JERICO Fixed Platforms Workshop

Consiglio Nazionale delle Ricerche

Rome, 29 February – 1 March, 2012

Minutes from the Workshop

Prepared by

S. Sparnocchia, N. Greenwood, M. Ntoumas,

G. Petihakis, W. Petersen, D. Sivyer

3 May 2012

Final Agenda

WEDNESDAY 29TH FEBRUARY 2012

Session 1: Fixed platforms: current status and improvement (WP3 T3.3)

MORNING

9.15 Registration at the CNR main entrance

9.40 Welcome by CNR and logistic information by *Stefania Sparnocchia (CNR)*

9.45 Objectives of the workshop by *Patrick Farcy (IFREMER, JERICO coordinator), Wilhelm Petersen (HZG, WP3 leader), George Petihakis (HCMR, WP4 leader)*

10.30 Current overview of fixed platforms at the European level
Giuseppe Manzella (ENEA & EMODNET PP)

11.00 Coffee Break

11.30 ***Overview of fixed platforms in JERICO: current status and their contribution to existing Coastal Observatories; methods and practices in use***

- First overview from the information collected in JERICO (T3.3.1 - Fixed Platforms Questionnaire) by *Dave* Sivyer *(CEFAS) and Wilhelm Petersen(HZG)*

Short presentations by partners (5-10 min each)

- Coastal Research Station in Lubiatowo by *Rafał Ostrowski and Piotr Szmytkiewicz*
- Flemish Banks Monitoring Network by *Stephanie Van de vreken*
- Coastal Observation System for Northern and Arctic Seas (COSYNA) by *Wilhelm Petersen*
- Marine EnvironmentalNetwork North and Balearic Sea (MARNET) *by Detlev Machoczek*
- The SmartBuoy programme by *Naomi Greenwood*
- Marine Institute Ireland *by Sheena Fennell*
- SMHI Fixed Platform *by Olle Petersson*
- Poseidon Buoy network *by Thanasis Chondronasios*
- MAREL fixed platforms system *by Laurent Delauney*
- Fixed Point Costal Observation around Italy by *Stefania Sparnocchia and Rajesh Nair*

13.00 Lunch Break

AFTERNOON

14.30 Needs of fixed observing sites for estimating/modelling processes in the coastal zone (in collaboration with WP9) by *Srdjan Dobricic (CMCC)*

15.00 New sensors (e.g. pH, DIC, nutrients, …) and techniques for in situ measurements at fixed points (e.g. profilers, image analysis, acoustic methods…) T3.3.4+WP10
- pH sensors; image analysis by *Laurent Coppola and Lars Stemmann (CNRS-UPMC)*
- experiences with new sensors at HZG (pCO2, pH, nutrients, PSICam...) *by Wilhelm Petersen (HZG)*

1600 Coffee Break

16.30 Discussion and conclusions:

- Recommendations concerning best technical practices with fixed platforms including technological solutions for integrating new sensors .

Questions: - how to choose the site?
- technologies of mooring (if needed) in calm or rough sea ?
- buoy technologies : material, power supply, access to maintenance, ...
- data collection : internal support, communication,
- sensors' housing (other sensor-related aspects – calibration, cleaning will be discussed in the following sessions)

- Recommendations concerning new sensors to be passed to WP10.
- Filling the gaps.

Questions: - What are the gaps in geographical areas, sensors, methodology, ...
- Solutions (national & EU level)?

- Plan of further actions towards the compilation of the D 3.3. report on status of fixed platforms (M21=Jan 2013)

18.00 Session end

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THURSDAY 1ST MARCH 2012

Session 2: Maintenance methods: calibration (WP4 T4.1)

MORNING

9.30 Review of the existing facilities and practices of calibration in JERICO (from the WP4 - Calibration questionnaire) by *George Petihakis (HCMR)*

10.00 Calibration of optical sensors: outcomes from the Helsinki workshop of February 2nd, 2012 by *Jukka Seppala (SYKE)*

10.30 Metrology for Oceanography: main issues and IFREMER's actions by *Florence Salvetat (IFREMER)*

11.00 Coffee Break

11.30 Discussion

- Sharing of calibration facilities:

Questions: - Should we organise another calibration workshop/seminar for Oxygen, Temperature, and Conductivity ?
- Can we identify potential trans-network nodes?
- Can we promote technical collaborations/partnerships?
- For chemical sensors, can we arrange inter-calibration exercises between the involved institutions in order to assure a common lab quality?

- Recommendations concerning Best Practice in calibration
- Plan of further actions towards the compilation of the D4.1 Report on existing facilities (M18 = Oct 2012) and D4.2 Report on calibration Best Practice (M36 = Apr 2014).

13.00 Session end & Lunch Break

Session 3: Maintenance methods: biofouling (WP4 T4.2)

AFTERNOON

14.30 Review of the methods in use in JERICO and relative cost analyses (WP4- Biofouling Questionnaire) by *Marco Faimali (CNR)*

15.00 Biofouling protection for marine sensors – Review by *Laurent Delauney (IFREMER)*

15.30 ***Impact of Biofouling on infrastructure and data: some cases from partners' experiences (different environmental conditions)***

- Biofouling examples by *Carlos Castilla*
- EOL buoy by *Laurent Coppola*
- Biofouling techniques by Detlev Machoczek

16.00 Coffee Break

16.30 Discussion

Questions:

- *As sensors by different manufactures use different techniques and construction geometries, can we identify which are the most reliable?*
- *Dissolved oxygen sensors are commercially available which are claimed to be relatively immune to bio-fouling, can we test this?*

- Recommendations towards Best Practice in biofouling prevention.

Questions:

- *Can we plan a common biofouling experiment?*
- *Chemical sensors used within the JERICO network, comparison of methodologies used. Can we identify the best?*

- Plan of further actions towards the compilation of the D4.3 Report on biofouling prevention methods (M36 = Apr 2014)

Conclusions by *Patrick Farcy*

18.00 Workshop end

List of participants

Name and surname	Organization	email
Patrick Farcy	IFREMER	Patrick.Farcy@ifremer.fr
Ingrid Puillat	IFREMER	Ingrid.Puillat@ifremer.fr
Florence Salvetat	IFREMER	Florence.Salvetat@ifremer.fr
Laurent Delauney	IFREMER	Laurent.Delauney@ifremer.fr
Rafał Ostrowski	IBWPAN	rafal.o@ibwpan.gda.pl
Piotr Szmytkiewicz	IBWPAN	P.Szmytkiewicz@ibwpan.gda.pl
Rajesh Nair	OGS	rnair@ogs.trieste.it
Stefano Kuchler	OGS	skuchler@ogs.trieste.it
Stefania Sparnocchia	CNR	stefania.sparnocchia@ismar.cnr.it
Marco Faimali	CNR	marco.faimali@ge.ismar.cnr.it
Mauro Bastianini	CNR	mauro.bastianini@ve.ismar.cnr.it
Carolina Cantoni	CNR	carolina.cantoni@ts.ismar.cnr.it
Francesco Riminucci	CNR	francesco@riminucci@bo.ismar.cnr.it
George Petihakis	HCMR	gpetihakis@hcmr.gr
Thanasis Chondronasios	HCMR	chondronasios@hcmr.gr
Manolis Ntoumas	HCMR	mntou@hcmr.gr
Michael J. Howarth	NERC	mjh@noc.ac.uk
Wilhelm Petersen	HZG	wilhelm.petersen@hzg.de
Detlev Machoczek	BSH	detlev.machoczek@bsh.de
Stephanie Vandevreken	Flemish Hydrography	stephanie.vandevreken@mow.vlaanderen.be
Naomi Greenwood	CEFAS	naomi.greenwood@cefas.co.uk
Dave Sivyer	CEFAS	dave.sivyer@cefas.co.uk
Olle Petersson	SMHI	olle.petersson@smhi.se
Bengt Karlson	SMHI	Bengt.Karlson@smhi.se
Sheena Fennell	MI	sheena.fennell@marine.ie
Carlos Hernández	AZTI	chernandez@azti.es
Laurent Coppola	CNRS/INSU	coppola@obs-vlfr.fr
François Bourrin	CNRS/INSU	fbourrin@univ-perp.fr
Pascal Morin	CNRS/INSU	pmorin@sb-roscoff.fr
Sara Almeida	IH	Sara.Almeida@hidrografico.pt
Jukka Seppala	SYKE	jukka.seppala@ymparisto.fi
Benjamín Casas Pérez	CSIC/IMEDEA	benjamin.casas@imedea.uib- csic.es
Carlos Castilla	SOCIB	ccastilla@socib.es
Adam Gauci	UOM	adam.gauci@um.edu.mt
Srdjan Dobricic	CMCC	srdjan.dobricic@cmcc.it
Giuseppe Manzella	ENEA/ EMODNET PP	giuseppe.manzella@enea.it

