Report: **Jerico-Next WP2 (T2.3.2) : Cabled Observatories Workshop**
Date: **19th-20th April 2016**
Place: **UPC**, Av. de Víctor Balaguer,08800 ,Vilanova i la Geltrú, **SPAIN**

Grant Agreement n° 654410
Project Acronym: JERICO-NEXT
Project Title: Joint European Research Infrastructure network for Coastal Observatory - Novel European eXpertise for coastal observaTories

Coordination: P. Farcy, IFREMER,
JERICO@ifremer.fr

Authors: Joaquín del Río Fernández
Involved Institution: UPC (Universitat Politècnica de Catalunya)
Date: 2nd November 2016

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H2020 Framework Programme under grant agreement No. 654410
Project coordinator: Ifremer, France.

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1. Document description

Document information	
Document Name	Jerico-Next WP2 (T2.3.2) : Cabled Observatories Workshop Report
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Author	Joaquín del Río
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History			
Revision	Date	Modification	Author
0.1	19/10/2016	First draft	Joaquín del Rio
0.2	2/11/2016	Corrections and comments	Ingrid Puillat

Diffusion list				
Consortium beneficiaries	X			
Third parties				
Associated Partners				
other				

2. Attendees

Family name	Name	Institution	Country
Toma	Daniel Mihai	UPC	Spain
Del Rio	Joaquin	UPC	Spain
Delauney	Laurent	Ifremer	France
Puillat	Ingrid	Ifremer	France
Laakso	Lauri	FMI	Finland
Nogueras	Marc	UPC	Spain
Fischer	Phillip	AWI	Germany
Nair	Rajesh	OGS	Italy
Chumbinho	Rogerio	SmartBay Ireland	Ireland
Torkelsen	Terje	METAS	Norway

3. Executive summary

The objective for this workshop was to review the state-of-the-art of these observing systems in terms of technology, procedures, maintenance, data processing, format, quality and management, identification of limitations and difficulties, applications, dissemination, etc.

This review will be presented on D2.1 on month 12 (September 2016).

Afterwards, the Cabled Observatories team will work to promulgate Best Practice from the specific perspective of operations in coastal waters. The Best Practices will be presented on D2.4 on month 40.

JERICO-NEXT proposes to strengthen the current knowledge regarding European coastal areas in three ways: first, by reinforcing the European cooperation that will enable interoperation between existing JERICO observing systems and new observing platforms: HF-radars and cabled coastal observatories. HF-radar will allow important progress on assessing surface currents, sea states, and transport in the coastal area. Similarly, the sea-bed observatories will contribute to the acquisition of long-term biological time-series that complement those currently obtained using water column profiling systems.

Both will significantly contribute to link biological processes with core physical; chemical and biogeochemical parameters in order to better understand: (1) the interactions between physics, chemistry, biogeochemistry and biology, and (2) how marine ecosystems react to anthropogenic disturbances and global environmental change.

In order to integrate these observing platforms into the overall JERICO systems, the first objective has been to describe the current status of HF-radar systems and cabled coastal observatories within the JERICO network. For that, two respective workshops have been organized gathering experts on both observing platforms.

- MS9-1 HF-radar workshop, San Sebastian, 9-11 March 2016
- MS9-2 Cabled Observatories workshop, Vilanova i la Geltrú, 19-20 April 2016

4. Statement of decisions

Decision	***WP***	***Content***	***Who***	***when***
1	2	To promulgate an interoperability and inter-comparison activity proposing a TNA activity that includes Cabled Observatories and also Calibration facilities.	*Joaquin del Rio*	2nd TNA Call
2	2	To organize a best practices workshop in order to prepare the D2.4 Report on Best Practice in the implementation and use of HF- radar systems and cabled coastal observatories.	*Joaquin del Rio*	July 2017

5. Main report

Cabled observatories offer the attractive advantage of freeing marine observing activity from the merciless restrictions of limiting power and bandwidth for communication and data transfer. Such observatories can be used with a broad variety of sensors and systems, and allows measurements to be made even under extreme conditions (e.g., storm events, under ice, etc.).

Such observatories can conduct a wide range of long-term and innovative experiments within the ocean volume using real-time control over the entire cabled system. A broad variety of sensors and systems can be used, and measurements can be made even under extreme conditions (e.g. storm events, under ice, etc.).

The observatories presented during the workshop are the ones resumed in the table below, where organization, country, installation and location are shown. As a first step towards homogenization, the status of the different observatories has been described following a common structure.

Organization	Country	Installation	Location
UPC	Spain	OBSEA	Barcelona, Catalan Coast (Spain), Western Mediterranean
SBI	Ireland	CPO	Galway Bay, Ireland, Atlantic Ocean
FMI	Finland	UTÖ	Utö Island, Archipelago Sea, Baltic Sea
IFREMER	France	EMSO-Molene	Molène Island, France, Atlantic Ocean
IMR	Norway	LoVe	Norwegian Sea
AWI	Germany	UNH	German Bight, North Sea
		UNS	Kongsfjord (Ny Ålesund), North Sea

Table 1: Cabled coastal observatories operated by JericoNEXT project partners

During the workshop the discussion focused on the following topics:

1. Issues during the installation phase

Site Selection and Approvals, Manufacturer, Environmental Concerns [Electromagnetic, Impacts (ground, plants, animals, views),…], Cabled deployment, Power, Communications.

2. Main operational issues

Power outages and communication failures, Deployment of new instruments, Cabling and connectors, Security.

3. Site maintenance

Schedule, tasks…

4. Quality assessment

Automatic reporting on changes in status of stations and computer systems, Web-based database of incidents and actions…

5. Data management

Format; Quality control, Data processing, Data flow for dissemination.

6. Applications

Users, Areas [research, engineering, fisheries…]

7. Biofouling session

Most of the off the shelf technics has been reviewed, from mechanical one like wipers, by un-active one like copper or tributyl ring, to the active one like for example seawater electrolysis that generates hypochlorous acid around the transducing interface of the sensor.

8. Best Practices - Cables and connectors

The Best Practices - Cables and connectors session started by a presentation on Standardisation / interoperability efforts on cabled underwater observatories. This contribution was being possible thanks to the inputs proposed by Jean François Rolin from Ifremer.

9. Costs

Cost of deployment and maintenance of the observatories was an important topic also discussed. A rough estimation was done just to know the orders of magnitude in terms of costs and personnel effort. The following tables just intend to give an overview of these magnitudes:

OBSEA (K€)	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	300	30
STAFF	3X12 MM	3 X 12 MM
DEPLOYMENT	300	
OPERATION		15
FUNDING	NATIONAL = REGIONAL = 0	NOT SUSTAINABLE
		NATIONAL 30%
		EUROPEAN : 60%
		PRIVATE 10%

LOVE (M€)	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	2.8	0.1
STAFF	1.1	1.1
DEPLOYMENT (18 KM CABLE (19 TONS))	9	
OPERATION		0,67
FUNDING		NATIONAL = 1.1 M€
		PRIVATE = 1 M€

UTO	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	1 M€	100 K€
STAFF	72 MM	24 MM
DEPLOYMENT	0,5	
OPERATION		50 K€
FUNDING	IN HOUSE : 1M€	INHOUSE SALARY : 60%
	NATIONAL : 0,5 M€	OTHER : 40%
		EU + NATIONAL FOR OTHER

HELGOLAND	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	700 K€	50 K€
STAFF	3X3 YEAR MM	3 MM
DEPLOYMENT	100-200 K€	
OPERATION		10 K€
FUNDING	NATIONAL : 100%	NATIONAL : 100%

SPITZ...	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	200 K€	50 K€
STAFF	3 MM	2.5 MM
DEPLOYMENT	50 K€	
OPERATION		10 K€
FUNDING	NATIONAL : 100%	NATIONAL : 100%

MOLENE	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	300 K€	?
STAFF	?	160 K€
DEPLOYMENT	100 K€	
OPERATION		30 K€
FUNDING	INTERREG IV MEDON	EU PROJECT 80%

6. Conclusions

6.1. Synthesis of conclusions

The harmonization of technologies, methodologies and procedures is a vital step in ensuring efficiency and optimal returns from any kind of distributed, heterogeneous, multifaceted, coastal observing infrastructure operating on a transnational level such as the JERICO network. This is because such harmonization leads to an intelligent use of resources across the network, adds to the consistency of its services and products, and helps to provide uniformed access modes and interfaces to users.

A characterization of this new platforms such Cabled Observatories, has been performed, the status of the current observing systems that will be integrated into JERICO-RI has been described, and a basis towards harmonization was put in place through intense exchanges during the workshop MS9-2 Cabled Observatories workshop, Vilanova i la Geltrú, 19-20 April 2016).

6.2. Next steps

A practical activity will be proposed by the Cabled Observatories Team: In order to take profit of the Jerico-Next TNA Call, an interoperability and inter-comparison experiment will be proposed during the 2nd TNA Call. The team will decide to deploy a specific instrument (a CTD for example TBC). This instrument will require a deployment on different sites and also a calibration/verification at some calibration facility. The objective will be to gather as much as possible information about the procedures for deployment at each site, constrains, access to data, etc…

Quality of data will be important, but also, to know in depth the procedures that each observatory follows to access and deploy an instrument will be also very important.

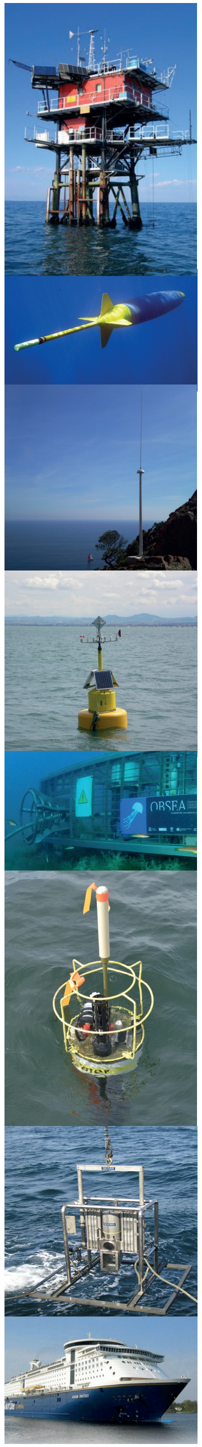
A second workshop will be also organized in order to start preparing the D2.4 Report on Best Practice in the implementation and use of HF- radar systems and cabled coastal observatories. Tentative place and dates for the 2nd workshop are at UPC (Vilanova-Spain) during spring 2017 (TBC).

The next steps will be to work on defining more homogeneous best practices on the different aspects that have been tackled (Planning and installation phase, operational issues, quality assessment, data management, applications). The final objective is to reach some consensus on methods and practices. The results will be reported in Deliverable D2.4: *Report on Best Practice in the implementation and use of HF-radar systems and cabled coastal observatories*. Moreover a link with the other platforms that have been previously addressed in the first JERICO project (Fixed platforms, Ferryboxes and Gliders) will be organized. EuroGOOS observing platforms Task Teams could be also a tool to extend the scope in Europe and to disseminate the outputs of these JERICO-NEXT actions.

7. Annexes and references

All the slides and workshop materials can be downloaded from the following dropbox link pdf document (150Mb):

https://www.dropbox.com/s/of94kaa5bd2pzdq/JericoNext%20WP2%20T2.3.2%20Cabled%20Observatories%20Workshop%20-%20Material.pdf?dl=0



WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3.2 Harmonizing new network systems: Cabled observatories

JERICO-NEXT Cabled Observatories workshop / Vilanova I la Geltrú / SPAIN / 19th – 20th April 2016

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JericoNext
WP2: T2.3.2
Cabled
Observatories
Workshop

Dates

19th-20th
April 2016

Venue:

UPC

Av. de Víctor
Balaguer,08800

Vilanova i la
Geltrú,
Barcelona

SPAIN

☏
+34938967207

JericoNext WP2 (T2.3.2) : Cabled Observatories Workshop Meeting Agenda

Venue : UPC, Av. de Víctor Balaguer,08800 , Vilanova i la Geltrú, SPAIN
Date : 19th-20th April 2016
For specific questions regarding venue and local logistics, please contact:
Neus Vidal Olivieras : neus.vidal@upc.edu ; Phone:+34 938967207

JericoNext logistics :
Dr. Joaquín del Rio : Joaquin.del.rio@upc.edu Phone: +34 609926966

Please, remember to **register** and confirm your attendance at the following form :

Registration form: https://goo.gl/6A7MZZ
Location: https://goo.gl/jz4zIU

Objectives of the Workshop:

In the framework of WP2, T2.3, UPC is responsible for organizing the following workshop:

CABLED COASTAL OBSERVATORIES: Review of the current level of development: That will take place next 19th-20th April in Vilanova, Barcelona (Spain).

Task 2.3 deals with the harmonization of HF-radar systems and **cabled coastal observatories** with the JERICO network.

The objective for this workshop is to review the state-of-the-art of these observing systems in terms of technology, procedures, maintenance, data processing, format, quality and management, identification of limitations and difficulties, applications, dissemination, etc, and promulgate Best Practice from the specific perspective of operations in coastal waters.

Following JericoNext partners/infraestructure's are associated with this task:

AWI (UNH, UNS), philipp.fischer@awi.de
IFREMER (Molene) nadine.lanteri@ifremer.fr, laurent.delauney@ifremer.fr
FMI (Utö) Lauri.Laakso@fmi.fi
IMR (LoVe) henningw@IMR.no, Terje Torkelsen <terjet@metas.no>
SBI (CPO in Galway Bay) rogerio.chumbinho@smartbay.ie, diarmuid.oconnor@smartbay.ie
UPC (OBSEA) joaquin.del.rio@upc.edu, Marc.nogueras@upc.edu

JericoNext
WP2: T2.3.2
Cabled
Observatories
Workshop

Dates

19th-20th
April 2016

Venue:

UPC

Av. de Víctor
Balaguer,08800

Vilanova i la
Geltrú,
Barcelona

SPAIN

☎
+34938967207

Agenda:

Day 1 – 19th April 2016

MORNING SESSIONS – 9:00h to 13:30h

8:30h – 9:00h Registration

9:00h – 9:15: Welcome and Logistics: Joaquín del Río (UPC)
9:15h – 9:30: WP2 Overview and status: Rajesh Nair (OGS)

9:30h – 10:30 Session 1.1. Observatories presentation (1)
Chair: Joaquín del Río (UPC) - 30 minutes per Observatory
Please use the template for focusing the different contributions.

- Coastal Observing System for Northern and Arctic (COSYNA) by Philipp Fischer (AWI)
  Underwater Node Spitzbergen
  Underwater Node Helgoland

10:30h – 11:00h Coffee Break

11:00h – 13:30 Session 1.2 Observatories presentation (2)
Chair: Rogério Chumbinho (SmartBay Ireland) - 30 minutes per Observatory
Please use the template for focusing the different contributions.

- Atmospheric and Marine Research Station (Utö) by Lauri Laakso (FMI)
- Coastal-cabled observatory EMSO-Molène by Delauney Laurent (Ifremer)
- LoVe cable based observatory by Terje Torkelsen

13:30 – 14:30 – Lunch and group photo!!

AFTERNOON SESSIONS 14:30h to 18:00h

14:30h – 15:30 Session 1.3. Observatories presentation (3)
Chair: Philipp Fischer (AWI) - 30 minutes per Observatory
Please use the template for focusing the different contributions.

- SmartBay Marine Test and Validation Facility by Rogério Chumbinho (SmartBay)
- Expandable Seafloor Observatory (OBSEA) by Marc Nogueras (UPC)

15:30h – 16:30 Session 1.4. JericoNext D2.1
Chair: Joaquín del Río (UPC)

Workshop to organize the work for D2.1: Report on the status of Cabled Coastal Observatories Sep16 (lead: UPC)

16:30h – 17:00h Coffee Break

17:00h – 18:00 Session 1.5 Proposal for a collective TNA activity
Chair: Joaquín del Río (UPC)

A proposal for a collective TNA activity will be proposed. The objective will be mainly technical to overcome the difficulties due to lack of interoperability between the observatories at all levels.

Closure and recap of the first day

20:00h All partners dinner and cultural activity.

JericoNext
WP2: T2.3.2 Cabled Observatories Workshop

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19th-20th April 2016

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SPAIN

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WP2: T2.3.2 Cabled Observatories Workshop

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Vilanova i la Geltrú, Barcelona

SPAIN

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Day 2 – 20th April 2016

Critical Revision of current level of development of cabled observatories

MORNING SESSIONS – 9:00h to 13:30h

9:00h – 10:30 Session 2.1 - Instrument to observatory hardware interface. Cabling, connectors…
Chair: Marc Nogueras

10:30h – 11:00h Coffee Break

11:00h – 13:30 Session 2.2 - Main operational issues. Biofouling and corrosion.
Chair: Laurent Delauney

13:30 – 14:30 – Lunch

AFTERNOON SESSIONS 14:30h to 17:00h

14:30h – 15:30 Session 2.3. Real Time Data access and archiving. Data QC/AQ. Plug and work standards.
Chair: Daniel Mihai Toma

15:30h – 17:00 Session 2.4. Funding strategies. Applications, Users– research, engineering.
Chair: Ingrid Puillat

17:00h Coffee Break. Closure and recap of the second day

JericoNext
WP2: T2.3.2
Cabled Observatories Workshop

Dates

19th-20th April 2016

Venue:

UPC

Av. de Víctor Balaguer,08800

Vilanova i la Geltrú, Barcelona

SPAIN

☎ **+34938967207**

GENERAL INFORMATION

◘ How to arrive:

TRANSPORT from El Prat (Barcelona) Airport to Vilanova

Private car

1. Take the C-32 Motorway south (45 kms.) Barcelona to Vilanova i la Geltrú (toll; 6,20€).
2. Take exit 26 to C-31 road.
3. Take first exit to Vilanova i la Geltrú.

(IT COMES FROM FRANCE): Take the AP-7 Motorway until Vilafranca del Penedès and then take the C-15 road for 14 Km. to Vilanova i la Geltrú.
From Airport: You can hire a car and drive to Vilanova using the C-31 coastal road (free tax) or the C-32 Motorway (payment; 6,20€).

Train & bus

From Barcelona:

From “Estació de França”, "Passeig de Gracia" or "Sants" stations in Barcelona, direct to Vilanova on the line to Sant Vicenç the R-2 line. See www.renfe.es There are about 3 or more trains per hour and the price for a single trip ticket (Request ticket for 4 railway zones) is about 3,60 Euros (2012).

From Barcelona International Airport (El Prat):Take the airport train to the station of El Prat, and from there to catch a Vilanova train, on the Sant Vicenç R-2 line. (MORE INFO).
By bus, it is possible to take Line Barcelona (aeroport) - Vilanova in Mon-bus. The bus stop in the airport could be found in Terminal 1 and platforms number 8, 9 and 10.

◘ Accommodation

HOTEL CEFERINO Passeig Ribes Roges 2·3 Vilanova i la Geltrú 08800 Barcelona. Spain. Phone: +34 93 815 17 19 +34 93 815 89 31	
	Hotel Ceferino, situated on the shores of the Mediterranean, on the Garraf coastline, is a family hotel, with its own unique charm where you will be made welcome from the very moment you arrive. As a client of ours, you will be able to enjoy all the differents services we provide, and at the same, in this privileged setting, enjoy all the differents kinds of cultural, leisure and water sports activities the town of Vilanova i la Geltrú can offer.

JericoNext

WP2: T2.3.2 Cabled Observatories Workshop

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Vilanova i la Geltrú, Barcelona

SPAIN

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HOTEL CESAR C/ Isaac Peral 4 08800 Vilanova i la Geltrú. Barcelona.Spain. Phone: +34 93 815 11 25	 Only a few metres from the beach of Vilanova i la Geltrú, about a 30 minutes drive from Barcelona and Tarragona, at the heart of the Costa Daurada, between the Nature Reserves of Garraf and Foix, Hotel Cèsar is to be found in a building originally owned by an "Indiano" – a rich Spaniard returning from overseas – which still preserves its structure and garden.
HOSTAL CAN GATELL Carrer Puigcerdà, 6-16 08800 Vilanova i la Geltrú Barcelona. Spain. Phone: +34 93 893 01 17	 Located in the city centre, this guest house is 280 metres from the train station and the Railway Museum. Hostal Can Gatell features a restaurant and rooms with free Wi-Fi. Can Gatell is located in Vilanova i La Geltrú, 20 minutes' drive from Sitges and 45 minutes' drive from the centre of Barcelona.
ATENEA PARK SUITES APARTMENTS C/ Juan Sebastian Elcano, 4 08800 Vilanova i la Geltrú. Barcelona. Spain. Phone: +34 93 815 06 38	 Atenea Park Suites & Apartments is just 50 metres from Vilanova's Faro Beach,

	45 minutes' drive from Barcelona. It offers an outdoor pool and air-conditioned studios with free Wi-Fi. The studios at Atenea Park feature tiled floors and smart, minimalist décor. Each one comes with satellite TV and a kitchenette with a fridge and electric hob.
LA TREVA HOSTEL Plaça dels Lledoners, 10. 08800 Vilanova i la Geltrú. Phone: (+34) 93 893 7718 info@latrevahostal.com	 Located in the centre of the antique part of Vilanova city. It has been totally renew.

JericoNext
WP2: T2.3.2 Cabled Observatories Workshop

Dates

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JericoNext WP2 (T2.3.2) : Cabled Observatories Workshop
19th-20th April 2016
Vilanova i la Geltrú

Name	Institution	19/4/2016	20/4/2016
Daniel Mihai Toma	UPC		
Delauney Laurent	Ifremer		
Ingrid Puillat	Ifremer		
Joaquin del Rio	UPC		
Lauri Laakso	FMI		
Marc Nogueras Cervera	UPC		
Philipp Fischer	AWI		
Rajesh Nair	OGS		
Rogério Chumbinho	SmartBay Ireland		
Terje Torkelsen	METAS		

WP2 (T2.3.2) : Cabled Observatories Workshop Meeting
WP2 Overview and status

Presenter: Rajesh Nair email: rnair@ogs.trieste.it

Contributor(s): Wilhelm Petersen (HZG, Germany)

Main objective of WP2

Harmonization of technologies, methodologies and procedures across the JERICO observing network in the JERICO-NEXT project.

This will involve:

- ***organizing, managing and reporting on the WP during the lifetime of the project;***
- ***consolidating ongoing network harmonization efforts carried over from the concluded JERICO project;***
- ***extending these efforts to include new systems and sensors;***
- ***standardizing operations and processes, as much as possible.***

WP2: List of partners

Work package number	2	Start Month		1	End Month		48
Work package title	NA2 - Harmonization of technologies and methodologies - technical strategy				Type of activity		NA
Lead Beneficiary	OGS & HZG						
Participant number	23	15	2	4	6	7	9
Short name of participant	OGS	HZG	AZTI	CEFAS	CNR-ISMAR	CNRS	DELTARES
Person-months per participant:	24.5	15	7.5	4	10	2	0.6
Participant number	13	14	17	1	22	27	28
Short name of participant	FMI	HCMR	IMR	Ifremer	NIVA	SMHI	SOCIB
Person-months per participant:	1	11	1.75	5.5	5.3	3	2
Participant number	29	31	11				
Short name of participant	SYKE	UPC	EURO ARGO				
Person-months per participant:	3	5	0				

WP2: Tasks

Task 2.1: Coordination of network harmonization (M1-M48);

Task 2.2: Consolidation of initiated network harmonization actions (M1-M48);

Task 2.3: Harmonizing new network systems (M1-M48);

Task 2.4: Harmonizing new network sensors (M1-M48);

Task 2.5: Calibration and assessment (M1-M48);

Task 2.6: The JERICO Label Technical Committee (M1-M48).

WP2 Tasks: main actions

(M1/September 2015 - M18/February 2017)

Task 2.1 ➤ **Kick-off Meeting/WP2 Coordination (MS1)** ✓

Task 2.3 ➤ **First Workshop/HF Radar systems & Cabled Observatories (MS9)** ✓

Task 2.4 ➤ **First Workshop/New sensors (MS10)** x

Task 2.5 ➤ **First Workshop/Calibration & Assessment (MS11)** x

WP2 Tasks: deliverables
(M1/September 2015 - M18/February 2017)

Task 2.3 **Report on the status of HF-radar systems and cabled coastal observatories within the JERICO network and, more generally, in the European context.**
(D2.1, M12 - August 2016) x

Task 2.4 **Report on the status of sensors used for measuring nutrients, biology-related optical properties, variables of the marine carbonate system, and for coastal profiling, within the JERICO network and, more generally, in the European context.**
(D2.2, MS18 – February 2017) x

D2.1 (#1)

What should the Report cover with respect to *Cabled Observatories*?

- *Mapping and descriptions of systems;*
- *Design details, highlighting commonalities and differences;*
- *Installed sensors (commercial and experimental);*
- *Deployment, operating and maintenance practices;*
- *Data handling;*
- *Existing collaborations (if any).*

D2.1 (#2)

What will be needed to do a good job?

- *Right questions;*
- *Timely and speedy answers;*
- *Accurate information;*
- *Adhesion to deadlines.*

Thank you for listening!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654410.


3. Site maintenance

Helgoland Spitz.... : Divers → CTD, O2, Chla, Methane

In area where Diving is a bit difficult

: Pressure Sensor : Membrane + Silicon oil

Wiper on Radiation + water + sensor (Wet Labs)

Camera : Wiper HM (flat windows 20 cm ∅)

Quality Control
- CTD (Reference)
- Methane : Watersample every 2 weeks + Chla

Lowrie →
- Flow Thru System (Ferrybox) (TritonX) + pH
- ADCP : Divers (Twice a year)
- CTD : Copper + Wiper (Wet Labs)
- Seabird TBT ring
- PCO2 : Pump + Copper (Hydrogen Peroxide)

Fouling Protection

UBSEA

Wiper (CAMERA) ← HI
(TURBIDITY) ← N

CAMERA DOME → H

pH sensor -

GALWAY BAY : Wiper W (Since A - Camera

LOVE : WetLab ecoTriple

Camera : JM
Sma

Fouling Protection

UBSEA

Wiper
(CAMERA) ← HM (1 wiper Brush)
(TURBITY) ← Nanoflare (1 wiper, brush)

ADCP (1 wiper)
(Copper grease)
↳ To [illegible] at easily

CAMERA DOME → HM Wiper (in progress)
(3D printing)
(Nanoflare form)
↳ Divers → 3 weeks !

pH sensor → Copper [illegible] ?
Adverse effect ???

GALWAY BAY

: Wiper Wetlabs EcoEco (exp. actually running)
(Since August)
– Camera : Divers ⟹ Twice in 6 months (Sufficient)

LOVE

; Wetlabs ecoTriplet Wiper Copper (July……)

Camera : JM7 ring (+ reference plate) (JM7 : Brass Bronze) Johnson Metal
↳ Swedish manufacturer
Small Spots after 9 months.

Graphen material ?
↳ conductive layer on glass


OBSEA
EMOD Net. - Physics.
Near Real Time 30/60 min.
Web Page.
SOS Server - Sensor Web
OGC.
A.. Algorithm. → QC./QA. SeaDataNet.

OBSEA

- EMODNet. - Physics.
- Near Real Tim 30/60 min. Average of Da
- Web Page.
- SOS Server - Sensor Web Fra
  OGC.

A. Algorithm. → QC./QA. SeaDataNet.

Pbr Pull push Protocol Serie/Ethernet. →

GALWAY BAY

Web Page in progress.
SOS Server (on Buoy)

QC. Basic spikes/outliers.
No Plug Be Work..

HK Sp

- Web Page to acces Arch. Data
NetCDF ASCII Files.
- Near real time data.
-> Pangea -> DOI per File
-> Turnating to the scientist.

QC/QA -> HCG -> Algorithm. Basic QC
-> Tempus -> Accuracy and Precision.

Plug In Work -> Logic? ID, UUID,

Utö

→ Developing Web page.

→ C C / Pyton → Vimol inspection,

→ EmodN

→ Manual Data Calibration

EMSO - Molime

Utö

→ Developing web page.
→ QC / Pyton → Visual inspection.
→ EmodNet
→ Manual Data Calibration.

EMSO - Moline

DOI - Number to any set of Data

QC/QA.

Plug & Work - COSTOF2. → Drivers. ← sensorML

- Data Storage on Node.
- Inter Sensors Comm.

LoVR

Cloud. - Web page.

new. IMR - 4-6 weeks storage

- Real time for Temp. & Salinity.

- Calibration Files. 1/year.

QC. [illegible] - out of Range.

ID - IP Network IP. address. - Static

IP. <-> DNS. →

COSTS OBSCA (k€)	INITIAL COST	yearly operating & maintenance
Equipm^t	300	30
STAFF	3x12 mm	3x12mm (Σ)
Funding Deploym^t	300	
operating		15

Funding : sustained
National = Regional
∅

Not sustained = competit°
National = 30%
European = 60%
private = 10%

COST LOVE	I	y	
M€	2,8 M€	0,1 M€	
	1,1	1,1	
M€	9 M€		18km 19T
		0,67 M€	

Funding
National : 1,1 M€
private 1 M€

UTB COST	I	y
	1 M€	100 k€
	72mm	24 mm
	0,5	
		50 k€
Funding	Inhouse 1 M€ national 0,5 M€	Inhouse → salary = 60% other 40% EU National

Helgoland COSTS	I	y
Eq HARDWARE	700 k€	50 k€
STAFF	3x3 year mm	3 mm
Deploy^t	100-200 k€	
operating		10 k€
Funding		
National	100%	

COST
2,8 M€
0,1 M€
1,1
1,1
9 M€
0,67
Funding
National : 1,1 M€
Private 1 M€
UB COST
I
y
1 M€
100 k€
72 MM
24 MM
0,5
50 k€
Funding
In house 1 M€
National 0,5 M€
In house → salary = 60%
other 40%
EU
National
Helgoland COSTS
I
y
Eg HARDWARE
700 k€
50 k€
STAFF
3x3 year MM
3 MM
Deploy^t
100-200 k€
operation
10 k€
Funding
National
100%
200 k€
50 k€
3 MM
2,5 MM
50 k€
30 - 40 k€
100%

UTP cost	I	Y
	1 M€	100 k€
	72 mm	24 mm
	0,5	
		50 k€
Funding	Inhouse 1M€ National 0,5 M€	Inhouse → salary = 60% other 40% EU / National

Helgoland costs	I	Y	Spain I	Spain Y
eq HARDWARE	700 k€	50 k€	200 k€	50 k€
STAFF	3x3 year mm	3 mm	3 mm	2,5 mm
Deploy^t	100-200 k€		50 k€	
operating		10 k€		30 – 40 k€
Funding National	100%		100%	

Molene	I	Y
eq	300 k€	
STAFF		30 mm ≈ 160 k€?
Deploy	100 k€	
Op		30 k€

update: 26/04/2016

JERICO NEXT - COASTAL OBSERVATORIES COST

OBSEA (K€)	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	300	30
STAFF	3X12 MM	3 X 12 MM
DEPLOYMENT	300	
OPERATION		15
FUNDING	NATIONAL = REGIONAL = 0	NOT SUSTAINABLE
		NATIONAL 30%
		EUROPEAN : 60%
		PRIVATE 10%

LOVE (M€)	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	2.8	0.1
STAFF	1.1	1.1
DEPLOYMENT (18 KM CABLE (19 TONS))	9	
OPERATION		0,67
FUNDING		NATIONAL = 1.1 M€
		PRIVATE = 1 M€

UTO	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	1 M€	100 K€
STAFF	72 MM	24 MM
DEPLOYMENT	0,5	
OPERATION		50 K€
FUNDING	IN HOUSE : 1M€	INHOUSE SALARY : 60%
	NATIONAL : 0,5 M€	OTHER : 40%
		EU + NATIONAL FOR OTHER

HELGOLAND	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	700 K€	50 K€
STAFF	3X3 YEAR MM	3 MM
DEPLOYMENT	100-200 K€	
OPERATION		10 K€
FUNDING	NATIONAL : 100%	NATIONAL : 100%

SPITZ...	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	200 K€	50 K€
STAFF	3 MM	2.5 MM
DEPLOYMENT	50 K€	
OPERATION		10 K€
FUNDING	NATIONAL : 100%	NATIONAL : 100%

MOLENE	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	300 K€	?
STAFF	?	160 K€
DEPLOYMENT	100 K€	
OPERATION		30 K€
FUNDING	INTERREG IV MEDON	EU PROJECT 80%

GALWAY BAY	INITIAL COST	OPERATIONAL AND MAINTENANCE (YEARLY)
EQUIPEMNT	?	?
STAFF	?	?
DEPLOYMENT	?	
OPERATION		?
FUNDING		

TECHNICAL SCHOOL OF ENGINEERING
OF VILANOVA I LA GELTRÚ

The Technical University of Catalonia (UPC)

Dr. Joaquín del Río Fernández
Profesor Ing. Electrónica UPC
Grupo SARTI

www.obsea.es
www.cdsarti.org
www.epsevg.upc.edu
www.upc.edu

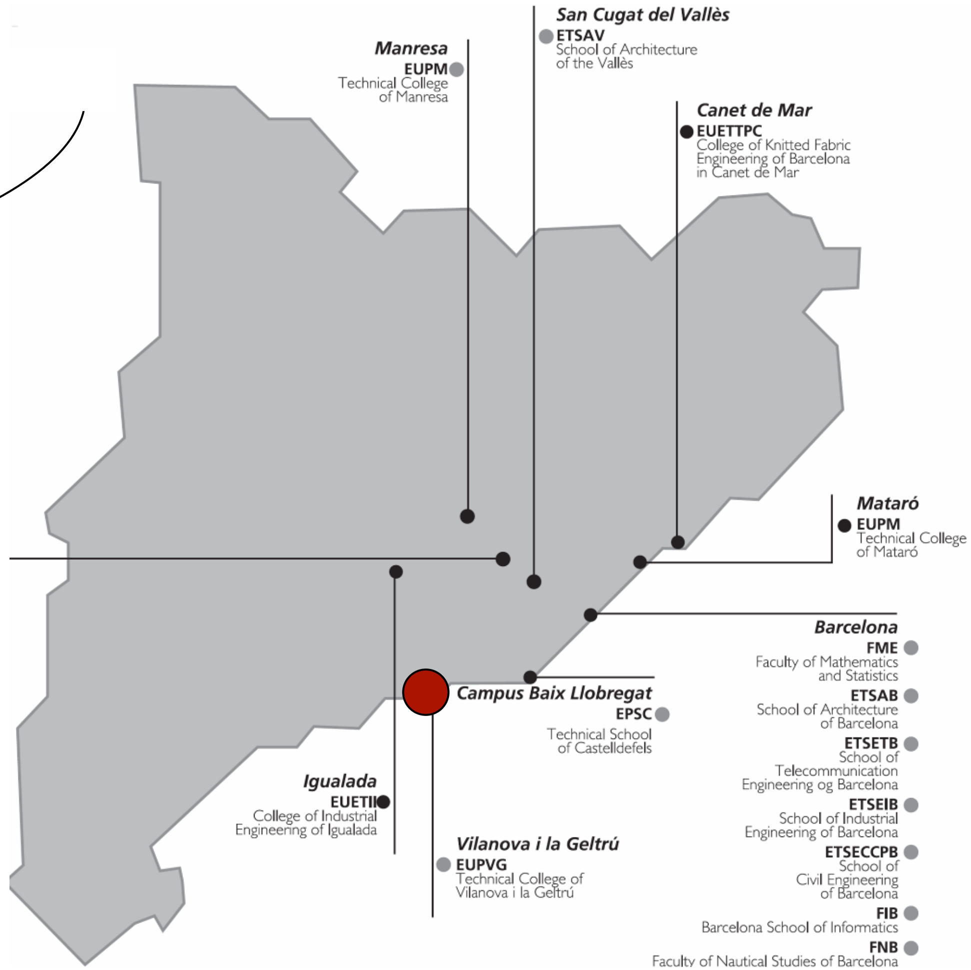
CENTRE DE DESENVOLUPAMENT TECNOLÒGIC DE SISTEMES D'ADQUISICIÓ REMOTA I TRACTAMENT DE LA INFORMACIÓ

Contents

TECHNICAL SCHOOL OF ENGINEERING OF VILANOVA I LA GELTRÚ

The Technical University of Catalonia (UPC)

Localization: **Barcelona – Spain**
Schools: **23**
Departments: **40**
Campus: **7**
Students: **40000**
Lectures & researcher: **2642**
Research Institutes: **3**



The Technical University of Catalonia (UPC)

EDUCATION AREAS

Architecture
Civil Engineering
Mathematic Sciences
Industrial Engineering
Health Sciences
Nautical Studies
Economics
Computer Science
Telecommunications
Multimedia and Photography
Farming and Forestry
Aeronautics

RESEARCH AREAS

Architecture
Civil Engineering
Social, Human and Life Sciences
Physics and Chemistry
Mathematics and Statistics
Environment
Energy
Natural Resources
Information and Communication Technologies
Production Technologies

Contents

- The Technical University of Catalonia (UPC), Barcelona, Spain.
- The Technical Engineering School of Vilanova i la Geltrú (EPSEVG)
- Grupo SARTI: Sistemas de adquisición Remota y Tratamiento de la Información
- Proyecto de Observatorio Submarino Expandible: OBSEA

The School of Engineering

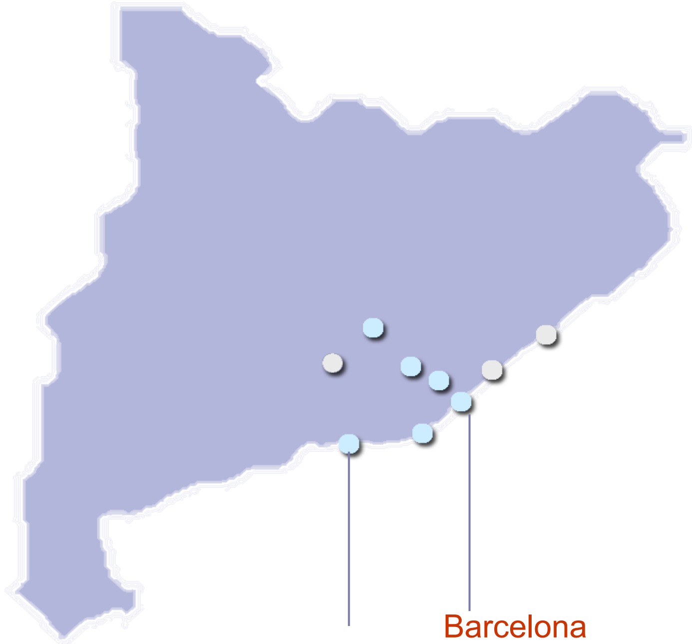
Escola Politècnica Superior
d'Enginyeria de Vilanova i la Geltrú
UNIVERSITAT POLITÈCNICA DE CATALUNYA

Edificio EPSEVG

Edificio Centro Tecnológico.
SARTI Headquarters

The School of Engineering

1901	It was founded as an arts and crafts school
1972	It became part of the Technical University of Catalonia (UPC)
2001	The university campus is born with new facilities and services



Main indicators

- 1500 students
- 200 academic and research staff
- 50 administrative staff
- 17 departments

- 14.000 m^2
- 22 lecture rooms
- 22 laboratories
- 8 computer rooms

Estudis

Graus d'Enginyeria àmbit TIC:
-Grau en Enginyeria Informàtica
-Grau en Enginyeria de Sistemes Electrònics

Graus d'Enginyeria àmbit industrial:
-Grau en Enginyeria de Disseny Industrial i Desenvolupament del Producte
-Grau en Enginyeria Mecànica
-Grau en Enginyeria Elèctrica
-Grau en Enginyeria Electrònica Industrial i Automàtica

Ensenyaments de 2n cicle d'Enginyeria:
-Enginyeria Superior en automàtica i electronica industrial

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SARTI Research group

- Centro de Desarrollo Tecnológico de Sistemas de Adquisición Remota y Tratamiento de la Información (SARTI) de la Universitat Politècnica de Catalunya

➢ Tiene como objetivo fundamental

- El desarrollo científico y tecnológico de equipos y sistemas de adquisición remota de datos, con especial énfasis en la instrumentación virtual y oceanográfica

SARTI Research group: members

• Artero Delgado, Carla	Tècnic d'aplicacions hardware
• Bghiel, Ikram	Becaris i Doctorands
• Cadena Muñoz, Javier	Tècnic d'aplicacions hardware
• Carreras Pons, Normandino	Becaris i Doctorands
• del Río Fernández, Joaquín	Cap de projectes electrònics, PDI
• Garcia Benadí, Albert	Tècnic d'aplicacions hardware
• Hidalgo Castro, Alberto	Tècnic d'aplicacions informàtiques
• Mànuel Làzaro, Antoni	Director, PDI
• Nogueras Cervera, Marc	Cap de projectes electrònics
• Santamaria Català, Josep	Responsable de qualitat
• Sarrià Gandul, David	Tècnic d'aplicacions hardware
• Toma, Daniel Mihai	Becaris i Doctorands
• Vidal Oliveras, Neus	Cap de formació
• Spartacus Gomariz	PDI
• Rafael Ramos	PDI
• Mariano Lopez	PDI
• Oriol Pallares	Tècnic
• Ivan Masmitja	Tecnic

SARTI Research group

Research

Technology Transfer

Services

Education and Outreach

- Group creation: 1998
- Multidisciplinar:

electrónics, telecos, mecánicos, físicos, matemáticos, informáticos

AUV Guanay II

http://www.youtube.com/watch?v=Nwd3k0J9uKM

Link video proves Guanay

Grupo SARTI: Organización de Congresos

http://www.martech-workshop.org

MARTECH, INTERNATIONAL WORKSHOP ON MARINE TECHNOLOGY
1st ,2nd and 3rd took place in Vilanova I la Geltrú. Barcelona.
4th Edition, 2011: Universidad de Cadiz
5th Edition, 2013: Universidad de Girona
6th Edition, 2015: Universidad Politecnica de Cartagena: 15-17th september 2015
7th Edition, 2016: UTM-CSIC: 26-28th octubre 2016

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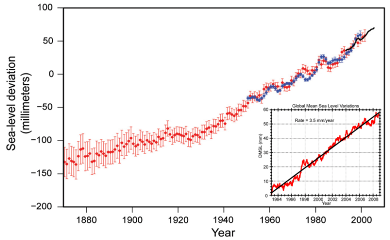
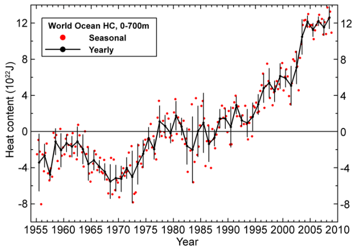
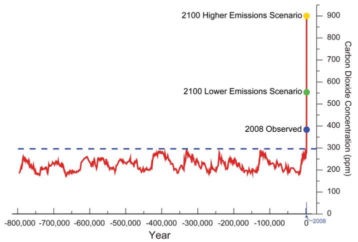
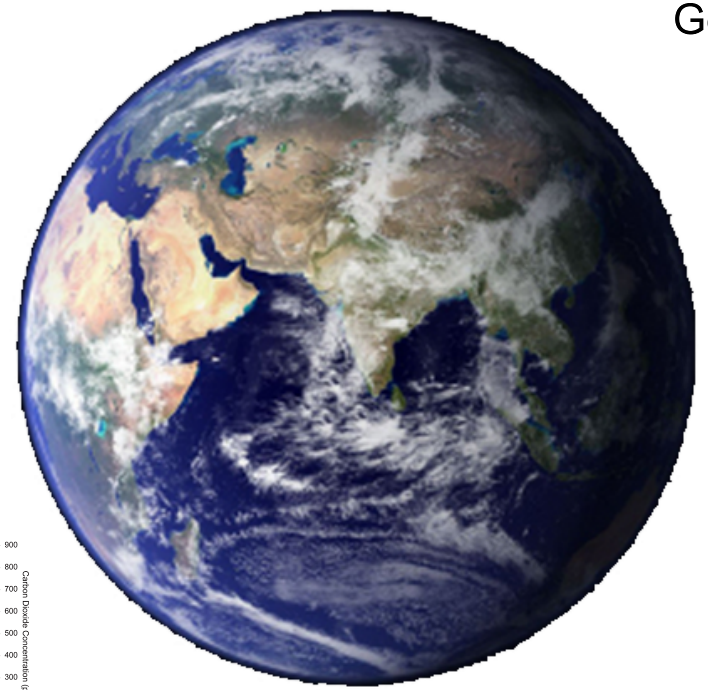
Cabled Observatories

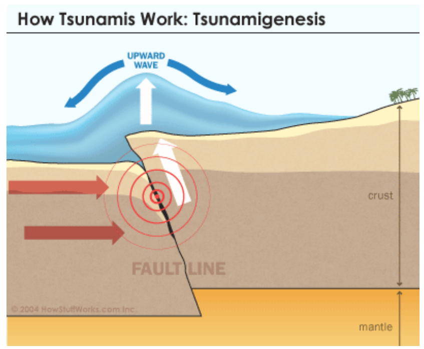








Geohazards early warning systems



Long and continuos time data series

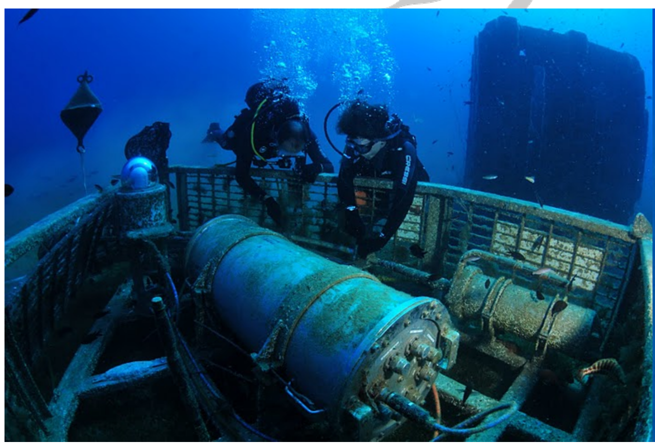
Global Climate Change Indicators. National Oceanic and Atmospheric Administration. National Climatic Data Center. http://www.ncdc.noaa.gov/indicators/

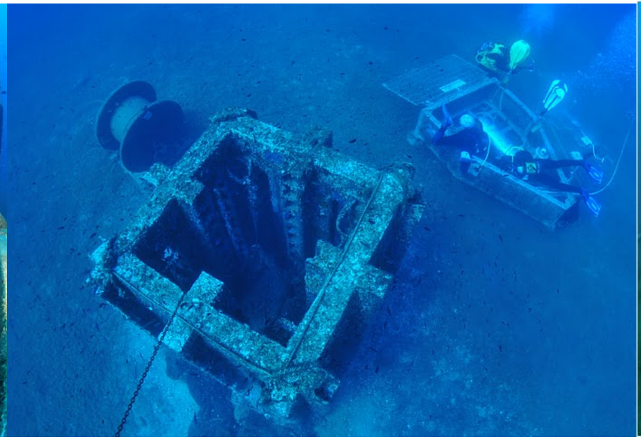
OBSEA Observatory

OBSEA
EXPANDABLE SEAFLOOR OBSERVATORY

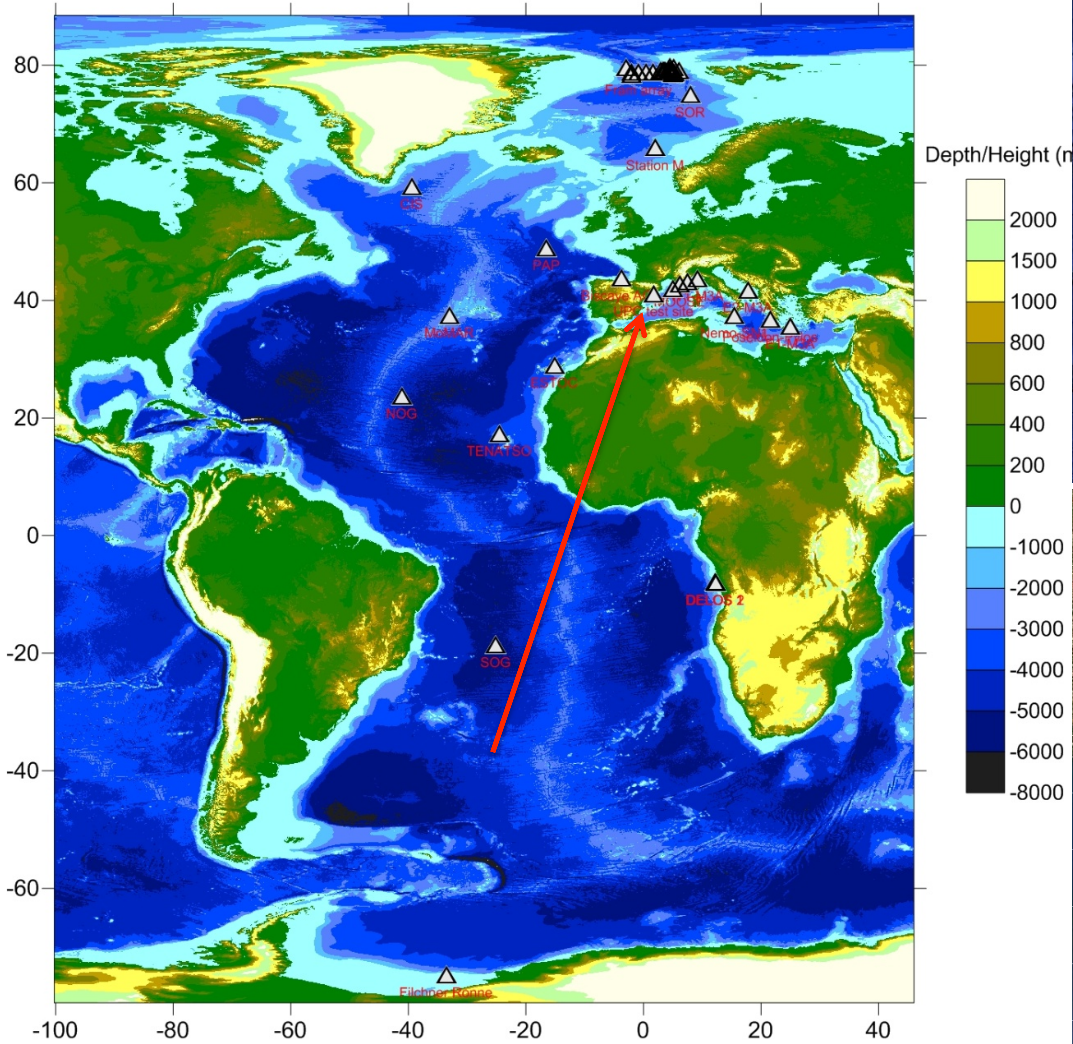
Operated by:

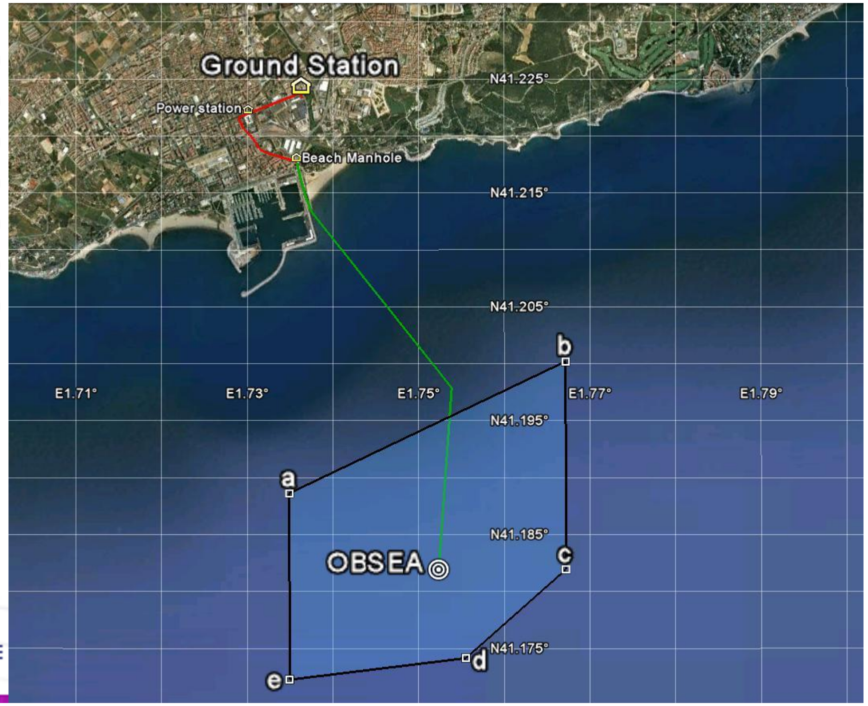
UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH



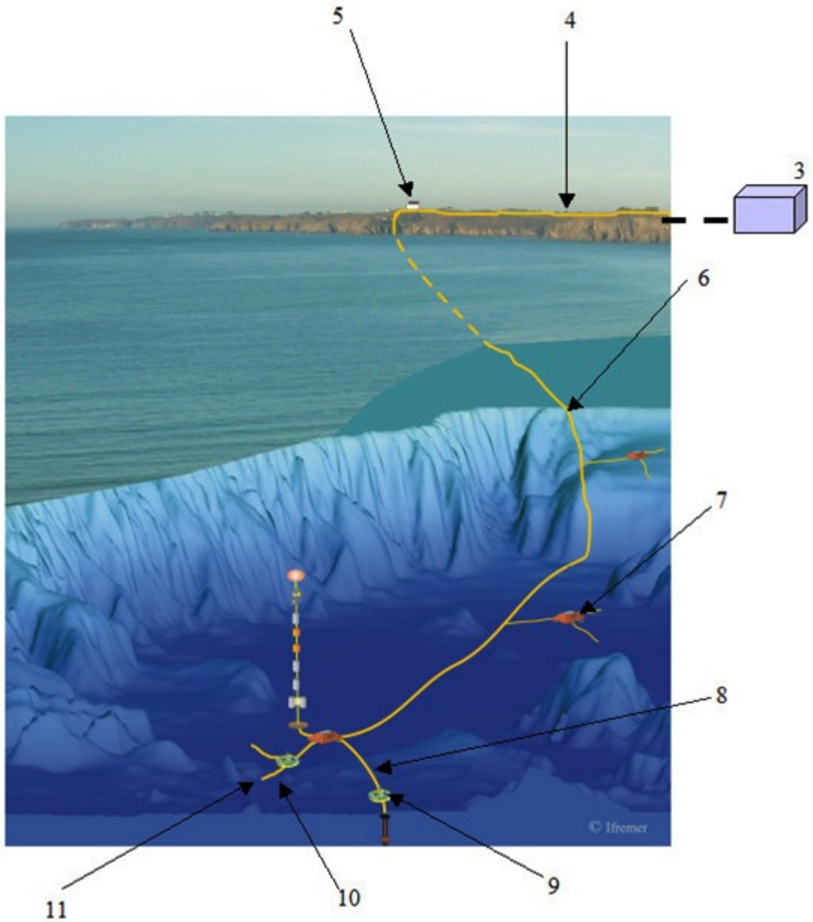


TECHNICAL SCHOOL OF ENGINEERING OF VILANOVA I LA GELTRÚ





Cabled Observatories



Observatorios Submarinos Cableados

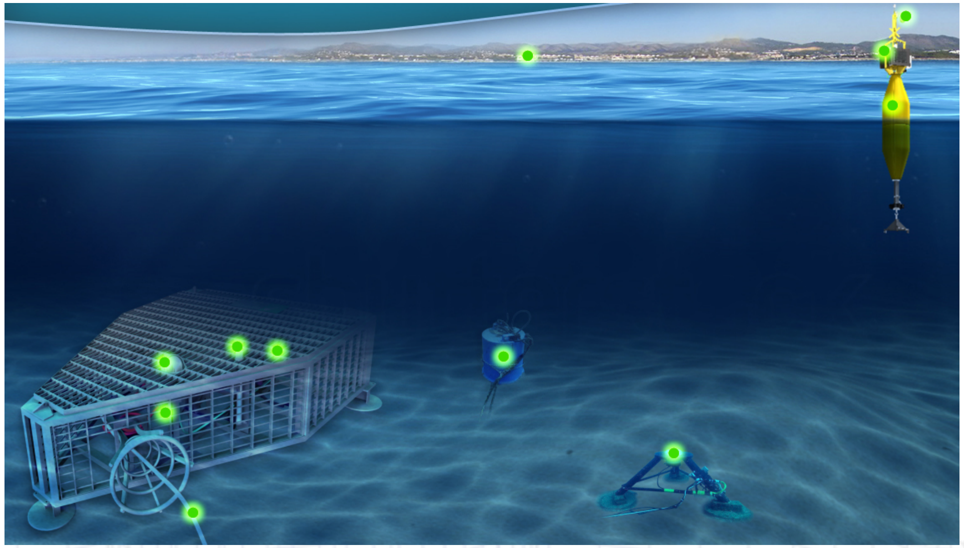
- Monterey Accelerated Research System (MARS), California, USA.
- Victoria Experimental Undersea System (VENUS), Canada.
- Neptune Canada Cabled Observatory (NEPTUNE), Canada.
- Aloha Observatory (ALOHA), Hawai.
- Astronomy with a Neutrino Telescope and Abyss environmental RESearch (ANTARES), Francia
- Dense Oceanfloor Network System for earthquake and Tsunamis (DONET), Japon.
- Neutrino Ettore Majorana Observatory, NEMO-SNI (NEMO), Italia.
- Marine e-Data Observatory Network (MEDON), Francia.
- Martha's Vineyard Coastal Observatory, (MARTA), Massachusetts, USA.
- Marine Cable Hosted Observatory (Hsu,S.-K. et al.2007), Taiwan.
- New Millenium Observatory (MILLENIUM), Oregon, USA.
- Observatorio Submarino Expandible OBSEA, (Mànuel A. et al 2010), España.

