 2		1525 - 1545 nm
Pin 3		1538 - 1607 nm	Pin 3		1570 - 1576 nm
Pin 4	Phase S		Pin 4	Phase S	
Pin 5	Phase T		Pin 5	Phase T	
Pin 6		1546 - 1552 nm	Pin 6		N.C.
Pin 7		1528 - 1568 nm 1578 - 1607 nm	Pin 7		N.C.
Pin 8	Neutral		Pin 8	Neutral	

Existing procedure to access to the infrastructure:

- Conditions of access
- Applying file contents

The use of the infrastructure is open to the scientific community.
A proposal must be submitted to INFN and INGV.
Any request must be formally agreed between applicant, INGV and INFN.

Person to contact for more details on access to the infrastructure:

Name	Paolo Piattelli (INFN-LNS) Giorgio Riccobene (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 392 +39 095 542 304 +39 06 51860 428
Email	piattelli@lns.infn.it riccobene@lns.infn.it paolofa@ingv.it

III - Underwater intervention

Available means for underwater intervention (Ships, ROV…) :

The Eastern Sicily infrastructure includes underwater handling capability to manage experiments, such a capability consists of a deep-sea light-class ROV with 2 manipulators (SeaEye Cougar, 4000-m operative depth) and a Deep-Sea Shuttle (DSS) able to deploy and recover on the seafloor heavy systems (40 kN, the systems have to be equipped with a compatible mechanical interface). Also the ROV and DSS have been realised in the frame of the PEGASO project. Details on ROV and DSS can be also found in Annex 5.

Existing procedures for intervention and work on the infrastructure:

- Conditions of access
- Applying file contents

The use of the infrastructure is open to the scientific community.
A proposal must be submitted to INFN and INGV.
Any intervention must be formally agreed between applicant, INGV and INFN.

Person to contact for more details on intervention and work on the infrastructure:

Name	Mario Musumeci (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 388 +39 06 51860 428
Email	musumeci@lns.infn.it paolofa@ingv.it

Planned interventions on the site 2009-2010-2011:
Object of intervention: Deployment of the ESONET LIDO-DM
Means: Ship rented under the MECMA agreement. PEGASO ROV and DSS
Expected dates: November-December 2009
Possibility of added work: YES

Object of intervention: Recovery of the ESONET LIDO-DM
Means: Ship rented under the MECMA agreement. PEGASO ROV and DSS
Expected dates: End of 2011
Possibility of added work: YES

Possibility of extra operation (in addition to planned interventions):
YES

Procedures to apply for a specific intervention:
The use of the infrastructure is open to the scientific community.
A proposal must be submitted to INFN and INGV.
Any intervention must be formally agreed between applicant, INGV and INFN.

Person to contact for more details on underwater intervention:

Name	Giorgio Riccobene (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 304 +39 06 51860 428
Email	riccobene@lns.infn.it paolofa@ingv.it

IV - Instruments already installed or planned

Detailed reference of the instruments:
TSN
Instrument: SN1
Live Time: January 2005 – April 2008
Reference: P. Favali, et al., 2006, Nuclear Instruments and Methods in Physics Research A: 567 (2006) 462-467. (Annex 2)

Instrument: LIDO DM – Refurbished SN1
Expected Live Time: End of 2009 -- End of 2011
Reference: M. Andrè et al, LIDO DM Full Proposal submitted to ESONET NoE. (Annex 6)

TSS
Instrument: NEMO-OvDE
Live Time: January 2005 – November 2006
Reference: G. Riccobene et al., Nuclear Instruments and Methods in Physics Research A 604 (2009) S149–S157. (Annex 3)

Instrument: NEMO-Phase 1
Live Time: December 2006 – May 2007

Reference: E. Migneco et al., Nuclear Instruments and Methods in Physics Research A 588 (2008) 111–118. (Annex 4)

Instrument: LIDO DM – Refurbished NEMO-OνDE
Expected Live Time: End of 2009 -- End of 2011
Reference: M. Andrè et al, LIDO DM Full Proposal submitted to ESONET NoE. (Annex 6)

Accessibility to the data from these sensors:
Recorded NEMO-OnDE data are available on request.
Recorded SN1 data are available.
Recorded SN1 data are available and will be on-line downloaded through a dedicated database (this part is planned for the end of this year).
NEMO-Phase 1 data are available with restriction.

Real-Time LIDO DM Data will be available on-line using the same dedicated database already above mentioned.

Person to contact for more details on sensors already installed:

Name	Giorgio Riccobene (INFN-LNS) for NEMO-OνDE and LIDO DM Paolo Piattelli (INFN-LNS) for NEMO Phase-1 Laura Beranzoli (INGV) for SN1 and LIDO DM
Phone number	+39 095 542 304 +39 095 542 392 +39 06 51860 428
Email	riccobene@lns.infn.it piattelli@lns.infn.it beranzoli@ingv.it

V – Deployment possibilities of additional instruments

Deployment conditions:
Mechanics, power/data transmission systems and deployment operations must be agreed with INFN and INGV.

Access conditions to data collected:
INFN and INGV require access to data collected using the infrastructure.

Person to contact for more details on deployment conditions of additional instruments:

Name	Giorgio Riccobene (INFN-LNS) Mario Musumeci (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 304 +39 095 542 388

	+39 06 51860 428
Email	riccobene@lns.infn.it musumeci@lns.infn.it paolofa@ingv.it

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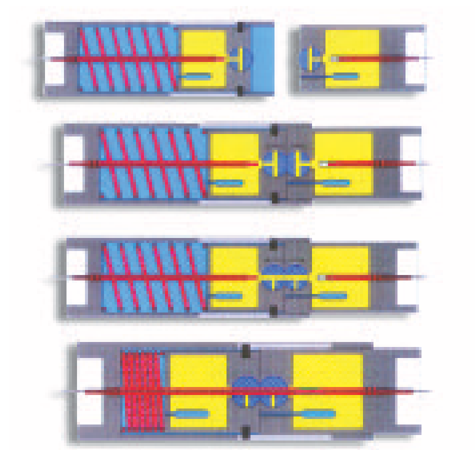
The connector is fully qualified to the latest industry standards and customer specifications including: optical & electrical performance, helium leak, mechanical shock & vibration, thermal cycling & shock, turbid hyperbaric mate/demate and misaligned mateability. Optical harnesses using ODI oil-filled hose have also been qualified to these standards & specifications.



The connector functions by virtue of the patented rolling seal design. The goal is to exclude water and silt from the region where the optical fibers are being brought into contact. The roller seal design provides isolation from seawater when the connectors are unmated. Any silt between the connector halves becomes trapped when the halves are first brought together and then is moved to one side as the seals rotate, to provide a clear oil-filled path for the optical pin to move into the receptacle and complete the mate. Any of the circuits may be specified for single-mode fiber, multi-mode fiber or electrical circuits.

Since 1996, over 2,400 Rolling-Seal connectors have been delivered, accumulating more than 75 million service hours with reliability greater than 99.9%.

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Rolling-Seal Connector

Standard Wet-Mate Optical & Hybrid Connector
Up to 8-Circuits: ROV, Stab & Diver-Mate

GENERAL	Standard
Material:	Titanium is preferred shell material
Design Life:	25 Years
Max Operational Pressure:	Full Ocean Depth (Contact ODI for differential pressure applications) Fully qualified for 3,000m use
Mate Cycles:	>100 without refurbishment
Mating Force:	<80 lbs per circuit
Demating Force:	<40 lbs
Operational Temperature:	-2ºC to +50ºC
Storage Temperature:	-25ºC to +60ºC
Configurations:	ROV, Stab & Diver-Mate (Plug only as Bulkhead Mount)
ROV Handle Type:	Flexible Paddle as Standard

OPTICAL & ELECTRICAL

Number of Circuits:	8 max, optical or electrical
Insertion Loss: 1310/1550 nm	<0.5 dB
Mated back reflection: 1310/1550 nm	<-30 dB
Max Operational Current:	7 Amps
Max Operational AC Voltage:	700 VAC Phase-to-Ground (mated)
Max Operational DC Voltage:	1000 VDC mated
Insulation Resistance:	>10 GΩ @ 1000 VDC
Contact Resistance:	<10 mΩ

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NEMO-SN-1 the first "real-time" seafloor observatory of ESONET

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Available online 10 July 2006

Abstract

The fruitful collaboration between Italian Research Institutions, particularly Istituto Nazionale di Fisica Nucleare (INFN) and Istituto Nazionale di Geofisica e Vulcanologia (INGV) together with Marine Engineering Companies, led to the development of NEMO-SN-1, the first European cabled seafloor multiparameter observatory. This observatory, deployed at 2060 m w.d. about 12 miles off-shore the Eastern coasts of Sicily (Southern Italy), is in real-time acquisition since January 2005 and addressed to different set of measurements: geophysical and oceanographic. In particular the SN-1 seismological data are integrated in the INGV land-based national seismic network, and they arrive in real-time to the Operative Centre in Rome. In the European Commission (EC) European Seafloor Observatory NETwork (ESONET) project, in connection to the Global Monitoring for Environment and Security (GMES) action plan, the NEMO-SN-1 site has been proposed as an European key area, both for its intrinsic importance for geo-hazards and for the availability of infrastructure as a stepwise development in GMES program. Presently, NEMO-SN-1 is the only ESONET site operative. The paper gives a description of SN-1 observatory with examples of data.

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Keywords: Seafloor Observatory in real-time communication; Geo-hazard mitigation

1. Introduction

Marine technology advancement now enables the deployment, operation and recovery of seafloor sensors and platforms down to abyssal depth (>1000 m w.d.). Real-time data transmission and power autonomy still represent the major limitations for the achievement of long-term (>1 year) autonomy at deep seafloor, especially for marine networks with civil protection purposes. At present the followed solution to fulfil these two goals is the use of underwater cables both new and reused [1–9]. Although demanding and requiring specific infrastructures for the installation and maintenance operations, this solution is the most reliable and the only one feasible when high data transfer velocity is required. This latter requirement is necessary for high sampling rates as in geo-hazard monitoring. Recently near-real time data transmission systems based on acoustic telemetry, moored relay buoys and radio/satellite telemetry have been already successfully tested (i.e. GEOSTAR 2 mission, ORION-GEOSTAR-3 pilot experiment [10]), but the limited capacity of the transmission link allows only recovery of limited quantities of data such as short wave forms, summary periodic messages, alarms in case of event detection.

Although the early seafloor observation systems have been developed in the frame of the Earth Sciences and disciplines addressed to the Biosphere, Astroparticle Physics has recently moved toward the seafloor to study the universe through the detection of neutrinos, generated by very far sources. The detection is based on revealing the

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Cherenkov light radiated by particle (muons) produced by the interaction of the neutrinos with Earth matter. The deep sea water offers a natural shield from the solar radiation and favours the Cherenkov light detection. Given the low flux of neutrinos expected, huge "neutrino telescopes" equipped with array ($\sim 1\,km^3$) of photo-multipliers with large power supply and high capacity of data transmission are needed to perform such observations. The deployment of dedicated cables on the seafloor is thus indispensable.

In January 2005, thanks to the Collaboration of Istituto Nazionale di Fisica Nucleare (INFN) and Istituto Nazionale di Geofisica e Vulcanologia (INGV), the NEMO-SN-1 seafloor multiparameter observatory (NEutrino Mediterranean Observatory—Submarine Network-1) was deployed off-shore Eastern Sicily (Southern Italy), in the site of the NEMO Phase-1 pilot project (NEMO Test site). SN-1, the seafloor observatory addressed to geophysical and oceanographic measurements, and the NEMO acoustic station were deployed in the proximity of the northern and southern terminations, respectively, of an electro-optical cable and real-time connected following the approach depicted in Fig. 1 (see next paragraph for details). The NEMO test site now hosts the first European cabled seafloor observatory and first operational node in one of the "key-sites" selected in the European Commission (EC) project European Seafloor Observatory NETwork (ESONET) [11] addressed to a feasibility study for the development of a European seafloor observatory network around Europe from the Baltic Sea to the Black Sea.

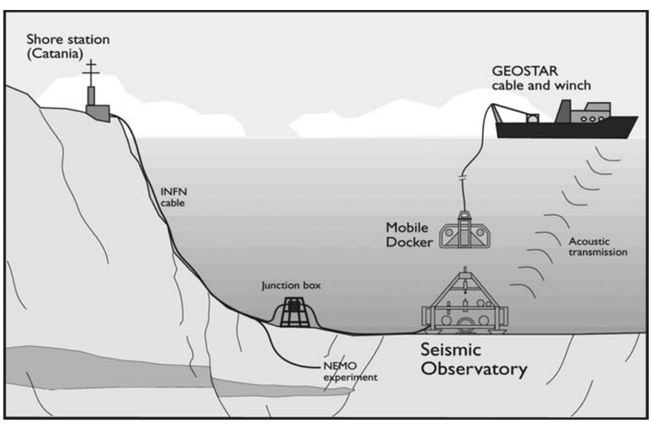

Fig. 1. Scheme of the sea operations for the deployment and connection to the cable.

2. NEMO Test site

Following similar activities being carried out world wide [12–14], the INFN has started a pilot experiment, NEMO Phase-1, off-shore Eastern Sicily for the development of a prototype of deep seafloor neutrino telescope. The completion of NEMO Phase-1 is foreseen by 2006. For this purpose, a 25 km electro-optical cable (Nexans supplier) was deployed in 2001 from the Catania harbour down to an abyssal plane at 2100 m w.d.

Cable design includes six power conductors ($4\,mm^2$), 10 single-mode optical fibres and steel armoured (single in the offshore section, double in the onshore section). At the shore end, the cable is terminated in the INFN-Laboratori Nazionali del Sud (LNS) laboratory located in the Catania harbour (Fig. 2). One peculiarity of the cable design is that 20 km off-shore it is spliced into two separate tails, each about 5 km long. Each tail is terminated with a frame equipped with two connectors (Ocean Design supplier, eight-way hybrid) mateable by Remote Operated vehicle (ROV), therefore making available two powerful

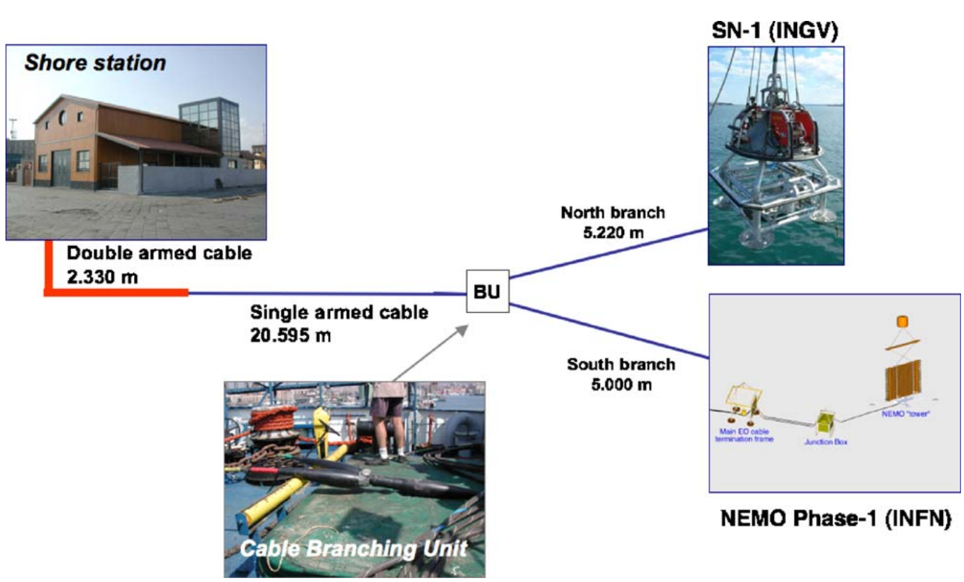

Fig. 2. Layout of the NEMO-SN-1 real-time seafloor observatory.

Fig. 3. SN-1 on board of *C/V Pertinacia* during the sea operations of deployment and connection to the cable (January 2005).

Table 1
SN-1 specifications

Overall dimensions (m) (L × W × H)	Weight (kN)		Depth (rated) (m)
	In air	In water	
2.90 × 2.90 × 2.90	14.0	8.5	4000

independent infrastructures for the connection of seafloor experiments.

The cable split was motivated by the particular importance of the area as regards geo-hazards (seismic and volcanic activity) as well as by the need to support the NEMO experiment by monitoring the environmental parameters (i.e., turbidity). Accordingly, the northern tail has been dedicated to the connection of the SN-1 multi-parameter seafloor observatory, originally built within an Italian project coordinated by INGV and funded by the National Group for the Defence from Earthquakes.

3. SN-1 seafloor observatory

SN-1 is a GEOSTAR-class observatory (Fig. 3 and see Table 1 for information on size, weight and depth rate). SN-1 represents the most recent effort of Italian marine research and technology towards the development of a seafloor seismic monitoring network around Italy [1].

SN-1 shares with GEOSTAR the deployment/recovery procedure based on the dedicated vehicle MObile Docker for Underwater Sciences (MODUS), the Data Acquisition and Control System (DACS) and the special infrastructure for seismometer installation [10]. SN-1 payload is focused

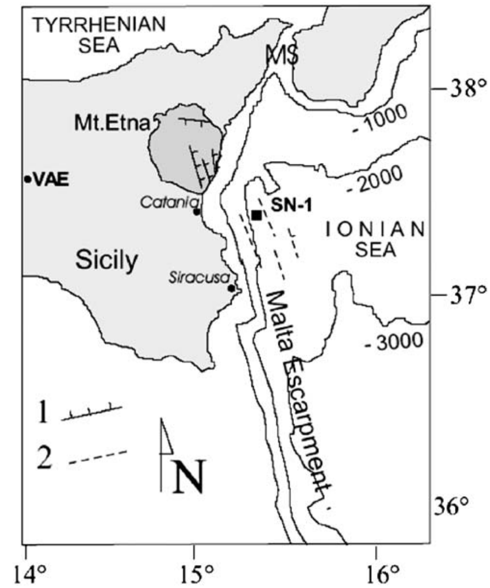

Fig. 4. Tectonic sketch of the off-shore Eastern Sicily (Ionian Sea), the black square indicated the position of SN-1. MS = Messina Straits.

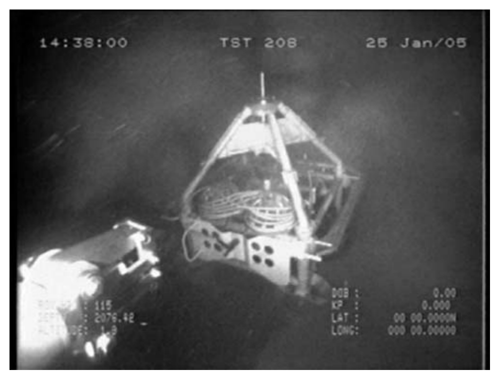

Fig. 5. ROV is approaching SN-1 for its connection to the electro-optical cable.

Table 2
SN-1 sensors and sampling rates

Sensor	Type	Sampling rate
3-C broadband seismometer	Guralp Systems, CMG-1T	100 Hz
Hydrophone	OAS E-2PD	100 Hz
Gravity meter	IFSI-INAF Prototype	1 Hz
Scalar magnetometer	Marine Magnetics	1 s/10 min
3-C single point current meter	FSI 3D-ACM	2 Hz
CTD (Conduc., Temp., Depth)	Seabird, SBE37-SM	1 s/12 min

on seismological, geophysical and oceanographic monitoring. Like GEOSTAR, SN-1 original design includes a vertical acoustic modem to enable bi-directional communication with a ship of opportunity or a moored buoy. From October 2002 to May 2003, SN-1 was deployed close to the NEMO Test site (at 2105 m w.d.) and successfully completed the first long-term experiment in autonomous mode recording about 15 Gbytes of high-quality seismic, gravity and oceanographic data [15]. The special seismometer installation, de-coupling the sensor from the frame and coupling it to the seafloor, was demonstrated very effectively collecting very high-quality signals [16].

After this experiment, SN-1 was upgraded in 2003–2004 to become a cabled observatory, in view of a new deployment and connection to the Northern Branch of INFN underwater cable [17].

Fig. 6. The titanium-sphere containing the broadband seismometer.

In January 2005, the upgraded observatory was newly deployed by MODUS close to the northern tail of the cable, in the same site of the first mission (about 25 km East from Catania at 2060 m w.d.) on the first plateau of the Malta escarpment (Fig. 4). Once recovered MODUS, SN-1 was approached by a work-class ROV and connected to the Junction Box. Immediately after, the shore station SN-1 was powered on through the cable and set into real-time operation. The sea operations were carried out using the C/V *Pertinacia* (owned by Elettra Tlc S.p.A.) and the SN-1 connection was performed by a Perry-Slingsby Triton work-class Remote Operated Vehicle (ROV) operated by Cayman Offshore (Fig. 5).

SN-1 is at present the only real-time seafloor observatory in Europe and it is integrated in the INGV land-based national seismic network. The SN-1 signals arrive to the Operative Centre in Rome.

4. Data

The data acquired and transmitted in real time by the SN-1 seafloor observatory to the shore station include geophysical and oceanographic data. The sensors, types and sampling rates are listed in Table 2. The titanium-sphere housing of the broadband seismometer is shown in Fig. 6. Examples of seismological real-time data, regional and teleseismic events, are reported in Figs. 7 and 8, respectively.

5. Conclusions

NEMO-SN-1, jointly managed by INFN and INGV, is the first real-time cabled seafloor observatory in Europe

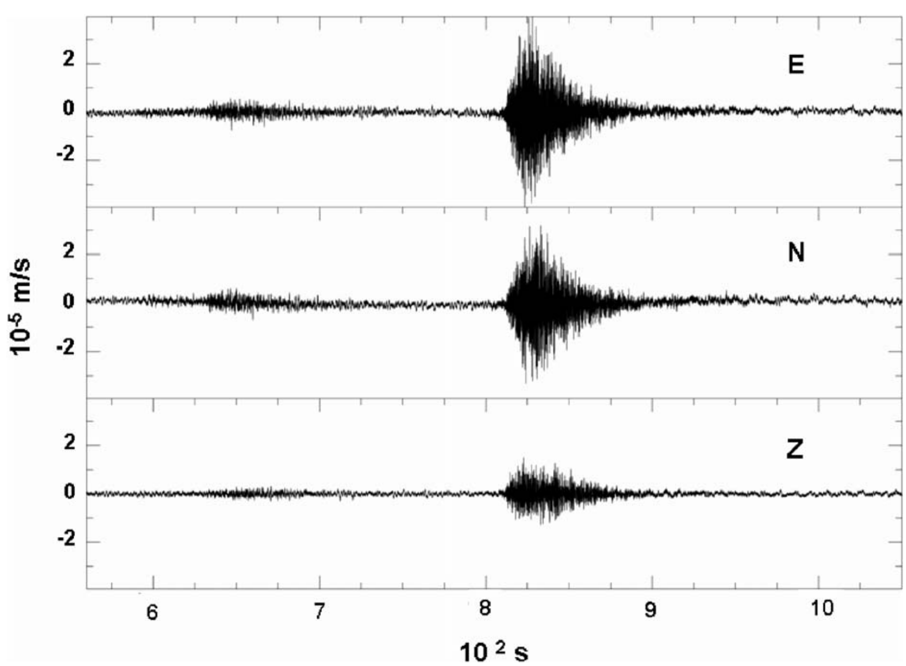

Fig. 7. Regional earthquake occurred in the Ionian Sea on September 16, 2005 ($M_L = 4.7$).

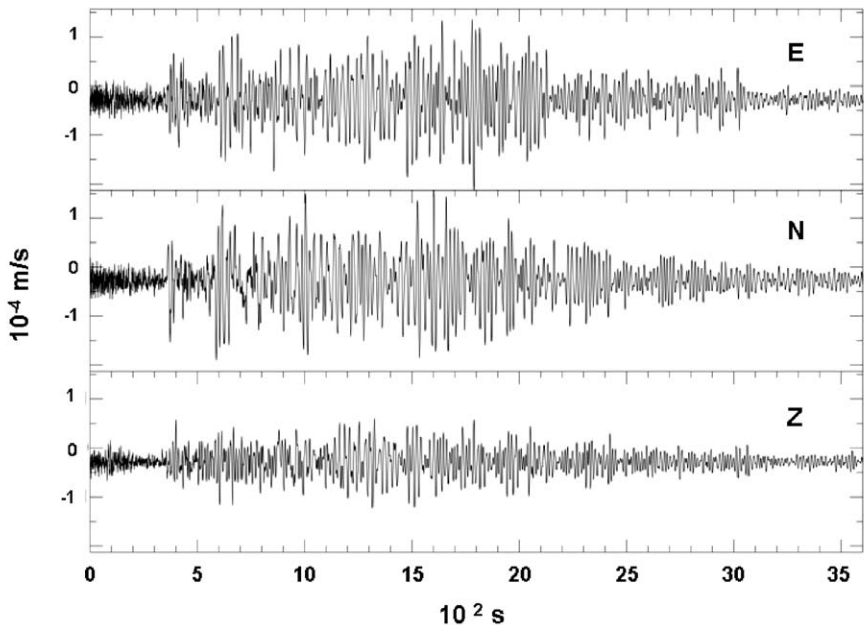

Fig. 8. Teleseismic event occurred in Pakistan on October 8, 2005 ($M_w = 7.3$).

and one of the few in the world. NEMO-SN-1, operative since January 2005, has successfully passed over 1-year of operation. In particular, SN-1 acquires geophysical and oceanographic data and transmits them in real time to a shore station, where the seismological data are integrated to the INGV land-based national network data for monitoring seismicity. It is also the first operational seafloor observatory in one of the "key-sites" selected in the EC project ESONET for the future European seafloor observatory network to be established around Europe.

The NEMO-SN-1 seafloor observatory can be considered the core for the development of a open marine laboratory in the Mediterranean able to host deep-sea experiments.

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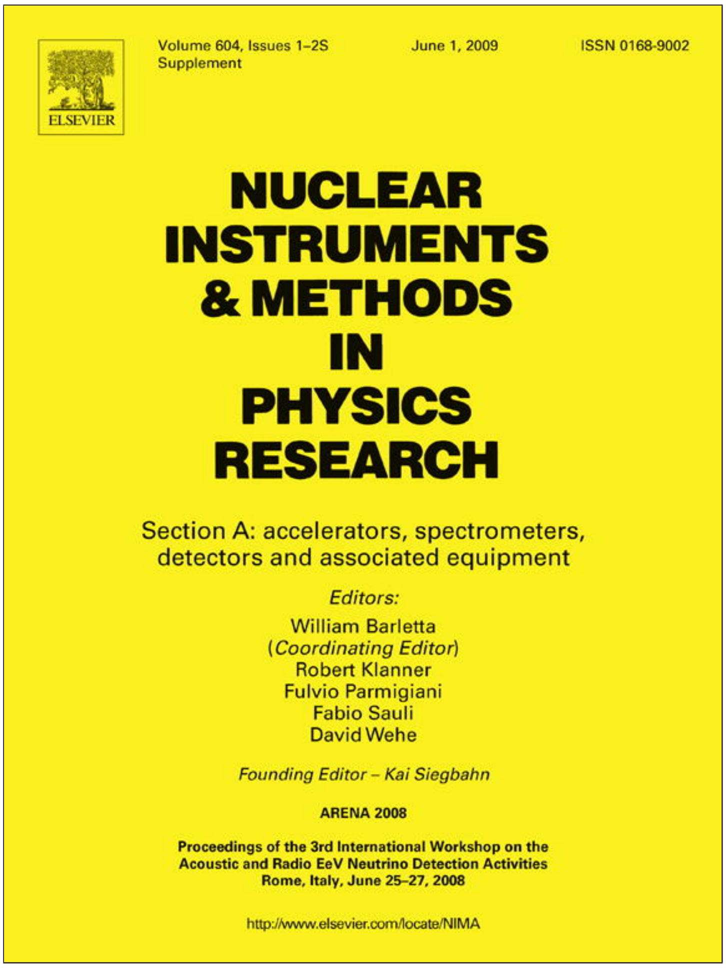

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Long-term measurements of acoustic background noise in very deep sea

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ABSTRACT

The NEMO (NEutrino Mediterranean Observatory) Collaboration installed, 25 km E offshore the port of Catania (Sicily) at 2000 m depth, an underwater laboratory to perform long-term tests of prototypes and new technologies for an underwater high energy neutrino km^3-scale detector in the Mediterranean Sea. In this framework the Collaboration deployed and successfully operated for about two years, starting from January 2005, an experimental apparatus for on-line monitoring of deep-sea noise. The station was equipped with four hydrophones and it is operational in the range 30 Hz–43 kHz. This interval of frequencies matches the range suitable for the proposed acoustic detection technique of high energy neutrinos. Hydrophone signals were digitized underwater at 96 kHz sampling frequency and 24 bits resolution. The stored data library, consisting of more than 2000 h of recordings, is a unique tool to model underwater acoustic noise at large depth, to characterize its variations as a function of environmental parameters, biological sources and human activities (ship traffic, etc.), and to determine the presence of cetaceans in the area.

1. Introduction

The NEMO (NEutrino Mediterranean Observatory) Collaboration is strongly involved in the design and construction of the Mediterranean km^3 Cherenkov neutrino detector. In the same time the Collaboration is starting studies on the acoustic detection technique; the first task, in this framework, was the measurement and monitoring of the acoustic background at large depth to evaluate the expected signal to noise ratio (SNR). At present, only few measurements of acoustic noise have been carried out at very large depth, where acoustic detectors should be presumably located. This is mainly due to technological difficulties in constructing, deploying and operating real-time monitoring stations in deep sea. Noise in the sea has different origins: biological (fishes, marine mammals, crustaceans), seismic and micro-seismic, mechanical (wind and surface waves), molecular thermal vibrations and human activities (navigation, fishing, military operations, oceanographical instrumentation, oil exploration). Bibliographic data indicate that, in the frequency range of interest for neutrino detection (10−100 kHz), the acoustic noise in water is a sum of a diffuse and relatively steady background due to ship traffic and sea state conditions that occasionally add up with loud and transient sources, such as biological sounds (dolphin and whale vocalizations), and man-made noise (close ships, navigation and scientific instrumentation: pingers, air-guns) [2]. In order to measure the level of acoustic noise in the deep Mediterranean Sea, the NEMO Collaboration constructed and operated the experimental station OνDE (Ocean noise Detection Experiment), a real-time experiment to monitor acoustic signals in deep sea. Due to the small amplitude of the expected neutrino bipolar signal [3], it is mandatory to measure the acoustic noise in the sea as a function of frequency in order to study the performances of a future acoustic detector as a function of the number of sensors and of the design of the antenna. This was the main goal of OνDE. The detector was deployed during January 2005 at the INFN Laboratori Nazionali del Sud (LNS) deep-sea Test Site, located at depth of ~2000 m, 25 km E offshore the port of Catania (Sicily), see Fig. 1. The detector acquired data from January

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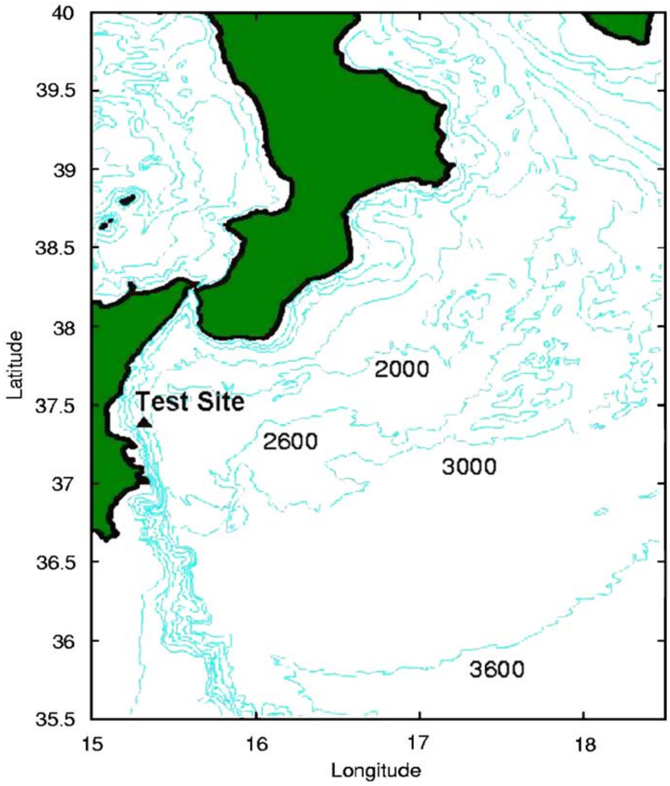

Fig. 1. Bathymetric chart of the Eastern Sicilian Coast region. The location of the Catania TSS (triangle) is shown. The OνDE frame is moored at 2050 m depth, latitude 37°30′008 N and longitude 015°23′034 E.

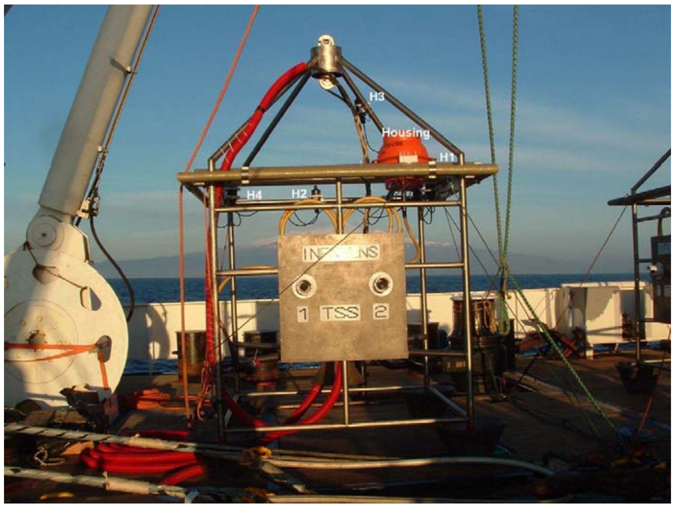

Fig. 2. The titanium frame installed on TSS. The ROV operable electro-optical connectors are visible on the front panel. The hydrophones and electronics housing of the OνDE station are also shown (see text).

2005 to November 2006, when the NEMO Collaboration started to install the NEMO Phase 1 detector: a technological demonstrator for the future km^3 Cherenkov neutrino telescope [1].

2. The OνDE apparatus

2.1. The Catania Test Site infrastructure

The Catania Test Site consists of a shore laboratory, a 28 km long electro-optical (hereafter e.o.) cable connecting the shore lab to the deep-sea lab. The shore laboratory hosts the land termination of the cable, the on-shore data acquisition system and power supplies for underwater instrumentation. The underwater cable is an umbilical underwater e.o. cable, armored with an external steel wired layer, containing 10 optical single-mode fibers (standard ITU-T G-652) and six electrical conductors (4 mm^2 area). At about 20 km E from the shore, the cable is divided into two branches, roughly 5 km long each, that reach two different sites namely Test Site North (TSN, latitude 37°30′810 N, longitude 015°06′819 E depth 2100 m), and Test Site South (TSS, latitude 37°30′008 N, longitude 015°23′034 E, depth 2050 m). The TSN cable branch has two conductors and four fibers directly connected to shore, the TSS branch has four conductors and six fibers. After deploying the main underwater cable, in January 2005 the Collaboration installed, on TSN and on TSS, two underwater frames. Each frame, made of grade two titanium, is equipped with a pair of e.o. connectors (see Fig. 2). The two frames were deployed on the seabed. The e.o. connectors are made to be handled by underwater robots ROV (Remotely Operated Vehicles) to allow plugging and unplugging of underwater experimental apparatuses, avoiding further recovery operations of the main cable. During the same naval campaign two experimental apparatuses were deployed, plugged and put in operation. The seismic and environmental monitoring station Submarine Network 1 (SN-1), designed and operated by the INGV (Istituto Nazionale di Geofisica e Vulcanologia, Italy) [5] was connected to the TSN termination. This station is presently the only cabled node of the ESONET (European Seafloor Observatory NETwork) project [6]. In 23 January 2005 the OνDE station was deployed and connected to the TSS termination.

OνDE was designed to perform on-line monitoring of the acoustic noise at large depth. The station is equipped with four large bandwidth hydrophones (30 Hz–50 kHz). Each hydrophone (hereafter H1–H4) was mounted on an aluminum alloy vessel, pressure resistant, which also hosted the hydrophone preamplifier. The analog signals from the preamplifiers were transmitted, through underwater cables suitable for audio applications, to signal conditioning and digitization electronics hosted in a pressure-proof glass housing. Underwater, digital signals were translated into optical and sent to shore through the optical fibers. On shore, acoustic data were reconverted into electrical and recorded using a PC, in which a pair of professional PCI audio boards were mounted. Electrical power was supplied from shore.

2.2. Mechanical set-up

The mechanical structure of OνDE is composed of a commercial pressure-proof glass housing (which hosts the DAQ and power supply electronics), one e.o. cable that connects the station to the e.o. plug mounted on the frame and four electrical cables that connect the housing to the four hydrophone vessels.

The hydrophone vessels were hooked on the upper part of the TSS frame, forming a tetrahedral antenna of ~1 m side. The hydrophone vessel H3 was mounted in the highest position, close to the frame apex, which is at about 3.2 m above the seabed. Since most of the noise comes from above (the station is moored on the seabed) H3 was used as pilot hydrophone during signal analysis. H1, H2 and H4 were attached approximately at the same height (about 2.6 m above the seabed), in the squared upper edge of the frame. In picture 2, H1 is visible on the right with respect to the instrument housing (the orange spherical shell), H2 is placed behind the shell and H4 on the left. The glass housing is a commercial 17 in. diameter sphere, manufactured by *Nautilus* [7]. The sphere is made of two halves: the electronics was placed inside the sphere and, before deployment, the two halves were sealed together slightly de-pressuring to 750 mbar the cavity of the sphere, in a nitrogen filled environment. This pressure ensures both the sealing and the circulation of nitrogen inside the sphere, thus the cooling of the electronics. The sphere was equipped with five titanium connectors. One is an e.o. dry-mateable connector, holding three optical and two electrical contacts. This connector was used to link the station to the frame e.o. connectors, by means of an e.o. harness cable. The harness was terminated on one side with a dry mateable-plug, on the other with a ROV-mateable connector that matches the one installed in the frame. The other four electrical connectors were used to link independently each hydrophone to the electronics glass housing.

2.3. Hydrophones and pre-amplifiers

We used *RESON* [8] TC-4042C hydrophones, derived from the TC4037 Series and tested by the manufacturer to operate at 250 bar pressure for long-term deployment. The used hydrophones are piezoelectric sensors, having a mean receiving sensitivity of -195 ± 3 dB re 1 V/μPa, linear over a wide range of frequencies: from few tens Hz to about 50 kHz.[1] The hydrophone analog output is differential. The TC-4042C hydrophones were mounted on the channels H1–H3. A hydrophone from a different series, having a sensitivity 5 dB lower, was mounted on channel H4. All hydrophones have an omnidirectional directivity pattern suitable for ambient noise measurements, which is the purpose of the experiment. The hydrophone output signal was feeded into a preamplifier, developed also by *RESON*, which has a gain of 20 dB. Two preamplifiers (namely the ones installed on channels H2 and H4) were modified applying a hi-pass filter (>1 kHz, 6 dB per octave) to reduce the expected ambient noise, which has typically $1/f$ spectrum. This was done to avoid possible saturations due to the low frequency noise and to focus the measurements to the frequency range interesting for neutrino detection (>10 kHz). On the other hand, the use of a pair of unfiltered large-bandwidth hydrophones (H1 and H3) allowed comparison with bibliographic data, which is more abundant for low frequency measurements.

2.4. Data digitization and transmission electronics

The differential output of each preamplifier was sent to a pair of line-output and line-input transformers. Line transformers were used to galvanically insulate the lines in case of shorts inside the hydrophone vessels and to balance the audio line. The line-output transformer was hosted inside the aluminum vessel, the line-input transformer inside the glass housing. The electrical line between the transformers, 4 m long, was a shielded twisted-pair cable suitable for analogue audio signal transmission.

The hydrophones signals were then sent to two stereo Analog to Digital Converters (ADC). Signal digitization was performed using *Crystal* CS5396 stereo ADCs. In particular channels H1 and H3 were plugged in the left and right channel of one board, respectively, H2 and H4 (modified applying an $f>1$ kHz hi-pass filter, 3 dB per decade) were plugged to the left and right channels of the other board. The two ADCs received the same 12.288 MHz clock, thus they were synchronized. The CS5396 is a sigma delta ADC which samples the analog data at a rate of 96 kHz with a resolution of 24 bits, the input voltage range of the ADC is 4 V_{PP}. The ADC outputs were sent to a Digital Interface Transmitters *Crystal* CS8404A that converted the data stream into standard SPDIF (Sony Philips Digital Interface Format) stream. The SPDIF protocol contains, together with data, the sampling time information; since the two ADCs and the two digital audio transmitters were driven by the same common clock the two stereo streams are synchronized. Since we know the phase response of the >1 kHz hi-pass filters applied on H2 and H4, the whole array can be also phased. This feature is extremely useful for TDoA (Time difference of arrival) analysis of signals detected by the four hydrophones, in order to recover the direction of emission of the detected sounds. The two output streams were sent to a pair of e.o. media converters capable to transmit data over ~50 km single-mode optical fiber.

3. On shore data acquisition

On shore, data from the underwater station were re-translated into electrical audio SPDIF standard using a pair of fiber optical data receivers. The two SPDIF stereo data stream are then addressed to a PC (Pentium IV, 3 GHz, 1 GB RAM) equipped with two professional PCI audio boards, RME DIGI96-8 PAD [9]. In this sections the data acquisition/recording software and the file archiving strategy are described.

3.1. Software tools

Data acquisition on shore was performed, from January to April 2005, using standard 16 bits audio software tools and sampling independently the two pairs of hydrophones (H1–H3 and H2–H4). From May 2005 we used a custom software tool *SeaRecorder* developed by CIBRA [10] running under Windows XP. The program reads and keeps synchronized the two digital stereo data streams coming from the underwater station. Data, received in SPDIF format at 24 bit resolution and 96 kHz sampling frequency, are saved into standard Microsoft `.wav` 32 bit float format ($24+8$ bit). This format was chosen to allow data porting to Matlab for off-line analysis.

SeaRecorder permits both data recording with floating point format or integer (16 or 32 bit/sample) and digital amplification of data at several gain factors. During acquisition, the software displayed average and peak values measured by the four channels and plotted, in real time, their envelope to provide on-line monitoring of the recording. The program also generated a log text file containing complete information of the software settings, average and maxima values measured for each recording. In Fig. 3 the data acquisition window of the used software is shown.

File recording can be programmed to be continuous, with automatic file splitting every hour or every 30 min, or scheduled for predefined file duration. A special filenaming protocol was adopted to reduce the risk of data losses or data misinterpretation. Filenames included a date-and-time stamp, number of channels, recording gain (linear), file format; sample rate was omitted as it was a hardware-locked parameter (96 kHz); a typical filename was therefore `ONDE_20050827_161500_4CH1X_3200.wav`.

3.2. Data archival

After the experiment start-up, the data were continuously recorded for about one month, this allowed to evaluate the average value and variability of sound level and to define the successive strategy for scheduled recording. Continuous recording strategy was not possible due to storage space constraints: the amount of data sent to shore requires about 124 GB/day. Data were therefore recorded for 5 min (randomly chosen)

[1] We remind to the reader that the hydrophone sensitivity is defined as the sensor transduction factor V over μPa, thus it is not the minimum value of pressure detectable by the sensor. The used hydrophones have a sensitivity of -195 dB thus they convert an acoustic signal of 1 μPa into an electric signal of ~1.78 nV.

continuatively every hour, this was a compromise to save a representative sample of unbiased data, reducing disk space consumption: the storage space required daily for four channel recording at 32 bits was 10.2 GB. A larger sample of data (about 20' per hour) coming from H3 only, was also recorded using 16 bit file format.

The data sample presently analyzed amounts to ~1200 h, covering 16 months from January to December 2005, and from July to November 2006. From mid February to the end of March 2005, and from January to June 2006, the station was not in operation due to maintenance of the e.o. main cable and on-shore hardware. As explained in the following, the present paper deals with data recorded from May 2005 on.