1. Objectives of the workshop

The objectives of the workshop were to review the current distribution of Fixed Platforms in European coastal observing efforts and to advance the development of harmonized Fixed Platforms operations within the JERICO network utilizing information gathered through actions undertaken in JERICO work packages WP3 and WP4.

1. Overview of existing Fixed Platforms systems in Europe.
2. Review of the current status of Fixed Platforms operations in sustained (operational) coastal monitoring activity at the European level.
3. Review development of appropriate new sensors.
4. Plan development of recording of best practice procedures for Fixed Platforms operations (sensors, calibration, maintenance, antifouling).

Patrick Farcy (IFREMER and JERICO coordinator) introduced this first workshop on fixed platforms, a second one will be before the end of this year, when a deliverable will be also finalised describing on the best practices in running fixed platforms. The coordinator gave also a general description of the JERICO project, its structure and activities.

Wilhelm Petersen (HZG and WP3 leader) gave a general description of the objectives and actions of WP3 – Harmonizing Technological Aspects. As regards the Fixed Platforms Task 3.3, it is organized through four subtasks:

1) A review of the current status of all existing fixed observing sites in Europe via a questionnaire (shared Excel document on Zoho.com) which started in February 2012.
2) The present workshop.
3) Harmonization and merging quality assessed data from fixed platform with other systems such as FerryBoxes and fishing vessels. The test sites for this will be the North Sea (Cefas, HZG, Ifremer) and Adriatic (CNR).
4) Comparison of new sensors and assessment for FPs, in conjunction with WP10 (kickoff meeting on March 2nd).

A specific deliverable will be produced by this Task at M21 (Jan 2013): D 3.3 - Review of current marine fixed instrumentation. Moreover, the Task will also contribute to D 3.4 - Report on new sensor developments (M36 = May 2014) and to D 3.5. - Conclusion report (M42 = Oct 2014).

George Pethiakis (HCMR and WP4 leader) gave a description of the objectives and actions of WP4 – Harmonizing Operation and Maintenance Methods focusing on Tasks and Deliverables. The WP is organized into four Tasks:

1) Calibration, whose objectives are the harmonization of practices through documentation and assessment of existing methodologies, sharing of calibration facilities, best practices and dissemination of know-how.
2) Biofouling prevention, whose objectives are describing methods in use across the network with reference to the costs and adaptability, sharing best practices and methodologies, evaluating new methods used by the community external to JERICO.
3) End-to-end Quality Assurance, aiming at describing best practices in all phases of the system (pre-deployment test, maintenance, calibration etc), to adopt common methodologies and protocols, to move towards the harmonisation of equipment which will help in reducing maintenance and calibration costs. For this inter calibration tests and in-situ validation will be organised.

Two questionnaires has been sent to partners in November to collect information on existing calibration facilities and calibration practices in use, and on practices against

biofouling adopted throughout the network. A spreadsheet/questionnaire is under preparation to evaluate the running costs of facilities. Partners will record expenses during 1 year so we will have a very good idea of how much we spend for each platform.
A common workshop has been organized by SYKE on February 9^{th}, 2012, dedicated to calibration and anti-fouling methods of optical sensors. Another common workshop would be very beneficial and this is a discussion point of the present workshop. Platform workshops and Questionnaires will contribute to define Best Practices. Dissemination of know-how is achieved through common calibration workshops as well as during common WP3 & WP4 platform workshops, including the present one.
Five deliverables are planned for this work package, the first one is D4.1 - Report on existing facilities with the capacity to handle pressure, temperature, salinity and dissolved oxygen calibrations amongst the active coastal observing networks (M18, October 2013). Following deliverables are D4.2 - Report on calibration best practices for the different Sensors and D4.3 - Report on biofouling prevention methods (both due at month M36 = May 2014), and D4.4 - Report on best practice in conducting operations and maintaining of different systems and D4.5 - Report on running costs of observing systems (both due at month M42 = October 2014).
The WP has a very important milestone, that is the MS15 - Constitution of a permanent Working Group within JERICO for Calibration Activities (M30 = October 2014).

Discussion and Comments

G. Manzella: First comment is on “best practices, QA, QC”, also Eurofleet has similar activities, it could be very nice a coordination between the two projects for a common approach. Second comment is on running costs. The EEA has produced a document with an evaluation of running costs of operational observing systems in European Seas, also in this case it will be nice to compare this evaluation with the one resulting from JERICO.
G. Pethiakis: In JERICO we have three different kinds of platforms (FerryBox, Fixed platforms and gliders) and calibration facilities, so we have the opportunity to go into a more detailed and balanced analysis of the costs. We are now preparing the form for collecting this information in JERICO.
S. Sparnocchia: Consider also that installations/infrastructures participating to SA (WP7) and TNA (WP8) activities have to register the detailed running costs for the whole duration of the projects. This is a starting point for running costs calculation.

2. Fixed platforms: current status and improvement (Session 1)

2.1 Current overview of fixed platforms at the European level

Giuseppe Manzella (ENEA/EMODNET PP) described the general objectives of DG MARE through the launch of EMODNET (the European Marine Observation and Data Network) as a way to retrieve, assemble and integrate marine data acquired under fragmented initiatives and to make them available to a wide community, reusing them as much as possible, for the benefits of knowledge and innovation in the marine research field and maritime economy sector.

There are many initiatives in Europe regarding data management, collection and information systems (e.g. EIONET, GMES-marine, WISE, SEIS, to cite only a few), some of them are contributing to provide data required by EU directives (e.g. the Marine Strategy Framework Directive - MSFD). It is now mandatory that spatial data are compliant with the standards defined in the INSPIRE directive. The present limitation is that the Data Collection Framework of DG MARE only deals with fishery data, GMES focuses mainly on satellite data, SEIS and WISE marine have a limited amount of data. Cross-border and open sea data are lacking, there are many gaps in the observations of the European Seas, both geographical and more in time frequency. EMODNET wants to demonstrate where there are these gaps, wants to provide information on the actions needed for the harmonization of the observing systems and possibly provide indication on the places where the monitoring has to be reinforced. By setting up EMODNET, the EU aims to provide a sustainable focus for improving systematic observations. This initiative, integrated in the general frameworks of GEOSS and GMES, will also increase the precision of estimating magnitude and impact of climate change.

In particular, through its portal EMODNET PP aims to provide free and open access to marine data from measurement stations and FerryBoxes. <u>Here it is the opportunity of collaboration between JERICO and EMODNET PP</u>. Measurements from fixed stations should cover: wave height and period, temperature of the water column, wind speed and direction, salinity of the water column, horizontal velocity of the water column, light attenuation, sea level. Measurements from FerryBoxes should cover: temperature and salinity of the water column. At present, near real time data provision for EMODNET PP is organised at regional level (from Arctic to Mediterranean and Black Sea) and is involving the communities acting in these areas: the EuroGOOS ROOSes and My Ocean-in situ. Archived data are retrieved from SeaDataNet JERICO, Data Buoy Cooperation Panel and National Initiatives are desirable sources of data.