Leyenda
3 - Estación Terrestre
4 - Red terrestre
5 - Terminación de la Estación Terrestre. Inicio infraestructura submarina.
6 - Cable de comunicación y alimentación submarino
7 - Nodo o extensión de una ramificación del Cable de comunicaciones submarino
8 - Ramificación de la red
9 - Junction box (nodo de conexión)
10 - Enlace a un instrumento
11 - Instrumentos

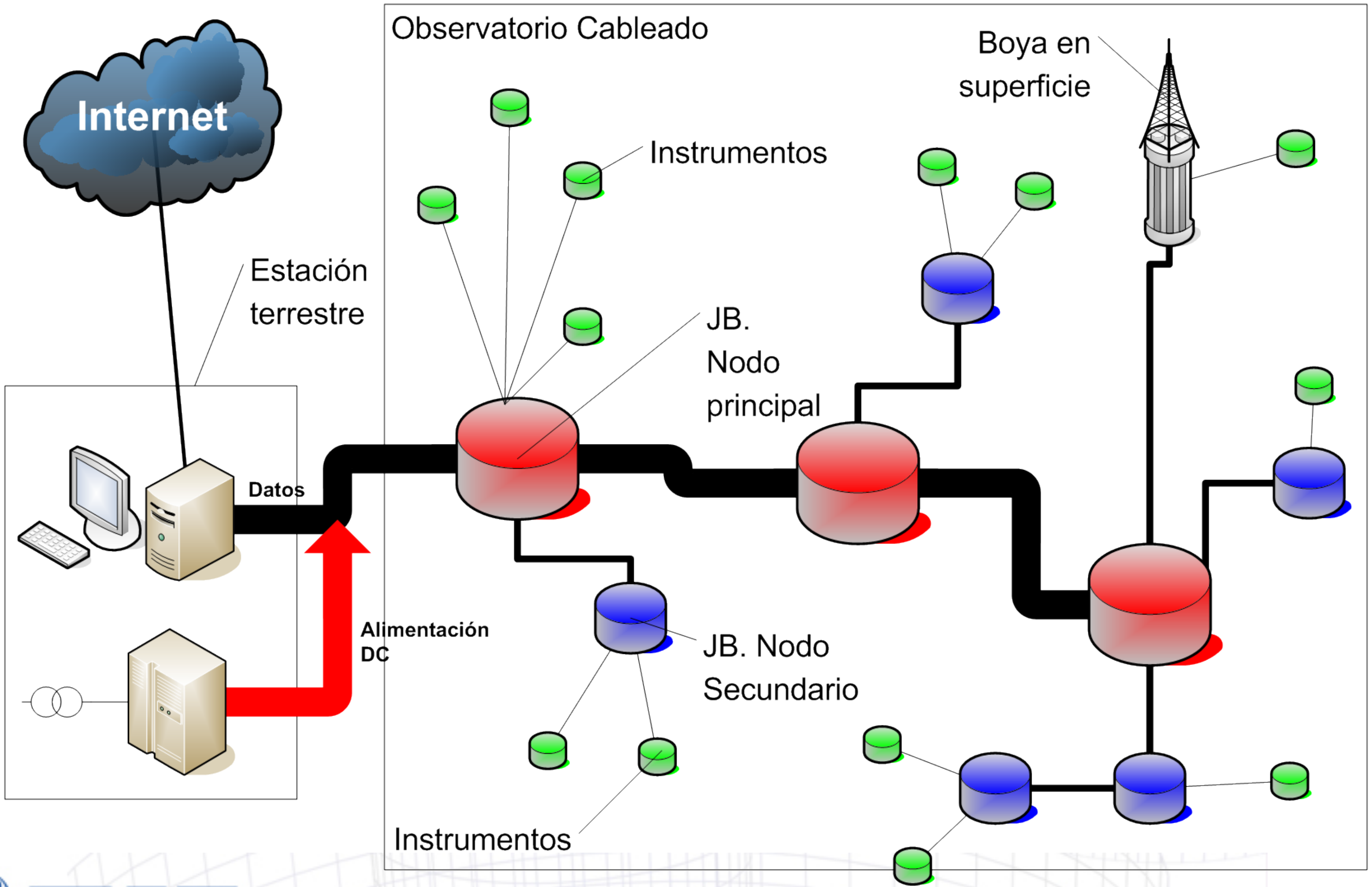
Figura Cortesía de Ifremer, Instituto Francés de Investigación para la Explotación del Mar.

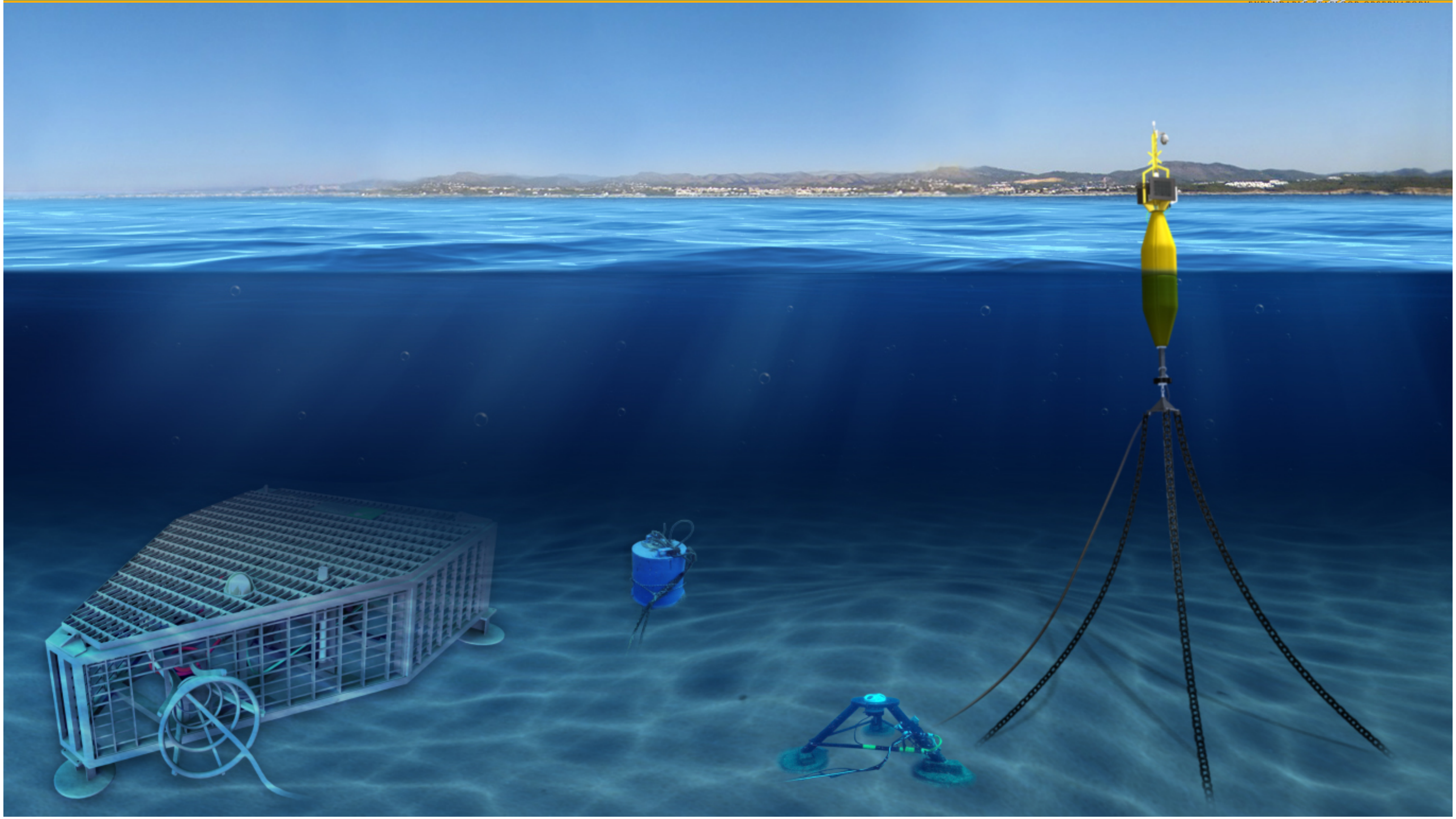
OBSEA schema

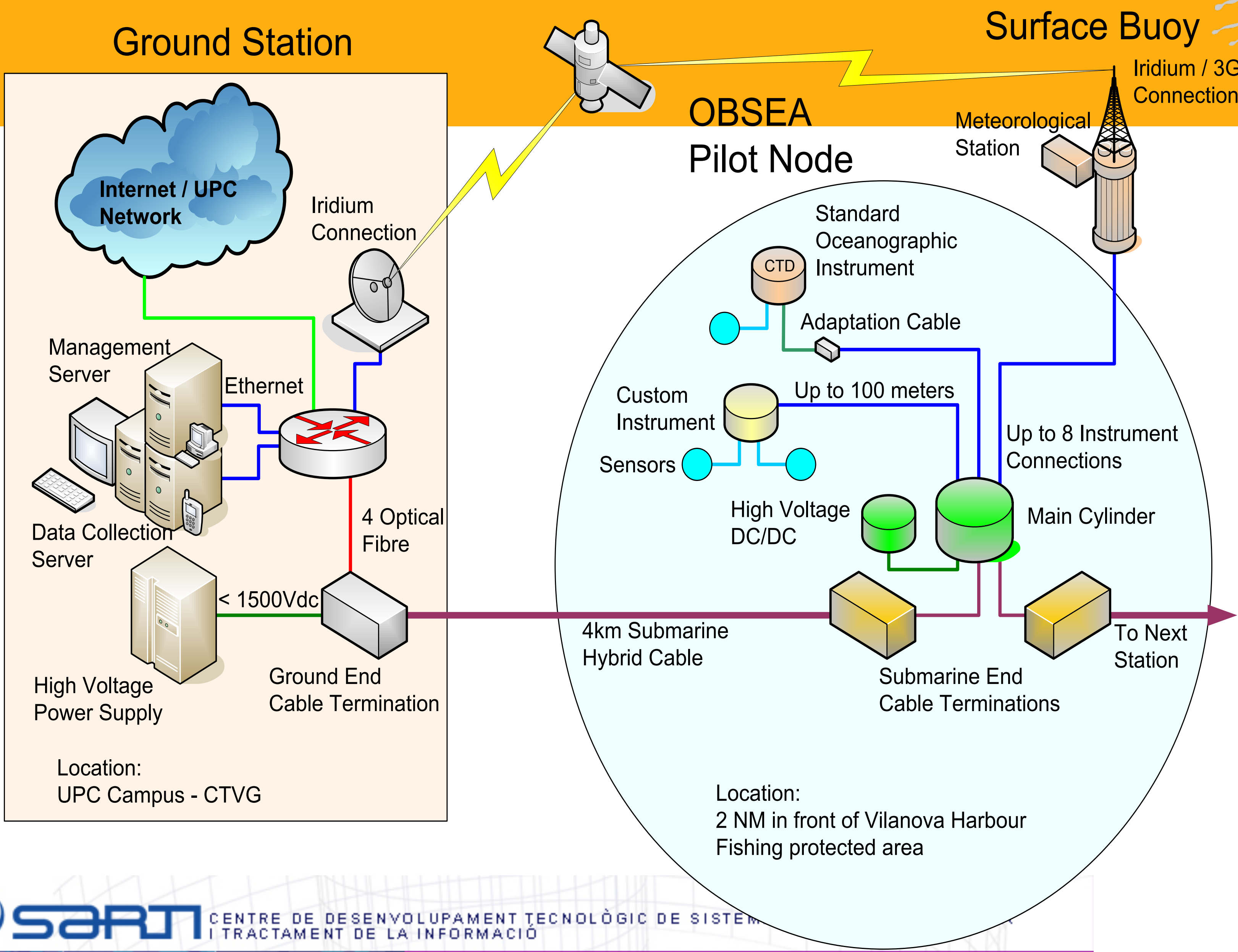
- 20m depth, 4km offshore, 16 wetmate connectors for instrumentation (power, communications, synchronization)
- Operations by scuba divers and small boats.
- The infrastructure is offered under transnational access (TNA).



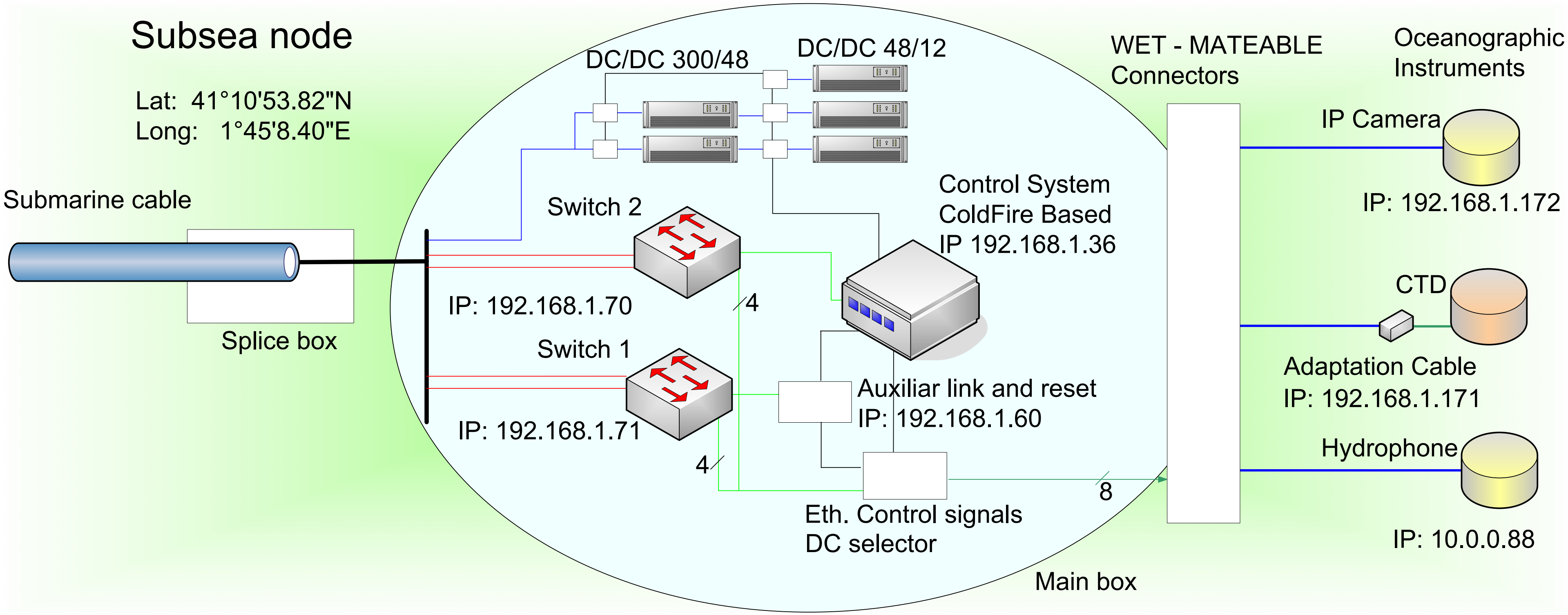
OBSEA schema



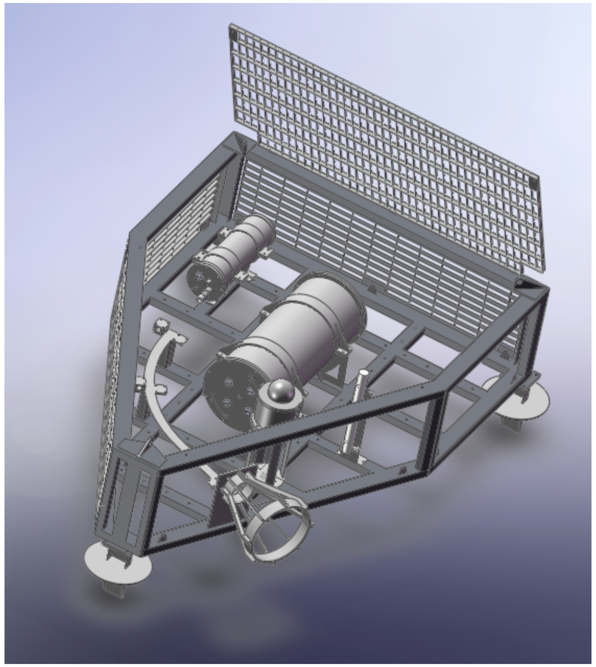


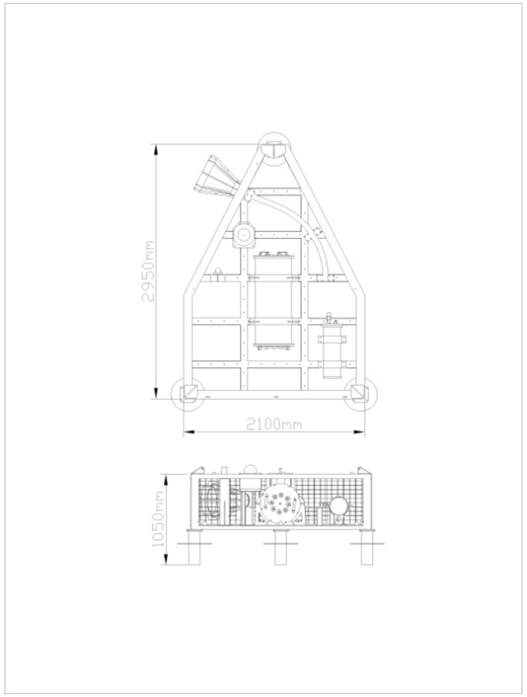

Ground Station
Surface Buoy
Iridium / 3G
Connection
OBSEA
Pilot Node
Meteorological
Station
Internet / UPC
Network
Iridium
Connection
Standard
Oceanographic
Instrument
CTD
Adaptation Cable
Management
Server
Ethernet
Custom
Instrument
Up to 100 meters
Up to 8 Instrument
Connections
Sensors
High Voltage
DC/DC
Main Cylinder
4 Optical
Fibre
Data Collection
Server
< 1500Vdc
4km Submarine
Hybrid Cable
To Next
Station
Ground End
Cable Termination
Submarine End
Cable Terminations
High Voltage
Power Supply
Location:
UPC Campus - CTVG
Location:
2 NM in front of Vilanova Harbour
Fishing protected area

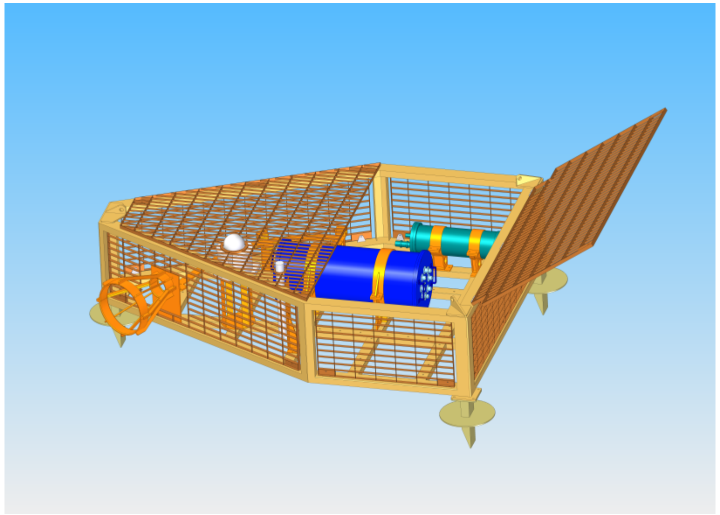
OBSEA: Junction Box



OBSEA: Mechanical protection



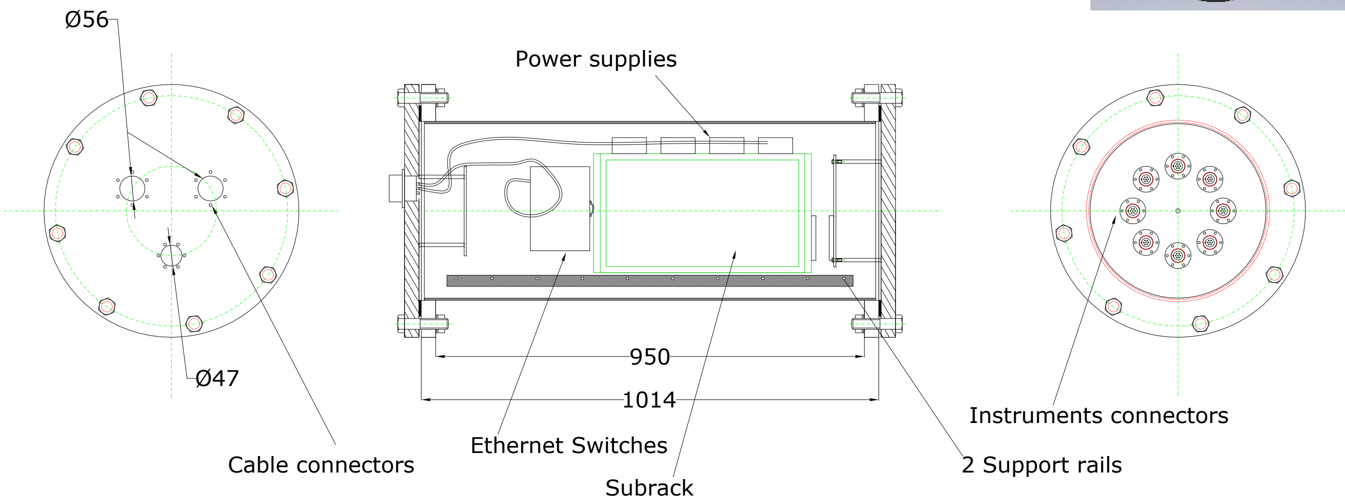




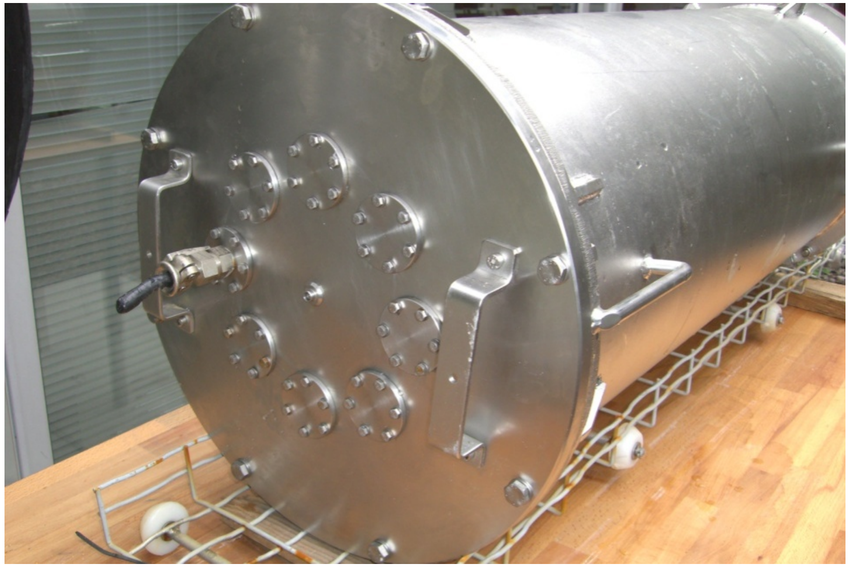
OBSEA: Mechanical Protection

OBSEA: Junction Box

- AISI Type 316L Stainless Steel
- Designed for 300 meters depth
- Up to 8 instrument ports
- 2 ports for trunk cable connection
- One sub-rack for 16 100 x 160mm PCB cards
- 150 watt redundant 1+1 power supply at 48Vdc
- 100 watt redundant 2+1 power supply at 12Vdc
- 1+1 redundant gigabit Ethernet switch

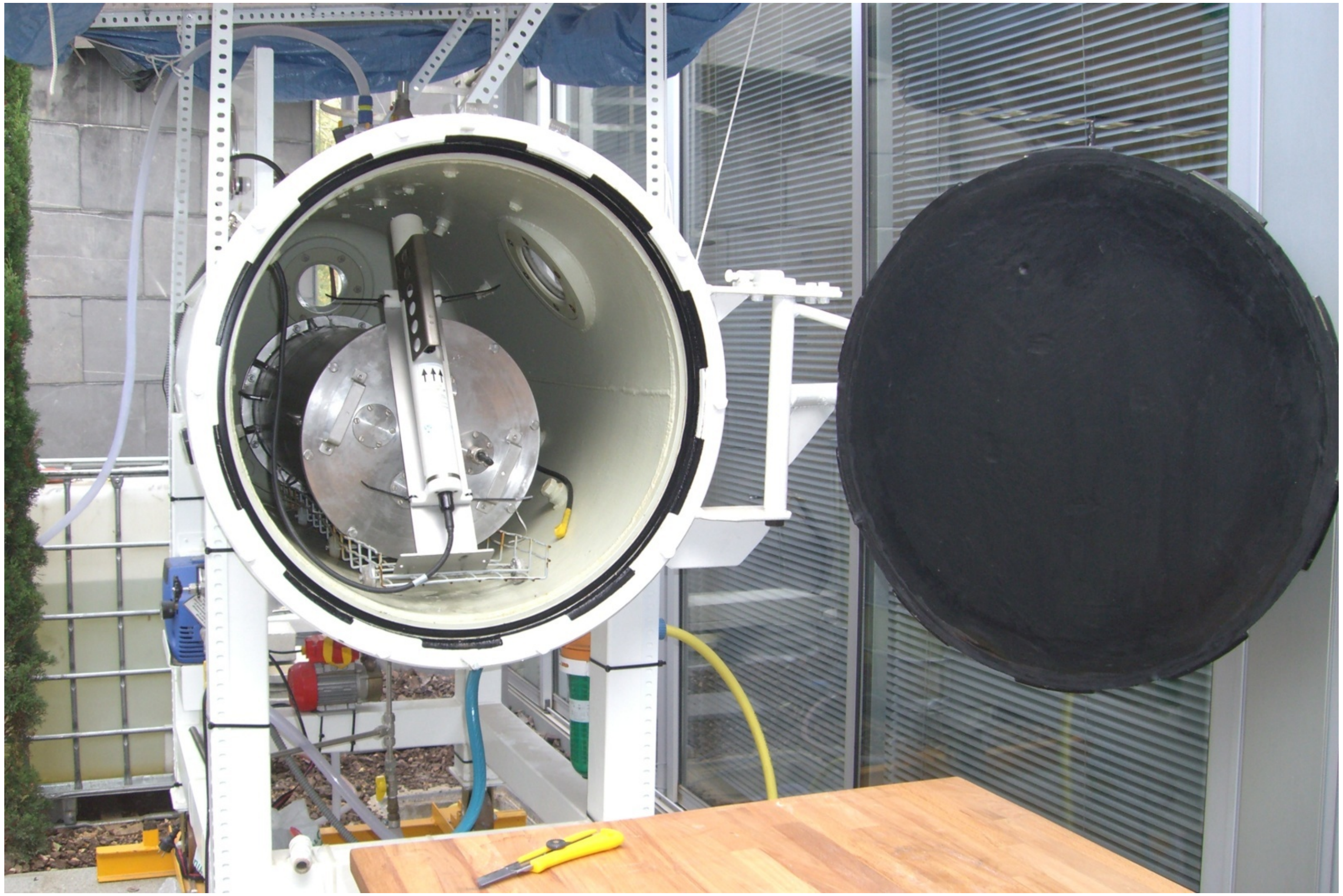


OBSEA: Junction Box



OBSEA: Hyperbaric chamber

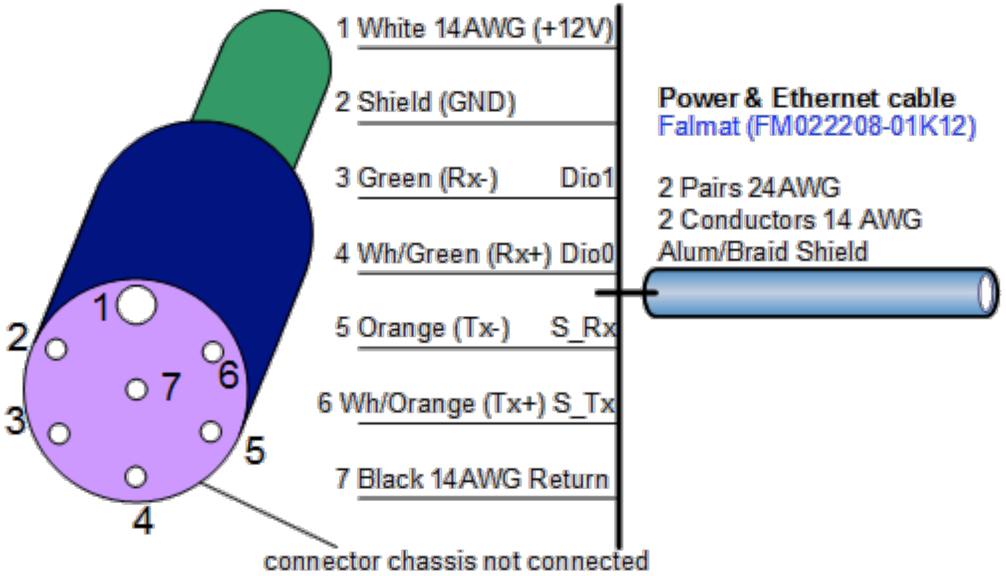
OBSEA: Hyperbaric chamber



OBSEA: wetmate connectors (Ethernet+Power)

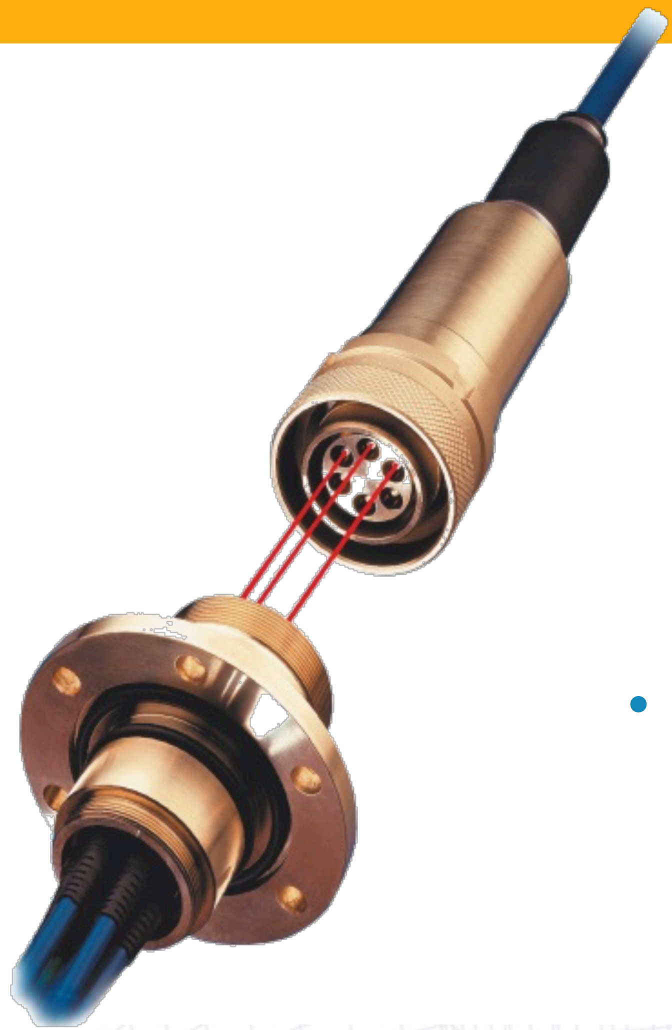
Gisma

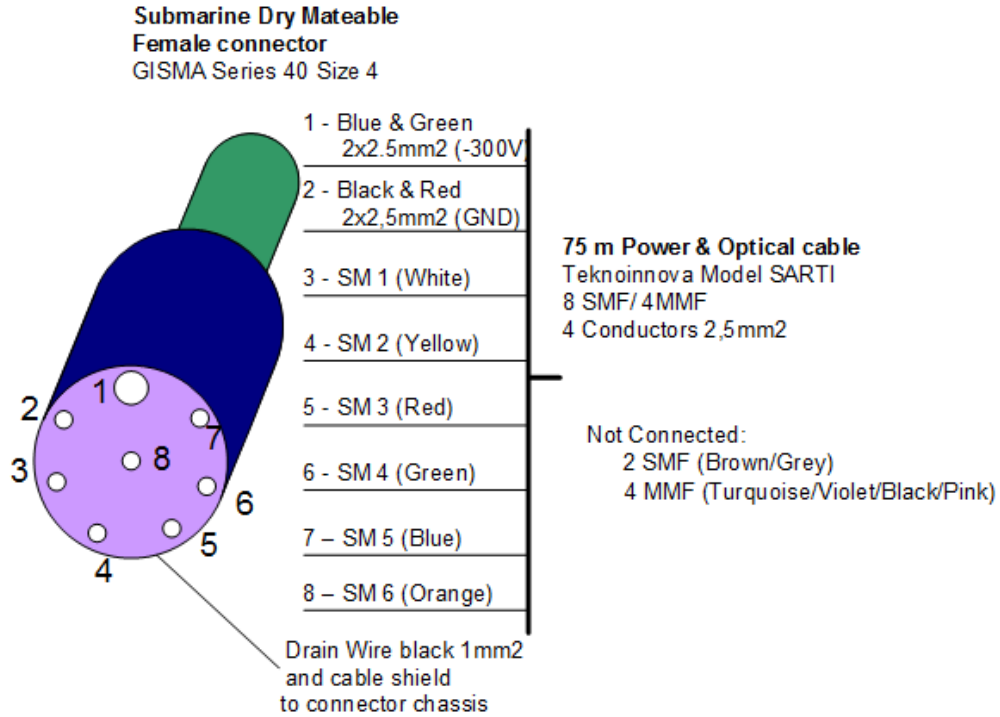
Instrumentation Connector



- GISMA series 10 size 3
  - 7 contacts Ø 1,5mm (max 250V & 15A)
  - Shell Material: Stainless steel 316L
  - Max working pressure 500bars
  - Wet mateable up to 100 meters depth
  - Min 200 mating operations

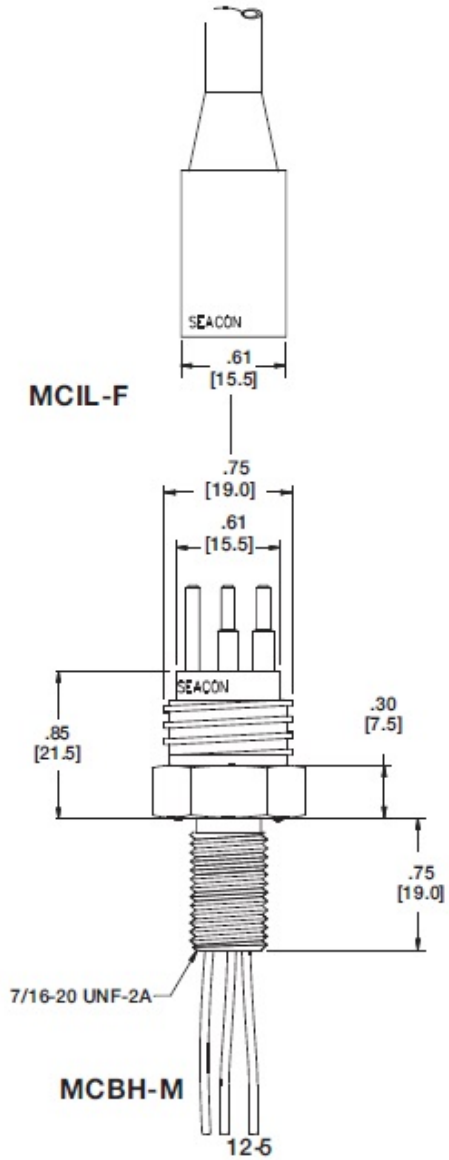
Trunk Connector





- GISMA series 40 size 4
  - 6 singlemode optical contacts (< 1dB atenuation)
  - 2 electrical contacts Ø 1mm (max 1000V & 8A)
  - Shell Material: Stainless steel 316L
  - Max working pressure 350bars
  - Dry mateable
  - Min 1000 mating operations

Auxiliar Connector



MCIL8M

300V 3 Amp
(w/20 AWG Cab)

MCIL8F/MCDLSF Pin	Cable "G" Function (color)	GISMA Series 10 Size 3 Pin
1	Tx+ (Wh/Orange 24 AWG)	6
2	Tx- (Orange 24 AWG)	5
3	Power + (White 14 AWG)	1
4	GND (Alum Shielding)	2
5	Rx+ (Wh/Green 24 AWG)	4
6	Rx- (Green 24AWG)	3
7	GND (Alum Shielding)	
8	Out Power (Black 14AWG)	7

- SEACON
  - 8 electrical contacts (max 300V & 3A)
  - Material: Neoprene & Stainless Steel or Brass
  - Max working pressure 700bars
  - Wet mateable
  - Min 500 mating operations

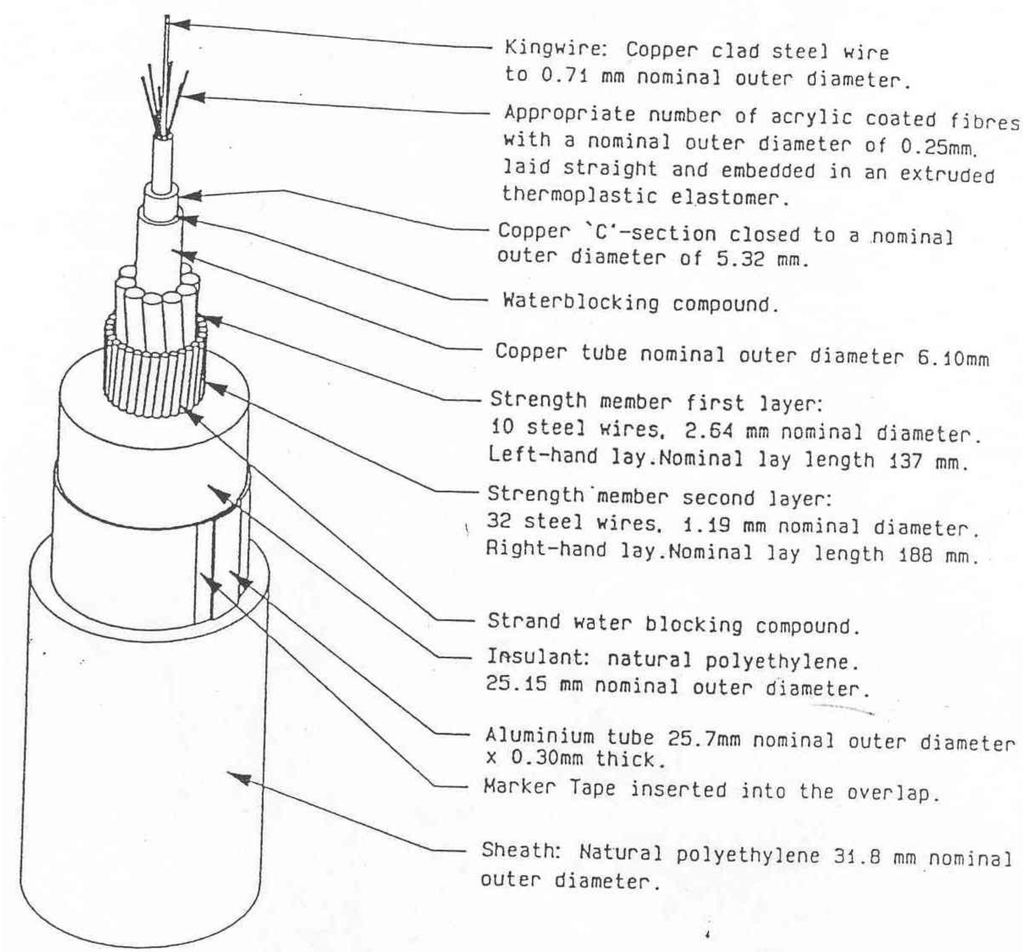
OBSEA: Cable

Cable submarino cedido por Telefònica:

- 5km, 6 F.O. 2 conductores

Cable terrestre

- 1 km, 8 fibras monomode
- 1 km, 3 conductors de 10mm2 de cobre



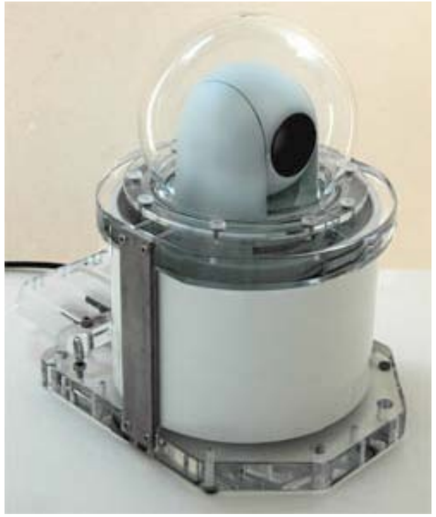
OBSEA: Power supply on-shore

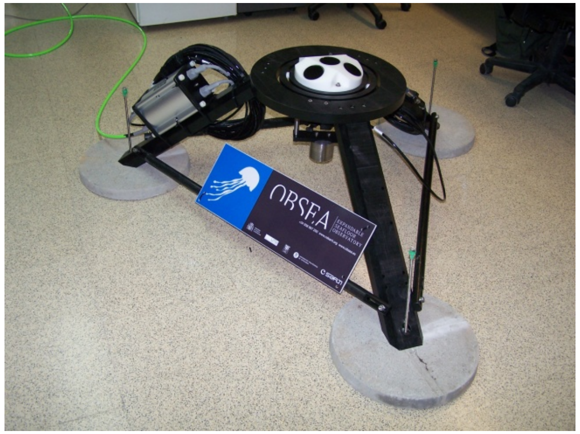
300V – 11A. Suministro de potencia al nodo submarino a través del cable. Un PLC gestiona el número de fuentes en serie necesarias para suministrar la potencia suficiente. El PLC es controlado y monitorizado via Eth mediante protocolo SNMP

OBSEA: Electronics at Junction Box

-Sistema basado en microprocesador de 32bits ColdFire de Freescale:
-Gestión de las fuentes de alimentación y relés que dan potencia a los instrumentos.
-Gestión Baterías. Estado
-Información de Temperatura y Humedad interior del cilindro
- Conectores con comunicación Ethernet : Switch Industrial Moxa.
-Comunicación Ethernet sobre protocolo SNMP (Single Network Managment Protocol)

OBSEA: Instrumentation





COBS, pH, meteo…

Observatory. OBSEA, UPC Test Site

- Possibility to deploy new instrumentation for testing: installation procedures, data communication, data management, performance, robustness, etc…
- Real-time access to data instrumentation.
- Present instruments: **Underwater**: CTD, seismometer, ADCP, hydrophone, pH, video camera. **Surface buoy**: meteo station, video camera.

TECHNICAL SCHOOL OF ENGINEERING OF VILANOVA I LA GELTRÚ

OBSEA
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Segueix-nos a Facebook!

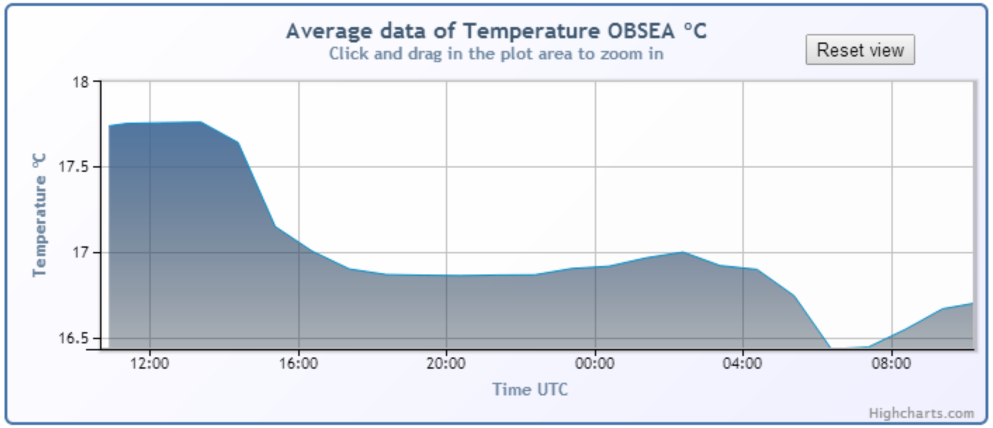
Inici | OBSEA | Dades | Citizen Science | Galeria | Enllaços | Col·laboradors | Login

Collapse All | Expand All

- OBSEA
  - CTD01
    - Temperature
    - Pressure
    - Conductivity
    - Salinity
    - Sound Speed
  - CTD02
    - Temperature
    - Pressure
    - Conductivity
    - Salinity
    - Sound Speed
    - PH
  - CO2
- BUOY
  - Temperature
  - Pressure
  - Wind Speed
  - Wind Direction
- METEO STATION
  - Temperature
  - Humidity
  - Pressure
  - Wind Speed
  - Wind Direction
  - Daily Rain
- Seismometer
  - Temperature
  - Humidity

From: 13-05-2014 Last 24 hours Update Plot
To: 14-05-2014 Min Max

OBSEA – Vilanova i la Geltrú.
Category: CTD02 (Conductivity, Temperature, Depth)



Generate Data

Temperature OBSEA °C

download (Average data)
download (Average data)
download (Average data)

Temperature Pressure Conductivity
Salinity Sound Speed PH
Every 10 minuts

download via FTP (Raw data)

UPC

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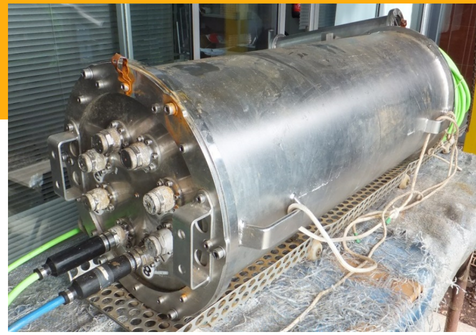
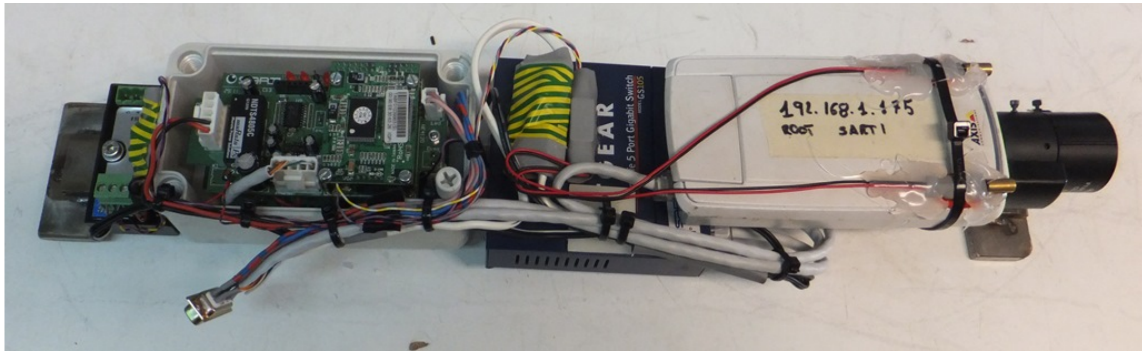
OBSEA
EXPANDABLE SEAFLOOR OBSERVATORY



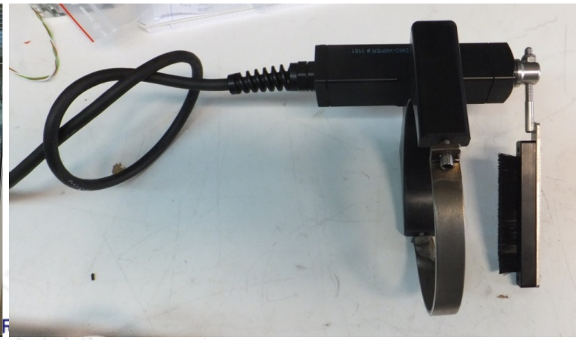
Expand Obsea with a deployment of a 2nd junction box to increase instrument ports

Deploy a new video camera with a custom housing and a wipper to avoid biofouling



New pCO2 and pH sensor.