4. Data analysis

As previously described, data from the four hydrophones were recorded as four channels `.wav` files at 24 bits and 96 kHz. This permitted off-line data analysis under Matlab environment.

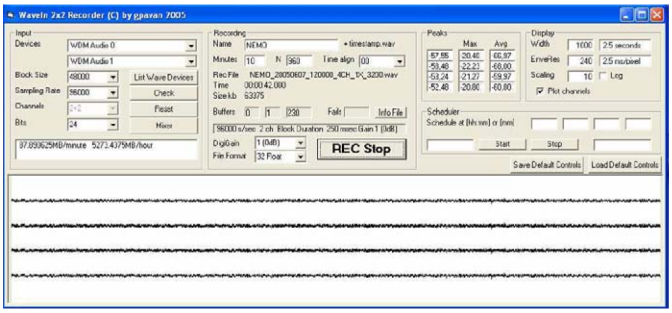

Fig. 3. The main window of the SeaRecorder program, used to record and monitor data coming from the four hydrophones installed on OvDE.

In Fig. 4 2 s of data, recorded on 14 November 2006 at h 23:30, are shown, as an example. The amplitude values of the four channels, separately displayed, are in V (the ADC input range was between −2 and +2 V). A biological sound is shown in Fig. 4: the *click* produced by a sperm whale (a signal emitted for echo-location) and its reflection on the sea surface. A software notch filter ($f = 50$ Hz, $\Delta f = \frac{50}{35}$ Hz, −10 dB, the same for all channels) is applied to cut off the 50 Hz noise picked up from the power system. The highest spectral components of sea noise appear at $f < 1$ kHz, thus they are filtered out in channels H2 and H4. The electrical signal amplitude corresponding to the click, recorded by H1–H3 is roughly the same, the signal in H4 is about 5 dB smaller, as expected.

In order to determine the spectral Sound Pressure Density (SPD) of sea noise, the Power Spectral Density (PSD) of the signal is calculated per each recorded file (5' recording $= 300 \cdot f_s$ samples):

$$PSD(f) = \frac{|X_{N_{DFT}}|^2}{f_s \cdot L} \quad (1)$$

where f_s is the sampling frequency (96 kHz), L is the time length of the signal (in units of seconds), and X is the Nth component of the Discrete Fourier Transform (DFT) corresponding to the frequency f. The file is divided into blocks of 2048 samples, weighted using an Hanning window and an overlap of 50% (i.e. a 1024 samples shift). The 2048 points DFT ($\Delta f \simeq 47$ Hz) is then calculated using the Fast Fourier Transform algorithm implemented on Matlab. Eventually we calculated the average, minimum and maximum values and the 30th, 50th, 90th and 95th percentile of the distribution of the obtained PSDs.

The analysis presented in this paper was carried out using only the data sample recorded with H3, from May to December 2005 and from July to November 2006 (~6400 files). Other data are not included in this paper, because they were taken using 16 bits

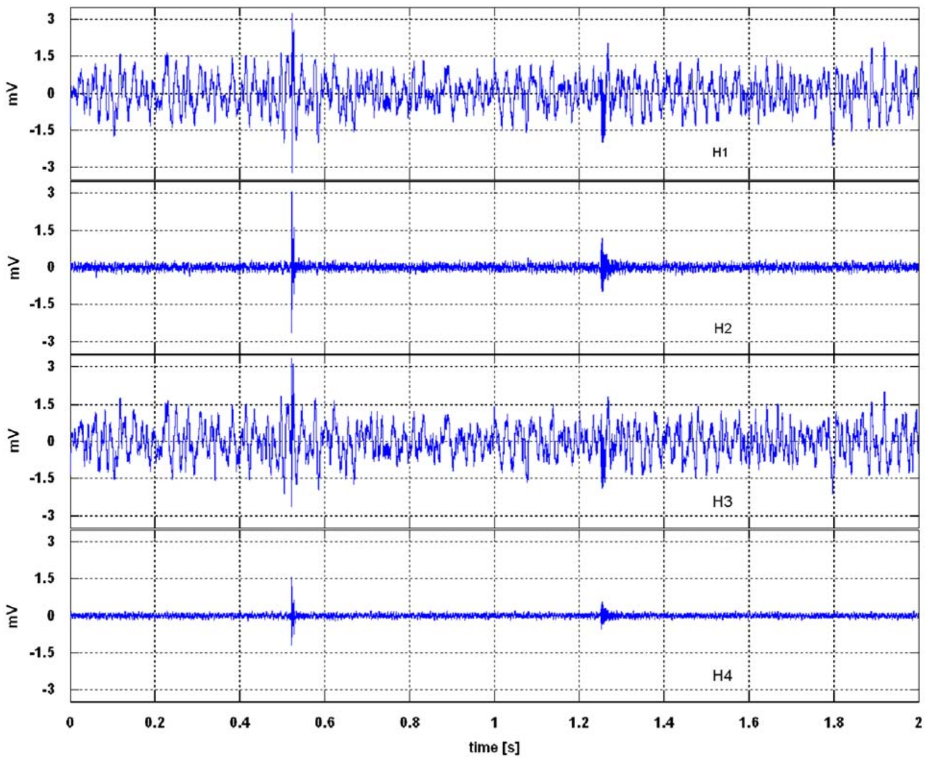

Fig. 4. Example of recorded raw data (only 50 Hz noise filtered): a sperm whale click (occurring at ~0.5 s) and its reflection on the sea surface (occurring at ~1.3 s). The four hydrophone channels are independently displayed. H2 and H4 had a hardware hi-pass filter $f > 1$ kHz and the whale click is clearly visible.

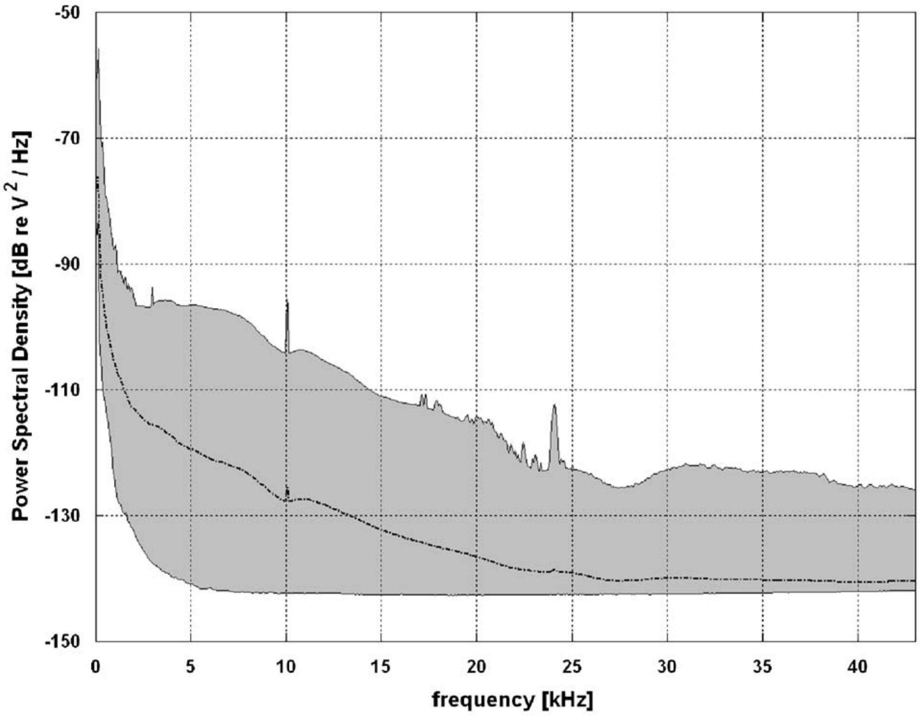

Fig. 5. The grey area represents the upper and lower limits of average PSDs calculated for the ~6400 files of data (the file time duration is 5') recoded using channel H3. The black curve is the average calculated over all PSDs.

recording software, so they are not homogeneous with the rest of the sample.

4.1. Determination of the detector electronic noise floor

Fig. 5 presents the limits of variations of the average PSD distributions (gray area) obtained analyzing ~6400 files recorded by the hydrophones H3. Data for $f > 43$ kHz ($0.45 f_s$) are not shown. The plot shows large variations in recorded signal amplitude, mainly for $f < 20$ kHz, and a baseline that represents the RMS power of the electronic noise of our detector. This is a *white* noise[2] for $f > 5$ kHz recorded when the contribution of acoustic sea noise was very low. As shown later, it is due to the self-noise of the hydrophone and the preamplifier, being the power of the ADC noise negligible (few nV^2/Hz). The black dash-dotted line in Fig. 5 represents the average of PSDs over the whole data sample.

The average (in blue) and the minima (in red) of average PSD curves calculated for different months with H3 are shown in Fig. 6. While the average curves change for different months, the minimum ones are very similar and almost independent on the frequency, for $f > 5$ kHz. This behavior indicates that minima are related to the electronics noise of the detector (hydrophone coupled to the preamplifiers).

The same results are observed in all the channels: Fig. 7 shows the minima (solid line) and average (dashed line) curves calculated using the data recorded in August 2005 for H1 (black) and H3 (red), respectively.

In order to demonstrate the correlation between PSD minima and electronic noise, the *equivalent* SPD of the PSD minima curves was calculated, as shown in Fig. 6. The SPD curves, shown in Fig. 8 were obtained multiplying PSD minima times the squared average sensitivity of channel H3 ($-195 + 20$ dB re 1 V/μPa), assumed flat in frequency. For $f > 5$ the equivalent SPD of PSD minima is $\simeq 33 \pm 0.3$ dB re μPa^2/Hz. In this range of frequencies the curves correspond in value and shape to the power of the self-noise estimated by the manufacturer for a typical *RESON* TC4037 hydrophone and preamplifier set-up for $f > 5$ kHz.[3] At lower frequencies this white electronics noise adds up with the noise induced by the power supply and with the acoustic background (not negligible at frequencies $\leqslant 1$ kHz).

Since the electric signal produced by acoustic sea noise sums incoherently with the electronics noise, the SPD of sea noise was recovered subtracting the average PSD curve of noise from the PSD of the signal.

We also took the standard deviation of the PSD minima curves distribution versus the month as a reference curve (for each frequency) to indicate the systematic error in the measurement of SPD.

4.2. First results

Once the PSD of the electronic noise was determined, the SPD of environmental acoustic noise was calculated taking into account the hydrophone sensitivity curve given by the manufacturer, shown in Fig. 9.

The SPD of the acoustic noise in deep sea calculated for each month (blue curves), compared with the statistical error curve (black) as defined in the previous section is shown in Fig. 10. The average curve of sea acoustic noise SPD calculated over the whole data sample (blue line) is shown in Fig. 11 . The blue dashed curves take into account the error on the electronic noise power determination. The black dashed curves plotted in the same figure represent the sea noise SPD expected in conditions of Sea State Zero (SS0) and Sea State Two (SS2) as defined by Urick [2],

[2] White noise is a random signal with a flat PSD.

[3] The *RESON* TC4042 is derived from TC4037 and used for larger depth applications.

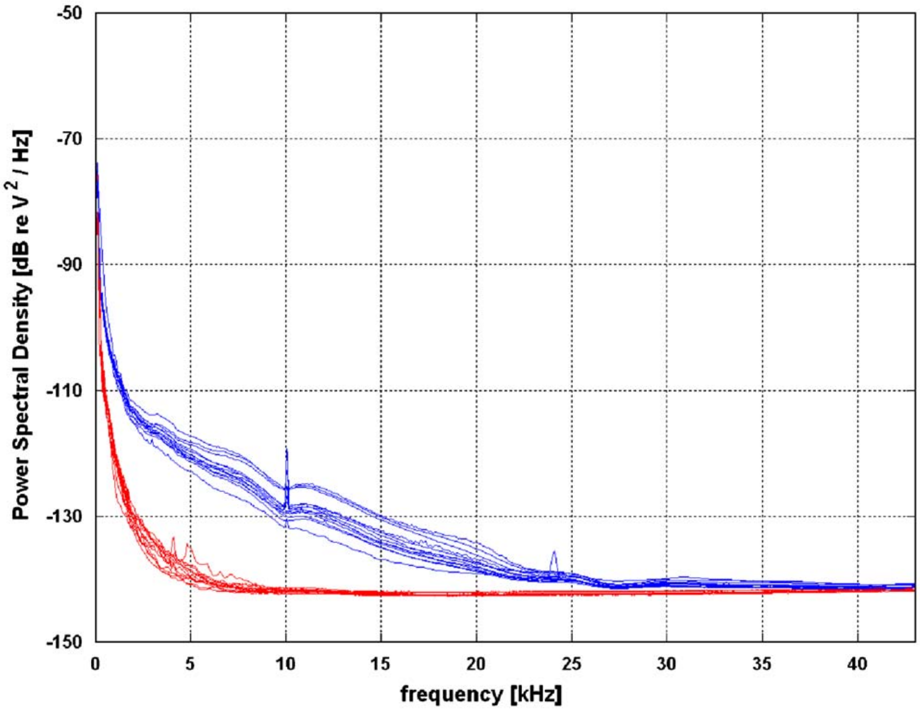

Fig. 6. Averages (blue lines) and minima (red lines) of PSD calculated, for each month, using channel H3 data. The minima curves are nearly superimposed: differences appears only at $f < 5$ kHz, in months showing a high acoustic background. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

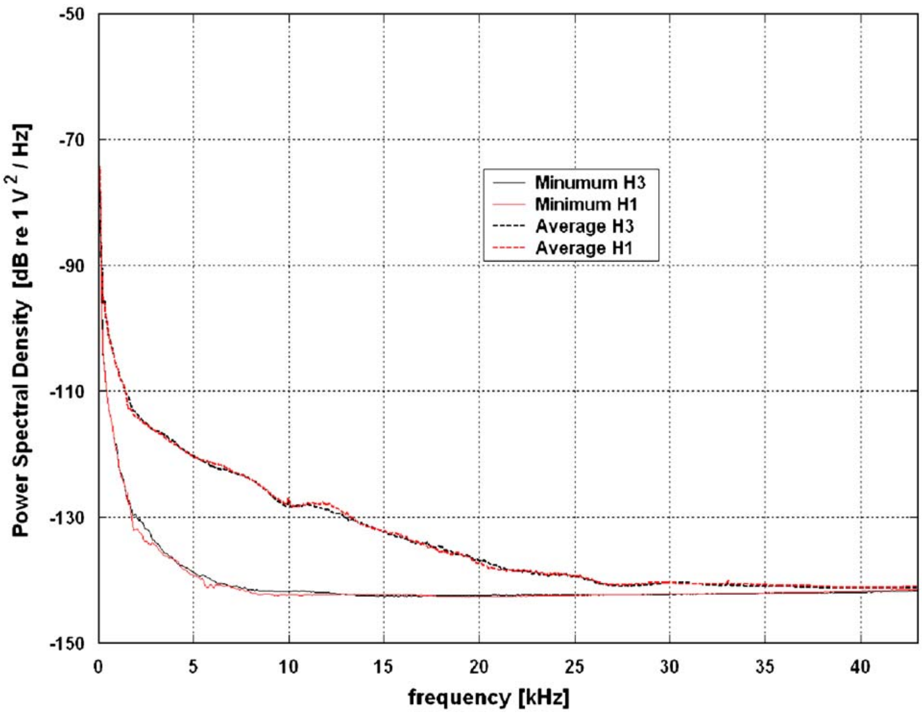

Fig. 7. Average (dashed line) and minimum (solid line) PSD curves calculated for about 740 files of data recoded during August 2005 with H3 (red) and H1 (black). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

i.e. the SPD of sea noise in conditions of the absence of sea surface agitation (SS0), or low surface agitation (SS2) and the absence of identifiable acoustic sources. A notable result for future underwater acoustic neutrino experiments is that the average acoustic sea noise in the band [20−43 kHz] amounts to $5.4 \pm 2.2_{stat} \pm 0.3_{syst}$ mPa RMS (the systematic error is due to the uncertainty on the electronic noise power). This value is comparable to the estimated acoustic signature of a 10^{20} eV neutrino interacting at 1 km distance from the detector (see Ref. [4]).

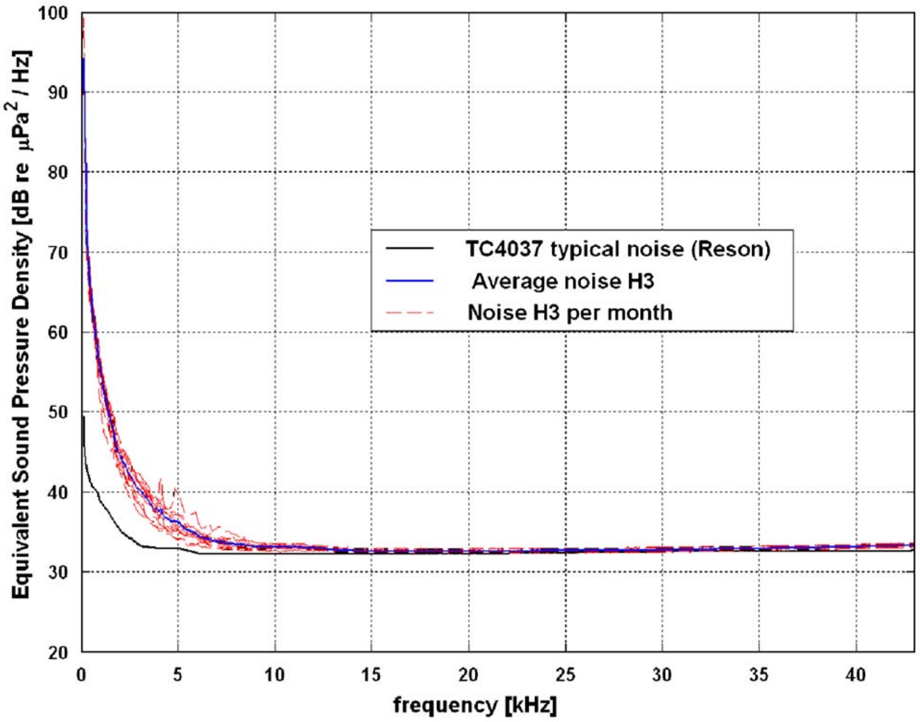

Fig. 8. Equivalent sound pressure density of PSD minima calculated for each month (red dashed lines) and their average value (blue thick line). The equivalent noise curve provided by *RESON* for a typical TC4037 hydrophone is shown for comparison (black curve). The value of the minimum curve at $f > 5$ kHz ($\simeq 33 \pm 0.3$ db re 1 μPa^2/Hz) corresponds to the RMS of equivalent noise power for a typical *RESON* TC4037 hydrophone and preamplifier acquisition system. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

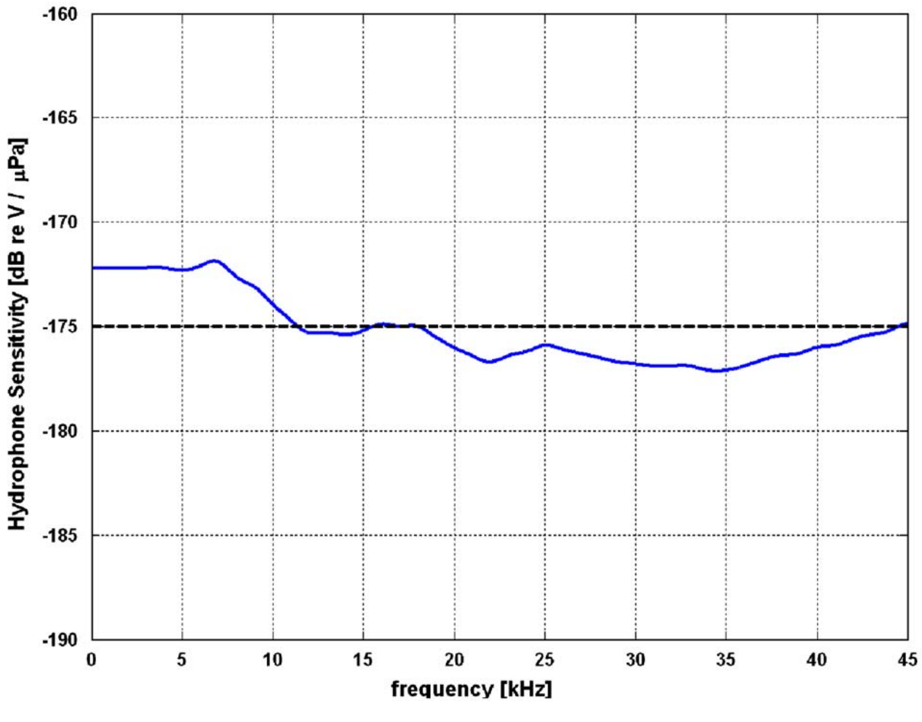

Fig. 9. Hydrophone sensitivity (acoustic to electrical transduction factor) curve in units of dB re V/μPa as a function of frequency provided by the hydrophone manufacturer for the hydrophone mounted in channel H3, the preamplifier gain is 20 dB. The average value of −175 dB used to estimate the equivalent sound pressure density of electronic noise is shown in black, as a reference.

5. Interdisciplinary activities

The OνDE other than providing long-term data on the underwater noise, also provides a unique opportunity to study the acoustic emissions of marine mammals living in the area or transiting during their movements within the Mediterranean basin. The most notable result was about the sperm whale presence and transits in the area [12]. Several biological sounds,

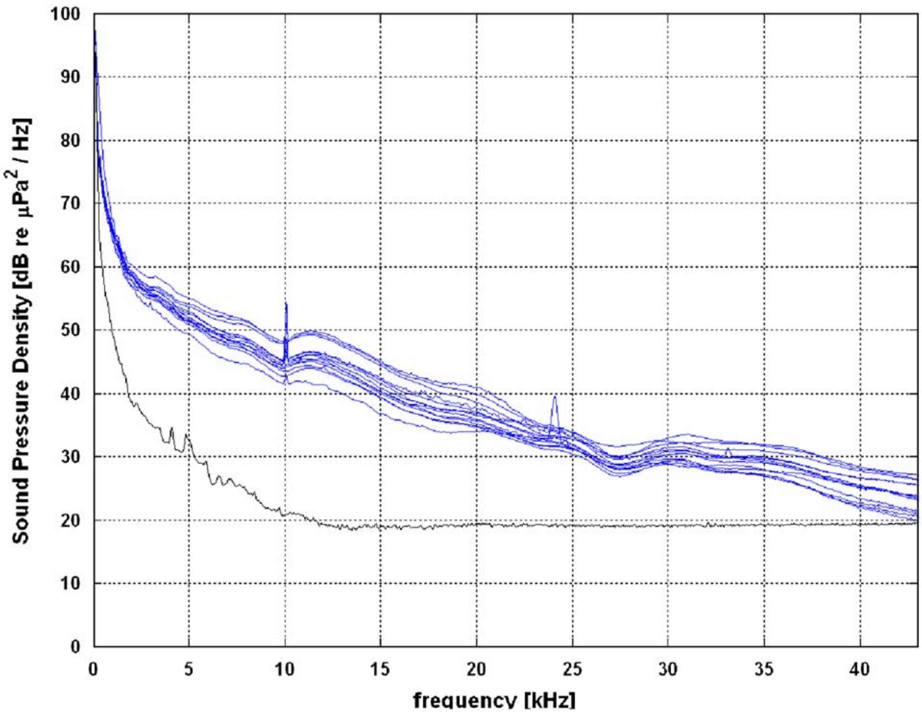

Fig. 10. Sound pressure density curves of average sea acoustic noise as a function of month (blue). The black curve indicates the systematic error in the measurement due to the uncertainty on the electronic noise power spectrum. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

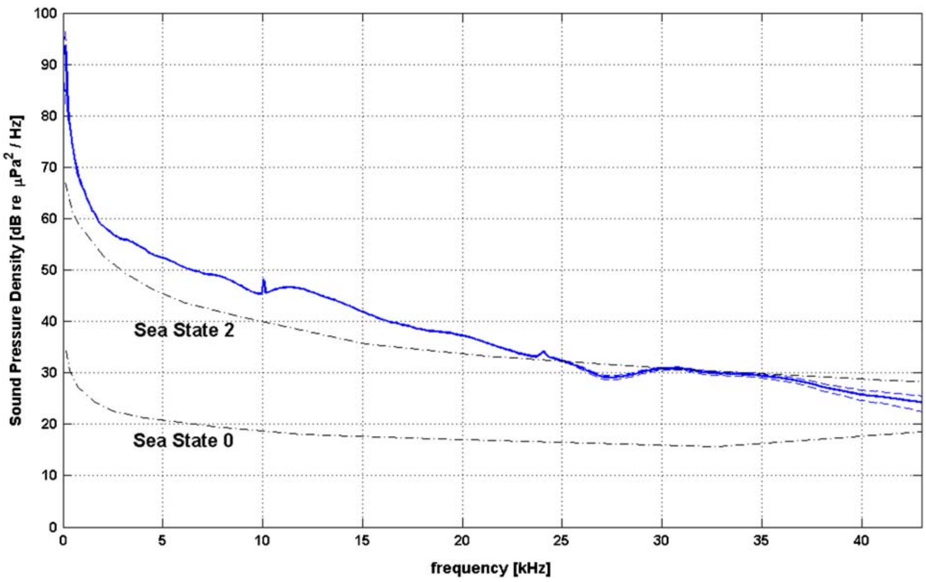

Fig. 11. The blue solid line indicates the average sound pressure density of sea noise recorded with OνDE channel H3 from May 2005 to November 2006. The dashed blue lines indicate the systematic error on the average curve due to uncertainty of the electronic noise power spectrum. The black curves indicates, respectively, the expected SPD of the sea in conditions of Sea State 0 and Sea State 2 [2]. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

unknown sounds and many man-made noises (ship and fishboat noise, sonars, echosounders, air-guns, and explosions) have been recorded and archived for reference. The collection of acoustic events collected so far represents a reference library to be used for discriminating/separating known sources from potential candidates of neutrino signatures in future larger dedicated arrays. Concerning whale detection, the most common sounds recorded are *clicks* produced by sperm whales arranged in regular sequences (inter-click interval in the range 0.5–2 s), or in special patterned sequences (chirrups, codas, creaks) [11]. According to other studies in the Mediterranean Sea, sperm whales may dive to more than 1000 m depth, but normally travel at 800–1000 m depth. Their source level is typically 200–220 dB re 1 μPa at 1 m on axis; the loudest clicks were received with sound pressure levels up to 170 dB re 1 μPa [11]. Clicks were often recorded with high SNR. Data from OνDE indicate a presence of sperm whales more consistent and frequent than previously believed [12].

6. Conclusions

The OνDE station successfully operated at the NEMO Test Site at 2000 m depth, 25 km offshore Catania (Sicily) from January 2005 to November 2006. Mechanical, electronics and data transmission and acquisition systems, designed and realized by INFN and CIBRA, demonstrated high reliability and fulfilled electronic noise design constraints. The station permitted for the first time a long-term characterization of deep-sea noise in the Mediterranean Sea in a large bandwidth (0−43 kHz), with optimal signal resolution. The electronics noise power spectrum of the detector was understood and evaluated to be 33 ± 0.3 dB re 1 μPa^2/Hz above 5 kHz. It was also demonstrated that OνDE is capable to measure the sea noise SPD at the reference level of SS0.

Data analysis is presently addressed to characterize the underwater noise power level and its variations as a function of time. The analysis carried out so far shows that the average SPD of sea noise (over 13 months between May 2005 and November 2006) agrees with equivalent SPD of SS2 for $f > 25$ kHz. Larger values are recorded at lower frequencies due to better propagation of lower frequencies sound from surface to sea bottom and to man-made noise (mainly ship traffic). The identification of different noise sources is on going.

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Recent achievements of the NEMO project

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Abstract

The status of the activities towards the realization of a km^3 Cherenkov neutrino detector carried out by the NEMO Collaboration is described. The realization of a Phase-1 project, which is under way, will validate the proposed technologies for the realization of the km^3 detector on a Test Site at 2000 m depth. The realization of a new infrastructure on the candidate site (Phase-2 project) will provide the possibility to test detector components at 3500 m depth.

PACS: 95.55.Vj; 95.85.Ry

Keywords: Underwater Cherenkov Neutrino Telescopes

1. Introduction

Due to the expectations on neutrino fluxes from galactic and extragalactic sources, mainly based on the measured cosmic ray fluxes and the estimated fluxes from theoretical models [1], the opening of the high-energy neutrino astronomy era can only be afforded with detectors of km^3 scale.

A first generation of "small" scale detectors has been realized (AMANDA [2] at the South Pole and NT-200 [3] in the Baikal lake) and have set limits on neutrino fluxes, while others are at different stage of realization (ANTARES [4] and NESTOR [5]). Following the success of AMANDA the realization of the IceCube km^3 detector [6] is now progressing at the South Pole. On the other hand, many issues, as the full sky coverage, strongly support the construction of a km^3-scale detector in Mediterranean Sea.

The activity of the NEMO collaboration has been mainly focused on the search and characterization of an optimal site for the detector installation and on the development of key technologies for the km^3 underwater telescope.

A deep sea site with optimal features in terms of depth and water optical properties has been identified at a depth of 3500 m about 80 km off-shore Capo Passero and a long term monitoring of the site has been carried out. Results of these measurements have been previously reported [7–9].

One of the efforts undertaken by the NEMO collaboration has also been the definition of a feasibility study of the km^3 detector, which included the analysis of all the construction and installation issues and the optimization of the detector geometry by means of numerical simulations. The validation of the proposed technologies via an advanced R&D activity, the prototyping of the proposed technical solutions and their relative validation in deep sea environment is presently carried out with the two pilot projects NEMO Phase-1 and Phase-2.

2. General layout of the NEMO km^3 detector

The considerations leading to the definition of a proposed architecture for the km^3 detector have been described elsewhere [10]. We will here briefly recall the main characteristics of the detector.

The proposed NEMO architecture is a modular array of detection units, called "towers", arranged in a 9×9 square lattice.

Performances of this detector, like effective area, angular resolution and sensitivity to point-like neutrino sources were evaluated by means of numerical simulations [10]. These simulations were carried out using the software [11] developed by the ANTARES collaboration and adapted to km^3 scale detectors [12]. In the simulation site dependent parameters such as depth, optical background, absorption and scattering length, have been set accordingly with the values measured in Capo Passero at a depth of about 3500 m.

3. The NEMO Phase-1 project

The NEMO Phase-1 project has allowed a first validation of the technological solutions proposed for the km^3 detector. The apparatus includes prototypes of the critical elements of km^3 detector: the junction box (JB) and the tower.

The apparatus has been installed at 2000 m depth at the Underwater Test Site of the Laboratori Nazionali del Sud in Catania, connected to the shore by means of a 28 km electro optical cable.

3.1. The junction box

The JB (Fig. 1) is a key element of the detector. It must provide connection between the main electro-optical cable and the detector structures and has been designed to host and protect from the effects of corrosion and pressure, the opto-electronic boards dedicated to the distribution and the control of the power supply and digitized signals.

The NEMO Phase-1 JB has been built following the concept of double containment. Pressure resistant steel vessels are hosted inside a large fiberglass container. This last one is filled with silicone oil and pressure compensated. This solution has the advantage to decouple the two problems of pressure and corrosion resistance.

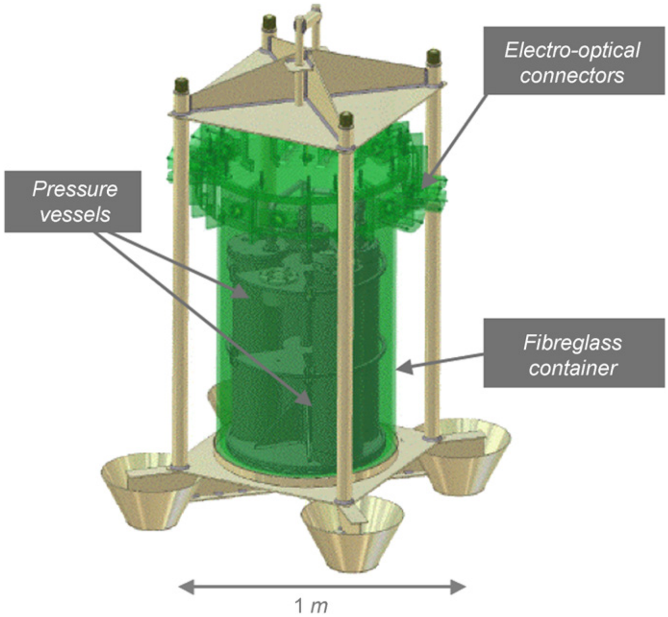

Fig. 1. The NEMO Phase-1 junction box.

Moreover, all the electronics components that were proven able to withstand high pressure were installed directly in oil bath.

3.2. The detector tower

The tower that hosts the optical modules and the instrumentation is a three dimensional flexible structure composed by a sequence of floors (that host the instrumentation) interlinked by cables and anchored on the seabed [13]. The structure is kept vertical by appropriate buoyancy on the top.

While the design of a complete tower for the km^3 foresees 16 floors, the prototype realized for the Phase-1 project is a "mini-tower" of four floors, each made with a 15 m long structure hosting two optical modules (one down-looking and one horizontally looking) at each end (4 OM per storey). The floors are vertically spaced by 40 m. Each floor is connected to the following one by means of four ropes that are fastened in a way that forces each floor to take an orientation perpendicular with respect to the adjacent (top and bottom) ones. An additional spacing of 150 m is added at the base of the tower, between the tower base and the lowermost floor to allow for a sufficient water volume below the detector.

A scheme of the prototype four floors tower is shown in Fig. 2. In addition to the 16 Optical Modules the instrumentation installed includes several sensors for calibration and environmental monitoring. In particular two hydrophones are mounted on the tower base and at the extremities of each floor. These, together with an acoustic beacon placed on the tower base and other beacons installed on the seabed, are used for precise determination of the tower position by means of time delay measurements of acoustic signals. The other environmental probes are: a

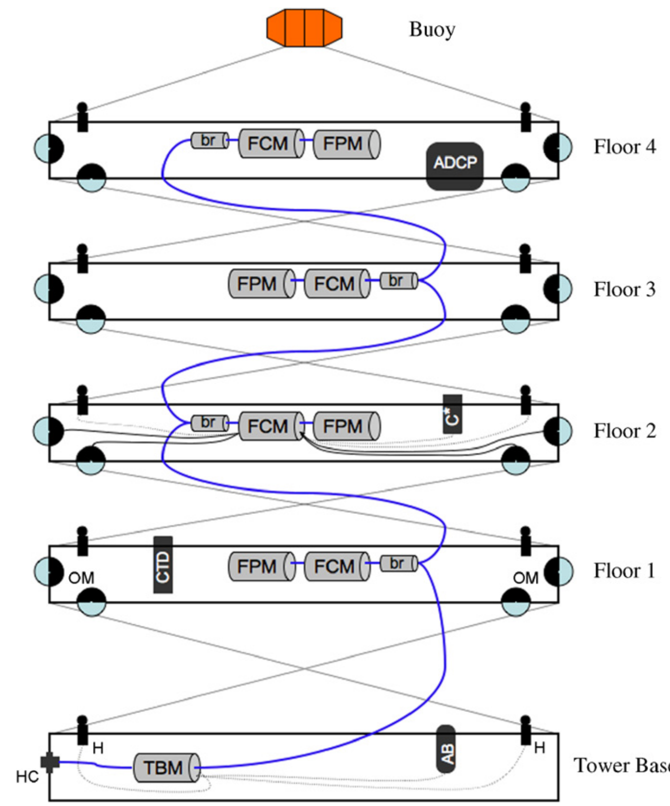

Fig. 2. Scheme of the four floors prototype tower of the NEMO Phase-1 project. The instrumentation mounted on it includes: 16 Optical Modules (OM); 10 Hydrophones (H); 1 Acoustic Beacon (AB) on the Tower Base; 1 Current–Temperature–Depth probe (CTD) on the first floor; 1 probe for light attenuation measurements (C^*) on the second floor; 1 Acoustic Doppler Current Profiler (ADCP) on the fourth floor. The scheme of the backbone cabling including the Tower Base Module (TBM), the floor breakouts (br), the Floor Control Modules (FCM) and the Floor Power Modules (FPM) is shown. Connection to the Junction Box is provided through a wet mateable hybrid connector (HC) placed on the tower base. For clarity the layout of the floor internal cabling is drawn only for floor 2, with electro-optic connections as continuous lines and electric connection as dotted lines.

Conductivity–Temperature–Depth (CTD) probe used for the monitoring of the water temperature and salinity, a light attenuation probe (C^*) and an Acoustic Doppler Current Profile (ADCP) that will provide continuous monitoring of the deep sea currents along the whole tower height.

The tower is designed such that it can be assembled in a compact configuration (see Fig. 3). This configuration is also maintained during the transport and the deployment, which is performed from a suitable surface vessel by means of a winch. Only after the correct positioning on the seabed and the connection to the undersea cable network, the tower is unfurled with a procedure that is actuated remotely and proceeds by using the pull provided by the buoy.

3.3. Tower cabling system

A number of considerations have lead to the design of the cabling system of the tower [14]. In particular fault

Fig. 3. The NEMO prototype tower fully assembled before its deployment.

tolerance and ease of management have been taken into account.

At the base of the tower there is a Tower Base Module (TBM). The TBM is connected by means of a hybrid penetrator to the backbone cabling and by means of a hybrid connector to a jumper cable terminated with a wet mateable bulkhead that allows the interconnection of the tower to the JB by means of a ROV.

A lightweight electro-optical backbone cabling system distributes the power and the data transmission signals to and from the tower floors. The splitting of the cable is performed by means of breakouts positioned at each floor level. The breakouts are realized with pressure vessels each one containing two passive optical devices that perform the Add/Drop functions for the optical data transmission signals of the outgoing and incoming data flows.

Inside each floor structure two containers are installed: a Floor Power Module (FPM) and a Floor Control Module (FCM). This last one is the core of the system since it hosts all the floor electronics for data transmission. This module is realized with an analogous solution to that adopted for the JB: a metallic pressure resistant vessel placed inside an external plastic container filled with silicone oil and pressure compensated. The FPM is a silicone oil filled plastic container, since all the power supply subsystem that is hosted inside has been tested to operate under pressure [15]. The FCM is interfaced to the floor instrumentation by means of four electro-optical (for the OMs) and three electrical (for the additional instrumentation) penetrators.

In this cabling system connectors are positioned only at the subsystems interfaces, to allow for testing of each single subsystem and for an ease of assembly, and at users interfaces. This allows to reduce their number thus reducing the cost of the system and increasing its reliability. Moreover, the use of penetrators instead of connectors minimizes the optical losses allowing for a higher budget for the data transmission system.

3.4. The optical module

The optical module is essentially composed by a photomultiplier (PMT) enclosed in a 17 in. pressure resistant sphere of thick glass. The used PMT is a 10 in. Hamamatsu R7081Sel with 10 stages.

In spite of its large photocathode area, the Hamamatsu PMT R7081Sel has a good time resolution of about 3 ns FWHM for single photoelectron pulses with a charge resolution of 35%.

Mechanical and optical contact between the PMT and the internal glass surface is ensured by an optical silicone gel. A mu-metal cage shields the PMT from the Earth's magnetic field.

The base card circuit for the high voltage distribution (Iseg PHQ 7081SEL) requires only a low voltage supply (+5 V) and generates all necessary voltages for cathode, grid and dynodes with a power consumption of less than 150 mW.

A front-end electronics board, built with discrete components, has been designed, realized and tested [16]. This board is also placed inside the OM. Sampling at 200 MHz is accomplished by two 100 MHz staggered Flash ADCs, whose outputs are captured by an FPGA which classifies (according to a remotely programmable threshold) the signal as valid or not; stores it with an event time stamp in an internal 12 kbit FIFO; packs OM data and local slow control information; and codes everything into a bit stream frame ready to be transmitted on a differential pair at 20 Mbit/s rate. The main features of this solution are the moderate power consumption, the high resolution and the huge input dynamics obtained by a quasi-logarithmic analog compression circuit, and the fine time resolution. Through an incoming slow control channel, managed by a DSP, all the acquisition parameters can be changed, and there is the possibility to remotely re-program the FPGA downloading new codes. Moreover, the board has embedded electronics, analog and digital, in order to control the Optical Module power supply to measure temperature, humidity and electrical parameters as well as to auto calibrate the non linear response of the logarithmic compressor.

3.5. Data transmission system

The design of the data transport system for NEMO Phase-1 has been based on technical choices that allow scalability to a much bigger apparatus [17,18]. Owing to synchronization purposes, a common timing must be known in the whole apparatus at the level of detection device to allow correlation in time of events. For this reason a synchronous and fixed latency protocol, which embeds data, synchronism and clock timing in the same serial bit stream, and allows an easy distribution of the clock signal to the whole apparatus, has been chosen. At the physical layer of communication the technology adopted relies on Dense Wavelength Division Multiplex

(DWDM) techniques, using totally passive components with the only exception of the line termination devices, i.e. electro-optical transceivers. The great advantages in terms of power consumption, reliability, and simplicity recommend this technique as a perfect candidate for the final km^3 detector.

The FCM on each floor collects data from the floor OMs and the auxiliary instrumentation, creates a data stream with a payload of 640 Mbps, and sends data toward the shore laboratory. From the opposite direction, the FCM receives slow control data, commands and auxiliary information, and the clock and synchronizations signals needed for apparatus timing. Bidirectional data transport is realized by means of the backbone optical fibre cabling system described in Section 3.3. In order to provide redundancy, data streams are doubled and re-directed onto two fibres using a "power splitter". The one fibre of the two that is used to carry the meaningful information is chosen on the on-shore station.

The underwater structure has a mirrored on-shore counterpart, where all optical signals are reconverted into electrical signals. In the on-shore laboratory the Primary Reference Clock, which is used to give the same timing to all the towers of the apparatus, is also located. Assuming that the two fibres per tower maintain their integrity, the designed system provides other experiments with a further bidirectional channel.

3.6. Electrical power system

For the Phase-1 project a three phase AC system has been chosen since it presents some advantages in terms of voltage drops and reliability. This system is used for the energy distribution up to the level of the local electronics module in each storey where a conversion to DC is made [15].

A control system has been realized to acquire all the relevant data such as currents, voltages and environmental parameters (temperature, humidity, etc…) inside the containers.

The system has been designed to have a large part of its components working under pressure inside an oil bath. For this aim extensive tests on electric and electronics components have been performed [15].

3.7. Calibration and control systems

The timing calibration requires an embedded system in order to track the possible drifts of the time offsets during the operations of the apparatus underwater [19]. The task of this embedded system is essentially to measure the offsets with which the local time counters inside the optical modules are reset on reception of the reset commands broadcasted from the shore, i.e. the time delays for such commands to reach the individual optical modules. All time measurements are in fact referred to the readout of such counters. The operation will be performed with a completely redundant system [18]: (1) a two-step procedure for measuring the offsets in the time measurements of the optical sensors and (2) an all-optical procedure for measuring the differences in the time offsets of the different optical modules.

In the first system the needed measurements are performed in two separate steps: using an "echo" timing calibration and using an "optical" timing calibration.

The former will allow us to measure the time delay for the signal propagation from the shore to the FCM of each floor; the latter, which is based on a network of optical fibres which distributes calibration signals from fast pulsers to the optical modules, will allow to determine the time offsets between the FCM and each optical module connected to it. The second system is an extension of the optical timing calibration system, which allows to simultaneously calibrate the optical modules of different floors of the tower.

An essential requirement for the muon tracking is the knowledge of each sensor position. While the position and orientation of the tower base is fixed and known from its installation, the rest of the structure can bend under the influence of the sea currents. A precise determination of the position of each tower floor is achieved by means of triangulation measurements performed by measuring time delays of acoustic signals between acoustic beacons placed on the sea floor and a couple of hydrophones installed on each tower floor. In addition to this the inclination and orientation of each tower floor is measured by a tiltmeter and a compass placed inside the FCM.

The acoustic Long Base Line (LBL) is realized with four standalone battery-powered acoustic beacons and one additional beacon located on the tower base. The accuracy on the measure of the flight time is of the order of 10^{-4} s which yields an accuracy on the estimation of each hydrophone position of 15 cm.