EMODNET PP benefits of the heredity of previous data collection initiatives, such as SEPRISE, the first EuroGOOS initiative on providing information on fixed platforms, and EDIOS, containing about 10000 observation entries and links to on-line real-time and archived data.

Access to NRT data is pretty much organized within ROOSes in collaboration with MyOcean. The existing network RT observing system presents spatial and temporal gaps, and a goal of EMODnet PP is to demonstrate that we are missing the observations needed for the operational and research applications.

Access to historical data is organised through SeaDataNet, but there are still gaps (data not yet available). EMODnet PP wants to demonstrate that NRT and historical data can be well organised in an unique Informative System (IS), and it wants also to demonstrate to be beneficial for the reanalysis products that are required for (e.g.) climate and fisheries applications.

EMODNET PP started one year ago, and most of the data collected until now are from the UK, but data from other European countries are progressively populating the database, as these countries are joining the project (see Figure 2.1). EMODNET PP differs from the other pilots, since it manages both Near Real Time and archived data. There are two different data streams but an unique interface providing information to the user. The flow of NRT data is based on MyOcean, and the one of archived data follows SeaDataNet. The window for NRT data is 60 days. The data in the portal are accessible after registration.

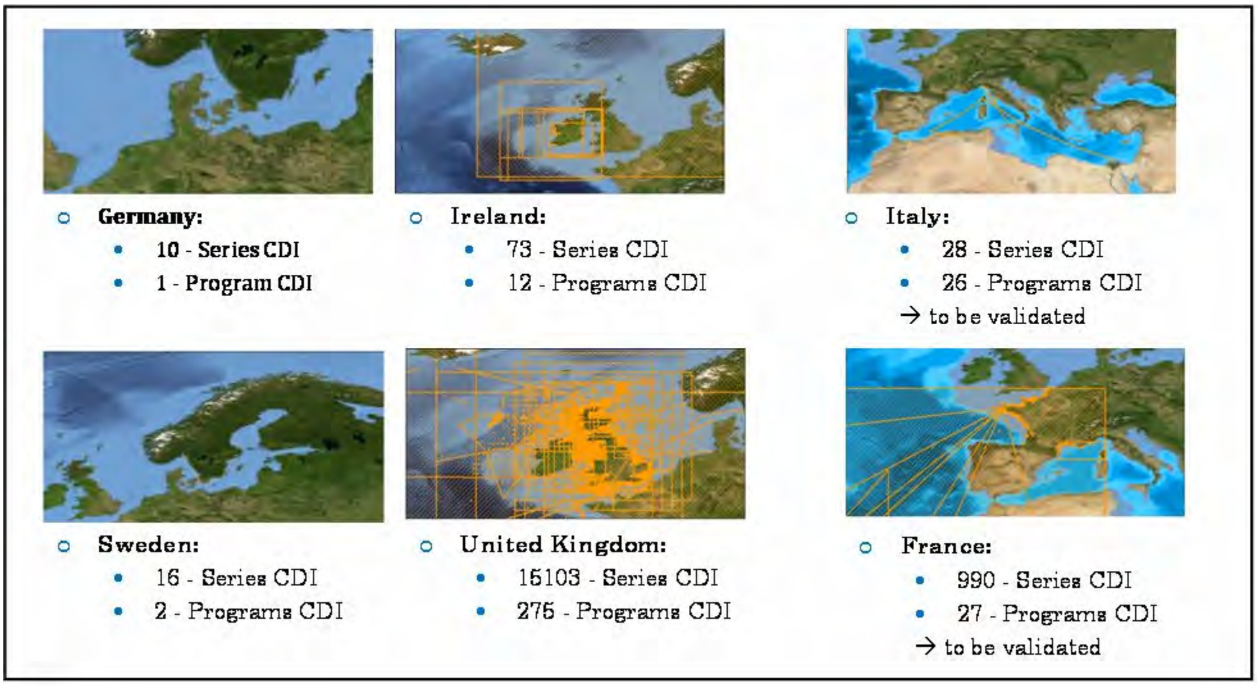


Figure 2.1 - *Overview distribution of historical data in EMODNET PP at the date of the workshop (from G. Manzella)*

Discussion and Comments

G. Pethiakis asks why the time window for Real Time data in EMODNET-PP is large (60 days), and if RT data mode miss the calibration.

G. Manzella replies that the time window is kept large for now to permit all the data providers be able to furnish data. This is enough in a proof of concept as the pilot is, it has to be solved in future. EMODNET requires quality data, so data providers are asked to apply QA and QC procedures before delivering them following already defined protocols.

R. Nair comments on the necessity to rethink the concept of data: no longer as a short term resource (e.g. for a single project or activity) but a resource that will be archived and reused for purposes other than the original (multi-user). This is an opportunity and a challenge for our community.

G. Manzella concludes that the philosophy behind the EMODNET is to collect once and reuse many times. Reusing the data could be a benefit for ocean science, research and society in a wider sense. By providing access to RT data, EMODNET PP is also giving the opportunity to have products and services to a wide European community.

2.2 JERICO survey on fixed platforms (T3.3.1 - Fixed Platforms Questionnaire)

Dave Sivyer (CEFAS) gave a presentation containing a preliminary analysis of the survey launched among the JERICO partners as an Excel in a password protected area on the Zoho server. The database contains additional records other than the ones inserted by the JERICO partners (from the EDIOS database). More than 50% of the information is collected from Italy, United Kingdom, Spain and France. Sea-level stations represent the 43% of entries and Black Sea looks to be under-represented in the census so far. Some of the information outside the JERICO consortium is probably outdated and lacking, and Dave suggested to check the entries at the national or regional level (EuroGOOS regions).

Actions to take

- compare JERICO table as it stands with work to update SEADATANET / EDIOS (Identify national representatives, Cefas to coordinate at the top level)
- Compare JERICO table (~550 stations) with MyOCEAN live data feeds (~850 stations) Define who will coordinate – possibly need to be someone inside MyOcean?
- Once a complete station list is made, each country / or OOS will: 1) verify if positions and depths are correct, 2) assure standard GPS format, std parameter codes etc.
- Write a report on final list and identify gaps according to geographic regions, or measurement parameter. Identify groups with common standards and common sets of instruments.

Wilhelm Petersen (HZG) provided a view of the stations included at present in the survey using Google tools, also evidencing the presence of station "out of order" (poor or missed information, e.g. in the Venice lagoon). There is the need of updating the information, then the next step is to ask description of the equipment installed in the fixed sites, and also to choose a vocabulary to describe the entries.

A discussion followed on how to update and maintain updated this file.

<u>I. Puillat</u> suggested to put all the questionnaires (from every WPs) in a restricted area of the JERICO website to give the possibility to everybody to check and update own information. It will be also a way to show to the community at what step we are.

<u>R. Nair</u> suggested to ask the contact persons for each station in the EDIOS database to update own file.

<u>S. Sparnocchia</u> supported Dave Sivyer's proposal of identify a national referent for checking and correcting the entries.

<u>W. Petersen</u> replied it is not a solution, since only for some country it will be easy to identify a national referent, but not for all.

Giuseppe Manzella showed some additional few slides describing existing initiatives for information systems related to Earth data (e.g. GEOSS, GMES, SEIS, EGIDA). Each initiative and each data provider has its own reference catalogue. This is a problem for an information system, since different programs refer to different catalogues, and the information system has to adapt to this change when it refers to a different program. The common architecture for data sharing provides a direct link from the client asking for data to the data provider (see Figure 2.2a), doing so the client and the service provider refer to the same catalogue. EGIDA, an European project related to EuroGEOSS, proposes a new design of an information system based on already existing data, which avoid the problem with different catalogues. EGIDA deletes the link from the client to the service provider, and inserts amid a “service broker” acting as a mediator which looks at the different catalogues and download the information requested by the client (Figure 2.2b).