Maintain present services as a data provider for UPC, CSIC, IGN, IGC and new institutions trough TNA calls



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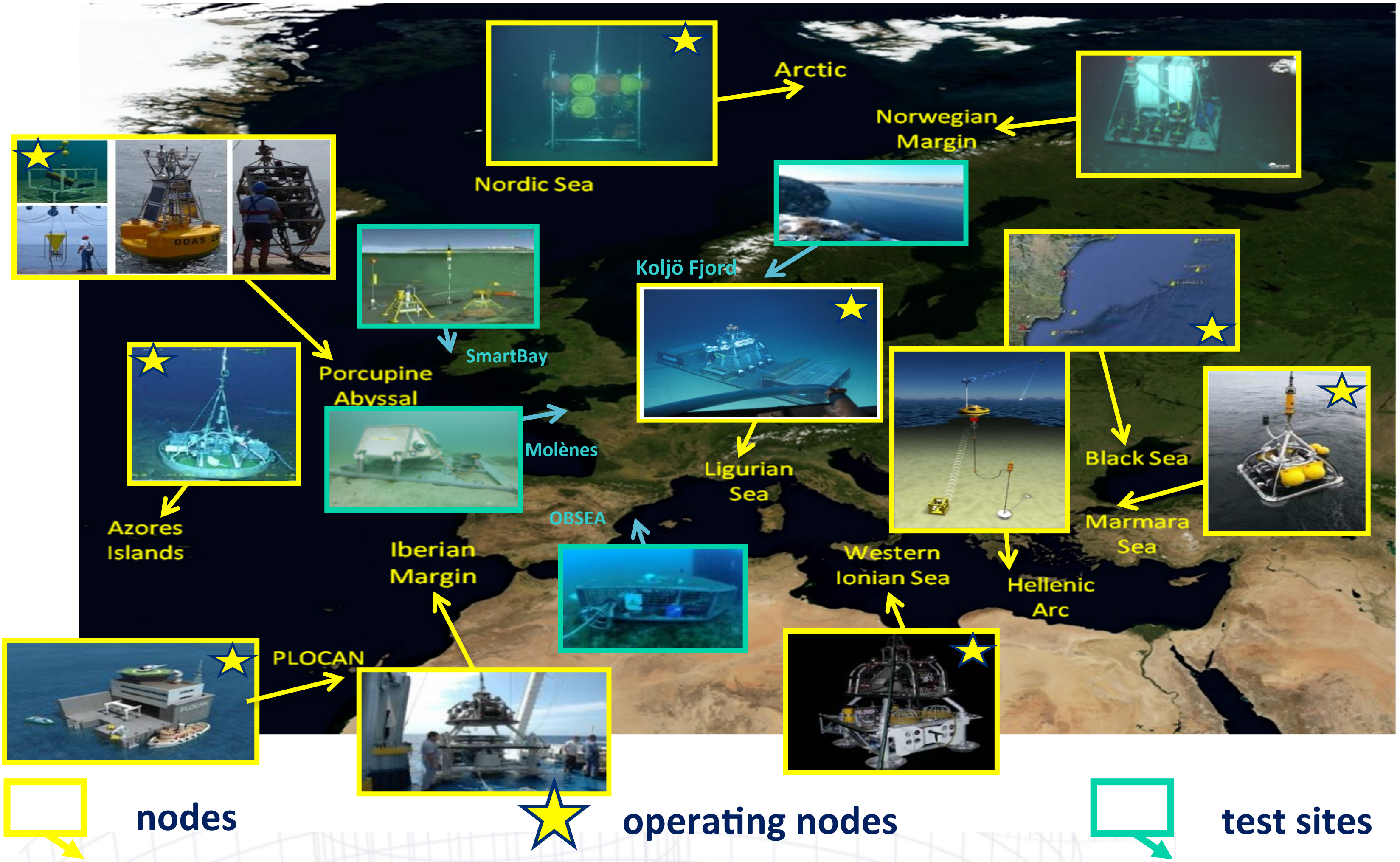
OF VILANOVA I LA GELTRÚ

EMSO nodes: European Multidisciplinary Seafloor and Water-Column Observatory

european multidisciplinary seafloor & water column observatory emso



OBSEA: Buoy

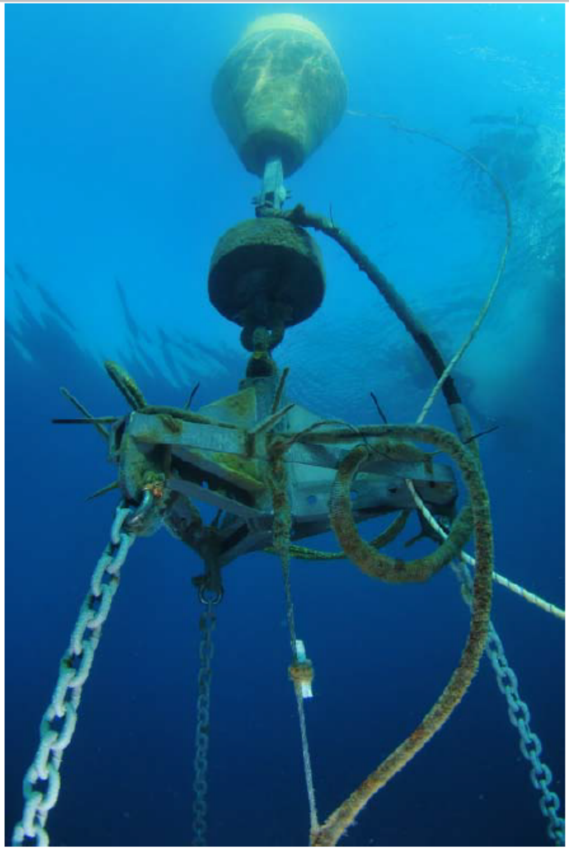
IP Camera: 704x576 pixels; 25 fps; 10x Optical Zoom
Solar panels: 4 x 20W
Weather station:
- Position, velocity and GPS time
- Speed and wind direction
- Pressure and temperature
- magnetic compass
- 3-axis accelerometer for Pitch and Roll angles

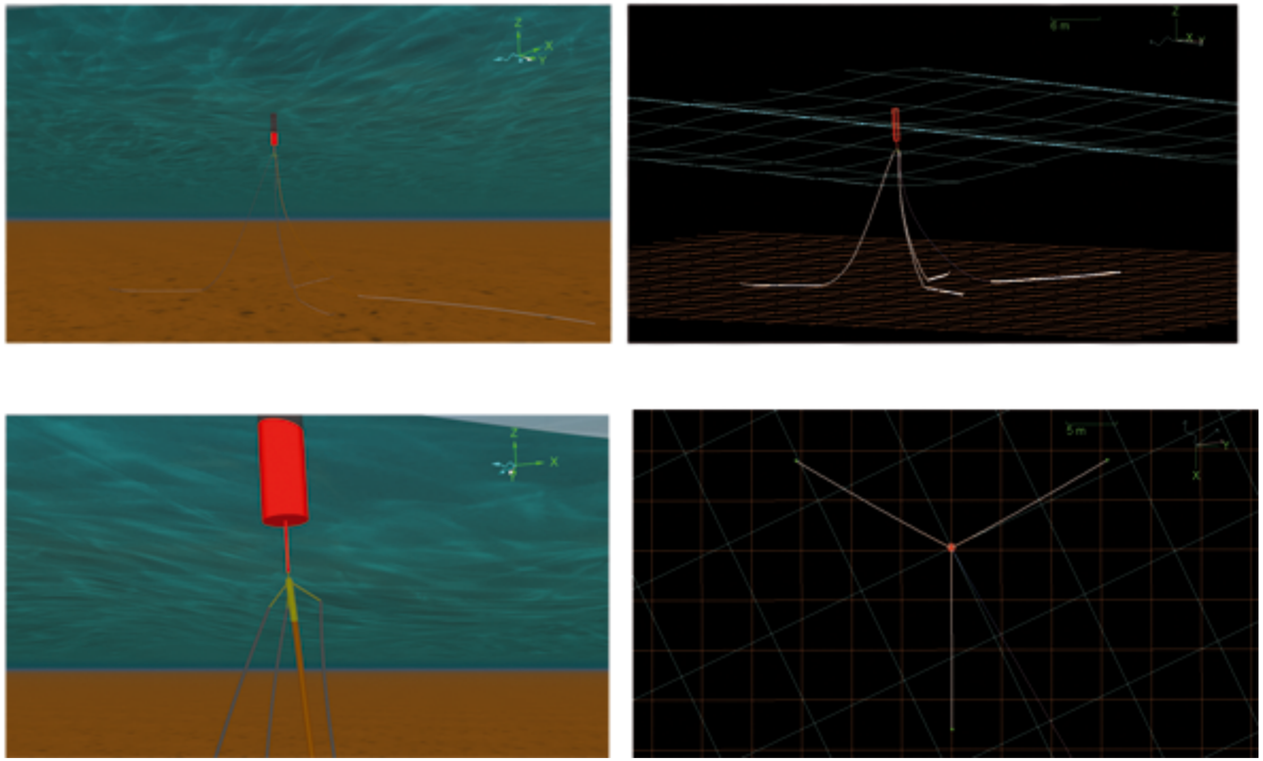
Buoy signalling light, self-powered:
- High efficiency yellow LED light
- Reach 3 nautical miles

Junction box
- Electronic Control
- 3G Modem Communication

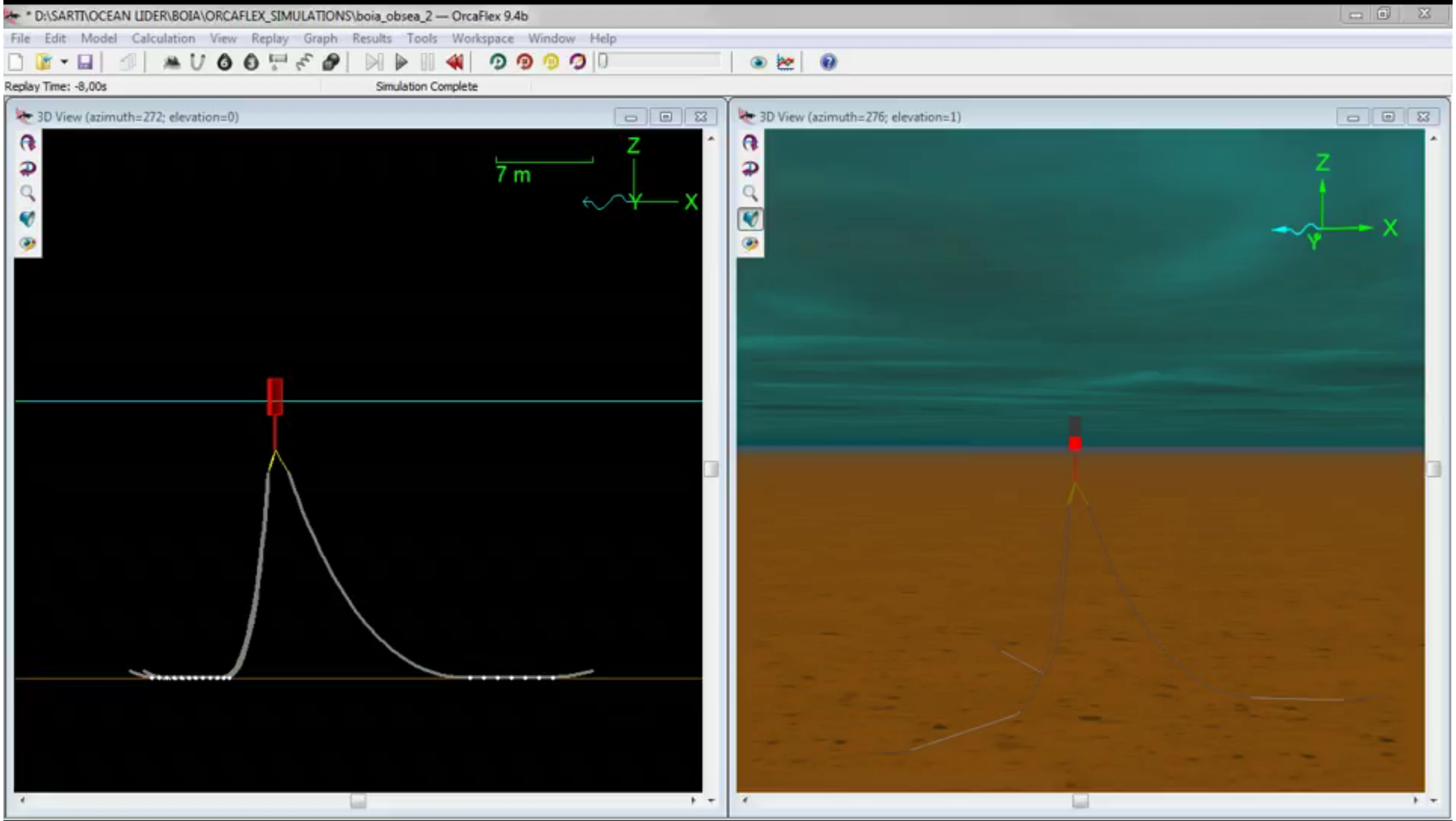
Battery Box
- Battery: 12v & 65Ah
- Solar charge controller: 6A

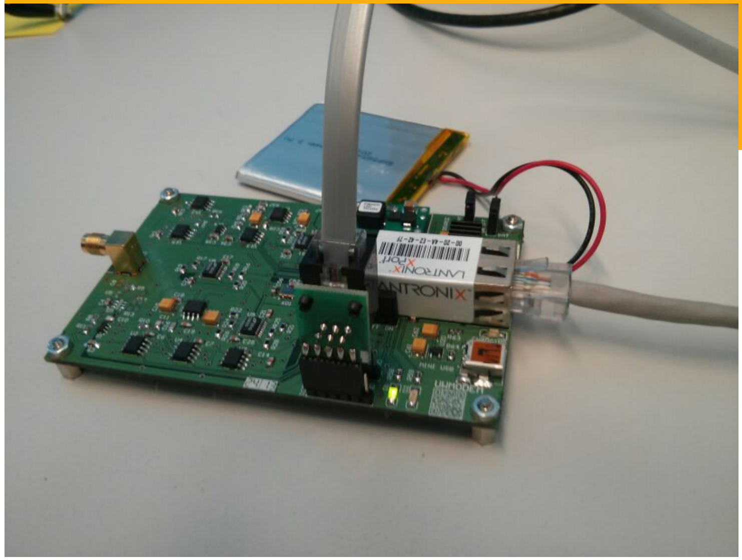
OBSEA: Boya, fondeo

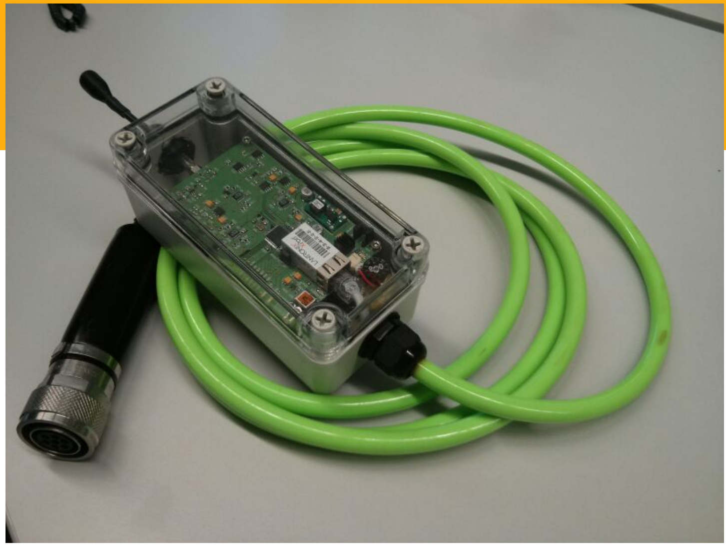


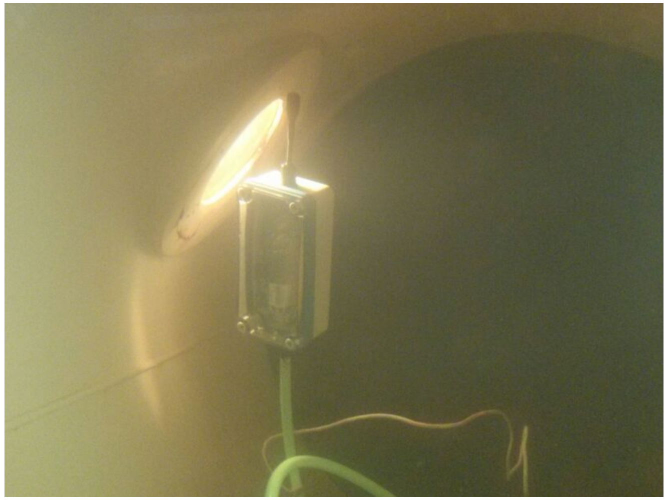


Orcaflex Software. Orcina.

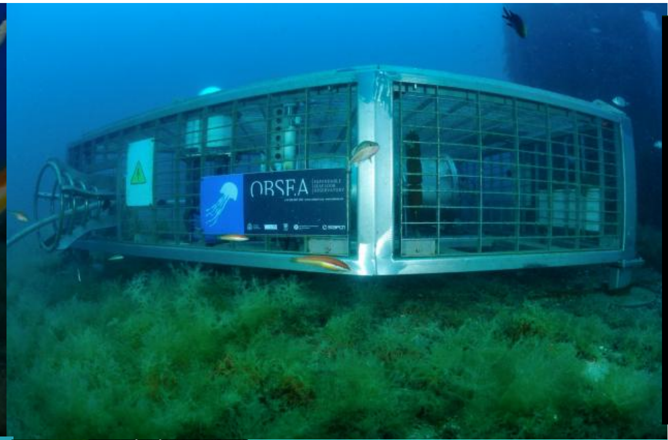

* D:\SARTI\OCEAN LIDER\BOIA\ORCAFLEX_SIMULATIONS\boia_obsea_2 — OrcaFlex 9.4b
File Edit Model Calculation View Replay Graph Results Tools Workspace Window Help
Replay Time: -8,00s
Simulation Complete
3D View (azimuth=272; elevation=0)
7 m
Z
X
3D View (azimuth=276; elevation=1)
Z
X
Y

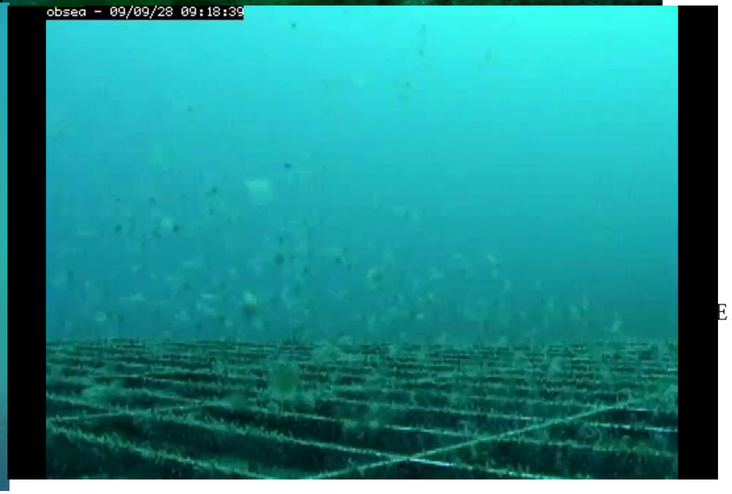






OBSEA: Thank you for your attention. Questions?





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FINNISH METEOROLOGICAL INSTITUTE

Utö Atmospheric and Marine Research Station

Lauri Laakso, Juha Hatakka, Tuomas Laurila, Timo Mäkelä, Sami Kielosto, Sanna Sorvari, Riikka Hietala, Tero Purokoski, Harry Lonka, Samppa Jenu, Ville Vakkari, Minttu Tuononen, Ewan O'Connor, Eija Asmi, J.-P. Jalkanen, Lasse Johansson, Tuomo Roine, Achim Drebs, Pekka Alenius, Mikko Lensu, Jan-Victor Björkqvist etc, Jari Haapala, Sanna Sorvari, Yrjö Viisanen, Petteri Taalas, Juhani Damski
Finnish Meteorological Institute

Jukka Seppälä, Timo Tamminen, Pasi Ylöstalo
Finnish Environment Institute

FINNISH METEOROLOGICAL INSTITUTE

1. Background

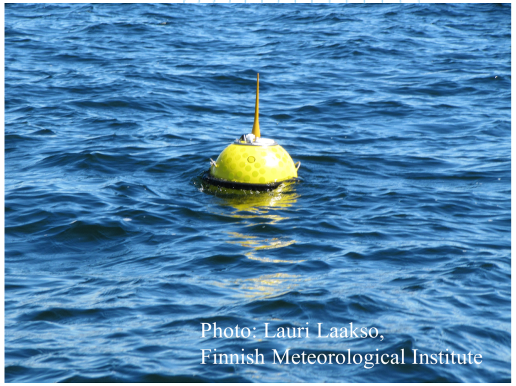
Finnish meteorological Institute (and Finnish Marine Research Institute) have a long history of observations at Utö

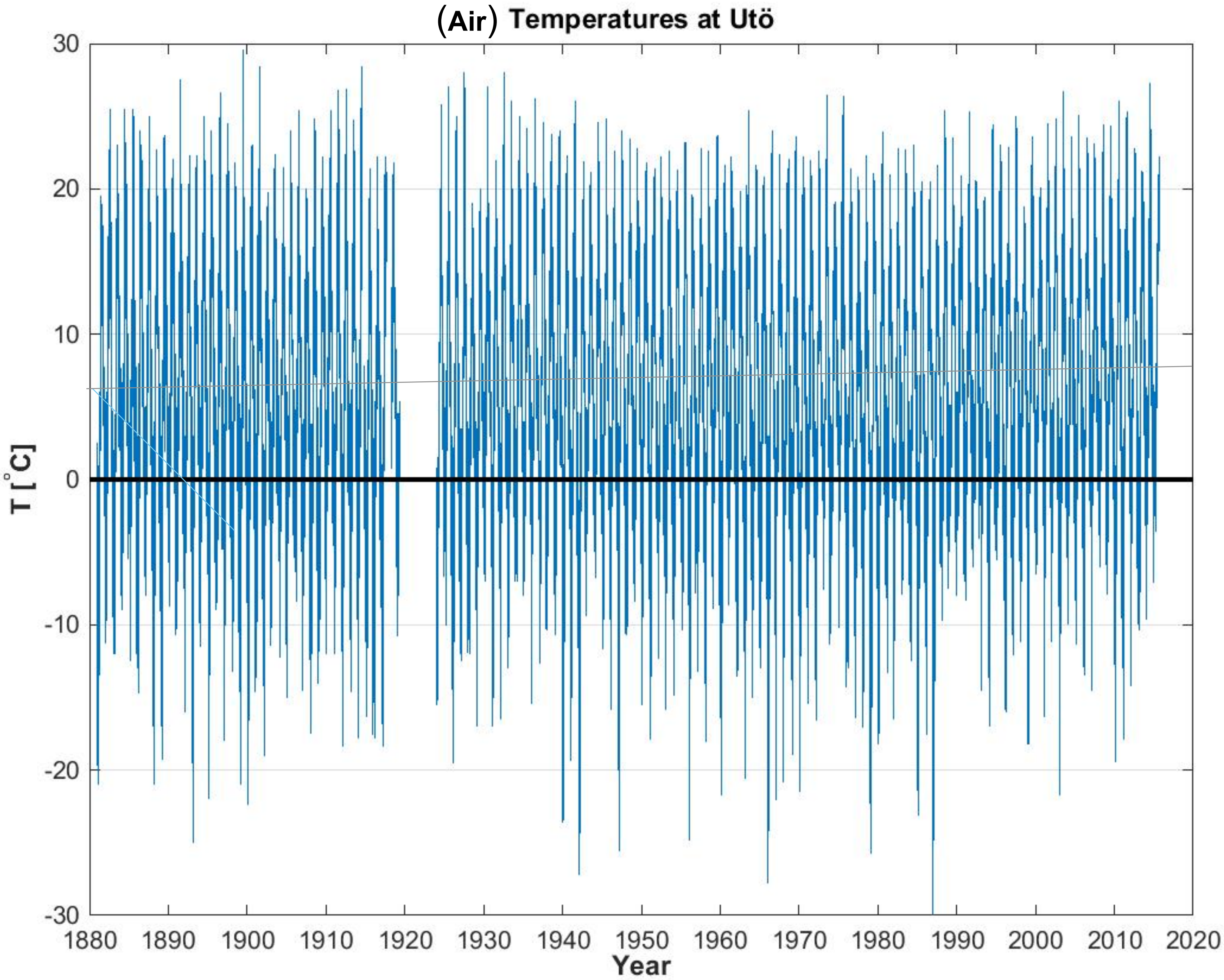
- 1881 → meteorological observations
- 1900 → salinity and temperature profiles (0 …-100 m)
- 1980 → EMEP-air quality HELCOM
- 2012 → ICOS-GHG-observations
- 2014 → FINMARI (one of key Finnish Research Infrastructures)
- 2015 → JERICO-NEXT facility (H2020)

2012 → Utö Marine Research Station

- FMI: Infrastructure, gas fluxes, physics of the sea
- SYKE: Biological research and observations
- Navy, private companies, universities

<u>Easy and cost-efficient logistics at Utö:</u>
a hotel, a shop, 4+ weekly ferries (free), conference facilities, one FMI employee living at Utö, fast optical fibre network, enough electricity (> 20kW)

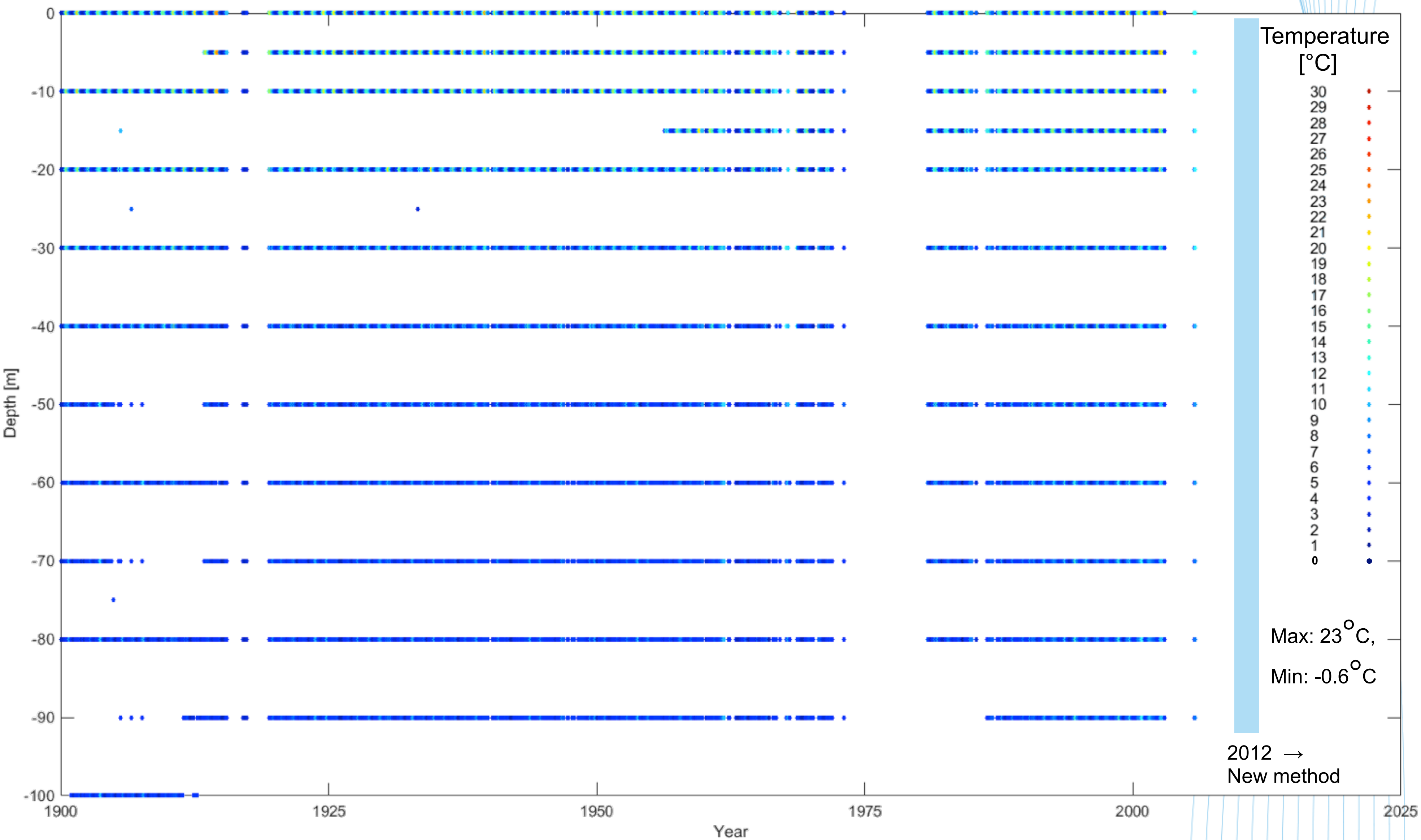




(Air) Temperatures at Utö
T [°C]
Year
30
20
10
0
-10
-20
-30
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020

FINNISH METEOROLOGICAL INSTITUTE

Sea water temperatures at Utö Deep (Ice cover data for the same period as well)



1.2 FINMARI

- Finnish Marine research infrastructure including all major research institutes and marine infrastructures in Finland
- Research stations, research vessels, Ferrybox routes, autonomous platforms, laboratory facilities, profiling buoy's, glider
- Extra funding from Finnish Academy (2015-16, 2017-18?)
- National coordination of resources, methods and investments
- http://www.finmari-infrastructure.fi/
- Close co-operation with Jerico-next (H2020 infra preparation project)

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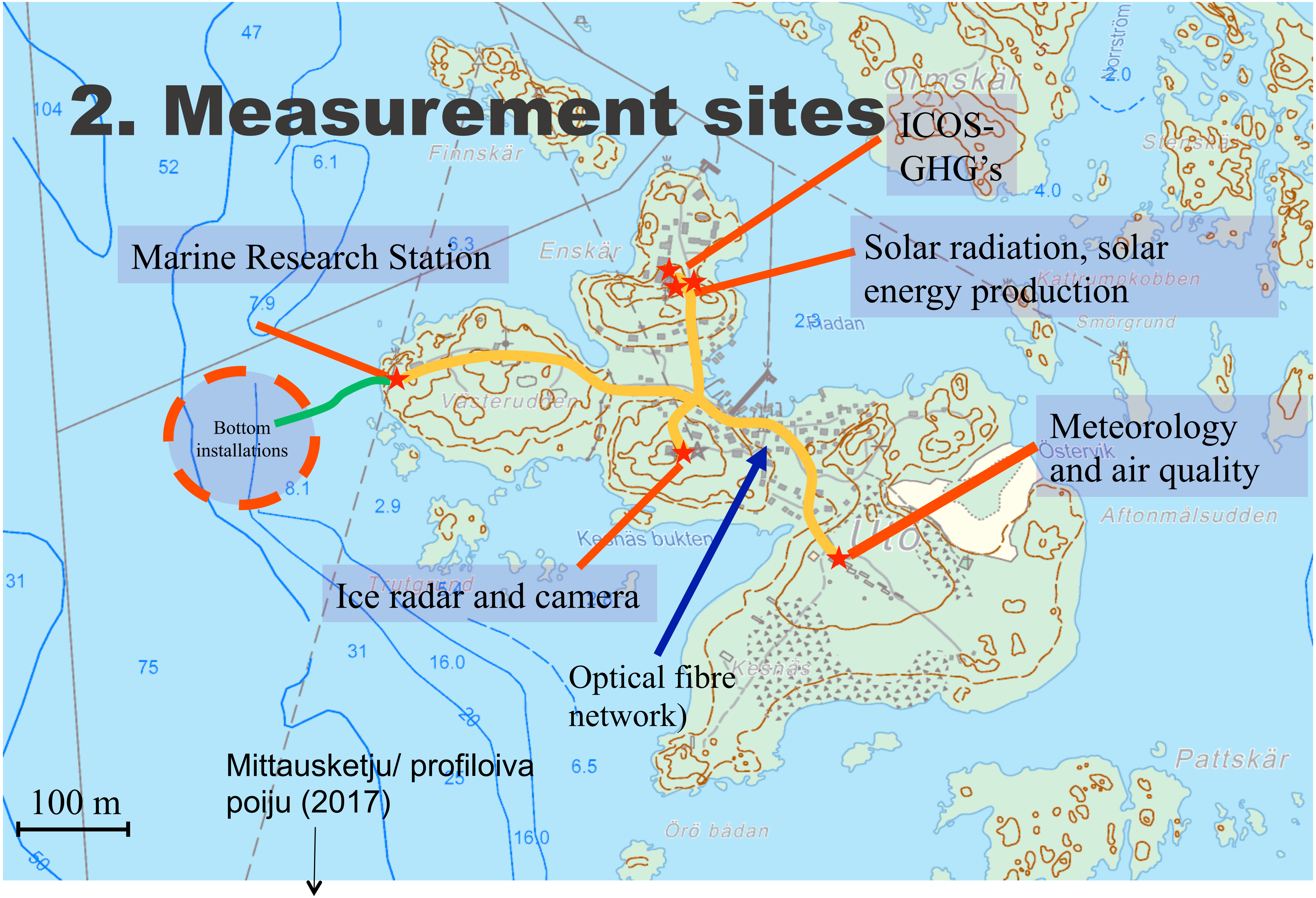
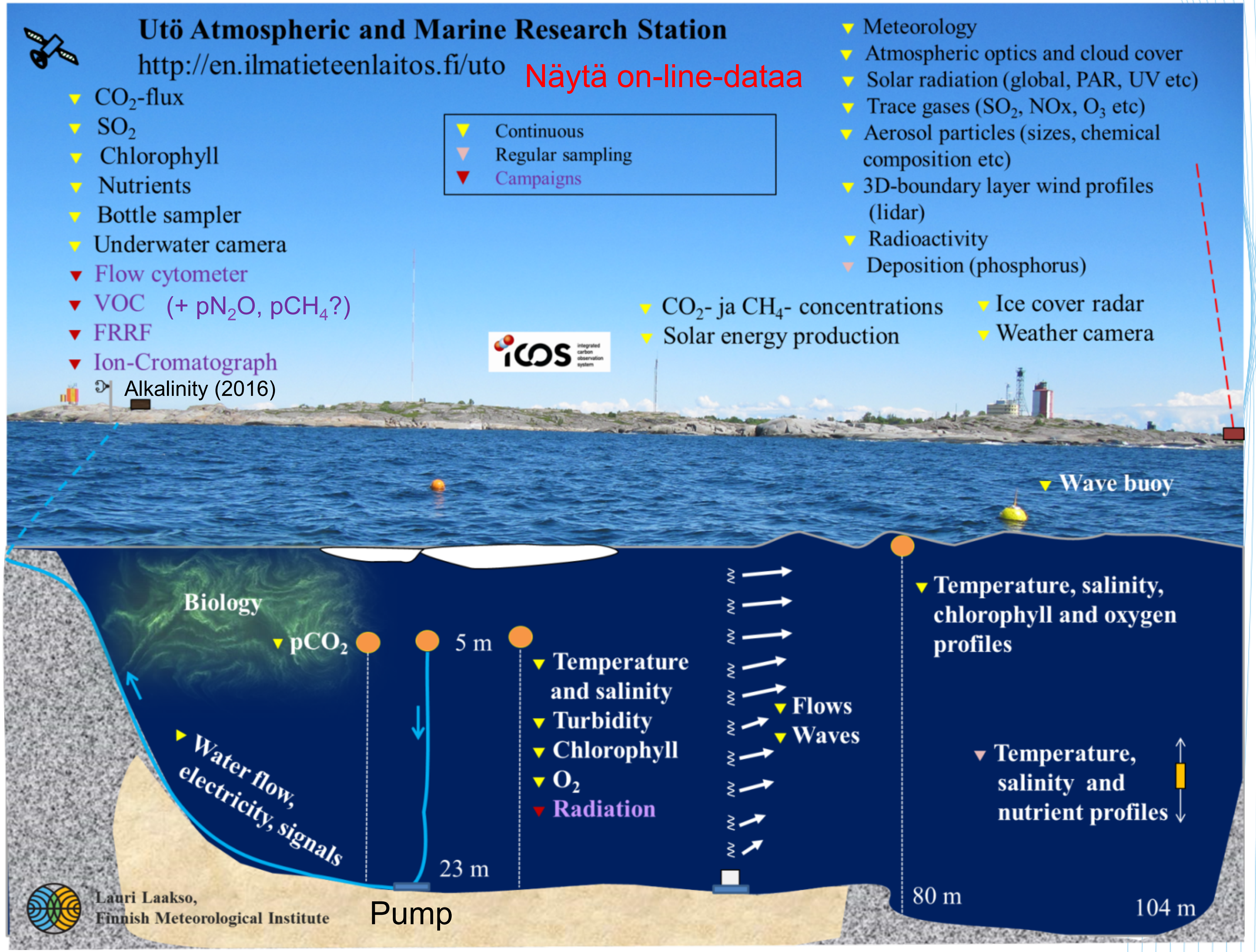
1.3 JERICO-NEXT

- Joint European research infrastructure network for coastal observatory – novel European expertise for coastal observatories (JERICO-NEXT)
- 2015-2019
- 33 partners from 15 countries; Utö main focal point in Finland
- Continuation of FP7 JERICO with partly different partners
- Development and integration of sensors, observing systems, and control and processing procedures for validated in-situ data and information
- Field of research: pelagic and benthic biodiversity, chemical contaminants and related biological responses, hydrography and transport, carbon fluxes and carbonate system and operational oceanography.
- Supporting ICOS-OTC and other ESFRI's

2. Measurement sites





Utö Atmospheric and Marine Research Station
http://en.ilmatieteenlaitos.fi/uto
Näytä on-line-dataa
CO_2-flux
SO_2
Chlorophyll
Nutrients
Bottle sampler
Underwater camera
Flow cytometer
VOC (+ pN_2O, pCH_4?)
FRRF
Ion-Cromatograph
Alkalinity (2016)
Continuous
Regular sampling
Campaigns
Meteorology
Atmospheric optics and cloud cover
Solar radiation (global, PAR, UV etc)
Trace gases (SO_2, NOx, O_3 etc)
Aerosol particles (sizes, chemical composition etc)
3D-boundary layer wind profiles (lidar)
Radioactivity
Deposition (phosphorus)
CO_2- ja CH_4- concentrations
Solar energy production
Ice cover radar
Weather camera
Wave buoy
Biology
pCO_2
5 m
Temperature and salinity
Turbidity
Chlorophyll
O_2
Radiation
Flows
Waves
Temperature, salinity, chlorophyll and oxygen profiles
Temperature, salinity and nutrient profiles
Water flow, electricity, signals
23 m
80 m
104 m
Pump
Lauri Laakso, Finnish Meteorological Institute

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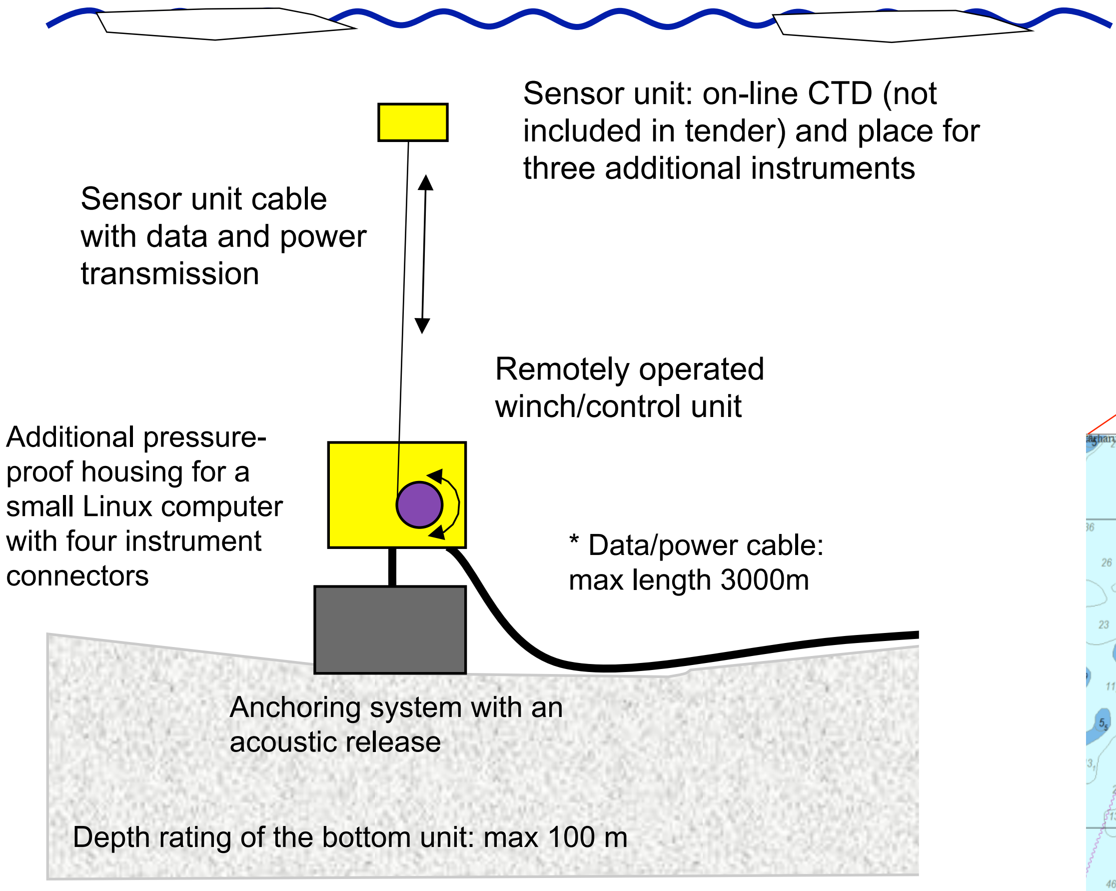
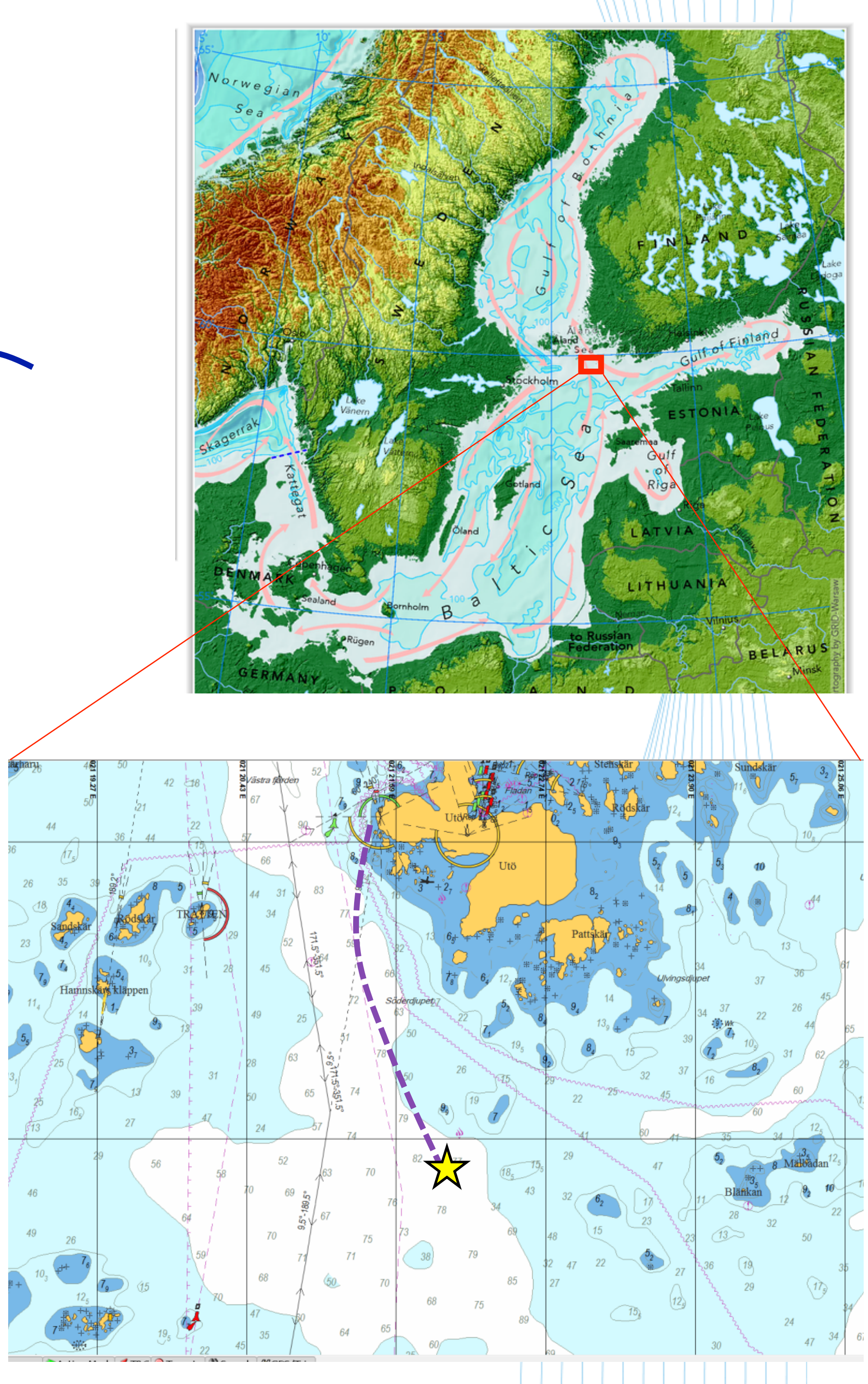
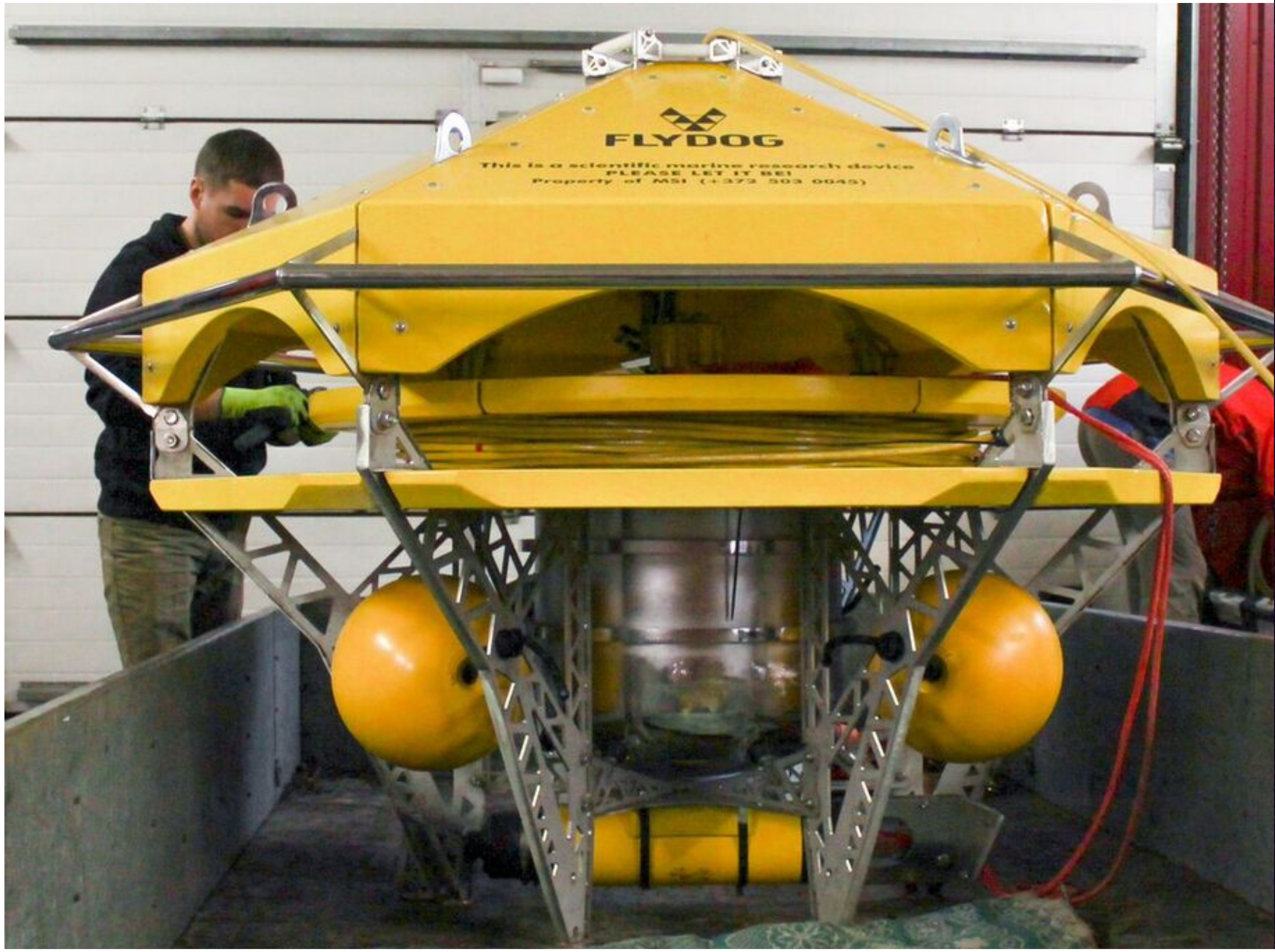
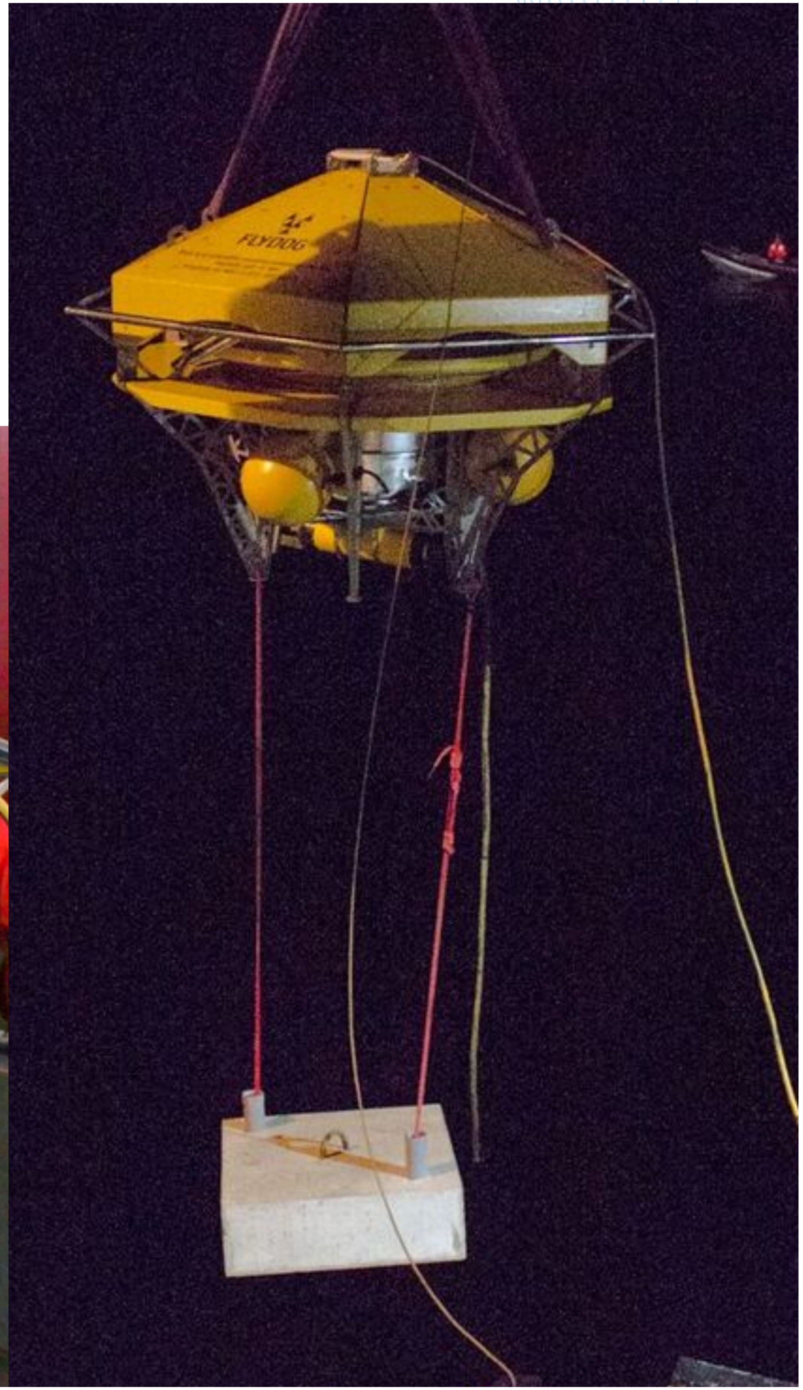
Schematic drawing of the cabled profiling buoy (installation in 2017)