To determine the position of the hydrophones the LBL must be synchronised to the master clock of the apparatus. This synchronisation takes place acoustically using a monitoring station placed in correspondence to the tower base.

All the Slow Control data (including data from all environmental sensors and the acoustic positioning system) are managed from shore by means of a dedicated Slow Control Management System [20].

4. Installation and operation of NEMO Phase-1

4.1. Deployment and installation

The NEMO Phase-1 system was successfully installed in December 2006 in a sea operation conducted with the cable layer vessel TELIRI.

The JB and the tower were deployed from the surface by means of a winch (Fig. 4) and positioned at 2100 m depth with an accuracy of a few meters with respect to the target positions.

Prior to the connection of the system, the four acoustic beacons providing the LBL for the acoustic positioning system were deployed around the apparatus at an approximate distance of 500 m. Their relative position was determined with the desired accuracy of 10 cm with the help of the ROV equipped with a suitable calibration tool.

The JB was connected to the main cable termination frame and the tower to the JB with electro-optical links equipped with wet mateable hybrid connectors. Connection operations were performed with an underwater Remotely Operated Vehicle (ROV).

The operation was completed with the successful unfurling of the tower that assumed the correct configuration.

4.2. First data and performance

After several months of operation no water leakage was detected in any component of the tower.

The data taking and analysis started soon after the deployment and the correct functioning of the system was verified.

The data transmission and acquisition system has been successfully tested, meeting its target performances [21].

Fig. 4. Deployment of the NEMO prototype.

As an example the time development of the average rate values of an OM is shown in Fig. 5: the shown data sample has been acquired during 18 h starting from the 10th of January 2007 at 21 h. The thick plateau at about 73 kHz is the hit rate baseline, due to the contribution of both ^{40}K and diffused bioluminescence; the high peaks emerging from the baseline and reaching values up to 5 MHz are caused by localized bioluminescence activity.

Also the acoustic positioning system was satisfactorily tested, the three dimensional measurements of the positions of the various hydrophones were taken simultaneously and then the 3D distance of the two hydrophones was measured.

Fig. 6 shows the results of this operation, carried out on the second floor of the tower. The mean length of the distance of the hydrophones was measured as 14.22 m and more than 80% of the data falls within 10 cm of the mean.

The time calibration system was able to reconstruct the calibration signal with the accuracy requested ($\sigma \cong 1.5$ ns), as shown in Fig. 7.

A preliminary track reconstruction of the downgoing atmospheric muons was also performed, an example is shown in Fig. 8.

Nevertheless some problems occurred after some months of functioning. The buoyancy of the tower decreased with the time, producing a lowering of the tower position.

The problem originated in the construction process of the buoy that will be improved for the realization of the new tower for the Capo Passero installation (Phase-2).

Another problem was related to a malfunction inside the JB that requires the recovery for a full diagnosis.

The main results point out a malfunctioning of the optical penetrator. Consequently this component will be modified in the design and construction for the new tower of Phase-2.

5. The NEMO Phase-2 project

Although the Phase-1 project provided a fundamental test of the technologies proposed for the realization and installation of the detector, these must be finally validated

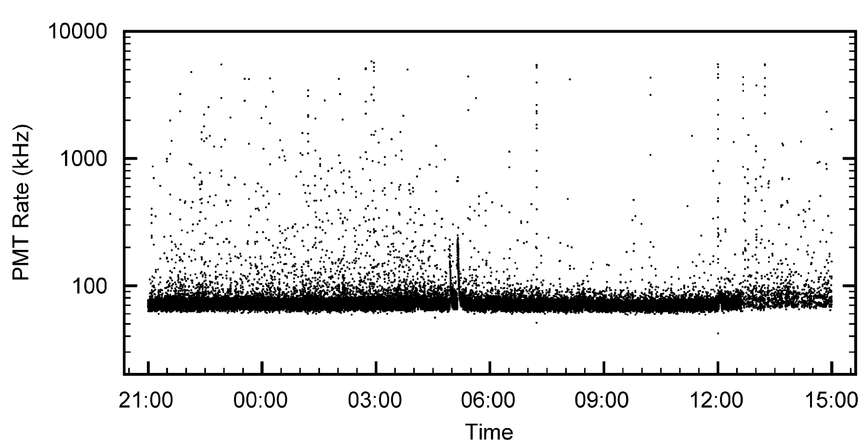

Fig. 5. Optical background during 18 h.

at the depths needed for the km^3 detector. For these motivations the realization of an infrastructure on the site of Capo Passero has been undertaken. It consists of a 100 km cable, linking the 3500 m deep sea site to the shore, a shore station, located inside the harbor area of Portopalo

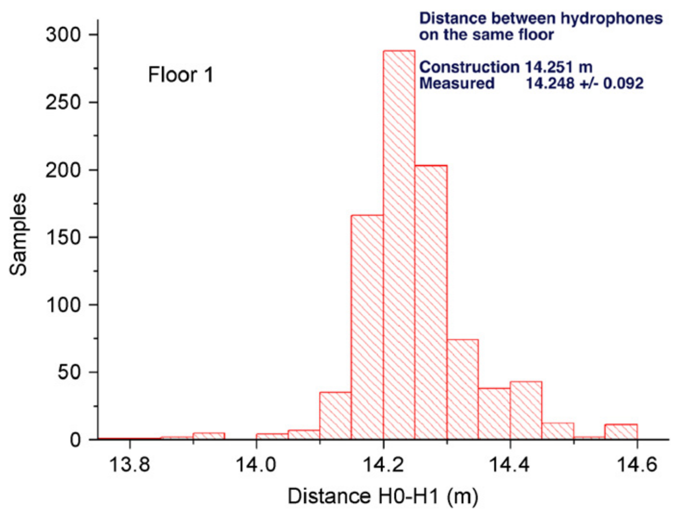

Fig. 6. Accuracy of the acoustic positioning system.

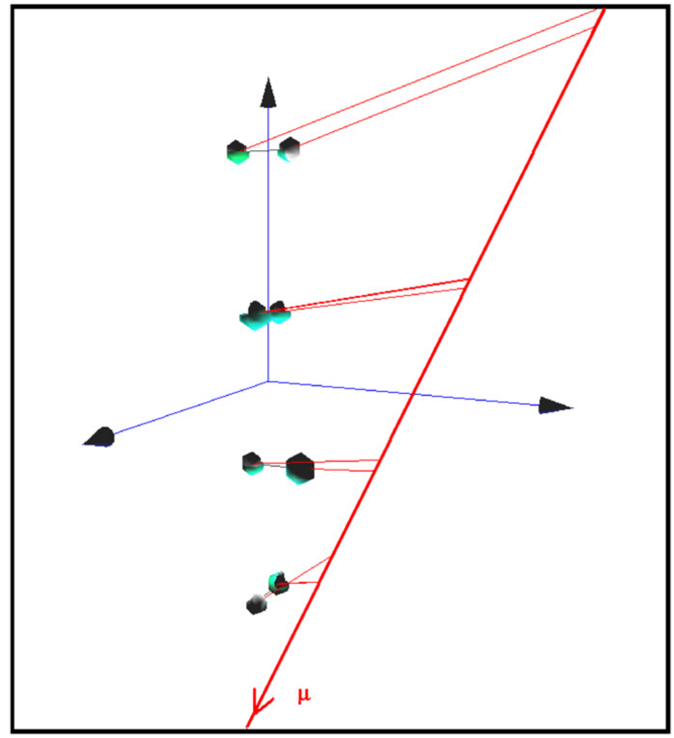

Fig. 8. Reconstruction of a downgoing atmospheric muon track.

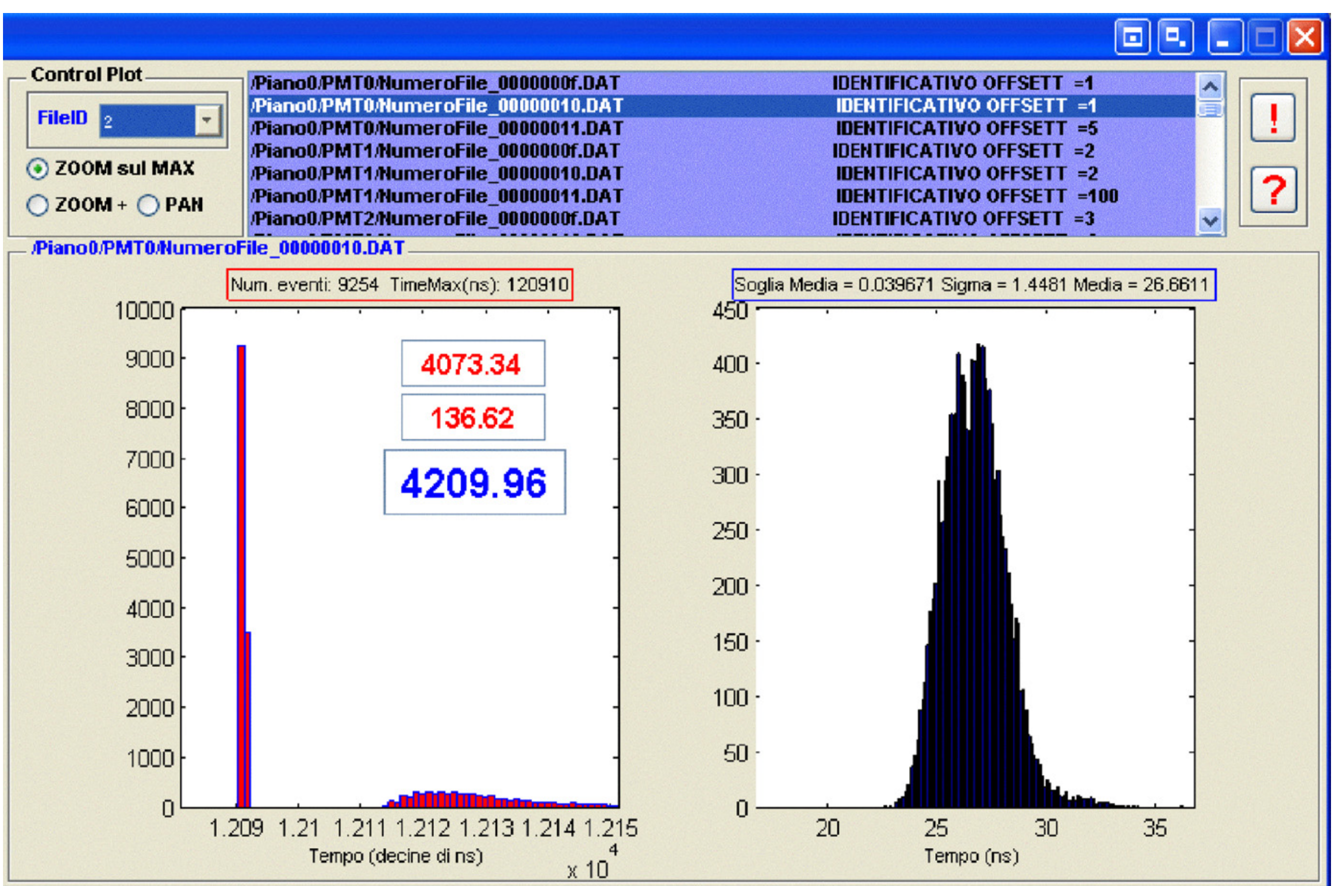

Fig. 7. View of the control panel of the time calibration system. The acquisition times of the hits triggered by flashes of the calibration pulsers are compared to the expected values, in order to calculate the time offsets of the individual optical modules. The left panel shows a low-resolution histogram of the acquisition times of calibration hits while a high-resolution zoom of the peak area is shown in the right panel.

of Capo Passero, and the underwater infrastructures needed to connect prototypes of the km^3 detector.

At the same time a fully equipped 16 storey detection tower is under construction and will be installed on the Capo Passero site. With the completion of this project, foreseen by the end of 2008, it will be possible to perform a full test at 3500 m of the deployment and connection procedures and at the same time set-up a continuous long term on-line monitoring of the site properties (light transparency, optical background, water currents, ...) whose knowledge is essential for the installation of the full km^3 detector.

5.1. Phase-2 main electro-optical cable

Due to the longer cable needed, with respect to the Phase-1 project, the DC solution was chosen for the electro-optical cable power feeding. The main cable, manufactured by Alcatel, carries a single electrical conductor, that can be operated at 10 kV DC allowing a power transport of more than 50 kW, and 20 single mode optical fibres for data transmission [22]. The DC/DC converter will be realized by Alcatel and will convert the high voltage coming from the shore into 400 V.

The cable has been laid in July 2007. The cable deep sea termination, that includes the 10 kW DC/DC converter system, is presently under realization and will be deployed in the second half of 2008.

6. Conclusions and outlook

The activities of the NEMO collaboration have recently progressed with the achievement of a major milestone: the realization and installation of the Phase-1 apparatus. With this apparatus it has been possible to test in deep sea the main technological solutions developed by the collaboration for the construction of a km^3 scale underwater neutrino telescope.

A Phase-2 project, which aims at the realization of a new infrastructure on the deep-sea site of Capo Passero at 3500 m depth, is presently progressing. The realization of the deep-sea infrastructure has begun with the deployment of the long electro-optical cable while a shore station is under construction near the mole of Porto Palo harbor. After a careful revision of its design, following the experience gained with the Phase-1 project, the construction of a fully equipped 16 storeys tower is under way. The tower will be installed and connected by the end of 2008.

A further R&D program is also underway within the KM3NeT consortium [23] in which all the European institutes currently involved in the Mediterranean neutrino astronomy projects are participating. The project, partly supported by the European Union, has started in February 2006 a three year Design Study, which aims at producing a Technical Design Report for the realization of an underwater Cherenkov km^3-scale neutrino telescope. This will be followed by a Preparatory Phase project, that will start early 2008, that aims at defining all the aspects needed to bring the km^3 detector at the construction phase.

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POR 2000-2006

PEGASO PROJECT

Project references

Project Name: PotEnziamento di reti Geofisiche e Ambientali SOttomarine (enhancement of underwater geophysical and environmental networks)

Acronym: PEGASO

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1. Introduction

1.1 What is PEGASO ?

PEGASO is the acronym of a 34-month project (December 1st, 2005 – September 30th, 2008) "PotEnziamento di reti Geofisiche e Ambientali Sottomarine" (enhancement of underwater geophysical and environmental networks). The partners of the project are Istituto Nazionale di Geofisica e Vulcanologia (INGV) and Istituto Nazionale di Fisica Nucleare (INFN). It is funded by the regional government "Regione Siciliana" to enhance already existing infrastructures within the POR 2000-2006 (FESR - European Structural Funds at regional level). The amount of the project is about 5.6 MEuro (50% co-financed by the partners). The existing, on-shore and off-shore Eastern Sicily infrastructures are: 1) the laboratory within the Catania harbour area, and 2) NEMO-SN1 seafloor observatory. The latter is the first operating cabled site of the EC project ESONET-NoE (European Seas Observatory NETwork - Network of Excellence, http://www.esonet-emso.org/esonet-noe/) and node of the future European large-scale seafloor infrastructure EMSO (see below).

The "European Strategy Forum on Research Infrastructures (ESFRI)", launched by EC in April 2002, brings together representatives of EU Member States and Associated States, appointed by Ministers in charge of Research, and one representative of the European Commission, with the main objective to facilitate a coherent support to large Research Infrastructures at the at the European level. The forum periodically issues a roadmap with a list and description of strategically important Research Infrastructures to be supported by the European Union. In September 2006 the ESFRI report was published containing a list of 35 large-scale Research Infrastructures belonging to different fields (http://cordis.europa.eu/esfri/roadmap.htm). Among these, EMSO (European Multidisciplinary Seafloor Observatory) is one of the most important infrastructures in Environmental Sciences based on a European-scale network of seafloor observatories and platforms, forming a widely distributed pan-European infrastructure (Fig. 1.1). The EMSO basic scientific objective is the long-term monitoring, mainly in real-time, of environmental processes related to the interaction between the geosphere, biosphere, and hydrosphere, including natural hazards. It will be a geographically distributed infrastructure composed of several deep-seafloor observatories, that will be deployed on specific sites around European waters, from the Arctic to the Black Sea passing through the Mediterranean Sea. Another important ESFRI infrastructure is KM3NET (Underwater Neutrino Telescope) in Astronomy, Astrophysics, Nuclear and Particle Physics, aimed at the realisation, validation and long-term use of a deep-sea observatory devoted to the neutrino detection through photomultipliers.

The European Commission, under the Research Infrastructures sub-section of the Capacities Programme within the 7th Framework Programme, launched a call for Preparatory Phase (PP) projects of the Research Infrastructures listed in the ESFRI Report. EMSO-PP, 4-years project, has just started in April 2008 and is coordinated by Italy represented by INGV with other 11 Institutions, each representing its own country. The infrastructures planned and realised within the PEGASO project will support the activities of deployment, recover and maintenance and of the seafloor observatories to be planned in the mainframe of the EC-funded projects. KM3NeT-PP, 3-years project, has started in March 2008 and is coordinated by Italy represented by INFN with other 20 European Institutions. The infrastructure realised within PEGASO will support the activities of deployment, connection and maintenance of prototypes of the underwater KM3 telescope for neutrino detection.

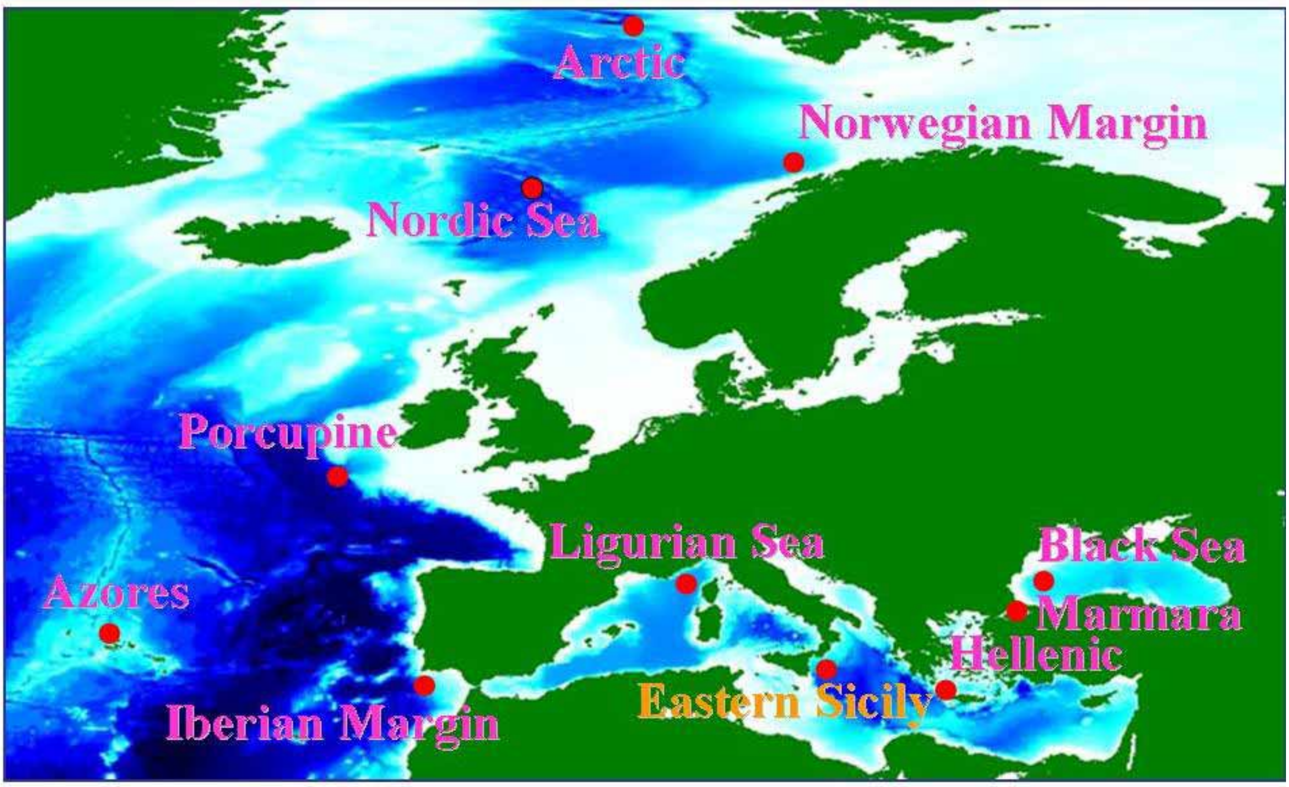

Fig. 1.1

1.2 PEGASO objectives

The main aim of PEGASO is the development of a deep-sea modular handling facility able to service underwater infrastructures down to 4000 m w.d.

PEGASO handling facility is composed by two main sub-systems:

- the Deep Sea Shuttle (DSS);
- a Customised model of a deep-sea ROV (C-ROV);

The DSS was designed and built to work both as a lifter of heavy scientific payloads. The INGV cable-winch system acts as link between the surface control station and the deep-sea handling facility.

The PEGASO facility allows, in its different configurations, the following deep-sea operations:

- deployment and recovery of heavy complex structures (such as: GEOSTAR-like observatories, NEMO towers, multi purpose Junction Boxes, deep-sea scientific stations);
- plug and unplug of ROV wet mateable connectors;
- visual inspections and maintenance operations on existing infrastructures;
- multi purpose scientific operations (e.g. survey of bio-constructions, samplings).

The sea operations related to underwater scientific apparatus installation (deployment, recovery and connection to the shore) will be made straightforward also in terms of cost reduction and possibility to use ships of opportunity (like pontoon, supply vessel equipped with simple dynamic positioning system).

2. DSS – Deep-Sea Shuttle

The general layout is shown in Fig. 2.1, and is the same as ROVs or similar systems for the deep sea. The work for the realisation of the DSS has been divided into 9 Work Packages (WPs).

Fig. 2.2 shows how the different WPs are distributed between the winch and the umbilical that allow to carry heavy loads, to give power from the surface and to transmit data by two-way communication fibre-optical link.

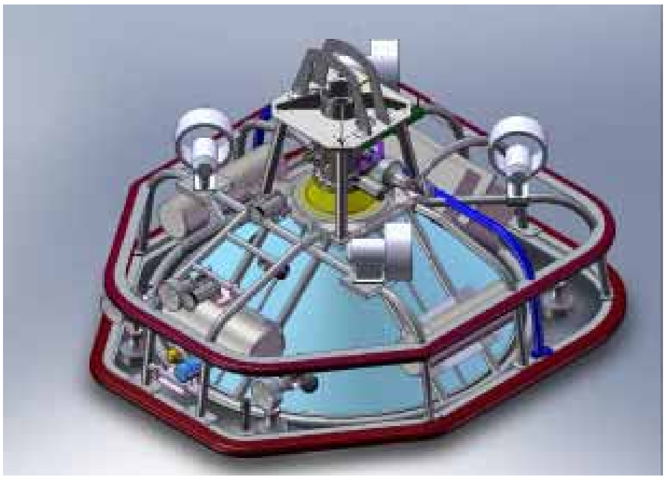

Fig. 2.1

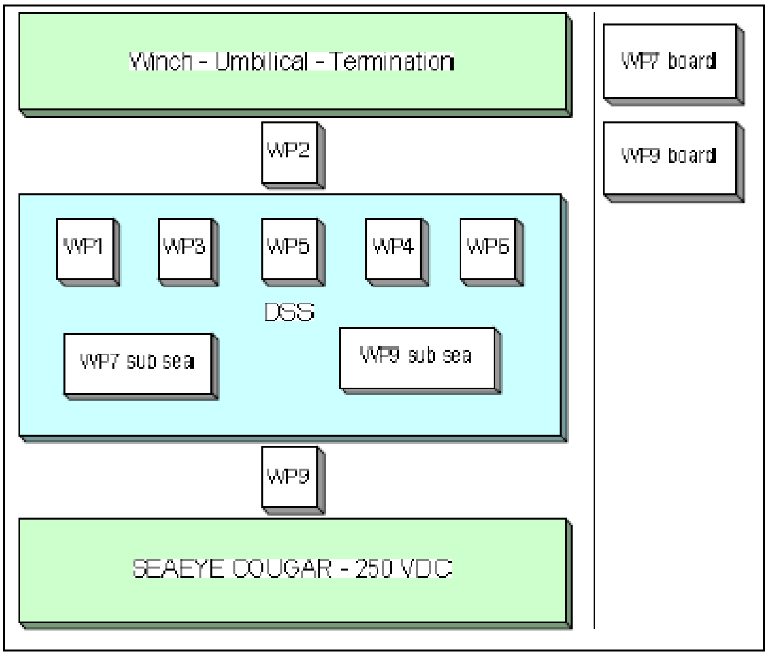

Fig. 2.2

The mechanical structure of DSS is shown in the block diagram (Fig. 2.3).

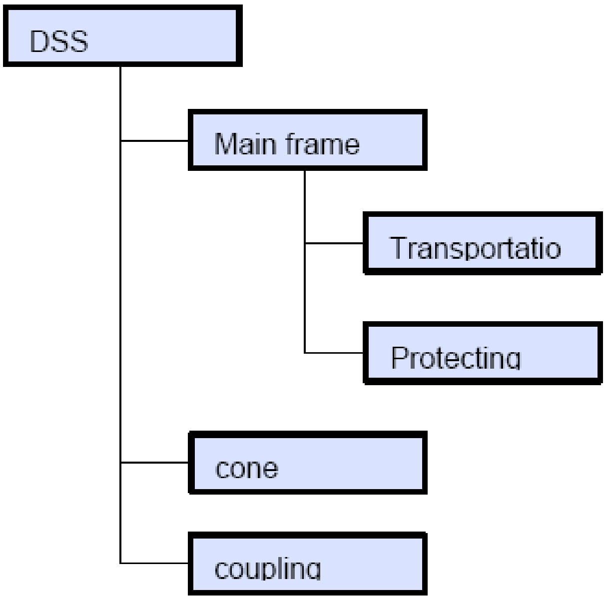

Fig. 2.3

It is relevant to divide functions into different mechanical design groups with clear interfaces. The structure is composed by:

(1) the cone and the coupling on top is for the transportation and docking of the bottom station. The cone helps to guide the stations pin directly to the coupling and to compensate the heave motion of the vessel at a sea state, which has to be moderate, as long as there is no heave compensation.

(2) the carrier frame has an interface to the top area of the cone to lead the forces introduced by the termination of the umbilical, which is connected on top of it, directly to the structure and the coupling that is linked with the load of the station.

(3) the payload frame that is made to hold all components such as thrusters, electronic boxes, cameras and so on. The frame is made from aluminium tubes that allows a flexible positioning and assembly of components and allows also the use of yet unknown tools and components.

The system foresees four thrusters. This requires to have a free area for the in- and outflow of the water (Fig. 2.4).

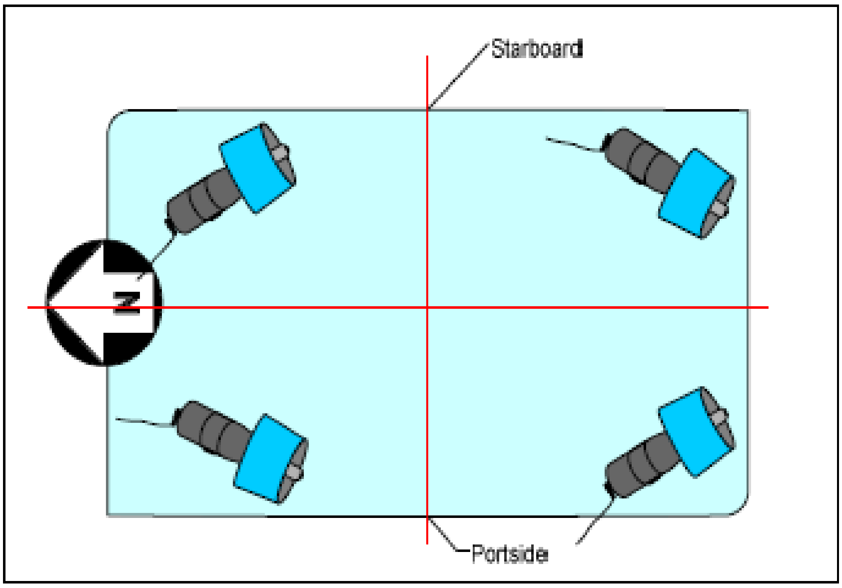

Fig. 2.4

The components are pressure boxes for the electronic, thrusters for the lateral movement, the transformer, lighting and cameras, sonar and altimeter for visual and pseudo visual support of operation and documentation.

The coupling unit (Fig. 2.5) fits to the interface flange on the top of the cone. The actuation of the coupling unit is conducted with a motor.

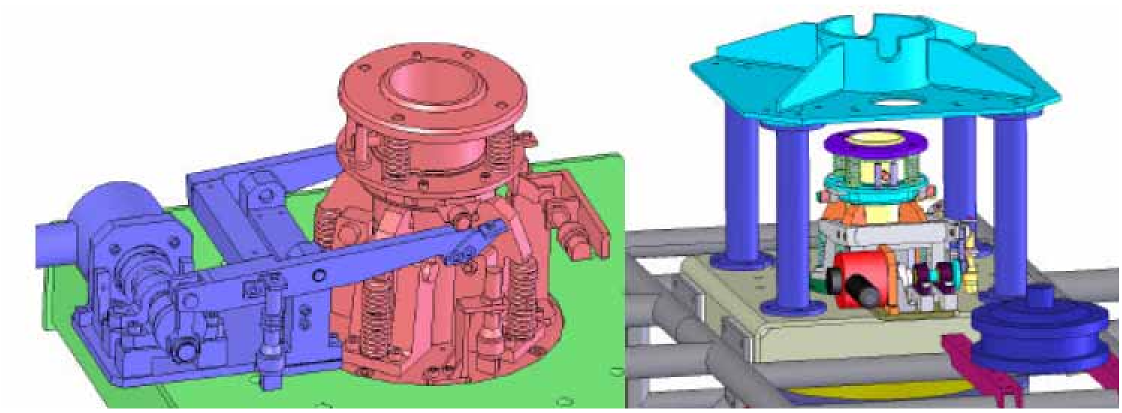

Fig. 2.5

3. C-ROV – Customized deep-sea ROV

The PEGASO project has acquired the Seaeye Cougar-XT able to operate down to 4000 m w.d. This version is a development of the Seaeye Cougar range, proven worldwide in demanding applications and recognised for its capability to operate effectively as a compact work ROV. A picture of the ROV is shown in Fig. 3.1.

The Cougar-XT presents considerable improvement in the performances. Developments in drive and power technology has allowed the vehicle thrust increased by over 50% in all directions – creating a vehicle with the highest thrust to weight ratio in its class. The vehicle power has been doubled by increasing the supplied voltage from the standard 250 V DC to 500 V. Apart from improving the vehicles handling this enables a Seaeye Cougar-XT to accommodate a wider range of heavier duty tooling for work tasks. These include drill support, salvage and IRM. Tackling an expanding range of applications is made easier with Seaeye Cougar ROVs because task-specific tooling skids can easily be bolted on, and changed as needed.

The Seaeye Cougar-XT leads a new generation of compact, highly flexible and extremely powerful electric ROVs that offer users the ability to undertake a wider range of demanding tasks at lower operating costs.

Fig. 3.1

The main technical characteristics are:

Chassis

The extremely rugged polypropylene chassis with a stainless steel lift frame, is totally maintenance free, non corroding and self-supporting in seawater. The design allows for additional equipment to be directly bolted to the chassis for ready customisation. Seaeye was the first company to introduce polypropylene for the construction of ROV frames.

Buoyancy

The syntactic foam buoyancy block is split into two sections for easier handling and access to vehicle components. Apertures are provided for sonar, Xenon strobe and tracking transponders.

Equipment Interfaces

A wide range of standard or custom interfaces are provided:

- manipulator and cutter interfaces;

- CP interface (Proximity or Contact);
- obstacle avoidance, multi beam, profiling or side scan sonar;
- bathymetric systems;
- fixed focus, zoom and stills cameras;
- emergency strobes and beacons;
- tracking systems;
- 3-phase tooling supply;
- auxiliary connections providing telemetry and DC power for other accessories.

Propulsion

All Seaeye ROVs feature brushless DC thrusters (Fig. 3.2) which, apart from having the greatest power density, have integrated drive electronics with velocity feedback for precise and rapid thrust control. These thrusters are interfaced to a fast PID control system and a solid-state rate gyro for enhanced azimuth stability. These essential building blocks enable Saab Seaeye to provide control and response from their powerful ROVs and set them apart from the competition. Four vectored horizontal and two vertical SM7 500 Volt brushless DC thrusters provide full three-dimensional control of a Cougar-XT.

Fig. 3.2

Compass and Rate Gyro

A Flux-gate compass and a solid-state rate sensor are provided and give the Cougar-XT azimuth stability in forward flight and in auto heading.

Depth Sensor

The system uses an electronic depth sensor accurate to 0.1% FSD accuracy.

Automatic Pilot
The compass, rate gyro and depth sensors provide an automatic pilot for depth and heading.

Video System
The standard configuration transmits multiplexed video over two multimode fibres in the umbilical/tether. This provides up to 4 simultaneous video channels.

Lighting
A total of 600 Watts of lighting is available as standard. Two individually controlled lighting channels are provided, both containing two fused 150W lamps.

Tether Termination
The tether, or soft umbilical, is electrically terminated in an oil filled and pressure compensated Vehicle Junction Box (VJB).

EUROPEAN UNION | Sixth Framework Programme

Full Proposal

ESONET NoE
CALL FOR PROPOSAL FOR
DEMONSTRATION MISSIONS

Full Proposal - Part B

Coordinator's Name:	Michel André		
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Proposal description

Proposal Acronym:	LIDO
Proposal Title:	**LI**stening to the **D**eep **O**cean environment
Duration in months:	24
Objective:	**LIDO (Listening to the Deep Ocean environment) proposes to establish a first nucleus of a regional network of multidisciplinary seafloor observatories contributing to the coordination of high quality research in the ESONET NoE by allowing the long-term monitoring of Geohazards and Marine Ambient Noise in the Mediterranean Sea and the adjacent Atlantic waters. Specific activities are addressed to a long-term monitoring of earthquakes and tsunamis and the characterisation of ambient noise induced by marine mammals (Bioacoustics) and anthropogenic noise.** The objective of the proposal will be achieved through the extension of the present capabilities of the observatories working in the ESONET key-sites of Eastern Sicily (NEMO-SN1) and of the Gulf of Cadiz (GEOSTAR configured for NEAREST pilot experiment) by installing not-already-included sensor equipments related to Bioacoustics and Geohazards;

	Scientific Objectives <u>Geo-Hazards</u>: LIDO aims at improving the real-time and near-real-time detection of signals by a multiparameter seafloor observatory network at regional scale for the characterisation of potential tsunamigenic sources. Its methodological approach is based on the cross-checking of geophysical, oceanographic and environmental time series acquired on the seafloor and in the water column. LIDO will provide real-time and near-to-real-time seismological and water-pressure comparative time series from near-shore sources and operational tools (e.g., prototype of tsunameters) integrated in seafloor observation systems, and in the terrestrial networks LIDO follows the recommendation of the Intergovernmental Coordination Group of the Intergovernmental Oceanographic Commission (UNESCO) for the North-Eastern Atlantic and Mediterranean Tsunami Warning System (ICG/NEAMTWS) for the urgent deployment of a tsunami warning system in the related areas with special regard to the definition of trans-national seismic and sea level monitoring networks. <u>Bioacoustics</u>: LIDO will evaluate the human and natural contributions to marine ambient noise and for the first time describe the long-term trends in ambient noise levels, especially from human activities (influenced for example by increasing shipping) and in marine mammals populations (migration patterns, presence, and habitat use of key species, like sperm -, fin - and beaked whales). LIDO will allow real-time and near-real-time long-term acoustic monitoring of marine mammals at regional level, as well as noise propagation that could be in the next years correlated with the effects of anthropogenic impacts and climate changes, using the same infrastructure defined above. ***Technological objectives*** The technological objective of LIDO is the development of the first nucleus of a regional multiparameter seafloor network of homogeneous observatories (same sensors) and its long-term operability beyond the duration of LIDO demo mission in two ESONET key-sites, East Sicily (cabled) and Gulf of Cadiz (acoustically linked with a surface buoy).
Scientific and/or technological excellence:	**a) Contribution at the expected impact of the NoE** Within the ESONET frame, there is a need to overcome individual observatories establishing regional networks, integrating physical sensing techniques and equipment into a unified long-term monitoring. **LIDO intends to demonstrate the viability of the integration of existing infrastructures and research methodologies with a particular emphasis on geophysical and biological aspects.** The same need implies progressing towards unified monitoring approach of the seafloor and water column, which the ESONET Consortium looks as the next step forward. The LIDO approach is intended to provide the scientific community and the general public a set of meaningful data and improved infrastructures. LIDO will contribute to all the efforts made since over 15 years by research institutions and companies with the national and EU support. Following the ESONET NoE **Strategic Impact**, <u>LIDO will help to demonstrate the European capabilities of using a network of underwater observatories by implementing the first regional nucleus of multidisciplinary seafloor observatories in the Mediterranean Sea and the adjacent Atlantic waters, providing also a step towards a European-African front on Civil Protection from geo-hazards</u>. The ESONET NOE **Outreach** towards the public will be ensured by implementing user-friendly interfaces that will be made available and displayed in Science Museums (e.g., CosmoCaixa, Barcelona, Spain and Natural Sciences Museum, Lisbon, Portugal) as well as through TV, radio and press channels (see details in WP3 table). This activity will take into account the policy of the Commission for information activities, including participation in the annual European Science Week. LIDO strongly contributes to the need of ESONET addressing aspects of **Interoperability** and **Standardisation** and defining key elements of the architecture as well as standards of future observatories. This will be accomplished by improving data quality and data management (real-time and near-real-time analysis of the data), as well as the implementation of standard user-friendly interfaces for the real-time transmission

	of acoustic/geophysical data and images to public institutions (see details in WP2 table). *Geo-hazards* One of the greatest dangers to which populations and infrastructures located along the Mediterranean coastline are exposed to, derives from the vicinity of potential tsunamigenic sources. As almost the totality of the tectonic, volcanic, gravitative and tsunamigenic sources are located along the Eurasia-Africa plate boundary, the warning systems only based on measurement of the tsunami wave far field are poorly efficient given the short distance covered by the waves from the source to land. In the Mediterranean and in the Atlantic waters, like the Gulf of Cadiz, the possible travel time of a tsunami wave towards the coast is in the order of 30 minutes or less. The reliable and very rapid detection of the tsunami generation in these regions is therefore crucial for a future development of early warning system. In addition, warning based uniquely on earthquake signature often generates false alarms. A multiparameter approach is therefore necessary to overcome these limitations. Several steps have been done towards the development of an effective early warning system integrating three components: land (seismic stations), shore (tide-gauge stations) and seafloor instruments (ESONET nodes). This complex system, that is being implemented under the recommendations of UNESCO/NEAMTWS, is progressing fast especially on the first two components, involving real-time information shared among the operational institutions (Portugal, Spain and Morocco for the Cadiz site; Italy and surrounding countries for the East Sicily site), but needs extra efforts on real-time seafloor monitoring. LIDO intends to participate in this multinational effort, providing a higher degree of integration of existing systems and a better level of standardisation of geophysical parameters. The geophysical monitoring of the areas covered by LIDO will also give an opportunity for the study of the physical processes associated with seismogenesis/tsunamigenesis, in densely populated key areas for the EU. *Bioacoustics* The sea environment is filled with natural sounds, although increasingly many anthropogenic sources have contributed to the general noise budget of the oceans. How the growth of anthropogenic sounds in the sea impacts and affects marine life is a topic of considerable current interest both to the scientific community and to the general public. Scientific interest arises from the need to understand more about the role of sound production and reception in the behaviour, physiology, and ecology of marine organisms. Actually, anthropogenic sound, including sound necessary to study the marine environment, can interfere with the natural use of sound by marine organisms. For acoustical oceanographers, marine seismologists, and minerals explorers, sound is the most powerful remote-sensing tool available to determine the geological structure of the seabed and to discover oil and gas reserves deep below the seafloor. ESONET NoE is particularly sensitive on the effects of noise on marine organisms. Because our knowledge is still quite limited, ESONET will develop through LIDO a research program that will help to establish a scientific base to allow 1) the automatic identification and classification of non biological and biological sounds, 2) the monitoring of marine organisms and population dynamics, 3) the assessment and control of the long-term effects of anthropogenic sources on marine organisms, 4) the education of the public, end-users and the administration. Although this project will concentrate primarily on the effects of noise on marine mammals, it will also consider other species as well (e.g., sea turtles, fish, cephalopods) that are part of the ecosystem and contribute to the food web on which marine mammals depend. The frequency band to be studied will be determined to range from 1 Hz to 45 kHz, which covers most of the bandwidth that various marine organisms are capable of producing and detecting at mid and long distances. The design and implementation of research on the effects and control of man-made noise in the marine environment must be an interdisciplinary enterprise. Contributions and expertise are needed from electronics experts on the choice and calibration of transducers for monitoring natural, biological and anthropogenic sound sources, from

	physical acousticians to process signal/information, from marine biologists to identify species sound-related behaviour and seasonality and large scale data, from psycho-acousticians to assess species related hearing sensitivities and from statisticians for the initial design, data analysis and presentation. **b) Detailed Work Plan showing the logical phase of the implementation of the DM.** The LIDO workplan is structured in the following 5 Work Packages (WPs): WP1 – *Recovery, refurbishment and enhancements of the observatories*: the work package will develop enhancements of existing NEMO-SN1 and GEOSTAR observatories and infrastructures to open the nodes of a first nucleus of regional network to other disciplines (bioacoustics) and homogenise the geophysical equipments of these observatories by integrating additional sensor, devices, and software. The development of the pilot experiment for long-term operation of the observatories and comparative tests is also included. WP2 - *Data Management* Future observatory systems will be oriented towards offering data services for not just the scientific community but also government bodies or industry. The ultimate goal is to integrate these services into the Marine Core Services of GMES taking into account the rules and standards that are currently developed as part of the GEOSS initiative. Within this demonstration mission the data stream from two sites will be integrated into a common data acquisition and distribution service. Existing concepts and standards like SWE (Sensor Web Enablement) will be evaluated and according to their feasibility implemented into a prototype system. By setting up a link to comparable initiatives in the US like for instance the Marine Metadata Project coordinated by MBARI or the SEACOOS observatory along the east coast of the US a coherent concept will be developed that may form a first step in achieving a truly global ocean observing system. This workpackage will organise the management and processing of the real-time data and near to real-time data collected in the DM sites, allowing 1) the long-term comparative testing in two seismogenic/tsunamigenic region and 2) the automatic detection, classification and tracking of biological and anthropogenic sound sources to assess long-term trends in marine ambient noise. WP3 - *Public Outreach* - Real-time transmission of marine mammal acoustic signals and acoustic images from seafloor cabled observatory to public institutions (e.g., Scientific Museums, Aquaria) where the whole ESONET network will be presented together with the “sonic imagery” of the LIDO stations. WP4 - *Technological Assessment* This workpackage will check design, test and document the available technology for the construction of highly reliable, large bandwidth and sensitive underwater acoustic antennas. The task includes the integration of such detectors with on-shore and off-shore infrastructures available at the proposed submarine node and the systems monitoring during operation. The final aim is the definition of a prototypal common technology for different ESONET nodes. WP5 - *Project Management*

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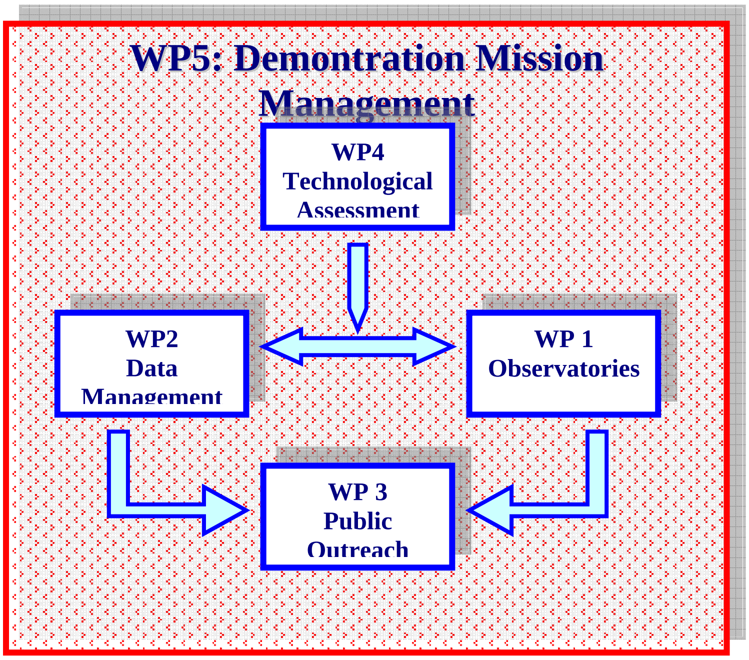
This workpackage will ensure the coordination of the above activities within the consortium and the communication with the ESONET steering and scientific committees, as well as the preparation of the financial plan and final report. The WPs relationship is depicted in the PERT diagram.