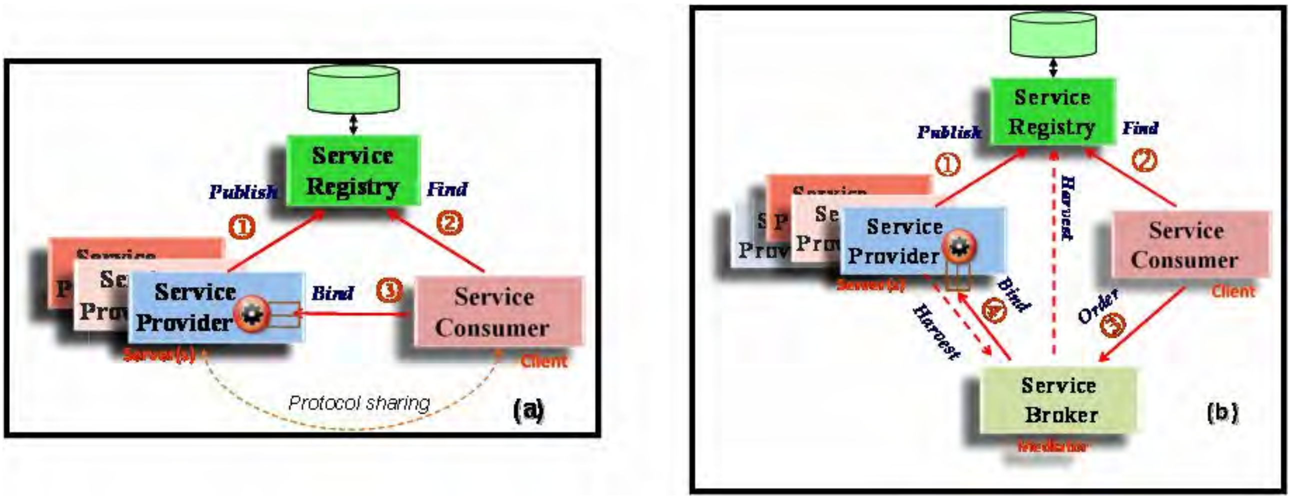


Figure 2.2 – *Common architecture of an Information System (a) and new approach by EGIDA (b) (from G. Manzella presentation - courtesy of Stefano Nativi CNR)*

Giuseppe showed and described the Excel file used in EMODNET PP to collect information, which also was initially adapted from EDIOS and contains similar fields as the Excel of JERICO. They use SeaDataNet vocabulary and make reference to ISO19115. They have just started collecting information, that could share with JERICO as soon as have a relevant number of entries. <u>It is desirable that EMODNET PP and JERICO will work together to have this kind of information</u>.

2.3 Overview of fixed platforms in JERICO: current status and their contribution to existing Coastal Observatories; methods and practices in use

Status reports about the Fixed Platforms operated in JERICO and their contribution to existing Coastal Observatories were presented by Institutions.

A summary of each presentation is given below:

IBW PAN (R. Ostrowski) Overview of monitoring carried out by Institute of Hydro-Engineering of the Polish Academy of Sciences (IBW PAN)
Platforms used and parameters measured:

- wave buoys Directional Waverider Mk. II, Mk. III (produced by Datawell BV, the Netherlands); Wave height, dominant wave period, average wave period, peak direction, wave spread, temperature
- string electric wave gauges (manufactured at IBW PAN, Poland);
- two-component electromagnetic current meters (produced by Valeport Ltd., UK and other companies);
- ADCPs Workhorse Monitor 1200 (RDInstruments, USA);
- laser Doppler particle size analyser LISST-100 (Sequoia Scientific Inc., USA);
- salinity, temperature and pressure sensors;
- soil samplers;

- wind gauges;
- GPS devices: two sets comprising base and rover stations;
- echo-sounders Odom Hydrohraphic Systems, USA (single-beam, multi-beam);
- sub-bottom profiler StrataBox (SyQwest Inc., USA);
- geodesic equipment (electronic total station)

Problems:
Icing of measuring towers during the winter causes them to become unstable

Flemish Hydrography (S. Van de vreken) Overview of Monitoring network of the Flemish Banks

It consists of:

- Measuring piles (water level, waves, current, water & air temperature, wind, atmospheric pressure)
- Wave buoys
- Tide gauges
- Meteorological stations

Data is telemetered in real time, quality controlled, stored and distributed.

End products include:

- Real time data
- Predictions resulting from hydrodynamic models
- Statistics
- Tide tables
- Tidal current atlas
- Storm tide predictions (Storm Surge Warning Service)

Maintenance and inspection of the above is carried out by contractors, awarded through a public procurement process. The description of the work needs to be very clearly defined to ensure that work is carried out correctly and to a high quality. Contractors may use sub-contractors which means it is difficult to coordinate and there are potential issues with health and safety.

HZG (W. Petersen) – Overview of COSYNA (Coastal Observatory in the North Sea)

Aims:
• Building an automated observing system as a „Community System“
• Development of an operational „Integrated System“ for
Operational observation of the state, trends and processes in the North Sea,
Operational modelling and prognoses of essential environmental parameters
and
Creation of scenarios as support for coastal management tasks
• Development of observation & modelling modules, together with German institutions (universities, monitoring authorities etc.)
• Integration into European structures (e.g. EuroGOOS, EMODNET, JERICO, MyOcean2)

Incorporates a large number of platforms including Research Vessels, FerryBoxes (on merchant ships and stationary on land), HF radar, X-band radar, WaveBuoys, measuring towers (FINO), buoys

Parameters include: salinity, temperature, currents, chlorophyll a, dissolved oxygen, turbidity, CDOM, waves, meteorological parameters

BSH (D. Machoczek) Overview of MARNET (Marine Environmental Network in the North and Baltic Seas)

Large buoys (21m tall, 60tonnes) measure in air; wind speed, air pressure, air temperature, wind direction, buoy direction; in water: temperature (multiple depths), conductivity, oxygen, radioactivity, nutrients
Positions off the coast, rough weather conditions, access by ship only, permanent operation, real time data
Unmanned lightships, lighthouse, towers for meteorological parameters
Wave measurements using buoys, X-band radar, AWACs, radar gauges, wave cameras

Problems: biofouling, access to buoys (sometimes use helicopter), expensive to maintain, damage by storms (17m wave event)

CEFAS (N. Greenwood) Overview of SmartBuoy monitoring network

7 routine monitoring sites (6 in UK waters, 1 in Dutch waters) using buoys (approx. 500kg). Operational for ten years.
Parameters measured routinely: salinity, temperature, turbidity, chlorophyll fluorescence, dissolved oxygen, inorganic nutrients, PAR, phytoplankton abundance and composition
Data stored on database with quality control routines implemented.