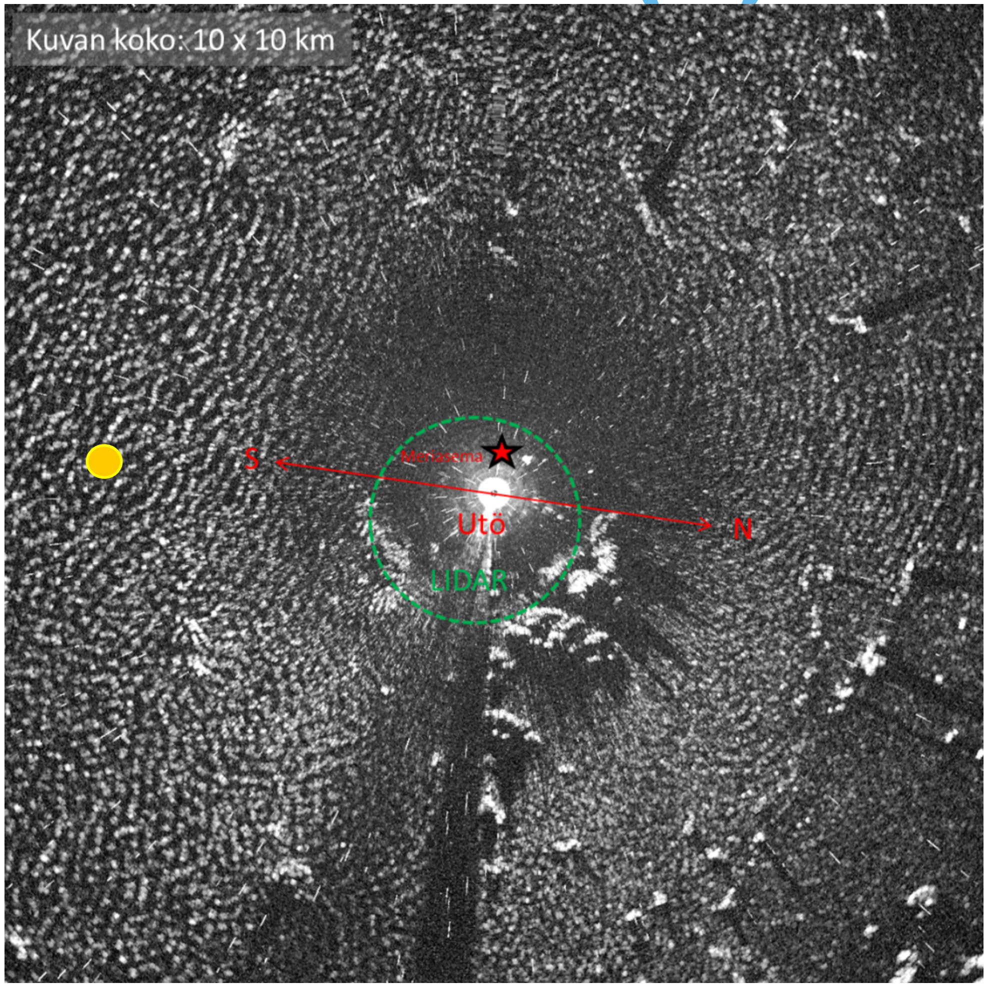


Potentential cabled buoy (tendering 05/2016) ~300 k€





3. Results (1): radar



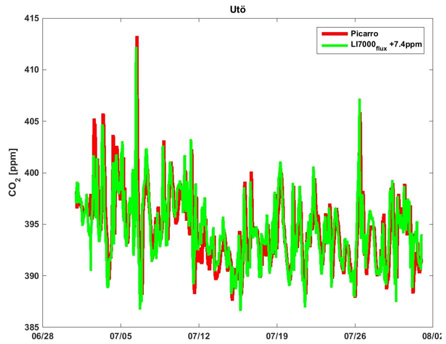
10 x 10 km

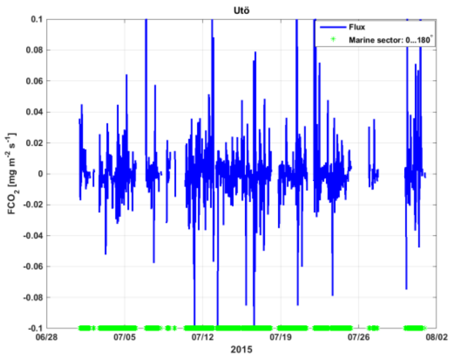
Costal radar with Ice/wave processing unit

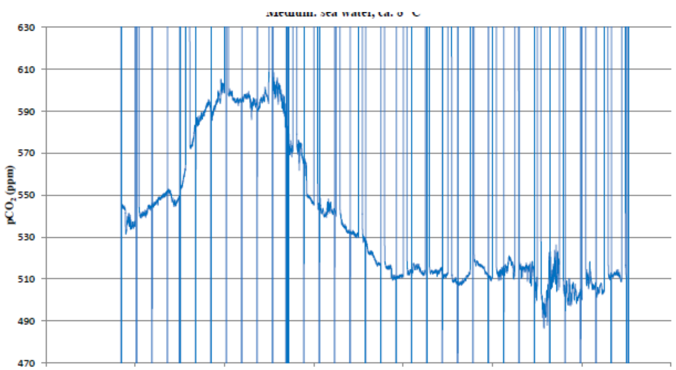
- 2 x wave buoy's and 1 x ADCP
- Camera
- 3D wind fields from HALO-lidar

Aim:
automated wave, ice and oil detection network throughout Finnish coast

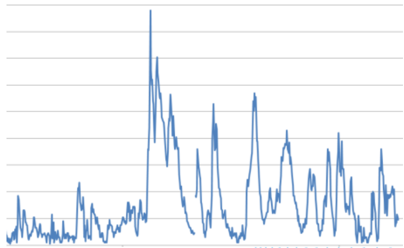
3. Results (2): carbon cycle







+ Waves, ice cover, nutrients, currents etc

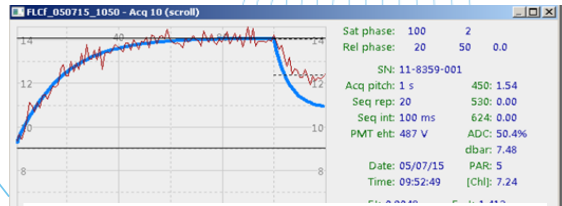


$[CO_2]$

F_{CO_2}

pCO_2

Biological carbon processes



Example of fluorescence induction curve to measure electron transport rate as an estimate for carbon production

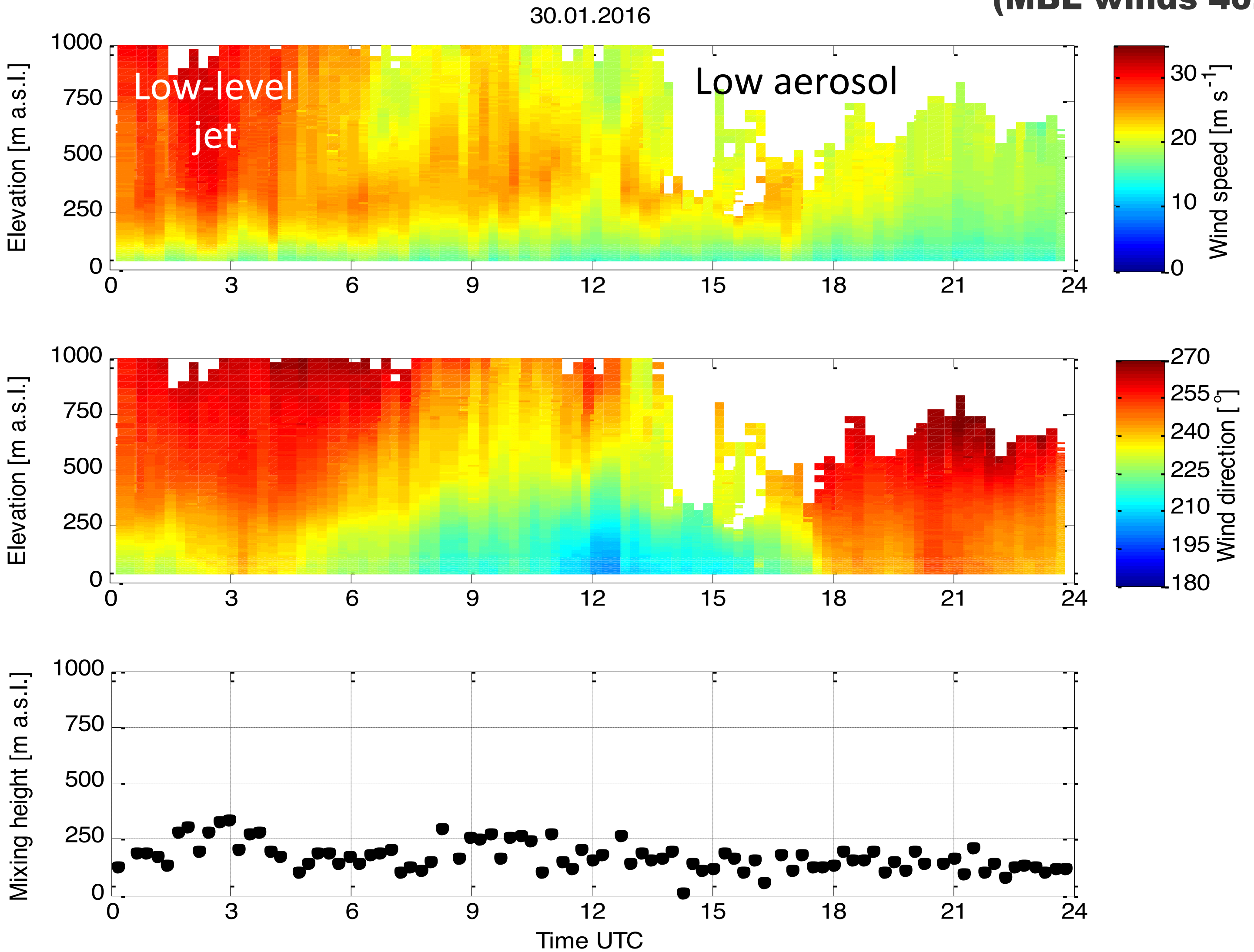
3. Results (3)

Show video

FINNISH METEOROLOGICAL INSTITUTE

3. Results (4): HALO-LIDAR

(MBL winds 40…1000m)



Low level jet

Vertical wind direction profiles

Mixed boundary layer height

4. Ongoing research projects (2014-18)

- Physics, biology and chemistry of carbon cycle (ICOS, *JERICO-NEXT, Finnish Academy)*
  → *development of combined marine BGC-models*
- Renewable energy production: waves, solar heat, PV electricity, wind (Vaisala, Nessling foundation)
- Low level jets 0…1000m (Nessling & Vaisala)
- Coastal radars: ice cover, waves, oil spills (Bonus & Image software ltd)
- Shipping emissions (e.g. Bonus)
- Underwater noise (Bonus, Finnish navy)
- Instrument development (e.g. *Meritaito Oy)*
- *ICOS, ACTRIS, EMEP, HELCOM etc.*

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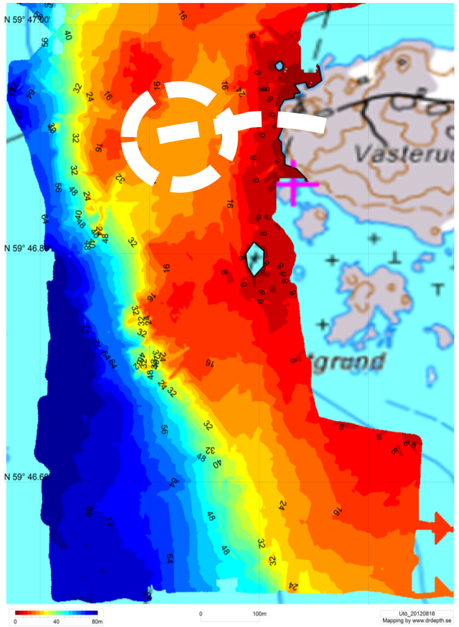
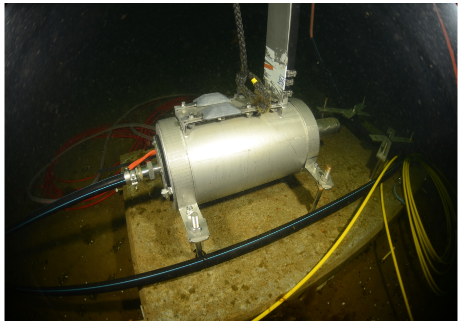
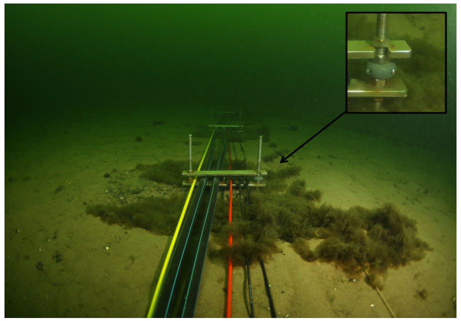
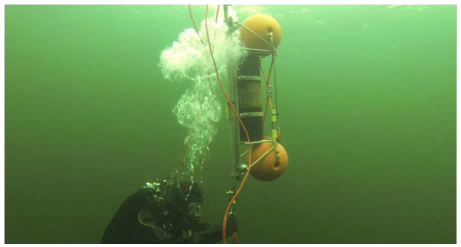








Technical questions

Issues during the installation phase

- Military area, national park: normal laws do not fully apply + a lot of support from navy
- Existing research station, optical fiber network, proper bottom shape, deep enough, west coast, building permission, ice protections for cables
- Pump with 3-phase power: noise on data signals; lightning etc.
- Archeology
- Mainly planned by me

Main operational issues.

- Serious problems with corrosion and barnacles; ice cover
- Security: difficult to get permissions for foreigners

Site maintenance .

- SOP's, one employee at the site, online data, visits ~one a month

Quality assessment

- At the moment, manual QC + weekly visits, electronic diary

Data management

- A server, currently developing python codes, ascii

Applications

- industry, shipping, navy etc

OBSEA

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3.2 Harmonizing new network systems: Cabled observatories

Presenter: Marc Nogueras email: marc.Nogueras@upc.edu

Contributor(s): Joaquin del Rio

JERICO-NEXT Cabled Observatories workshop / Vilanova I la Geltrú / SPAIN / 19th – 20th April 2016

INDEX

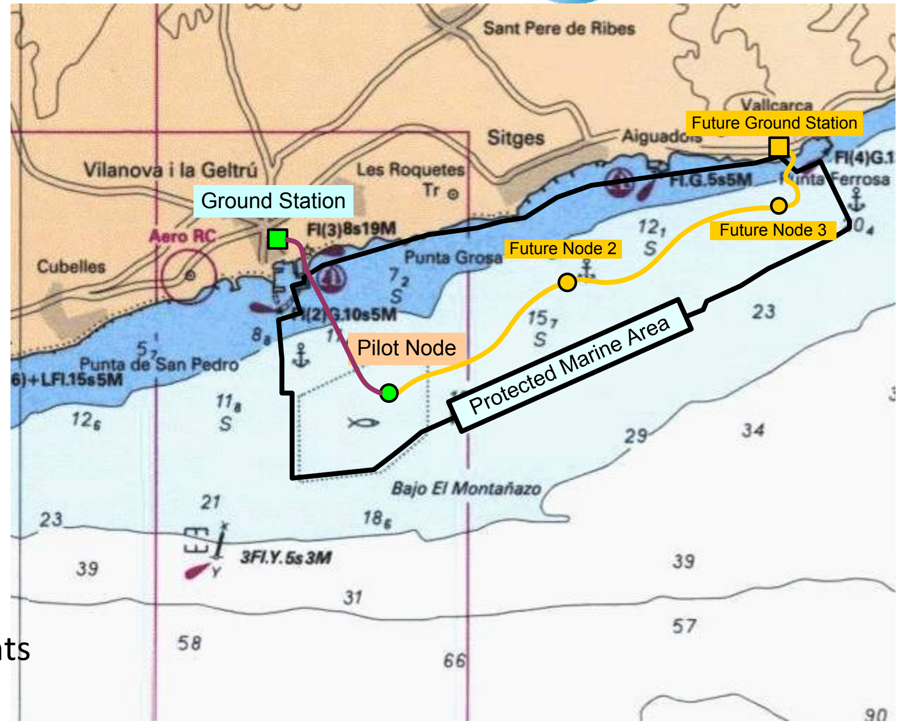
1. **Issues during the installation phase** Site Selection and Approvals; manufacturer; Environmental Concerns – Electromagnetic; Environmental Concerns – Impacts (ground, plants, animals, views); Cabled deployment, Power; Communications; …
2. **Main operational issues** Power outages and communication failures; deployment of new instruments, cabling and connectors; Security;.
3. **Site maintenance** Schedule; tasks; …
4. **Quality assessment** Automatic reporting on changes in status of stations and computer systems; Web-based database of incidents and actions; …
5. **Data management** Format; Quality control; Data processing; Data flow for dissemination
6. **Applications** Users; Areas – research, engineering, fisheries, etc-;
7. **Other items** you consider interesting in T2.3 context

1. Issues during the installation phase

1. Site Selection and Approvals
2. Manufacturer
3. Environmental Concerns
   – Electromagnetic
   – Impacts (ground, plants, animals, views)
4. Cabled deployment
   – Power
   – Communications
5. …

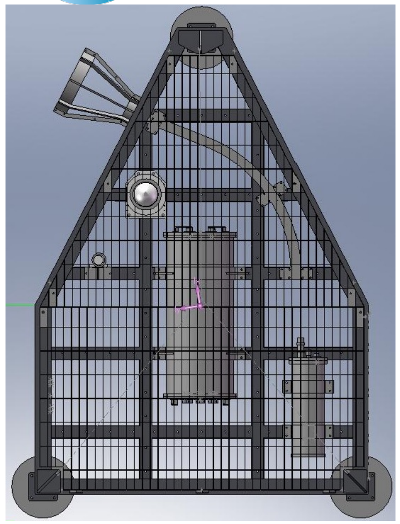
1.1. Site Selection and Approvals

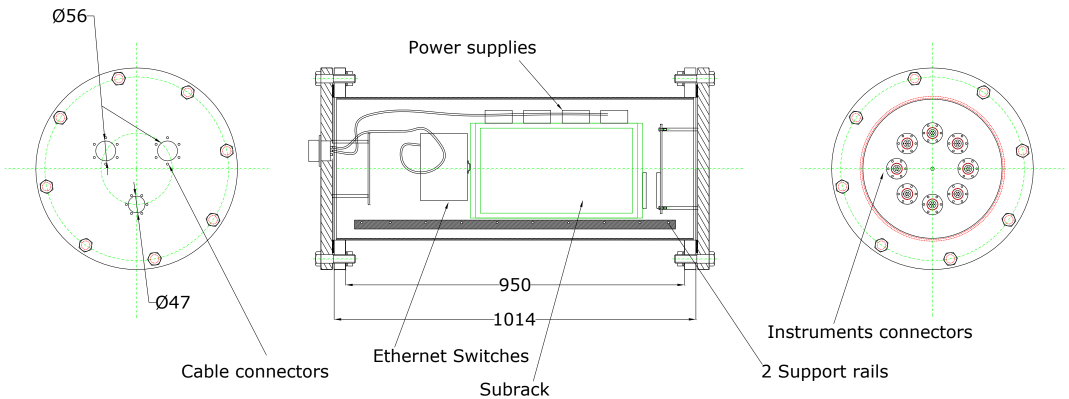
1. Protected Area
2. Operable by divers
3. Near from shore station (max 5km)
4. Lightweight structure
5. Design objectives
   – Base structure for several kinds of instruments Integration
   – Local Area Network (LAN) UDP & TCP/IP
   – High transmission capacity (1Gbps)
   – Affordable voltage Node Power Supply 300Vdc
   – Oceanographic Instruments 12 or 48 Vdc
   – Easy to transport and commissioning
   – Several instruments can be installed in the protected area
   – 5 kilometers of underwater cable given by Telefonica

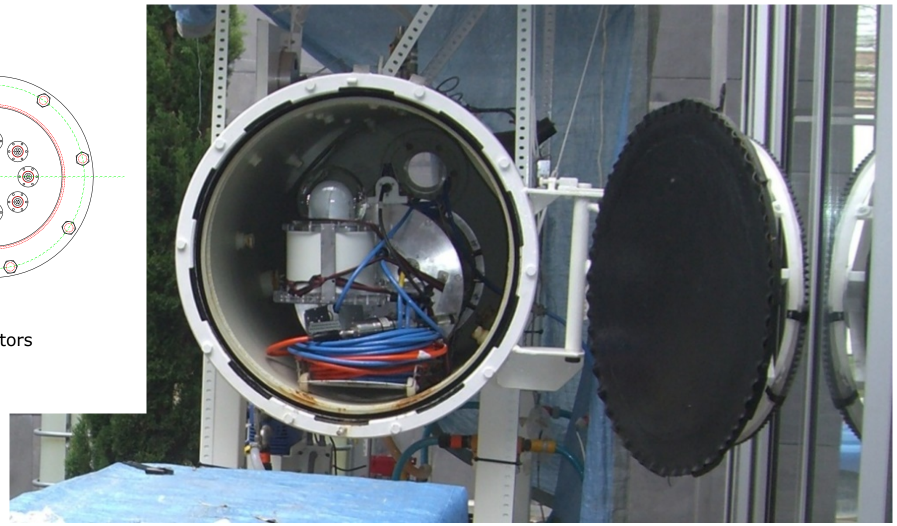


1.2. Manufacturer

- Engineered with own resources
- Manufactured by local workshops
  - STECMA, FELCO, BASTAN, Simgratec
- Most of electronics are standard modules
  - Ethernet switches, Power Supplies, subrack
- Connectors from european manufacturer
  - GISMA, Seacon, Impulse, Subconn

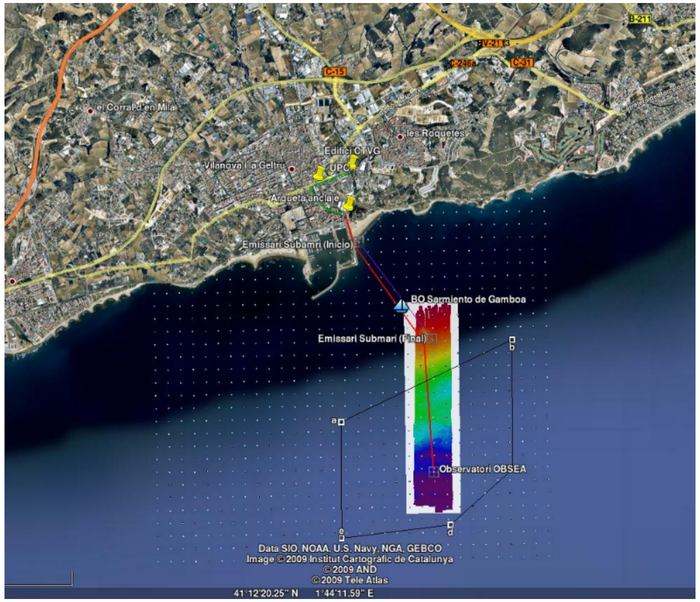






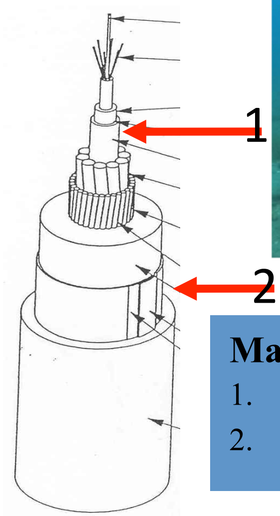
1.3. Environmental Concerns

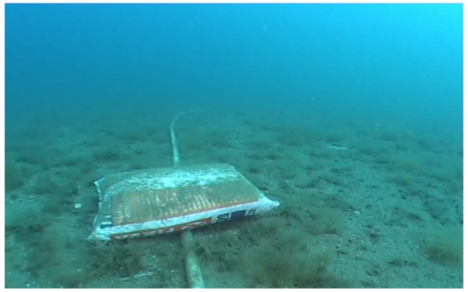
- Study of the area before the deployment
  - No vegetation can be affected
  - Cable protected in the beach with iron pipe



1.4. Cabled deployment

- ***From shore station to beach mainhole***
    - ***1 fiber optic cable***
    - ***1 power cable***
- ***From mainhole to subsea node***
    - ***1 hybrid cable***

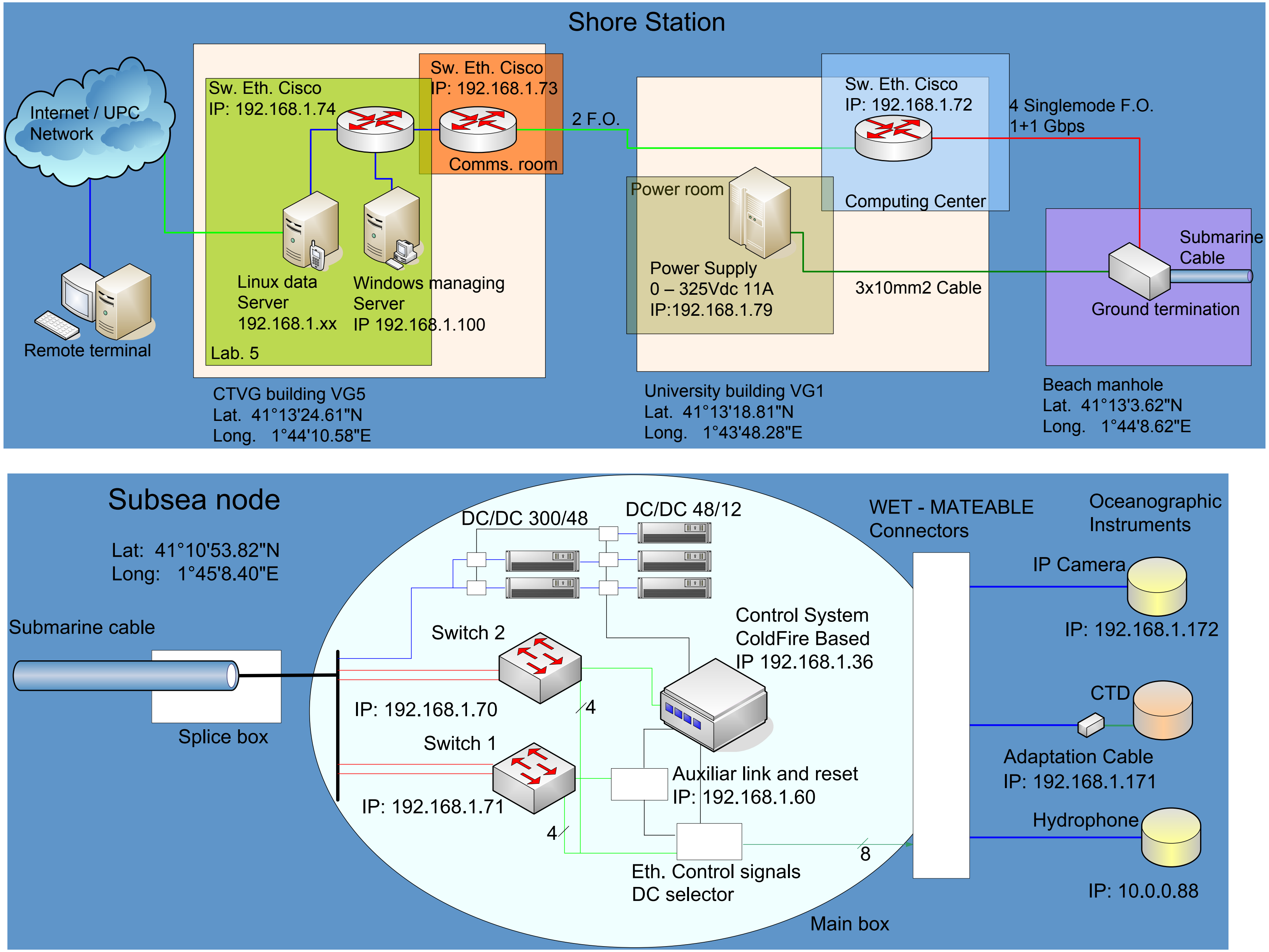




Marine hybrid cable

1. Copper tube at -300(neg)
2. Aluminum screen at 0Vdc (pos) parallel connection to ground

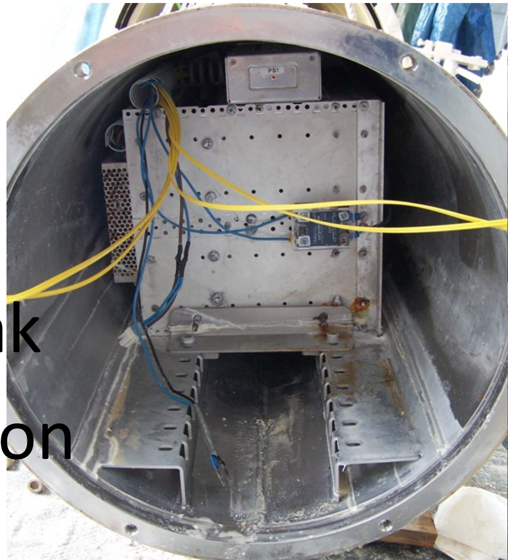
1.4. Cabled deployment



2. Main operational issues

1. Power outages and communication failures
2. Deployment of new instruments
3. Cabling and connectors
4. Security

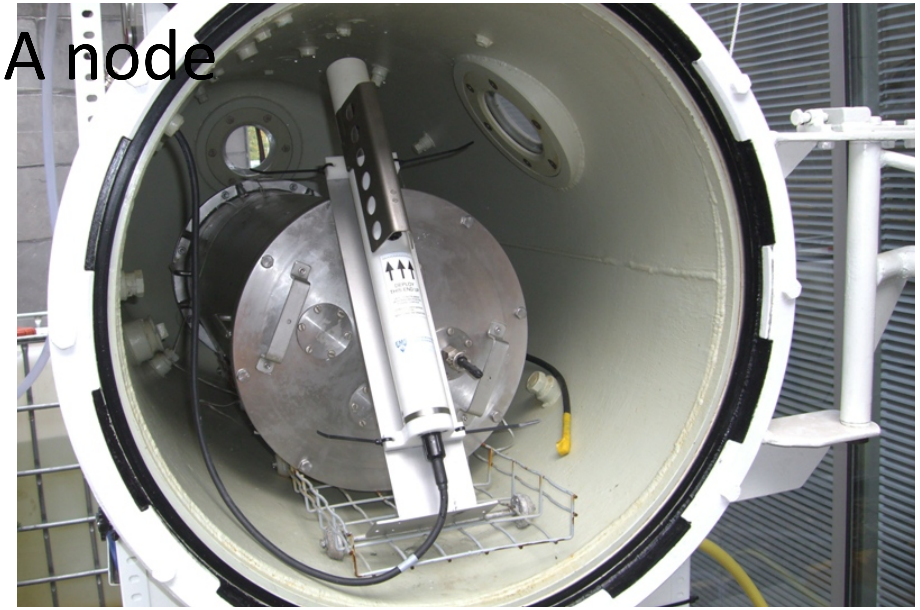
2.1. Power outages and communication failures



- Main Outages:
  - Submarine cable break
  - Junction box inundation
  - Land cable theft
- Main communication failures
  - Destruction of optical fiber eaten by rats

2.2. Deployment of new instruments

1. Design & Construction of cable adaptor
2. Test in OBSEA network
3. Test in hyperbaric chamber
4. Data integration to OBSEA Data Base if required
5. Installation in the OBSEA node



2.3. Cabling and connectors

1. OBSEA standard connector is a GISMA series 10 size 3
2. In custom instruments most used is Seacon MCIL8F / MCBH8M

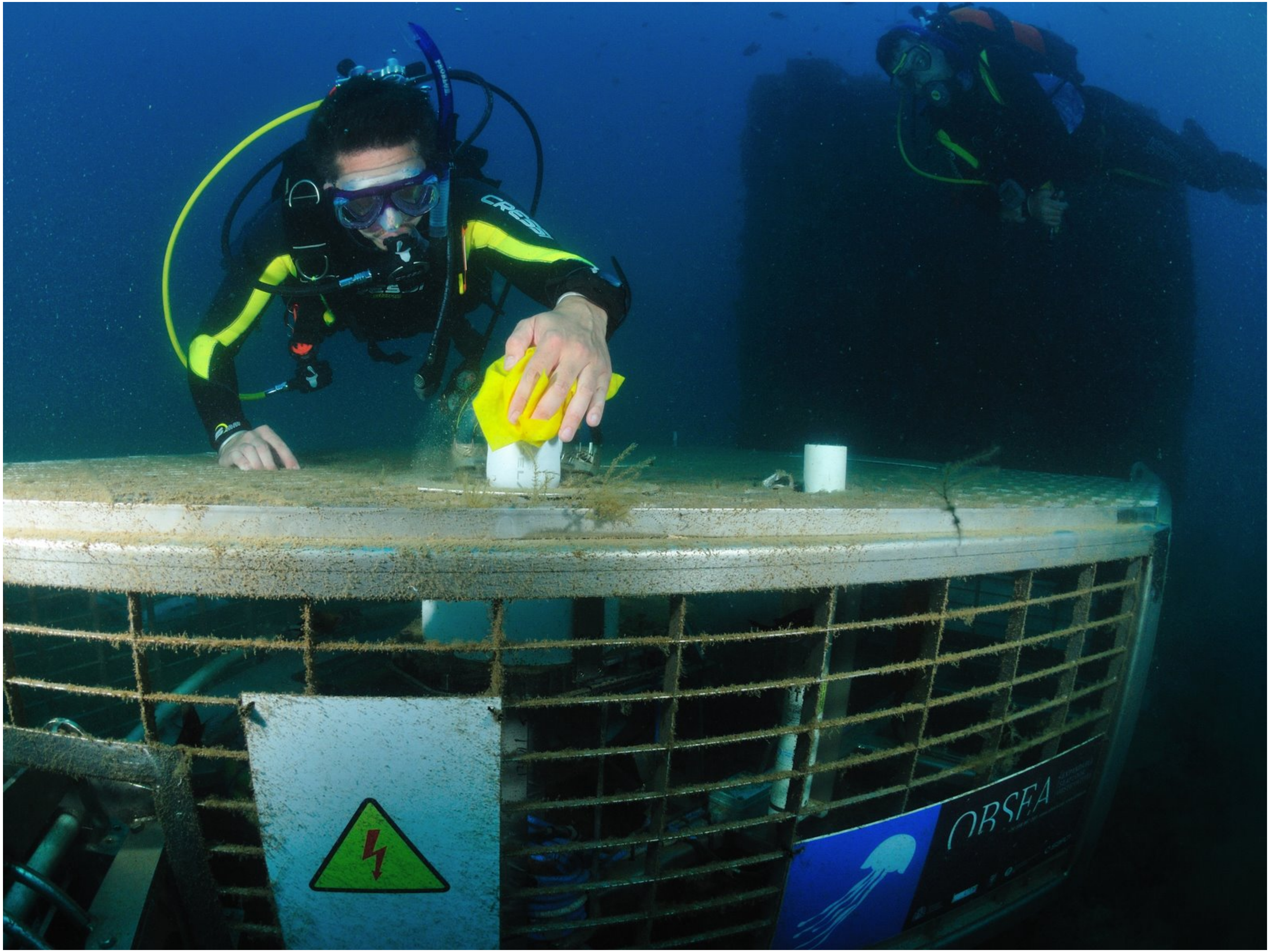
2.4. Security

- Installation partially covered by the university insurance
- At the beginning all the instruments were inside a screwed cage to minimize unauthorized manipulation
- Now we prefer easy

  access to the instruments

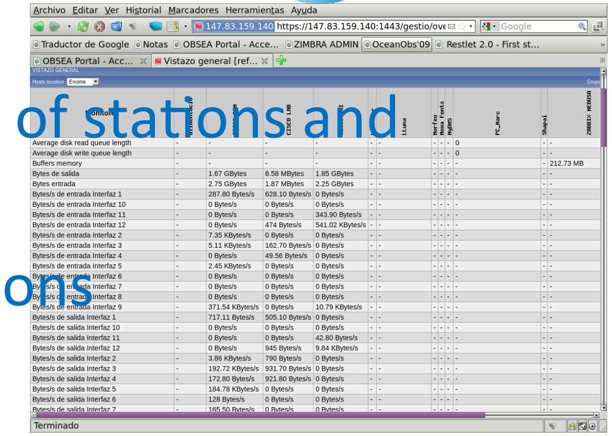
3. Site maintenance

1. Schedule
   - Immersion for inspection at least once per month
   - Maintenance of every instrument according to its fouling sensitivity
2. Tasks
   - Camera cleaning
   - Hydrophone, CTD, ADCP, seismometer visual inspection
   - Anodes inspection
   - Buoy chains, anchors, etc


OBSEA

4. Quality assessment

1. Automatic reporting on changes in status of stations and computer systems
2. Web-based database of incidents and actions



- Automatic Quality system is not fully implemented
  - Human visual inspection of received data
  - Log of instrument ports operations
  - Monitoring of main status in web based software (Zabbix)
  - Basic data quality control in some instruments

5. Data management

1. Format
2. Quality control
3. Data processing
4. Data flow for dissemination

5.1. Format

- Low rate instruments (e.g. CTD, Meteo)
  - Serial/Ethernet converter
  - Transmit of UDP packets
  - Custom software in the server to receive, decode and insert in DB
  - Developing of interoperability protocols (Puck,…)
- High rate instruments (e.g. Hydrophone)
  - Data redirected to consumer

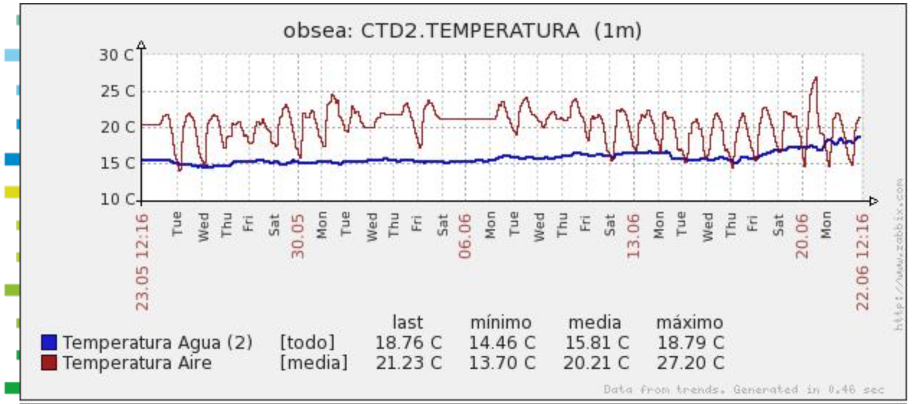
- Instruments with proprietary communication (e.g. AWAC)
  - Data received by manufacturer software and stored in files
  - Developed software to parse the files and insert data in our DB

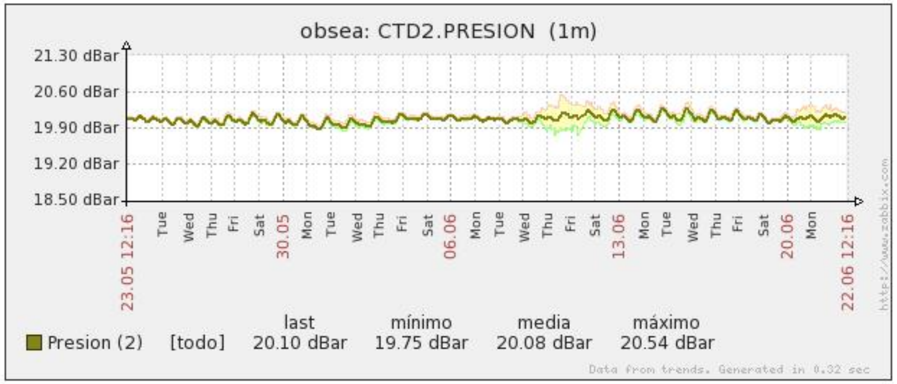
5.2. Quality control

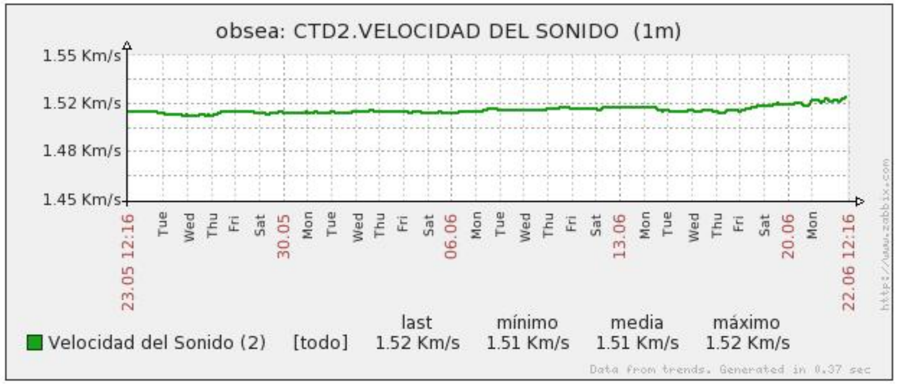
- Data monitoring with Zabbix
  - Integration of oceanographic data with engineering data
  - Easy to configure graphical views
  - Alarms for data out of range, no data, etc.
- Quality control algorithms for data transmitted to external data collectors (SOS)

Data monitoring with Zabbix

1 Year Web based charts







5.3. Data processing

- Storage in DB
- Custom Web based Data retrieval tools
- External data processing
  - Sound detections at LAB (Bioacustics Laboratory)
  - Fish counting at ICM from CSIC (Marine Sciences Institute)
  - Sediment movement studies at ICM from CSIC
  - Other studies on demand

5.4. Data flow for dissemination

- Data automatically transmitted to some clients
  - – Hydrophone -> LAB
  - – Images, currents -> ICM
  - – CTD, Meteorological -> SOS
  - – Metereological -> Meteoclimàtic

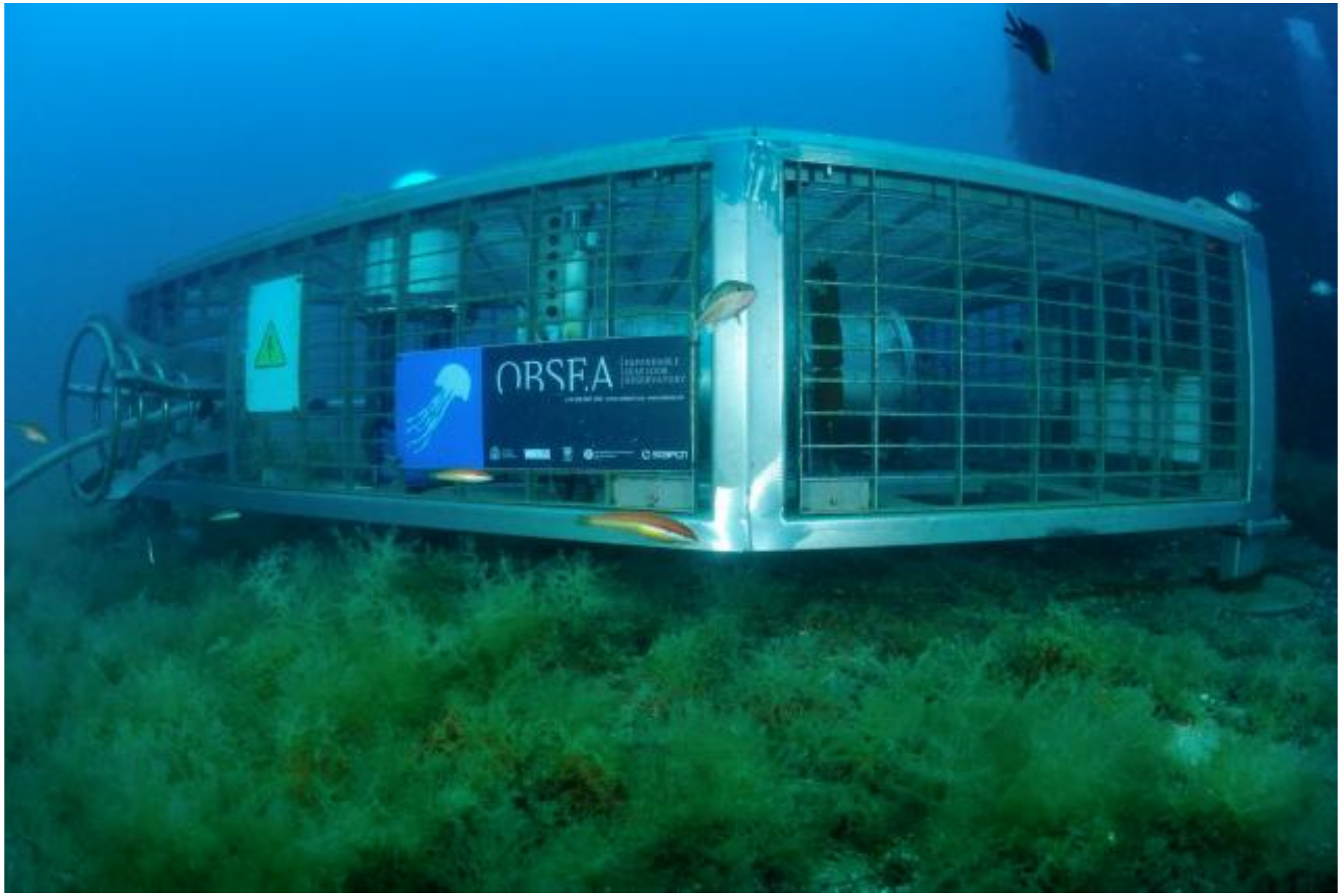
6. Applications

1. Users
   - LAB
   - ICM – CSIC
   - On demand
2. Areas
   - Research
   - Engineering

7. Other items

1. Interesting things

Thanks for your attention



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654410.

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3.2 Harmonizing new network systems: Cabled observatories

Galway Bay MARETS

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3.2 Harmonizing new network systems: Cabled observatories

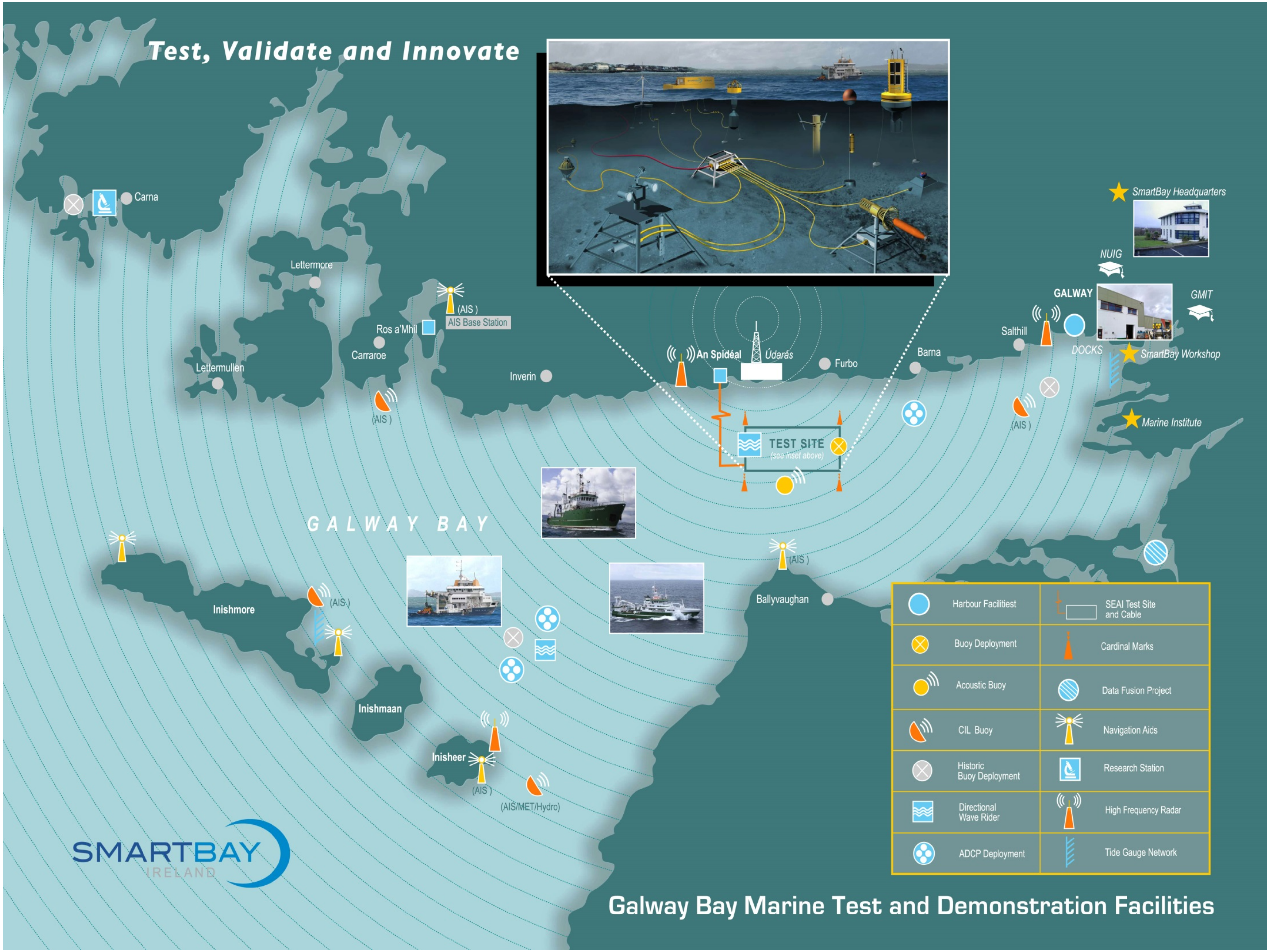
Presenter: **Rogério Chumbinho** email: **rogerio.chumbinho@smartbay.ie**

Contributor(s): SmartBay team

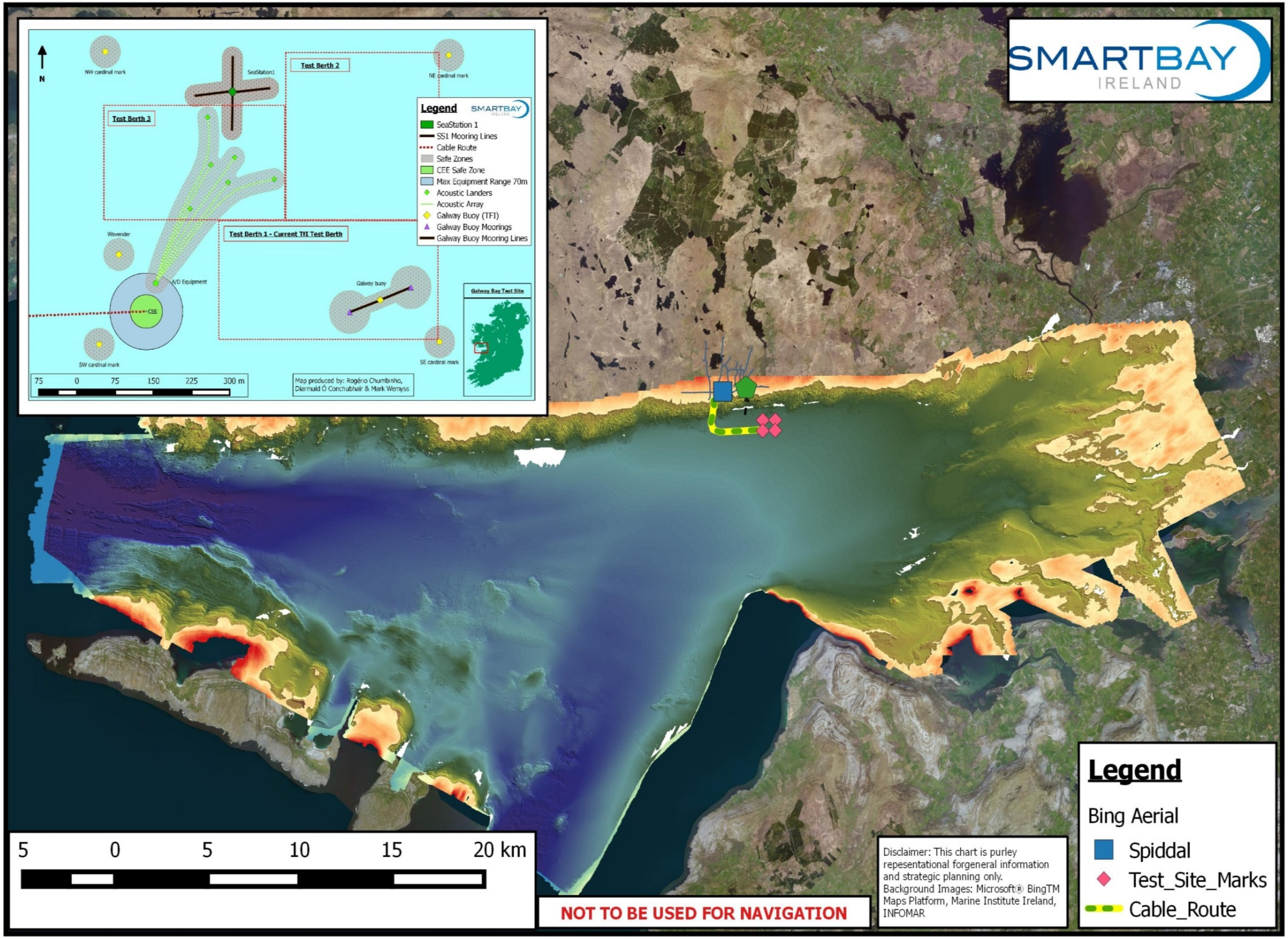
JERICO-NEXT Cabled Observatories workshop / Vilanova I la Geltrú / SPAIN / 19th – 20th April 2016

Summary

1. **Issues during the installation phase** Site Selection and Approvals; manufacturer; Environmental Concerns – Electromagnetic; Environmental Concerns – Impacts (ground, plants, animals, views); Cabled deployment, Power; Communications; …
2. **Main operational issues** Power outages and communication failures; deployment of new instruments, cabling and connectors; Security;.
3. **Site maintenance** Schedule; tasks; …
4. **Quality assessment** Automatic reporting on changes in status of stations and computer systems; Web-based database of incidents and actions; …
5. **Data management** Format; Quality control; Data processing; Data flow for dissemination
6. **Applications** Users; Areas – research, engineering, fisheries, etc-;
7. **Other items** you consider interesting in T2.3 context



Test, Validate and Innovate
SmartBay Headquarters
NUIG
GALWAY
GMIT
DOCKS
SmartBay Workshop
Marine Institute
Salthill
Barna
Furbo
Údarás
An Spidéal
Inverin
Carraroe
Ros a'Mhíl
(AIS)
AIS Base Station
Lettermore
Lettermullen
Carna
TEST SITE
(see inset above)
GALWAY BAY
Ballyvaughan
Inishmore
Inishmaan
Inisheer
(AIS)
(AIS/MET/Hydro)
SMARTBAY
IRELAND
Harbour Facilitiest
SEAI Test Site and Cable
Buoy Deployment
Cardinal Marks
Acoustic Buoy
Data Fusion Project
CIL Buoy
Navigation Aids
Historic Buoy Deployment
Research Station
Directional Wave Rider
High Frequency Radar
ADCP Deployment
Tide Gauge Network
Galway Bay Marine Test and Demonstration Facilities