LIDO PERT diagram



The LIDO time schedule is shown in Annex 3 (GANTT chart).

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Quality and efficiency of the implementation and management:

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a) Management

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

- A balanced participation in the network of the different types of members: large institutions, university laboratories, major industrial groups, SMEs.
- An efficient decision-making.
- A high quality management of the network's resources.

The LIDO management structure consists of:

- A Steering Committee (SC): composed by a representative of each of the partners institution
- An Advisory Councils (AC): composed by selected representatives of the partners institutions to serve as a Scientific, Test and Operational, and Management Council,
- Workpackage Leaders (WPLs)

The Coordinator implements the administrative and financial decisions of the SC, within the framework set by the European Commission and under the authority of the ESONET NoE. The Activity Leaders are advised by the Advisory Council.

The coordinator will:

- act as the intermediary between LIDO and the ESONET NoE coordinator,
- transmit all necessary information to the ESONET,
- verify the progress of the project referring to the ESONET NoE coordinator.

b) Quality of the LIDO Consortium

The LIDO Consortium directly benefits from:

- Existing infrastructures that have been deployed and tested in both shallow and deep waters constituting a first nucleus of the ESONET network;
- Existing teams with dilated and complementary expertise in technological

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developments, bioacoustics, ecology, zoology, geophysics and geo-hazards, including signal processing and data management;

- Interdisciplinary capabilities that include both technological and bio-ecological expertise
- Ethical and Environmental aspects that will be directly addressed through the long-term analysis of human, natural and biological contribution to the overall marine noise;
- Being located in Southern countries: this constitutes a strong geo-political aspect because LIDO will contribute to the public awareness in Central Mediterranean (Ionian Sea) in countries surrounding the Gulf of Cadiz and allow a the development of a civil protection connection between Europe and Africa;
- Strong industrial partners and end-users that will help achieving the proposal objectives;
- Existing links with international, European and non-European, institutions and projects like NOAA, UNESCO, NEPTUNE, JAPAN.

c) Technical feasibility

LIDO is based on existing infrastructures already deployed and tested both in shallow and deep-sea environments as well as on consolidated scientific teams with experience in working with the two LIDO observatories and belonging to the ESONET NoE Institution partners.

The proposed LIDO demo mission has solid bases in the operation of the NEMO-SN1 and GEOSTAR seafloor observatories, which represent successful examples of cabled and autonomous multidisciplinary deep-sea complex platforms, respectively. Moreover the LIDO stations (East Sicily and Cadiz) will be designed and operated following severe criteria based on reliability and high redundancy levels.

The new components to be used are state of the art deep-sea instruments and methods, now integrated in an observatory for sound and pressure measurements. Thus the system relies on proven technology. There is no development effort necessary to get the envisaged infrastructure into an operational condition.

Sea Operations and marine infrastructures:

The operational depths of the LIDO sites are over 2100 m for East Sicily and over 3200 for Gulf of Cadiz. The LIDO recovery/deployment and underwater connection operations will be carried out using reliable and tested procedures and vessels (e.g., research and cable ships, ROVs, the MODUS shuttle, handling facilities). In the case of the East-Sicily site, the underwater station will be connected to the main electro-optical cable using connections available on the market, whose reliability is widely demonstrated. In the case of Cadiz the data transmission infrastructure through surface buoy was validated by the present NEAREST mission.

Instrumentation and probes:

The acoustic antennas for the LIDO stations will be arrays of hydrophones and their front-end electronics. The digitisation and data transmission electronics will be hosted inside underwater pressure-resistant vessels. The front-end and data digitisation electronics will be realized on the basis of the available professional audio technology and components that permit excellent performances both in frequency sampling (192 kHz) and amplitude (24 bits, ~120 dB effective dynamic range) and permit low power consumption. This technology is highly reliable, and was already used for NEMO-SN1. The geophysical, oceanographic and other environmental probes and data sampling electronics installed on LIDO stations will be based on the design already tested for GEOSTAR and NEMO-SN1: commercial probes (e.g., CTD, seismometers, pressure sensor), selected on the basis of their accuracy and reliability, will be acquired using custom front end and data sampling electronics. In the case of the East Sicily site, data transmission will be based on optical fibres DWDM technology. This technology is well established and allows “all data to shore” transmission. The NEMO-SN1 experience demonstrates full sustainability of the expected data rates using this technique. The shore data acquisition electronics will be based on digital signal processing in order to

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allow fast data management, analysis and availability through Internet. An adequate computing farm on shore will allow on-line calculation of sea noise spectra, first-level trigger to subsequently recognize acoustic pulse shape and identify source position using TDoA analysis. The digital signal processing technology offers a wide range of possibilities to implement hardware and software solutions for the data acquisition. Software analysis and visualisation tools will be realised based on open-source and/or commercial software. Therefore, all the proposed technologies for the experiment realisation are feasible and coherent with the present status of technology, making the realisation the LIDO project a challenging but concrete opportunity within the proposed time schedule.
d) Cost effectiveness
LIDO will be developed taking advantage of infrastructure managed and put at disposal by the partners.
Available infrastructures:
- NEMO-SN1 cabled seafloor observatory which is the ESONET first operative key-site located in Eastern Sicily (Central Mediterranean, Southern Italy) including the seafloor geophysical and oceanographic station SN-1, the seafloor acoustic station O□de, the underwater neutrino telescope prototype (mini-tower), the underwater electro-optical cable from Catania harbour down to 2100 m w.d., about 28 km offshore, a shore station hosting the cable land termination.
- East Sicily: INFN-LNS shore laboratory located in the port of Catania, equipped with: construction hall, electronics and mechanics workshops, electro-optical cable landing terminal, data acquisition room, computing and data storage room, internet connection to LNS-INFN (see above).
- GEOSTAR seafloor multiparameter observatory operating in the Gulf of Cadiz in autonomous mode in the framework of the EC NEAREST Project; It includes the multiparameter seafloor observatory equipped with geophysical and oceanographic sensors, a surface buoy for the communication between the observatory and the control station on land;
MODUS a simplified version of ROV dedicated to the deployment and recovery of GEOSTAR-type observatories.
- A light work-class deep-sea ROV, 4000 m depth rated (available from 2nd half of 2008) with manipulators for underwater cable connection/disconnection;
- the R/V Urania through application to the Ship Committee of CNR.
- the R/V Sarmiento de Gamboa through application of the Spanish ship Committee
- a Bioacoustic Laboratory with acoustic instrumentation and acoustic data analysis facilities at University of Pavia.
- Laboratory of Applied Bioacoustics, Technical University of Catalonia, Barcelona (see above)
The above listed resources represent the partnership’s co-funding to the proposed demonstration mission.
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<td>Relevance to the objectives of ESONET NoE:</td>
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a) Quality and effectiveness of integration
Following the ESONET NoE objectives and recommendations, LIDO will:

Promote integration through the development of Activities designed:

to continue the networking process going from individual observatories to regional efforts, integrating some simple physical sensing techniques into a unified long-term monitoring. LIDO proposes to first demonstrate the viability of this approach on geophysical and bioacoustics aspects. The project will be the first step towards a complete and unified physical oceanographic monitoring of the water column. This approach is intended to provide the scientific community and the general public a set of meaningful data so that the effort being conducted by countries and EU must be maintained.
to constitute integrative groups initially between geophysical and bioacoustics

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experts, expanding the integration towards physical oceanographers.

- o to include in the consortium management structure an Advisory Committee (Scientific, Test and Operation, Data Management) guiding the integration in all three fields ;
- o to plan all activities in order to demonstrate at national and regional decision level the viability on integration at European level before month 18;
- o to use the results of the activities to mobilise interest of socio-economic actors and train the staff of the ESONET NoE partners to share a common scientific and technological culture;
- o to implement user-friendly interfaces to make available acoustic images to the general public (e.g., Scientific Museum and Aquaria);
- o to help integrating LIDO output into the Joint Research Programme to develop common economic and legal approach.

- 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. LIDO will propose a regional development that will integrate several national groups, members of the consortium.
- The principle of exchanging and sharing means and personnel by the NoE is well supported in LIDO since the two underwater observatories (NEMO and NEAREST) will allow to implement new technologies on existing structures to allow the acquisition and analysis of an extended set of data that will be shared by all members of the ESONET NoE.

The integration at European level is of most importance for the NoE 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. Demonstrating that the NoE can go from individual (national) to regional level is a necessary step to integrate a European level.

These indicators will be checked at the end of the LIDO demonstration mission during independent reviews regarding the progress towards integration and will be a permanent concern of the Steering Committee.

b) Expected impact and durability of the achieved results

Geo-hazards

LIDO represents a new step towards a comprehensive multi-disciplinary monitoring of the southern ocean border of Europe. After the Sumatra tsunami decision-makers understood that the populations expect that existing know how of deep seafloor observation must be used to build early warning systems that can prevent the effects of major catastrophes. Presently tsunami “warnings” and “dismisses” are followed by the media in all places on Earth and Europe must develop its own system along its seismic active border, particularly vulnerable during the Summer.

ESONET must provide the seafloor component of the Early Warning System. Data integration between the different segments of the warning system will be made by the national operational institutes and messages will be spread by Civil Protection Authorities. As most of the geo-hazard sources that affect Europe are located on sea, the system will also provide an important set of information for the study of the physical processes related with seismogenesis, one of the biggest challenges for geosciences in the forthcoming decades.

Bioacoustics

LIDO considers as key long-term objectives the following questions that will contribute, at the European level, to the expected impacts listed in the ESONET NoE DoW:

• to concentrate in one location through ESONET NoE existing and future data on man-made sources and noise as well as on marine biological sources (especially whales and

	dolphins). • to develop quantitative relationships between man-made noise and levels of human activity; • to establish a long-term ocean noise and biological sounds interactions/monitoring program covering the frequency band from 1 to 80,000 Hz; • to conduct research on the long-term distribution, migration patterns, habitat use, characteristics, identification and classification of marine biological sounds and organisms; • to implement a European ocean acoustic map by monitoring ocean noise in geographically diverse areas with emphasis on marine mammal habitats; • to examine the impact of ocean noise on marine mammals species, with emphasis on the impact of intense individual sound sources as well as on the behavioural and masking effects of diffuse noise, to support management and regulatory actions for the conservation of marine mammals. • to examine the impact of ocean noise on non mammalian species in the marine ecosystem; • to propose a long-term mandate to the ESONET NoE to coordinate at European level the ocean noise monitoring and research, and its effects of noise on the marine ecosystem; **c) Standardisation** The planned infrastructure of LIDO is designed as a long-term observatory system. The installed instruments may have to be replaced for recalibration purposes or for service and maintenance. On top of that different types of temporary used, guest instruments will be integrated dependent on the scientific requirements during certain observation periods. Therefore it will be necessary to come up with a concept that allows for easy integration and operation of all anticipated instruments. The standardization concept that will be pursued during LIDO starts at the detailed description of each sensor and instrument inserted by the user into a standard interface control document. In the first phase of LIDO, this will be started by each partner having to fill out a form for each deployed instrument. As planned within WP2 inside ESONET an online form will be created where all specifications of the observatory instruments are stored. With this sensor registry an inventory of all instruments in use of the observatory can be derived and published on the Internet. For the first construction phase there will be no real-time data access available to the LIDO observatory. However, in the context of a future fully integrated observatory the conceptual design will take all foreseeable aspects in regard to standardisation and interoperability into account. This applies in particular to the following issues, where a full description will be given to the • Function and operation of all observatory instruments • Communication and power interfaces • Time synchronisation • Actual geographical position for mobile systems • Safety issues • Deployment requirements. It cannot be foreseen that current instruments will all be equipped with a standard connector or power and data interface. However, this problem can be circumvented by employing additional, intermediate modules that for instance are under development in the USA (PUCK, MBARI). In the case that the existing infrastructure is fully described the integration of these intermediate devices is easily feasible. Together with this metadata information that will be compatible to GEOSS the WDC-MARE/ PANGAEA data archiving and management system will make all collected data available through an ESONET internet portal. This part of the work will particularly benefit from the work and results from ESONET NoE WP1.The operational status of all observatory

instruments and the available archived data will be accessible via a Web service which means that the information is machine readable and can be accessed without the need of a human interaction. This will be the first step towards establishing a standard observatory service that will not only assist the directly involved scientist in retrieving and evaluating the data but will allow all interested external users to access the collected data in a convenient way.

d) Synergy with European and national initiatives

The LIDO mission benefits of the synergy with several national and EU initiatives. LIDO is strictly related to European and national funded initiatives. The East Sicily site, in particular, was built and operated in the framework of the LAMS project funded by PON 2000-2006. Moreover INFN and INGV have received funds by “Regione Siciliana”, named PEGASO, for the realisation of a deep sea handling infrastructure for the deployment, recovery and connection of scientific and research deep sea station. This project foreseen the complete realisation for the end of 2008. LIDO is going to use the ROV for the deployment and connection of the station on the NEMO-SN-1 site in the second half of 2008. Presently INFN, INGV and ISMAR are participating to the KM3NeT-DS (Design Study) that is funded by the 6° FP, the NEMO-SN1 site represents a key point for the testing of the new system developed during the project. ISMAR is the coordinator of the EC project NEAREST, in this project INGV, FFCUL, CSIC, TFH are partner, while Tecnomare as sub-contractor. INFN and INGV are also coordinators of the preparatory phase of the two ESFRI (European Forum for Research Infrastructures) in strong synergy each other): KM3NET (kilometre-cubic underwater neutrino observatory) and EMSO (European Multidisciplinary Seafloor Observatory) respectively. In particular EMSO aims at realising and managing the seafloor network, fulfilling one of the main goals of the ESONET projects (CA and NoE).

e) External funding

Te Italian project PEGASO will fund (about 700 kE) the recovery of SN1 and O□de stations and their enhancement for the development of the LIDO experiment. This means:

- the use of a cable-ship and a ROV for the cable disconnection and recovery of the seafloor platforms;
- the acquisition of the new sensors and devices to be installed on SN1;
- the man-months dedicated to the refurbishment and enhancements of SN1 and Ovde;
- the shore station adaptation.

The EC project NEAREST will cover the recovery and re-deployment of the GEOSTAR station for refurbishment and of the surface buoy for enhancements. This means the use of the R/V Urania shiptime (about 140 kE).

From other European projects like CARBO-OCEAN 150kE-external funds being related to data management tools.

ANNEX 1. WORK DESCRIPTION

WP No1	WP title	WP Leader	Person - months	Start month	End month	Deliverable No
WP1	Recovery, refurbishment and enhancements of the observatories	INGV	90,5	1	20	D1.1.1, D1.1.2, D1.1.3, D1.1.4, D1.1.5, D1.1.6
WP2	Quality and Data Management	UB	45	6	22	D2.1, D2.2, D2.3, D2.4, D2.5
WP3	Public Outreach	FFCUL	12	3	24	D3.1
WP4	Technological Spreading	INFN	50	3	24	D4.1.1, D4.1.2, D4.1.3 D4.1.4, D4.1.5, D4.1.6. D4.7, D4.8
WP5	Project Management	UPC	10	1	24	D5.1, D5.2
	TOTAL		**207,5**			

WORKPACKAGES DESCRIPTION

Workpackage number	1	**Start date or starting event:**	

Workpackage title: *Recovery, Refurbishment and Deployment of Observatories*

Participant id	UPC	UB	FFCUL	**INGV**	ISMAR	INFN	CSIC	DBS	CIBRA	TFH	TEC
Person-months per participant:	2			**36**	19	18	4			4	7.5

Objectives: the work package will develop enhancements of existing NEMO-SN1 and GEOSTAR observatories and infrastructures to open the nodes of a first nucleus of regional network to other disciplines (bioacoustics) and homogenize the geophysical equipments of these observatories by integrating additional sensor, devices, and software. The development of the pilot experiment for long-term operation of the observatories and comparative tests is also included.

Description of work

Activity 1.1 - Enhancement of existing NEMO-SN1 infrastructure by integrating additional devices, specifically full depth pressure sensor for deep water pressure signal detection, high sampling rate hydrophones for marine mammal tracking.

- Recovery of SN-1 and OvDE Station
- Refurbishment and upgrade of the OvDE station.
- Deployment of SN-1 and OvDE station after enhancements.
- Refurbishment of MODUS (e.g., spare parts).

Activity 1.2. – Refurbishment of the GEOSTAR observatory and upgrade of the surface buoy for communications operating in the Gulf of Cadiz within the EC-NEAREST pilot experiment

- Recovery of the observatory by means of MODUS
- Refurbishment (e.g., batteries and spare parts) of the observatory
- Refurbishment of the surface buoy and upgrade with installation of new sensors (high sampling rate standardized hydrophones)
- deployment by means of MODUS of GEOSTAR and new long-term mission (1 year) in the Gulf of Cadiz (same site as in NEAREST experiment)

Activity 1.3 – Pilot experiment of the Regional network of seafloor observatories

- periodical reporting on the pilot experiment.

Deliverables

D1.1 - Procedures for sea operations: recovery and deployment of SN-1 and O□de stations (East Sicily)
D1.2 - Status of the SN-1 and Ovde stations, new requirements and technical specifications of the enhancements
D1.3 - Developments of the enhancements and tests
D1.4 - Sea operations procedures for recovery and deployment of GEOSTAR (Gulf of Cadiz) and refurbishment
D1.5 - New requirements and technical specifications of the enhancements of the GEOSTAR surface buoy
D1.6 - Demo mission planning, development and follow-up

Workpackage number	2	**Start date or starting event:**	

Workpackage title: *Data Management*

Participant id	UPC	**UB**	FFCUL	INGV	ISMAR	INFN	CSIC	DBS	CIBRA	TFH	TEC
Person-months per participant:	8	**16**		4	4	6	1	6			

Objectives: standardisation of ocean observatory measurements by implementing international accepted standard methods in data acquisition and management; Establishment of a sensor inventory; Long-term sound recording and analysis; Long- term seismometric measurements and analysis.

Description of work

Activity 2.1 - Long-term comparative testing in two seismogenic/tsunamigenic near-shore areas (Eastern Sicily and Gulf of Cadiz) of the same methodological approach developed in EC-NEAREST for Tsunami warning and risk assessment by integration of marine (seafloor and surface) and land-based data.

Activity 2.2 - Implementation of advanced dsp software: real-time sampling & automatic identification and classification of biological (marine mammals), natural and artificial sounds through a wide network of sensors (hydrophones at the observatories).

Activity 2.3 - Analysis of long-term trends:

- in ambient noise levels, especially from human activities (influenced for example by increasing shipping);
- in marine mammals populations (migration patterns, presence, and habitat use of key species, like sperm, fin and beaked whales).
- of noise interactions (e.g. masking) with marine mammal sounds (key species, like sperm, fin and beaked whales).

Activity 2.4 – Implementation of a data collection and dissemination service based on the Sensor Web Enablement (SWE) and Spatial Data Infrastructure (SDI) concepts and compliant to the GEOSS guidelines allowing interoperability and demonstrating this service concept by including and presenting data from a non-European site, like NEPTUNE, MARS, SEACOOS or VENUS.

Activity 2.5. - The sensor registry will consist of data that describe in detail the instruments in use, including an identification code and a calibration procedure. From the sensor registry, all necessary metadata for describing the deployed instruments properly will be made available. Any partner supplying sensors will be responsible for supplying the corresponding metadata as well.

Deliverables

D2.1 - Software of real-time detection of biological sounds (whales and dolphins) and anthropogenic noise
D2.2 - Software of automatic classification of biological sounds (whales and dolphins) and anthropogenic noise
D2.3 - Software of marine mammal localisation and tracking
D2.4 - Report on the implementation of prototype SWE concepts
D2.5 - Report on the sensor registry

Workpackage number	3	**Start date or starting event:**	

Workpackage title: *Public Outreach*

Participant id	UPC	UB	**FFCUL**	INGV	ISMAR	INFN	CSIC	DBS	CIBRA	TFH	TEC
Person-months per participant:	2		6	1	2		1				

Objectives: Real-time transmission of marine mammal acoustic signals and acoustic images from seafloor cabled observatory to public institutions (e.g., Scientific Museums, Aquaria) where the whole ESONET network will be presented together with the "sonic imagery" of the LIDO stations.

Description of work

Activity 3.1 – Development of software tools to distribute and browse on the web real-time marine mammal acoustic signals and acoustic images from seafloor cabled observatory to public institutions (e.g. Scientific Museums).

Activity 3.2 - Real-time transmission of marine mammal acoustic signals and acoustic images from seafloor cabled observatory to public institutions (e.g. Scientific Museums). This activity will be demonstrated in a set of three different institutions, by the installation of large size plasma screens where the whole ESONET network will be presented together with the "sonic imagery" of the LIDO stations.

Deliverables

D3.1 -Website with real-time transmission of marine mammal acoustic signals and acoustic images from seafloor cabled observatory to public institutions.

Workpackage number	4	**Start date or starting event:**	

Workpackage title: *Technological Assessment*

Participant id	UPC	UB	FFCUL	INGV	ISMAR	**INFN**	CSIC	DBS	CIBRA	TFH	TEC
Person-months per participant:	2			1	4	**29**		6	6	2	

Objectives: test and validation of low cost acoustic arrays and recording systems to be implemented in additional locations to extend the monitoring network and possibly evaluate new European sites for long term monitoring.

Description of work

Activity 4.1 – On-shore tests and analysis of the recovered SN1 and O□DE Stations.

Activity 4.2 – Tests and validation of low-cost underwater arrays of hydrophones

- Test specifications and reliability of low-cost hydrophones - Test specifications and reliability of underwater data acquisition chain - Test specifications and reliability of underwater mechanical structures *Activity 4.3* – Integration of hydrophone arrays compliant with the existing underwater instrumentation, shore and deep-sea infrastructures - Test specifications and reliability of optical fiber links - Test specifications and reliability of power transmission links - Test specification and reliability of recording and analysis software *Activity 4.4* – Monitoring and supervision of deployed hydrophone arrays and infrastructures *Activity 4.5* – Tests and validation of the tsunami detector on SN1 and GEOSTAR - Test specifications and reliability of the tsunami detectors *Activity 4.6* – Test and validation of a multi axis neutrally buoyant geophone as a low-cost solution to bearing estimation in long-range acoustic monitoring of low-frequency and infrasonic whales from the sea-bed.
Deliverables D4.1 - Report on functioning/mis-functioning parts and subsystems of the recovered instrumentation D4.2 -TDR of new hydrophone arrays; TDR of data acquisition, power and data transmission systems, sea operations D4.3 - Reports on testing activity D4.4 - Reports on integration activity D4.5 - Final report on station tests after integration. D4.6 - Periodic reports of underwater stations, on-shore and off-shore systems under activity. D4.7 - Report on the necessities of standardization of commercially available underwater acoustic sensors and tsunami detector. D4.8 – Report on technological conclusions from test activities.

Workpackage number	5			**Start date or starting event:**						
Workpackage title: *Project management*										
Participant id	**UPC**	UB	FFCUL	INGV	ISMAR	INFN	CSIC	DBS	CIBRA	TFH	TEC
Person-months per participant:	**6**			2	2						
Objectives The Coordinator implements the administrative and financial decisions of the SC, within the framework set by the European Commission and under the authority of the ESONET NoE. The Activity Leaders are advised by the Advisory Council.											
Description of work *Activity 5.1* - Organization of the Committees and Agenda *Activity 5.2 – LIDO* Coordination and Internal Communications *Activity 5.3* - Periodical Reporting to ESONET											
Deliverables D5.1 - Management reports on 6-months D5.2 – Final Report											

ANNEX 2: DELIVERABLE LIST

Deliverable No	Deliverable title	Delivery date	Nature[1]	Dissemination level
D1.1	Procedures for sea operations: recovery and deployment of SN-1 and Ovde stations (East Sicily)	1	R	Consortium
D1.2	Status of the SN-1 and Ovde stations, new requirements and technical specifications of the enhancements	3	R	Consortium
D1.3	Developments of the enhancements and tests	7	R	Consortium
D1.4	Sea operations procedures for recovery and deployment of GEOSTAR (Gulf of Cadiz) and refurbishment	5	R	Consortium
D1.5	New requirements and technical specifications of the enhancements of the GEOSTAR surface buoy	3	R	Consortium
D1.6	Demo mission planning, development and follow-up	5	R	Consortium
D2.1	Software of real-time detection of biological sounds (whales and dolphins) and anthropogenic noise	22	R	Consortium

[1] Please indicate the nature of the deliverable using one of the following codes:
R = Report
P = Prototype
D = Demonstrator
O = Other

D2.2	Software of automatic classification of biological sounds (whales and dolphins) and anthropogenic noise	22	R	Consortium
D2.3	Software of marine mammal localisation and tracking	22	R	Consortium
D2.4	Report on the implementation of prototype SWE concepts	22	R	Consortium
D2.5	Report on the sensor registry	22	R	Consortium
D3.1	Website with real-time transmission of marine mammal acoustic signals and acoustic images from seafloor cabled observatory to public institutions	12	R	Consortium
D4.1	Report on functioning/mis-functioning parts and subsystems of the recovered instrumentation	3	R	Consortium
D4.2	TDR of new hydrophone arrays; TDR of data acquisition, power and data transmission systems, sea operations	5	R	Consortium
D4.3	Reports on testing activity	12	R	Consortium
D4.4	Reports on integration activity	15	R	Consortium
D4.5	Final report on station tests after integration.	18	R	Consortium
D4.6	Periodic reports of underwater stations, on-shore and off-shore systems under activity.	9,12,15,18, 21	R	Consortium
D4.7	Report on the necessities of standardization of commercially available underwater acoustic sensors and tsunami detector.	22	R	Consortium
D4.8	Report on technological conclusions from test activities Report on standardisation and spreading of acoustic sensors and tsunami detector	22	R	Consortium
D5.1	Six month based reports	6,12,18,24	R	Consortium and ESONET NoE Steering Committee
D5.2	Final report	24	R	Consortium and ESONET NoE Steering Committee

ANNEX 3: PLANNING WITH MILESTONES

LIDO - Time Table

Months		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
WP1																									
WP2																									
WP3																									
WP4																									
WP5							R						R						R						FR
Milestones								M1				M2								M3					

R = report, FR = Final Report

Milestone number	Milestone name	Work package(s) involved	Expected date 1	Means of verification2
M1	Infrastructures ready and Observatories deployed for the pilot experiment start.	WP1	Month 7 - 8	The pilot experiment is declared started.
M2	Museum involved in the DM outreach	WP3	Month 11 - 12	Number of connection to the LIDO website
M3	End of the pilot experiment	WP1	Month 18 - 19	The pilot experiment is closed.

ANNEX 4. STAFF EFFORT PER PARTNERS

		WP1	WP2	WP3	WP4	WP5	Total
1	UPC	2,0	8,0	2,0	2,0	6,0	20,0
2	UB	0,0	16,0	0,0	0,0	0,0	16,0
3	FFCUL	0,0	0,0	6,0	0,0	0,0	6,0
4	INGV	36,0	4,0	1,0	1,0	2,0	44,0
5	ISMAR	19,0	4,0	2,0	4,0	2,0	31,0
6	INFN	18,0	6,0	0,0	29,0	0,0	53,0
7	CSIC	4,0	1,0	1,0	0,0	0,0	6,0
8	dBS	0,0	6,0	0,0	6,0	0,0	12,0
9	CIBRA	0,0	0,0	0,0	6,0	0,0	6,0
10	TFH	4,0	0,0	0,0	2,0	0,0	6,0
11	TEC	7,5					7,5
	Total	**90,5**	**45,0**	**12,0**	**50,0**	**10,0**	**207,5**

ANNEX 5. FINANCIAL INFORMATION (KEUROS)

		Personnel		Durables		Travels		Consumables		Other cost		Infrastructure		Overheads	Total	ESONET Contribution
		Cost	**Request**	**Cost**	**Request**	**Cost**	**Request**	**Cost**	**Request**	**Cost**	**Request**	**Cost**	**Request**		**Cost**	
1	UPC	80	60	80		5	3	100	13				0	30	265,00	106,00
2	UB	80	42	5	0	3	3	10	10						98,00	55,00
3	FFCUL	30,00				5,00	3,00								35,00	3,00
4	INGV	190,00		15,00		10,00	3,00	160,00	80,00	320,00		1200,00			1895,00	83,00
5	ISMAR	208,00	15,00			12,00	3,00	20,00	6,00	12,00	11,00	140,00		5,00	397,00	40,00
6	INFN	330,00		100,00		5,00	3,00	65,00	45,00	200,00	127,00	7000,00			7700,00	175,00
7	CSIC	36,00				5,00	3,00					180,00			221,00	3,00
8	dBS	42,00	3,00	4,00	0,00	3,00	3,00	4,00	4,00						53,00	10,00
9	CIBRA	20,00				3,00	3,00		7,00						23,00	10,00
10	TFH	42,00	0,00			5,00	3,00	22,00	22,00	20,00	20,00	350,00			439,00	45,00
11	TEC	150,00	50,00			10,00	3,00	25,00	17,00						185,00	70,00
	TOTAL	**1208,00**	**170,00**	**204,00**		**66,00**	**33,00**	**406,00**	**204,00**	**552,00**	**158,00**	**8870,00**		**35,00**	**11311,00**	**600,00**

Annex 3: Letters sent in August 2009 to each site

From: Roland PERSON
Coordinator of ESONET NoE
Ref: FP6-2005-GLOBAL-4 - Proposal n° 036851-2
IFREMER/TSI
Centre de Brest - BP 70
F-29280 Plouzané
esonet-coordinator@ifremer.fr

To: ANTARES's PI

Plouzané, the 6 August 2009

Subject : Test Call, ANTARES

Dear Colleagues,

According to the Steering Committee meeting held by audio conference the 28th of July 2009, more information is requested regarding the test proposal for the ANTARES site.

1/ Indeed Financial information provided deals mainly with equipment and consumable cost and requested grant to ESONET. The staff cost is stated only for INSU whereas INVG and INFN for instance are participating too.

Costs for "Travel and Accommodation" should be paid on the exchange of personnel budget, so please identify them well with the suitable information (who's going where for how long?). Transit of instruments; equipments for calibration and test in ground facilities like to Brest or for boarding should be also included in the exchange of personnel budget associated to the travel of one person at least. We will calculate the exchange of personnel budget according to the information you will provide.

Consequently, please provide us with all costs per category and partner according to the excel sheet provided. Of course the specified costs for equipment and consumable that you provided are welcome and must be kept.

2/ The steering Committee also required more information on what part of the data management is paid by WP9, Exchange of Personnel and what would be funded by this proposal. In addition it is requested to check how the experiment could be opened to test plug and play instruments in Deep Ocean after their test in shallow water.

3/ Please list also the tests that will be performed:

Prototype Equipments, Hardwares, softwares	When? + duration	Where?

Calibration **procedures** for	When? + duration	Where?

Underwater interventions **procedures** for	When? + duration	Where?

Other: specify	When? + duration	Where?

The requested information is expected for the 11th of September and must be sent to Jean.Marvaldi@ifremer.fr with copy to esonet-coordinator@ifremer.fr.

Best regards

Roland Person
ESONET NoE Coordinator

Attached documents:

Received final proposal
Excel sheet to complete

From: Roland PERSON
Coordinator of ESONET NoE
Ref: FP6-2005-GLOBAL-4 - Proposal n° 036851-2
IFREMER/TSI
Centre de Brest - BP 70
F-29280 Plouzané
esonet-coordinator@ifremer.fr

To: Koljo Fjord's PI

Plouzané, the 6 August 2009

Subject: Test Call, Koljo Fjord

Dear colleagues

We received 5 proposals after the call for test activities on cabled sites: 2 proposals for deep-sea waters (ANTARES and NEMO) and 3 proposals in shallow waters (OBSEA, Koljo Fjord and Koster Fjord).

During the Steering Committee meeting held by audio conference the 28th of July 2009, it was discussed if it is possible to add or not 2 shallow water test sites in ESONET, which are not listed in the ESONET contract (DoW). The Steering committee agreed that funding 5 sites with cable will be a great opportunity to outcome data and to show that it works. It will be also an opportunity to exchange methods and know how on very applicative purposes. The competition in this framework is good. It would better to include 5 sites. In addition it will show that standardisation is applied on 5 sites. This will also enhanced the links with WPs activities too. Consequently it has been decided to go on with the process including both Koljo Fjord and OBSEA site for the next step.

In any case, please note that the final merged description of ESONET testing activities on cabled sites including the 5 proposals will be sent to the European commission for approval.

To go ahead now, more information is requested regarding the test proposal for the Koljo Fjord.

1/ Financial information.
Please provide us with all costs per category and partner according to the excel sheet provided in attachment. **Costs for "Travel and Accommodation" should be paid on the exchange of personnel budget, so please identify them well with the suitable information** (who's going where for how long?). Transit of instruments; equipments for calibration and test in ground facilities or for boarding should be also included in the exchange of personnel budget associated to the travel of one person at least. We will calculate the exchange of personnel budget according to the information you will provide.

2/ Link with HYPOX
The Steering Committee also requests to clarify the link with HYPOX: the integration of HYPOX activities in ESONET is a great opportunity and is very welcome, but we have to be very clear on what is paid and done by ESONET and what is paid and done by HYPOX in order to show that double funding is avoided.

3/ Tests list
Please list also the tests that will be performed:

Prototype Equipments, Hardwares, softwares	When? + duration	Where?

Calibration **procedures** for	When? + duration	Where?

Underwater interventions **procedures** for	When? + duration	Where?

Other: specify	When? + duration	Where?

The requested information is expected for the 11th of September and must be sent to Jean.Marvaldi@ifremer.fr with copy to esonet-coordinator@ifremer.fr.

Best regards

Roland Person
ESONET NoE Coordinator

Attached documents:

Received final proposal
Excel sheet to complete

From: Roland PERSON
Coordinator of ESONET NoE
Ref: FP6-2005-GLOBAL-4 - Proposal n° 036851-2
IFREMER/TSI
Centre de Brest - BP 70
F-29280 Plouzané
esonet-coordinator@ifremer.fr

To: Koster Fjord's PI

Plouzané, the 6 August 2009

Subject: Test Call, Koster Fjord

Dear colleagues

We received 5 proposals after the call for test activities on cabled sites: 2 proposals for deep-sea waters (ANTARES and NEMO) and 3 proposals in shallow waters (OBSEA, Koljo Fjord and Koster Fjord).

During the Steering Committee meeting held by audio conference the 28th of July 2009, it was discussed if it is possible to add or not 2 shallow water test sites in ESONET, which are not listed in the ESONET contract (DoW). The Steering committee agreed that funding 5 sites with cable will be a great opportunity to outcome data and to show that it works. It will be also an opportunity to exchange methods and know how on very applicative purposes. The competition in this framework is good. It would better to include 5 sites. In addition it will show that standardisation is applied on 5 sites. This will also enhanced the links with WPs activities too. Consequently it has been decided to go on with the process including both Koljo Fjord and OBSEA site for the next step.

In any case, please note that the final merged description of ESONET testing activities on cabled sites including the 5 proposals will be sent to the European commission for approval.

To go ahead now, more information is requested regarding the test proposal for the Koster Fjord.

1/ Financial information.
Please provide us with all costs per category and partner according to the excel sheet provided in attachment. **Costs for "Travel and Accommodation" should be paid on the exchange of personnel budget, so please identify them well with the suitable information** (who's going where for how long?). Transit of instruments; equipments for calibration and test in ground facilities or for boarding should be also included in the exchange of personnel budget associated to the travel of one person at least. We will calculate the exchange of personnel budget according to the information you will provide.

2/ Tests list
Please list also the tests that will be performed :

Prototype Equipments, Hardwares, softwares	When? + duration	Where?

Calibration **procedures** for	When? + duration	Where?

Underwater interventions **procedures** for	When? + duration	Where?

Other: specify	When? + duration	Where?

The requested information is expected for the 11th of September and must be sent to Jean.Marvaldi@ifremer.fr with copy to esonet-coordinator@ifremer.fr.

Best regards

Roland Person
ESONET NoE Coordinator

Attached documents:

Received final proposal
Excel sheet to complete

From: Roland PERSON
Coordinator of ESONET NoE
Ref: FP6-2005-GLOBAL-4 - Proposal n° 036851-2
IFREMER/TSI
Centre de Brest - BP 70
F-29280 Plouzané
esonet-coordinator@ifremer.fr

To: NEMO's PI

Plouzané, the 6 August 2009

<u>Subject</u>: Test Call, NEMO

Dear colleagues

We received 5 proposals after the call for test activities on cabled sites: 2 proposals for deep-sea waters (ANTARES and NEMO) and 3 proposals in shallow waters (OBSEA, Koljo Fjord and Koster Fjord).

To go ahead now, more information is requested regarding the test proposal for NEMO site.

1/ Financial information.
Please provide us with all costs per category and partner according to the excel sheet provided in attachment. **Costs for "Travel and Accommodation" should be paid on the exchange of personnel budget, so please identify them well with the suitable information** (who's going where for how long?). Transit of instruments; equipments for calibration and test in ground facilities or for boarding should be also included in the exchange of personnel budget associated to the travel of one person at least. We will calculate the exchange of personnel budget according to the information you will provide.

2/ Tests list
Please list also the tests that will be performed:

Prototype Equipments, Hardwares, softwares	When? + duration	Where?

Calibration **procedures** for	When? + duration	Where?

Underwater interventions **procedures** for	When? + duration	Where?

Other: specify	When? + duration	Where?

The requested information is expected for the 11th of September and must be sent to Jean.Marvaldi@ifremer.fr with copy to esonet-coordinator@ifremer.fr.

Best regards

Roland Person
ESONET NoE Coordinator

Attached documents:

Received final proposal
Excel sheet to complete

From: Roland PERSON
Coordinator of ESONET NoE
Ref: FP6-2005-GLOBAL-4 - Proposal n° 036851-2
IFREMER/TSI
Centre de Brest - BP 70
F-29280 Plouzané
esonet-coordinator@ifremer.fr

To: OBSEA's PI

Plouzané, the 6 August 2009

Subject: Test Call, OBSEA

Dear colleagues

We received 5 proposals after the call for test activities on cabled sites: 2 proposals for deep-sea waters (ANTARES and NEMO) and 3 proposals in shallow waters (OBSEA, Koljo Fjord and Koster Fjord).

During the Steering Committee meeting held by audio conference the 28th of July 2009, it was discussed if it is possible to add or not 2 shallow water test sites in ESONET, which are not listed in the ESONET contract (DoW). The Steering committee agreed that funding 5 sites with cable will be a great opportunity to outcome data and to show that it works. It will be also an opportunity to exchange methods and know how on very applicative purposes. The competition in this framework is good. It would better to include 5 sites. In addition it will show that standardisation is applied on 5 sites. This will also enhanced the links with WPs activities too. Consequently it has been decided to go on with the process including both Koljo Fjord and OBSEA site for the next step.

In any case, please note that the final merged description of ESONET testing activities on cabled sites including the 5 proposals will be sent to the European commission for approval.

To go ahead now, more information is requested regarding the test proposal for OBSEA.

1/ Financial information.
Please provide us with all costs per category and partner according to the excel sheet provided in attachment. **Costs for "Travel and Accommodation" should be paid on the exchange of personnel budget, so please identify them well with the suitable information** (who's going where for how long?). Transit of instruments; equipments for calibration and test in ground facilities or for boarding should be also included in the exchange of personnel budget associated to the travel of one person at least. We will calculate the exchange of personnel budget according to the information you will provide.

2/ Tests list
Please list also the tests that will be performed :

Prototype Equipments, Hardwares, softwares	When? + duration	Where?

Calibration **procedures** for	When? + duration	Where?

Underwater interventions **procedures** for	When? + duration	Where?

Other: specify	When? + duration	Where?

The requested information is expected for the 11th of September and must be sent to Jean.Marvaldi@ifremer.fr with copy to esonet-coordinator@ifremer.fr.

Best regards

Roland Person
ESONET NoE Coordinator

Attached documents:

Received final proposal
Excel sheet to complete

Annex 4: Final Merged proposal

ESONET cabled sites – Merged Test Proposal

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1. Introduction

The ESONET NoE still suffers from insufficient access to online data. Most demonstration missions are conventionally run with lander deployment / retrieval and subsequent data publication. ESONET needs a Web portal with real-time web interface from online observatories. In order to do so, online data are urgently needed. This was one strong demand during the 2009 review of ESONET in Brussels. The LIDO demonstration mission is expected to go online soon, but more examples are needed. The test sites will allow to launch the Web portal with real-time web interface and show to all users (the ESONET community, public, industry and politicians) incoming data and underwater activities of Internet operated vehicles and service-ROVs. This will enable the ESONET partners as well as the general public (to a given extend) to actively participate in ESONET research. The test sites with their power supplies will also allow scientists and engineers to test power-hungry sensors for future ESONET observatories. As they will test new technologies or sampling programs, the data connection allows ESONET to immediately know how things are going on. Especially the coastal test sites will enable ESONET to send a maintenance ship and ROV to the study sites on short notice in case there are eventual problems. There is no better place to try out new equipment for ESONET. But deep sea test are also required to progress in deployment procedures.

The direct Internet connectivity makes it possible for classrooms to participate as virtual explorers in the environment. The test sites and connected Web sites will finally give access to real-time data including streaming video and even access to some interactive experiments.

As few demonstration missions (LIDO) are using cables, real time data access will only be possible in a few cases. So, it appears most important to promote real time access to data on existing cabled site.

A call for tests on cabled sites was issued in July 2009. Its title was:

"Integrated organisation of tests and observatory methodologies on cabled ESONET observatory sites"

Emphasis was put on ten key issues that should be addressed:

1- Integration of the defined generic sensor package into cabled observatories

2- Validate calibration procedure of the generic sensor package

3- Standardisation and interoperability issues should be addressed by referring to procedures that have been described within relevant reports from WP2

4- Test of standard interfaces and Plug and Work Concepts

5- Integration into ESONET sensor registry activities

6- Test of recommended ROV instrument deployment procedures in particular for wet mateable connectors

7- Employing ESONET testing facilities

8- Evaluation of recommended quality management procedures

9- Integration into ESONET data management concepts as for instance in regard to metadata description, real time data access, free access to collected data.

10- Training of scientists and engineers to use and develop deep sea observatory sub systems.

The call was focused on long term deployment in deep sea water and technical issues (Science is not the main objective).

The coordinator received 5 proposals involving more often only one site. Only three are ESONET sites (NEMO-East Sicily, Antares, Kosterfjord) and three proposed sites (Kosterfjord, OBSEA, Koljofjord) are in shallow water.

The Coordination team was mandated by the Steering Committee (07 October 2009) to prepare a proposal integrating a maximum of proposed tests in a coherent way.