MI (S. Fennell)

Weather Buoy Network; Tide Gauge Network; Coastal Networks (includes CO2 at Mace Head and offshore wave energy test site)
4 weather buoys around Ireland in 2011 (1 additional in 2012). Moving from ODAS to Oceanor buoys
Problems: flooding and accuracy of ultrasonic wind sensors, lack of power, lithium batteries (health and safety), damage to instruments during deployment
Tide Gauge Network - funded by local authorities, works well.
Offshore wave energy test site – includes ADCP, 2 x Waverider buoys, tide gauge

SMHI (O. Petersson) Overview of fixed platforms

Ocean buoy measuring wind, pressure, air, sea temp, wave height, ADCP, surface CTO, Wetlabs Flu,ntus, 15 x Seabird 37 inductive modem on wire, Iridium data-link
Experimenting with moored ARGO profiling floats
Three Datawell DWR mk III (Wave height and direction, surface temperature)
19 x Vaisala MAWS water level recorders and 3 experimental Campbell CS 475, CR800, radar, pressure

HCMR (T. Chondronasios) Overview of POSEIDON buoy network

Main measurement parameters:

- Air-pressure
- Air-temperature
- Wind speed and direction
- Wave height, period and direction

- Sea surface salinity and temperature
- Surface current speed and direction
- Sea surface dissolved oxygen
- Light attenuation with fluorescence
- Salinity and temperature in depths 20-1000 m
- Chlorophyll-A in depths 0-100 m
- Dissolved oxygen in depths 20-100 m

Gave overview of maintenance methods and practices – aiming for 6 monthly servicing, had noted some problems with inductive cabling from sub-surface measurements

IFREMER (L. Delauney) Overview of MAREL system (automated monitoring of coastal waters)

Numerous sites around French coastline, different platform types including piers, buoys, intertidal platforms, harbour walls with different configurations for different platforms. All use chlorine for biofouling protection (in situ production or pumped system). Operational network for ten years.

Core parameters measured:

- water temperature
- conductivity
- dissolved oxygen
- turbidity
- chlorophyll
- air temperature and pressure
- PAR
- Humidity
- Wind speed and direction

Additional parameters include nitrate, silicate, ammonia and pCO_2.

Data stored on database with quality control routines implemented.

Routinely have 3 sensor packs to maintain each site.

OGS (R. Nair) The North Adriatic Coastal Observatory

Real time observing system in the Friuli-Venezia Giulia region of north-east Italy
Consists of 3 profiling data buoys, 3 wave measuring buoys, 2 ADCPs (in rivers)
Inshore measurements:

- Bottom temperature & pressure
- Stage
- Streamflow
- Discharge

Offshore measurements:

- Atmospheric pressure
- Air temperature
- Wind direction & intensity
- Water-column profiles of temperature, conductivity, salinity, dissolved oxygen & pH

- Mean & significant wave heights
- Wave direction and spectra
- Current profiles

The system has centralized data management and visualisation

Problems include damage to instrumentation, biofouling, corrosion, mechanical wear and tear, collision, vandalism, storm damage

CNR (S. Sparnocchia) The CNR Coastal Fixed Platforms Network

CNR existing installations: underwater moorings, buoys and floating platforms, platforms fixed at the sea bed, shore/harbour stations. All use different sorts of instrumentation.

Coastal platforms measure:

- Atmospheric pressure, Air temperature, Wind direction & intensity, precipitation
- Sea Temperature,
- Conductivity/Salinity, Dissolved
- Oxygen
- Waves
- Sea level
- Current (discrete levels and profiles)

Underwater Moorings measure:

- Current profiles
- Temperature
- Conductivity/Salinity

Common problems include hits by shipping, biofouling and corrosion

Data stored on local server, available on request

2.4 Needs of fixed observing sites for estimating/modelling processes in the coastal zone (in collaboration with WP9)

Srdjan Dobricic (CMCC and WP9 leader) started by describing the main objective of WP9, that is to provide the information on how to optimize investments and extract the most of the information from data coming from European coastal observing systems by applying mathematically sophisticated methods. One of the tasks of the WP is to evaluate the impact of assimilating data from existing platforms on estimates of costal processes using high resolution coastal models (OSE experiments).

Examples of successful data assimilation exercise in previous project were shown, e.g. the assimilation of CTD and sea level anomaly data, which improved the ability of the POM model in simulating mesoscale features in coastal Adriatic Sea, and glider observations, which assimilated along a short track in the Ionian Sea, for a limited period (three months) produced effects in the whole basin and for a longer term (several months after recovery the glider).

Impact of assimilation of data from fixed platforms will be evaluated in the Adriatic and Mediterranean Sea by CMCC, in the Baltic and North Sea by DMI and MUMM, and in the North-Eastern Atlantic shelf by DELTARES using different models, assimilation schemes, fixed point data sources and different data types (e.g. temperature, salinity and sea level). While testing the effectiveness of present configurations, these type of experiments will also be useful to give directions to the future implementation of coastal observatories.

The problem is complex, since in the coastal area the processes are very non-linear, but some of the methods applied are optimal only for linear processes. This will imply some degree of uncertainty on the final results.

Discussion

A discussion started around the significance of assimilating data from fixed points compared to other data collection approaches (e.g. gliders vertical sections, radars or satellite horizontal surfaces). A suggestion rose from the audience to evaluate the different impacts of using or not contemporary data from different types of platform (e.g. buoys, FerryBoxes and gliders). Fixed platforms offer high frequency observations in time, but data assimilation systems are not designed for such a frequency (they assimilate with a daily frequency) and really lose information.
No biochemistry is considered for the moment.

2.5 New sensors and techniques for in situ measurements at fixed points

Laurent Coppola (CNRS-INSU) gave an overview of progresses at the Observatoire Océanologique de Villefranche-sur-Mer with image analysis (on behalf of Lars Stemmann) and chemical sensors (pH-pCO2).
Image analysis. Imaging systems are promising approaches for an end-to-end plankton communities analysis, from viruses to jellyfishes. They provide indicators of ecosystem status (abundance, biomass, taxonomy, size spectra) that can be used to develop mathematical models (e.g. zooplankton size spectra to get information on physiological rates, vertical distribution of appendicularian and effect on vertical fluxes, vertical distribution of particle fluxes, etc.). The idea is to combine four systems, one is a new video-profiler developed in Villefranche (UVP) for bigger species, the other systems are for smaller species: Flowcytometer, FlowCam, and Zooscan. Developments of the approach are planned in WP10 (Task 10.1), in particular within JERICO they will develop a sampling and an analytical protocol for the end to end pelagic ecosystem monitoring based on sample collection (with nets and bottles) and image analysis for the semi-automatic recognition of different plankton groups. Currently each instrument works with its suite of software while operational deployment requires an integrated and compatible methodology. Today the software is an early version and does not include any features for automatic recognition. This development is in progress and tests were performed in a coastal area near Villefranche-sur-Mer for one year. They will be repeated for a longer period starting from next spring to have interannual variability.
Carbonate system. In the framework of EuroSITES, a pH sensor was developed and tested in open ocean by ULPBG. The sensor is based on spectrophotometric methods to measure pH removing dye effect in each measurement. It is done for surface measurements (range 0-20m) and it was tested at ESTOC site (North Atlantic) for 24 months with a pH reading every hour. It revealed to be an extremely stable pH sensor with precision < 0.002 pH units and accuracy ±0.005 pH units. Spanish colleagues are working now on biofouling correction.
In Villefranche there is an ongoing activity of monitoring pH in the Villefranche Bay by using water sampling every 2 weeks. These records are not enough to understand the pH variability and the reason of such variability, so in WP10 (Task 10.2) they plan to integrate pCO2 and pH sensors on EOL coastal buoy and to cross-validate data (in situ sampling), to transmit data by GSM and to check biofouling issues (10 min from lab). The pH sensor they will use on EOL is manufactured by Martz lab (SIO), it is smaller and cheaper than the one of ULPBG, and widely used from US to Asia. As regards the pCO2

measurements, useful to complete the observation of the carbonate system, they will install a Pro-Oceanus sensor on the EOL buoy.