N
NW cardinal mark
SeaStation1
Test Berth 2
NE cardinal mark
Test Berth 3
Legend
SMARTBAY IRELAND
SeaStation 1
SS1 Mooring Lines
Cable Route
Safe Zones
CEE Safe Zone
Max Equipment Range 70m
Acoustic Landers
Acoustic Array
Galway Buoy (TFI)
Galway Buoy Moorings
Galway Buoy Mooring Lines
Test Berth 1 - Current TfI Test Berth
Waverider
A/D Equipment
Galway buoy
Galway Bay Test Site
CEE
SW cardinal mark
SE cardinal mark
75 0 75 150 225 300 m
Map produced by: Rogério Chumbinho, Diarmuid Ó Conchubhair & Mark Wemyss
SMARTBAY IRELAND
5 0 5 10 15 20 km
NOT TO BE USED FOR NAVIGATION
Disclaimer: This chart is purley repesentational forgeneral information and strategic planning only.
Background Images: Microsoft® BingTM Maps Platform, Marine Institute Ireland, INFOMAR
Legend
Bing Aerial
Spiddal
Test_Site_Marks
Cable_Route

1. Issues during the installation phase

1. The observatory is part of the Galway Bay Marine And Renewables Test Site (GB MARETS)
2. The approval process was included in the overall Test Site selection, consenting, environmental assessment, archeological assessment, and licensing aimed at Ocean Energy Conversion (OEC) devices
3. Consequently, no major consenting issues except:
    1. Cable route – impact on fishing grounds (local fishermen)
    2. Observatory site – possible impact on shrimp grounds

1. Issues during the installation phase

4. The cable was laid in phases:
    1. Shore Station to Spiddal Pier end (2014)
    2. Spiddal Pier end to Test Site (April 2015) – RV Celtic Explorer temporarily fitted with cable laying equipment
5. Cable was reinforced with armour shells and rocks in the first 30m from the pier, and then buried in the seabed (to 60cm)
6. All junctions and cable sections checked for losses and proper connectivity all along

1. Issues during the installation phase

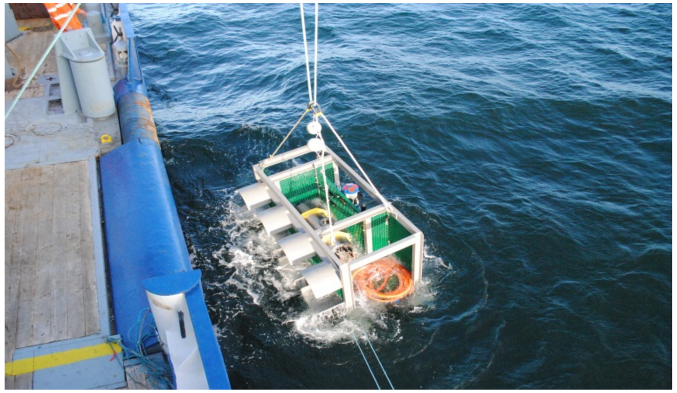
7. It has been found recently that some of the rocks and armour shells have been removed by currents / waves, leaving the cable exposed close to the end of the pier
8. The Cable Termination Unit (CTE) with two underwater mateable connectors was laid together with the last section of the cable
9. The Cable End Equipment (CEE) was deployed four months later

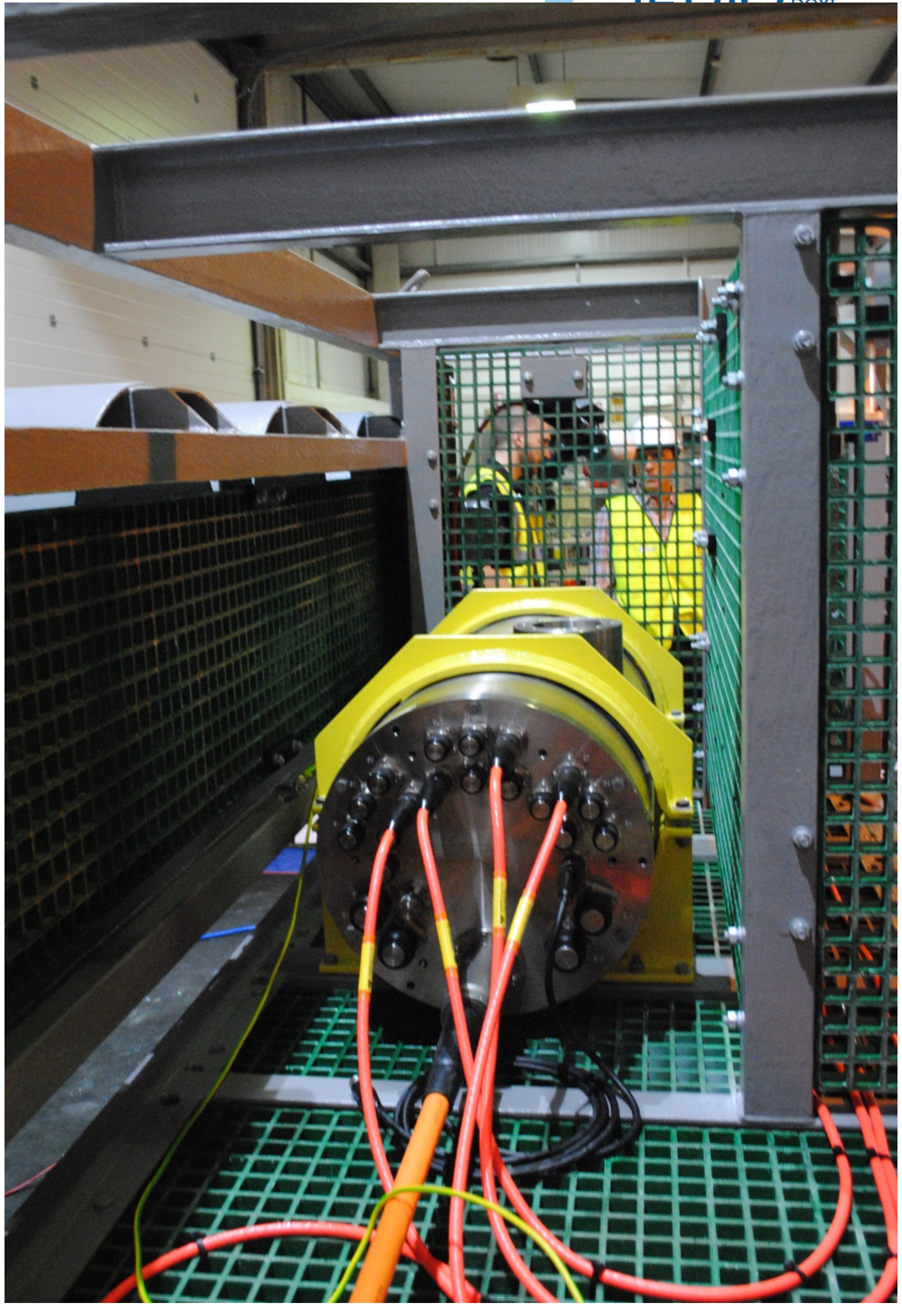
1. Issues during the installation phase

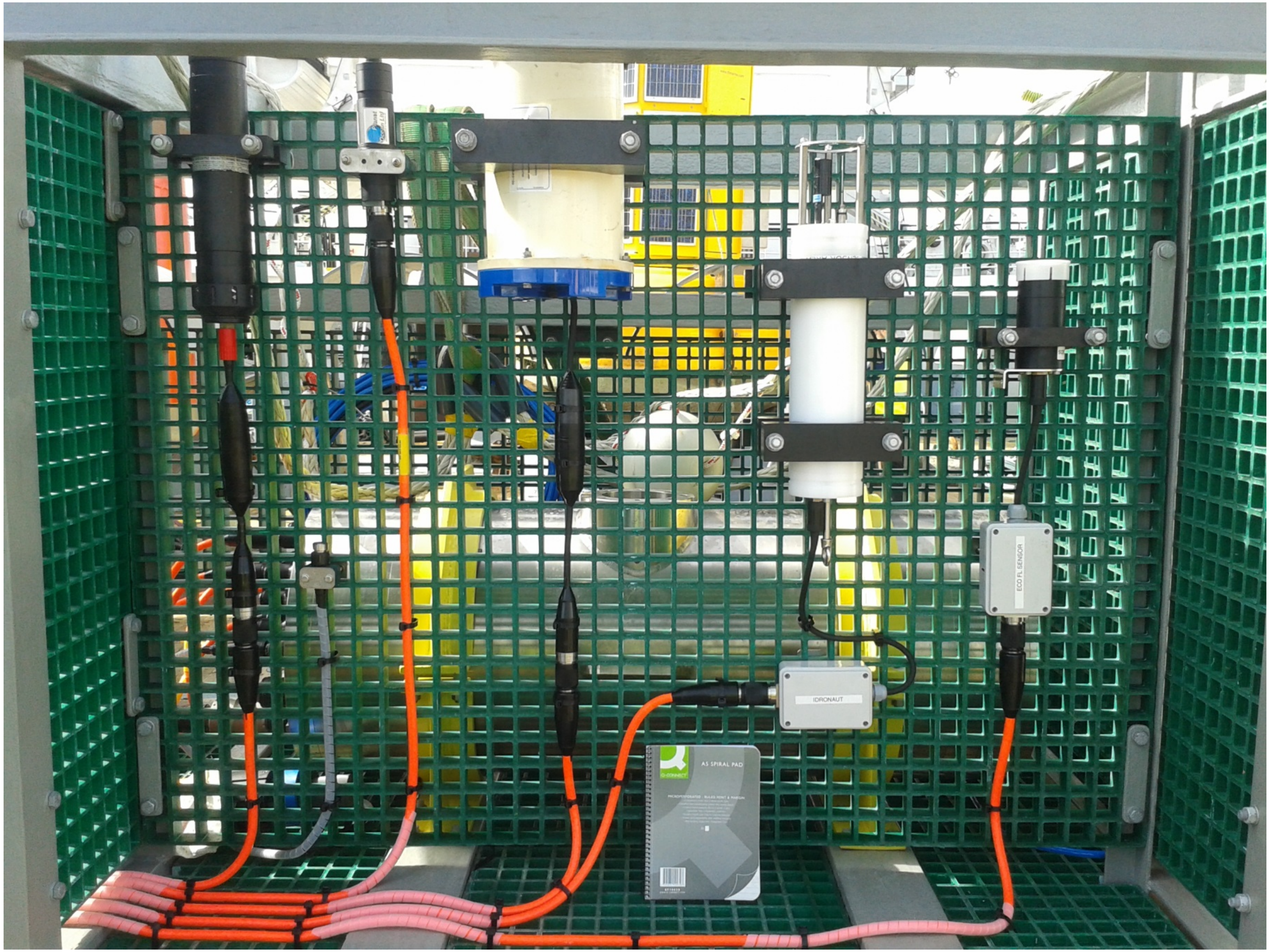
10. **During testing of the CEE (before deployment) a number of issues were found and solved:**
    1. **Underwater lamps did not work properly**
    2. **Reversal of polarity on all adapter whips power terminals**
    3. **Planned position for the underwater camera turned out to be not adequate**
    4. **Settings on CEE power boards**

JERICO next


TRIPLEX
TRIPLEX






ECO FL SENSOR
IDRONAUT
A5 SPIRAL PAD

2. Main operational issues

1. Power outages
    1. System has been down three times, although there is a UPS in place (problems in PFEs)
2. No UM connectors installed yet – No possibility of installing new instruments or service failed instruments without lifting the underwater node
3. The test site has been equipped with a surveillance camera from shore, and an AIS receiver will be installed shortly

3. Site maintenance

1. Observatory – underwater node planned to be lifted once a year at most
2. Periodic visits by divers to clean camera and instruments – in the future, eventual installation of other instruments
3. First node lift planned for this summer:
    1. Install underwater lights
    2. Replace instruments that need calibration / service
    3. Install anti-fouling for the camera
    4. Install UMEC and spare electrical cables
    5. Install one (or more) hybrid cables for WEC

4. Quality assessment

1. Continuous monitoring of status by NMS
   1. Automatic recording of events
   2. Automatic generation of alerts
2. Event database kept in its own server in the shore station, powered by the UPS
3. It is possible to determine the conditions of the observatory equipment up to the moment of failure
4. Status of equipment deployed is checked as well (manually during business hours)

5. Data management

1. Still on-going task, but the following has been achieved
    1. Data collected “continuously” from instruments (i.e., at high sampling rates) in an automatic fashion
    2. Data is not converted to any standard common format, but kept “raw” in the native instrument format; no quality control performed yet
    3. Timestamp applied to data from equipment without RTC
    4. Data stored in a fileserver; directories being made available in the net via FTP or HTTP
    5. Metadata stored in SQLServer database

6. Applications

1. Users of the observatory:
   1. Irish researchers through NIAP grants or other grants for specific research projects
   2. WEC developers
   3. General public (camera, visual feeds)
   4. Data from standard set of instruments is made publicly available, supporting any suitable project
   5. Irish state bodies, such as Inland Fisheries (fish tags detection project) or SEAI (through support to WEC developers)
   6. Facility listed for TNA

7. Other items

1. Recently installed, so still in the learning curve and observing best practices in other observatories
    1. Ex: FixO3 TNA project with OBSEA
2. Major issue with bio-fouling
3. Major issue with cost of operations (being within a test site for WEC means a lot of surface and subsurface equipment being moved about – precise positioning required)
4. Major issue with acoustic noise generated, affecting hydrophone data collection

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WP2: Harmonisation of technologies and methodologies: technical strategy (NA)
Task 2.3.2 Harmonizing new network systems: Cabled observatories

Coastal Observing System for Northern and Arctic Seas (COSYNA): Underwater Node Helgoland

COSYNA

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3.2 Harmonizing new network systems: Cabled observatories

Presenter: Philipp Fischer (Alfred-Wegener-Institut, Helmholtz Centre for Polar- and Marine Research - philipp.fischer@awi.de

Contributor(s): Wilhelm Petersen, Holger Brix, Burkard Baschek (Helmholtz Centre Geesthacht), Reiner Loth (Loth engeneering), Micha Boer (4HJena).

INDEX

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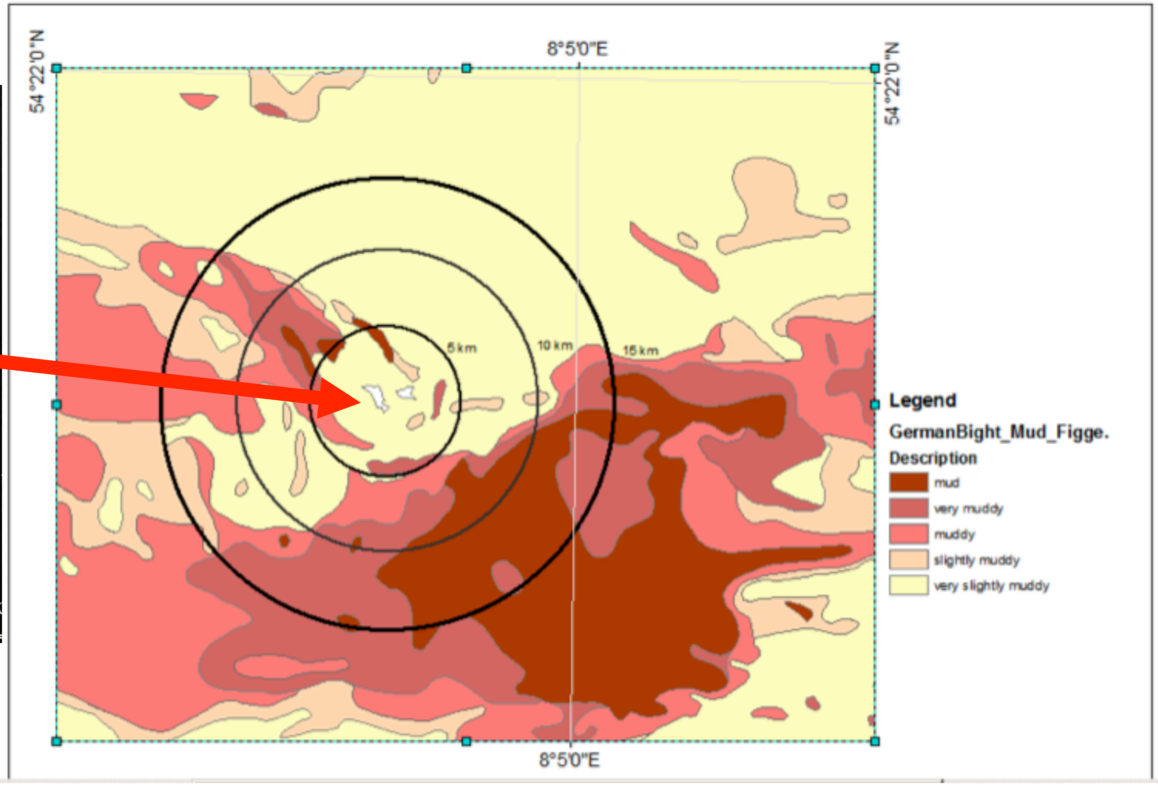
1. Issues during the installation phase

Site Selection and Approvals (criteria for site selection):

- Must be a relevant for the North Sea. Site should be in the proximity of different “typical” North Sea habitats / sediment provinces.



1. Issues during the installation phase

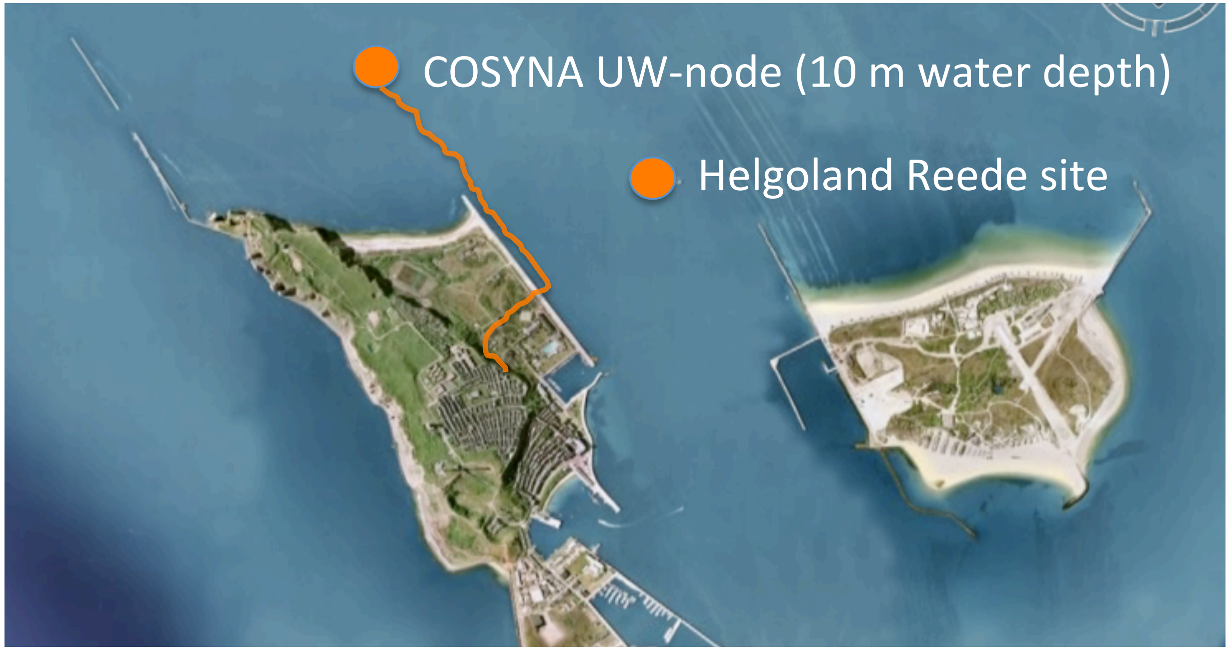
Site Selection and Approvals (criteria for site selection):

- Must be a relevant for the North Sea. Site should be in the proximity of different “typical” North Sea habitats / sediment provinces.

1. Issues during the installation phase

Site Selection and Approvals (criteria for site selection):

- Should be in close distance to our “long term” measuring station “Helgoland Reede” where data are taken since 1889 in a continuous time series.
- Should be easy accessible by divers for system management and maintenance



1. Issues during the installation phase

Site Selection and Approvals (criteria for site selection):

- Should be in an area where many research groups work together already.

Survey about research groups which are potentially interested in such a facility:

- Six research groups from the AWI.
- Three research groups from the HZG.
- Four external institutes.

General Idea of a "Coastal Observation Network"

1. Issues during the installation phase

Manufacturer

- The system we planned was not available on the market. Therefore we looked for cooperation partners in the industry (medium sized enterprises) and developed the system together with them.

4H-Jena, Jena, Germany	Loth Engineering, Wiesbaden, Germany
Hardware and Electronics	Software and Networking

1. Issues during the installation phase

Environmental Concerns: none

Environmental Concerns – Impacts (ground, plants, animals, views):

- According to German environmental regulations, a professional environmental expertise on the potential impact of the system was ordered by an environmental consultant.

  -> **Result:** The impact of the system is lower compared to the expected knowledge gain from such a permanent observatory.

- We had to applied for site approval by the German authorities for ship traffic and waterways.

  -> **Result:** The site was approved and is now marked as "exclusion zone for ship traffic" in the official sea charts from the German Bight.

1. Issues during the installation phase

Cabled deployment:

- According to German environmental regulations, a professional environmental expertise on the potential impact of the cable was ordered by an environmental consultant.

  -> **Result:** The impact of the system is lower compared to the expected knowledge gain from such a permanent observatory.

- Getting the right cable was a challenge with respect to the price and the durability. Three different offers were requested from different companies.

  -> We finally used a heavy duty and armed (Kevlar) sea-cable with 6 separate power and three separate fiber-optic lines (about 20 000 € x km).

1. Issues during the installation phase

Power:

- Because the node system is constructed for a potential operational range of 30 km, we use 1000V DC as main power supply via the cable.
- In the node system, we convert this to 48V.
- The system has an internal power supply (USV-48V) allowing to switch off the main power for about 5-8h for maintenance by divers.

Communications:

- We use
  1. Fiber-optic and TCP/IP communication for long distance (> 70m) communication (Land station to the node).
  2. Cooper and TCP/IP communication for short distance communication (< 70m) (Node to the Lander/Sensors systems).
  3. All other communication protocols (RS232, 422, USB etc. etc.) to attach sensors to the Lander systems/Sensor carriers.

2. Main operational issues

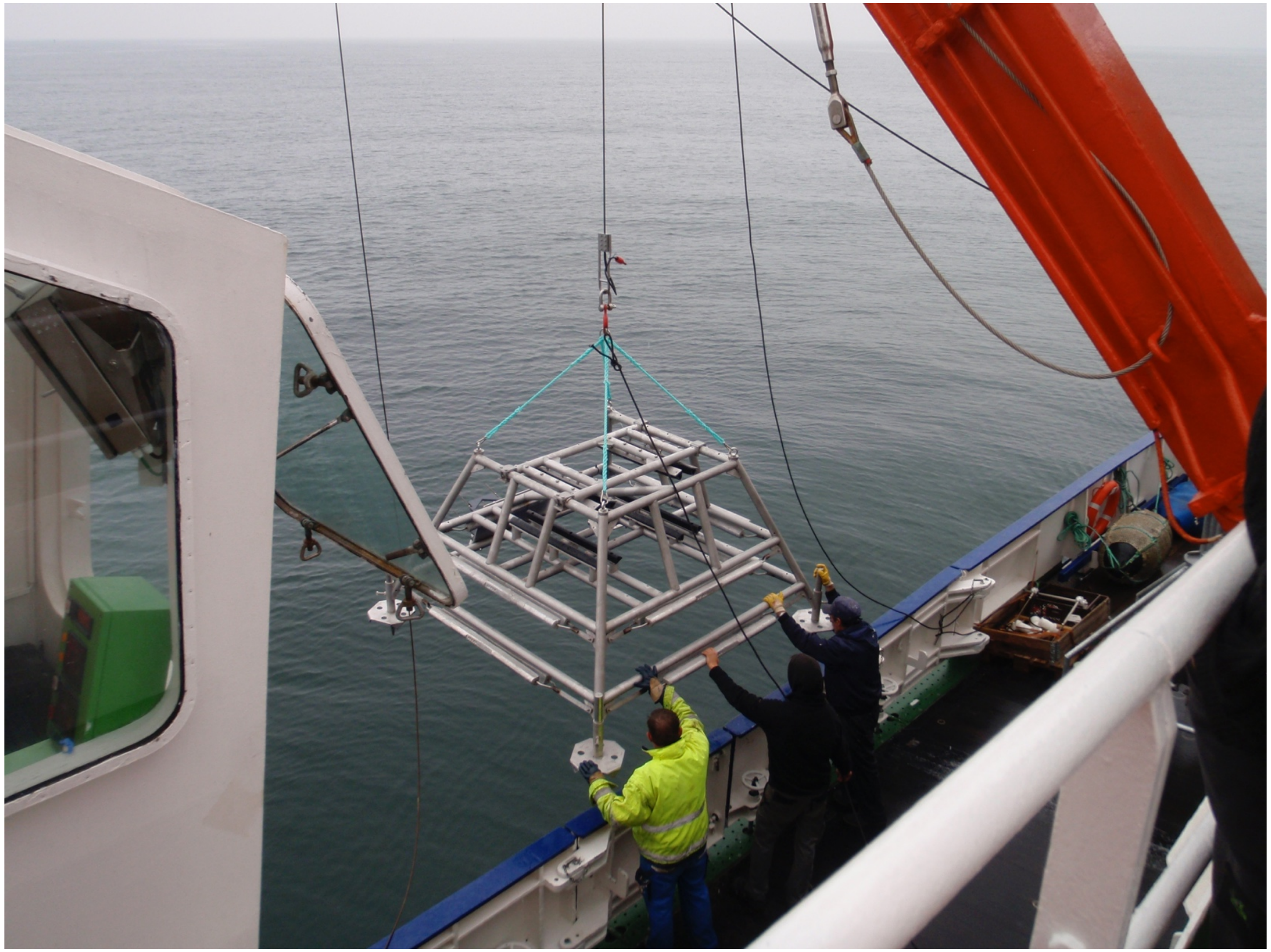
Power outages and communication failures;

- System is operated with 1000V DC and is shut down during maintenance by divers.
- Can be operated in USV mode for at least 3-4 hours with 48V (German/EU safety regulations allow 60V DC when divers are operating at the system).

Deployment of new instruments;

- Deployment of new sensors is done by divers according to a strict procedure.
    1) System has to pass a test-run in the lab for demonstrating the general functionality of the hard and the software.
    2) System has to pass a test-run in our indoor test basin (3 m deep, 3x3m base dimension) for 24h.
    3) Depending on the complexity of the instruments, the deployment takes fe hours to days.

2. Main operational issues

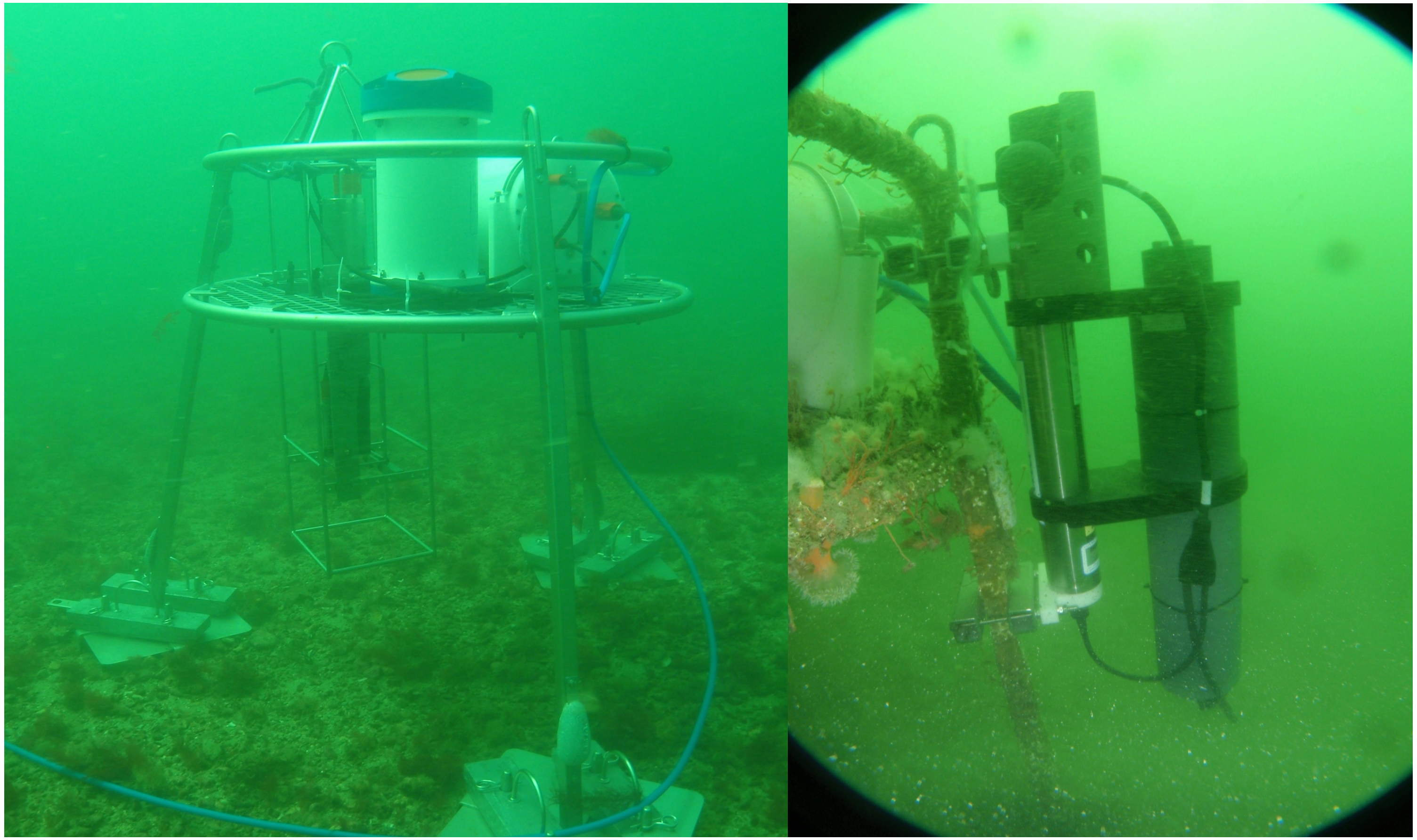


2. Main operational issues

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3.2 Harmonizing new network systems: Cabled observatories

2. Main operational issues



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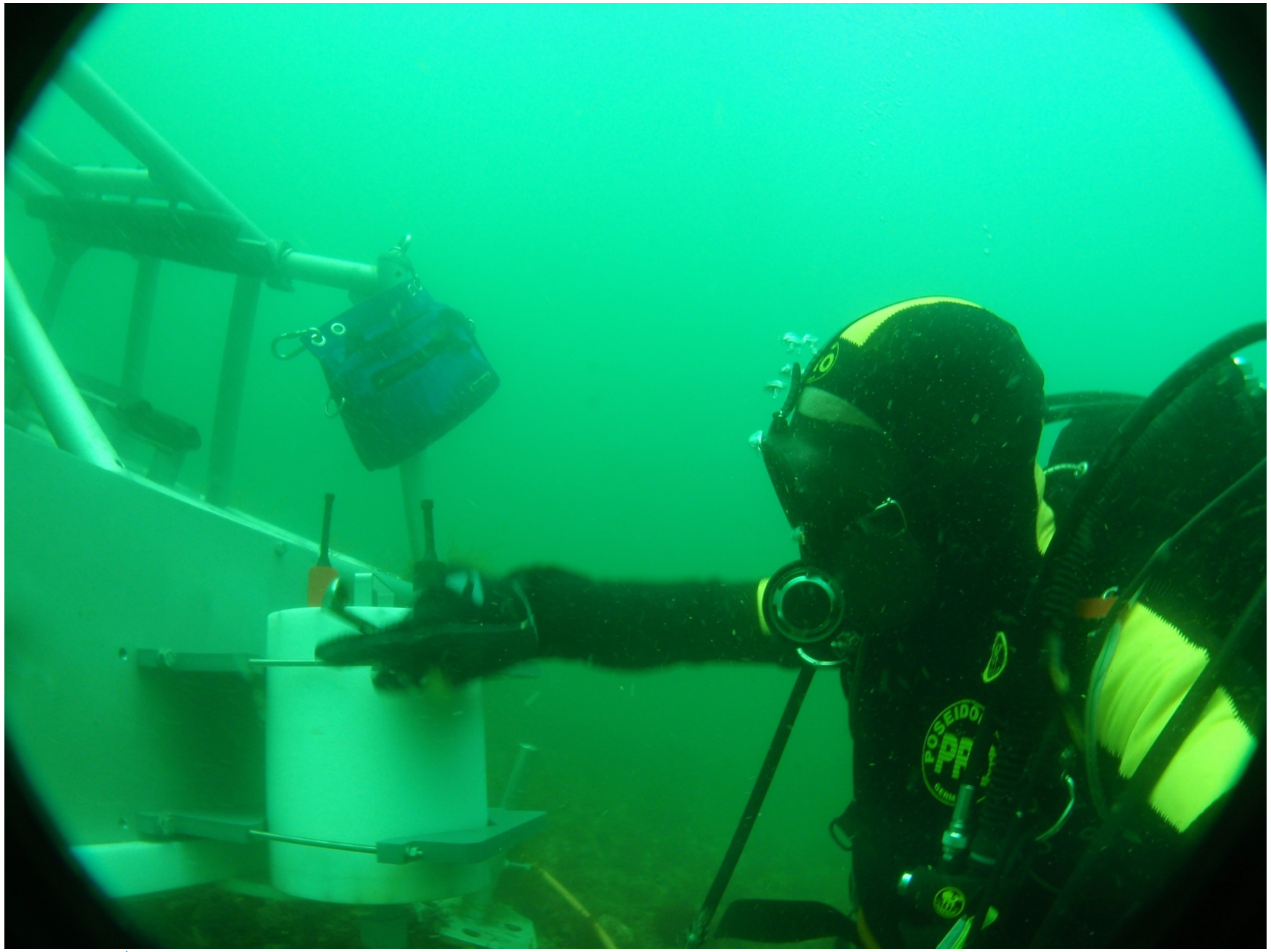
Task 2.3.2 Harmonizing new network systems: Cabled observatories

2. Main operational issues



2. Main operational issues

Cabling and connectors;

- Long-distance: Power / Fiber optic underwater cable Kevlar armed.

- Short distance: Subconn hybrid Network/Power cables (max. 70m)

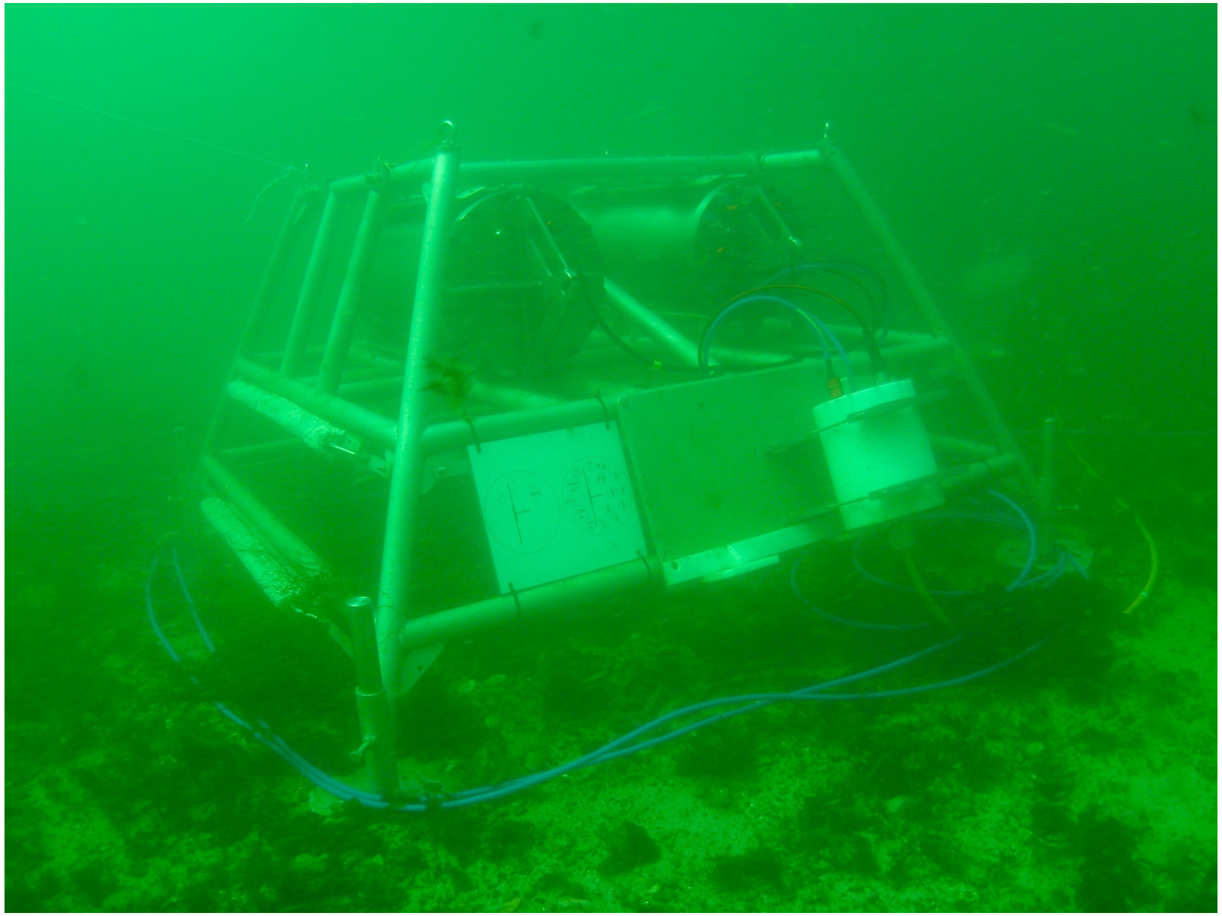
- Sensor connection: Depending on the sensor manufacturer. Required cables are produced (configured) in our workshop.

Specific procedures for cables and plugs

- Male connectors at fixed installations under water.
- Female connectors for the (removable!) cables.
- Proper greasing is mandatory for proper functioning of the plugs.

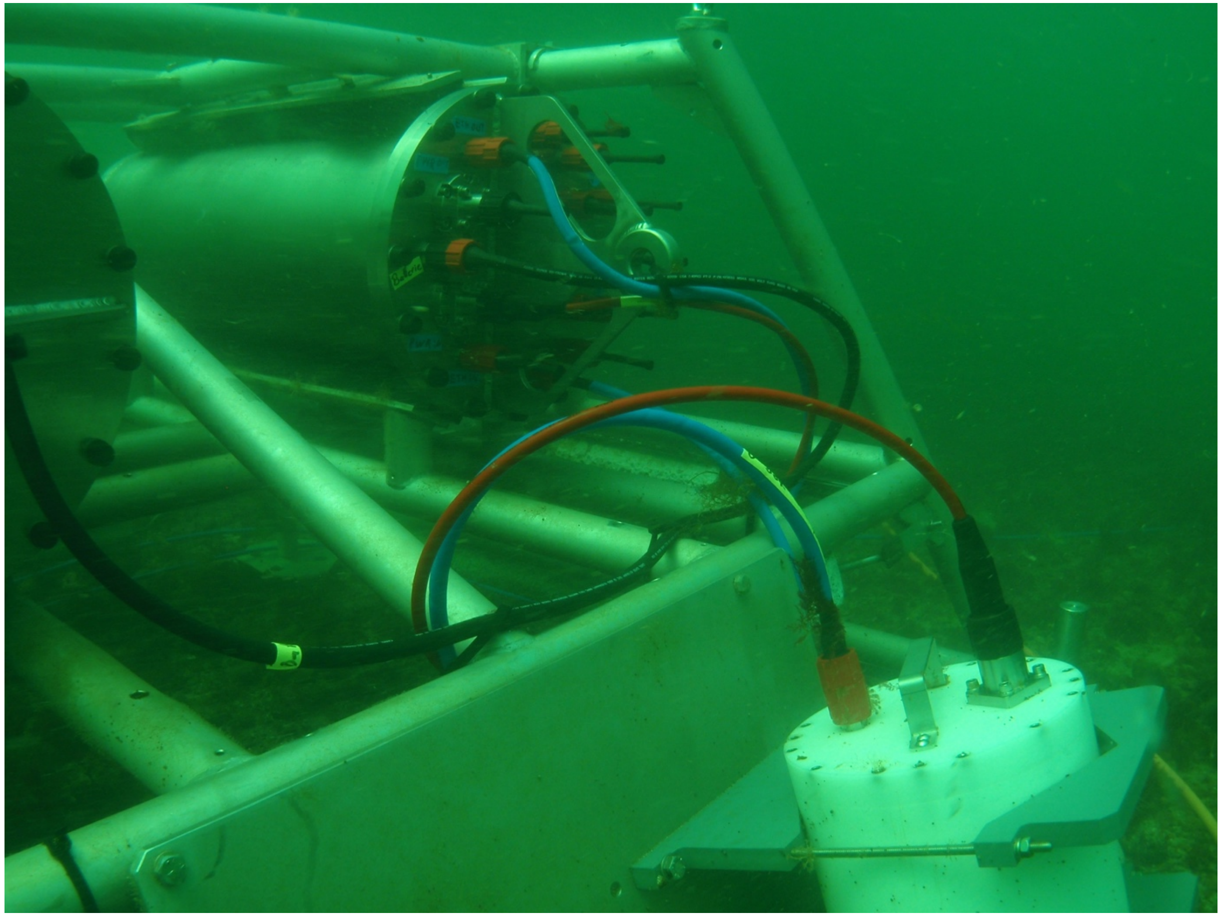
2. Main operational issues

Cabling and connectors;



2. Main operational issues

Cabling and connectors;



2. Main operational issues

Cabling and connectors;

2. Main operational issues

Cabling and connectors;

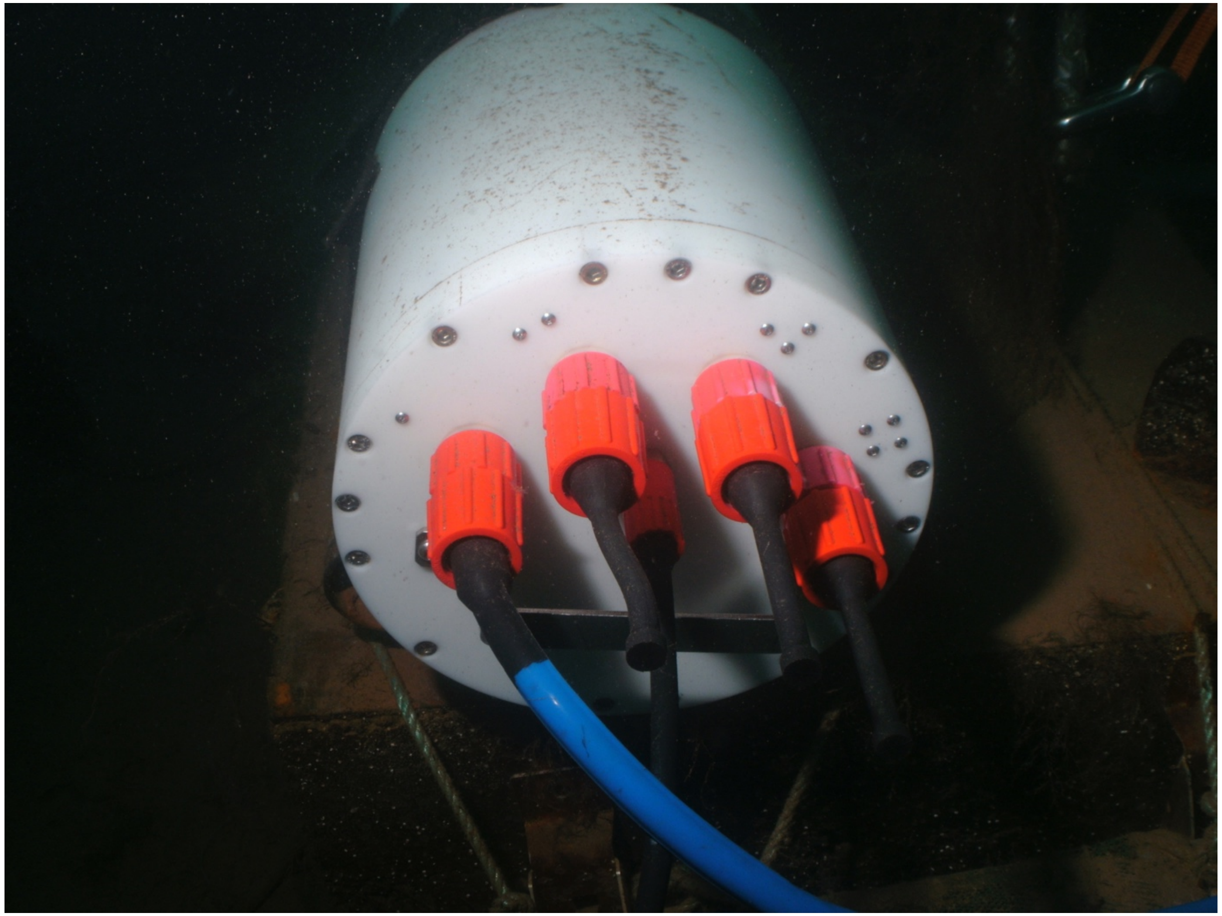
2. Main operational issues

Cabling and connectors;

- It is absolutely mandatory to use the proper grease before wet-mating the plugs.
- Without or with the wrong grease , the average lifetime of our 1000V was about 3 month, that of out 48V plugs about 6-8 month.
- Since we use the proper grease, we have not a single problem with our plugs since about 2.5 years.

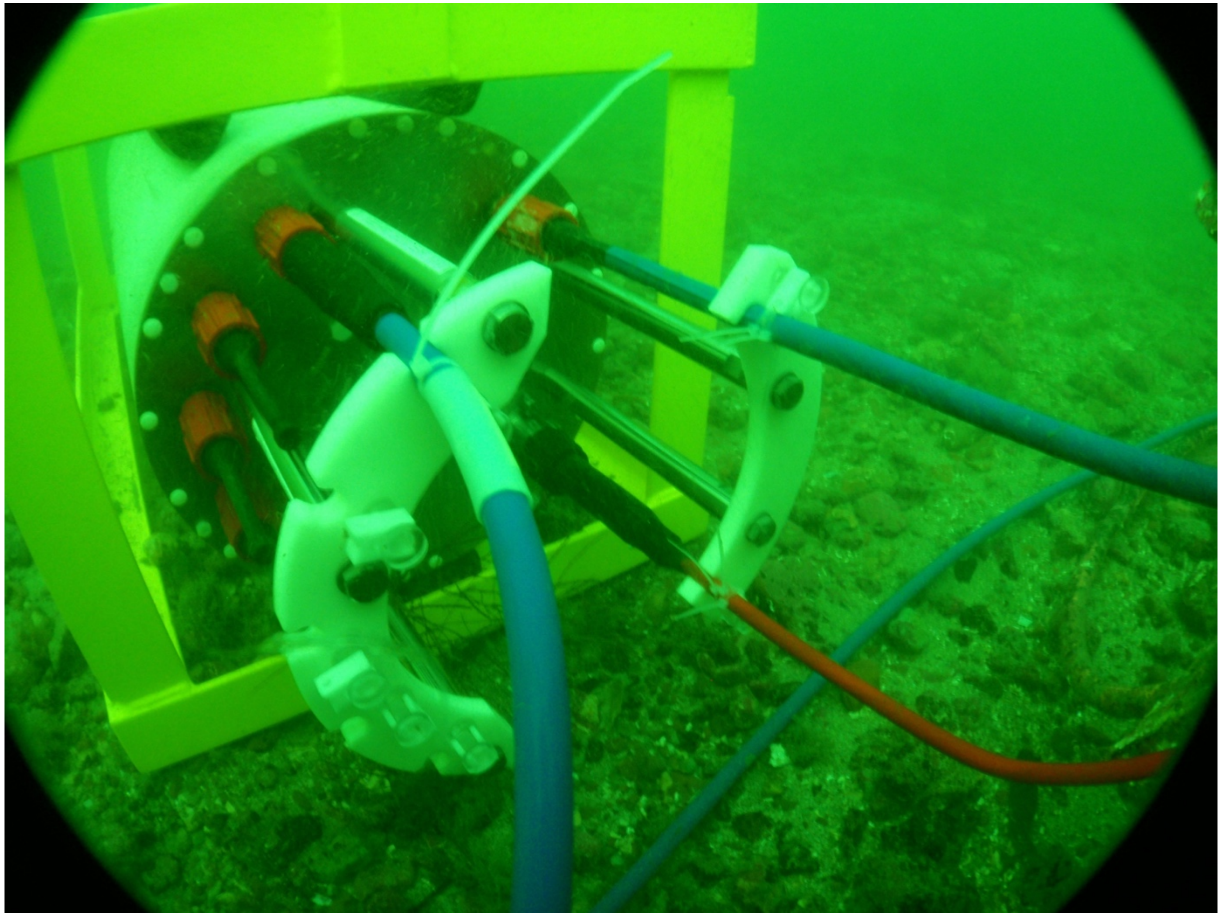
2. Main operational issues

Cabling and connectors;



2. Main operational issues

Cabling and connectors;



2. Main operational issues

Cabling and connectors;

- It is recommended to use proper cable fixations to prevent for current induced movements of the plug systems.

- To our experience, in shallow water observatories where the maintenance and installation of sensors or components is done by divers, the use of SUBCONN or similar (cheap) connectors is possible.
- For long time exposure and ROV handling, GISMA-like plugs seem to b necessary.

2. Main operational issues

Biofouling

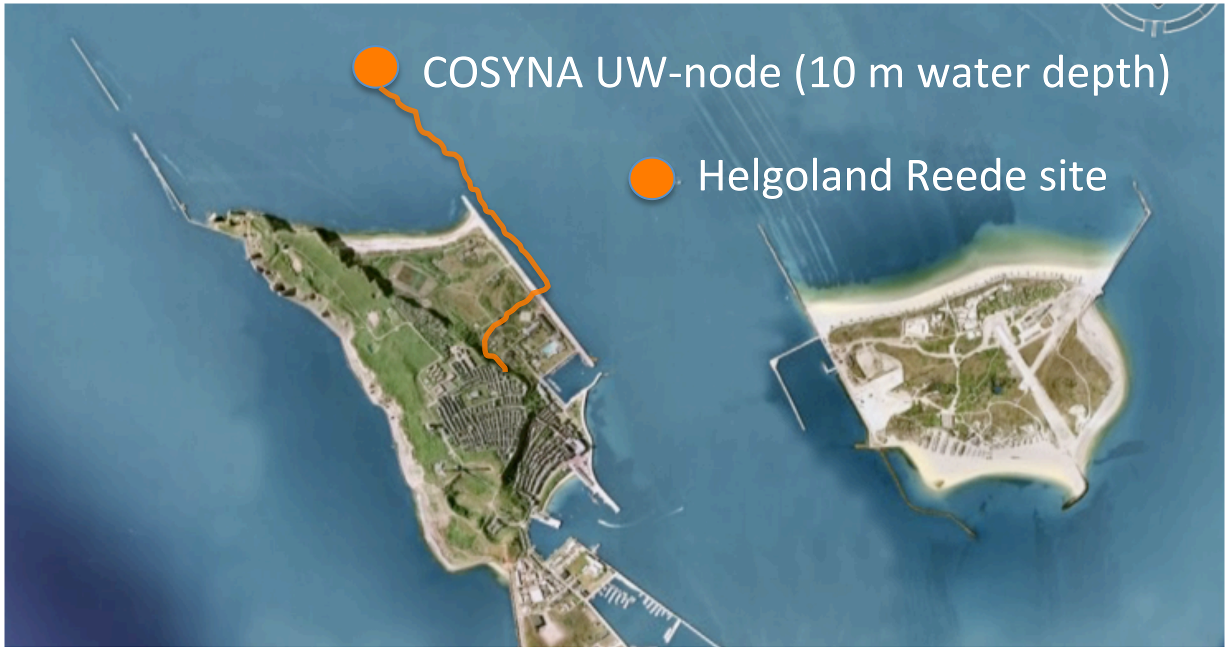
2. Main operational issues

Biofouling

3. Site maintenance

Schedule;

- Node Helgoland is situated in our main underwater experimental field “MarGate”, about 400m North of Helgoland.

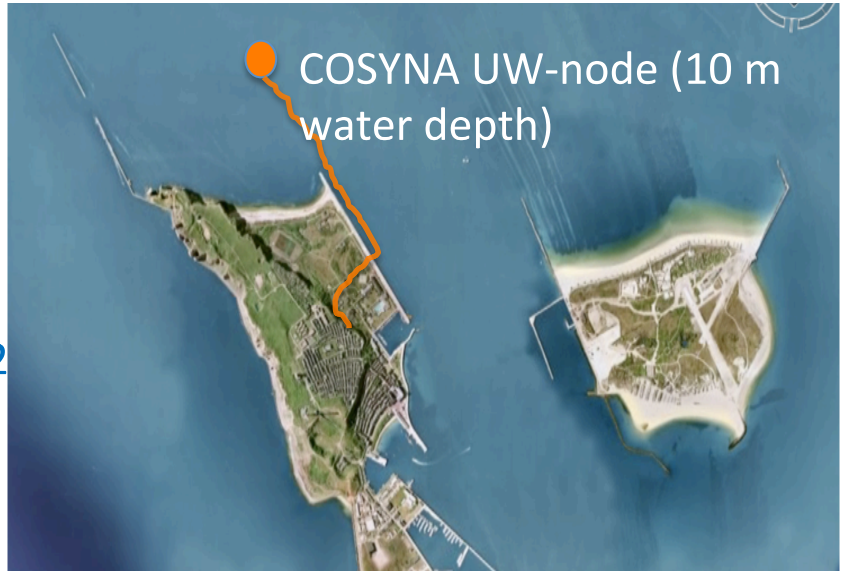


3. Site maintenance

Schedule; Tasks;

- Node Helgoland is situated in our main underwater experimental field “MarGate”, about 400m North of Helgoland.