The test call was discussed during the 2nd Best Practices Meeting in Brest (08 October 2009). Main recommendations were issued from the discussions, according to the list of items considered for analysing the proposals:

PROPOSAL NAME	Merged Test Call
IDENTIFICATION	
Proposal leader	Unique
Proposal partners	Several countries
TECHNICAL	
Site localisation	Several sites accepted (range of salinity and temperature)
Site depth - m	One or more in deep water
Infrastructures	
Cable to shore	Mandatory
Sea bottom	Diversity is welcome - Open to wide range
Shore station	Existing
Land based premises	Existing
Intervention means	
Ships	Planned and co-financed (extra days)
ROV	Important for tests at sea
Divers	Additionally
Deployed equipment and sensors	Generic sensors of Esonet (See Deliverable D13)
	Additional sensors welcomed
Deployment planning	Compatible between the sites
	Check list to be reported
On shore equipment test programme	Environment resistance test for all equipments before deployment
Sensor calibration programme	Pre and post deployment for the sensors
	Parallel calibration by a reference equipment is an advantage during deployment
At sea equipment test programme	Functional testing
	Must be reported.
	Feed back of proper operation before leaving the site unattended.
At sea measurement programme	Biofouling to be addressed in various conditions (sensors and cameras)
	Frequencies of measurement: high frequency possible for technology tests.
	Reference scientist for each sensor.
Data management	Refers to WP9 - Periodical checking of the data quality.
Site access to others	Mandatory according to liability and access rules.
Data access to others	Mandatory
FINANCIAL	Maximum budget is 550 000 k€ for the total

A work meeting was held in Barcelona on 21 November 2009 and the following statements were agreed:

- As concerns the thematics addressed by the proposal:

A site partner was charged of writing each item

. Sensor qualification: UGOT (Per Hall)

Measuring protocol: measure, calibration ... / Generic packages / Quality control. Drift check. Bio fouling prevention. / Long term behaviour. Inter calibration (different kinds of sensors for the same parameter)

. Standardization: UPC (Joaquim Del Rio)

Interoperable Data management / Instrument control / Plug and play concepts. Sensor registry.

. ROV operations: INFN with INSU / Ifremer (Giorgio Riccobene)

Interoperability: deployment procedures, ROV and vessels / Connector mating / Maintenance.

. Public outreach: Jacob University (Laurenz Thomsen)

Access to data in real time. / Taking into account mammals.

- As concerns the contribution of each site:

Describe existing infrastructure, what instrumentation will be deployed within the frame of the proposal, what instrumentation is already in place and will be accessible to ESONET, availability of plugging point to test other instruments not provided by the site proponent (plugs, electrical characteristics, mechanical constraints, acquisition constraints…).

ANTARES - Dominique Lefevre

NEMO- SN1, East Sicily - Giorgio Riccobene)

OBSEA- Joaquim Del Rio

Koljo Fjord – Per Hall

Koster Fjord – Laurenz Thomsen

- As concerns the amount and sharing of Esonet financial contribution:

The budget of the test call will be limited to total 550 000 € shared as under:

ANTARES:	208 000
NEMO:	180 000
OBSEA:	100 000
Koljo Fjord:	60 000
Koster Fjord:	2 000

A complementary proposal will be submitted to Exchange of personnel for total 90 000€ shared as under:

ANTARES:	12 000
NEMO:	20 000
OBSEA:	20 000
Koljo Fjord:	20 000
Koster Fjord:	18 000

Finally the Koster Fjord was not maintained in the Merged Proposal.

2. Thematics

2.1 Sensor qualification

The Koljo Fjord is ideally suited for conducting tests on sensor systems. In particular the high variability of physical and biogeochemical parameters makes the environment predestined for long-term tests and the qualification of sensors that are meant for long term deployments on deep sea observatories. One of the major objectives is to define measuring protocols that describe the calibration, handling and maintenance of sensors under test. For CTD systems this is already well established and within ESONET targeted information exchange on these topics are underway. Due to the multidisciplinary aspect of ocean observatories it is of utmost importance to proceed in a similar way on other parameters, and in particular for biogeochemical measurements no comprehensive description is available. Therefore it is planned to select a specific parameter, in this case oxygen, to define procedures in cooperation with other ESONET partners and by this contribute to the idea of an ESONET label. Oxygen sensors are part of the generic sensor package defined within WP3 and therefore play a prominent role also for deep-sea environments. New methods like multivariate statistical analysis will be employed to improve the evaluation of the performance of the sensor itself and to conduct intercomparisons with other parameters.
The Koljo Fjord is an environment with a great variability in oxygen. Therefore it is ideally suited to carry out long-term tests at either high or low oxygen conditions, or both. As the conditions in the deeper part of the water column are very stable in situ calibrations are possible. Measurements at low oxygen conditions are crucial in evaluating corresponding sensor systems.
The Koljo Fjord is also well suited to test biofouling prevention again making use of the high variability of the environment. While in the surface zone strong fouling can occur the deeper dark, cold, low oxygen zone shows slower fouling and with other chemical processes as drivers behind.

Due to the flexibility of the moored observatory systems additional sensors can be connected easily. This will allow for intercomparison of for instance oxygen sensors based on different measuring principles.

2.2 Standardization

ESONET needs a Web portal with real-time web interface from online observatories. In order to do so, online data are urgently needed. This was one strong demand during the 2009 review of ESONET in Brussels.

Actually each observatory has its own software architecture and data management process. Some standards can be applied on top of each observatory's data management in order to access data from Internet in an standard way. Some of these standards can be SensorWebEnable, IEEE1451.0. or initiatives like DataTurbine for high speed real time data streaming.

The use of these standards in an observatory to access data and metadata from a general Web interface can provide interoperable data visualization from a the user point of view.

Other issues, not related with data access or data visualization, are important to archive interoperability between observatories as plug and work capabilities of the instrument. Initiatives as MBARI PUCK or interfaces like the SmartSensorBoard (Ifremer, UPC) have to be tested in different observatories.

Time synchronization in cabled observatories by Ethernet networks can be achieved implementing IEEE1588 Precision Time Protocol versus NTP or SNTP.

Next proposals have the objective to fix or demonstrate some of the related issues:

- Standardization:

. Real Time access to observatories data instrument:

using standards as: SensorWebEnable (SWE - SOS), IEEE1451.0 and DataTurbine. Demonstration of real time access to instrument data from generic Web clients. These standards will be applied to deployed instruments and new instruments in the OBSEA observatory. This test could be repeated in other observatories at the same time.

. Plug and Work demonstration:

PUCK protocol, XML IEEE 1451 TEDS and OGC standards like SensorML will be tested in real instruments at OBSEA Observatory. New instruments as *CTDs* and an *ADCP* instruments that implement PUCK protocol will be deployed to test theses standards. Retrieved components may include IEEE1451 TEDS, SensorML document, and instrument "driver" software to be installed on the instrument "host" computer or Network Capable Application Processor or "NCAP".

. Test of IEEE1451.4 TEDS (Transducer Electronic Datasheet):

integration with Mixed Mode Sensor applied to plug and play Hydrophones. Automated installation of a 1451.4 Mixed Mode Hydrophones will be tested in real conditions with an integration of this type of sensors with SWE (SensorWebEnable) standard.

. Test of the IEEE 1588 clock synchronization protocol:
through cable OBSs and the water column applied to OBSs synchronization. Underwater communication with acoustic modem will be installed and tested at the OBSEA observatory in order to establish underwater acoustic link with other acoustic modems for performance of Precision Time Protocol. Acoustic modem UWM2000 Link-Quest will be used.

. Tests of Smart Sensor interface, IEEE1488V2, IEEE 1451 connected to a new generation of MicrOBS-Ethernet (Ocean Bottom Seismometer):
Ethernet Smart Interface board are been developed by Ifremer in collaboration with UPC. This new open hardware and software project will support automated clock synchronization (IEEE-1588v2), installation of IEEE-1451, serial instrumentation interfaces, time stamping services, continuous recording and continuous clock synchronization even during a power outage or a network failure, Power Over Ethernet interface and Plug and Play capabilities. A new generation of MicrOBS-Ethernet connected to a Smart Sensor board will be deployed as a demonstration application

. Test of the GEOSTAR Bioacoustic Antenna:
before deployment at Iberian Margin site, RT software analysis and storage of optimised data. Evaluation of prototype of geomagnetic observatory which includes three magnetometers and an electric sensor.

. Test: ESONET Instrument Registration:
Creation and test of automatic registration of instruments SensorML files to ESONET Sensor Registry (CTD, OBS, Hydrophones)

. Test: IEEE1451 to SML automatic mapping:
Automatic conversion of TEDS to SML

. Test: ESONET Sensor Registry Maintenance:
Test of information update functionality of Sensor Registration interface for a reduced set of parameters (history, status, position, etc.)

- Calibration procedures:

Comparison and calibration of the RT analysis of acoustic data performed via OBSEA with RT analysis on the stand-alone Geostar Bioacoustic Antenna
Implementation procedure calibration patterns Nortek AWAC. Current profiler.
Implementation procedure calibration patterns Hydrophone Ethernet 02345 Bjørge (Naxys).
Implementation procedure calibration patterns Geophone-OBS

Calibration of the IP Camera for real-time video acquisition for species recognition

- Underwater interventions procedures for

Deployment, Mooring and Retrieval of GEOSTAR Bioacoustic Antenna

Deployment of PUCK enabled CTD and ADCP

Deployment of IEEE1451.4 plug&play Hydrophone.

Deployment of the illumination staff for underwater IP camera

Deployment and recovery of sensors with ROV CHEROKEE of MARUM

Definition and test of workflows for integrating sensors into the subsea network as a contribution for defining an ESONET label

Test of Biofouling measures

2.3 ROV operations

A typical infrastructure of an ESONET cabled site is formed by a shore station, an electro-optical (e.o) cable and a submarine cable termination, possibly equipped with a Junction Box acting as connection hub for submarine Science Nodes (SN). The JB, usually, hosts also high-to-medium and/or medium-to-low voltage power converters and media converters for data transmission.

This kind of infrastructure permits the operation of dedicated Science Nodes with the only requirement of compliancy with the infrastructure's e.o. interfaces (software and hardware). The Science Nodes (SN) and the deep sea infrastructure are interconnected by a network of electro-optical cables with lengths of some tens metres. These cables have to be accurately laid on the seafloor along well-determined paths in order to avoid damages to this network during successive deployment of other Science Nodes. A possibility is to use interlink cables that will be deployed to the seabed on dedicated drum and then laid with the ROV with a technique well tested by the ANTARES Collaboration.

A major point of interest in ESONET is the standardization of the procedures for deployment, connection, maintenance and interchange of Science Nodes. This is a challenging task due to the fact that each ESONET Site is expected to serve several SN, thus installation procedures must be optimised in order to work in densely instrumented environments.

In recent years successful operations in deep sea have been conducted in the ANTARES Site (Ligurian Sea) and in the NEMO Test Site (East-Sicily) at depths of 2400 m and 2100 m respectively.

This merged proposal aims at sharing knowledge between ESONET members and at defining and validating common deployment, connection and maintenance procedures for deep sea operations in the ESONET sites.

- ESONET cabled infrastructures

Among the ESONET NoE only few sites benefit, at present, of cabled link to shore. The cabled sites for deep sea are: the ANTARES Site (2400 m depth, 40 km offshore Toulon, France), the NEMO Test

Site (2100 m depth, 25 km offshore Catania, Italy), the NEMO Capo Passero Site (3500 m depth, 85 km offshore Capo Passero, Italy).
The OBSEA is a cabled site at shallow water depth (20 m), 4 km offshore Vilanova I la Geltrù, Spain. While the Ligurian and East Sicily (Catania and Capo Passero) deep Sea Sites are recognized ESONET Site, the shallow water OBSEA will be an optimal candidate for long term test of science nodes, after the installation of interfaces (i.e. wet mateable e.o. connectors) similar to the ones present in the deep sea sites.

- General requirements for deployment and connection of Science Nodes

The deployment, connection and recovery of Science Nodes (SN) in deep sea cabled sites can be carried out only using specialized surface and underwater vessels, i.e. ships equipped with Dynamic Positioning (DP) systems and deep sea Remotely Operated Vehicles (ROVs) respectively.
Safe deployment and correct positioning underwater require that surface vessel must be equipped with a DP system able to maintain the ship position (a fully redundant DP system would be recommended). Moreover the ship must be equipped with an A-Frame and a heavy load crane capable to handle the science node (typically 5 ton to 10 ton load)
In order to minimise the Science Node installation costs, the deployment and connection of the Science Nodes must be performed in a single naval campaign. For this reason the ship must have a deck large enough to allow the transport of at least one SN, the installation of an ROV (plus its control container), and –possibly- of a special winch (and deep sea shuttle) to be used for the deployment.

- Deployment

Two techniques have been successfully tested for safe deployment and accurate positioning of SNs in deep sea cabled sites.
The first technique, extensively used in the ANTARES Ligurian Site, makes use of an acoustic Long Base Line (LBL), previously installed on the seabed that permits monitoring and driving of the SN deployment operation, from the surface vessel. The vessel is equipped with acoustic receivers capable to monitor, during the deployment, the position of the SN with respect to the LBL. This system was demonstrated to permit deployment on seabed with absolute accuracy of few metres.
The second technique (already used in the NEMO East-Sicily Site) makes use of a dedicated Deep Sea Shuttle (DSS) that holds the SN during the deployment. The DSS (the MODUS shuttle was used up to now) is equipped with acoustic transducers, sonar and cameras and it is handled by a winch with a long electro-optical-mechanical cable (adapted to the depth site), with cable speed control system (velocity range between 0.1 m/s and 1 m/s) and with a load measuring system with 100 kg accuracy. When the SN is close to the seabed, cameras and sonars, whose signals are sent to the surface vessel through the winch cable, provide all the information for a safe and accurate deployment.

For the present proposal the new PEGASO facility, owned by INFN and INGV, will be used to test and qualify deployment and recovery procedures of SNs in the two deep sea sites mentioned above. PEGASO consists of a DSS and of a light work class ROV, with garage and a 250 m long tether cable. Both the DSS and the ROV are handled by means of an electro-optical-mechanical cable, driven from a winch installed on the surface vessel. During the deployment in the ANTARES Site, tests of ROV/DSS navigation aided by the LBL signals will be also carried out. This test will be performed installing a special acoustic receiver onboard the PEGASO facility.

- Connection

Once the SN is deployed, it is connected to the infrastructure (Junction Box or Cable Termination) using ROV wet mateable connectors. An ROV is, therefore, mandatory for SN connection.
This kind of operations has been carried out, with success in most of the cases, both in ANTARES and NEMO sites. In the Ligurian Site the VICTOR ROV, owned by IFREMER, was used. In the East Sicily Site operations were conducted using ROVs rented on the market.
In the framework of this proposal the use of the new PEGASO ROV is planned both in the ANTARES and in the NEMO Sites for tests of connection and operability in densely instrumented areas. The PEGASO ROV is a light work class ROV, adapted from the SeaEye Cougar for operation down to 4000 m depth. This vehicle is lighter than the VICTOR and fully available for scientific applications. The aim is to validate the PEGASO ROV for operation in ESONET deep sea sites, improving the capacities of the ESONET NoE members in deep sea connection operations.
Another point of interest is that the ROV wet mateable connectors (Rolling Seal, hybrid connectors from ODI Teledyne) used in the two sites require maintenance and delicate connection procedures, preceded by optical inspection and cleaning (through low pressure water pumping) before connection. Connection failure and break is not uncommon. In this proposal repeated tests of connection and disconnection of ODI ROV wet mateable connectors together with possible use of different connectors (from the Seacon and the GISMA Companies) are planned. For this purpose the PEGASO ROV has been implemented with:

1) a system for connection/disconnection of wet mateable connectors and
2) a connector cleaning system.

- Recovery: maintenance and decommissioning of SNs

Similarly to what is described in the previous sections, both DSS and ROV will be used to recover Science Nodes (or part of the infrastructure, say the JBs). Tests of recovery procedures in the two deep sea sites are planned.

3. Overview of cabled site equipment and operations

This section presents a synthesis of the information provided for each cabled site regarding: infrastructures, deployed sensors and measuring equipment, data management, ship and ROV for interventions, operations carried out before deployment and during tests at sea.
Proposals are given in appendices.

3.1. Infrastructures

Deep sea sites

SITE	1-ANTARES	2-NEMO-SN1
IDENTIFICATION		
Final tech proposal date	11 September 2009	26 June 2009
Proposal leader	Univ. Méditerranée – COM / CNRS - LMGEM	INFN
SITE DATA		
Physical data		
Site category	Deep sea	Deep sea
Site localisation	Mediterranean Sea – South Toulon	East coast of Sicily Off shore Catania
Site depth - m	2500	2050 - 2100
Site distance to shore and/or harbour	42 km to shore and harbour	25 km to shore and harbour
Infrastructures		
Main cable to shore	• Antares MEOC in place - **Power**: 4400 VAC -10 A - (44kVA) - **Data**: 48 fibers	• East Sicily MEOC in place - **Power**: 500 VAC – 20 A – (10kVA) – 1 phase - **Data**: 10 single mode fibers • Cable dividing into 2 branches up to: Test Site North (TSN): 2 cond- 4 fibers Test Site South (TSS): 4 cond - 6 fibers
Sea bottom equipment	• Antares Junction Box (BJA) in place connected to: - Antares 6 storeys Instrumented Line IL07 in place - 2ary Junction Box (BJS) tb deployed	• At each TS: Ti frame connected to MEOC fitted with 2 UWM ODI 8 pins connectors: – 4 conductors: 700 VAC max - 7 A max – (4.9 kVA max)

SITE	1-ANTARES	2-NEMO-SN1
	connected to: . Acoustic relay (MII) tb deployed and . Instrument connectors available • Autonomous instrumented line (ALBATROSS) acoustically linked to MMI	- 4 fibers • At TSS frame, 1 of ODI connector s connected to Nemo-Phase.1 Junction Box fitted itself with: 2 UWM ODI 8 pins connectors: - Power : 380 VAC – 3 phases -1.5 kVA - Data : DWDM laser transmission (CWDM optional)
MEOC landing shore station		• INFN building in Catania harbour
Main land based premises	Antares terminal room– Building Michel Pacha	
Site access to others	• Accessible pending Antares collaboration agreement according to Antares User Guide procedures • During planned interventions at no extra cost / Out of planned interventions at operation cost	• Accessible pending: - Operation file submitted to and agreed by INFN-INGV - Access to data permitted to INFN-INGV

Coastal sites

SITE	3-OBSEA	4-KOLJO FJORD
IDENTIFICATION		
Final tech proposal date	06 July 2009	15 July 2009
Proposal leader	University Polytechnical Catalunya (UPC)	Göteborg University (UGOT)
SITE DATA		
Physical data		
Site category	Coastal	Coastal
Site localisation	Off shore Vilanova y Geltru	Koljö Fjord on Swedish west coast ~ 100 km north of Gothenburg
Site depth - m	20	45
Site distance to shore and/or harbour	4 km to shore and harbour	150 m to shore station 1 hour sailing to harbour
Infrastructures		
Main cable to shore	• MEOC in place - **Power**: 320 VDC - 11 A – (3.5 kW) (extendable to 1000 VDC) - **Data**: 6 single-mode fibers 1 Gbps / (1+1redundant) currently used	• Main 500 m armoured cable - **Power:** 100 W max - **Data**: 5 twisted pairs • UWM connectors at both ends (Under Water Mateable)
Sea bottom equipment	• Currently 1 cage-node housing: - Termination Box to MEOC, - Junction Box comprising: . (1+1redundant) DC/DC converter - 150 W . 6 UWM GISMA connectors (Series 10-Size 3-7 pins) to instruments: 3 currently occupied / 3 free Possibility to add 2 others	• Power-Communication Hub fitted with: - 2 Develogic modems - 4 serial ports (RS 422 or 232) - 1 twisted pair for camera - 5 UWM SubCon connectors – (Microseries-8 pins) - 2 ROV mateable GISMA connectors (Series 80) • Armoured cables to instrument nodes (20 & 30 m): - Power: - Data: RS 485

SITE	3-OBSEA	4-KOLJO FJORD
MEOC landing shore station		Transportable container (1m2 floor area): - Power: windmill 100 W + battery for 1 month - Communication: GPRS with Vizla server - Data collection & storage: IEEE 1451 server / AADI database collector / AADI Geoview for display
Main land based premises	• UPC premises 1 km in shore	• Data transferred to Göthenburg University – Also accessible through Kiel University server and Pangaea
Site access to others	• Accessible by contacting UPC	• Accessible pending submission of operation & instrument file and agreement by the contact person for underwater intervention

3.2. Sensors and measuring equipment

Deep sea sites

	TEST CABLED SITES - SENSORS-INSTRUMENTS										
	SITE	1-ANTARES					2-NEMO-SN1				
1	GENERIC SENSORS	Measure	Builder	Reference	Nb	Provider	Measure	Builder	Reference	Nb	Provider
1.1	Physical parameters										
	Press-Temp-Conduc	P	Genisea-Eca		1	Antares-IL07	P	Paroscientific	8CB4000-I	1	SN1-OnuDE
		C-T	SBE	SBE-SI	1	Antares-IL07	P-differential	Univ.S.Diego	Custom	1	SN1-OnuDE
		C-T-D	SBE	SBE-37-SMP	1	Antares-IL07	C-T-D	SBE	SBE-37-SM-24835	1	SN1-OnuDE
		C-T-D	SBE	SBE-37-SMP	1	Un.Med-Albatross					
	Dissolved O2	O2	AADI	Optode 3830	1	Antares-IL07					
		O2	AADI	Optode 3830	1	Un.Med-Albatross					
	Turbidity	Transmittivity	Wetlabs	C-Star	2	Antares-IL07	Turbidity	Wetlabs		1	SN1-OnuDE
1.2	Currents	ADCP	Teledyne-RDI	Workhorse	2	Antares-IL07	3C-1P-Current	Nobska	MAVS-3	1	SN1-OnuDE
		ADCP	Nortek	Aquadopp	1	Un.Med-Albatross	ADCP	Teledyne-RDI	Workhorse-600kHz	1	SN1-OnuDE
1.3	Passive Acoustics	Sound-Level	HTI	HTI-90-U	2 * 6	Antares-IL07	Hydro-Geophys	OAS	OAS E-2PD	1	SN1-OnuDE
		Sound-Level	Univ.Erlangen	Custom	1 * 6	Antares-IL07	Hydro-Geophys	SMID		1	SN1-OnuDE
							Hydro-BioAcous	Reson	Reson-TC4037	4	SN1-OnuDE
							Hydro-BioAcous	SMID	SMID-TR-401-V1	4	Lido-DemMission
2	OTHER SENSORS & INSTRUMENTS	Measure	Builder	Reference	Nb	Provider	Measure	Builder	Reference	Nb	Provider
2.1	Acoustics	Sound-Velocity	Genisea-Eca	QUUX-3A(A)	1	Antares-IL07					
1.3	Geophysics	Gravity-Waves	ACRI	Custom	1	ACRI-SJB	3C-BB-Seismo	Guralp	CMG-1T	1	SN1-OnuDE
							Gravity	IFSI-INAF	Custom	1	SN1-OnuDE
							3C-Acc+Gyro	Gladiator-Tec	Landmark 10	1	SN1-OnuDE
							Scal-Magneto	Mar.Magn.Sent.	Mar.Magn.Sentinel.	1	Lido-DM
							Vect-Magneto	INGV	Custom	1	Lido-DM
2.2	Optics-Video	Video-Images	AXIS	AXIS-221	2	Antares-IL07					
		Light-Level	Antares	Optical-Module	2	Antares-IL07					
		Bioluminescence			1	Univ.Med-SJB					
		Video-Particles	LOV		1	Univ.Med-SJB					
2.3	Various Types	O2-Consump	CPPM	Custom	1	Univ.Med-SJB					
		K40-activity	INGV	GEMS	1	INGV					

Coastal sites

	TEST CABLED SITES - SENSORS-INSTRUMENTS										
	SITE	3-OBSEA					4-KOLJOFJORD				
1	GENERIC SENSORS	Measure	Builder	Reference	Nb	Provider	Measure	Builder	Reference	Nb	Provider
1.1	Physical parameters										
	Press-Temp-Conduc	C-T-D	SBE	SBE-37-SMP	1	UPC-In.Place	T	AADI		1	RDCP- tb.borrowed
		C-T-D	SBE	SBE-16Plus-V2	1	UPC-Planned	C	AADI	4019	2	RDCP- tb.borrowed
							C-T	AADI	4319-A	4	Hypox-40 m String
							O2-T	AADI	3835	2	RDCP- tb.borrowed
	Dissolved O2						O2-T	AADI	4835	3	Hypox-40 m String
							O2-T	AADI	3835	2	RDCP- tb.borrowed
	Turbidity	Turbidity	Seapoint		1	UPC-Planned	Turbidity	AADI	3612-A	1	RDCP- tb.borrowed
1.2	Currents	ADCP	Nortek	AWAC		UPC-Planned	RDCP	AADI			RDCP- tb.borrowed
1.3	Passive Acoustics	Hydrophone	Björge	Naxys-Ether.02345	1	UPC-In.Place					
2	OTHER SENSORS & INSTRUMENTS	Measure	Builder	Reference	Nb	Provider	Measure	Builder	Reference	Nb	Provider
2.1	Acoustics										
1.3	Geophysics										
2.2	Optics-Video	Video-Images	OPT	OceanCam Opt-06	1	UPC-In.Place					
2.3	Various Types										

3.3. Data management

Deep sea sites

SITE	**1-ANTARES**	**2-NEMO-SN1**
IDENTIFICATION		
Final tech proposal date	11 September 2009	26 June 2009
Proposal leader	Univ. Méditerranée – COM / CNRS - LMGEM	INFN
Proposal partners	CNRS – IFREMER – INFN - INGV	INFN – INGV - CNRS
Data management	• Data recovery: - From Antares oceanographic sensors: tb extracted from Antares database - From Albatross line sensors: tb extracted at each line recovery • Data validation: - Archiving of all sensor metadata - 1st automatic data coherence check - 2nd check by each responsible person of sensor classes • Data dissemination: - Web portal tb set up: 1 year engineer contract agreed by Esonet; Coordination with Ifremer-Brest -UPC- Marum - Data made available to Esonet community < 3 months - Data made available to international community after2 years	• SN1 past & future data accessible from data base tb implemented end 2009
Data access to others	• Data made available to Esonet community < 3 months • Data made available to international community after2 years	• SN1 past & future data accessible from data base tb implemented end 2009 • NEMO-Phase 1 past data accessible with restriction • NEMO-OvDE future data accessible on request • Access to data from hosted partner equipment permitted to INFN-INGV

Coastal sites

SITE	3-OBSEA	4-KOLJO FJORD
IDENTIFICATION		
Final tech proposal date	06 July 2009	15 July 2009
Proposal leader	University Polytechnical Catalunya (UPC)	Göteborg University (UGOT)
Proposal partners	UPC – CSIC – IFREMER – MARUM - DBSCALE	UGOT - MARUM
Data management	• At main land station – 4 servers - 1- SQL database for low bandwidth sensors - 2- Video images storage - 3- Network & instruments monitoring & control - 4 – Linux server for internet access	• Access to online data stream through IEEE 1451 server at Kiel University or through Pangea • For other data centres, data online stream made available according to OGC Sensor Web Enablement recommendations • Internet graphic presentation thanks to Geoview AADI software
Data access to others	• Accessible under agreement tb defined	• All data made available to Esonet community

3.4. Intervention means

Deep sea sites

SITE	1-ANTARES	2-NEMO-SN1
IDENTIFICATION		
Final tech proposal date	11 September 2009	26 June 2009
Proposal leader	Univ. Méditerranée – COM / CNRS - LMGEM	INFN
Intervention means		
Ships	• Castor (?) / BJS deployment • Antedon – Thetys / MII deployment	• Elettra cable ships based in Catania
ROV	• Deep sea – ROV: Victor (6000 m - 2 manipulators) - Ifremer • Deep sea - Light ROV: Cougar Sea Eye (4000 m - 2 manipulators) - INFN / INGV	• Pegaso equipment: - Deep sea-Light ROV: Cougar Sea Eye (4000 m - 2 manipulators) - Deep Sea Shuttle: powered & instrumented platform for system deployment by cable (40 kN max in water)
Site access to others	• Accessible pending Antares collaboration agreement according to Antares User Guide procedures • During planned interventions at no extra cost / Out of planned interventions at operation cost	• Accessible pending: - Operation file submitted to and agreed by INFN-INGV - Access to data permitted to INFN-INGV

Coastal sites

SITE	3-OBSEA	4-KOLJO FJORD
IDENTIFICATION		
Final tech proposal date	06 July 2009	15 July 2009
Proposal leader	University Polytechnical Catalunya (UPC)	Göteborg University (UGOT)
Intervention means		
Ships	• Accessible by small ships	• RV Skagerat (UGOT)
ROV	• Currently interventions only possible by divers (2 local teams) • Modifications to accommodate ROV feasible • Possibility of light ROV renting	• ROV Sperre (UGOT) and ROV Cherokee (Marum) • Interventions also possible by cable lowering / lifting
Site access to others	• Accessible by contacting UPC	• Accessible pending submission of operation & instrument file and agreement by the contact person for underwater intervention

3.4. Operations

Deep sea sites

	TEST CABLED SITES - OPERATIONS					
	1-ANTARES					
1	**Infrastructures Deployment**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	Deployment BJS & MII	2010	Autumn			
	BJS connection to BJA	2010	Autumn			ROV-Victor
2	**Sensors & instruments Depl**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	Deploy-Recov Albatross line - from	2010	End year			Autonomous every 3 months
	Deploy-Recov Albatross line - to	2011				
3	**On shore equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	BJS-MII interlink - Pressure tests	2010				Pressure vessels Ifremer
	MII / Antares acoutic compatibilty	2010				
	MII data logger - pressure tests	2010				Pressure vessels Ifremer
	MII data logger - comm. & function. tests	2010				
4	**Sensor calibrations**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	CTD - O2 optode - Aquadopp ADCP	2010				Prior deployment - Laboratory
	CTD - O2 optode - Aquadopp ADCP	2011				During deployment - In situ
	CTD - O2 optode - Aquadopp ADCP	2011				Post deployment - Laboratory
5	**At sea equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
6	**At sea measurements**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	According to deployed sensors	2011	All			
	CTD-O2 optode-Aquadopp ADCP	2011	1 time			In situ calibration

	TEST CABLED SITES - OPERATIONS					
	2-NEMO-SN1					
1	**Infrastructures Deployment**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
2	**Sensors & instruments Depl**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	Esonet Lido DM equipment deployment	2009	Nov-Dec			Cable-Ship + Pegaso equipment
	Esonet Lido DM equipment recovery	2011	End year			Cable-Ship + Pegaso equipment
3	**On shore equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
4	**Sensor calibrations**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	CTD - ADCP - Hydrophone array	2010	Jan-Feb		10	In situ
5	**At sea equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	** Underwater intervention	2010	Jan-Feb		10	
	Modules deepsea deploy & recovery					
	UWM connectors connection-deconn.					ROV
	Equipment inspection					ROV
	** Equipment operation					
	UW acoustic transmitter GPS linked					
	Acous. sources pos & ampl.reconstr.					
6	**At sea measurements**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	According to deployed sensors					

Coastal sites

	TEST CABLED SITES - OPERATIONS					
	3-OBSEA					
1	**Infrastructures Deployment**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	MEOC - Node	2009	May	3	2	RV Sarmiento De Gamboa
	Equipment check	2009	Semester 2			Divers
2	**Sensors & instruments Depl**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	CTD SBE - Hydrophone Björge	2009	May	3	2	RV Sarmiento De Gamboa
	Video-camera OPT	2009	May	3	2	RV Sarmiento De Gamboa
	Instruments checking & cleaning	2010	Semester 1			Divers
	Geostar bioacoustic antenna	2010	April	1		
	PUK for CTD & ADCP	2010	April	1		
	Instruments Deployment & recovery	2011	March			ROV Cherokee-Marum
3	**On shore equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
4	**Sensor calibrations**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	Hydrophone Naxys Ethernet	2010	January	4		UPC laboratory
	CTD SBE 37-SMP	2010	February	2		UPC laboratory
	Current profiler Nortek Awac	2010	February	1		UPC laboratory
	Geophone for OBS	2010	June	2		UPC laboratory
5	**At sea equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	Biofouling measurements	2009	Autumn			
	Esonet instrument registration	2009	November	1	40	
	Esonet interoperability	2009	December	2	40	
	Esonet sensor registry maintenance	2009	December	3	20	
	Biofouling measurements	2010	Winter-Spring			
	IEEE 1451.4 TEDS	2010	April	3	30	
	Geostar bioacoustic antenna	2010	May	1		
	IEEE 1451 to SML automatic mapping	2010	July	3	20	
	IEEE 1588/ clock registration	2010	July	4	30	
	Smart sensor interface on MicrObs Ethernet	2010	Quater 4			
	Esonet interoperability	2010	December	2	40	
	Tests of network workflows - from	2010	May			
	Tests of network workflows - to	2011	February			
6	**At sea measurements**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	RT analysis comparison Obsea / Geostar	2009	Nov-Dec		30	
	Waves & current profiles	2009	December	2	5	Current profiler Nortek Awac
	Species recognition with IP camera	2010	February	1	20	Video Oceancam OPT-06
	Waves-current profiles / Turbidity	2010	April	1	5	Seapoint Turbidimeter
	Geomagnetic measurements	2010	May		7	Proto geomagnetic observatory
	Geostar bioacoustic antenna	2010	June	1	2	

	TEST CABLED SITES - OPERATIONS					
	4-KOLJOFJORD					
1	**Infrastructures Deployment**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	Start of deployment	2009	October			
	Sensor recovery wo ROV	2010	June		7	
	Sensor recovery with each ROV	2011	February			ROV-Sperre (UGOT)
	Sensor recovery with each ROV	2011	February			ROV-Cherokee (Marum)
2	**Sensors & instruments Depl**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
3	**On shore equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
4	**Sensor calibrations**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	CTD	2010	February		7	Rostock laboratory
	O2 optodes	2010	June		1	In situ
	O2 optodes	2010	October		1	In situ
5	**At sea equipment tests**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	Sensor integration in network	2009	December			
	Metadata harmonization	to 2011	February			
	Communication					
	Flexible data collection & display					
	Eval. cial.softwares for up to 20 nodes					
	Workflows for integrating sensors in network	2010	May			
		to 2011	February			
6	**At sea measurements**	**Year**	**Month**	**Week**	**Nb-days**	**Means**
	According to deployed sensors					

4. Esonet financial contribution

In this section two tables (one for Test Call budget, the other for Exchange of personnel budget) outline how the Esonet financial contributions, decided at Barcelona meeting of 21 November 2009, are shared for each site between cost items:

Equipment – Personnel – Travels & accommodation – Others – Sub-contracts – Indirect cost.

Barcelona meeting of 21 November 2009 financial statements:

Euros	**1-Antares**	**2-NEMO-SN1**	**3-OBSEA**	**4-Koljo Fjord**	**Total**
Test Call budget	208 000	180 000	100 000	60 000	548 000
Exchange Personnel budget	12 000	20 000	20 000	20 000	72 000
Total	220 000	200 000	120 000	80 000	620 000

Detailed tables for each site and cost item are given in appendices B

Test Call budget

SITE	1-ANTARES			2-NEMO-SN1			3-OBSEA			4-KOLJOFJORD		
	Eligible	Request	Proposed	Eligible	Request	Proposed	Eligible	Request	Proposed	Eligible	Request	Proposed
Equipment	485 500	186 600	107 333	420 000	50 000	28 800	78 100	39 000	13 660	20 000	8 000	4 000
Pers	837 760	0	0	49 200	0	0	150 000	107 750	43 000	95 000	62 000	22 000
Travels	28 000	13 000	0	30 000	30 000	0	9 500	7 500	0	10 000	10 000	0
Others	288 500	86 120	64 000	540 000	320 000	100 000	47 800	36 800	12 157	61 000	61 000	19 000
sub contract	20 000	0	0	20 000	20 000	20 000	0	0		0	0	
indirect costs	443 052	70 244	36 667	207 840	80 000	31 200	79 800	56 460	29 561	37 200	30 200	15 000
TOTAL	2 102 812	355 964	208 000	1 267 040	500 000	180 000	365 200	247 510	98 378	223 200	171 200	60 000
	ALL SITES											
	Eligible	**Request**	**Proposed**									
Equipment	1 003 600	283 600	153 793									
Pers	1 131 960	169 750	65 000									
Travels	77 500	60 500	0									
Others	937 300	503 920	195 157									
sub contract	40 000	20 000	20 000									
indirect costs	767 892	236 904	112 428									
TOTAL	3 958 252	1 274 674	546 378									

Personnel Exchange budget

SITE	1-ANTARES			2-NEMO-SN1			3-OBSEA			4-KOLJOFJORD		
	Eligible	Request	Proposed	Eligible	Request	Proposed	Eligible	Request	Proposed	Eligible	Request	Proposed
Pers	837 760	0	0	49 200	0	0	150 000	107 750	19 248	95 000	62 000	10 000
Travels	28 000	13 000	12 000	30 000	30 000	20 000	9 500	7 500	2 374	10 000	10 000	10 000
TOTAL	865 760	13 000	12 000	79 200	30 000	20 000	159 500	115 250	21 622	105 000	72 000	20 000
	ALL SITES											
	Eligible	**Request**	**Proposed**									
Pers	1 131 960	169 750	29 248									
Travels	77 500	60 500	44 374									
TOTAL	1 209 460	230 250	73 622									

5. Networking requirements

This section outlines the requirements to be satisfied by each site to cope with the networking principles promoted by Esonet.

5.1. Hosting capacity of additional equipment

On each cabled site the possibility will be provided to host equipment or sensors of Esonet partners in addition to the ones deployed by the cabled site operator and his associated partners, pending contractual and technical agreement between candidate Esonet partners and site operator.
Physically this possibility will be based on the availability of unoccupied connecting points on the bottom infrastructures.

5.2. Reporting and information exchange on equipment preparation and sensor calibration

Site operators and associated partners will document the actions and procedures carried out to prepare the equipment for deployment or calibrate the sensors. Information about these actions will be exchanged between sites in view of setting up common best practices.

5.3. Reporting and information exchange on underwater and ROV operations

Site operators will document the procedures followed in ROV operations either for equipment deployment, monitoring or maintenance. Information about these procedures will be exchanged between sites in view of setting up common best practices.

5.4. Incentives on successive deployments of sensors or use of ROV on different sites

Incentives will be put, as much as possible, on parallel or successive deployments of the same sensors on different sites, so as to get experience of use in different technical or environmental conditions. The same would be beneficial as concerns ROV.

5.5. Collaborative analysis of similar measurements on different sites

Measurements on different sites, either with the same sensor models or with similar ones will be collaboratively analysed, so as to get shared information on sensors behaviour in different environmental conditions.

5.6. Access of data to Esonet community

Acquired data on the various sites will be made available to Esonet community using Esonet recommended data management procedures.

6. Reporting requirements

This section outlines the requirements regarding the reporting on the operations carried out on each site. Reporting on each site activities will be coordinated and carried out by the site operator. Reporting on inter site activity comparisons will be jointly performed by the involved site operators.

Quarterly progress reports will be issued for each site. At the end of tests a set of comprehensive reports will be issued for each site activities and inter site comparisons dealing with the following items.

6.1. Reporting on equipment preparation, tests on land and deployment

These reports will document the actions and procedures carried out to prepare the equipment, test it on land and deploy it at sea. Information about these actions will be exchanged between sites in view of setting up common best practices.

6.2. Reporting on sensor and measuring system calibrations

These reports will document the facilities used and procedures carried out to calibrate the sensors and measuring systems. Comparison between procedures and results will be dealt with when different procedures have been used.

6.3. Reporting on operations at sea and interventions by ROV

These reports will document the procedures followed in ROV operations either for equipment deployment, monitoring or maintenance. Comparison of procedures with different ROV or on different sites will be dealt with.

6.4. Reporting on return of experience of equipment operation

These reports will document the return of experience of equipment operation and behaviour on each site. Comparison of similar equipment on different sites will be dealt with.

6.5. Reporting on quality and intercomparison of recorded data

These reports will document the recorded data series and analyse the quality of them.. Comparison of data acquired with different sensor models or identical equipment on different sites will be dealt with.

****

Appendices – A : Test site description and technical data

A.1. Antares site – Deep sea

A.2. East Sicily / Nemo-SN1 site – Deep sea

A.3. OBSEA site - Coastal

A.4. Koljo Fjord site - Coastal

A.1. Antares site – Deep sea

Responsible for the site: Dominique LEFEVRE
Email: Dominique.lefevre@univmed.fr

<u>Foreword:</u>

The international ANTARES collaboration (Astronomy with a Neutrino Telescope and Abyss environmental RESearch) aims to detect and study the production of high energy neutrinos in the Universe. The ANTARES infrastructure is also a permanent marine observatory providing high-bandwidth real-time data transmission from the deep-sea for geosciences and marine environmental sciences.

The aim of this proposal is to develop an autonomous instrumented line to provide real-time high-frequency time series of a variety of hydrological and biogeochemical variables. This line will be equipped with standard sensors as well as a number of new innovative sensors. The project is based on implementing an acoustic data transmission between the autonomous line and the ANTARES cabled infrastructure. This project is pursued within the framework of national and international project (MOOSE, Mediterranean project, EuroSITES, NEPTUNE...) and would represent an important step forward in the development of autonomous sensor technology interfaced to deep-sea cabled infrastructures.

This proposal also intends to demonstrate the necessity of well defined calibration procedures, with the aim of finalising a common protocol for measurements on different existing ESONET sites.

Calibration procedures:

Today a variety of calibration procedures are available for oceanographic sensors. These, calibration procedures are designed either for static devices (mooring line) or dynamic devices (water column profiles) and are performed either by the manufacturer or by the scientific teams.

Thus, a crucial issue concerns the field of the standardisation. On the one hand, this is related to the inter-calibration of various sensors between themselves, such as two instruments from two different manufacturers, which should provide the same results. This step could be done either at sea or in the laboratory in controlled condition.

On the other hand, it concerns the calibration procedures themselves, in other words if a same instrument could give same results depending on its calibration procedure. Both topics are essential for the future in order to compare oceanographic measurements across worldwide sea observatories.

Another crucial issue is to define the procedure for in situ calibration of existing instrument during their mooring time. Based on existing procedure (i.e. European project Animate) we will define procedure for generic sensors such as CTD and O2.

This proposal intends to demonstrate the necessity of well defined calibration procedures. The final goal of the methodology is to be able to compare measurements on different existing ESONET sites. Our action is focused:

- 1) on standardisation and validation of in situ data transfer using acoustic modem for real time data (procedure...).
- 2) on standardisation of deployment of generic sensor package in view to be linked to an acoustic modem.
- 3) to host any sensor (existing or prototype) for test procedure.
- 4) to make the data collected available to the Esonet database using a standard procedure.