Wilhelm Petersen (HZG) talked about development and testing of new sensors at HZG. *Nutrients*. They tested different type of nutrients analyzers commercially available from SYSTEA: μMAC-1000, Micromac C and WIZ probe. The first two are laboratory instruments, the third is a submersible instrument. They were tested both on operational FerryBox systems and fixed platforms. They were not satisfied by μMAC-1000 because of leakages that caused also problems to the electronic system. Micromac C resulted more robust because of separation between measurement wet apparatus and electronics. It works properly on fixed platforms but can be unsuited for FerryBoxes because of the limited time resolution (sequential analysis of the different parameters,up to one hour for a full cycle), large dimensions and power limitations. WIZ probe should be more promising because of very low reagent consumption but the laboratory tests at HZG gave no reliable measurements yet and it seem not reliable for long-term unattended operation.
A new sensor for high reliable underway nutrient measurements is under development at HZG, based on Sequential Injection Analysis (SIA). It is currently tested for PO4 and NH3 and further development are planned for NOx. They hope to have an operational prototype in the next months.
Carbon system. Testing new technologies with FerryBox systems includes different membrane based systems for pCO2 measurements, manufactured by ProOceanic and Contros. Tests show a good agreement between the two instruments and also reliable measurements along transects.
A high precision sensor for automatic contemporary measurements of pH and alkalinity to quantify the carbon budget is also being developed. Laboratory tests show good performance and no drift in the field is a big advantage compared to other commercial sensors.
Chl-a and algae species. A Point-Source Integrating-Cavity Absorption Meter (PSICam) is developed for a better quantification of chlorophyll-a and detection of algal species. It is able to measure the absorption in high turbidity waters. It is a laboratory instrument and the idea is to use on underway systems and fixed platforms. The challenge is to keep the reflectivity of the chamber stable for long time, since it is strongly affected by biofilms or other contamination. There is the need to develop suitable cleaning stuff.
Finally, a nucleic acid biosensor for algae taxa and algal groups is under development in cooperation with AWI.

2.6 Final discussion and actions

The discussion was led by ***Wilhelm Petersen***, since the task leader (Rodney Forster, CEFAS) was not present.
The main objective of the discussion was to define what kind of information we need for deliverable 3.3.1 “Review of the current marine fixed instrumentation” due on January 2013 (Month 21). In particular, what further information we need that is not yet included in the present version of the questionnaire and then how we have to update it.

Q1. What is the experience with different kind of platforms? What kind of purposes do need big or small platforms, fixed platforms or buoys, etc.?

- The choice of the type of platform depends on a balance between resources availability and objectives on a medium-term perspective (say 10 years).

- Working with fixed platforms is easier than with buoys, so they are preferred by someone (e.g. BSH, CNR), but buoys can be more flexible and so they are preferred by others (e.g. CEFAS).
- The choice between big or small platforms depends on the number and dimensions of the instruments one wants to install. Big platforms offer more opportunities, but when they are very big (e.g. BSH platforms) they ask great amount of money and man power for maintenance. If the objective is measuring only a few set of parameters, a small platform is enough and probably cheaper.

Q2. How do we resolve the vertical (depth profiles)? What is the experience with profiling devices?

- The simplest solution is to use several sensors at different depths, but it could be very expensive (if the sensors are many) and biofouling could be more an issue.
- Profiling devices are an interesting alternative solution, but there are limitations in areas where there are strong currents and suspended matter. These could be very limiting factors in coastal areas.
- Despite fixed depth installations, profiling systems can be protected against biofouling by keeping them below the euphotic zone or near the bottom, or with new approaches as in the EOL buoy (Coppola, WP10 kick off on Friday), where the profiling probe is kept inside the structure.
- There are depth limitations for the operability of profiling systems, about 80-100 m with the one used in the EOL buoy.
- Profiling systems are expensive in the initial phase (some hundreds of thousands euros of initial investment), but they can result to be advantageous compared to other approaches (e.g. a line with lots of fixed sensors) on a longer term, both for maintenance costs and amount of data collected in the water column. The questionnaire to evaluate the running costs of facilities will help in defining the “cheaper system”.

Q3. What type of platforms should we mention in the deliverable?

1) Buoys
2) “Fixed” platforms (piles, towers, …)
   including platforms of private companies, eg. energetic platforms (wind farms, oil platforms…), which often are offered to scientific institutions for free, so the only maintenance costs are those for the sensors.

Q4. What is the accessibility of the platforms? What are the advantages and disadvantages of different options?

Ship, helicopter, ...

Big towers in the North Sea are better accessible by helicopter, because of difficulties in climbing them (height: 20 m), and occurrence of tall waves. The main problems with using helicopter are strong winds or fog. Helicopter is also cheaper than renting ship-time.

In the Mediterranean, e.g. coastal greek buoys, it is feasible a fast boat.

Distance from the coast, typical weather, sea state and costs condition the choice.

Next actions for the advancement of the deliverable 3.3.1

A1. Identify people using the same platform to describe their experiences with them in order to achieve some kind of standardization of the implemented technology.

- Description of types of platforms in use (Bengt Karlson offers a report he has already prepared describing different platforms).
- Review of experiences of people (analyze advantages and problems), also related to types of platforms and different geographical areas (Dave Sivyer suggests to find regional coordinators to manage this task at the local level and then put together the results obtained).
- Gathering information on equipment and onboard sensors.

All the information collected, including best practices, must serve to define a JERICO label and help the broader community of users (or potential users) in making choices regarding costal observatories.

A2. Redesign WP3 questionnaire adding more details:

- system downtime,
- platform manufacturers,
- sensor manufacturers,
- hidden costs (e.g. moving elements of a system from one place to another),
- impact of the platform on data quality.

3. Maintenance methods: calibration (Session 2)

3.1 Review of the existing facilities and practices of calibration in JERICO

George Pethiakis (HCMR) presented the results of the first questionnaire of WP4 on calibration facilities and practices. The questionnaire was mainly prepared by Rajesh Nair (OGS) and sent to the other Sub-Task leaders (HZH and SMHI) first, and then to all partners for improvements and compilation (see following schedule).

ACTION	WHO	DEADLINE
1st version of questionnaire	Task – SubTask leaders (HZG, OGS, SMHI)	Mid Oct.
2nd version of questionnaire	All partners	End Oct 2011
Completion of questionnaire	All partners	End Jan 2012
Working on results	Task – SubTask leaders (HZG, OGS, SMHI)	End Feb 2012

Deadline for compilation was set at the end of January and almost all the partners replied in time, but MUMM and NIVA didn't and were solicited to send the compiled questionnaire soon.

Main results so far:

- Only 6 out of 16 partners operate a dedicated calibration facility.
- ***Organization and responsibility:*** 40% of them possess a well-defined organizational framework with dedicated staff, even if it is not well defined a clear hierarchy in 47% of the cases, the 60% of answers declare a transparent chain of responsibility for management, technical / scientific and operational decisions.
- ***Funding:*** two questions asked the source of funds for the facilities, and 73% of answers refer both internal funding (Institute/Center) and external funding (projects). The funding is not constant for 40% of the cases, and only 47% of answers declare to have a separate budget for upgrading or acquiring new instrumentation.
- ***Budget*** (for calibration activity): only 7 partners gave an answer, and figures range from few thousands to some tens of thousands. More detailed information will come from the questionnaire on costs in "End-to-end Quality Assurance" task.
- ***Quality standards:*** A 46% of the facilities adopts Quality Management Standards and Good Laboratory Practices, but the 67% doesn't possess any kind of accreditation of the calibration and doesn't endorse a policy of continual training of personnel involved.
- ***Documentation:*** A documented in-house Quality Assurance Program is maintained only in 40% of the cases as also control charts. The 87% maintain a formal quality manual, and 67% assure an effective traceability chain to primary standards or to conventionally accepted reference material.
- ***Accuracy:*** Most of the facilities do not furnish uncertainty estimations for their calibration systems (53%) and don't have links with the National Metrology Institutes (60%).

- ***Calibration practices:*** Most of partners send their sensors to manufacturer for calibration. This is an expensive practice, since most of the manufactures are in the USA.