- If necessary daily access within 30 min.
- Many other projects in the same area for which we organize the diver support.
- Working group “Center for Scientific Diving / In situ ecology” has about 12 members (post-doc, PhD students, Master and Bachelor students).
- All are divers and do field work, so site maintenance is done as a side job.



4. Quality assessment

Automatic reporting on changes in status of stations and computer systems;

- Multi-level reporting system

  1) Web-based Node configuration (Hardware) to
     - Switch power and network on/off
     - Configure ports
     - Control systems functioning
     - Error reporting in case of system change (power down, network failure, transmission rate failure etc. etc.

     -> Handled by the node steering group

  2) Web-based protocol for maintenance work
     - What is planned at the different node systems, e.g. which sensors are installed where, when was the last cleaning/ maintenance etc. etc.

     -> Handled by the dive group (in cooperation with the steering group)

4. Quality assessment

Automatic reporting on changes in status of stations and computer systems;

- Multi-level reporting system

  3) E-mail based control system for data availability

  - Check every 60 min if data files for the different sensors are available and of correct size.
  - Reports errors in case a sensor is not online or no ata are available.

  4) Wiki with all specific information on the node systems.

  - Node specifications
  - Sensor configuration
  - All information which are not assessed by the other reporting systems (electric drawings, sensors available in the entire project….

Under development:

A web-based COSYNA report and information system integrating the above mentioned (5) separate reporting and information system in a single system.

5. Data management

Format; Quality control; Data processing; Data flow for dissemination

Two redundant philosophies:

1. Helmholtz-Centre for Coastal Research (HZG):
   - Specifically developed programs to extract data from the online dataflow from the sensors.
   - Data are flagged as “good”, “probably god” and “bad” data according to basic check algorithms.
   - Data can be downloaded (open access) as ASCII or netCDF data in the web-based data portal.

5. Data management

Format; Quality control; Data processing; Data flow for dissemination

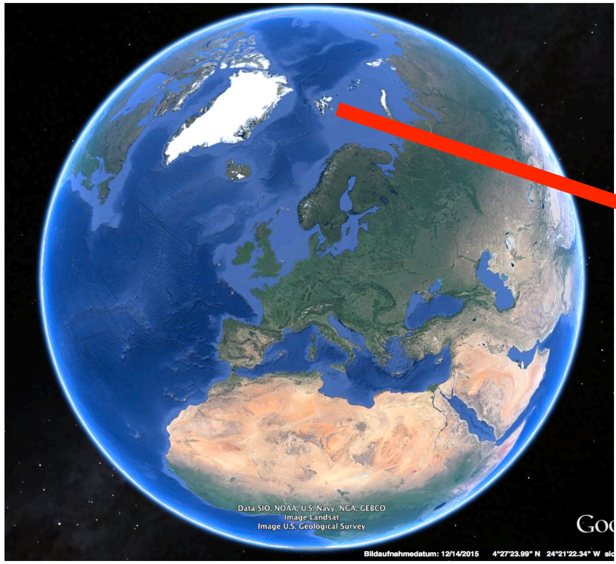
Two redundant philosophies:

1. **Alfred-Wegener-Institute, Helmholtz-Centre for Polar- and Marine Research (AWI):**
   - Programs from the manufacturer are used for data assessment form the sensors.
   - These programs are controlled by a specific macro language allowing to easily set up "user actions" for the programs.
   - Data are saved as "hour-files" or "daily-files" as
     a) Original sensor files readable by the program of the sensor.
     b) ASCII-file with metadata.
   - Data are processed with algorithms for accuracy and precision calculations (ongoing project -> TempEX Experiment at AWI).
   - **Data are provided with delay ½ day or 1-2 days (open access)** at the AWI-NRT Database in ASCII and JSON format.

Site 2: Spitzbergen Observatory

Site Selection and Approvals (criteria for site selection):

- Must be a relevant for the Arctic ocean. Site should be in the proximity of different "typical" Arctic habitats.
- Should be in an area where many research groups work together already.

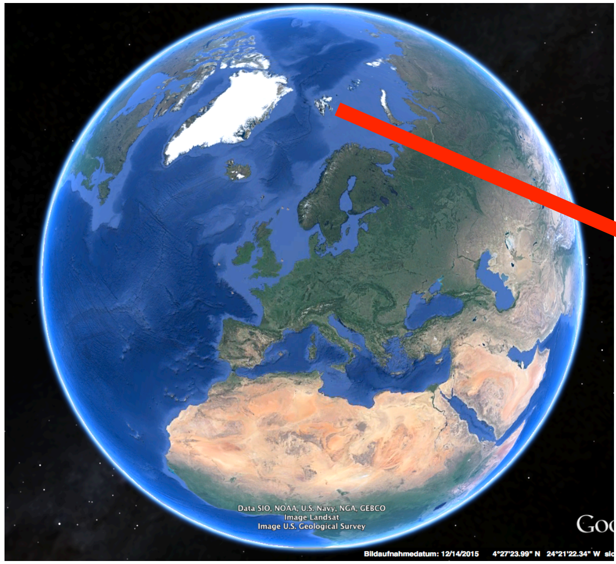


AWIPEV-COSYNA underwater observatory at 79°N.

Site 2: Spitzbergen Observatory

Site Selection and Approvals (criteria for site selection):

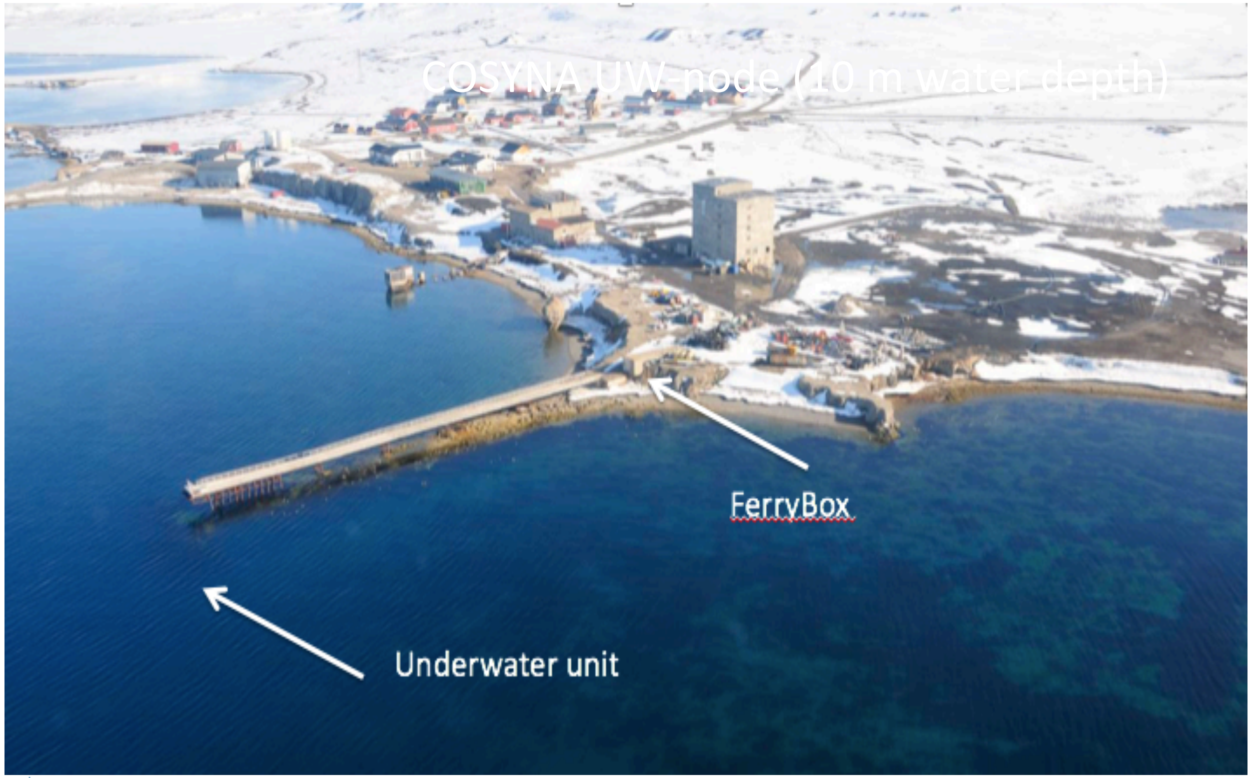
- AWIPEV research station in Svalbard (West-Spitzbergen)



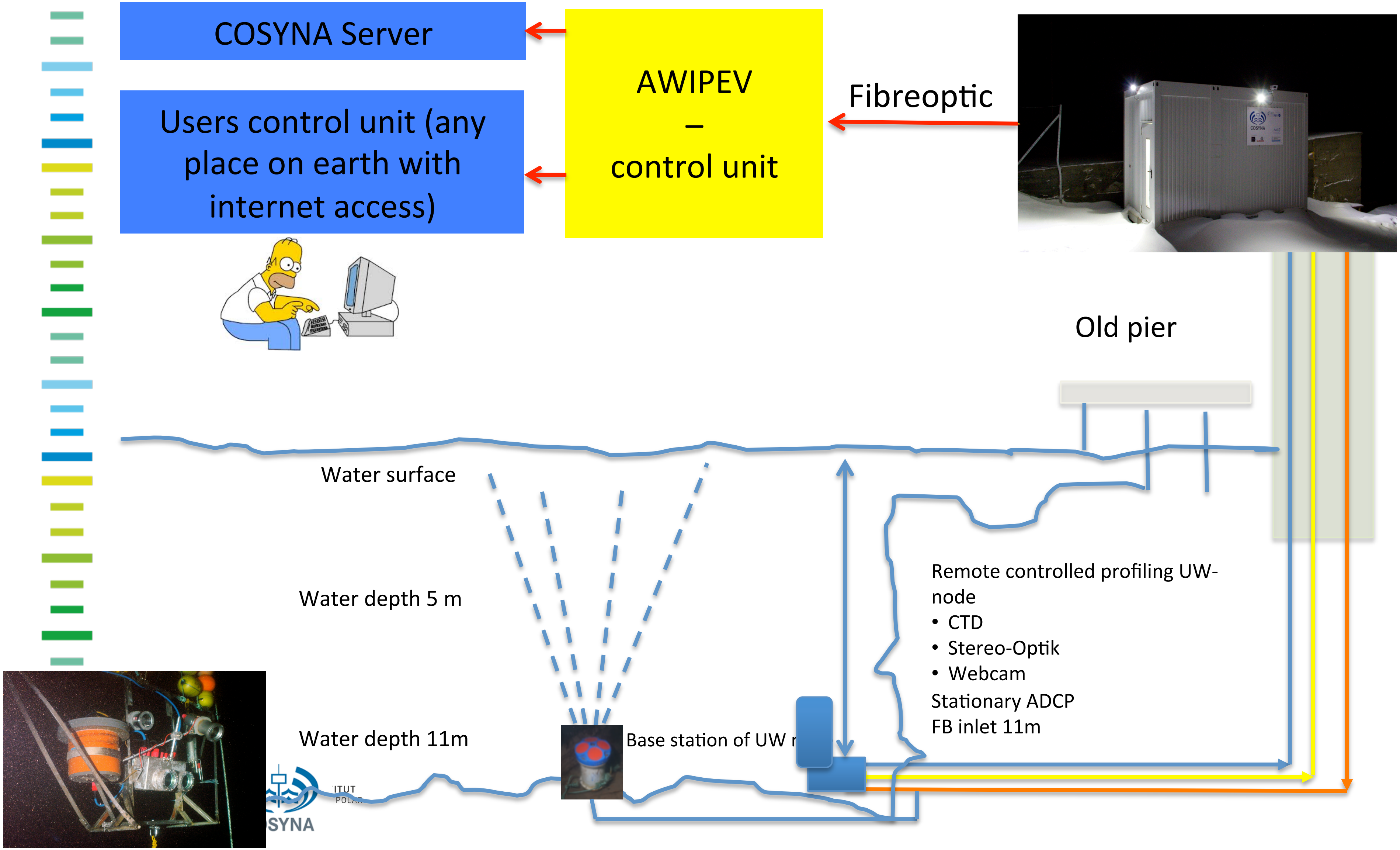
3. Site maintenance

Schedule;

- Node Spitzbergen is situated about 150 m in front of the so called "Old Pier" in one of our main research areas in Spitzbergen.



Underwater set-up at AWIPEV



3. Site maintenance

Schedule;

- Node Spitzbergen is situated about 150 m in front of the so called “Old Pier” in one of our main research areas in Spitzbergen.

- Two 3-week expeditions per year with divers (spring and autumn) for maintenance and sensor installation.
- Emergency expeditions in case of system failure (2 times since 2012).
- Extensive test procedures of new sensors in Germany prior to a deployment.
- System configuration Helgoland and Spitzbergen is identical. Sensors which are tested and configured for the Helgoland node work without change in Spitzbergen.

2. Main operational issues

1. Companies / colleagues which underestimate the restricted access, the missing spare part supply and the limited time available to the site.

2. The system parts must work for 9 month at least without any physical access 7 maintenance.

3. The sensors must work for 9 month at least without any physical access 7 maintenance.

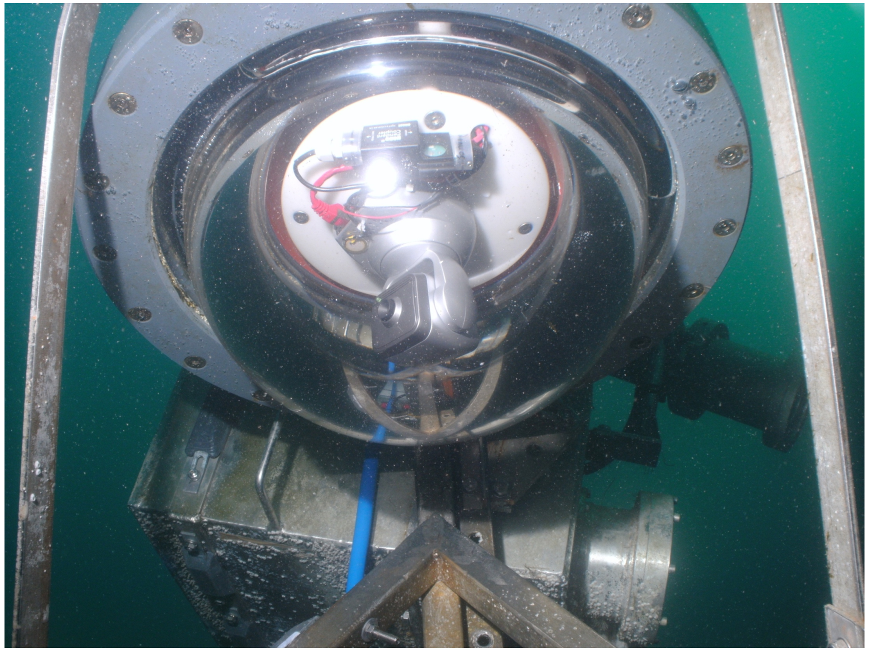
4. The controlling hard- and software (Server etc.) must be fully remote controllable including reliable redundancies (all server systems at AWIPEV are redundant).

5. The system is designed to reduce the chance of being destroyed by an iceberg collision -> collisions happened 4 times since 2012.

2. Main operational issues

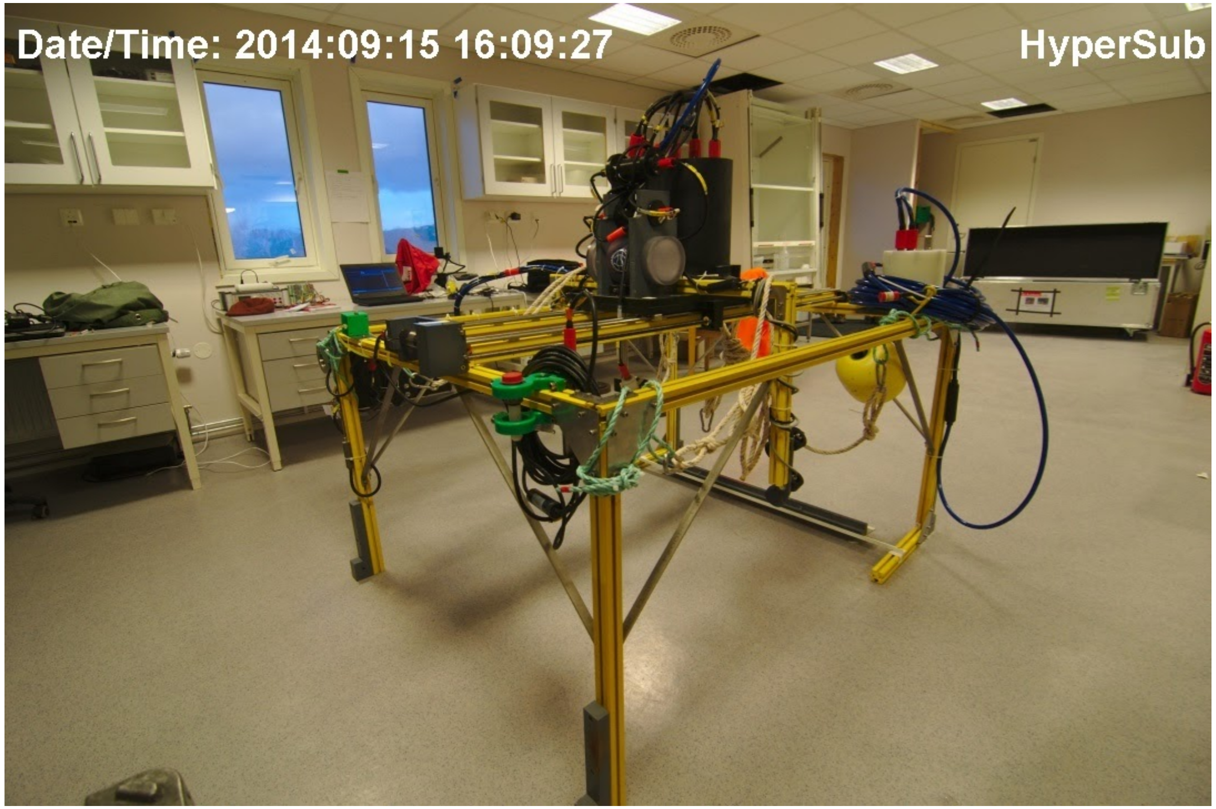
6. Compared to Helgoland, in Svalbard we have a much better system surveillance via surface and underwater webcams.

   We continuously monitor the area for drifting icebergs, especially in spring.



2. Main operational issues

7. We mentally prepare our cooperation partners that it is possible to loose equipment.



2. Main operational issues

1 month later

after the collision with an iceberg.

6. Applications

The user profiles:

1. Cooperation partners
    - Other institutes with their sensors attached to the system.
    - Tunneling sensor control and the data directly to the colleagues.
    - Responsibility for the sensors and the data is at the owner.

2. Research (post-processing mode)
    - Dataflow is linked to research search portals and archives like PANGEA and MANIDA.

3. Public and governmental agencies (operational mode)
    - Data flow is linked to institutional data bases.
    - Calculation of online current information
    - COSYNA App for data access

4. Data sets are published as data publication.

6. Applications

Shallow water fish community
- AWI / HZG
- Philipp Fischer, Markus Brand & Max Schwanitz

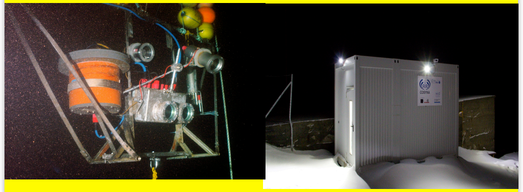
Hypersub
- MPI Bremen
- Cooperation partners: Dirk de Beer & Arjun Chennu

Acoustic monitoring
- Züricher Hochschule für bildende Künste
- AWI

weFoce (Ocean acidifi-cation – under evaluation)
- Villefranche
- Cooperation partners: Jean-Pierre Gattuso

COSYNA

AWIPEV-COSYNA UW - Observatory



<-RemOs1 FerryBox ->

- Temperature
- Salinity
- Depth
- Turbidity
- Chl-A Flourescence

COSYNA Server
http://codm.hzg.de/codm/

eFoce: pCO2 / Alcalinity sensors
- IPEV (Pascal Morin)
- Villefrnache: Jean Pierre Gattuso

The viral component of the microbial food web
- NIOZ
- Cooperating partners. Douwe Maat *et al.*

MAP: Monitoring Arctic Phytoplankton
- University Groningen
- Cooperating partners. Willem van de Poll *et al.*

New Projects………
- 2016/17: Optic plancton recorder v. Tünen Institute Hamburg-
- ACROSS

The main challenge: From sensors to publications

- **We have a stable technological framework for a continuous data stream even from offshore or polar areas.**

But: Our current methodologies in data assessment, data delivery and data processing are "very often" not prepared to handle a continuous and scientifically verified data flow.

ITUT
POLAR-

Experiences from 4 years COSYNA UW-node

Most probes are not designed for long-term exposure in shallow (productive) water areas.

1. Almost all sensors are designed for short term-exposure (<1 month or even only for hours).
2. Sensors do not have protection against bio-fouling (-> ChlA, turbidity, light).
3. Even simple connectors are not designed for underwater use (underwater matable connectors)

We need technological innovations for the development of underwater sensors for real long-term exposure (> 6 month).

Experiences from 4 years COSYNA UW-node

Data transfer even via the Internet is not fully reliable with respect to real continuous online operation.

– Almost all data transfer routines and protocols have **NO self-connecting procedures**, **No self-repair mechanisms like watch-dog functions** and **NO reliable alert functions in case of a connection failure**

– It needs to much human interactions to get a sensor online even after a slight change in the configuration or after the change of some components.

We need technological innovations for self-configuring probes and data transfer protocols.

COSYNA

ITUT
POLAR-

Experiences from 4 years COSYNA UW-node

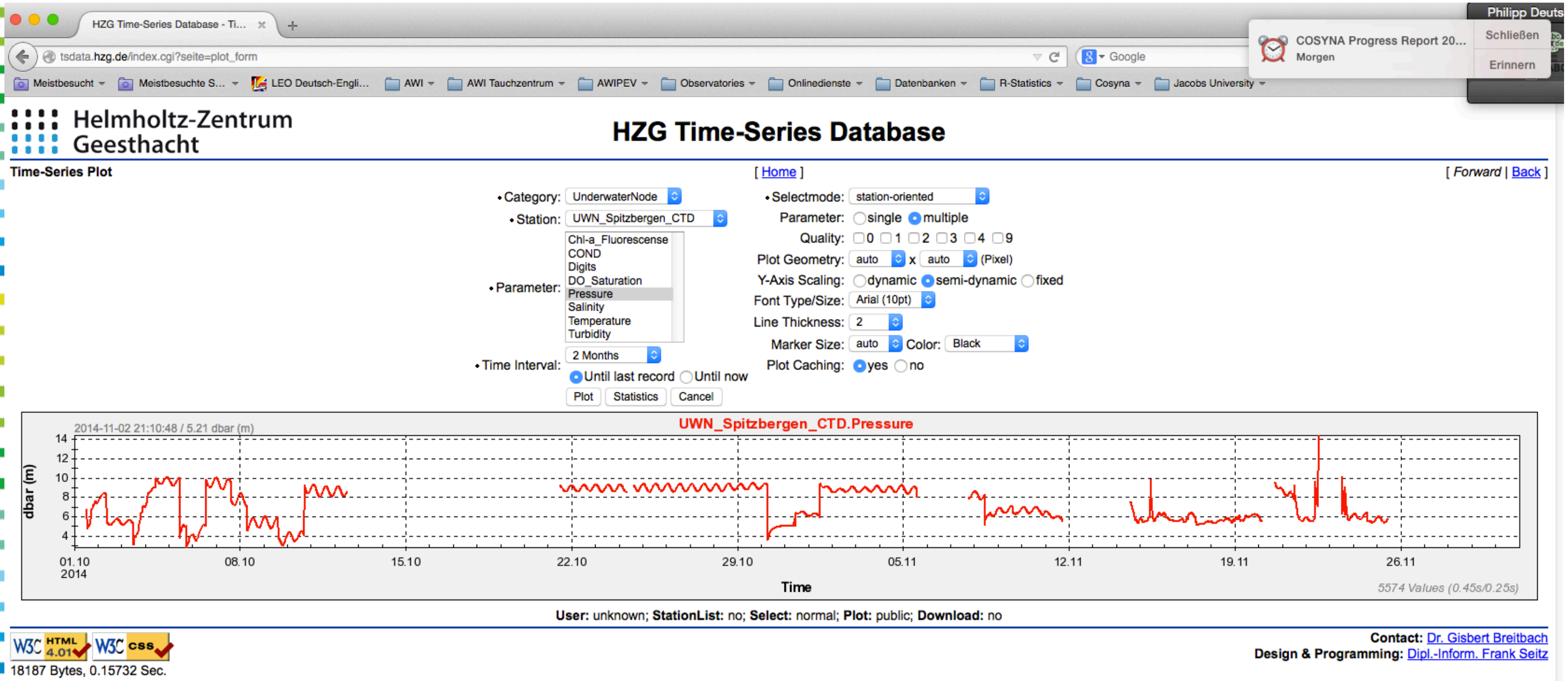
Data handling and verification procedures are often not designed for unsupervised data processing.

- Our data handling and verification procedures are still designed for a manually supervised data control.
- We do not use the capabilities of online sensor technology to countercheck data against other probes.
- We do not use forecasting methods for online sensor control.

We need more data control and data verification procedures to achieve a higher data quality.

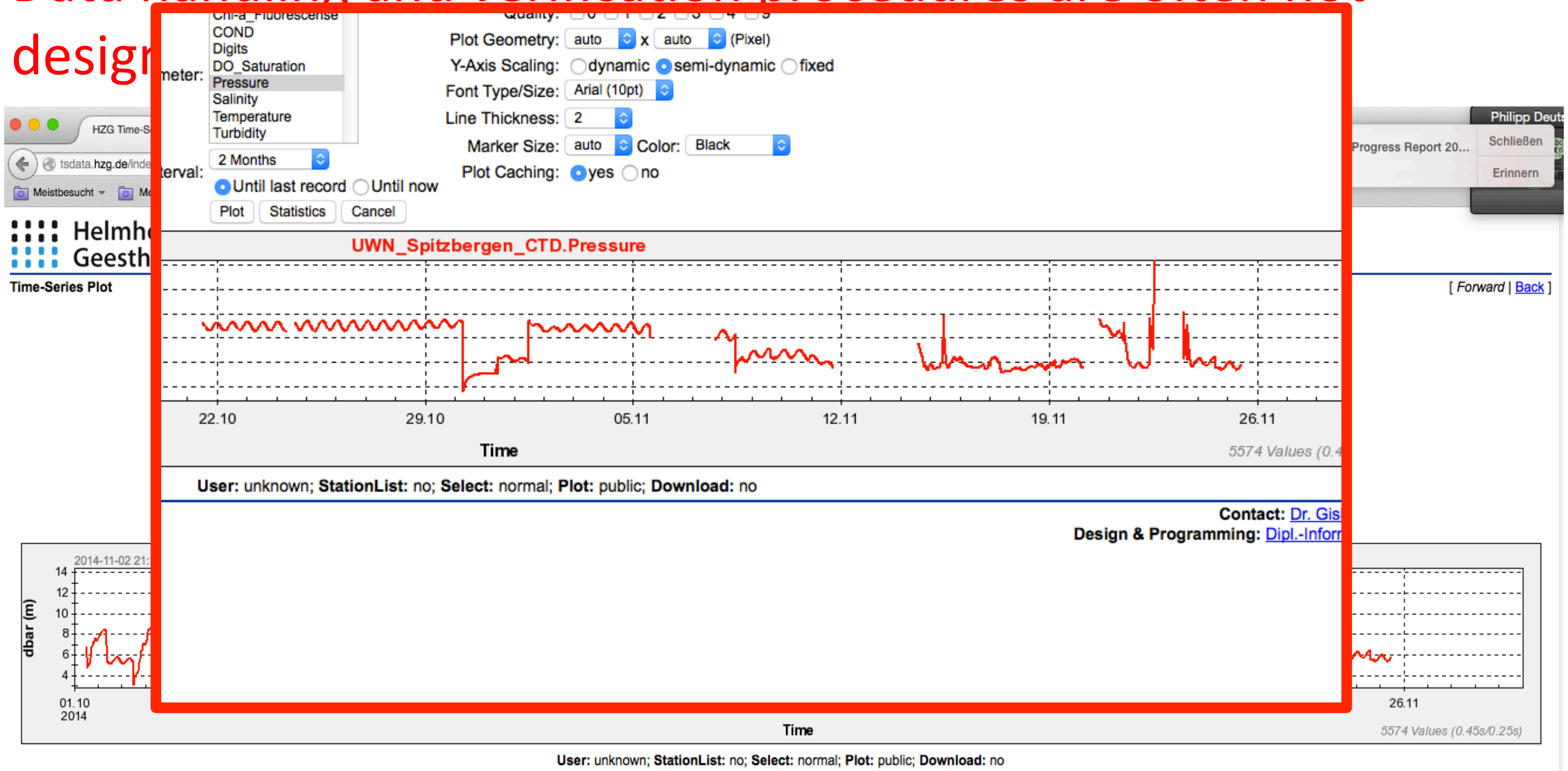
Experiences from 4 years COSYNA UW-node

Data handling and verification procedures are often not designed for unsupervised data processing.



Experiences from 4 years COSYNA UW-node

Data handling and verification procedures are often not desig



Experiences from 4 years COSYNA UW-node

1. Development of underwater sensors for long-term exposure (> 6 month).

2. Self-configuring probes and data transfer protocols.

3. Data control and data verification procedures to achieve a continuously high data quality.

COSYNA

ITUT POLAR-

Our next steps in COSYNA

– New workgroup "Datastreams" (HZG - AK Datenmanagement, AWI - AK Unterwasserknoten and MARUM - AK Bodennahe Messysteme) to continuous improve sensor resilience and data quality from long-term online sensors.

– Meeting every 6 month.

The main goals are:

– To reduce human supervision in data assessments from continuous operating online sensors.

– To provide scientifically correct online sensor data including accuracy and precision information in our "public accessible" databases.

ITUT
POLAR-

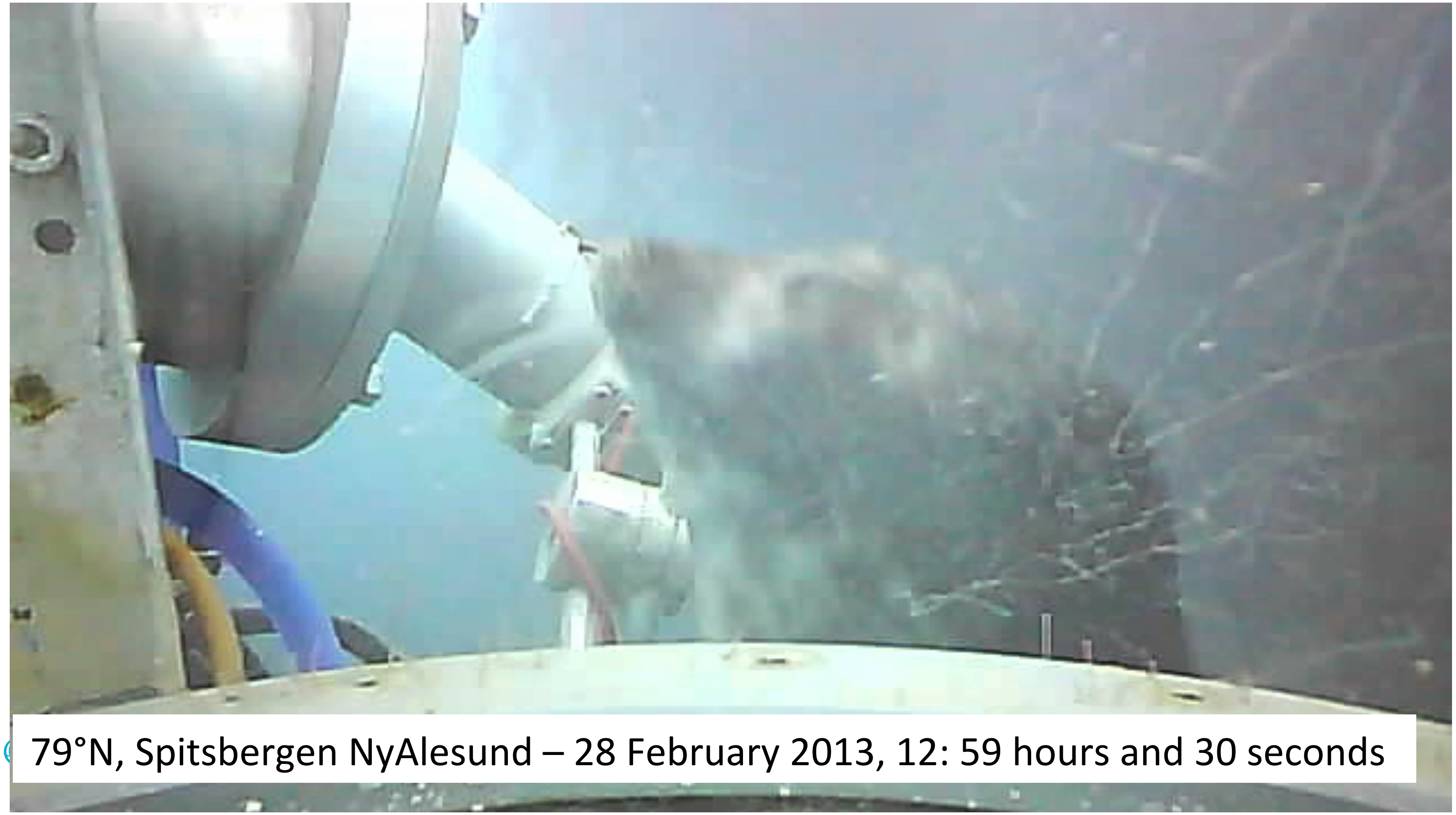
COSYNA

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

loth engineering GmbH

JERICO next

Thank you for your attention



79°N, Spitsbergen NyAlesund – 28 February 2013, 12: 59 hours and 30 seconds

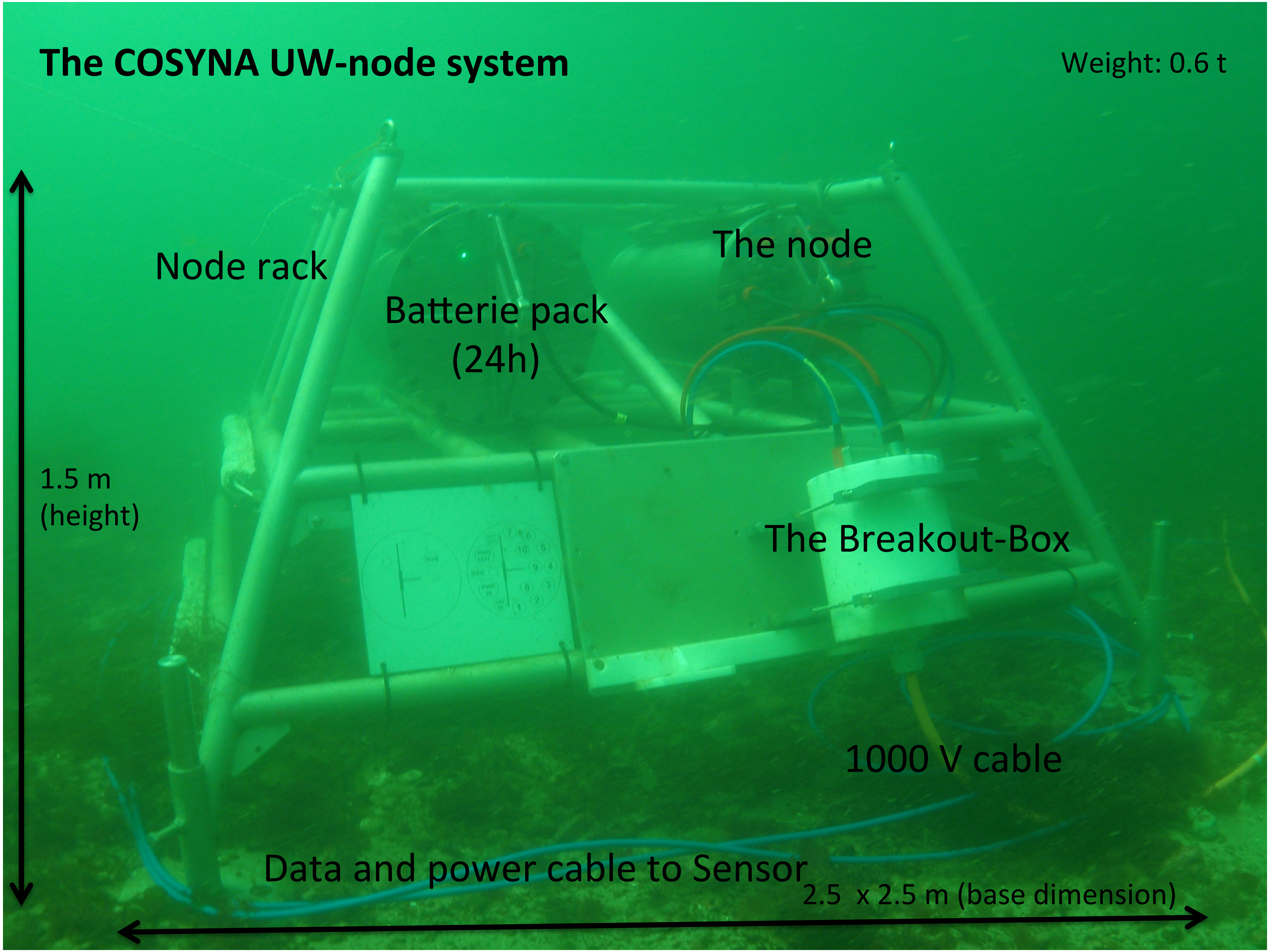
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

Helmholtz-Zentrum
Geesthacht
Zentrum für Material- und Küstenforschung

JERICO next

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654410.

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)
Task 2.3.2 Harmonizing new network systems: Cabled observatories


The COSYNA UW-node system
Weight: 0.6 t
Node rack
Batterie pack
(24h)
The node
1.5 m
(height)
The Breakout-Box
1000 V cable
Data and power cable to Sensor
2.5 x 2.5 m (base dimension)

EMSO-Molène
Shallow water test site of EMSO

WP2: Harmonisation of technologies and methodologies: technical strategy (NA)
Task 2.3.2 Harmonizing new network systems: Cabled observatories

Presenter: Laurent Delauney (Ifremer REM/RDT/LDCM) email : laurent.delauney@ifremer.fr

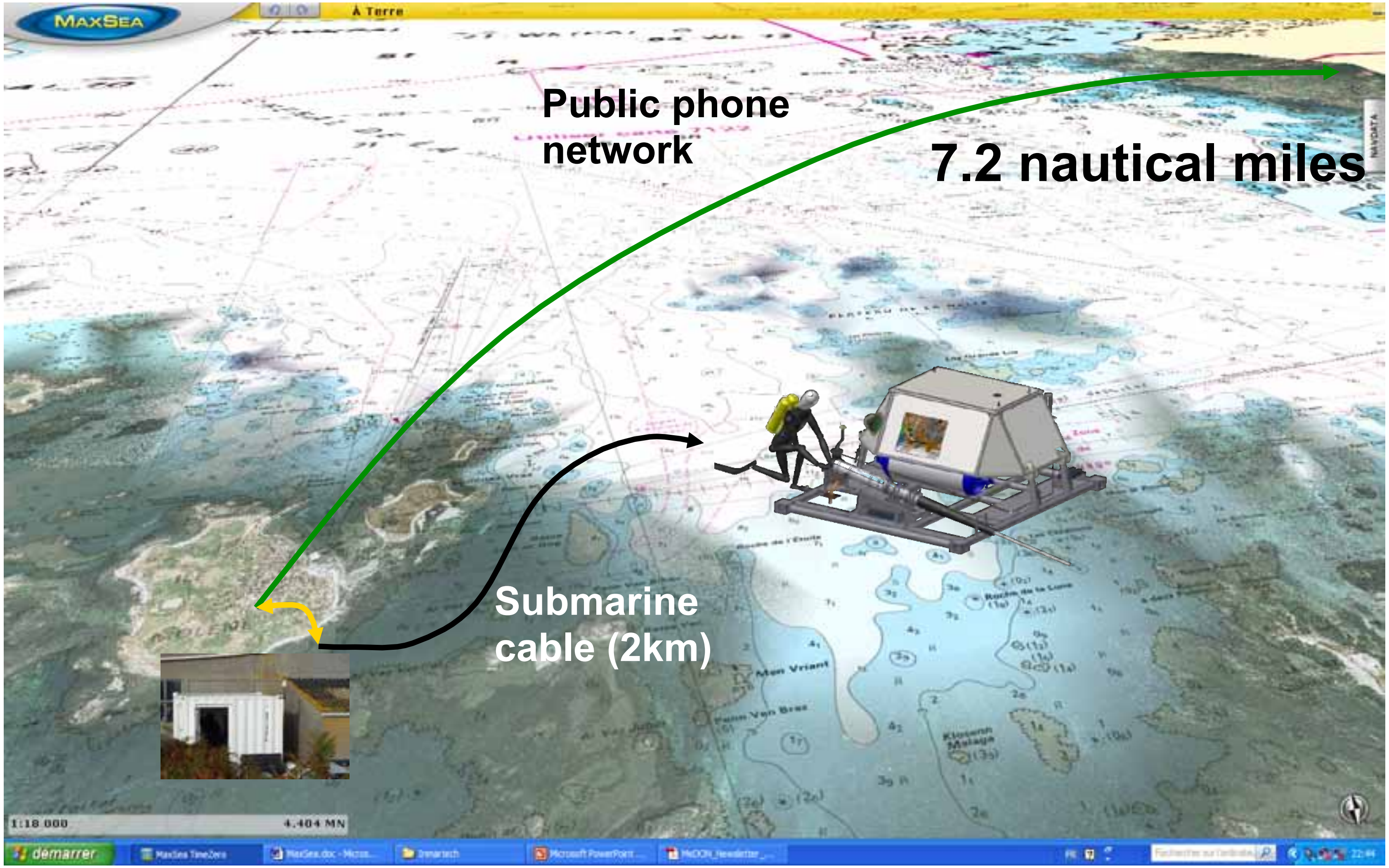
Contributor(s): Nadine Lanteri, Rolin jean François
nadne.lanteri@ifremer.fr

JERICO-NEXT Cabled Observatories workshop / Vilanova I la Geltrú / SPAIN / 19th – 20th April 2016

INDEX

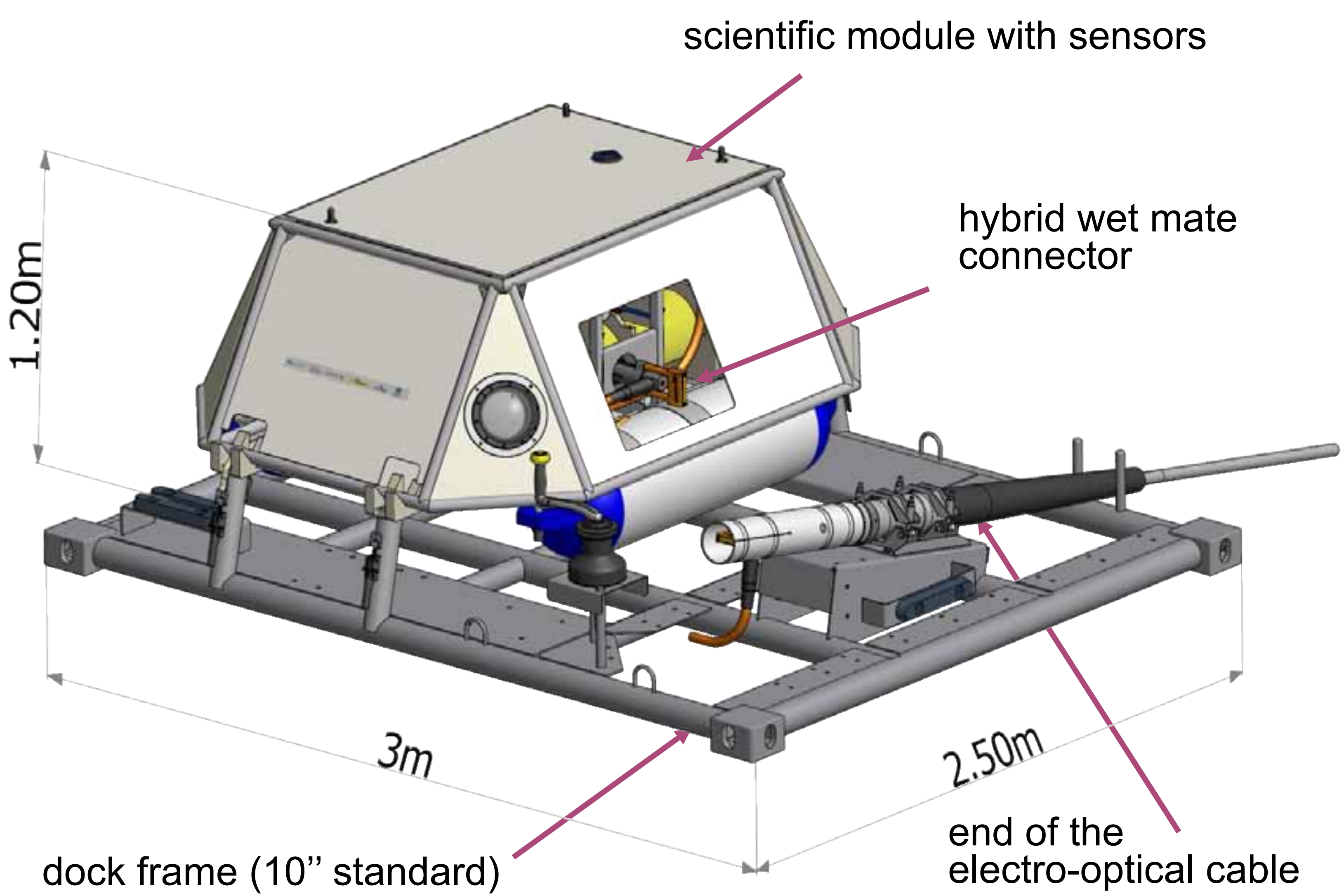
1. **Issues during the installation phase** Site Selection and Approvals; manufacturer; Environmental Concerns – Electromagnetic; Environmental Concerns – Impacts (ground, plants, animals, landscape); Cabled deployment, Power; Communications; ...
2. **Main operational issues P**ower outage and communication failure during a strong storm; deployment of new instruments, cabling and connectors; Security;.
3. **Site maintenance** Schedule; tasks; ...
4. **Quality assessment** Automatic reporting on changes in status of stations and computer systems; Web-based database of incidents and actions; ...
5. **Data management** Format; Quality control; Data processing; Data flow for dissemination
6. **Applications** Users; Areas – research, engineering, fisheries, etc-;
7. **Other items** you consider interesting in T2.3 context

-. Introduction



WP2: Harmonisation of technologies and methodologies: technical strategy (NA)
Task 2.3.2 Harmonizing new network systems: Cabled observatories

-. Introduction



WP2: Harmonisation of technologies and methodologies: technical strategy (NA)
Task 2.3.2 Harmonizing new network systems: Cabled observatories

Technical specifications

Maximal operating depth: 4000 meters for standardization reason (actual depth : 20m)

Nominal distance from the coast (Molene-Node) : 2 km

Remote control of the instruments and data recovery: Each instrument is provided with a virtual computer, accessible via internet, in order to run driver and store data.

Network throughput: 1 Gbit/s
Data are transmitted to the subscriber by a land based server.

Technical specifications

Data time stamping: GPS clock, NTP/PTP Network, Network Attached Storage

Instruments connexion
Number of ports: 1 or several modules of 6 inputs (Subconn MCBH12M, Micro Bulkhead, 12 contacts)

Voltage: 15V and 48V

Effective rated power for the 6 connections:
75W in 15V 5W in 48V

Throughput per port: 100 Mbit/s

Communication protocols: Ethernet and serial RS232, RS485 and RS422

1. Issues during the installation phase

Site Selection results from a compromise:

- Scientific interest.
- Power and Ethernet availability.
- Transport and access, regular crossing from Brest.
- People available on the site.

Approvals:

Environmental Concerns – Electromagnetic, Environmental.

Manufacturer, For the very specific components:

Cable, Orange Marine.

Electro-optical wet mateable connector, ODI despite cost and time of delivery.

1. Issues during the installation phase

Manufacturer: For the very specific components

Cable, Orange Marine

Electro-optical wet mateable connector, ODI despite cost and time of delivery.

Impacts (ground, plants, animals, views)

Marine protected area : « Parc Marin d'Iroise »

Little impact as far as EMSO-Molene is concerned

- Small unit, hardly no equipment on the island, cable just laid on the sea floor.
- The system behave like an artificial reef.
- Social impact: additional activity on the island (hotel, transport, etc.).

Cabled deployment

No major difficulty, use of a small barge by Orange Marine cable ship specialists.

2. Main operational issues

Power outages and communication failures:

- The server reached its safety temperature: the temperature in the container raised because the air cooler did not operated when the temperature outside was less than 18°C (just anecdotal...)
- The major power loss was due to the destruction of the outdoor power equipment during a heavy and long storm. It took a certain time before we could fix the system. The area is protected by rocks but the divers have quite a long way for crossing.
- There were no power outage due to man work (seaweed collection) in the area. Despite warning to mariners, the cable was brought to surface without damage.

2. Main operational issues

Deployment of new instruments, cabling and connectors:

- As permanent equipment, a dissolved oxygen sensor, a CTD and a turbidity sensor;

- As temporary test, we are deploying OBS in the field of the camera to help interpret seismic data acquired in the MARMARA sea;

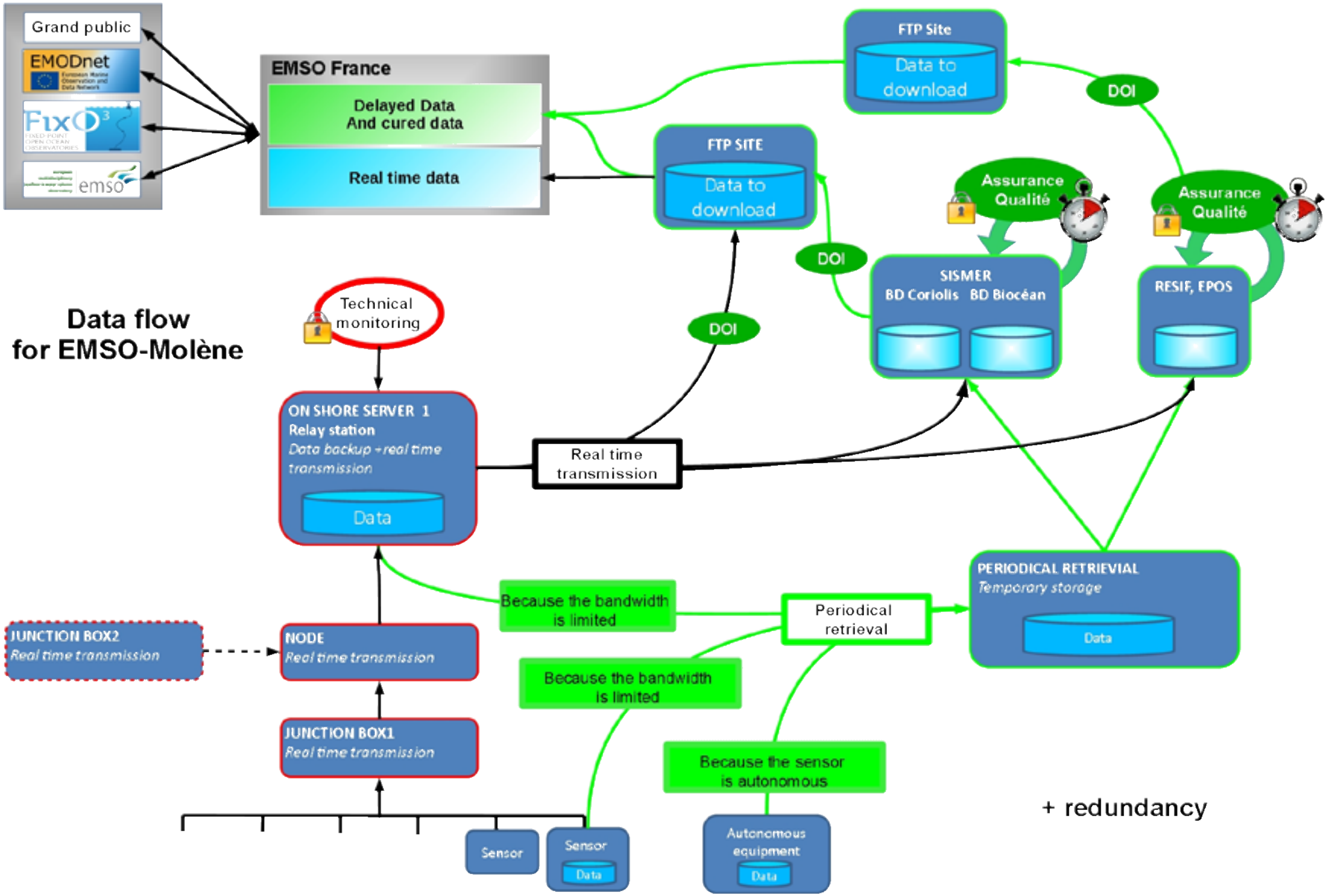
3. Site maintenance

Visual inspection and cleaning
Every 3 months

Swapping components
Every 6 months or when required

Difficult during winter

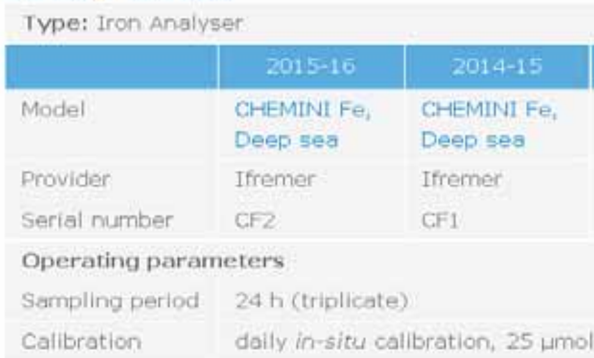
5. Data management



WP2: Harmonisation of technologies and methodologies: technical strategy (NA)
Task 2.3.2 Harmonizing new network systems: Cabled observatories

5. Data management

Through http://www.emso-fr.org/, Access to DOIs, Real time Data plot, sensor medata...