I - Location of Test Site and main features

- ANTARES is located in the Mediterranean Sea at 42°48'N - 6°10'E.
- Water depth: 2500 m
- Bottom topography and soil conditions: see Figure 1
- Distance to coast / Distance to port of operation: 42 km from La Seyne-sur-Mer (Var, France)

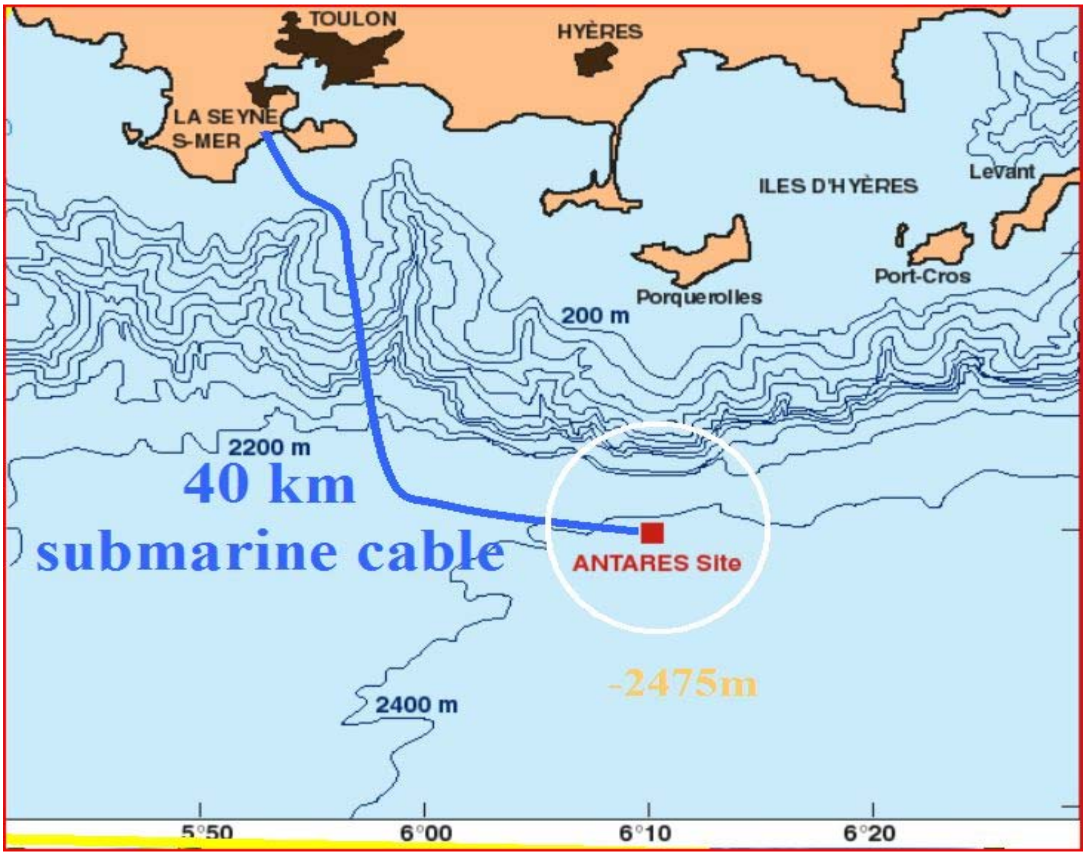


Fig.1: ANTARES site location

II - Existing infrastructure

General architecture and main characteristics:

- Sea bottom test area infrastructures
- Main cable to shore
- Shore station

The detector comprises a grid of about one thousand photomultipliers (PMT), sensitive to the Cherenkov light emitted by high energy neutrinos interacting close to the detector. The PMTs are distributed over 12 detector lines, each nearly 500m high and installed on the seabed at a depth of 2500m. The outputs from up to 16 lines are connected to a passive Junction Box via interlink cables. A 48 fibre electro-optical submarine cable, the Main Electro-Optical Cable (MEOC) connects the detector to the shore station. The submarine cable supplies ~4400 VAC, 10 A to a transformer in the Junction Box. The sixteen independent secondary outputs of the Junction Box provide ~500 VAC, 4A. Each ODI wet mateable connector provides 2 optical fibres for data communication. ROV intervention is necessary for connection of any equipment.

The ANTARES infrastructure already incorporates an instrumentation line (IL07), situated between 2000 and 2350m-depth and designed for multi-disciplinary studies comprising a variety of oceanographic sensors. It allows numerous studies in the fields of Sea, Earth and Environmental Sciences.

Figure 2: IL07 description

The numbers indicate the distance between storeys in meters.

Equipment:

CT: Measurement of conductivity and temperature

OM: Optical module

ADCP - Current profiler

Cam: Video camera for investigation of the deep sea fauna.

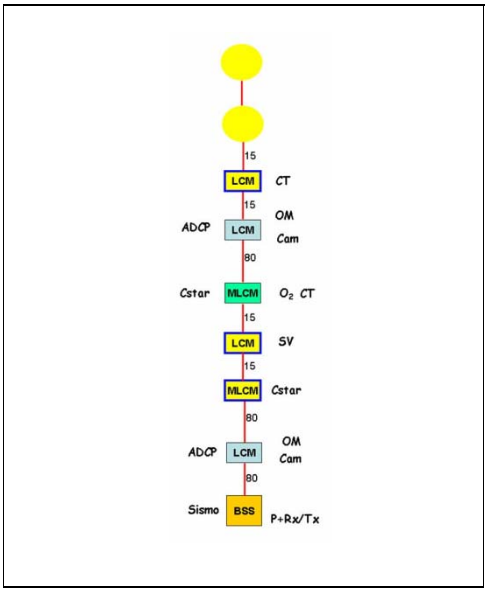
Cstar: Measurement of light transmittivity.

O2: Measurement of deep sea oxygen

SV: Sound velocimeter

Sims: seismometer

BSS: Bottom string socket



A secondary junction box (SJB) is planned to be installed on ANTARES in 2010, using one of the 16 connexion lines (at the same level as a neutrino detector line).

Sensors could be either connected directly to the Secondary Junction Box or to the Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS). This autonomous line does not require an external power supply, since all sensors will have their own supply through battery. However, it could transmit samples of data to the SJB via acoustic transmission. The aim of the autonomous line is to deploy sensors throughout the water column (surface to the deep ocean) and to add new sensors or replace existing ones without requiring a ROV intervention

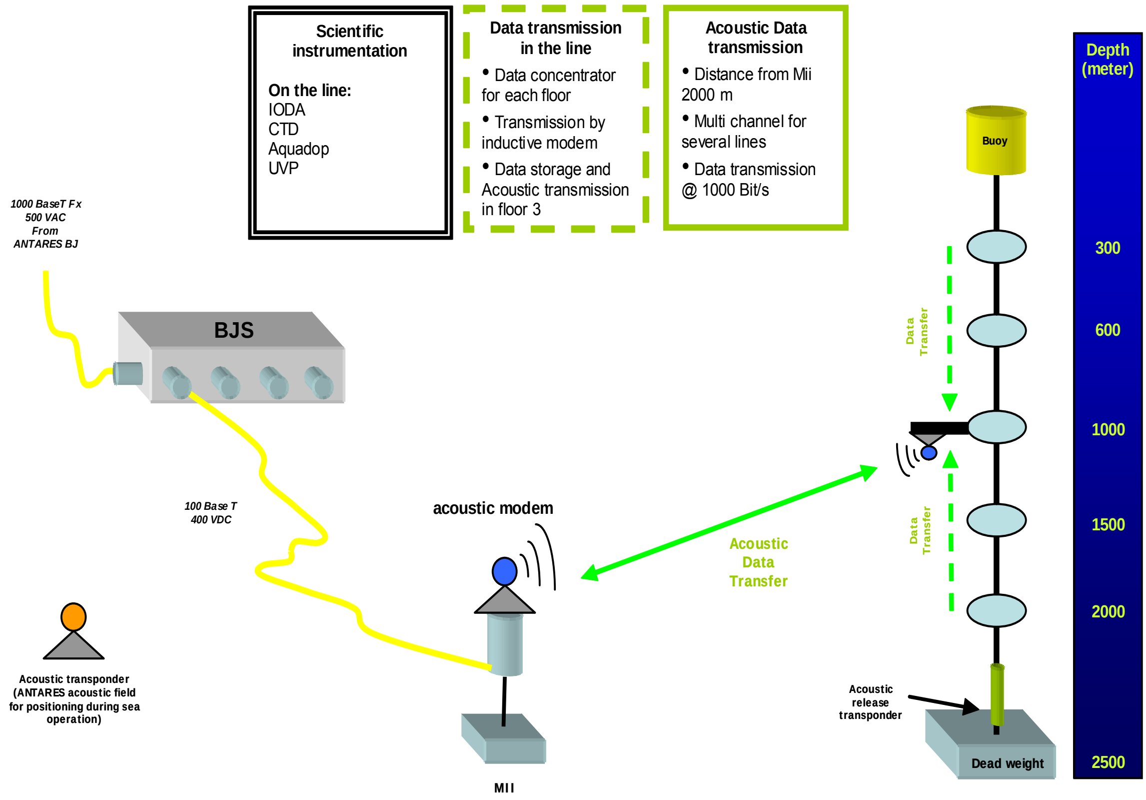


Figure 3: Schematic view of the data transmission between the Secondary Junction Box (BJS), the acoustic modem and the Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS). The BJS will be directly connected to the ANTARES Junction Box (JB).

Precise description of existing structures on test area for housing instruments or pieces of equipment in test:

- Mechanical interfaces
- Power and data interfaces and connector references

Junction box (JB) description

The main junction box provides a supply of 500 VAC with a power around 1.5 KW. The data transmission will be done by one optical fibre by bidirectional CWDM with a bandwidth of 4 x 1.2 Gbit/s.

The BJ is equipped by ODI Wet Mateable connectors.

Secondary junction box (SJB) description

A cable of around 400 m length will link the SJB with the main existing ANTARES junction box. This secondary junction box will offer between 4 and 6 general purpose sockets for the connection of equipments under conditions of shared time, power and bandwidth.

Each socket provides a supply of 400 VDC with a maximal power of 1 KW (shared with all outputs). The data transmission will be via Ethernet at 100Mbit/s.
The BJS is equipped by ODI Wet Mateable connectors (ROV-161-01-12-4).

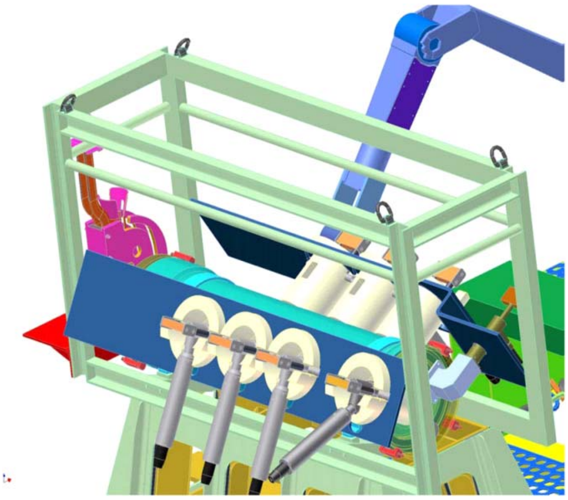


Figure 4: Schematic view of the Secondary Junction Box system, with a ROV arm behind the device in the process of making a cable connection.

Existing procedure to access to the infrastructure:

- Conditions of access

Principles, techniques and procedures to access to the infrastructure for users are defined by the GUASA document (User Guide refers to the Access to ANTARES), and are updated by the head of the SAI (access service infrastructure, in charge of managing the ANTARES access by Users, for the ANTARES Collaboration). The SAI is in charge to define and develop the technical requirements and procedures to access to ANTARES infrastructure, investigate requests from user, and manage the implementation of the activities on behalf of the ANTARES Collaboration in order to be sure that the ANTARES experiment is not disturbed by the implementation of the users' experiments. The function of SAI is presently assumed by the CPPM of the CNRS/IN2P3, who appoints the chairperson.

Any project has to be reviewed by a CTA (Technical Access Committee to ANTARES) specifically created for each request and responsible of investigation and compliance of the experiment implementation with the GUASA rules.

The Institution Board of ANTARES gives its final agreement for access to ANTARES.

Person to contact for more details on infrastructure:

Name	JJ DESTELLE
Phone number	+33 685 901 884
Email	destelle@cppm.in2p3.fr

III - Underwater intervention

Available means for underwater intervention (Ships, ROV…):

Underwater interventions on the SJB are managed by IFREMER.

The VICTOR (IFREMER) and/or the COUGAR (INFN/INGV) are possible ROVs that could be made use of.

Such operations could be performed in conjunction with maintenance operations on the ANTARES neutrino telescope.

The ALBATROSS autonomous line does not require support from a ROV. Periodical recoveries are planned every 3 months.

Existing procedures for intervention and work on the infrastructure:

Deployment and underwater intervention procedures are already defined for operations on the ANTARES site. These include operations concerning detection lines of the neutrino telescope as well as operations on the Junction Box.

All procedures have to ensure that there will not disturbance for the ANTARES neutrino telescope and have to make sure that operations will be performed in safety.

Planned interventions on the site 2009-2010-2011:

For the test campaign proposed in the framework of ESONET, deployments concern the Secondary Junction Box (SJB), the acoustic modem with its interface module and the ALBATROSS autonomous line.

Underwater interventions will concern connection between the Junction Box and the SJB, and possibly some other interventions such as the deployment and burying of the seismometer, (connected on the line 12 of the ANTARES detector), the deployment of the Radiometer, and the connection of the Ratcom etc.

• Sea deployment interventions:

Objects:

Deployment of the SJB and the Acoustic Modem

Dates:

Autumn 2010

• ROV interventions:

Objects:

It consists of an underwater connection between the BJ and the SJB with the Victor ROV. This intervention is not under the Albatross project, and it has been financed by other parts. But it is a crucial and unavoidable step for the project.

Dates:

Autumn 2010

Possibilities of added works:

Underwater inspections and interventions

• Sea deployment interventions:

Objects:

Deployment / recovery of the ALBATROSS autonomous line

Dates:

From Autumn 2010 to Winter 2011, once every three-months

• ROV interventions:

Objects:

Underwater inspections and interventions (seismometer deployment/burying, deployment/connection of instrumentation on the SJB or in the vicinity…)

Dates:

2011

Possibilities of added works:

Connection or interventions on SJB or instrumented lines, including ALBATROSS, IL07 or ANTARES line 12, if intervention concerns multidisciplinary purposes.

Possibility of extra operation (in addition to planned interventions):

Extra funds have to be found to cover ROV operations costs during other periods

Person to contact for more details on underwater intervention:

Name	Jean-François DROGOU
Phone number	+33-(0)4 94 30 48 39
Email	Jean.Francois.Drogou@ifremer.fr

IV - Instruments already installed or planned

Instruments already installed

Detailed reference of instruments installed on the Instrumentation Line IL07, already connected to the main junction box:

Storey	Height above seabed	Device type	Manufacturer	Model	Measured parameters
6	305m	6 hydrophones	HTI	HTI-90-U	sound level, transients
		CTD	SEABIRD	SBE 37-SMP	conductivity, temperature
5	290m	Optical Module	ANTARES	Custom	light level
		ADCP	Teledyne RD	Workhorse	sea current
		Camera	AXIS	AXIS221	images
4	210m	C-Star	WETLABS		water transparency
		SV	GENISEA/ECA	QUUX-3A(A)	sound velocity
		CT	SEABIRD	SBE SI	conductivity, temperature
3	195m	6 hydrophones	Erlangen	Custom	sound level, transients
		O_2 probe	AANDERAA	Optode 3830	oxygen level
2	180m	6 hydrophones	HTI	HTI-90-U	sound level, transients
		C-Star	WETLABS		water transparency
1	100m	Optical Module	ANTARES	Custom	light level
		ADCP	Teledyne RD	Workhorse	sea current
		Camera	AXIS	AXIS221	images
BSS	0	Pressure sensor	GENISEA/ECA		Pressure
		Transponder	IXSEA	RT661B2T	acoustic positioning

Table 1. Details of the instruments on the line IL07.

Instruments planned to be deployed

Autonomous Line with a Broad Acoustic Transmission for Research in Oceanography and Sea Sciences (ALBATROSS) – See Fig.2

This line consists of five instrumented storeys connected by a supporting wire allowing induction data transfer using an inductive modem. The cable maintains the structure, enables the data transmission between floors and facilitates the deployment of the line. The bottom is constituted of a dead weight attached to the line by acoustic release transponder for the recovery. At the top, there is a buoy to maintain the line vertical. The line will be deployed at least 2500 m away from the SJB and the ANTARES infrastructure.

Each floor hosts a CTD, an UVP and an IODA6000. An ADCP is also planned in the line. A modification of the electronic embedded in the IODA6000 will allow to use it as a data concentrator. Instruments will be connected to the IODA6000 by RS232. It is possible to integrate instruments with inductive modem interface.

Data are sent to a data management unit located on the storey 4 (at 1000 meter depth). Transmission is made using an inductive modem. Data are stored and transmitted to the SJB by the acoustic modem integrated in the same storey.

Each floor can receive any new instrumentation if made compatible with the data flow and ANTARES telescope.

Summary of sensors planned to be installed on the autonomous line ALBATROSS:

Where	Height above seabed	Device type	Manufacturer	Model	Measured parameters
Line	500	CTD	Seabird	SMP37P	Conductivity, temperature, pressure
		Oxygen optode	Aanderaa	3830	Dissolved oxygen concentration, temperature
		IODA	CPPM/LMGEM		Dissolved Oxygen dynamics
		UVP	LOV		Video of particles
		ADCP	Nortek	Aquadopp	sea current
		Camera			Images
		Inductive Modem			(Data transmission)
		Acoustic modem			
		Radiometer	INFN		Radioactivity
BJS	0	Camera			Bioluminescent organisms
		Ratcom	ACRI		Tsunamis
BSS	0	Acoustic Transponder	IXSEA	RT661B2T	acoustic positioning

Table 2. Detailed description of instruments laid out on the Autonomous Line ALBATROSS.

Except for the $IODA_{6000}$, recently technologically approved on the line 12 of ANTARES, all other sensors/instruments are regularly deployed on mooring lines or during oceanographic cruises.

IODA

The $IODA_{6000}$ consists of an equi-pressure system, which aims to measure the oxygen concentration and the oxygen dynamics in shallow or deep waters, up to 6000 m depth. $IODA_{6000}$ consists of a 5L-chamber in polycarbonate equipped with an internal Aanderaa® Optode that samples the seawater by a slow rotation. The seawater sample is enclosed between two Versilic® mats during a period of time (from few hours to few days).

Optode

Oxygen Optode model 3830 from AANDERAA which is an optical sensor based on dynamic fluorescence quenching. In this device, a specially designed chemical complex is illuminated with a blue LED and emits in return a red luminescent light with a lifetime that directly depends on the oxygen concentration of the medium.

UVP

Under water Video Profiler is a video camera, which allows to measure:

- Particles size spectrum above 60µm and less than 5cm.
- Particles biovolume and their respective sedimentation rates.
- to determine meso and macroplankton (from 1 mm to 5 cm)

The UVP is interfaced with other sensor and a CTD

Aquadopp

The Aquadopp® profiler measures the current profile in water using acoustic Doppler technology. It is designed for stationary applications and can be deployed on the bottom, on a mooring rig, on a buoy or on any other fixed structure. The Aquadopp® profiler uses three acoustic beams slanted at 25° to accurately measure the current profile in a user selectable number of cells. The internal tilt and compass sensors tell the current direction and the high-resolution pressure sensor gives the depth—and the tidal elevation if the system is fixed mounted.

Water Velocity Measurement :

Range ±5 m/s (inquire for higher ranges), *Accuracy* 1% of measured value ±0.5 cm/s

Maximum sampling : rate (output) 1 Hz. 4 Hz on request, *Internal sampling rate* 23 Hz

Measurement area

Measurement cell size 0.75 m, *Measurement cell position, (user selectable)* 0.35–5.0 m, *Default position (along beam)* 0.35–1.8 m

Doppler uncertainty (noise)

Typical uncertainty for default configurations 0.5–1.0 cm/s, *Uncertainty in U,V a 1Hz sampling rate* 1.5 cm/s

Echo Intensity

Acoustic frequency 2 MHz, *Resolution* 0.45 dB, *Dynamic range* 90 dB

Sensors

Temperature Thermistor embedded in head, *Range* –4°C to 40°C, *Accuracy/Resolution* 0.1°C/0.01°C, T*ime response* 10min

Compass Flux-gate with liquid tilt, *Maximum tilt* 30°, *Accuracy/Resolution* 2°/0.1° for tilt < 20°

Tilt Liquid level, *Accuracy/Resolution* 0.2°/0.1° for tilt < 20°, *Up or down* Automatic detect

Pressure Piezoresistive, *Range* 0–200 m (standard), *Accuracy/Resolution* 0.5% / Better than 0.005%

Microcat CTD

Conductivity-Temperature-Depth (CTD) probes from Sea-Bird Electronics, SBE 37-SMP.

Temperature is acquired by applying an AC excitation to a hermetically sealed, VISHAY reference resistor and an ultra-stable aged thermistor with a drift rate of less than 0.002°C per year. A 24-bit A/D converter digitises the outputs of the reference resistor and thermistor and pressure sensor.

Conductivity is acquired using an ultra-precision Wien Bridge oscillator to generate a frequency output in response to changes in conductivity.

The MicroCAT pressure sensor, developed by Druck, Inc employs a micro-machined *silicon diaphragm* into which the strain elements are implanted using semiconductor fabrication techniques, free of pressure hysteresis. Compensation of the temperature influence on pressure offset and scale is performed by the MicroCAT's CPU.

Real Time clock: To minimize power and improve clock accuracy, a temperature-compensated crystal oscillator (TCXO) is used as the real-time-clock frequency source. The TCXO is accurate to ± 1 minute per year (0 ºC to 40 ºC).

Accuracy with conductivity resolution 13.10^{-4} S/m for a measurement range 0-7 S/m , with a resolution of 10^{-5}.Temperature accuracy of 0.002 with a resolution of 10^{-4} °C for a measurement range –5 to +35°C. Pressure accuracy is 0.1% of full scale range with a resolution of 0.002% of full scale range.

Hydrophone :

Hydrophones sensors are based on piezo-electrical ceramics that convert pressure waves into voltage signals, which are then amplified for readout. The ceramics and amplifiers are coated in polymer plastics. The hydrophane sensors are tuned to be sensitive over the whole frequency range of interest from 1 to 50 kHz with a typical sensitivity around −145 dB ref. 1V/µPa or 0.05V/Pa (including preamplifier) and to have a low noise level.

Radiometer:

GEMS (Gamma Energy Marine Spectrometer) INGV is a sensor for underwater radioactivity measurement.

A new Radiometer/Gamma-spectrometer for ^{40}K and other radionuclides in the ocean. A prototype of radioactivity sensor (radiometer and nuclear spectrometer) for underwater measurement was developed by INGV in collaboration with Minsk University and Tecnomare ENI SpA. The sensor, named GEMS (Gamma Energy Marine Spectrometer) is sensitive to gamma detection of ^{40}K but suitable to detect also other natural (e.g., U, Th) and man caused radionuclides (e.g., ^{137}Cs, etc.) occurring in the ocean seawater. The ^{40}K isotope contained in sea salt, particulate and sediments yields a flux of photons generating a background noise for photo-multiplier tubes used for the detection of neutrinos, as planned in the KM3NET project experiments; It is therefore important to monitor eventual variations over time of this background (e.g., due to benthic sediment mobilization, water currents). The radiometer consists of a gamma-sensor - NaI crystal (Fig.1), with PMT, high voltage

supply, shaping amplifier, compact digital module for data acquisition, accumulation, processing and transmission to the control unit via digital interface. The radiometer can be installed in a benthic observatory, mooring or hosted in a multi-sensor probe for casts and profiles from a ship.
After several tests in laboratory, GEMS performed successfully a first long-term monitoring (6 months, Nov. 2008 – May 2009) in deep sea in the Mediterranean Sea (data not shown).

RATCOM:

Experimental set-up for a tsunami warning system for the Mediterranean,
by a private company ACRI, 260 route du pin montard 06904 SOPHIA ANTIPOLIS.
Contact person: Philippe Barbey
« TSUNAMIMETRE RATCOM ACRI-IN»_*
Our long gravity wave detector is based on stain gages measurement of hydrodynamic forces. The sensor has a capability to detect sea level fluctuation of few millimetres for characteristic wave period of the order of minutes to hours. The complete package includes a sensitive element in a waterproof chamber. The overall geometrical characteristics are:
External diameter: 500 mm
* Height: 600mm
* Variable Weight in water depending of water depth from -25kg to + 25kg from 0 to 2500m of water . The grip system for the ROV as well as the necessary valve to be closed after the equipment has reached the final position can be adapted to the ROV specifications.
The connector for power and signal transmission will be compatible with the site capabilities

Accessibility to the data from these sensors:

Data are available from the ANTARES database.
A website is in under development through WP7 Esonet resources. The aim is to carry out a functional database, bringing all the necessary information to the validation and the valorisations of the data taking in the ALBATROSS project framework, associated with the data taken by the ANTARES detector.
1) Validation of data set :
The database will be built around three types of tables corresponding to three life stages of a data set:
Before the data acquisition: Tables will gather the whole of the metadatas recalling the configuration of the various probes, calibration information, condition of the water, the exact positions of the probes on the site, the parameters used during the calculation of a data, etc…

During the data acquisition: The raw data will be stored in "RAWData" table. Then distributed in real-time in the various tables corresponding to the various probes. A first automatic validation will be carried out to check the absence of aberrant values. If it is not the case, an alarm could be sent to the person responsible for this probe.

After the data acquisition: The data set will be checked by the person responsible for a probe or a type of probe. The table of data will be updated: information concerning the recalibration of probes and possible special events will be traced in specific tables.

For long-term: All the data will be archived and saved regularly.

2) Valorisation of data set :

A particular strain is brought to the compatibility of the data formats and metadata in order to be able to, in an automatic or quasi-automatic way, abound the global databases, which are under development.

A WEB portal, for data consultation and data management, is under construction. It will be designed as user friendly, from which the use of the data and the analysis will be easy for the international scientific community (Mercator and Coriolis database for example). This work will be done in close collaboration with people involved in the WP6.

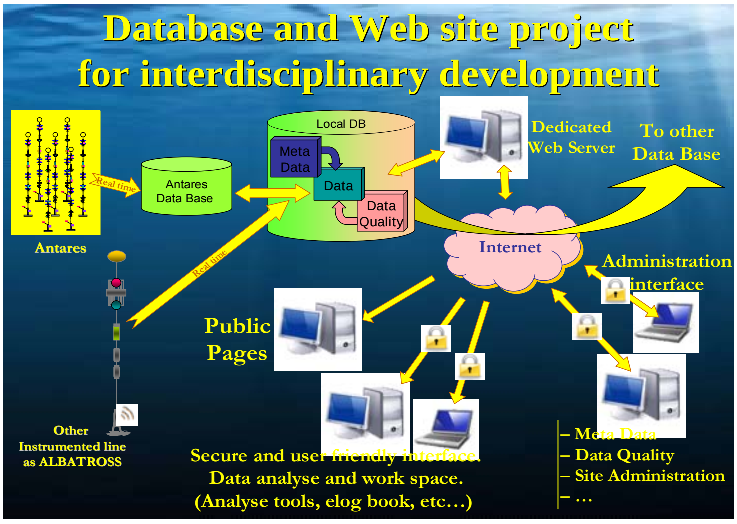


Figure 4: Overview of the Data management for ANTARES data, SJB sensors and the Autonomous Line sensors

Person to contact for more details on sensors already installed:

Name	Christian Curtil
Phone number	+33 (0)4 91 82 72 99

Email	curtil@cppm.inp3.fr

V – Deployment possibilities of additional instruments

Deployment conditions:

Housing on seafloor structure and power and data connection

The Acoustic Modem (and its interface module) deployment will be performed at the same time as the SJB is deployed. Any equipment fitted to either of these two interfaces will have to deploy at that point in time.

The autonomous mooring line will be equipped with inductive data transfer. Any equipment can be added to the line as long it is meeting the requirement specified for the inductive modem. The line will be recovered after 3 months thus facilitating the addition of new sensors. The evolution of the sensor to be made compatible with the communication system will be at the cost of the sensor's owner responsibility.

Test of added instrument:

New added instrumented could be merged onto existing line during new deployment. There is

From October to December 2009 there is a monthly cruise to recover and deploy a deep mooring line in the framework of the French programme LEFE-Cyber Opera and the FP7 project Eurosites. In 2010, 4 cruises will be scheduled fro the recovery/deployment of the line as part of the previous programme and Moose. Also instrument may be tested at sea on short term deployment using the RV Antedon off shore of Marseille. This is dependant on ship time availability.

Access conditions to data collected:

Once the data will be validated by their identified owner/responsible, the data will be made available within 3 months to the Esonet community and within 2 years to the international community.

Person to contact for more details on deployment conditions of additional instruments:

Name	Dominique Lefevre
Phone number	+33(0)4 91 82 90 49
Email	Dominique.lefevre@univmed.fr

This proposal intends to demonstrate the necessity of well defined calibration procedures. The final goal of the methodology is to be able to compare measurements on different existing ESONET sites.

A.2. Nemo-SN1 site – Deep sea

Responsible for the site: Giorgio Riccobene
Email: riccobene@lns.infn.it

I - Location of Test Site and main features

- Geographical situation and coordinates
- Water depth / Bottom topography and soil conditions
- Distance to coast / Distance to port of operation

The Eastern Sicily infrastructure consists of a shore laboratory located in Catania harbour (Sicily, Italy) and a 28 km long electro-optical (hereafter e.o.) cable connecting the shore lab to the deep-sea infrastructure. Two underwater cable terminations are available, namely: Test Site North (TSN) and Test Site South (TSS).

Water depth: TSN 2100 – TSS 2050 m
TSN: regular physiographic profile; maximum slope 0.5°. Volcanic soil. Sediment layer < 1.5 m.
TSS: steep slopes and flat areas (slope 1°). Volcanic soil. Sediment layer < 1.5 m.
Further details available on request
Distance to coast / Distance to port of operation: about 25 km to Catania harbour

The harbour of Catania is the logistic base of Elettra Tlc., owner of the Certamen C/L and of the Teliri C/L vessels. Elettra Tlc. is member of the MECMA Consortium.

II - Existing infrastructure

General architecture and main characteristics:

- Shore station
- Main cable to shore
- Sea bottom test area infrastructures

The shore laboratory (Fig. 1, left panel) hosts the land termination of the cable, the on-shore data acquisition system and power supply for underwater instrumentation. It is equipped with a large hall (20 m x 6 m x 6 m height) for large structure mounting and integration, an electronics workshop, climatic rooms for computing and data acquisition devices. A GPS antenna and receiver is installed in the lab. The shore laboratory has also a radio link (maximum speed 56 Mbps) to LNS-INFN that allows fast Ethernet link (1 Gbps) to the internet. An hyperbaric vessel is also available for high pressure tests. Characteristics are reported in Table 1.

Table 1

Internal diameter	80 cm
Filling medium	Fresh water
Max pressure	400 bar
Electrical contacts	9
Max V	100 V
Max A	5 A

The underwater cable (Fig. 1, right panel) is an umbilical underwater e.o. cable, armoured with an external steel wired layer, containing 10 optical single-mode fibres (standard ITU-T G-652) and 6 electrical conductors (4 mm^2 area). At about 20 km E from the shore (22.925 m of cable), the cable is divided into two branches, roughly 5 km long each (5220 m and 5000 m respectively), that reach two different sites:

- Test Site North (TSN, latitude 37°30'810 N, longitude 015° 06'819 E depth 2100 m)
- Test Site South (TSS, latitude 37°30'008 N, longitude 015° 23'034 E, depth 2050 m).

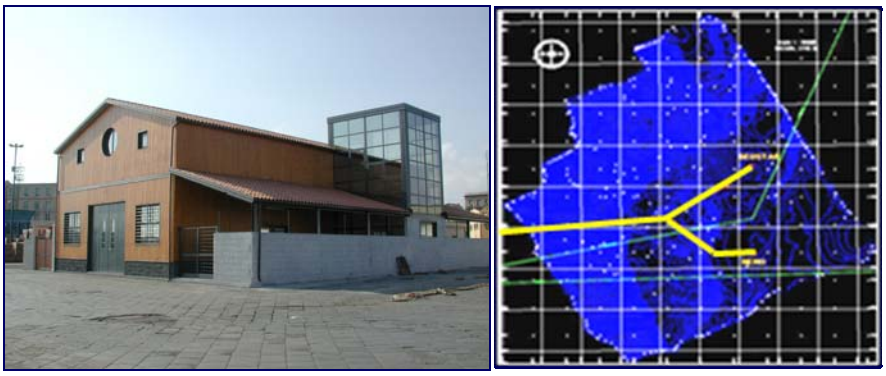


Figure 1. Left: The Shore Lab in the port of Catania. Right: Test site bathymetric chart and path of the main electro optical cable.

The TSN cable branch has 2 conductors and 4 fibres directly connected to shore. The TSS branch has 4 conductors and 6 fibres. The scheme of optical and electrical connections is shown in Fig. 2, the numbering in the sea infrastructures side refers to the pin number of the ODI Rolling Seal hybrid connector 8 ways (see Annex 1) used for the installation and shown in Fig. 3. The Cable characteristics are summarised in Table 2, the connectors characteristics are summarised in Table 3.

Table 2	
Electrical Characteristics	
DC resistance (max)	4.9 Ohm / km
Insulation resistance (min)	1000 MOhm · km
Impedance	0.75 mH / km
Capacity	75 nF / km
Optical Characteristics	
Attenuation @ 1310 nm (max)	0.40 dB / km
Attenuation @ 1550 nm (max)	0.25 dB / km
Dispersion for 1288 nm – 1339 nm (max)	3.5 ps / nm· km
Dispersion for 1550 nm (max)	18 ps / nm· km

Table 3	
Number of Circuits:	4 electrical
	4 optical
Electrical Characteristics	
Max Operational Current:	7 Amps
Max Operational AC Voltage	700 VAC Phase-to-Ground (mated)
Max Operational DC Voltage	1000 VDC mated
Insulation Resistance	>10 GOhm @ 1000 VDC
Contact Resistance	<10 mOhm
Optical Characteristics	
Insertion Loss: 1310/1550 nm	<0.5 dB
Mated back reflection: 1310/1550 nm	<-30 dB

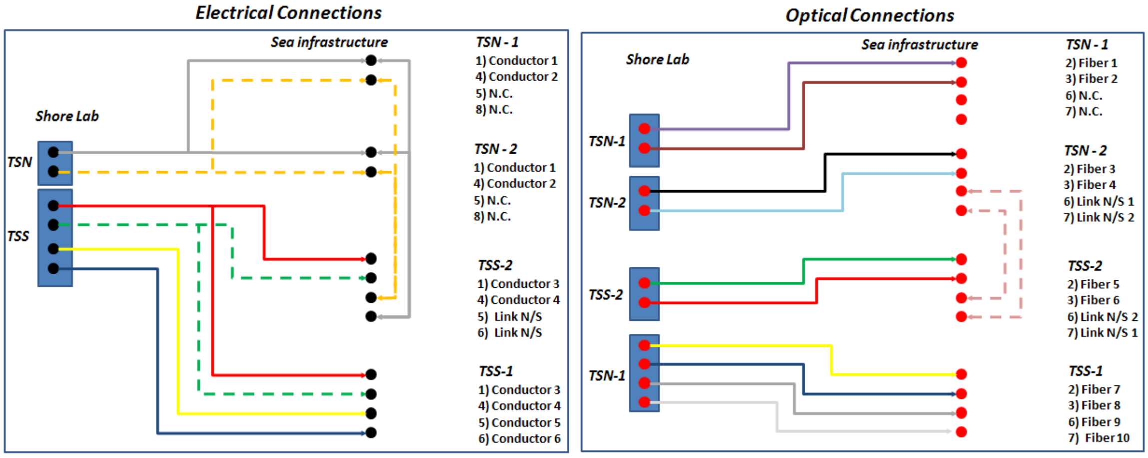


Figure 2. Scheme of conductors (left) and optical fibres (right) available at the Catania Test Site.

In January 2005 INFN and INGV performed a sea operation onboard the Pertinacia -Elettra C/L vessel to recover the underwater cable terminations TSN and TSS and to install, on them, two underwater frames. Each frame, made of grade 2 titanium (see Fig. 4, left panel), is equipped with a pair of ODI Rolling Seal hybrid connector 8 ways. The two frames were deployed on the seabed. The e.o. connectors are made to be handled by ROV to allow plugging and unplugging of underwater experimental apparatuses, avoiding further recovery operations of the main cable.

During the same naval campaign two experimental apparatuses were deployed, plugged and put in operation:

the multidisciplinary seafloor observatory Submarine Network 1 (SN1) for the geophysical and environmental monitoring, a GEOSTAR-class observatory designed and operated by the INGV (Istituto Nazionale di Geofisica e Vulcanologia), was connected to the TSN termination (Fig.4, right panel). Details on the sensors installed can be found in Annex 2.

the OνDE (Ocean Noise Detection Experiment) station was deployed and connected to the TSS termination (Fig.5, left panel). Details on the sensors installed can be found in Annex 3.

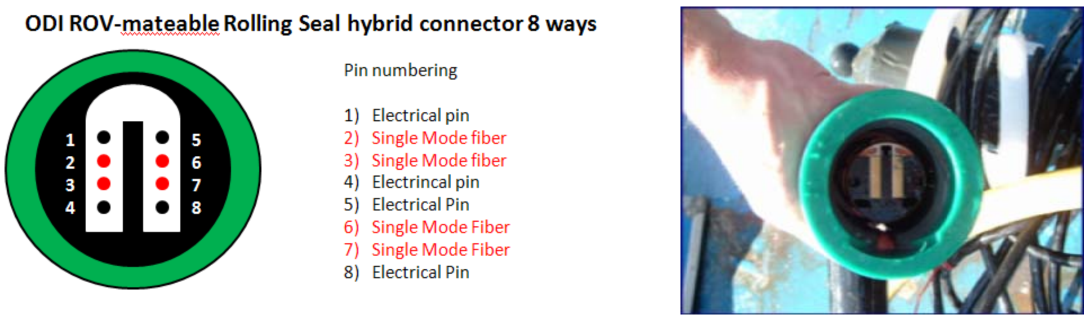


Figure 3. Pin numbering valid for all the ODI ROV mateable connectors installed on TSS and TSN frames.

Another operation in the Site was performed on January 2006, in the framework of the NEMO Phase-1 project. The NEMO Phase-1 project was realised in order to validate the technological solutions proposed by INFN for the construction of the so called *km3 high energy neutrino detector*. NEMO Phase-1 consisted in the deployment and operation of prototypes of the critical elements of the km^3 detector: a junction box (JB) and a tower hosting optical sensors and data acquisition/transmission electronics. In Fig.5, right panel, the photo of the JB is shown. The NEMO Phase-1 experiment is described in Annex 4.

Figure 4. Left: The titanium frame installed on TSS, hosting the e.o. ODI connectors. Two identical frames are installed on TSN and TSS. Right: the SN1 seafloor observatory deployed on the seafloor (2100 m w.d.) in January 2005.

The JB provides connection between the main electro-optical cable and the detector structures. The JB has been designed to host and protect from the effects of corrosion and pressure, the opto-electronic boards dedicated to the distribution and the control of the power supply and digitised signals.
The JB is working and it is fully usable for deep-sea experiments. The JB offers optical several fibre links and power connection (380 VAC 3-phase, 3 kW in total) to several end users. Connections to end users are realised through four e.o. ROV mateable connectors.

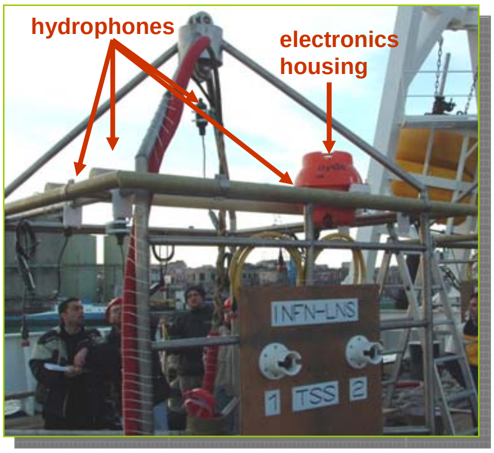


Figure 5. Left: the OνDE station installed on the top of TSS. Right: the NEMO Phase JB installed on TSS.

In April 2008 SN1 and OνDE were recovered after 3 years and 3 months, within the activities planned in the frame of the PEGASO project (PotEnziamento di reti Geofisiche e Ambientali SOttomarine = enhancement of underwater geophysical and environmental networks), funded by "Regione Siciliana" (2005-2008). Details on the project can be found in Annex 5. PEGASO covered also the resources for the refurbishment and the enhancement of both SN1 and OνDE. Their deployment is planned within the end of 2009 as part of the activities of the LIDO (LIstening to the Deep Ocean) ESONET Demo Mission (DM) (see LIDO-DM full proposal in Annex 6). The new complete list of sensors installed is shown in Table 4.

Table 4

Sensor	Rate	Model
3-C broad-band seismometer	100 Hz	Guralp CMG-1T (0.0027-50 Hz)
Differential Pressure Gauge (DPG)	10 Hz	Prototype Univ. St. Diego
Hydrophone (Geophysics)	200 Hz	OAS E-2PD
Hydrophone (Geophysics)	2000 Hz	SMID (0.05-1000 Hz)
8 Hydrophones (Bio-acoustics)	96 kHz	Reson TC4037 / SMID TR-401 V1
Absolute Pressure Gauge (APG)	15 s	Paroscientific 8CB4000-I
3-C Accelerometer + 3-C Gyro (IMU)	100 Hz	Gladiator Technologies Landmark 10
Gravity meter	1 Hz	Prototype IFSI-INAF
CTD + Turbidity meter	1 s/h	SeaBird SBE-37SM-24835 + Wet Lab
ADCP	1 profile/h	RDI Workhorse Monitor (600 kHz)

Vectorial magnetometer	1 Hz	Prototype INGV
Scalar magnetometer	1 Hz	Marine Magnetics Sentinel (3000 m)
3-C single point currentmeter	2 Hz	Nobska MAVS-3

Precise description of existing structures on test area for housing instruments or pieces of equipment in test:

Test Site North (TSN)
Underwater frame made of grade 2 titanium deployed on the seabed and equipped with a pair of ODI e.o. Rolling Seal 8 ways hybrid connectors. The frame dimensions are 200 x 200 x 300 (h) cm. The connection scheme is shown in Fig. 2 and Fig. 3.

AC and DC Power transmission is feasible using connectors TSN-1 and TSN-2.

At present a 500 VAC (1-phase) 10 kVA power supply is installed on-shore.
Power link is available on both ODI connectors.
TSN-1 - Pin 1 neutral; Pin 4 phase.
TSN-2 - Pin 1 neutral; Pin 4 phase.

The power supply and electrical pin-out can be changed according to cable and connector specs given in Tables 2 and 3.

Test Site South (TSS)
Underwater frame made of grade 2 titanium deployed on the seabed and equipped with a pair of ODI e.o. Rolling Seal 8 ways hybrid connectors. The frame dimensions are 200 x 200 x 300 (h) cm. The connection scheme is shown in Fig. 2 and Fig. 3.

AC and DC Power transmission is feasible using connectors TSS-1 and TSS-2.
At present a 700 VAC (3-phase) 10 kVA power supply is installed on-shore.
Power link is available on both ODI connectors.
TSS-2 - Pin 1 phase-R; Pin 4 phase-S.
TSS-1 - Pin 1 phase-R; Pin 4 phase-S; Pin 5 phase T; Pin 8 neutral.
The connector TSS-1 is connected at present to the NEMO Phase-1 Junction Box.
The connector TSS-2 is used as backup link for the Junction Box.

The JB offers to end-users two outputs on two ODI Rolling Seal Connectors. The maximum power load per each connector is 1.5 kVA with 380 VAC (3-phase). Optical fibre link is affordable using DWDM (optional CWDM) laser transmission.

The Connection Scheme is shown in Table 5

Table 5					
JB-Output 1			*JB-Output 2*		
	Electrical	*Optical*		*Electrical*	*Optical*
Pin 1	Phase R		Pin 1	Phase R	
Pin 2		1540 - 1545 nm	Pin 2		1525 - 1545 nm
Pin 3		1538 - 1607 nm	Pin 3		1570 - 1576 nm
Pin 4	Phase S		Pin 4	Phase S	
Pin 5	Phase T		Pin 5	Phase T	
Pin 6		1546 - 1552 nm	Pin 6		N.C.
Pin 7		1528 - 1568 nm 1578 - 1607 nm	Pin 7		N.C.
Pin 8	Neutral		Pin 8	Neutral	

Existing procedure to access to the infrastructure:

- Conditions of access
- Applying file contents

The use of the infrastructure is open to the scientific community.

A proposal must be submitted to INFN and INGV.

Any request must be formally agreed between applicant, INGV and INFN.

Person to contact for more details on access to the infrastructure:

Name	Paolo Piattelli (INFN-LNS) Giorgio Riccobene (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 392 +39 095 542 304 +39 06 51860 428
Email	piattelli@lns.infn.it riccobene@lns.infn.it

	paolofa@ingv.it

III - Underwater intervention

Available means for underwater intervention (Ships, ROV…) :

The Eastern Sicily infrastructure includes underwater handling capability to manage experiments, such a capability consists of a deep-sea light-class ROV with 2 manipulators (SeaEye Cougar, 4000-m operative depth) and a Deep-Sea Shuttle (DSS) able to deploy and recover on the seafloor heavy systems (40 kN, the systems have to be equipped with a compatible mechanical interface). Also the ROV and DSS have been realised in the frame of the PEGASO project. Details on ROV and DSS can be also found in Annex 5.

Existing procedures for intervention and work on the infrastructure:

- Conditions of access
- Applying file contents

The use of the infrastructure is open to the scientific community.
A proposal must be submitted to INFN and INGV.
Any intervention must be formally agreed between applicant, INGV and INFN.