- ***Sensors in use:***

  - Chemical sensors – There are only few sensors used in JERICO (CONTROS pCO2, Nutrient Analyzers, Dissolved Oxygen, pH). Calibrations are not regular.

    In-house calibration / validation is done only for DO (SBE43), pH, and Nutrients (TON, NH4, SiO2, o-PO4) only by 5 partners. Only 2 questionnaires were completely answered.

    Accuracy and precision depend on reference material/solution, methodology and sensor characteristics. Calibration involves a lot of reference materials, especially for analyzers. No steady intervals are used in calibration but on the need base ie. usually before deployment. This type of sensors needs frequently field validation. There is an overall uncertainty to discuss.

    For calibrating the chemical DO sensor SBE 43 everybody follows the method provided by the manufacturer.

    Suggestions from the questionnaire:
    - Bubbling system to reach different concentrations.
    - Improvement of knowledge on influential parameters.

  - Physical sensors – Only referring to in-house calibration, sensors are Salinity, Temperature, Pressure and Currents. Calibrations intervals are 6-12 months. Accuracy and precision of calibration depend on the equipment (PRT, salinometer, bath). The only reference material/solution involved is the SSW and PRT. There is an overall uncertainty to discuss.

    Laboratories performing Temperature and Salinity calibrations
    - ensure an effective traceability chain for the specified parameter / measurand;
    - maintain a Manual with a description of the calibration method (not everybody attached it);
    - perform factory calibration only for reference sensors/instruments;
    - maintain an archive containing issued calibration reports/certificates with minimum retention time 2 years (including metadata files).

    5/7 laboratories perform also field calibrations of the data.
    5/7 laboratories perform internal quality audits to monitor and assess their calibration systems, but only 2 of them perform independent quality audits.

  - Optical sensors – Only referring to in-house calibration, sensors are Chlorophyll-a, Turbidity, Dissolved Oxygen and PAR (this last only 1 laboratory). Calibration intervals are 6-12 months. Accuracy and precision depend on reference material/solution, methodology and sensor characteristics. Calibration involves a lot of reference materials. For Turbidity all partners use Formazine standards but there is no common adopted material/solution for Chl-a sensors. Also in this case there is an overall uncertainty to discuss.

    Laboratories performing optical sensors calibrations
    - think that traceability is not so effective as to physical sensors;
    - maintain a manual with a description of the calibration method (not everybody attached it);
    - perform factory calibration / maintenance only after a malfunction / failure;

- maintain an archive containing issued calibration reports/certificates with minimum retention time 2 years (including metadata files);
- 4 of them perform field calibrations of the data;
- almost no internal / independent quality audits are performed.

There were several suggestions for improving the quality optical sensors:

- Manufacturers supply a secondary solid standard for Chl-a to test one point response.
- We are currently doing studies to improve our knowledge about influence parameters and comparisons of sensors answers to different fluorophores and algae extraction.
- Solid secondary standards should be provided by manufacturers (not available in Wetlabs). New inert reference material for Chl-a calibrations should be found. Calibration with cultures will never yield comparable results.
- Ideally we would collect more field samples for calibration as laboratory calibrations do not reflect the response of fluorometer to natural phytoplankton populations.

For calibrating the AAnderaa Optode optical DO sensor, everybody follows the method provided by the manufacturer, except for IFREMER using a bubbling bath to achieve DO concentration gradients.

Suggestions from the questionnaire:

- Collecting more samples for field calibrations during deployments.
- Bubbling system to reach different concentrations. Improvement of knowledge on influential parameters.
- The ARGO community have developed more detailed procedures for calibrating the Optodes. These improve on both the accuracy and linearity of the manufacture's calibration.

- ***Points to work out in the future:***

- Enlarge the community of operators of in-house calibration facilities.
- Promote the adoption of accreditation for the calibration, and in general work more on the Quality Standards issues.
- Sharing of facilities and mutual training of technical staff.
- Create a space on the JERICO web-site where people can upload/download manuals.
- Set up a permanent calibration working group. Identify key nodes as reference for calibrating specific type of sensors. This will help in reducing costs.
- Homogenize calibration approaches.
- Organize a calibration workshop, including DO Optode sensors.

3.2 Calibration of optical sensors

Juka Seppala (SYKE) presented the results, and a summary of the presentations, of the Workshop of February 9th at Helsinki regarding the calibration of the optical sensors.

There were 21 attendants and the aims of the workshop where:

1. How to perform the primary instrument calibration for fluorometers?
   - Algae cultures / Solid secondary standards / Chemical standards
   - Comparison of instruments

2. How to perform validation with field samples?
   - How to deal with the variable fluorescence yield?

3. How to prevent bio fouling ?

Can we identify best practices, harmonize protocols, and disseminate Jerico know-how?

The presentation included slides and information from the Helsinki workshop as presented there by the partners. First there was an introduction with

Diversity of phytoplankton and implications for the use of fluorescence of photosynthetic pigments as biomass proxies by Bengt Karlson SMHI

Pointing the pigments we are trying to detect using fluorescence

- Chlorophyll a – found in all phytoplankton except for Prochlorococcus
- Phycocyanin – found in some cyanobacteria but also in some cryptophytes
- Phycoerythrin – found in some cyanobacteria and in some cryptophytes, dinoflagellates and a ciliate

Followed by *the Challenges in matching up concentration & fluorescence data by Jukka Seppälä SYKE*

Chlorophyll a in vivo vs. in vitro

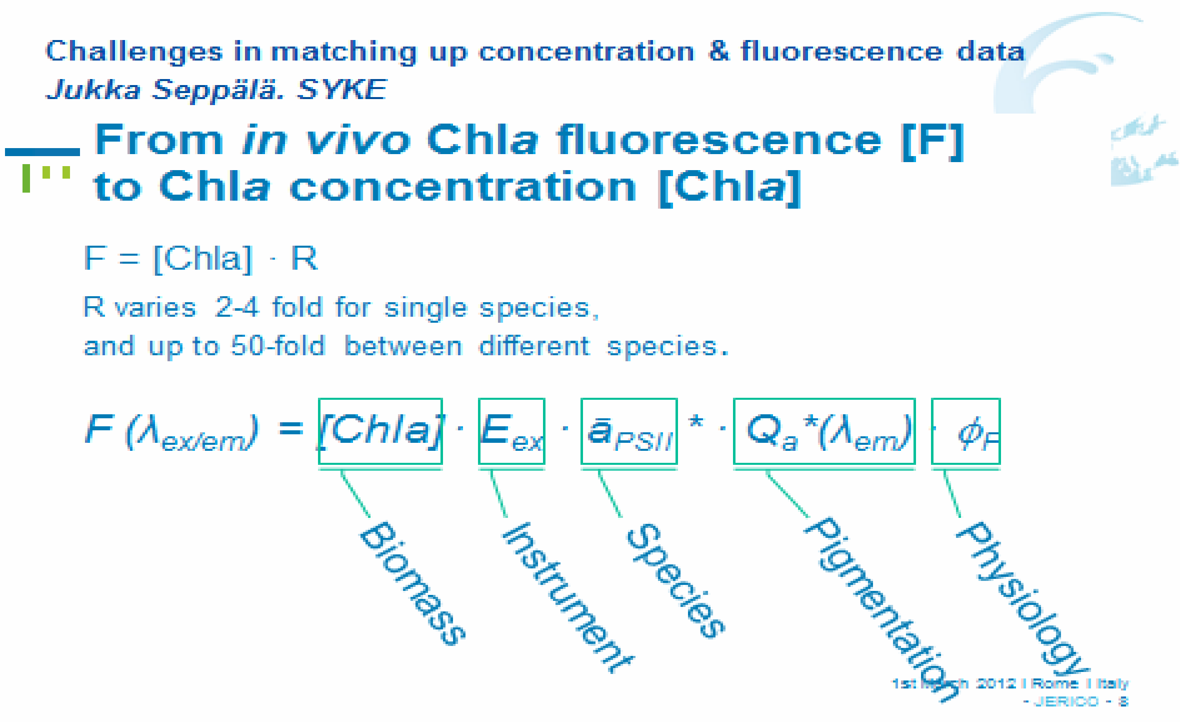
Fluorescence yield, φF = fluorescence emission / light absorption

Chla in vitro: φF = kf / (kf + kd + ki) ≈ 0.3

kf , kd and ki are rate constants for excited state decay by fluorescence, thermal emission and triplet formation.