Type: Iron Analyser

	2015-16	2014-15
Model	CHEMINI Fe, Deep sea	CHEMINI Fe, Deep sea
Provider	Ifremer	Ifremer
Serial number	CF2	CF1
Operating parameters		
Sampling period	24 h (triplicate)	
Calibration	daily *in-situ* calibration, 25 µmol	

6. Applications

For scientific purpose

2- **ADCP:** Current and waves measurement

3- **Hydrophones**, Ambient noise and dolphins monitoring (ENSTA Bretagne)

4- **Camera:** Local species

7- **Multi-parameter probe**

9- **BMB,** JERICO

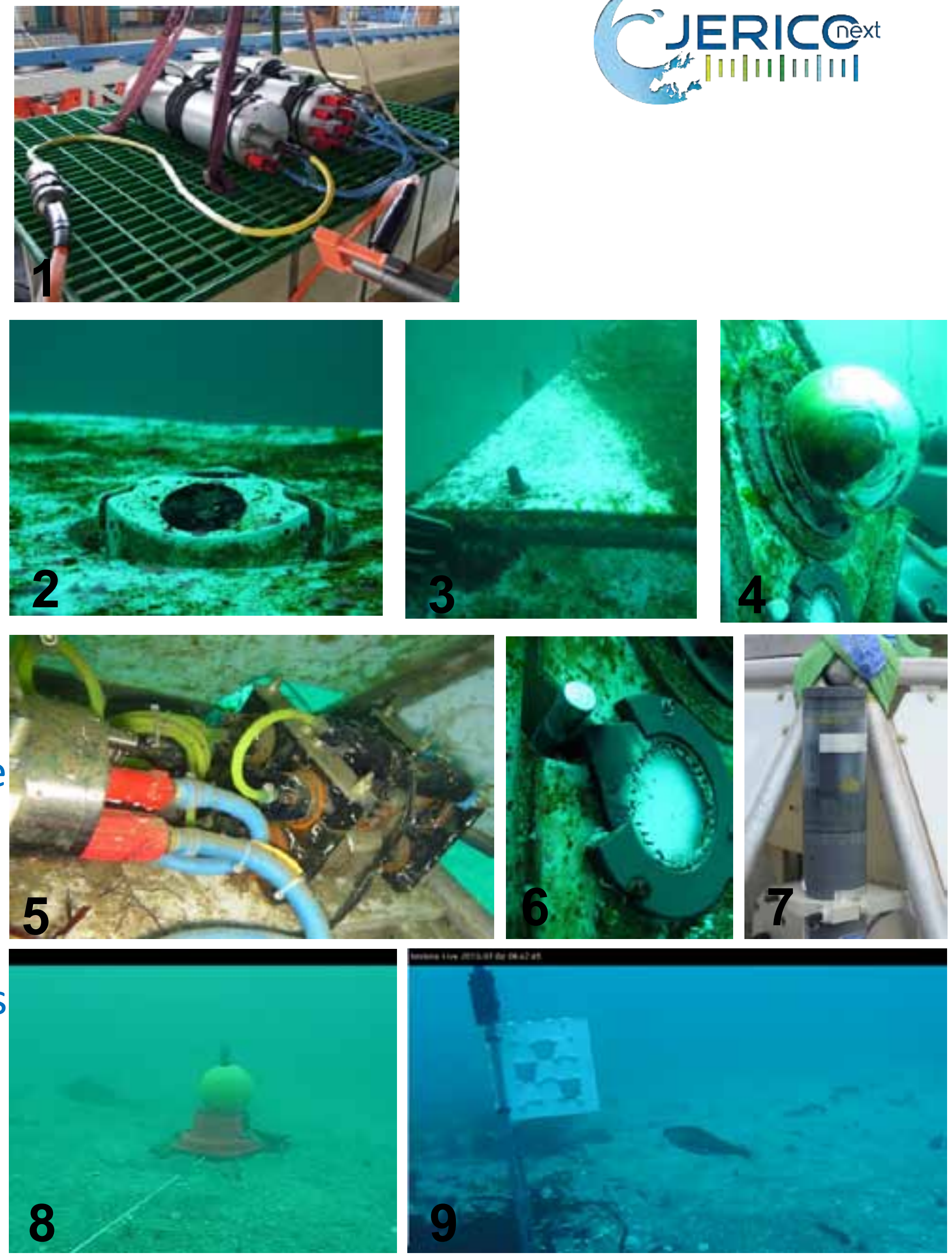
As a test site

1- BJ and Node: Mature technology for other coastal nodes (EMSO-Nice...)

5- **Piezometer:** Prepare the maintenance of an equipment deployed on Ocean Neptune Canada

6- **Anti fouling device**

8- **Mastodon:** Monitor the performances at sea before deployment of numerous units



7. Other items

* Partnership with Oceanopolis Aquarium

* EMSO Molène is in the list of contributing sites for the Marine Strategy Framework Directive.

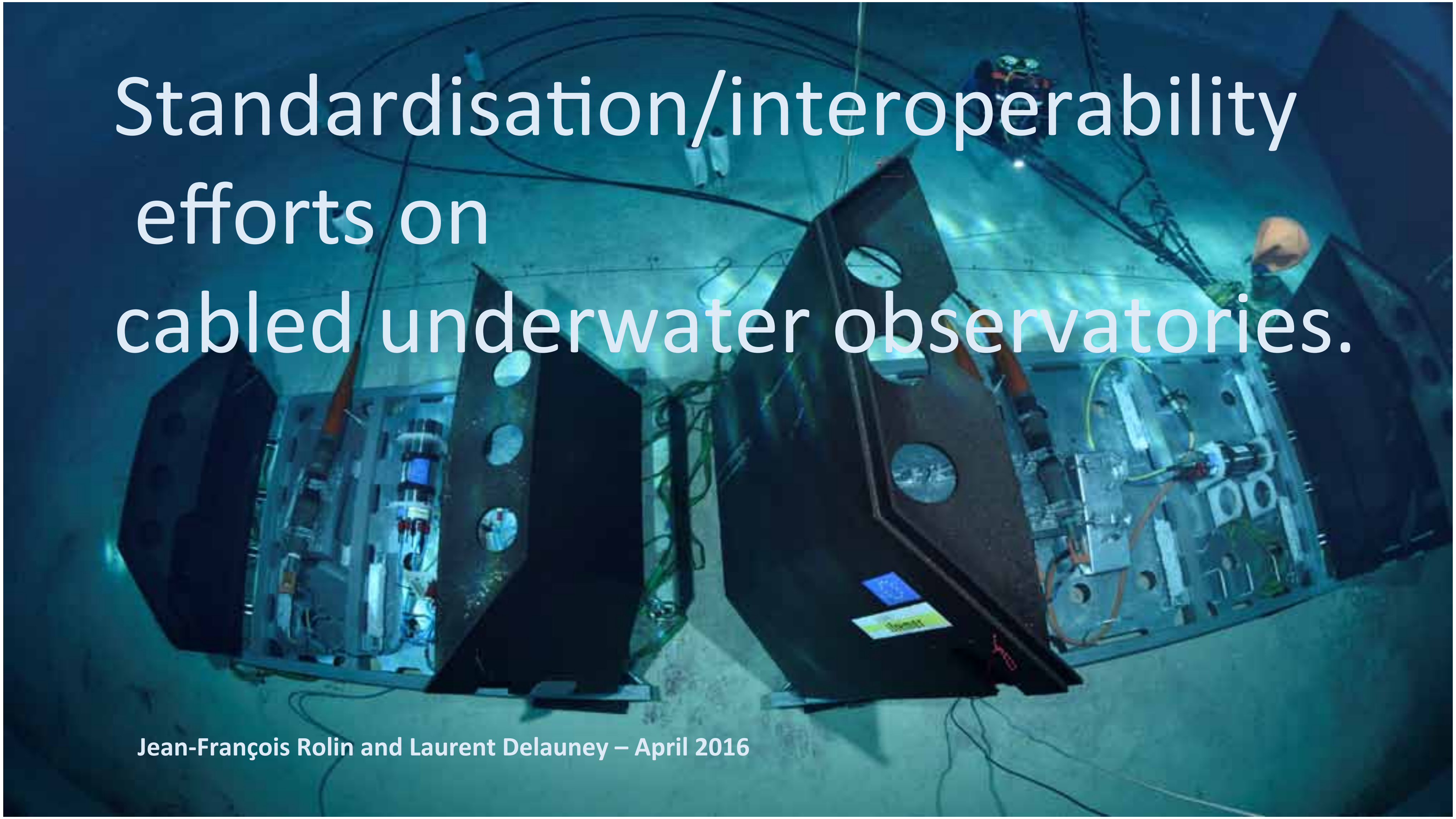
*www.ifremer.fr/**emsomolene***

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654410.

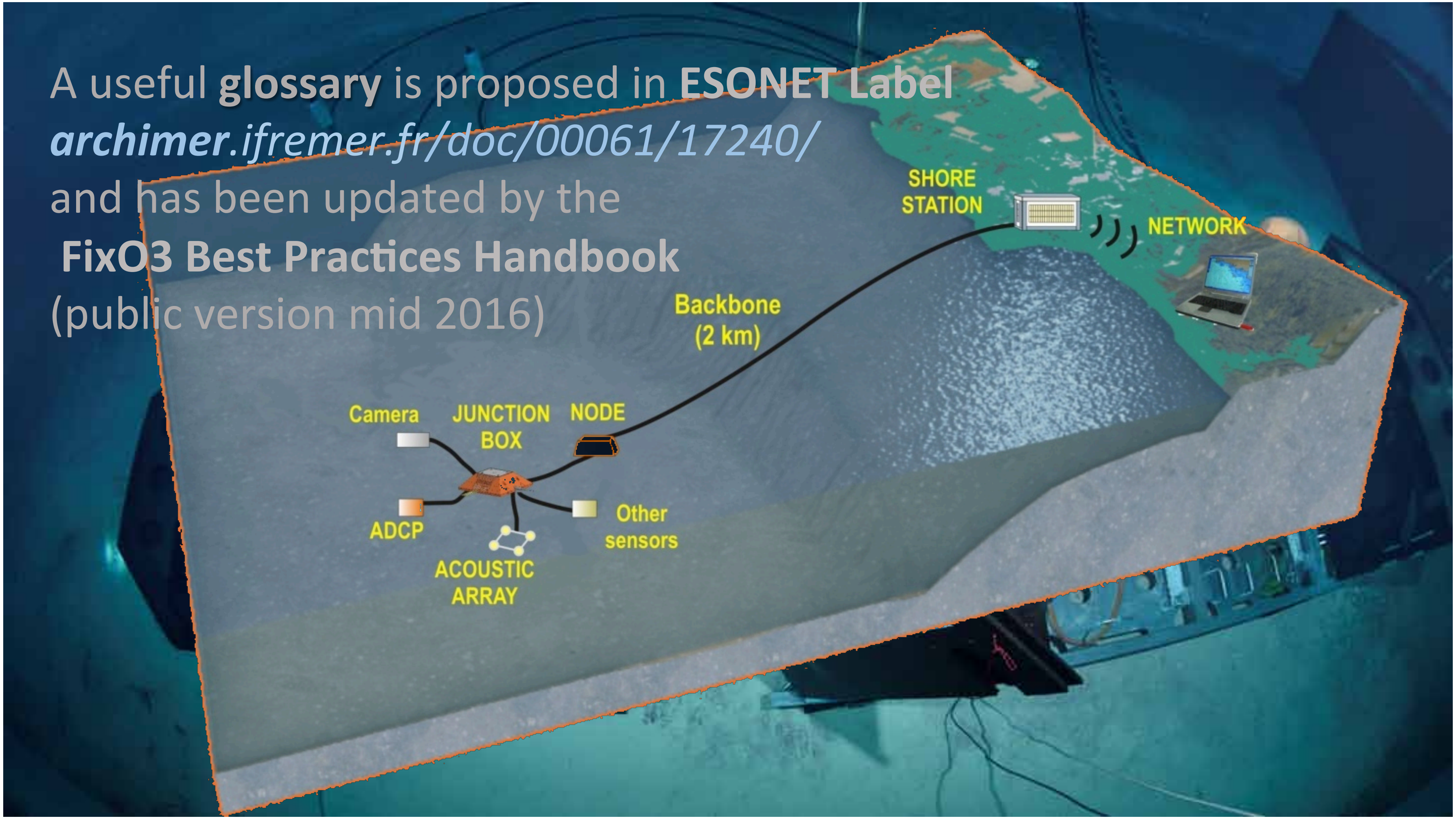
WP2: Harmonisation of technologies and methodologies: technical strategy (NA)

Task 2.3.2 Harmonizing new network systems: Cabled observatories

Standardisation/interoperability efforts on cabled underwater observatories.



Jean-François Rolin and Laurent Delauney – April 2016


A useful **glossary** is proposed in **ESONET Label**
archimer.*ifremer.fr/doc/00061/17240/*
and has been updated by the
FixO3 Best Practices Handbook
(public version mid 2016)
SHORE
STATION
NETWORK
Backbone
(2 km)
Camera
JUNCTION
BOX
NODE
ADCP
Other
sensors
ACOUSTIC
ARRAY

Best practices comparisons and synthesis may lead to a label

ESONET Label in 2011 introduced some recommendations on cabled observatories.

JERICO FP7 Label did not address cable observatories topic.

FixO3 Label will be issued in 2016 with some updates on cabled observatories.

EMSO ERIC will update and support the use of these labels over the next decade.

JERICO-NEXT input comes at the right time!

ESONET LABEL towards EMSO Label

Make choices for the specifications of observatories.

Mandatory aspects and description of recommended solutions or options.

What is mandatory in the point of view expressed and experienced by the European Subsea observatory community :

- Recommendation on power supply, connectors,
- Recommendation for stand alone observatories **(improved in FixO3 Label)**
- Recommendation on material **(improved in FixO3 Label)**
- Generic sensor module and specific sensor modules **(implemented in EMSODEV)**
- Description of the modules **(improved in JERICO Label with sensor definition)**
- Module interface.
- Metrology issues **(improved in JERICO Label with sensor definition)**
- Qualification and testing procedures **(new version of standard NF X 10-812)**
- Deployment and maintenance **(to be improved by EMSO-Link)**
- Data management
- Environmental impact

AC or DC?

As an international interoperability need, a 400V DC output is recommended at the end of the backbone infrastructure for the downlink uses.

It is often necessary to provide higher voltage feeds to obtain the 400V DC at this junction level.

In any case, a qualification is required. High power converters have to be validated and experienced in similar environment. Extensive simulations and tests of transients conditions are necessary prior to final design (mandatory).

DC power feeding is the most common choice and will gain from previous experiences. AC may be a solution for short distance (example of AC for *Catania NEMO* and *Antares* infrastructures).

Power return by sea water

Magnetic field and by products of the corrosion of the current return devices must be evaluated with respect to their environment disturbance effect.

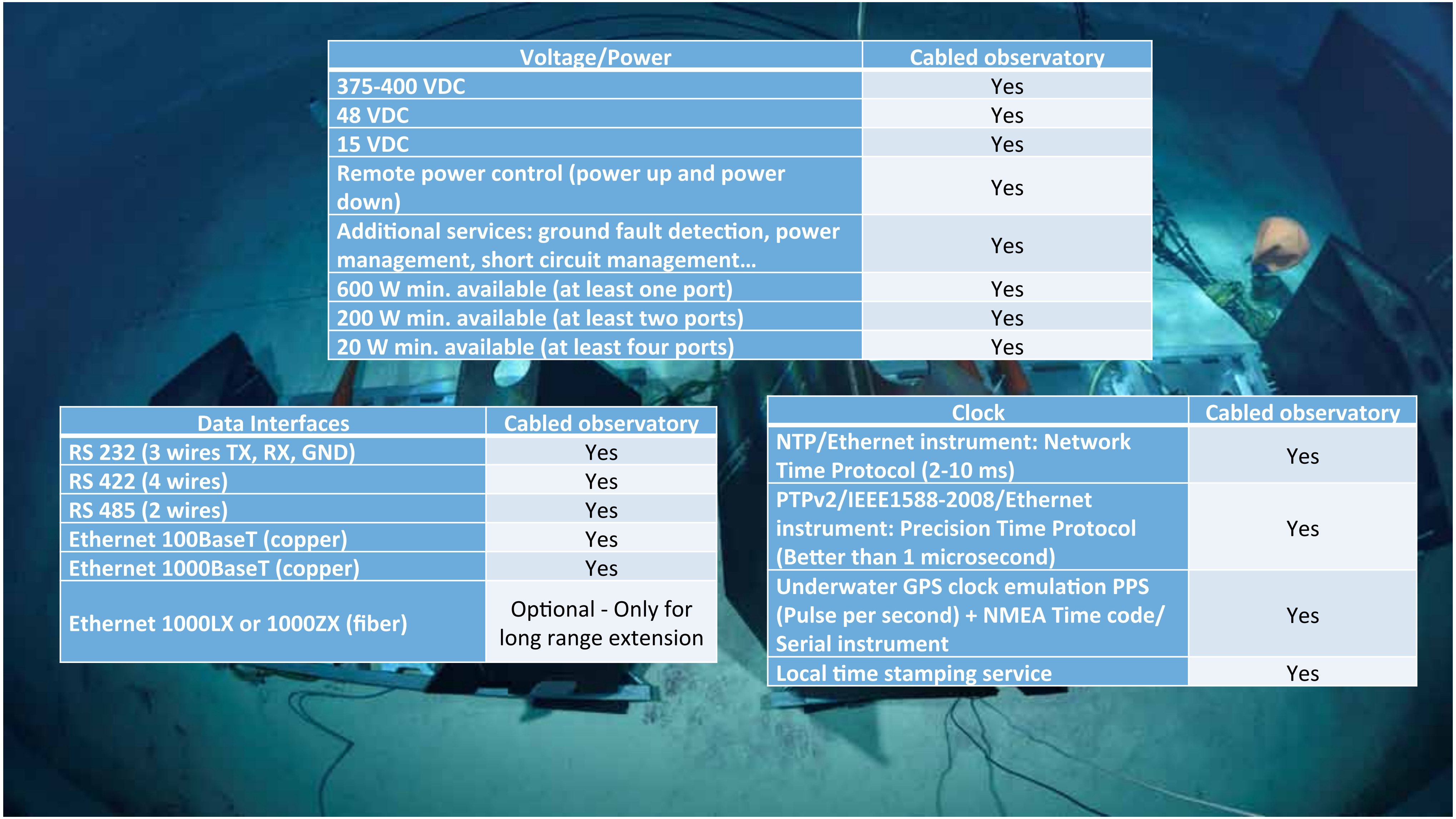
Connectors are the most unreliable components in cabled observatories!

Bulkhead part of connectors, including **dry mateable** should withstand open face pressure and be studied for long term ageing (cf. *Ifremer testing specification of submarine engineering n° 31 SE19 B*) (mandatory)

Wet mateable connectors are delicate components. Their manipulation has to fulfil ROV good practices. Any improvement in guiding the connecting process is welcome.
(to be improved including through partnership with oil and gas)

Cost and purchase time is a limiting factor of our projects
(spare part policy in EMSO or JERICO-NEXT?)

http://wwz.ifremer.fr/institut/content/download/21181/305450/file/Ifremer-Connector tests-31 SE 19 B.pdf



Voltage/Power	Cabled observatory
375-400 VDC	Yes
48 VDC	Yes
15 VDC	Yes
Remote power control (power up and power down)	Yes
Additional services: ground fault detection, power management, short circuit management…	Yes
600 W min. available (at least one port)	Yes
200 W min. available (at least two ports)	Yes
20 W min. available (at least four ports)	Yes

Data Interfaces	Cabled observatory
RS 232 (3 wires TX, RX, GND)	Yes
RS 422 (4 wires)	Yes
RS 485 (2 wires)	Yes
Ethernet 100BaseT (copper)	Yes
Ethernet 1000BaseT (copper)	Yes
Ethernet 1000LX or 1000ZX (fiber)	Optional - Only for long range extension

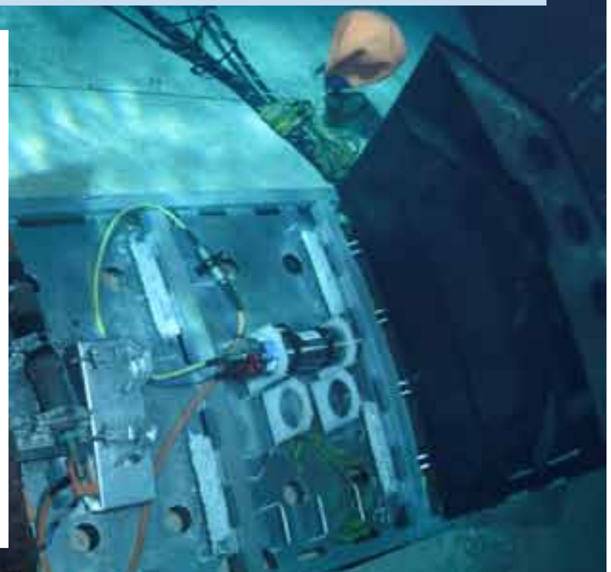
Clock	Cabled observatory
NTP/Ethernet instrument: Network Time Protocol (2-10 ms)	Yes
PTPv2/IEEE1588-2008/Ethernet instrument: Precision Time Protocol (Better than 1 microsecond)	Yes
Underwater GPS clock emulation PPS (Pulse per second) + NMEA Time code/ Serial instrument	Yes
Local time stamping service	Yes

Pin out recommendations: a dream of real plug and play!

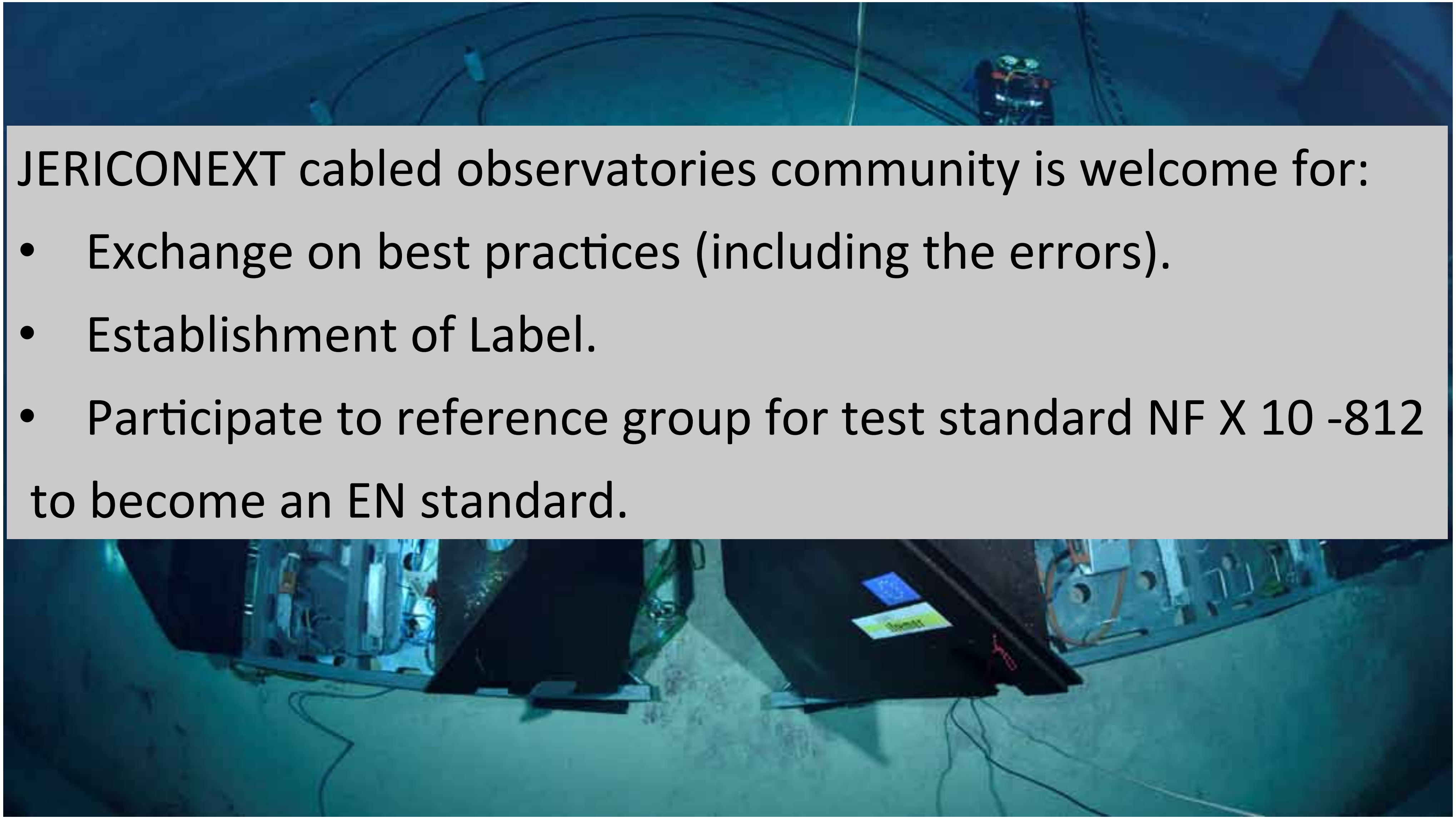
Exemple:

Junction box connector pin-out. Signal to instrument

	Ethernet	EIA-232	EIA-422/EIA485 4 wires	EIA-485 2 wires	1-Wire
1	Power$^-$ (0V)	Power$^-$ (0V)	Power$^-$ (0V)	Power$^-$ (0V)	Power$^-$ (0V)
2	Power$^+$ (5-28V)	Power$^+$ (5-28V)	Power$^+$ (5-28V)	Power$^+$ (5-28V)	Power$^+$ (5-28V)
3	*Tx+*	Tx	TxD+(A)	Data+	-
4	*Tx-*	Gnd	TxD-(B)	Data-	Gnd
5	Rx+	Rx	RxD+(A)	-	-
6	Rx-	-	RxD-(B)	-	Data
7	PPS$^+$	PPS$^+$	PPS$^+$	PPS$^+$	PPS$^+$
8	PPS$^-$	PPS$^-$	PPS$^-$	PPS$^-$	PPS$^-$
9	NMEA Tx$^+$	NMEA Tx$^+$	NMEA Tx$^+$	NMEA Tx$^+$	NMEA Tx$^+$
10	NMEA Tx$^-$	NMEA Tx$^-$	NMEA Tx$^-$	NMEA Tx$^-$	NMEA Tx$^-$
11	Chlorinator$^+$	Chlorinator$^+$	Chlorinator$^+$	Chlorinator$^+$	Chlorinator$^+$
12	Chlorinator$^-$	Chlorinator$^-$	Chlorinator$^-$	Chlorinator$^-$	Chlorinator$^-$



GND_48VDC_15VDC Power supply ground for the instrument
48VDC 48 VDC power supply for the instrument
15VDC 15 VDC power supply for the instrument
Data[1..4] Serial (RS232/RS422/RS485) or Ethernet 100BaseT
1-Wire tag metadata information memory that contains Transducer Electronic Data Sheets (TEDS)
PPS[1..2] Pulse Per Second output
NMEA[1..2] NMEA serial interface that contains Time Code ASCII message



JERICONEXT cabled observatories community is welcome for:

- Exchange on best practices (including the errors).
- Establishment of Label.
- Participate to reference group for test standard NF X 10 -812

to become an EN standard.

Biofouling protection for *in situ* Oceanographic Sensors

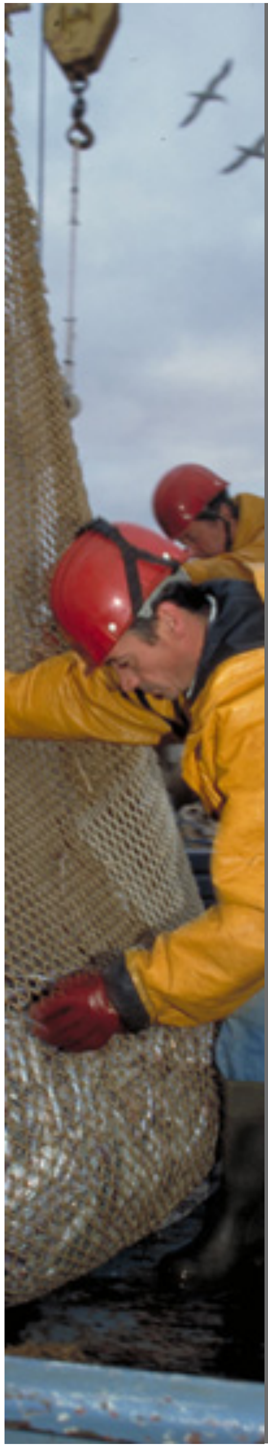
The bootleneck in Long-Term Monitoring!

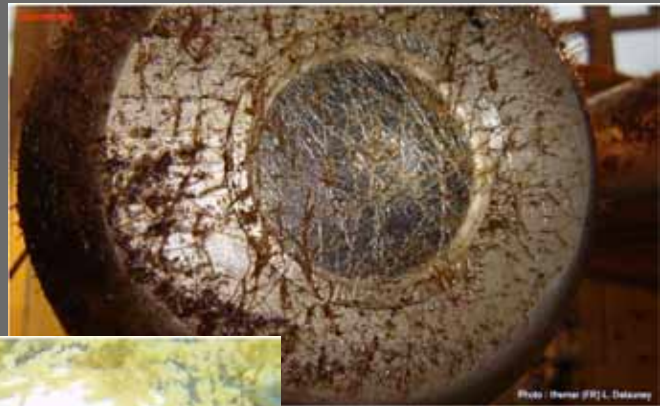
Nexos EU project

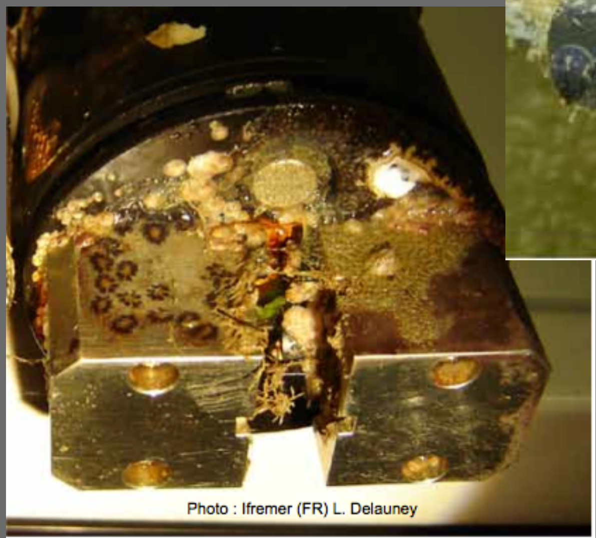
Laurent Delauney – Ifremer REM/RDT/LDCM

laurent.delauney@ifremer.fr

An agressive medium...



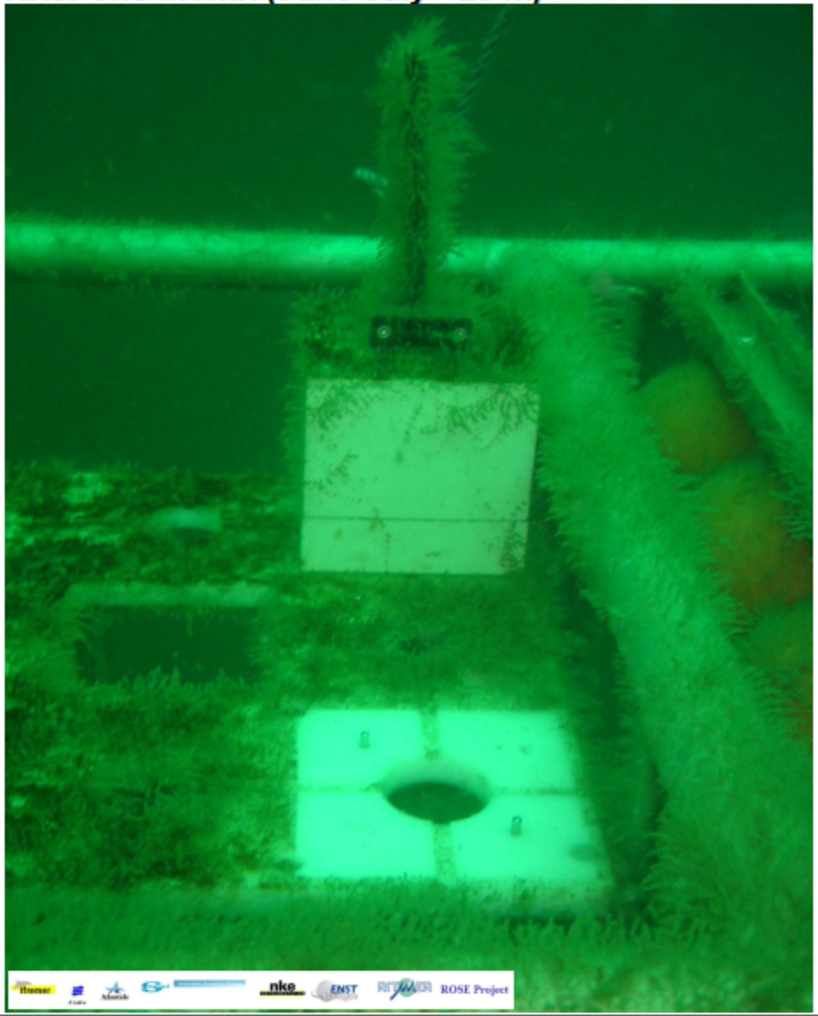




Biofouling and sensors

Marine Benthic Observatories.

After one month (June-July - 25 m)



After three months (June-Sept. - 25 m)

Photos : Ifremer (FR)

Biofilm development must be taken into acount ...

Biofouling example

YSI 6600 EDS (Extended Deployment System) - Clean SweepTM
150 days ◆ April - Sept 2005 ◆ St Anne Portzic Brest

Photo : Ifremer (FR) L. Delauney

Biofouling example

Optisens Transmissometer

90 days ◆ August - October 2005 ◆ Trondheim

Photo : Ifremer (FR) L. Delauney

Biofouling example

Seapoint Fluorometer

90 days ◆ May - July 2006 ◆ Brest

Photo : Ifremer (FR) L. Delauney

Biofouling example

YSI 6600 EDS (Extended Deployment System) - Clean SweepTM

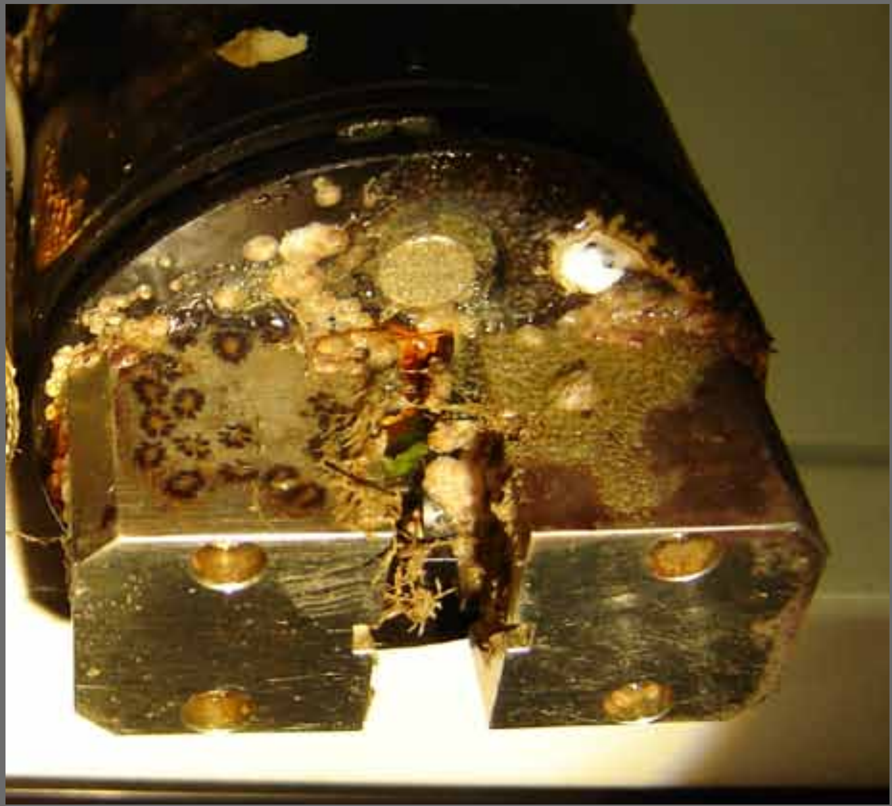
150 days ◆ April - Sept 2005 ◆ St Anne Portzic Brest

Photo : Ifremer (FR) L. Delauney

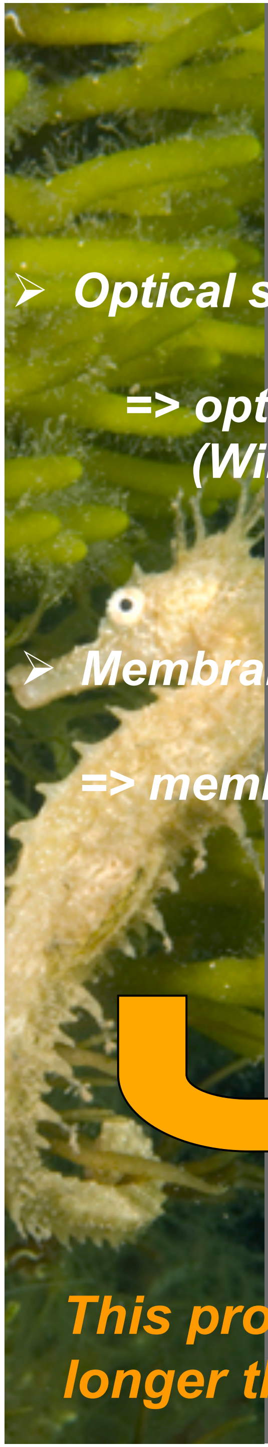
Biofouling example

- Materials and shape shoud be choosed very carefully in order to reduce fouling attachement.

40 days ◆ August - October 2005 ◆ Helgoland - DE



Photos : Ifremer (FR) L. Delauney



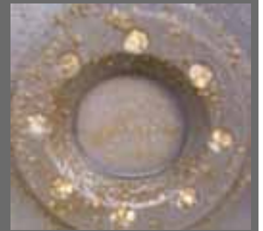
Biofouling effect on marine sensors : Progressive interface modification.

- **Optical sensors : turbidimeter, fluorometer, ...,**

  => optical property modification (Window opacity, interference, ...

Atlantic Ocean

Bosphorus strait

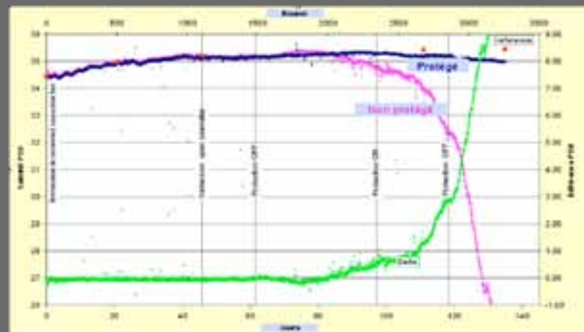


Baltic sea

- **Membrane based sensors : pH, oxygen.**

  => membrane permeability modifications.

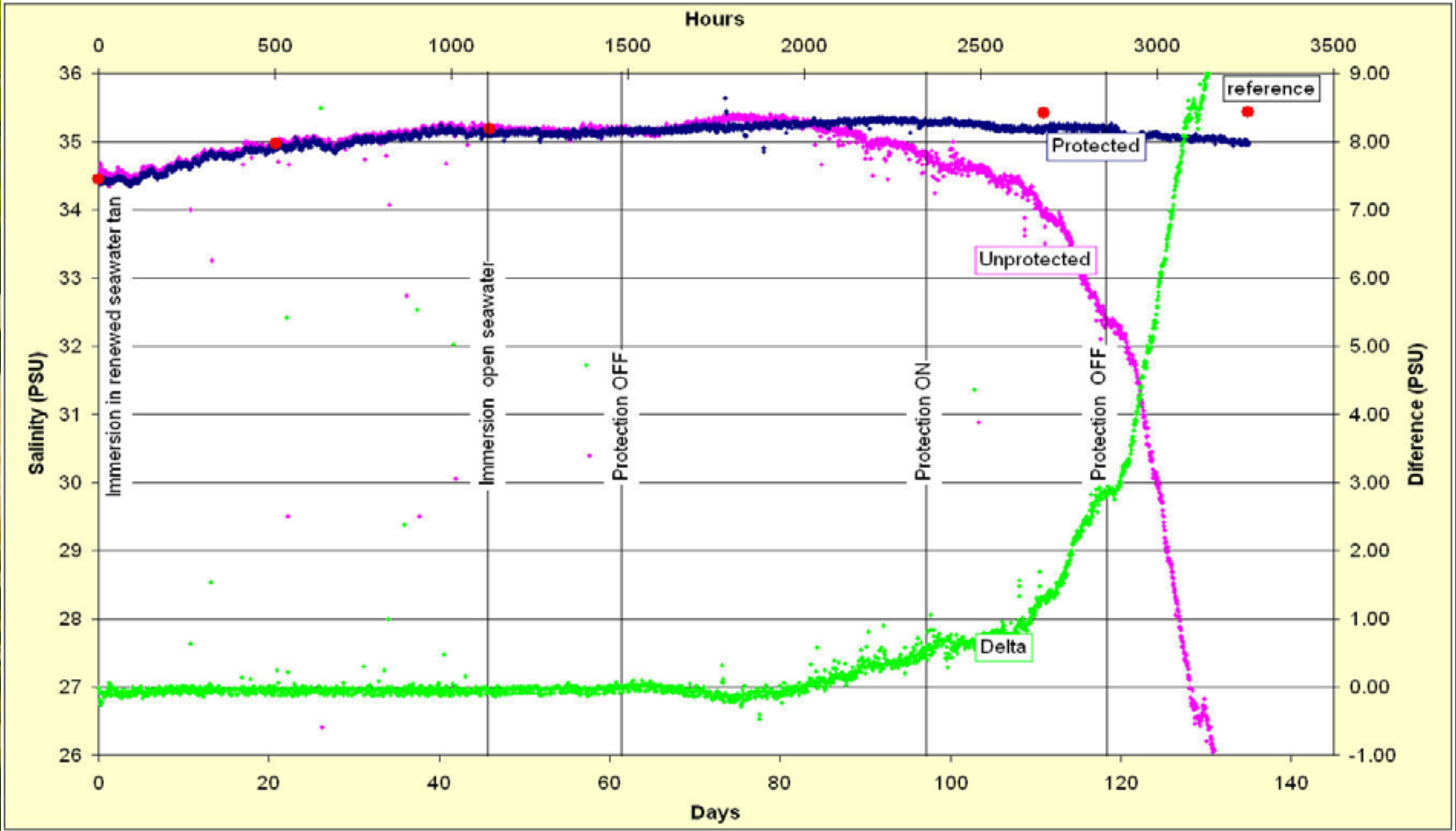
Loss of sensibility,
drift,
response time, etc.



This problem must be treated as long as autonomous measurement longer than 1 week is involved.

Sensor deviation example : conductivity

133 days ◆ 03 June - 16 October 2003 ◆ St Anne Portzic Brest



Conductivity Measurement - TPS35 Micrel Instrument

Objectives

- *For coastal observatories, the sensor protection system must delay the biofouling effect on the response of the measuring system for at least r 3 months in average condition.*

  For specific applications like deep sea observatories, biofouling protection effect should last for at least 12 months.

- *The protection system should be compatible with autonomous energy (batteries).*

- *The protection system must be adaptable quite easily on existing instrumentation.*

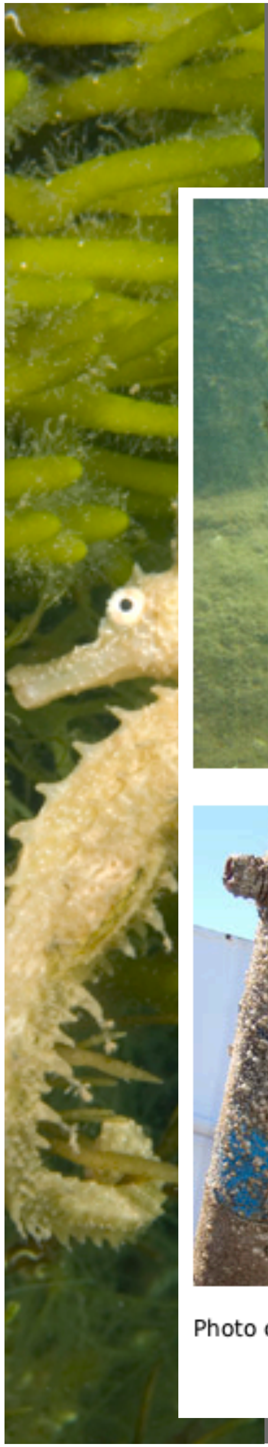
- *The protection system must not affect the measurements produced.*

Existing “off shelf” biofouling protection for oceanographic sensors

Mecanical Protection

YSI 6600 EDS (Extended Deployment System) - Clean SweepTM

Wipers



Mecanical Protection

ZEBRA-TECH (NZ) – Hydro Wiper

Photos courtesy of MScience Pty Ltd, Australia

Photo courtesy of USGS, Santa Cruz

Photo courtesy of NIWA, New Zealand

Photos : Zebra-Tech Web Site

Mecanical Protection

ZEBRA-TECH (NZ) – Opto Shutter

Film : Courtesy of NORTEKMED

Copper Biofouling protection

Fluorimeter Seapoint + Hobilabs Hydroshutter

Ifremer (FR) L. Delauney

- ***The instrument must be customised in order to build a Copper cell.***
- ***The Hydroshutter must be controlled by an external unit in order to open and to close it.***

Biocide diffusion

Seabird conductivity sensor => TBT rings

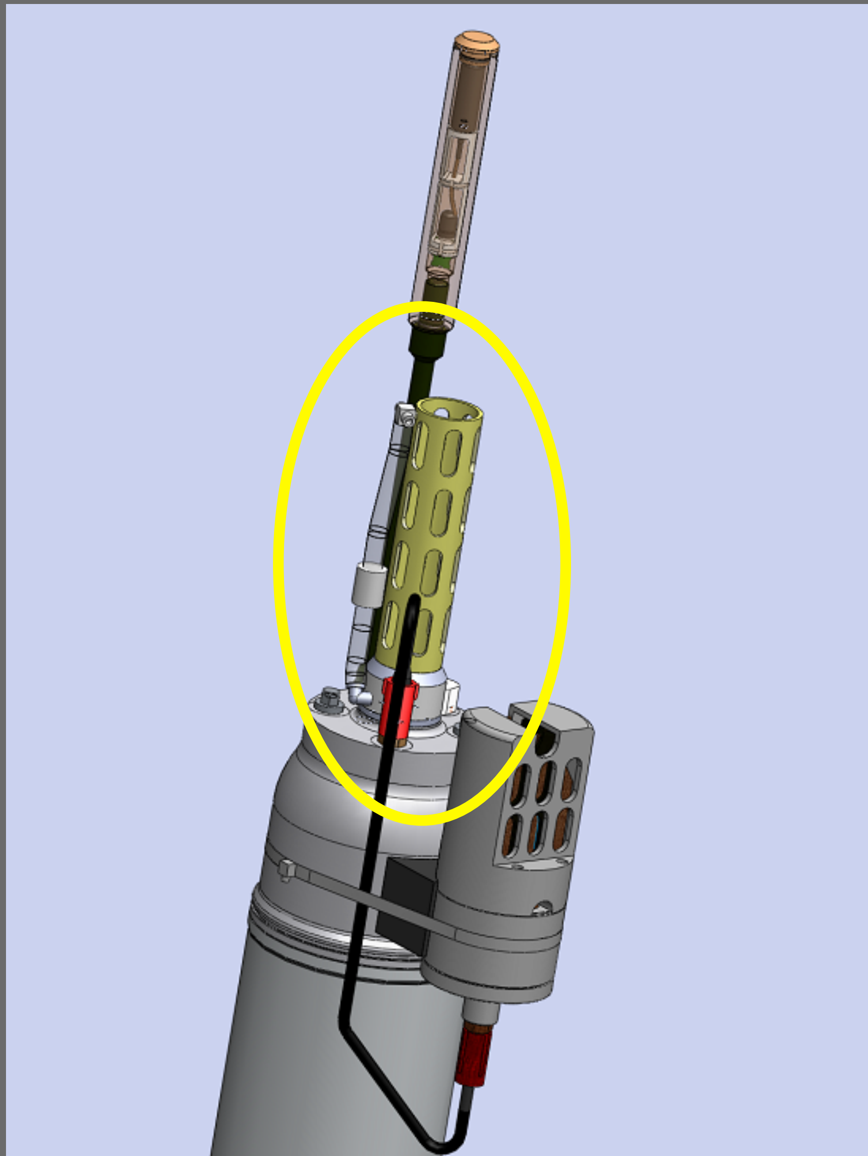


Illustration : NKE

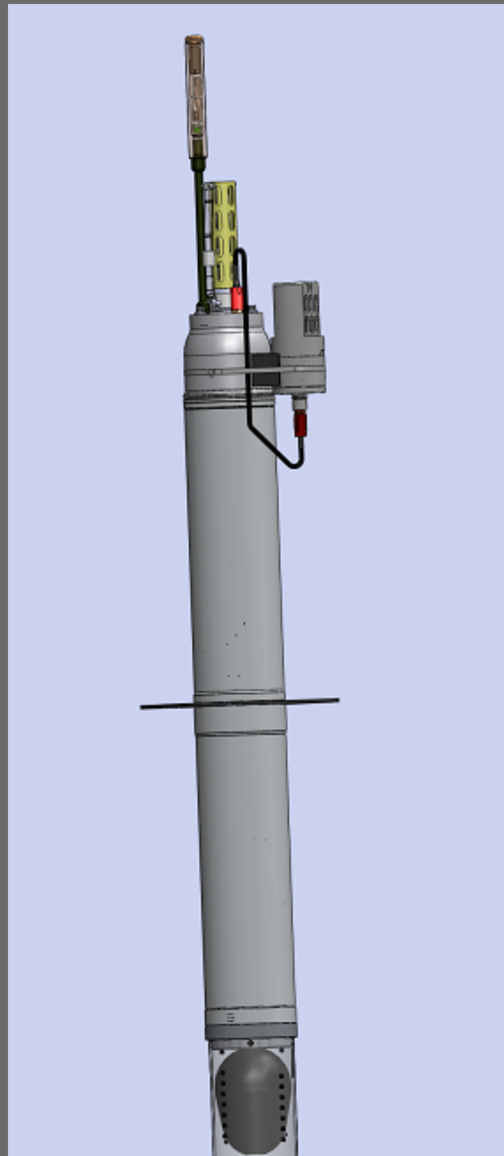


Illustration : NKE

Projet NOSS : NKE, Telecom Bretagne, SHOM, ifremer

Biofouling protection for sensor : the catalog

- Various techniques are now available to protect sensors:
  - Wipers
  - Copper shutter
  - Bleach
  - UV generation
  - Local biocide generation (described later…)

- The choice can be driven by different aspects :

  Hardware matter :
  - Robustness (depth of use)
  - Mechanical complexity
  - Easiness of adaptation to the existing instrument
  - Level of integration

  Metrological aspect :
  - Adverse effect to the measured parameter.
  - Is system can be turned on and off.