Person to contact for more details on intervention and work on the infrastructure:

Name	Mario Musumeci (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 388 +39 06 51860 428
Email	musumeci@lns.infn.it paolofa@ingv.it

Planned interventions on the site 2009-2010-2011:

Object of intervention: Deployment of the ESONET LIDO-DM

Means: Ship rented under the MECMA agreement. PEGASO ROV and DSS

Expected dates: November-December 2009

Possibility of added work: YES

Object of intervention: Recovery of the ESONET LIDO-DM

Means: Ship rented under the MECMA agreement. PEGASO ROV and DSS

Expected dates: End of 2011

Possibility of added work: YES

Possibility of extra operation (in addition to planned interventions):

YES

Procedures to apply for a specific intervention:

The use of the infrastructure is open to the scientific community.

A proposal must be submitted to INFN and INGV.

Any intervention must be formally agreed between applicant, INGV and INFN.

Person to contact for more details on underwater intervention:

Name	Giorgio Riccobene (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 304 +39 06 51860 428
Email	riccobene@lns.infn.it paolofa@ingv.it

IV - Instruments already installed or planned

Detailed reference of the instruments:

TSN

Instrument: SN1

Live Time: January 2005 – April 2008

Reference: P. Favali, et al., 2006, Nuclear Instruments and Methods in Physics Research A: 567 (2006) 462-467. (Annex 2)

Instrument: LIDO DM – Refurbished SN1

Expected Live Time: End of 2009 -- End of 2011

Reference: M. Andrè et al, LIDO DM Full Proposal submitted to ESONET NoE. (Annex 6)

TSS

Instrument: NEMO-OνDE

Live Time: January 2005 – November 2006

Reference: G. Riccobene et al., Nuclear Instruments and Methods in Physics Research A 604 (2009) S149–S157. (Annex 3)

Instrument: NEMO-Phase 1

Live Time: December 2006 – May 2007

Reference: E. Migneco et al., Nuclear Instruments and Methods in Physics Research A 588 (2008) 111–118. (Annex 4)

Instrument: LIDO DM – Refurbished NEMO-OνDE

Expected Live Time: End of 2009 -- End of 2011

Reference: M. Andrè et al, LIDO DM Full Proposal submitted to ESONET NoE. (Annex 6)

Accessibility to the data from these sensors:

Recorded NEMO-OnDE data are available on request.

Recorded SN1 data are available.

Recorded SN1 data are available and will be on-line downloaded through a dedicated database (this part is planned for the end of this year).

NEMO-Phase 1 data are available with restriction.

Real-Time LIDO DM Data will be available on-line using the same dedicated database already above mentioned.

Person to contact for more details on sensors already installed:

Name	Giorgio Riccobene (INFN-LNS) for NEMO-OνDE and LIDO DM Paolo Piattelli (INFN-LNS) for NEMO Phase-1 Laura Beranzoli (INGV) for SN1 and LIDO DM
Phone number	+39 095 542 304

	+39 095 542 392 +39 06 51860 428
Email	riccobene@lns.infn.it piattelli@lns.infn.it beranzoli@ingv.it

V – Deployment possibilities of additional instruments

Deployment conditions:

Mechanics, power/data transmission systems and deployment operations must be agreed with INFN and INGV.

Access conditions to data collected:

INFN and INGV require access to data collected using the infrastructure.

Person to contact for more details on deployment conditions of additional instruments:

Name	Giorgio Riccobene (INFN-LNS) Mario Musumeci (INFN-LNS) Paolo Favali (INGV)
Phone number	+39 095 542 304 +39 095 542 388 +39 06 51860 428
Email	riccobene@lns.infn.it musumeci@lns.infn.it paolofa@ingv.it

A.3. Obsea site - Coastal

Responsible for the site: Antoni Mànuel &Juanjo Dañobeitia

Email: antoni.manuel@upc.edu / jjdanobeitia@cmima.csic.es

Responsible Technical development: Marc Nogueras

Email: marc.nogueras@upc.edu

I - Location of Test Site and main features

• Geographical situation and coordinates

OBSEA is a cabled seafloor observatory 4 km offshore Vilanova i la Geltru coast located in a fishing protected area, and interconnected to the coast by an energy and communications mixed cable. The exact location of the OBSEA is: Lat. 41°10'54.87"N; Long. 1°45'8.43"E.

The main advantage of having a cabled observatory is to be able to provide power supply to the scientific instruments and to have a high bandwidth communication link. In this way, continuous real time data is available. The proposed solution is the implementation of an optical Ethernet network that transmits continuously data from marine sensors connected to the observatory. With OBSEA, we can perform a real time observation of multiple parameters in the marine environment.

From the land station we provide power supply and fibre optics communication link Furthermore we have installed a general alarm management to detect any failure in the system and/or in the storage capacity. The land station is connected at the beach dock through a cable of 1000 m, from where the marine cable starts its route to the main node, 4 km offshore and at 20m water depth.

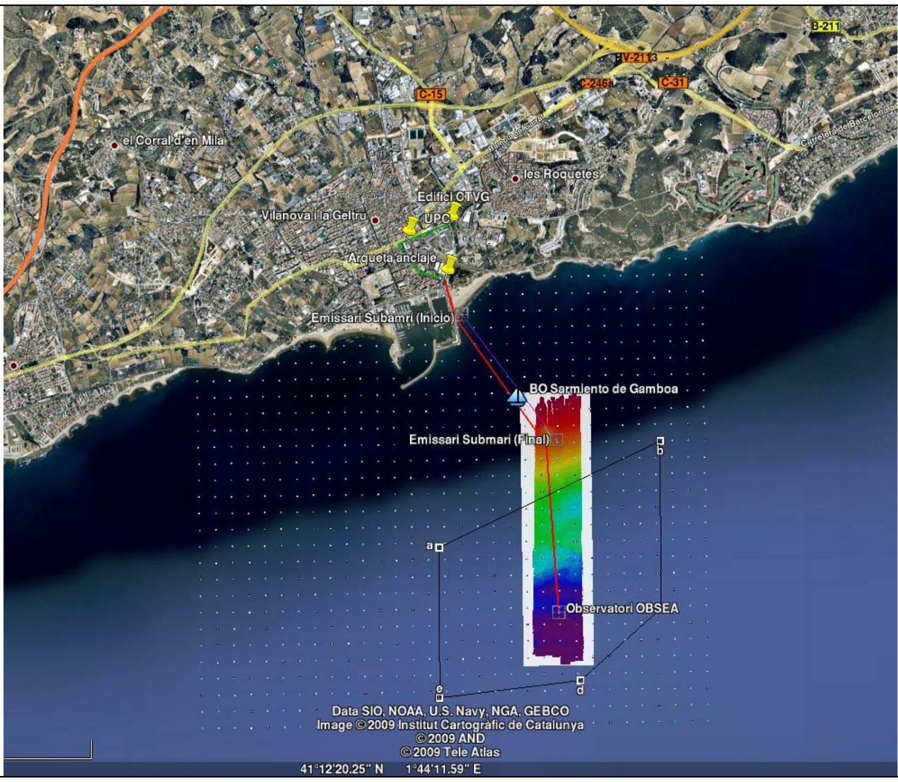


Fig.1 : OBSEA site location

• **Water depth:**

The Obsea underwater station has been installed at 20 m depth.

• **Bottom topography and soil conditions:**

Bottom topography can be seen in the next picture obtained with the Mutibeam echosounder with the CSIC-UTM Oceanographic vessel "Garcia del Cid". The sea floor is sandy, flat without rocks and really little vegetation. The OBSEA has been installed in a fishing protected area with artificial reefs to prevent trawling and allow fish growing

• **Distance to coast / Distance to port of operation:**

The underwater node has been installed at 4 km from the coast in front of the "Vilanova i la Geltrú" port.

II - Existing infrastructure

General architecture and main characteristics:

OBSEA was designed as a test observatory in a way that can be extended in future in order to form a seafloor observatory network that covers several interesting sites. Every node of this network will provide connectivity to many instruments (in the pilot phase, it is designed for the connection of 8 different instruments). It is planned to complete the observatory network with surface buoys that will provide a link through a satellite connection or GPRS. Current system implementation comprises only one node

In the next figure 2 it is shown the simplified diagram of the existing infrastructure composed by the ground station, cable and the underwater node.

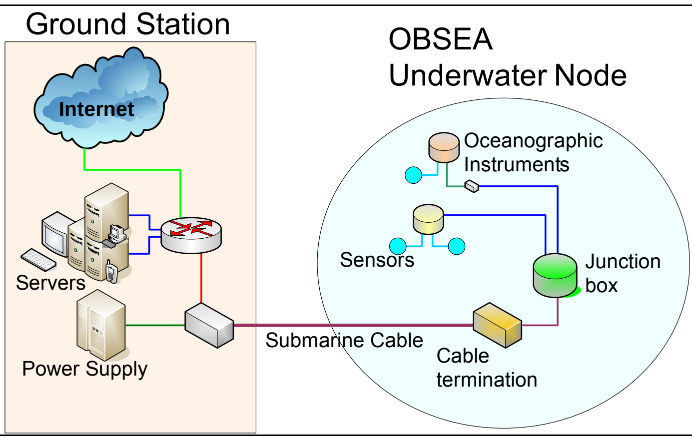


Fig.2 : General System architecture

- **Sea bottom test area infrastructures**

The sea bottom node is composed by a metallic cage structure that is supporting a junction box, a cable termination box and the oceanographic instruments at the same time that is protecting all the elements from unauthorized access. The termination box is a cylinder used to connect the rigid submarine cable that comes from land station with a flexible cable with the hybrid connector. The junction box contains the power, communications and control electronics of the node as well as the underwater connectors for the umbilical cable and oceanographic instruments.

The first underwater node has a power supply that is accepting power from 80 to 370Vdc by means of redundant 1+1 150W DC/DC converters. Marine instruments and control electronics are supplied with 12 and 48 V. Marine instruments are connected through cables that adapt their signal to the OBSEA Ethernet 10/100 interface

- **Shore station**

At present ground station can supply up to 320Vdc and 11A but all the electrical installations allow increasing it up to 1000V. Internet connection is carried out in the land station through a router that implements access control and protection. At shore there is a set of servers for oceanographic data management, snmp network elements supervision, controlling the underwater node electronics, and video storage. In figure 3 is shown the diagram of the shore station.

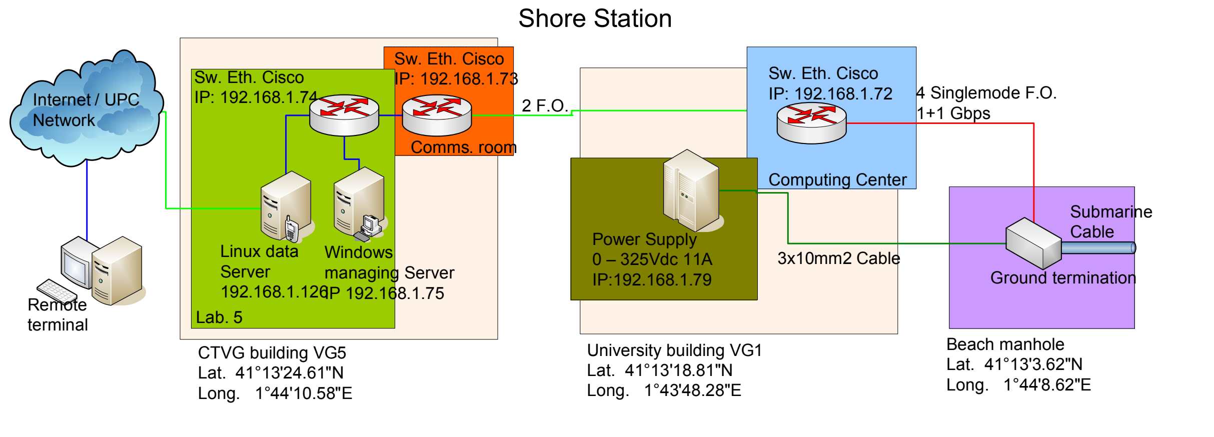


Fig.3 : Shore station Power and Communication system

- **Main cable to shore**

The submarine cable is a telecommunication cable donated by "Telefonica" that is composed by 6 single mode optical fibers for data transmission, one central copper conductor tube, and one aluminium shielding sheet. This cable acts as an umbilical cord between land station and marine node allowing continuous transmission of data and power supply for its operation. It is used the copper conductor of this hybrid cable to connect the negative pole of the power supply, the positive pole is connected to the aluminium cable shield and to earth.

Communication between nodes and land station is being carried through two redundant 1 Gbps fiber optic links with 1+1 configuration using TCP/IP protocols. Figure 4 is showing the underwater cable.

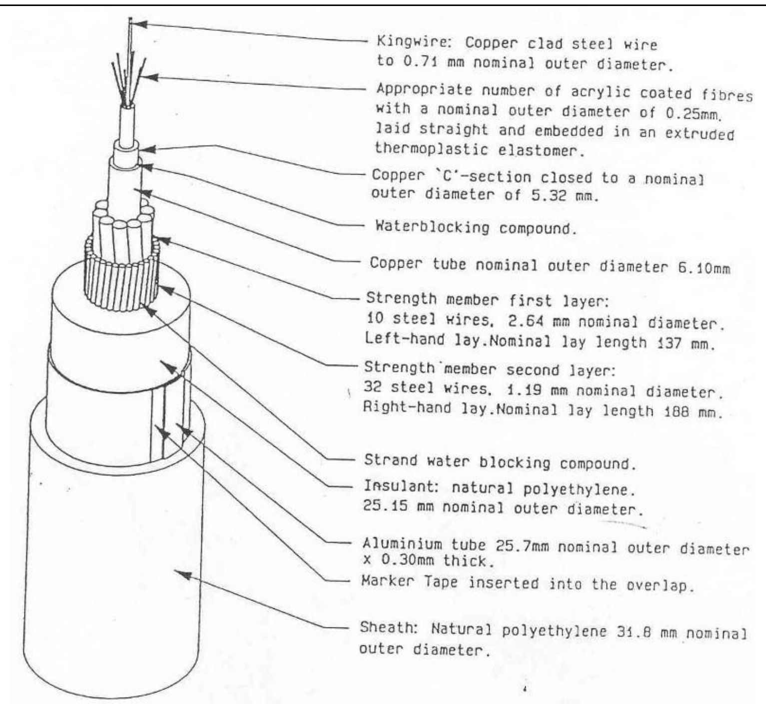


Fig.4 : Telecommunication cable

Precise description of existing structures on test area for housing instruments or pieces of equipment in test:

• **Mechanical interfaces**

The structure is designed to hold and protect several elements from external intervention. At the same time, this structure will stand the traction of the marine cable generated by the water currents. The mechanical seafloor structure has been designed to allow an easy installation of new elements. New instruments must be equipped with a 7 pin electrical GISMA underwater connector. Figure 5 is showing the 3D representation of the underwater structure

Fig.5 : Node structure

The main cylinder (Junction Box) that holds the control electronics is placed in the centre of this structure. This cylinder is designed to resist the pressure of a 300m water column and is providing the interface between the underwater cable and the marine instruments connected to the observatory.

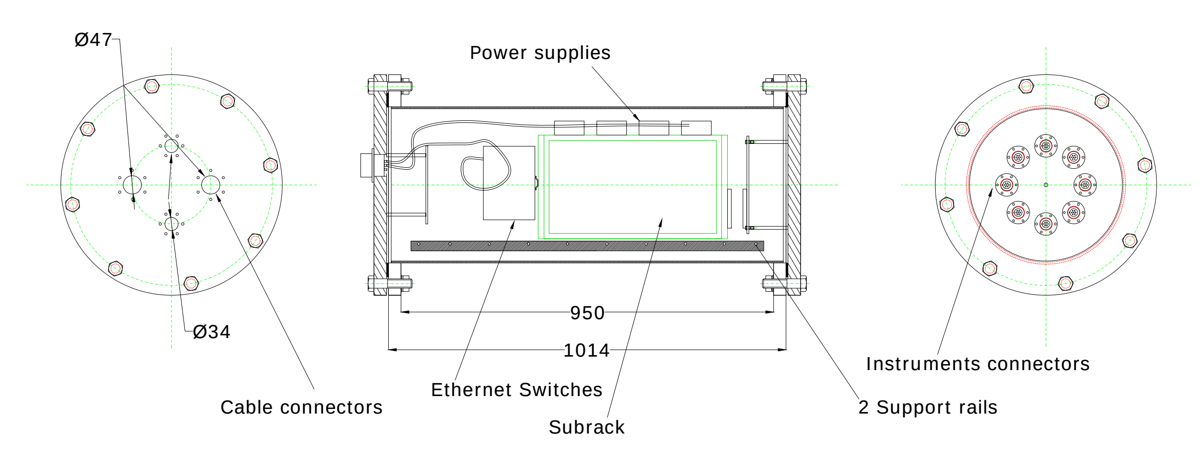


Fig.6 : Main cylinder

• Power and data interfaces and connector references

For the connexion of oceanographic instruments to the observatory, the cylinder is fitted with:

6 underwater mateable connectors: GISMA series 10 size 3 (see figure 7)

3 of these connectors are currently being used by the already installed instruments (see IV) but can be removed according to new experiment requirements.

The cylinder has space for two more connectors that at the moment are not installed.

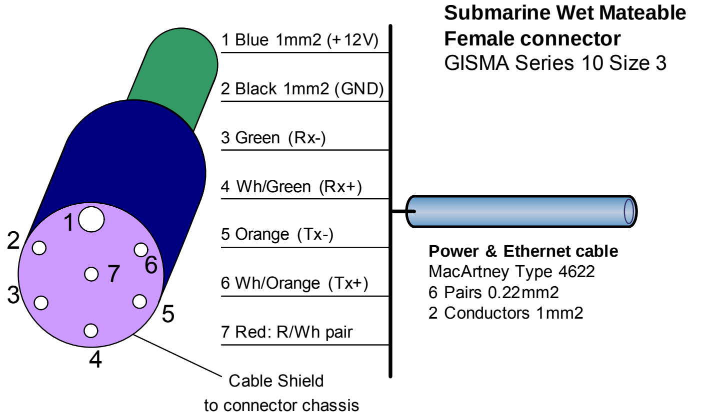


Fig.7 : Wiring diagram of the instruments connectors

Existing procedure to access to the infrastructure:

• Conditions of access

The OBSEA location is easily accessible using small ship in few minutes from the Vilanova port. A motorboat for the transport of a diver team can be rented in the port, in case of operations requiring bigger ships, is possible to contact local fishermen.

For underwater operations there is an agreement with two local companies of divers that can perform operations in the place.

• **Applying file contents**

Person to contact for more details on infrastructure:

Name	Marc Nogueras
Phone number	+34 938 967 200
Email	marc.nogueras@upc.edu

III - Underwater intervention

Available means for underwater intervention (Ships, ROV…) :

All maintenance interventions are performed by divers. We are in contact with some companies that can rent light ROVs for inspections and simple manipulations.
The OBSEA structure has been designed to be accessed only by human divers but is under study the required modifications in the structure and connectors to allow the installation of new instruments using ROVs. This will allow using this infrastructure as a training test bed for the use of ROVs in a deeper observatory.

Existing procedures for intervention and work on the infrastructure:

Do to the observatory in on service since only 19 may 2009 the intervention procedures are not yet completely defined. The procedures will adapted to the new project requests that will be received.

Planned interventions on the site 2009-2010-2011:

Object of intervention -Means utilized – Dates – Possibilities of added works
In the 1st phase of the project (2009) while at shore station is being improved the network supervisor, data management system, and user interface, the planned interventions in the underwater observatory are only the required to ensure the operability of the station: Cleaning of the camera hemisphere, anode inspection and integrity check.

Possibility of extra operation (in addition to planned interventions):

It is under study the possibility to add some new instruments, capabilities and accessories: Turbidity sensor, Acoustic Doppler Current Profiler, Sediment trap, tracking of animal species and acoustic communications for IEEE 1588 synchronization.

Procedures to apply for a specific intervention:

The OBSEA platform is for the moment open to receive new oceanographic projects, in case of interest must be contacted the responsible of the project

Person to contact for more details on underwater intervention:

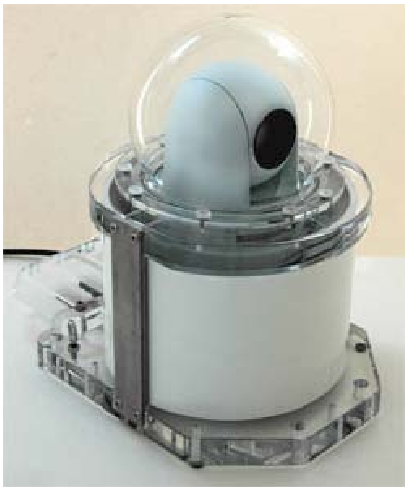
Name	Marc Nogueras / Michel Andre
Phone number	+34 938 967 200
Email	marc.nogueras@upc.edu / michel.andre@upc.edu

IV - Instruments already installed or planned

Detailed reference of the instruments:

The 3 instruments that are currently operative are, an IP camera with pan, tilt and zoom, a CTD for salinity, temperature and depth measurements and a Hydrophone for acoustic emissions measuring.

- OceanCam OPT-06 from Ocean Presence Technologies
- CTD SBE 37 SMP from SeaBird
- Hydrophone Naxys Ethernet 02345 from Bjørge

		
CTD SBE 37 SMP	Underwater camera OceanCam OPT-06	Hydrophone Bjørge Naxyx Ethernet 02345
Fig.8 : Instruments already installed		

They are 2 new instruments planned to be installed:

Turbidity Meter from Seapoint

Acoustic Modem UWM2000 from Linkquest

	
Seapoint Turbidity meter	Linkquest UWM2000
Fig. 9 : New planned instruments	

Accessibility to the data from these sensors:

The data management system will store, in the land station, all the historic data from sensors making it accessible for web clients. The system will have several servers for differentiated services. One server is for the storage of CTD data and new oceanographic sensors with low bandwidth in a SQL database, another is for the process, and storage of the video images with Zone Minder software and an additional server with Zabbix software is controlling using SNMP protocol all the network elements and devices of the OBSEA, providing to the clients historic information about the integrity of the components. Another Linux server is providing the Internet access and acting as a firewall.

Tests about SensorWebEnable (SWE - SOS) or IEEE1451.0 standards are been carried out to share data in an standard way by Internet. Other initiatives are been tested as PUCK protocol for plug&play instruments or DataTurbine for high real data streaming using Internet. All these tests run in parallel with the software architecture of OBSEA network.

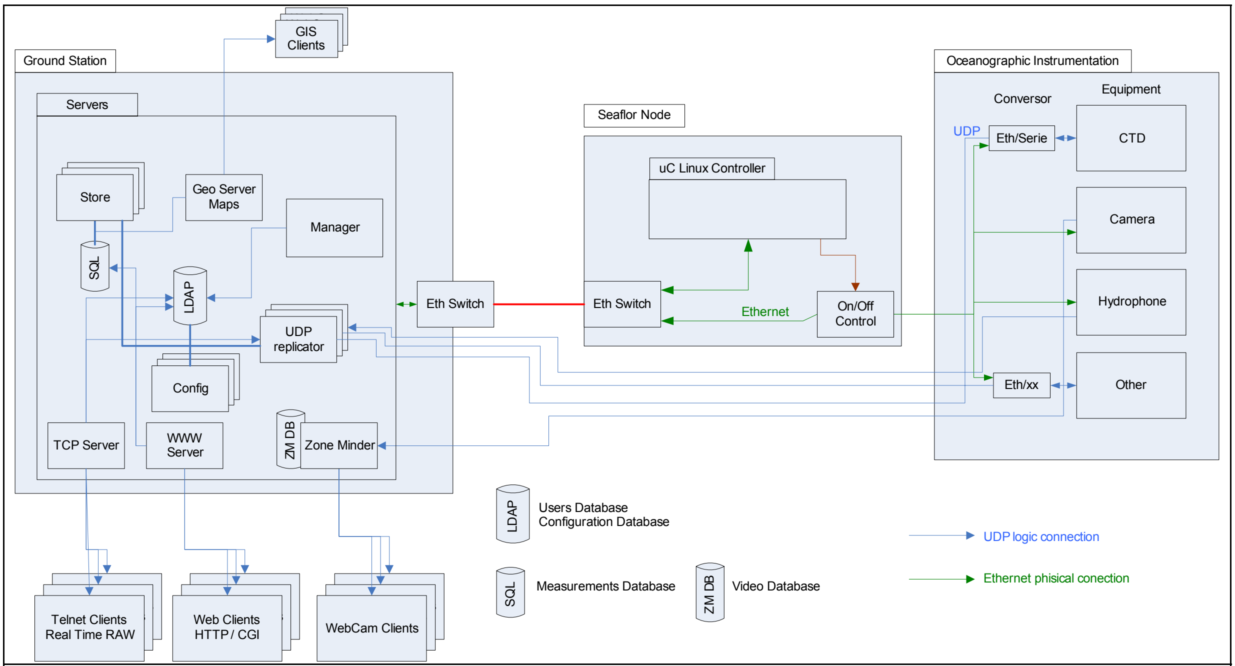


Fig.10 : Data acquisition system

Person to contact for more details on sensors already installed:

Name	Joaquín del Rio / Jordi Sorribas
Phone number	(+34) 938 967 200 / (+34) 93 230 95 00
Email	joquin.del.rio@upc.edu / sorribas@cmima.csic.es

V – Deployment possibilities of additional instruments

Deployment conditions:

Housing on seafloor structure and power and data connection

Instruments can be fixed to the node structure (Fig.5) and connected to underwater mateable connectors GISMA series 10 size 3 (Wiring in Fig. 7).

The junction box has 6 flange receptacle connectors; 3 currently in use and 3 available with the possibility to add to the box 2 more connectors. There is available a small quantity of plugs to build a custom cable for new instruments but additional plugs can be achieved from the manufacturer

Access conditions to data collected:

At present the conditions for the data access are not specified, when any institution will show interest in obtaining collected data we will sign a contractual agreement

Person to contact for more details on deployment conditions of additional instruments:

Name	Marc Nogueras / Jaume Piera
Phone number	+34 938 967 200
Email	marc.nogueras@upc.edu / jpiera@cmima.csic.es

A.4. Koljo Fjord site - Coastal

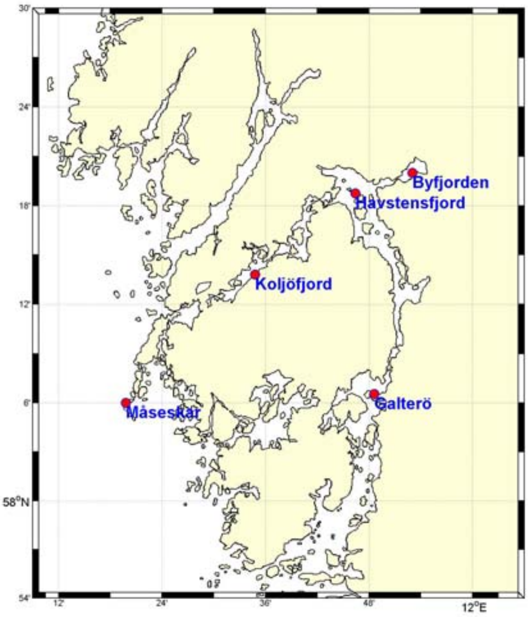
Responsible for the site: Per Hall

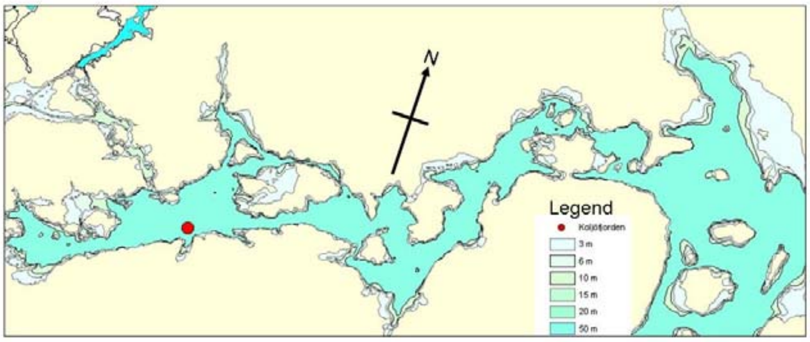
Email: perhall@chem.gu.se

I - Location of the infrastructure, bathymetry:

In the Koljo Fjord on the Swedish west coast about 100 km north of Gothenburg.

See attached map.





II - Existing infrastructure:

Precise description:

The Koljö Fjord is situated on the Swedish west coast approximately 100 km north of Gothenburg. Data exist in a data base (hosted by the Swedish Meteorological and Hydrological Institute (SMHI) in Gothenburg) on water column depth distributions of salinity (S), temperature (T), oxygen, hydrogen sulfide, nutrients, total N, total P, chlorophyll, Secchi depth, pH, alkalinity, etc. at the central deepest site (40-45 m). Most of these parameters (and certainly S, T and O_2) have been measured on a monthly basis since 1986, on a bimonthly or quarterly basis during 1958-1985, and (at least) annually during 1934-37. There are no measurements for the period 1938-57. The monitoring program in the Koljö Fjord is ongoing and presently run by SMHI.

Interfaces:

We propose a flexible, movable, self contained coastal observatory ESOFLEX (see attached drawing) that will have a single hub for connection of up to 5 nodes through serial interfaces (selectable Rs422 or Rs232). One of the existing nodes (provided by the HYPOX project) is a Seaguard string logger (from www.aadi.no). In addition to the sensors that are already connected to this instrument it has the capacity of accepting more than 10 sensors using AICAP (open AADI modified CAN bus standard for environmental sensors) and 4 analogue sensors. Consequently the combination of the ESOFLEX hub and the Seaguard node will provide power (max 100 W) and communication with the following specifications:

RS 232

RS 422

AICAP (AADI modified CAN bus)

Analogue

In regard to the implementation of IEEE 1451, in particular making use of the MBARI PUCK system, which is one of the major activities within WP2 of ESONET, an application will run on the shore side that implements an IEEE 1451.0 server. This will allow to use this infrastructure for demonstration experiments as planned for instance for OGC Interoperability Experiment 2. In addition commercially available software for data collection from nodes, instruments and separate sensors and for storage and on-line presentation of the collected data will be operated (more information on drawing).

Available connectors (detailed reference):

Underwater matable connectors from SubConn (Microseries 8 pin) or GISMA (series 80, 7 pin). For more information see attached drawing. In the present configuration the Seaguard string is equipped with AADI adapted LEMO connectors for plug and play connection of sensors using the AICAP format. These connectors are not underwater mat able but if necessary the existing 7 free outlets could be equipped with a SubConn underwater matable adaptors.

Existing procedure to access to the infrastructure:

ESOFLEX is designed for coastal use and easy access. The Hub and the so far proposed nodes can be lifted, recovered and modified within in 1-2 hours. The shore container for data transfer and power can be lifted on-board by the crane of R/V Skagerak (research ship of Göteborg Univeristy) and transferred to a different location if desired. It is planned to transfer all data from the shore station to Gothenburg University, which will play the role of central mission control centre. From there the data will be collected and presented with existing commercially available software (from www.aadi.no). The data will also be made accessible by the PANGAEA data system, through the IEEE 1451 server, that will provide the procedures to make the data available in a standard format (i.e. NetCFD) that allows users to freely access and process the data.

Person to contact for more detailed information on infrastructure:

Name	Anders Tengberg
Phone number	+46-703-466372
Email	anderste@chem.gu.se

and

Name	Christoph Waldmann
Phone number	+49-421-218 65606
Email	waldmann@marum.de

III - Underwater intervention:

Available tools for underwater intervention (Ships, ROV…):

Several ships like Skagerak, Oscar von Sydow and Alice. ROVs, benthic lander platforms, moorings, etc. are available. Steaming time from home location to the observatory is around 1 hour.

Existing procedure to work on the infrastructure:

Planning:

The infrastructure will be deployed in the Koljö Fjord starting in October 2010 and will among other things comprise of a fixed string of instruments covering the water column and a seafloor node (40-45 m depth) for payload experiments. For more information see attached drawing.

Possibility of extra operation:

The infrastructure is planned as a platform to not just provide data transfer from deployed instruments but also to train for deep-sea operations. For instance, the observatory will allow for ROV operations for instance checking the plugging process of underwater mateable connectors. It is also planned to get students involved as part of training activities within ESONET. The intention is to use the observatory as an easily accessible test bed for commercially available or newly developed (e.g. within EU project SENSNET) instruments and sensors. A major advantage with the proposed design is its flexibility and the ease to lift and connect new sensors without the need for costly and time consuming ROV operations.

Rules to apply for a specific intervention operation:

Specific intervention operations will be made possible. A description of the planned activities and to be deployed instruments has to be provided to the observatory operators. They will check whether the planned mission will follow all guidelines of the infrastructure that has been provided as a reference document. In case of any technical issues further information about how to adjust the deployment scenario will be provided.

Person to contact for more detailed on underwater intervention:

Name	Christoph Waldmann
Phone number	+49-421- 218 65606
Email	waldmann@marum.de

IV - Access to data collected by an instrument connected for test:

The basic instrument tests can be conducted on site to assure proper function of the payload sensors. The access to the online stream will then be accessible through the IEEE 1451 server running at the University of Kiel, which allows direct access to all sensor relevant characteristics or through the PANGAEA data system. For other data centres the data stream will be made available as well as the formats, and protocols will follow standard formats according to the guidelines of the OGC Sensor Web Enablement recommendations.

Person to contact for more detailed on data management problem:

Name	Christoph Waldmann
Phone number	+49-421- 218 65606
Email	waldmann@marum.de

V – Sensors already installed or planned

In the included ESOFLEX drawing we have presented some of the equipment that we have/will have access to for this project. In addition we also have other equipment available that could be connected and utilised including: CTD's (Sea and Sun BHP 8), Turbidity sensors (Wetlab), Fluorescence sensors (Turner C6), Video Cameras, Lights, Scanning Sonar (Kongsberg-Simrad EM1000), 3-D profiler (in-house development) and Planar Optode (in-house development)

Detailed reference of the sensors:

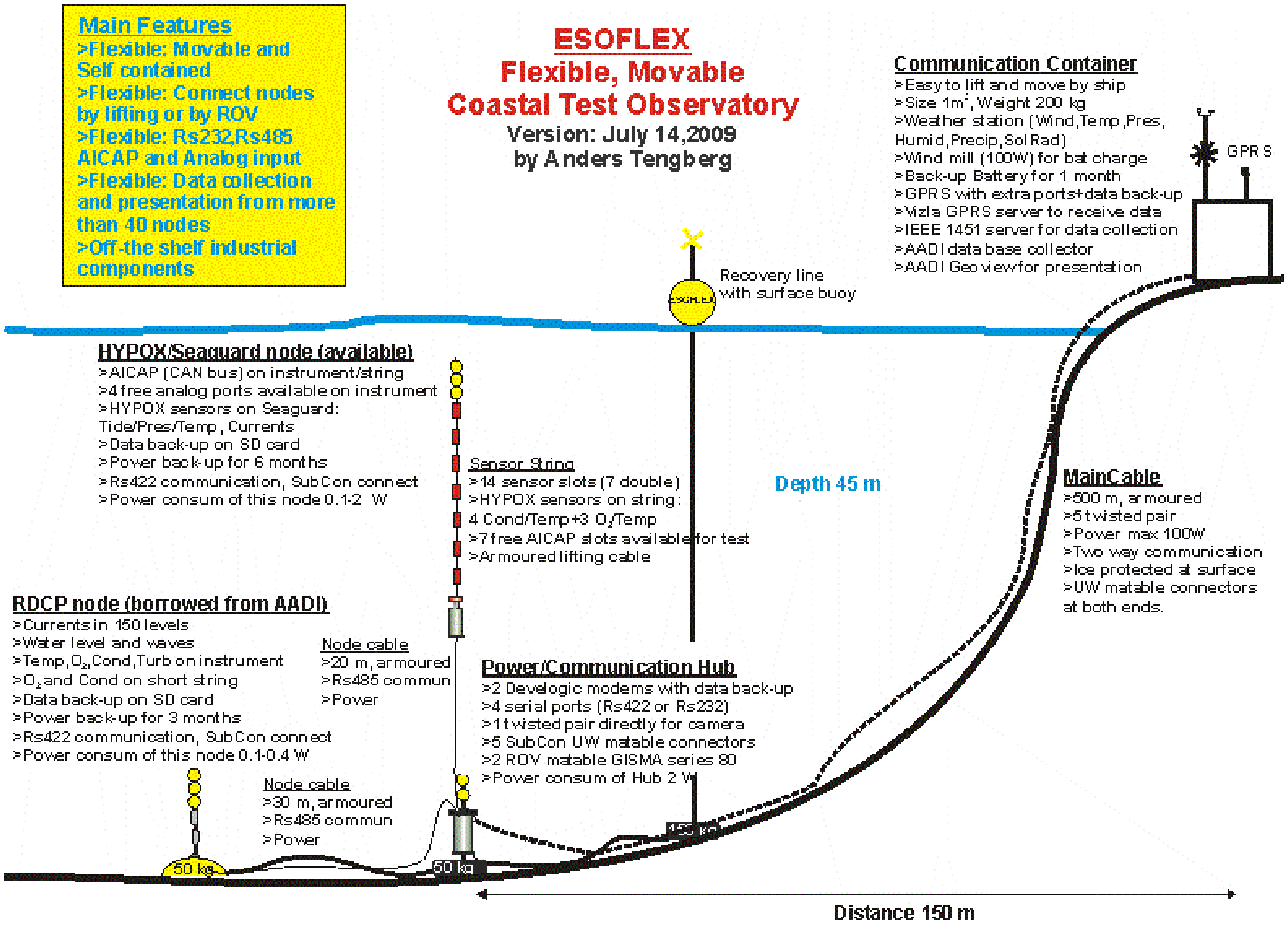
All main components, instruments and sensors suggested to be used for this observatory (see drawing) are commercially available off the shelf standard products. Detailed information about the modems for the communication hub is available at http://www.develogic.de/ (see HAM.NODE). The Seaguard string logger (single point current meter with sensor string), the Conductivity/Temperature sensors (4319A), the Oxygen/Temperature sensors (4835), the Tide/Pressure/Temperature sensor (4647C) and the RDCP-600 (Acoustic Doppler Profiling Current meter) with sensors for Temperature, Oxygen (3835), Wave and Tide (4405), Conductivity (4019A) and Turbidity (3612A) are all produced by Aanderaa Data Instruments. For detailed information and data sheets see www.aadi.no.

Accessibility to the data from these sensors:

All data will be fully available to the whole ESONET community using existing solutions for transfer, collection and presentation of data. We envisage streaming of data to the IEEE 1451 server running at the University of Kiel for incorporation of data into the Pangea data base and for direct access to all sensor relevant characteristics. For data presentation on the Internet in graphs we plan to use dedicated available software (Geoview, www.aadi.no).