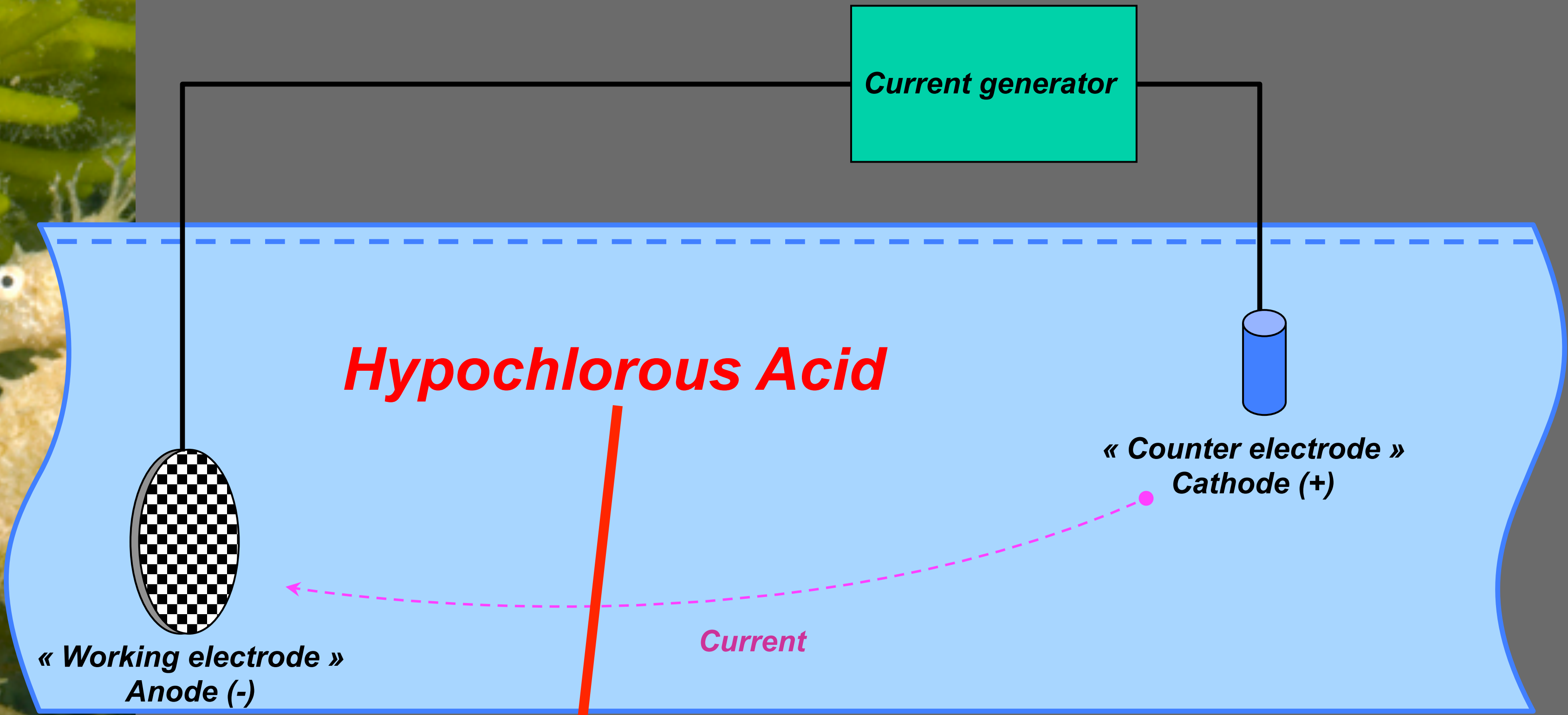
  Economical aspect :
  - Availability on the market.
  - Price.

An idea,
Producing the biocide in the sea:
Seawater electrolysis

Ifremer (FR) L. Delauney
laurent.delauney@ifremer.fr

Chlorine Generation System In Sea Water

- Sea water electrolysis : Hypochlorous Acid generation.



$$2\,Cl^- \longrightarrow Cl_2 + 2\,e^-$$

$$2H_2O + 2\,e^- \longrightarrow 2\,OH^- + H_2$$

Then in function of pH and Temperature :

$$Cl_2 + H_2O \rightleftharpoons H^+ + Cl^- + HClO$$

Ifremer (FR) L. Delauney
laurent.delauney@ifremer.fr

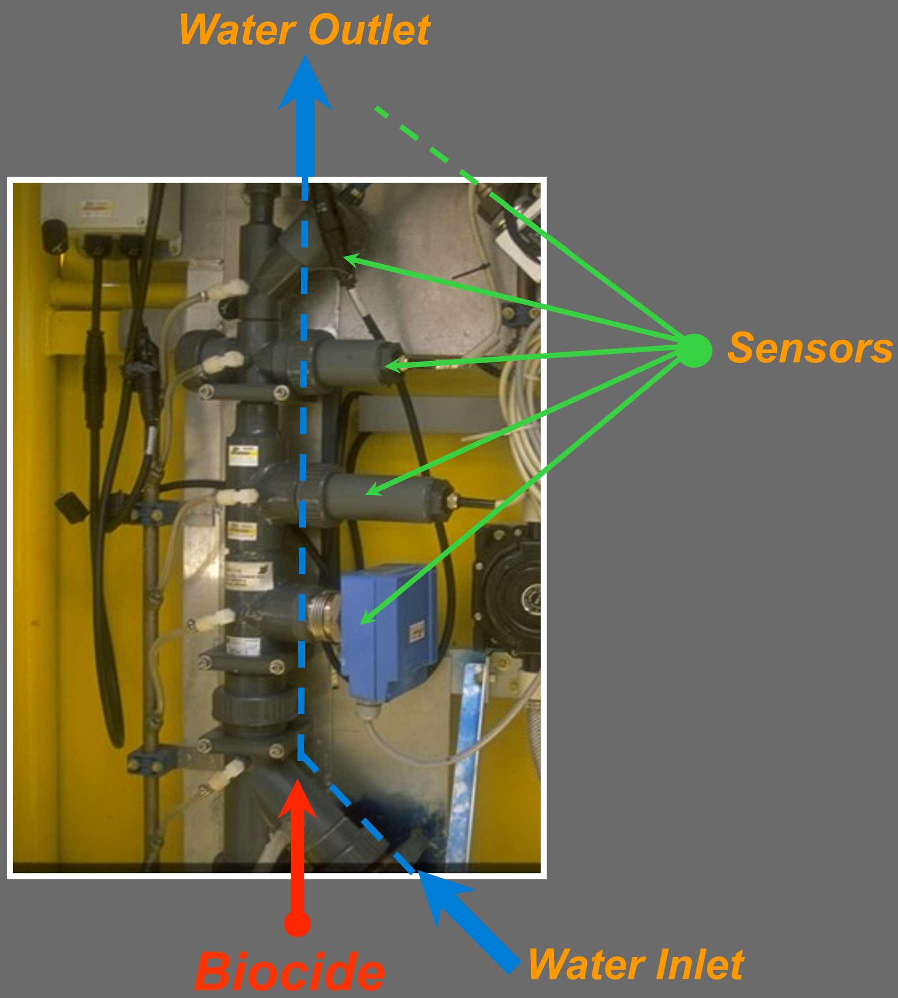
Note : Anode and Cathode naming is electrochemistry convention, electricity convention is the opposite.

Protection Strategy

Getting closer to the measurement interface…

Global Protection : an industrial usage

- ***Pumping is needed***



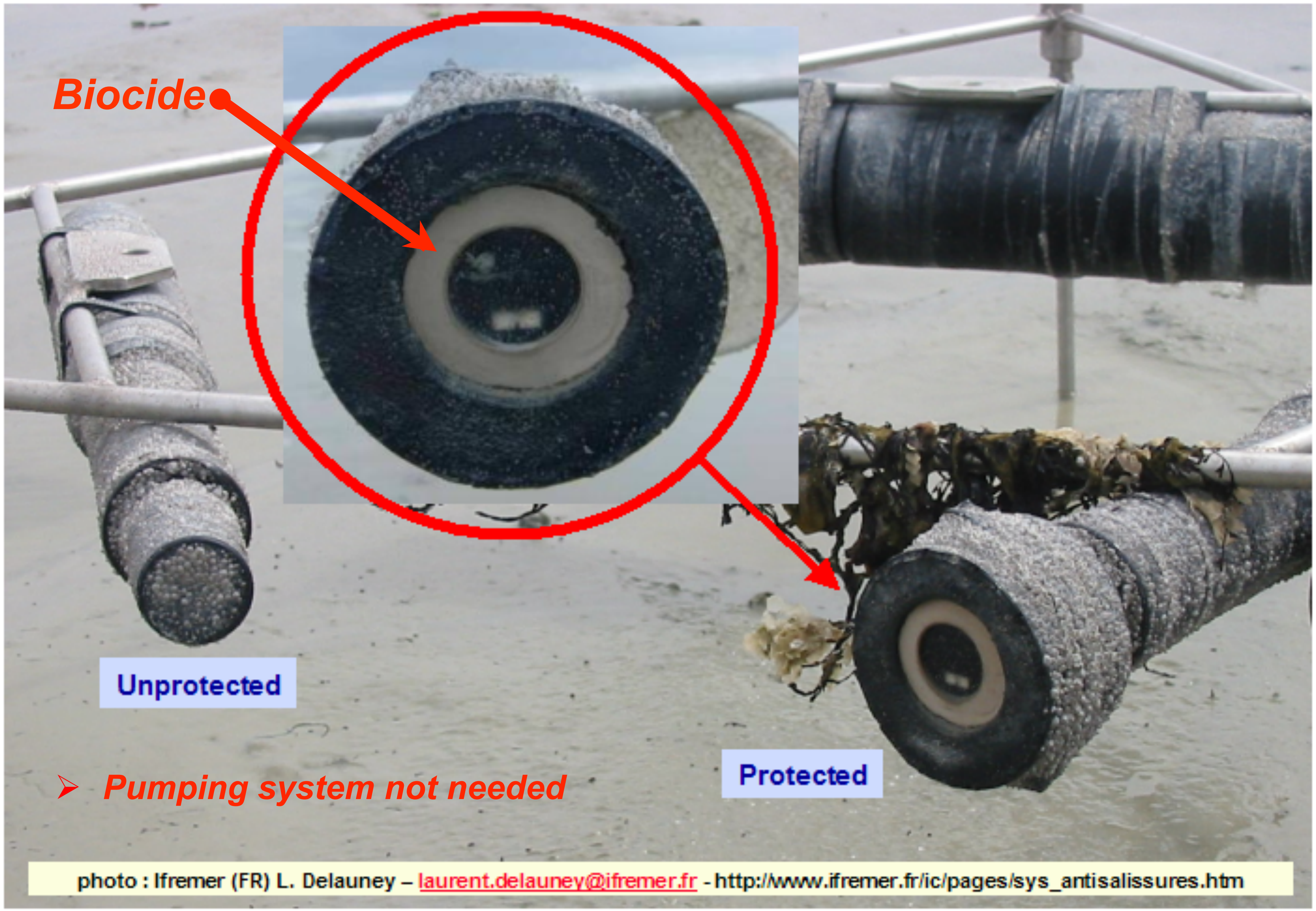
Photos : Ifremer (FR)

MAREL - Ifremer
Mesures Automatisées pour l'environnement littoral
(Autonomous Measurement for Coastal Environment)

Local Protection : annular electrodes

In situ biofouling prevention efficiency test

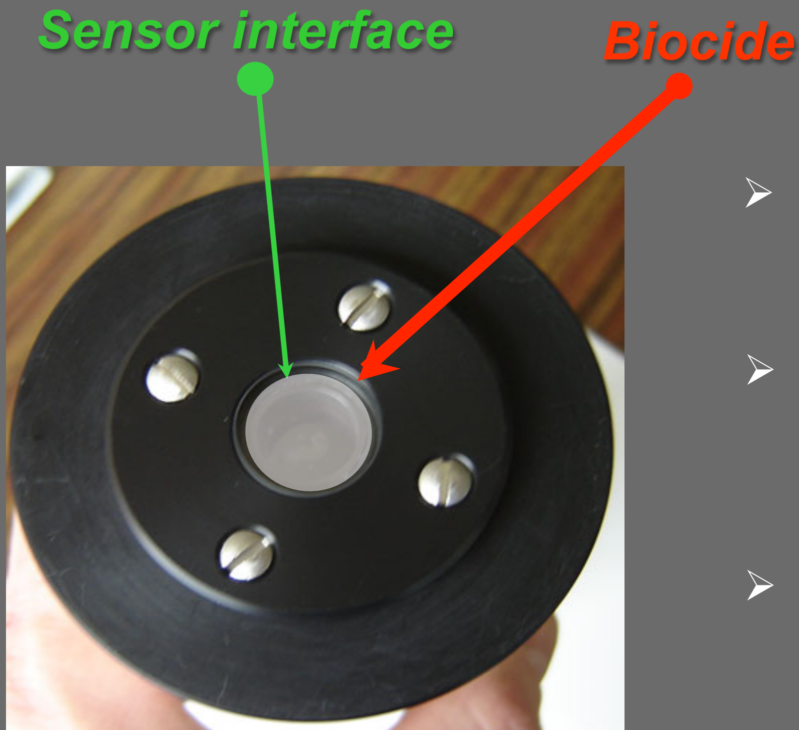
56 days duration ◆ March - May ◆ Mt St Michel Bay



Surfacic electrod : Coated window

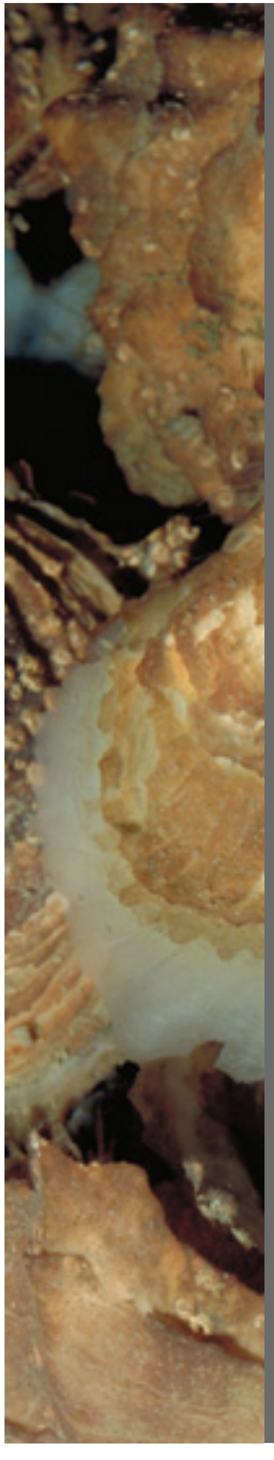
Interface Modification

Glass window coated with a specific material
in order to generate biocide on the surface



- *Optical sensor, camera, lights, ...*
- *Biocide generation is situated on the window surface.*
- *Biocide quantity needed is very low.*

How to implement these idea and strategy on sensors ?



Annular electrodes

localized seawater electrolysis

(ifremer)

ROSE Experiment results

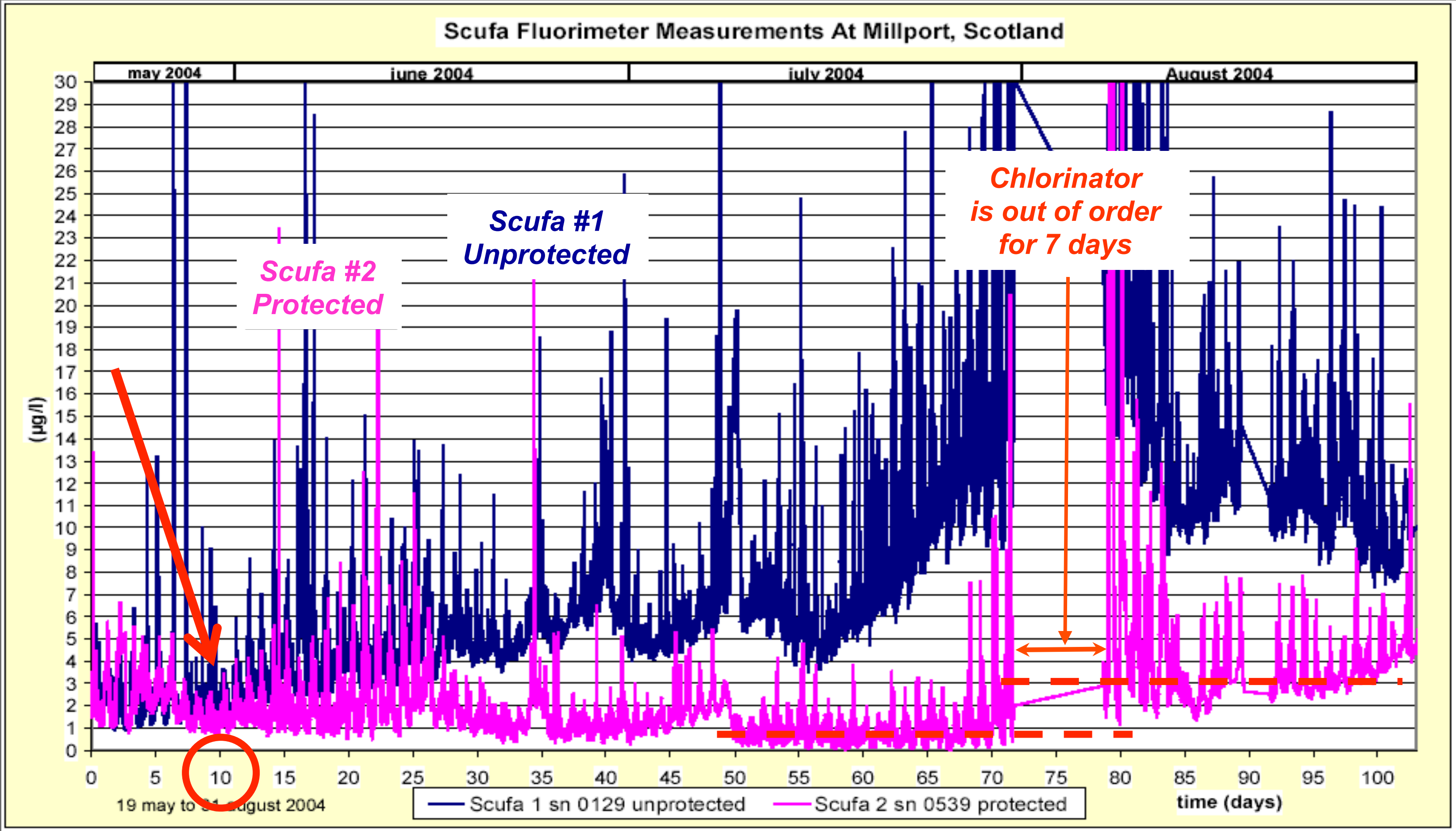
Benthic station – June to September 2006 - 25 meters deep

- *Hydrocarbon fluorometer : Trios EnviroFlu-HC*

Local Chlorination with annular electrode

In situ biofouling prevention efficiency test

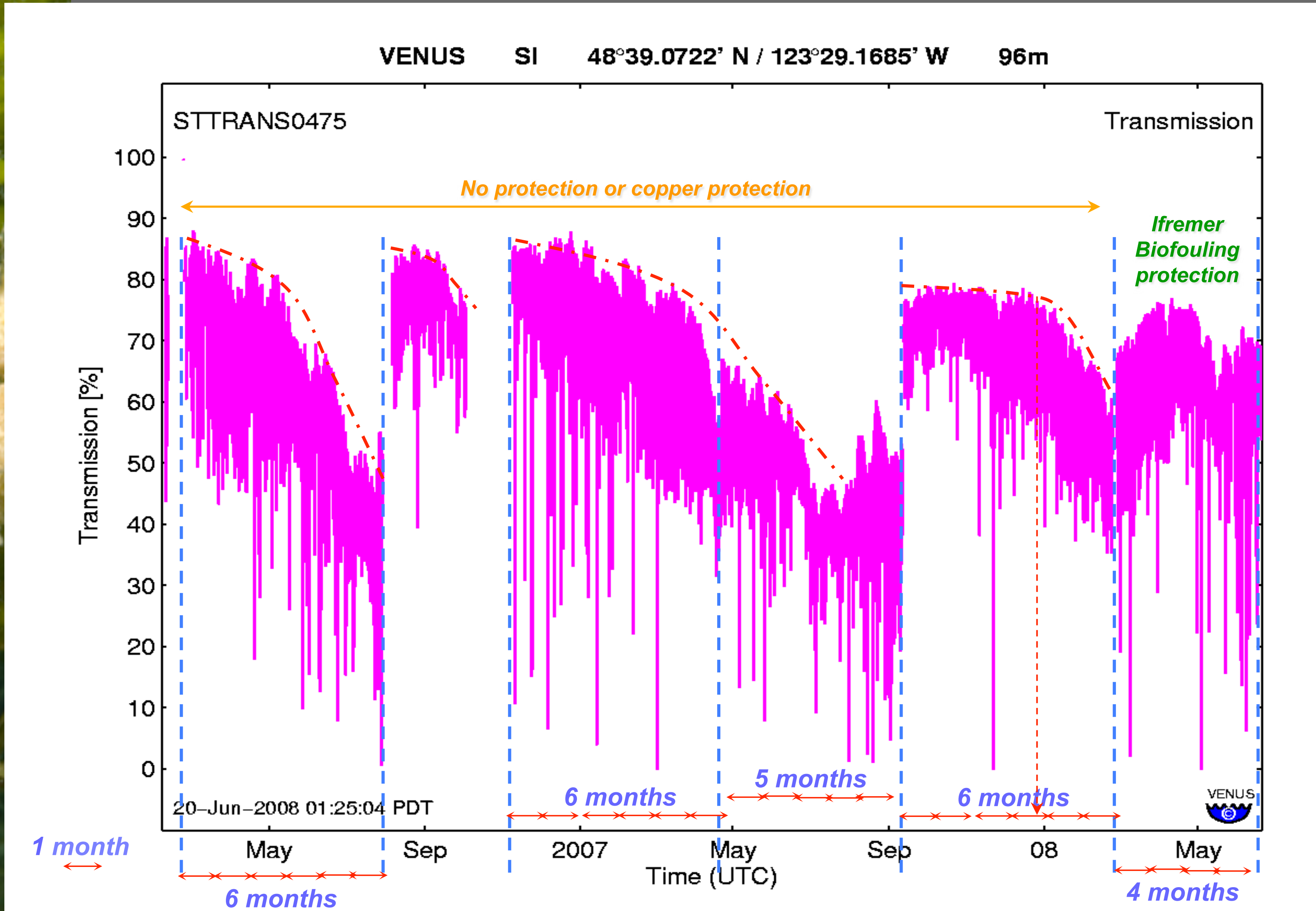
100 days duration ◆ 19th may - 31st Aug ◆ Millport



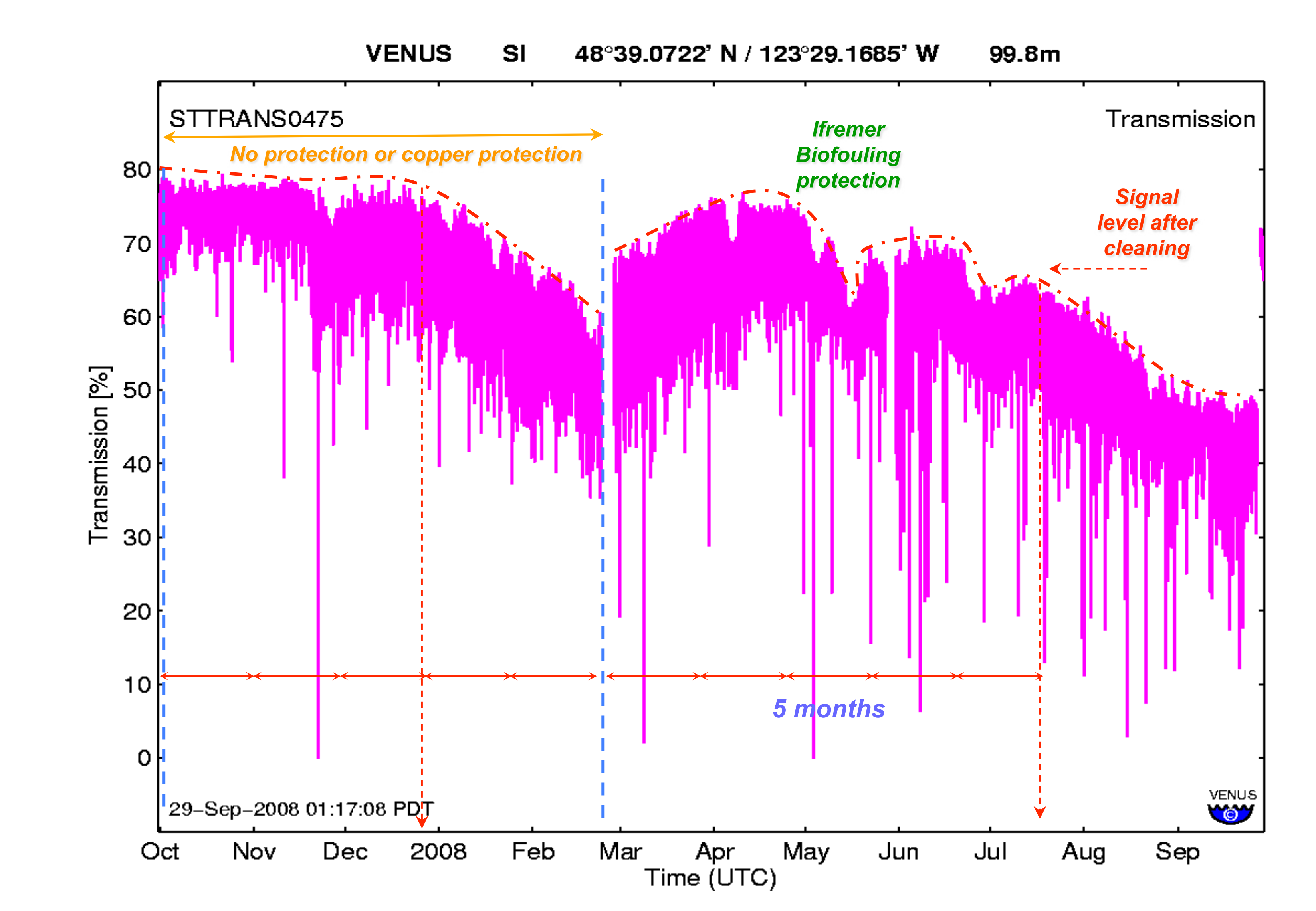
Fluorescence Measurement - Turner Scufa instrument

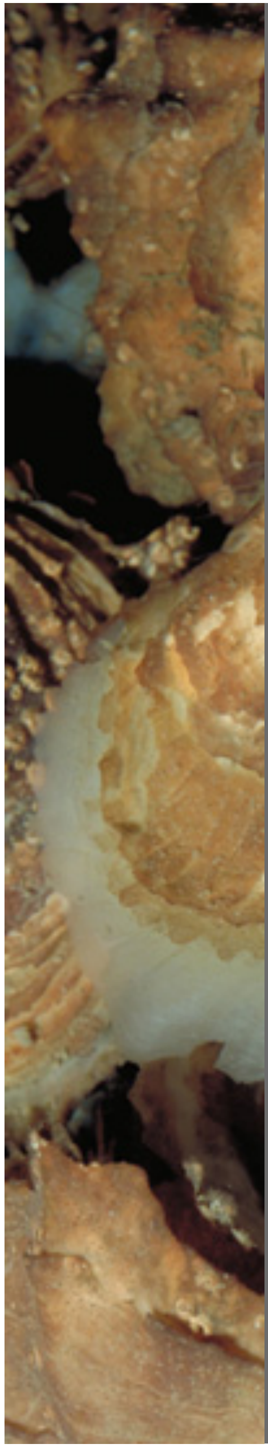
Ifremer (FR) Delauney, V.Lepage - GMTC (UK) Pr M.J. Cowling - Dr P. Cowlie

VENUS TRANSMISSOMETER
Ifremer Biofouling Protection – VENUS Data



VENUS TRANSMISSOMETER
Ifremer Biofouling Protection – VENUS Data





Protection antisalissure

chloration localisée (procédé ifremer)

Transmissometer Biofouling Protection System

Paul Macoun (VENUS Project Engineer)

Figure 4. INFREMER Biofouling system on VENUS

A customized bio-fouling protection system was installed on the Saanich Inlet SeaTech Transmissometer in February 2008. This local chlorination system was developed by engineers at the French research institute IFREMER.

The system is comprised of 3 electrodes, one adjacent to each optical window on the Transmissometer, and one centrally located between the two windows. The electrodes are supported by a small housing which contains the system controller and several Lithium cells.

The principle used to reduce bio-fouling is the electrolysis of sea water, which produces free chlorine in the vicinity of the optical windows. The controller alternates voltage potential between the central electrode and each window electrode switching every 10 minutes.

Figure 4 shows the IFREMER system mounted on the SeaTech Transmissometer. Figure 5 is a graph of Transmissometer data from March 1—Aug 1 2007 (+ symbol) overlaid with data from the same interval the following year (lines). There is a noticeable difference from before and after the system was mounted to the Transmissometer. The 2007 data indicate progressive fouling and resulting signal attenuation. The 2008 data look reasonable until mid-summer. The engineers at IFREMER believe the Lithium cells had become depleted at this point, and as a result we begin to see signal attenuation in June and July 2008.

In September 2008 the bio-fouling system was redeployed on the Transmissometer. The latest improvement to the system was the inclusion of a cable linkage to a Scientific Instrument

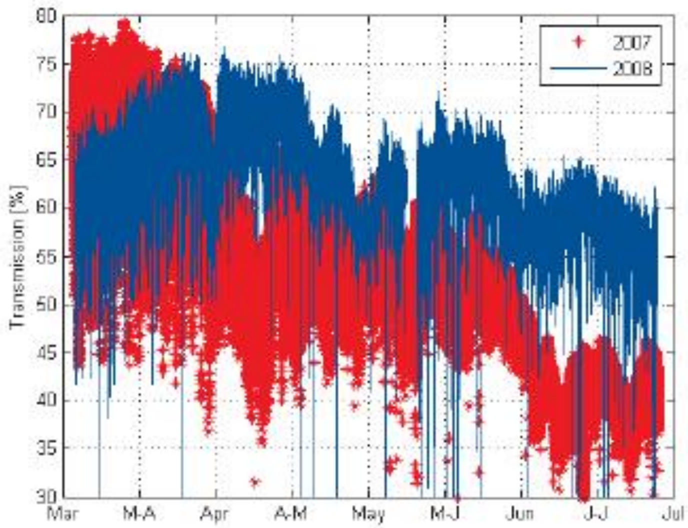


Figure 5. Transmissometer Data Comparison 2007-2008

Interface Module (SIIM). The system is now powered continuously through the VENUS array.

VENUS and IFREMER will continue to collaborate on bio-fouling protection systems. The present plan is to use the local chlorination system to protect other optical instruments on the various observatory platforms.

Issues and problems

Localized electrolysis with an annular working electrode, a good idea, but, how to…

=> Ensure the protection of large portholes

=> Lower power consumption (at least / 10)

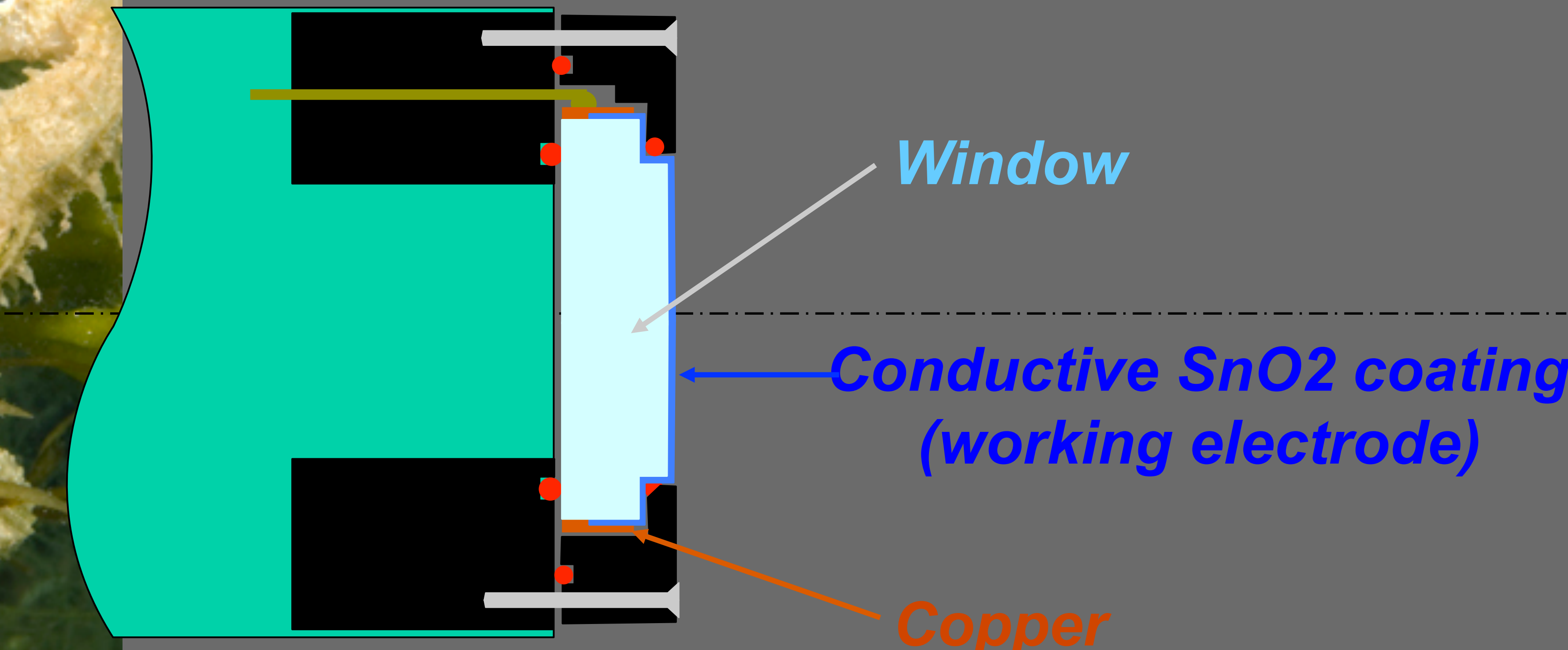
=> Improve the integration of the device.

Tempo Mini
Window for deep camera : 15cm diam.

Issues and problems

A smart solution for optical systems :

Electrochlorination by SURFACE thin film working electrode on window



Issues and problems

Electrochlorination by SURFACE thin film electrode on window

TriOS microFlu-chl Fuorometer

Ifremer (FR) L. Delauney Y. Faijan
GKSS (DE) K. Kröeger et Al.

Coating Durability

Finding out how long the electrochemical and optical characteristics of the SnO_2 coating last in Marine environment

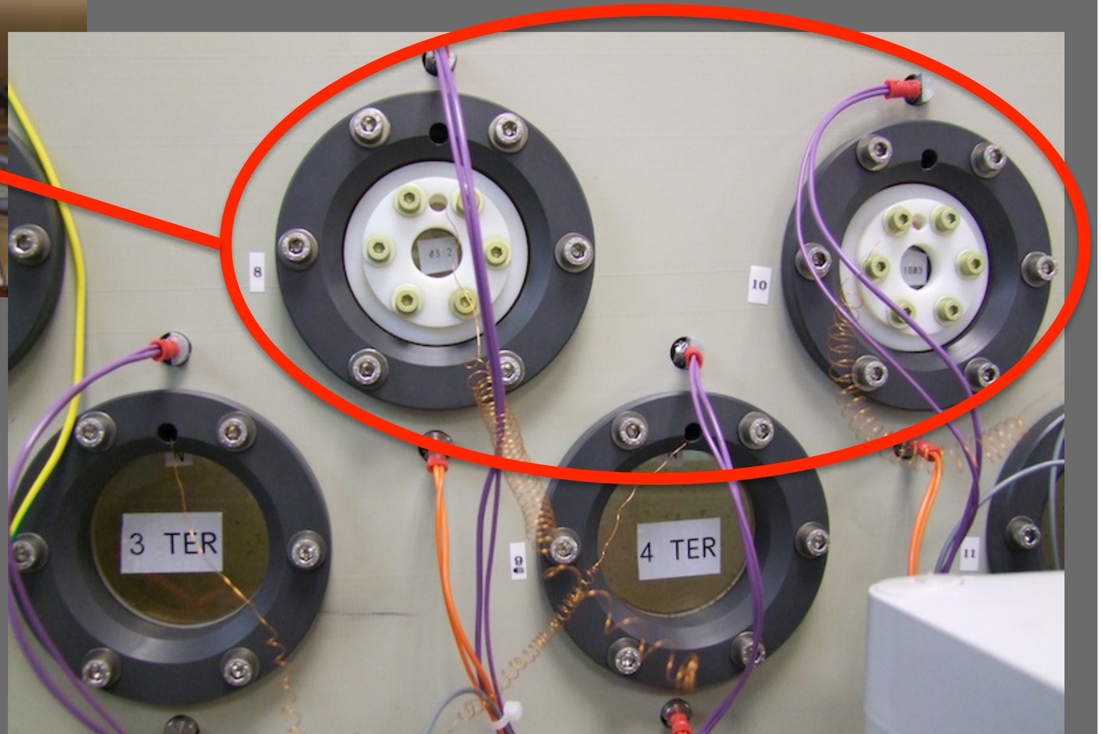
Goal => 3 years

12 windows tested in a continuously renewed seawater bench

Coating Durability

DURABILITY TESTS on functionalized TRIOS windows

For 24 months now, Trios functionalized windows are working correctly



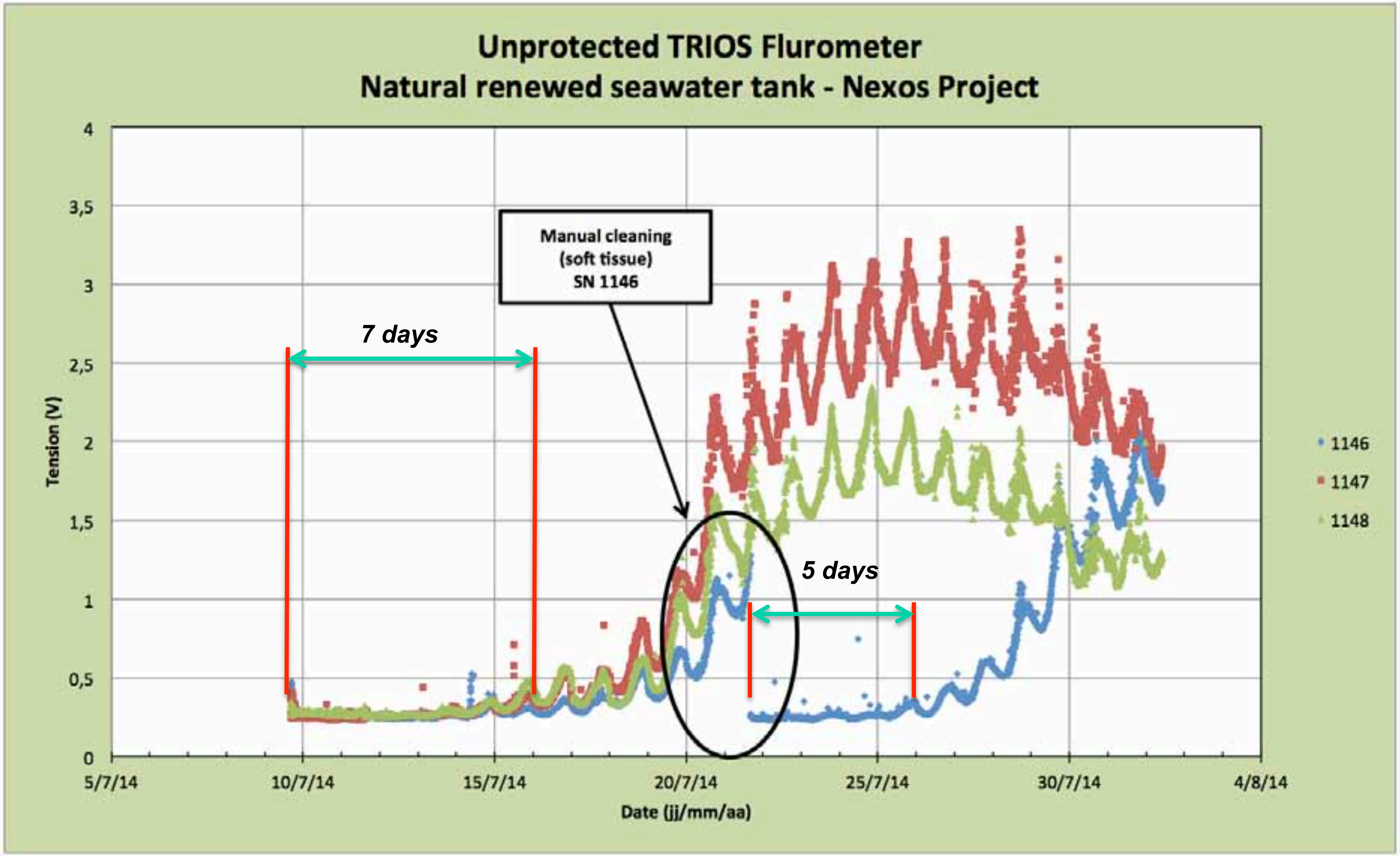
Durability test is still runned along the whole Nexos Project

In situ test

Electrochlorination by SURFACE thin film electrode on window
In situ testing platform – Continuously renewed seawater bath

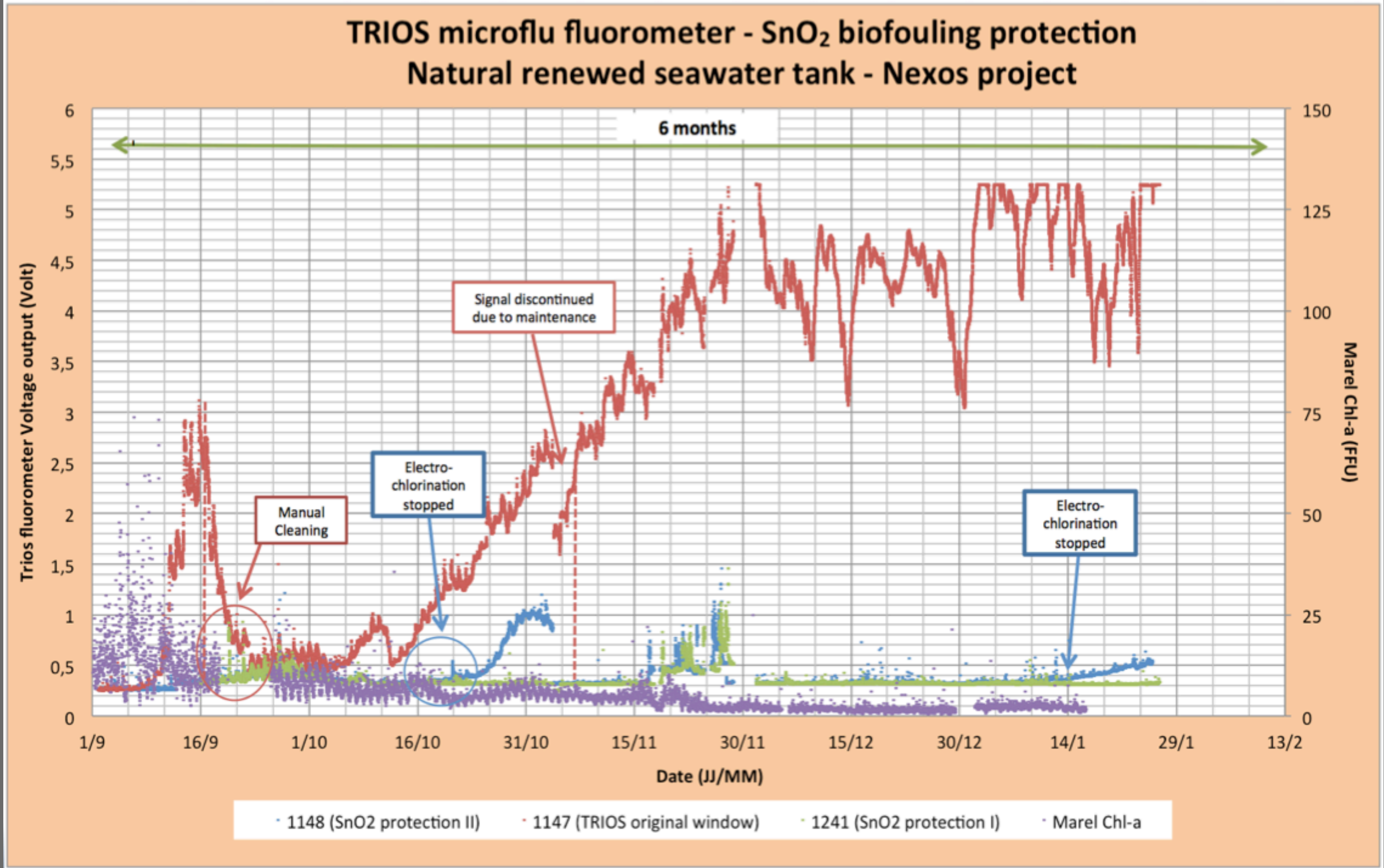
In situ test

Electrochlorination by SURFACE thin film electrode on window



In situ test

Electrochlorination by SURFACE thin film electrode on window
18 months of protection achieved



In situ test

Electrochlorination by SURFACE thin film electrode on window
18 months of protection achieved

No protection

Thin film electrode protection

Achieved results and Perspectives

To date 100% of tested windows show a good behavior after 24 months of operation in natural seawater.

The aim would be to reach 3 years of operation => The test benches are maintained.

Progression from a demonstration level to a qualification and validation level (TRL 4 to TRL6).

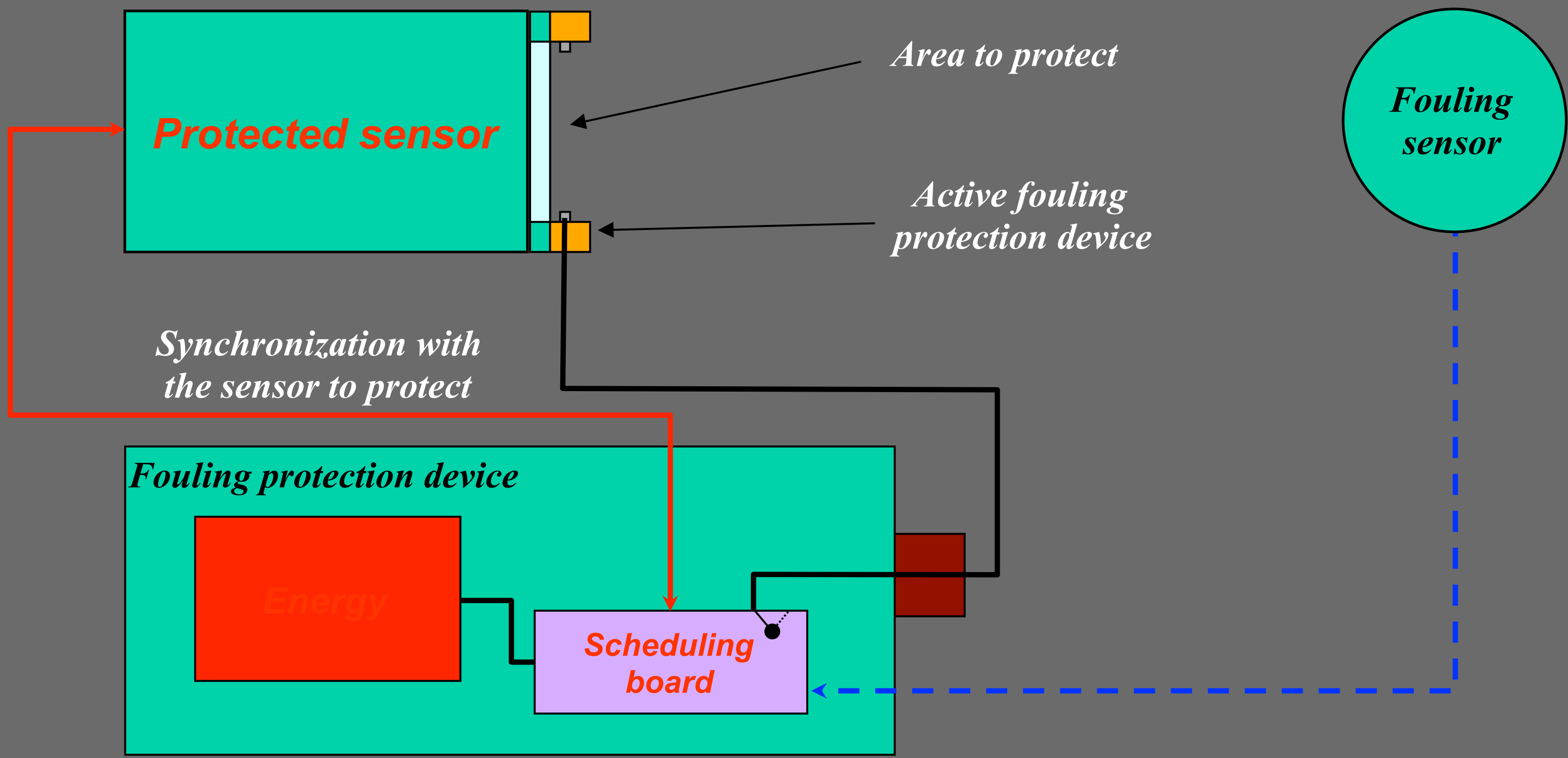
TRL8 nearly achieved: in situ test still in progress and giving encouraging results (13 months).

Level	Description
TRL 1	Basic principles of technology observed and reported
TRL 2	Technology concept and/or application formulated
TRL 3	Analytical and laboratory studies to validate analytical predictions
TRL 4	Component and/or basic sub-system technology valid in lab environment
TRL 5	Component and/or basic sub-system technology valid in relevant environment
TRL 6	System/sub-system technology model or prototype demo in relevant environment
TRL 7	System technology prototype demo in an operational environment
TRL 8	System technology qualified through test and demonstration
TRL 9	System technology qualified through successful mission operations

Prospectives

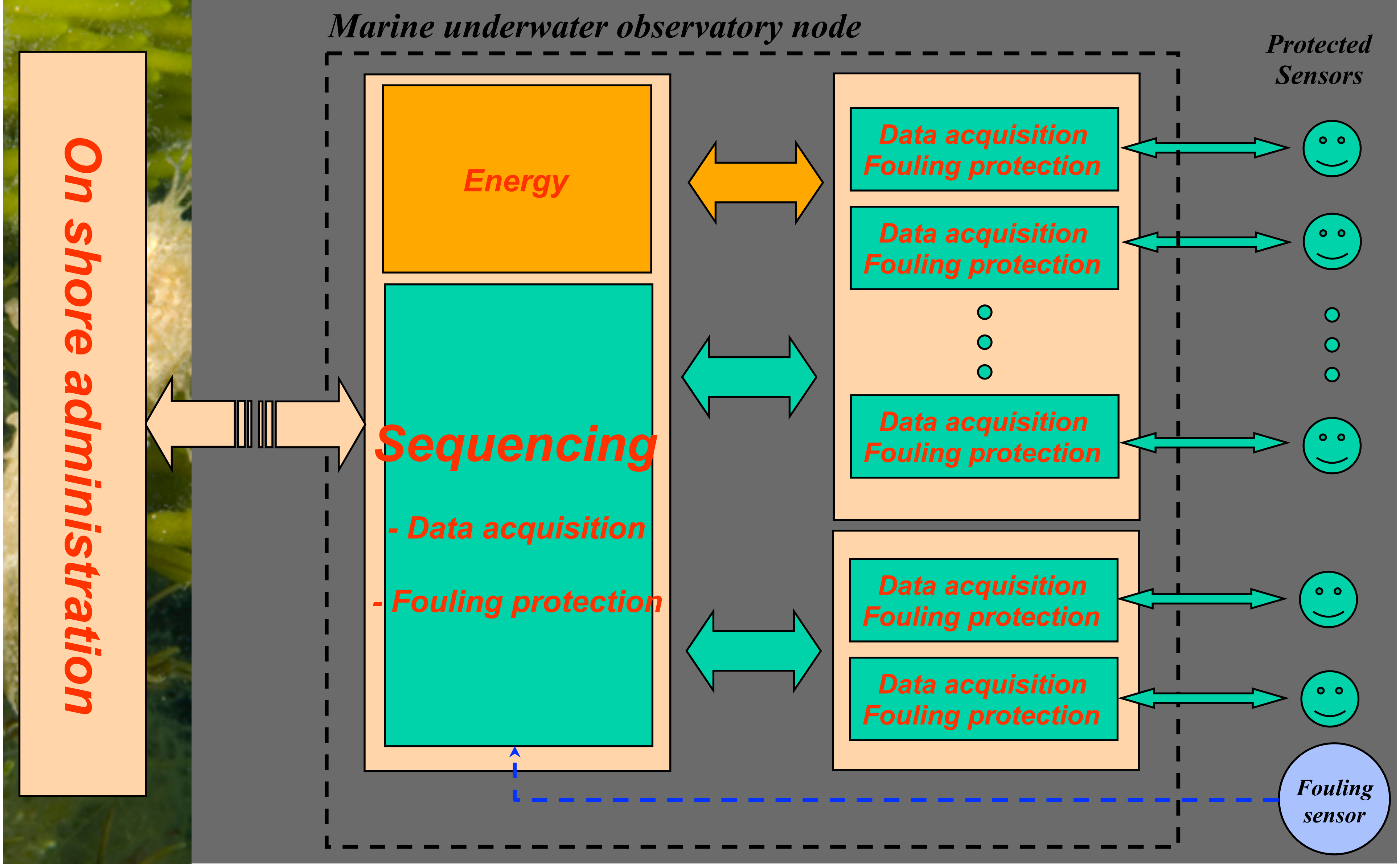
Biofouling management

- Fouling sensor for optimyzed scheduling
- Synchronization with the sensor to protect



Prospectives

Global Biofouling management



Thank you very much...