Person to contact for more detailed on sensors already installed:

Name	Anders Tengberg
Phone number	+46-703-466372
Email	anderste@chem.gu.se


Main Features
>Flexible: Movable and Self contained
>Flexible: Connect nodes by lifting or by ROV
>Flexible: Rs232,Rs485 AICAP and Analog input
>Flexible: Data collection and presentation from more than 40 nodes
>Off-the shelf industrial components
ESOFLEX
Flexible, Movable
Coastal Test Observatory
Version: July 14,2009
by Anders Tengberg
Communication Container
>Easy to lift and move by ship
>Size 1m³, Weight 200 kg
>Weather station (Wind,Temp,Pres, Humid,Precip,Sol Rad)
>Wind mill (100W) for bat charge
>Back-up Battery for 1 month
>GPRS with extra ports+data back-up
>Vizla GPRS server to receive data
>IEEE 1451 server for data collection
>AADI data base collector
>AADI Geo view for presentation
GPRS
Recovery line with surface buoy
HYPOX/Seaguard node (available)
>AICAP (CAN bus) on instrument/string
>4 free analog ports available on instrument
>HYPOX sensors on Seaguard: Tide/Pres/Temp, Currents
>Data back-up on SD card
>Power back-up for 6 months
>Rs422 communication, SubCon connect
>Power consum of this node 0.1-2 W
Sensor String
>14 sensor slots (7 double)
>HYPOX sensors on string: 4 Cond/Temp+3 O2/Temp
>7 free AICAP slots available for test
>Armoured lifting cable
Depth 45 m
MainCable
>500 m, armoured
>5 twisted pair
>Power max 100W
>Two way communication
>Ice protected at surface
>UW matable connectors at both ends.
RDCP node (borrowed from AADI)
>Currents in 150 levels
>Water level and waves
>Temp,O2,Cond,Turb on instrument
>O2 and Cond on short string
>Data back-up on SD card
>Power back-up for 3 months
>Rs422 communication, SubCon connect
>Power consum of this node 0.1-0.4 W
Node cable
>20 m, armoured
>Rs485 commun
>Power
Power/Communication Hub
>2 Develogic modems with data back-up
>4 serial ports (Rs422 or Rs232)
>1 twisted pair directly for camera
>5 SubCon UW matable connectors
>2 ROV matable GISMA series 80
>Power consum of Hub 2 W
Node cable
>30 m, armoured
>Rs485 commun
>Power
50 kg
50 kg
150 kg
Distance 150 m

Appendices – B: Detailed cost tables

B.1. Antares site – Deep sea

B.2. East Sicily / Nemo-SN1 site – Deep sea

B.3. OBSEA site - Coastal

B.4. Koljofjord site - Coastal

Test Call Budget / Deep sea sites

B.1. Antares - B.2. East Sicily / Nemo-SN1

Equipment

	TEST CABLED SITES - EQUIPMENT								
	SITE	**1-ANTARES**				**2-NEMO-SN1**			
	PARTNER-1	**CNRS-INSU**				**INFN**			
		Items	**Eligible**	**Request**	**Propos**	**Items**	**Eligible**	**Request**	**Propos**
1	**Infrastructures**		**0**	**0**	**0**	**Infrastructures**	**50 000**	**50 000**	**0**
						ROV manipulator & holder	50 000	50 000	
2	**Electronics s/syst**		**35 500**	**30 500**	**13 000**	**Electronics s/syst**	**0**	**0**	**0**
		Mooring-Line-Inductive modem	17 500	17 500	0				
		M.L-Electronic module	15 000	10 000	10 000				
		Electr.Adapt-BJS ACModem	3 000	3 000	3 000				
3	**Mechanics s/syst**		**34 500**	**34 500**	**28 000**	**Mechanics s/syst**	**65 000**	**0**	**0**
		Cable	18 000	18 000	13 000	Hybrid UW connect. harness	65 000	0	0
		Buoy	4 000	4 000	2 500				
		Deadweight	2 500	2 500	2 500				
		Mech.Adapt-BJS ACModem	10 000	10 000	10 000				
4	**Acoustics s/syst**		**68 500**	**63 000**	**61 333**	**Acoustics s/syst**	**50 000**	**0**	**0**
		BJS-Acoustic modem	50 000	46 000	46 000	Calibrated acoustic transducer	50 000	0	0
		ML-SurfaceAcoustic modem	1 500	1 500	1 500				
		Interlink ODI	17 000	15 500	13 833				
5	**Instruments**		**105 000**	**5 000**	**5 000**	**Instruments**	**0**	**0**	**0**
		5 IODA	100 000	0	0				
		IODA modification	5 000	5 000	5 000				
6	**Sensors**		**95 000**	**0**	**0**	**Sensors**	**0**	**0**	**0**
		5 Microcat	35 000	0	0				
		5 Aquadopp	60 000	0	0				
7	**DataAcq systems**		**0**	**0**	**0**	**DataAcq systems**	**35 000**	**0**	**0**
						Data acquisition system	35 000	0	0
8	**Softwares**		**0**	**0**	**0**	**Softwares**	**0**	**0**	**0**
	PARTNER COST	**CNRS-INSU**	**338 500**	**133 000**	**107 333**	**INFN**	**200 000**	**50 000**	**0**
	PARTNER-2	**IFREMER**				**INGV**			
		Items	**Eligible**	**Request**	**Propos**	**Items**	**Eligible**	**Request**	**Propos**
1	**Infrastructures**		**0**	**0**	**0**	**Infrastructures**	**0**	**0**	**0**
2	**Electronics s/syst**		**0**	**0**	**0**	**Electronics s/syst**	**35 000**	**0**	**3 000**
						Electronics	35 000	0	0
						Consumables			3 000
3	**Mechanics s/syst**		**0**	**0**	**0**	**Mechanics s/syst**	**100 000**	**0**	**25 800**
						Cables & connectors	100 000	0	22 800
						Consumables			3 000
4	**Acoustics s/syst**		**0**	**0**	**0**	**Acoustics s/syst**	**0**	**0**	**0**
5	**Instruments**		**0**	**0**	**0**	**Instruments**	**0**	**0**	**0**
6	**Sensors**		**0**	**0**	**0**	**Sensors**	**50 000**	**0**	**0**
						ADCP	35 000	0	0
						CTD	15 000	0	0
7	**DataAcq systems**		**0**	**0**	**0**	**DataAcq systems**	**0**	**0**	**0**
8	**Softwares**		**0**	**0**	**0**	**Softwares**	**35 000**	**0**	**0**
						Computing & IT	35 000	0	0
	PARTNER COST	**IFREMER**	**0**	**0**	**0**	**INGV**	**220 000**	**0**	**28 800**

	TEST CABLED SITES - EQUIPMENT									
	SITE	1-ANTARES					2-NEMO-SN1			
	PARTNER-3	INFN					CNRS			
		Items	Eligible	Request	Propos		Items	Eligible	Request	Propos
1	Infrastructures		0	0	0		Infrastructures	0	0	0
2	Electronics s/syst		0	0	0		Electronics s/syst	0	0	0
3	Mechanics s/syst		0	0	0		Mechanics s/syst	0	0	0
4	Acoustics s/syst		0	0	0		Acoustics s/syst	0	0	0
5	Instruments		0	0	0		Instruments	0	0	0
6	Sensors		0	0	0		Sensors	0	0	0
7	DataAcq systems		0	0	0		DataAcq systems	0	0	0
8	Softwares		0	0	0		Softwares	0	0	0
	PARTNER COST	INFN	0	0	0		CNRS	0	0	0
	PARTNER-4	INGV								
		Items	Eligible	Request	Propos		Items	Eligible	Request	Propos
1	Infrastructures		0	0	0		Infrastructures	0	0	0
2	Electronics s/syst		23 000	0	0		Electronics s/syst	0	0	0
		Electronics	8 000							
		Battery packs	15 000							
3	Mechanics s/syst		38 000	0	0		Mechanics s/syst	0	0	0
		Cables & connectors	10 000							
		2 Ti vessels	18 000							
		Components for mooring	10 000							
4	Acoustics s/syst		0	0	0		Acoustics s/syst	0	0	0
5	Instruments		0	0	0		Instruments	0	0	0
6	Sensors		86 000	0	0		Sensors	0	0	0
		Radiometer	80 000							
		Environmental sensors	6 000							
7	DataAcq systems		0	0	0		DataAcq systems	0	0	0
8	Softwares		0	0	0		Softwares	0	0	0
	PARTNER COST	INGV	147 000	0	0		0	0	0	0

	TEST CABLED SITES - EQUIPMENT									
	SITE	1-ANTARES					2-NEMO-SN1			
	PARTNER-5									
		Items	Eligible	Request	Propos		Items	Eligible	Request	Propos
1	Infrastructures		0	0	0		Infrastructures	0	0	0
2	Electronics s/syst		0	0	0		Electronics s/syst	0	0	0
3	Mechanics s/syst		0	0	0		Mechanics s/syst	0	0	0
4	Acoustics s/syst		0	0	0		Acoustics s/syst	0	0	0
5	Instruments		0	0	0		Instruments	0	0	0
6	Sensors		0	0	0		Sensors	0	0	0
7	DataAcq systems		0	0	0		DataAcq systems	0	0	0
8	Softwares		0	0	0		Softwares	0	0	0
	PARTNER COST	0	0	0	0		0	0	0	0

	SITE	1-ANTARES					2-NEMO-SN1			
			Eligible	Request	Propos			Eligible	Request	Propos
1	Infrastructures		0	0	0	1	Infrastructures	50 000	50 000	0
2	Electronics s/syst		58 500	30 500	13 000	2	Electronics s/syst	35 000	0	3 000
3	Mechanics s/syst		72 500	34 500	28 000	3	Mechanics s/syst	165 000	0	25 800
4	Acoustics s/syst		68 500	63 000	61 333	4	Acoustics s/syst	50 000	0	0
5	Instruments		105 000	5 000	5 000	5	Instruments	0	0	0
6	Sensors		181 000	0	0	6	Sensors	50 000	0	0
7	DataAcq systems		0	0	0	7	DataAcq systems	35 000	0	0
8	Softwares		0	0	0	8	Softwares	35 000	0	0
	TOTAL		485 500	133 000	107 333		TOTAL	420 000	50 000	28 800

Other costs

	TEST CABLED SITES - OTHER COSTS												
	SITE	**1-ANTARES**			**Eligible**	**Request**	**Propos**	**2-NEMO-SN1**			**Eligible**	**Request**	**Propos**
	PARTNER-1	**CNRS-INSU**						**INFN**					
	Transport				0	0	0				0	0	0
	Transit				2 500	2 500	2 500				10 000	10 000	10 000
	Insurance				0	0	0				0	0	0
1	**Sub-Total**				**2 500**	**2 500**	**2 500**				**10 000**	**10 000**	**10 000**
	Ship	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name												
	Length-m												
	Cost / day												
	Number days												
1	**Ship Cost**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	ROV + EQUIPnt	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name							Cougar	J-Box	Infrastr			
	ROV cost/day							4 500	1 500	6 500			
	Crew cost/day							8 000	0	0			
	Oper cost/day	0	0	0				12 500	1 500	6 500			
	Number days	0	0	0				10	10	10			
	ROV Oper cost	0	0	0	0	0	0	125 000	15 000	65 000	205 000	80 000	80 000
	Mob-Demob cost	0	0	0	0	0	0	0	0	0	0	0	0
1	**ROV+EQU cost**	**0**	**0**	**0**	**0**	**0**	**0**	**125 000**	**15 000**	**65 000**	**205 000**	**80 000**	**80 000**
	PARTNER COST	**CNRS-INSU**			**2 500**	**2 500**	**2 500**	**INFN**			**215 000**	**90 000**	**90 000**
	PARTNER-2	**IFREMER**						**INGV**					
	Transport				0	0	0				0	0	0
	Transit				0	0	0				10 000	10 000	10 000
	Insurance				0	0	0				0	0	0
1	**Sub-Total**				**0**	**0**	**0**				**10 000**	**10 000**	**10 000**
	Ship	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name							Mecma-C.Ship					
	Length-m												
	Cost / day							22 000					
	Number days							10					
1	**Ship Cost**	**0**	**0**	**0**	**0**	**0**	**0**	**220 000**	**0**	**0**	**220 000**	**220 000**	
	ROV + EQUIPnt	**1**	**2**	**3**				**1**	**2**	**3**			
	Name	Victor						Cougar	Winch	Infrastr			
	ROV cost/day	33 000						4 500	2 500	2 500			
	Crew cost/day	0						0	0	0			
	Oper cost/day	33 000	0	0				4 500	2 500	2 500			
	Number days	2						10	10	10			
	ROV Oper cost	66 000	0	0	66 000	0	0	45 000	25 000	25 000	95 000	0	0
	Mob-Demob cost	120 000			120 000	0	0	0			0	0	0
1	**ROV+EQU cost**	**186 000**	**0**	**0**	**186 000**	**0**	**0**	**45 000**	**25 000**	**25 000**	**95 000**	**0**	**0**
	PARTNER COST	**IFREMER**			**186 000**	**0**	**0**	**INGV**			**325 000**	**230 000**	**10 000**
	PARTNER-3	**INFN**						**CNRS**					
	Transport				0	0	0				0	0	0
	Transit				40 000	32 800	32 800				0	0	0
	Insurance				0	0	0				0	0	0
1	**Sub-Total**				**40 000**	**32 800**	**32 800**				**0**	**0**	**0**
	Ship	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name												
	Length-m												
	Cost / day												
	Number days												
1	**Ship Cost**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	ROV + EQUIPnt	**1**	**2**	**3**				**1**	**2**	**3**			
	Name	Cougar											
	ROV cost/day	9 000											
	Crew cost/day	8 000											
	Oper cost/day	17 000	0	0				0	0	0			
	Number days	3											
	ROV Oper cost	51 000	0	0	51 000	28 700	41 820	0	0	0	0	0	0
	Mob-Demob cost	0			0	0	0	0			0	0	0
1	**ROV+EQU cost**	**51 000**	**0**	**0**	**51 000**	**28 700**	**28 700**	**0**	**0**	**0**	**0**	**0**	**0**
	PARTNER COST	**INFN**			**91 000**	**61 500**	**61 500**	**CNRS**			**0**	**0**	**0**

	TEST CABLED SITES - OTHER COSTS													
	SITE	**1-ANTARES**			**Eligible**	**Request**	**Propos**		**2-NEMO-SN1**			**Eligible**	**Request**	**Propos**
	PARTNER-4	**INGV**												
	Transport				4 000	0	0							
	Transit				5 000	0	0							
	Insurance					0	0							
1	**Sub-Total**				**9 000**	**0**	**0**					**0**	**0**	**0**
	Ship	**1**	**2**	**3**	**Tot**				**1**	**2**	**3**	**Tot**		
	Name													
	Length-m													
	Cost / day													
	Number days													
1	**Ship Cost**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
	ROV + EQUIPnt	**1**	**2**	**3**					**1**	**2**	**3**			
	Name													
	ROV cost/day													
	Crew cost/day													
	Oper cost/day	0	0	0					0	0	0			
	Number days													
	ROV Oper cost	0	0	0	0	0	0		0	0	0	0	0	0
	Mob-Demob cost				0	0	0					0	0	0
1	**ROV+EQU cost**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
	PARTNER COST	**INGV**			**9 000**	**0**	**0**		**0**			**0**	**0**	**0**
	PARTNER-5													
	Transport													
	Transit													
	Insurance													
1	**Sub-Total**				**0**	**0**	**0**					**0**	**0**	**0**
	Ship	**1**	**2**	**3**	**Tot**				**1**	**2**	**3**	**Tot**		
	Name													
	Length-m													
	Cost / day													
	Number days													
1	**Ship Cost**	**0**	**0**	**0**	**0**				**0**	**0**	**0**	**0**	**0**	**0**
	ROV + EQUIPnt	**1**	**2**	**3**	**Tot**				**1**	**2**	**3**	**Tot**		
	Name													
	ROV cost/day													
	Crew cost/day													
	Oper cost/day	0	0	0					0	0	0			
	Number days													
	ROV Oper cost	0	0	0	0	0	0		0	0	0	0		
	Mob-Demob cost				0	0	0					0		
1	**ROV+EQU cost**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
	PARTNER COST	**0**			**0**	**0**	**0**		**0**			**0**	**0**	**0**
	TOTAL													
	Transport				4 000	0	0					0	0	0
	Transit				47 500	35 300	35 300					20 000	20 000	20 000
	Insurance				0	0	0					0	0	0
1	**Sub-Total**				**51 500**	**35 300**	**35 300**					**20 000**	**20 000**	**20 000**
1	**Ship Cost**				**0**	**0**	**0**					**220 000**	**220 000**	**0**
	ROV Oper cost				117 000	28 700	41 820					300 000	80 000	80 000
	Mob-Demob cost				120 000	0	0					0	0	0
1	**ROV+EQU cost**				**237 000**	**28 700**	**28 700**					**300 000**	**80 000**	**80 000**
	SITE COST	**1-ANTARES**			**288 500**	**64 000**	**64 000**		**2-NEMO-SN1**			**540 000**	**320 000**	**100 000**

Personnel – Travels & accommodation

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION								
	SITE	**1-ANTARES**				**2-NEMO-SN1**			
	PARTNER-1	**CNRS-INSU**				**INFN**			
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		18				8		
	Cost		791 160	0	0		4 000	0	0
2	**Travels-Accomod**								
	Travel Number		2				1		
	Stay Location		Brest			Catania / Nemo-SN1 site			
	Stay days / Travel		3				10		
	Stay days / Total		6				10		
	Cost Trav + Accom		6 000	6 000	0		0	0	0
	Cost / Travel		3 000				0		
	PARTNER-2	**IFREMER**				**INGV**			
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		2				13		
	Cost		29 000	0	0		45 200	0	0
2	**Travels-Accomod**								
	Travel Number						1		
	Stay Location					Catania / Nemo-SN1 site			
	Stay days / Travel						10		
	Stay days / Total		0				10		
	Cost Trav + Accom						15 000	15 000	0
	Cost / Travel		#DIV/0!				15 000		
	PARTNER-3	**INFN**				**CNRS**			
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		3				3		
	Cost		4 000	0	0		0	0	0
2	**Travels-Accomod**								
	Travel Number		1				1		
	Stay Location	Toulon / Antares site				Catania / Nemo-SN1 site			
	Stay days / Travel		10				15		
	Stay days / Total		10				15		
	Cost Trav + Accom		8 000	6 000	0		15 000	15 000	0
	Cost / Travel		8 000				15 000		

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION									
	SITE	**1-ANTARES**					**2-NEMO-SN1**			
	PARTNER-4	**INGV**								
		Comments	**Eligible**	**Request**	**Propos**		**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**									
	Number involved		7							
	Cost		13 600	0	0					
2	**Travels-Accomod**									
	Travel Number		1							
	Stay Location	Toulon / Site Antares								
	Stay days / Travel		10							
	Stay days / Total		10					0		
	Cost Trav + Accom		18 000	0	0					
	Cost / Travel		18 000					#DIV/0!		
	PARTNER-5									
		Comments	**Eligible**	**Request**	**Propos**		**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**									
	Number involved									
	Cost									
2	**Travels-Accomod**									
	Travel Number									
	Stay Location									
	Stay days / Travel									
	Stay days / Total		0					0		
	Cost Trav + Accom									
	Cost / Travel		#DIV/0!					#DIV/0!		
	SITE	**1-ANTARES**					**2-NEMO-SN1**			
			Eligible	**Request**	**Propos**			**Eligible**	**Request**	**Propos**
1	**Personnel**									
	Number involved		**30**					**24**		
	Cost		**837 760**	**0**	**0**			**49 200**	**0**	**0**
2	**Travels-Accomod**									
	Travel Number		**4**					**3**		
	Stay days / Total		**26**					**35**		
	Cost Trav + Accom		**32 000**	**12 000**	**0**			**30 000**	**30 000**	**0**

Personnel Exchange Budget / Deep sea sites

B.1. Antares - B.2. East Sicily / Nemo-SN1

Personnel – Travels & accommodation

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION									
	SITE	1-ANTARES					2-NEMO-SN1			
	PARTNER-1	CNRS-INSU					INFN			
		Comments	Eligible	Request	Propos		Comments	Eligible	Request	Propos
1	Personnel									
	Number involved		18					8		
	Cost		791 160	0	0			4 000	0	0
2	Travels-Accomod									
	Travel Number		2					1		
	Stay Location		Brest				Catania / Nemo-SN1 site			
	Stay days / Travel		3					10		
	Stay days / Total		6					10		
	Cost Trav + Accom		6 000	6 000	6 000			0	0	0
	Cost / Travel		3 000					0		
	PARTNER-2	IFREMER					INGV			
		Comments	Eligible	Request	Propos		Comments	Eligible	Request	Propos
1	Personnel									
	Number involved		2					13		
	Cost		29 000	0	0			45 200	0	0
2	Travels-Accomod									
	Travel Number							1		
	Stay Location						Catania / Nemo-SN1 site			
	Stay days / Travel							10		
	Stay days / Total		0					10		
	Cost Trav + Accom							15 000	15 000	10 000
	Cost / Travel		#DIV/0!					15 000		
	PARTNER-3	INFN					CNRS			
		Comments	Eligible	Request	Propos		Comments	Eligible	Request	Propos
1	Personnel									
	Number involved		3					3		
	Cost		4 000	0	0			0	0	0
2	Travels-Accomod									
	Travel Number		1					1		
	Stay Location	Toulon / Antares site					Catania / Nemo-SN1 site			
	Stay days / Travel		10					15		
	Stay days / Total		10					15		
	Cost Trav + Accom		8 000	6 000	6 000			15 000	15 000	10 000
	Cost / Travel		8 000					15 000		

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION								
	SITE	**1-ANTARES**				**2-NEMO-SN1**			
	PARTNER-4	**INGV**							
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		7						
	Cost		13 600	0	0				
2	**Travels-Accomod**								
	Travel Number		1						
	Stay Location	Toulon / Site Antares							
	Stay days / Travel		10						
	Stay days / Total		10				0		
	Cost Trav + Accom		18 000	0	0				
	Cost / Travel		18 000				#DIV/0!		
	PARTNER-5								
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved								
	Cost								
2	**Travels-Accomod**								
	Travel Number								
	Stay Location								
	Stay days / Travel								
	Stay days / Total		0				0		
	Cost Trav + Accom								
	Cost / Travel		#DIV/0!				#DIV/0!		
	SITE	**1-ANTARES**				**2-NEMO-SN1**			
			Eligible	**Request**	**Propos**		**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		**30**				**24**		
	Cost		**837 760**	**0**	**0**		**49 200**	**0**	**0**
2	**Travels-Accomod**								
	Travel Number		**4**				**3**		
	Stay days / Total		**26**				**35**		
	Cost Trav + Accom		**32 000**	**12 000**	**12 000**		**30 000**	**30 000**	**20 000**

Test Call Budget / Coastal sites

B.3. OBSEA - B.4. Koljofjord

Equipment

	TEST CABLED SITES - EQUIPMENT								
	SITE	**3-OBSEA**				**4-KOLJOFJORD**			
	PARTNER-1	**UPC**				**UGOT**			
		Items	**Eligible**	**Request**	**Propos**	**Items**	**Eligible**	**Request**	**Propos**
1	**Infrastructures**	**Infrastructures**	**9 500**	**4 500**	**0**	**Infrastructures**	**10 000**	**8 000**	**4 000**
		Expansion storage area network	6 000	3 000		Land station	10 000	8 000	4 000
		Air conditioning & UPS failover	3 500	1 500					
2	**Electronics s/syst**	**Electronics s/syst**	**8 500**	**5 000**	**0**	**Electronics s/syst**	**0**	**0**	**0**
		Sun Blade module	5 000	3 000					
		Electronic components	3 500	2 000					
3	**Mechanics s/syst**	**Mechanics s/syst**	**8 000**	**4 500**	**0**	**Mechanics s/syst**	**0**	**0**	**0**
		Submarine connectors	4 000	2 500					
		Cables & el-mec components	4 000	2 000					
4	**Acoustics s/syst**	**Acoustics s/syst**	**0**	**0**	**0**	**Acoustics s/syst**	**0**	**0**	**0**
5	**Instruments**	**Instruments**	**0**	**0**	**0**	**Instruments**	**0**	**0**	**0**
6	**Sensors**	**Sensors**	**0**	**0**	**0**	**Sensors**	**0**	**0**	**0**
7	**DataAcq systems**	**DataAcq systems**	**0**	**0**	**0**	**DataAcq systems**	**0**	**0**	**0**
8	**Softwares**	**Softwares**	**3 000**	**3 000**	**0**	**Softwares**	**0**	**0**	**0**
		Software licenses	3 000	3 000					
	PARTNER COST	**UPC**	**29 000**	**17 000**	***3 145***	**UGOT**	**10 000**	**8 000**	**4 000**
	PARTNER-2	**CSIC**				**MARUM**			
		Items	**Eligible**	**Request**	**Propos**	**Items**	**Eligible**	**Request**	**Propos**
1	**Infrastructures**	**Infrastructures**	**0**	**0**	**0**	**Infrastructures**	**10 000**	**0**	**0**
						Submarine cable	10 000	0	0
2	**Electronics s/syst**	**Electronics s/syst**	**0**	**0**	**0**	**Electronics s/syst**	**0**	**0**	**0**
3	**Mechanics s/syst**	**Mechanics s/syst**	**10 000**	**7 500**	**0**	**Mechanics s/syst**	**0**	**0**	**0**
		Connec & comp Turbidimeter	3 000	2 500					
		Frame & components ADCP	7 000	5 000					
4	**Acoustics s/syst**	**Acoustics s/syst**	**0**	**0**	**0**	**Acoustics s/syst**	**0**	**0**	**0**
5	**Instruments**	**Instruments**	**0**	**0**	**0**	**Instruments**	**0**	**0**	**0**
6	**Sensors**	**Sensors**	**0**	**0**	**0**	**Sensors**	**0**	**0**	**0**
7	**DataAcq systems**	**DataAcq systems**	**12 000**	**3 000**	**0**	**DataAcq systems**	**0**	**0**	**0**
		Expansion Video server	12 000	3 000					
8	**Softwares**		**0**	**0**	**0**	**Softwares**	**0**	**0**	**0**
	PARTNER COST	**CSIC**	**22 000**	**10 500**	***4 847***	**MARUM**	**10 000**	**0**	**0**

	TEST CABLED SITES - EQUIPMENT								
	SITE	**3-OBSEA**				**4-KOLJOFJORD**			
	PARTNER-3	**IFREMER**							
		Items	**Eligible**	**Request**	**Propos**	**Items**	**Eligible**	**Request**	**Propos**
1	**Infrastructures**	**Infrastructures**	**0**	**0**	**0**	**Infrastructures**	**0**	**0**	**0**
2	**Electronics s/syst**	**Electronics s/syst**	**2 000**	**2 000**	**0**	**Electronics s/syst**	**0**	**0**	**0**
		Smart sensor prototype	2 000	2 000					
3	**Mechanics s/syst**	**Mechanics s/syst**	**3 000**	**3 000**	**0**	**Mechanics s/syst**	**0**	**0**	**0**
		Ti housing	3 000	3 000					
4	**Acoustics s/syst**	**Acoustics s/syst**	**0**	**0**	**0**	**Acoustics s/syst**	**0**	**0**	**0**
5	**Instruments**	**Instruments**	**20 000**	**5 000**	**0**	**Instruments**	**0**	**0**	**0**
		MicrObs-Ethernet	20 000	5 000					
6	**Sensors**	**Sensors**	**0**	**0**	**0**	**Sensors**	**0**	**0**	**0**
7	**DataAcq systems**	**DataAcq systems**	**0**	**0**	**0**	**DataAcq systems**	**0**	**0**	**0**
8	**Softwares**	**Softwares**	**0**	**0**	**0**	**Softwares**	**0**	**0**	**0**
	PARTNER COST	**IFREMER**	**25 000**	**10 000**	***4 706***	**0**	**0**	**0**	**0**
	PARTNER-4	**MARUM**							
		Items	**Eligible**	**Request**	**Propos**	**Items**	**Eligible**	**Request**	**Propos**
1	**Infrastructures**	**Infrastructures**	**0**	**0**	**0**	**Infrastructures**	**0**	**0**	**0**
2	**Electronics s/syst**	**Electronics s/syst**	**0**	**0**	**0**	**Electronics s/syst**	**0**	**0**	**0**
3	**Mechanics s/syst**	**Mechanics s/syst**	**0**	**0**	**0**	**Mechanics s/syst**	**0**	**0**	**0**
4	**Acoustics s/syst**	**Acoustics s/syst**	**0**	**0**	**0**	**Acoustics s/syst**	**0**	**0**	**0**
5	**Instruments**	**Instruments**	**0**	**0**	**0**	**Instruments**	**0**	**0**	**0**
6	**Sensors**	**Sensors**	**0**	**0**	**0**	**Sensors**	**0**	**0**	**0**
7	**DataAcq systems**	**DataAcq systems**	**0**	**0**	**0**	**DataAcq systems**	**0**	**0**	**0**
8	**Softwares**	**Softwares**	**0**	**0**	**0**	**Softwares**	**0**	**0**	**0**
	PARTNER COST	**MARUM**	**0**	**0**	***962***	**0**	**0**	**0**	**0**

	TEST CABLED SITES - EQUIPMENT									
	SITE	**3-OBSEA**					**4-KOLJOFJORD**			
	PARTNER-5	**DBSCALE**								
		Items	**Eligible**	**Request**	**Propos**		**Items**	**Eligible**	**Request**	**Propos**
1	**Infrastructures**	**Infrastructures**	**900**	**900**	**0**		**Infrastructures**	**0**	**0**	**0**
		Personal Computer	900	900						
2	**Electronics s/syst**	**Electronics s/syst**	**0**	**0**	**0**		**Electronics s/syst**	**0**	**0**	**0**
3	**Mechanics s/syst**	**Mechanics s/syst**	**0**	**0**	**0**		**Mechanics s/syst**	**0**	**0**	**0**
4	**Acoustics s/syst**	**Acoustics s/syst**	**0**	**0**	**0**		**Acoustics s/syst**	**0**	**0**	**0**
5	**Instruments**	**Instruments**	**0**	**0**	**0**		**Instruments**	**0**	**0**	**0**
6	**Sensors**	**Sensors**	**0**	**0**	**0**		**Sensors**	**0**	**0**	**0**
7	**DataAcq systems**	**DataAcq systems**	**0**	**0**	**0**		**DataAcq systems**	**0**	**0**	**0**
8	**Softwares**	**Softwares**	**1 200**	**600**	**0**		**Softwares**	**0**	**0**	**0**
		Software licenses	1 200	600						
	PARTNER COST	**DBSCALE**	**2 100**	**1 500**	***0***		**0**	**0**	**0**	**0**
	SITE	**3-OBSEA**					**4-KOLJOFJORD**			
			Eligible	**Request**	**Propos**			**Eligible**	**Request**	**Propos**
1	**Infrastructures**	**Infrastructures**	**10 400**	**5 400**	**0**		**Infrastructures**	**20 000**	**8 000**	**4 000**
2	**Electronics s/syst**	**Electronics s/syst**	**10 500**	**7 000**	**0**		**Electronics s/syst**	**0**	**0**	**0**
3	**Mechanics s/syst**	**Mechanics s/syst**	**21 000**	**15 000**	**0**		**Mechanics s/syst**	**0**	**0**	**0**
4	**Acoustics s/syst**	**Acoustics s/syst**	**0**	**0**	**0**		**Acoustics s/syst**	**0**	**0**	**0**
5	**Instruments**	**Instruments**	**20 000**	**5 000**	**0**		**Instruments**	**0**	**0**	**0**
6	**Sensors**	**Sensors**	**0**	**0**	**0**		**Sensors**	**0**	**0**	**0**
7	**DataAcq systems**	**DataAcq systems**	**12 000**	**3 000**	**0**		**DataAcq systems**	**0**	**0**	**0**
8	**Softwares**	**Softwares**	**4 200**	**3 600**	**0**		**Softwares**	**0**	**0**	**0**
	TOTAL	**TOTAL**	**78 100**	**39 000**	***13 660***			**20 000**	**8 000**	**4 000**

Other costs

	TEST CABLED SITES - OTHER COSTS												
	SITE	**3-OBSEA**			**Eligible**	**Request**	**Propos**	**4-KOLJOFJORD**			**Eligible**	**Request**	**Propos**
	PARTNER-1	**UPC**						**UGOT**					
	Transport				0	0					0	0	
	Transit				2 000	1 500					3 000	3 000	3 000
	Insurance				0	0					0	0	
1	**Sub-Total**				**2 000**	**1 500**	**0**				**3 000**	**3 000**	**3 000**
	Ship	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name	x						Skagerat					
	Length-m												
	Cost / day	1 500						1 000					
	Number days	8						42					
1	**Ship Cost**	**12 000**	**0**	**0**	**12 000**	**6 500**		**42 000**	**0**	**0**	**42 000**	**42 000**	
	ROV + EQUIPnt	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name	ROV	Divers					Sperre					
	ROV cost/day	1 000	0					500					
	Crew cost/day	0	1 300					0					
	Oper cost/day	1 000	1 300	0				500	0	0			
	Number days	4	6					12					
	ROV Oper cost	4 000	7 800	0	11 800	11 800		6 000	0	0	6 000	6 000	6 000
	Mob-Demob cost	0	0	0	0	0		0	0	0	0	0	
1	**ROV+EQU cost**	**4 000**	**7 800**	**0**	**11 800**	**11 800**	**0**	**6 000**	**0**	**0**	**6 000**	**6 000**	**6 000**
	PARTNER COST	**UPC**			**25 800**	**19 800**	***4 100***	**UGOT**			**51 000**	**51 000**	**9 000**
	PARTNER-2	**CSIC**						**MARUM**					
	Transport				0	0					1 000	1 000	1 000
	Transit				10 000	5 000					0	0	
	Insurance				0	0					0	0	
1	**Sub-Total**				**10 000**	**5 000**	**0**				**1 000**	**1 000**	**1 000**
	Ship	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name												
	Length-m												
	Cost / day												
	Number days												
1	**Ship Cost**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	ROV + EQUIPnt	**1**	**2**	**3**				**1**	**2**	**3**			
	Name							Cherokee					
	ROV cost/day							1 500					
	Crew cost/day							0					
	Oper cost/day	0	0	0				1 500	0	0			
	Number days							6					
	ROV Oper cost	0	0	0	0	0		9 000	0	0	9 000	9 000	9 000
	Mob-Demob cost	0			0	0		0			0	0	
1	**ROV+EQU cost**	**0**	**0**	**0**	**0**	**0**	**0**	**9 000**	**0**	**0**	**9 000**	**9 000**	**9 000**
	PARTNER COST	**CSIC**			**10 000**	**5 000**	***2 308***	**MARUM**			**10 000**	**10 000**	**10 000**
	PARTNER-3	**IFREMER**											
	Transport				0	0	0				0	0	0
	Transit				0	0	0				0	0	0
	Insurance				0	0	0				0	0	0
1	**Sub-Total**				**0**	**0**	**0**				**0**	**0**	**0**
	Ship	**1**	**2**	**3**	**Tot**			**1**	**2**	**3**	**Tot**		
	Name	x											
	Length-m												
	Cost / day	1 500											
	Number days	1											
1	**Ship Cost**	**1 500**	**0**	**0**	**1 500**	**1 500**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	ROV + EQUIPnt	**1**	**2**	**3**				**1**	**2**	**3**			
	Name	x											
	ROV cost/day	1 000											
	Crew cost/day	0											
	Oper cost/day	1 000	0	0				0	0	0			
	Number days	0,5											
	ROV Oper cost	500	0	0	500	500		0	0	0	0	0	0
	Mob-Demob cost	0			0	0		0			0	0	0
1	**ROV+EQU cost**	**500**	**0**	**0**	**500**	**500**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	PARTNER COST	**IFREMER**			**2 000**	**2 000**	***941***	**0**			**0**	**0**	**0**

	TEST CABLED SITES - OTHER COSTS													
	SITE	**3-OBSEA**			**Eligible**	**Request**	**Propos**		**4-KOLJOFJORD**			**Eligible**	**Request**	**Propos**
	PARTNER-4	**MARUM**												
	Transport													
	Transit				1 000	0	0							
	Insurance													
1	**Sub-Total**				**1 000**	**0**	**0**					**0**	**0**	**0**
	Ship	**1**	**2**	**3**	**Tot**				**1**	**2**	**3**	**Tot**		
	Name													
	Length-m													
	Cost / day													
	Number days													
1	**Ship Cost**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
	ROV + EQUIPnt	**1**	**2**	**3**					**1**	**2**	**3**			
	Name	x												
	ROV cost/day	1 500												
	Crew cost/day	0												
	Oper cost/day	2 000	0	0					0	0	0			
	Number days	4,5												
	ROV Oper cost	9 000	0	0	9 000	10 000			0	0	0	0	0	0
	Mob-Demob cost				0	0						0	0	0
1	**ROV+EQU cost**	**9 000**	**0**	**0**	**9 000**	**10 000**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
	PARTNER COST	**MARUM**			**10 000**	**10 000**	***4 808***		**0**			**0**	**0**	**0**
	PARTNER-5	**DBSCALE**												
	Transport													
	Transit													
	Insurance													
1	**Sub-Total**				**0**	**0**	**0**					**0**	**0**	**0**
	Ship	**1**	**2**	**3**	**Tot**				**1**	**2**	**3**	**Tot**		
	Name													
	Length-m													
	Cost / day													
	Number days													
1	**Ship Cost**	**0**	**0**	**0**	**0**				**0**	**0**	**0**	**0**		
	ROV + EQUIPnt	**1**	**2**	**3**	**Tot**				**1**	**2**	**3**	**Tot**		
	Name													
	ROV cost/day													
	Crew cost/day													
	Oper cost/day	0	0	0					0	0	0			
	Number days													
	ROV Oper cost	0	0	0	0				0	0	0	0		
	Mob-Demob cost				0							0		
1	**ROV+EQU cost**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
	PARTNER COST	**DBSCALE**			**0**	**0**	**0**		**0**			**0**	**0**	**0**
	TOTAL													
	Transport				0	0	0					1 000	1 000	1 000
	Transit				13 000	6 500	0					3 000	3 000	3 000
	Insurance				0	0	0					0	0	0
1	**Sub-Total**				**13 000**	**6 500**	**0**					**4 000**	**4 000**	**4 000**
1	**Ship Cost**				**13 500**	**8 000**	**0**					**42 000**	**42 000**	**0**
	ROV Oper cost				21 300	22 300	0					15 000	15 000	15 000
	Mob-Demob cost				0	0	0					0	0	0
1	**ROV+EQU cost**				**21 300**	**22 300**	**0**					**15 000**	**15 000**	**15 000**
	SITE COST	**3-OBSEA**			**47 800**	**36 800**	**12 157**		**4-KOLJOFJORD**			**61 000**	**61 000**	**19 000**

Personnel – Travels & accommodation

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION								
	SITE	**3-OBSEA**				**4-KOLJOFJORD**			
	PARTNER-1	**UPC**				**UGOT**			
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		11				4		
	Cost		65 000	50 000	35 000		70 000	50 000	20 000
2	**Travels-Accomod**								
	Travel Number		6				5		
	Stay Location	UPC / OBSEA site				4 Koljö Fjord - 1 Bremen			
	Stay days / Travel		2-à-6				7 ou 14		
	Stay days / Total		*20*				*44*		
	Cost Trav + Accom		2 500	2 500	0		5 000	5 000	
	Cost / Travel		417				1 000		
	PARTNER-2	**CSIC**				**MARUM**			
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		6				4		
	Cost		20 000	12 000	0		25 000	12 000	2 000
2	**Travels-Accomod**								
	Travel Number		2				4		
	Stay Location	UPC / OBSEA site				Koljö Fjord			
	Stay days / Travel		7				7 ou 14		
	Stay days / Total		14				*42*		
	Cost Trav + Accom		0	0	0		5 000	5 000	
	Cost / Travel		0				1 250		
	PARTNER-3	**IFREMER**							
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		4						
	Cost		22 500	16 875	0				
2	**Travels-Accomod**								
	Travel Number		2						
	Stay Location	UPC / OBSEA site							
	Stay days / Travel		7						
	Stay days / Total		14				0		
	Cost Trav + Accom		3 000	3 000	0				
	Cost / Travel		1 500				#DIV/0!		

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION								
	SITE	**3-OBSEA**				**4-KOLJOFJORD**			
	PARTNER-4	**MARUM**							
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		4						
	Cost		20 000	12 000	0				
2	**Travels-Accomod**								
	Travel Number		4						
	Stay Location	UPC / OBSEA site							
	Stay days / Travel		7						
	Stay days / Total		28				0		
	Cost Trav + Accom		4 000	2 000	0				
	Cost / Travel		1 000				#DIV/0!		
	PARTNER-5	**DBSCALE**							
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		3						
	Cost		22 500	16 875	8 000				
2	**Travels-Accomod**								
	Travel Number		2						
	Stay Location	Marum - UPC / OBSEA site							
	Stay days / Travel		7						
	Stay days / Total		14				0		
	Cost Trav + Accom		0	0	0				
	Cost / Travel		0				#DIV/0!		
	SITE	**3-OBSEA**				**4-KOLJOFJORD**			
			Eligible	**Request**	**Propos**		**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		**28**				**8**		
	Cost		**150 000**	**107 750**	**43 000**		**95 000**	**62 000**	**22 000**
2	**Travels-Accomod**								
	Travel Number		**16**				**9**		
	Stay days / Total		**90**				**86**		
	Cost Trav + Accom		**9 500**	**7 500**	**0**		**10 000**	**10 000**	**0**

Personnel Exchange Budget / Coastal sites

B.3. OBSEA - B.4. Koljofjord

Personnel – Travels & accommodation

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION									
	SITE	**3-OBSEA**					**4-KOLJOFJORD**			
	PARTNER-1	**UPC**					**UGOT**			
		Comments	**Eligible**	**Request**	**Propos**		**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**									
	Number involved		11					4		
	Cost		65 000	50 000	0			70 000	50 000	5 000
2	**Travels-Accomod**									
	Travel Number		6					5		
	Stay Location	UPC / OBSEA site					4 Koljö Fjord - 1 Bremen			
	Stay days / Travel		2-à-6					7 ou 14		
	Stay days / Total		*20*					*44*		
	Cost Trav + Accom		2 500	2 500	0			5 000	5 000	5 000
	Cost / Travel		417					1 000		
	PARTNER-2	**CSIC**					**MARUM**			
		Comments	**Eligible**	**Request**	**Propos**		**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**									
	Number involved		6					4		
	Cost		20 000	12 000	5 539			25 000	12 000	5 000
2	**Travels-Accomod**									
	Travel Number		2					4		
	Stay Location	UPC / OBSEA site					Koljö Fjord			
	Stay days / Travel		7					7 ou 14		
	Stay days / Total		14					*42*		
	Cost Trav + Accom		0	0	0			5 000	5 000	5 000
	Cost / Travel		0					1 250		
	PARTNER-3	**IFREMER**								
		Comments	**Eligible**	**Request**	**Propos**		**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**									
	Number involved		4							
	Cost		22 500	16 875	7 941					
2	**Travels-Accomod**									
	Travel Number		2							
	Stay Location	UPC / OBSEA site								
	Stay days / Travel		7							
	Stay days / Total		14					0		
	Cost Trav + Accom		3 000	3 000	1 412					
	Cost / Travel		1 500					#DIV/0!		

	TEST CABLED SITES - PERSONNEL-TRAVELS-ACCOMODATION								
	SITE	**3-OBSEA**				**4-KOLJOFJORD**			
	PARTNER-4	**MARUM**							
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		4						
	Cost		20 000	12 000	5 768				
2	**Travels-Accomod**								
	Travel Number		4						
	Stay Location	UPC / OBSEA site							
	Stay days / Travel		7						
	Stay days / Total		28				0		
	Cost Trav + Accom		4 000	2 000	962				
	Cost / Travel		1 000				#DIV/0!		
	PARTNER-5	**DBSCALE**							
		Comments	**Eligible**	**Request**	**Propos**	**Comments**	**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		3						
	Cost		22 500	16 875	0				
2	**Travels-Accomod**								
	Travel Number		2						
	Stay Location	Marum - UPC / OBSEA site							
	Stay days / Travel		7						
	Stay days / Total		14				0		
	Cost Trav + Accom		0	0	0				
	Cost / Travel		0				#DIV/0!		
	SITE	**3-OBSEA**				**4-KOLJOFJORD**			
			Eligible	**Request**	**Propos**		**Eligible**	**Request**	**Propos**
1	**Personnel**								
	Number involved		**28**				**8**		
	Cost		**150 000**	**107 750**	**19 248**		**95 000**	**62 000**	**10 000**
2	**Travels-Accomod**								
	Travel Number		**16**				**9**		
	Stay days / Total		**90**				**86**		
	Cost Trav + Accom		**9 500**	**7 500**	**2 374**		**10 000**	**10 000**	**10 000**

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Annex 5: Introduction letter sent to referees in March 2010.

Subject: invitation to evaluate the proposal of tests call in the framework of ESONET -NoE

Dear Colleague

ESONET, the European Sea Observatory Network, is a Network of Excellence (NoE) co-funded by the European Commission and lunched in March 2007 under the coordination of IFREMER (France). This NoE includes a large number of European Research Institutions, Universities and Companies with a special skill in the multidisciplinary sea observatories. The first objective of the NoE is the achievement of a lasting integration of the European scientific and technological researches in this thematic area, overcoming the national fragmentation. It aims to create an organization capable of implementing, operating and maintaining a network of observatories in the seas around Europe from the Arctic Ocean to the Black Sea.

Within ESONET-NoE some internal calls are foreseen to support the integration of the multidisciplinary sea observatories community through the sharing of research methodologies and infrastructures, and the exchange of personnel.

Reaching mid-project, the ESONET NoE still suffered from insufficient access to online data. Most demonstration missions are conventionally run with lander deployments/retrieval and subsequent data publication. ESONET needs a Web portal with real-time web interface from online observatories. In order to do so, online data are urgently needed. This was one strong demand during the 2009 review of ESONET in Brussels. The LIDO demonstration mission is expected to go online soon, but more examples are needed. The test sites will allow to launch the Web Portal with real-time web interface and show to all users (the ESONET community, public, industry and politicians) incoming metadata and underwater activities of internet operated vehicles and service-ROVs. This will enable the ESONET partners as well as the general public (to a given extend) to actively participate in ESONET research. The test sites with their power supplies will also allow scientists and engineers to test power-hungry sensors for future ESONET observatories. As they test new technologies or sampling programs, the data connection allows ESONET to immediately know how things are going.

Especially the coastal test sites will enable ESONET to send a maintenance ship and ROV to the study sites on short notice in case they face any problem. There's no better place to try out new equipment for ESONET in Europe. But deep sea test are also required to progress in deployment procedures.

The direct internet connectivity makes it possible for classrooms to participate as virtual explorers in the environment. The test sites and connected websites will finally give access to real-time data including streaming video, some even access to interactive experiments.
Only a demonstration mission (LIDO) is using cables, so real time data access will be possible only in this case. Consequently, it appears of the most importance to promote real time access to data on existing cabled sites. A call for tests on cabled sites was issued towards the 49 ESONET members in July 2009. Its title was:
"Integrated organisation of TESTS and observatory methodologies on cabled ESONET observatory sites".

Emphasis was put on ten key issues that should be addressed:
1- Integration of the defined generic sensor package into cabled observatories
2- Validate calibration procedure of the generic sensor package
3- Standardisation and interoperability issues should be addressed by referring to procedures that have been described within relevant reports from WP2
4- Test of standard interfaces and Plug and Work Concepts
5- Integration into ESONET sensor registry activities
6- Test of recommended ROV instrument deployment procedures in particular for mate able connectors
7- Employing ESONET testing facilities
8- Evaluation of recommended quality management procedures
9- Integration into ESONET data management concepts as for instance in regard to metadata description, real time data access, free access to collected data etc.
10- Training of scientists and engineers to use and develop deep-sea observatory sub systems.

The call was focused on long-term deployment in deep-sea water and technical issue. The coordinator received 5 proposals involving more often only one site. Only three are ESONET sites (East Sicily, Ligurian Sea (Antares), Kosterfjord) and three proposed sites (Kosterfjord, OBSEA, Koljofjord) are in shallow water. A summary of these 5 proposals is given in the attached document "5 proposals synthesis".
As the total budget required was 1 564 464 € when the available budget was around 600 000€, the Coordination team was mandated by the Steering Committee (07 October 2009) to prepare a proposal integrating in a coherent way a maximum of proposed tests.
It took some time to find a consensus between proponents. Experiments will be conducted on 4 sites and complementary tests will be performed. You will find attached the final document: "ESONET-Cabled sites-Merged tests proposal"

We would appreciate you to contribute again to strengthen our European scientific community on the multidisciplinary sea observatories by giving us your comments on this proposal. We know that you are busy. So, if you cannot read these documents and comment them, we would be very pleased if you could ask somebody from your team to do this short review. To help you, we pointed some questions in the attached note.

For more detail, you can contact me or Mrs. Ingrid Puillat (see hereunder).

Best regards,

ESONET NoE Coordinator.
R. Person

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Some points to comment:

7- Quality and effectiveness of integration

8- Interoperability

9- Standardisation

10- Data management

11- Relevance of the technological advancements and methodologies

12- Feasibility and cost effectiveness

13- Potential impact through the development, dissemination and application of project results