Chla in vivo: φF = kf / (kf + kd + ki + kp + kq) ≈ 0.005-0.05   i.e. not constant

where kp and kq are rate constants for photochemistry and for other non-photochemical processes



Regarding the sensor calibration it was recommend a stable chemical standard or a secondary standard over the use of cultures due to

- stable and traceable signal, thus instrument performance can be tracked
- instruments (with similar optics) can be compared

BUT secondary standard does not, however, always allow direct instrument-instrument comparisons.

Partner's slides followed presenting their experience with optical sensors measurements, calibration and biofouling issues.

- Bio-fouling prevention and experiences with the solid-standards in HZG by Wilhelm Petersen HZG
- Fluorescence sensor metrology: Main issues and Ifremer's actions by Florence Salvetat IFREMER
- NOCS Experience on chlorophyll sensors - calibrations, applications and data - and on bio-fouling of various sensors by Thanos Gkritzalis et al NOC
- Calibration, validation and bio- fouling prevention of optical sensors in Alg@line project by Seppo Kaitala, Jukka Seppälä, Petri Maunula SYKE

- Experience from conversion («calibration») of Chl-a fluorescence data to Chl-a concentration in Ferrybox systems by Kai Sørensen, Marit Norli and Are Folkestad NIVA
- Biofouling protection for in situ oceanographic sensors by local chlorination by L.Delauney IFREMER

** all the presentations mentioned can be found in the http://www.jerico-fp7.eu/ under the WP.4 tab (password required).*

The outcomes of the workshop as presented, consider to be a 2 level problem starting from the luck of an commonly accepted reference material for chla calibration and the challenges of estimating the chla concentration using fluorescence measurements.

1st level problem

Reference materials for Chla calibrations

Secondary standards:

- Best practice to use solid standard to follow instrument performance
- Traceability of secondary standard (contact manufacturers)

Chemical standards:

- Chla in acetone (or other solvent) may be solution for some instruments but may not be compatible with other
- Should find better chemical standards for primary calibration (artificial Chla proposed by Rajesh)
- Are there special problems with instruments working in low range (stability of standards, offset)

2nd level problem

Conversion from fluorescence to Chla concentration

Many alternatives to estimate Chla concentration from fluorescence:

- Importance of keeping raw data
- Importance of archiving

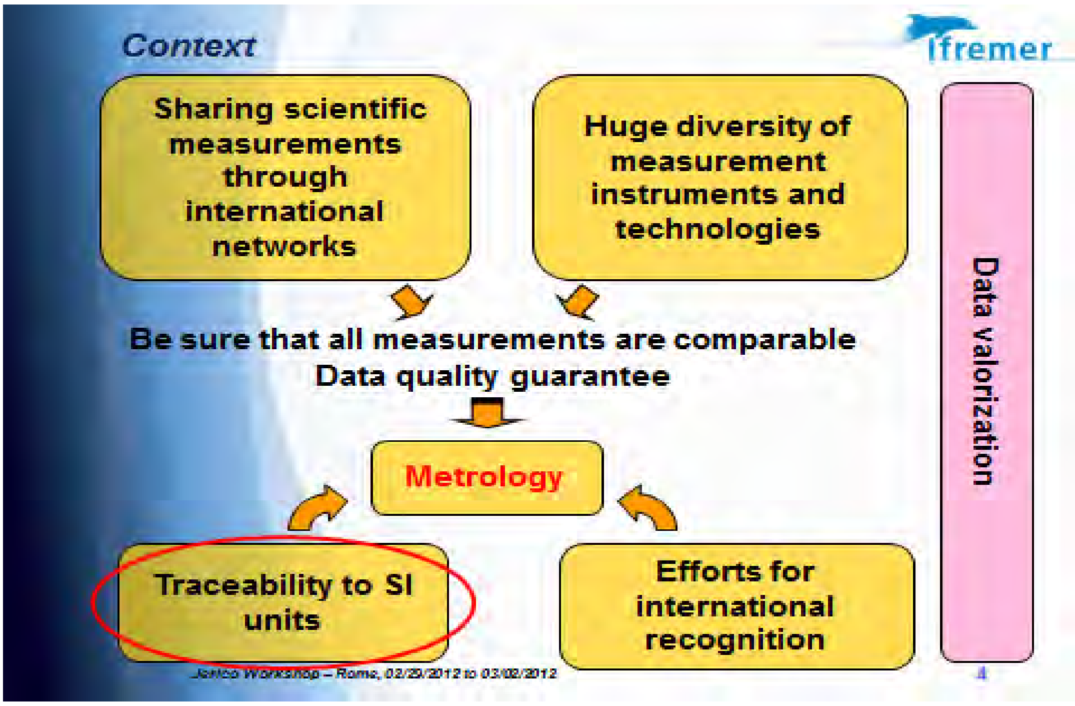
- Optimal data treatment solutions may be site-specific, time-specific , event specific, user specific …

New methods that may provide new solutions when it comes to optical sensors measuring fluorescence in the field

- measuring light, variable fluorescence, community structure may improve validation
- WP4 – WP10 communication

3.3 Metrology for Oceanography

Florence Salvetat (Head of Ifremer's metrology laboratory) presented main issues and Ifremer's actions regarding Metrology for oceanography. First there was an introduction of the Ifremer facilities for calibration consisting from metrology laboratory for physic-chemical parameters and the chemical laboratory for ammonia, nitrates/nitrites and silicates. The context of the metrology lab was presented in the above schematic.



Furthermore there was an analytical presentation for each parameter pointing out the issues that Ifremer's calibration lab faces during these procedures. The summary is presented in the above matrix.

Parameter	Range	Procedure	Issues
Temperature	Range: -10°C to +60°C with U= +/- 4m°C to 13m°C	comparison in temperature regulated bath for different values of temperature	reduce uncertainties (few m°C)
Pressure	Gauge P: Range: 0.1 MPa to 80MPa with U = 1.10-4 x PGauge	comparison for different values of pressure with a pressure balance	Absolute pressure measured, sea pressure delivered, gauge pressure calibrated
Current	Range: 0.1m/s to 1m/s	comparison for different values of current (mechanical current meter)	Acoustic Doppler current meter: Wall reflexion of the beam Particles spreading needed
Salinity	Range: from 2 to 42	calibration in temperature regulated bath for different stages of temperature and salinity (natural seawater diluted with fresh water)	No Certified Reference Material (no traceability) Conductivity sensor response dependent on salinity
PH	Range: from 0 to 14	calibration with standard pH solutions	Standard matrix: no seawater no Certified Reference Material (no traceability)
Turbidity	Range: from 0 to 1000 FNU	calibration with formazin solutions	Not the measurand to achieve (suspended matter) No CRM (no traceability) Lack of understanding of optodes behavior (signal drift, noise, … interactions with parameters to be found)

Especially for oxygen sensor calibration the presentation included the results/experiences from the Argo float DO calibration and the issues that arose.

Dissolved Oxygen	Range: from 0µmol/l to over-saturation	Current Procedure: - calibration at 0% (sodium sulphite) and 100% (stirred water) - Winkler titration as standard method

Issues:

a. Linearity control: 1 or 2 calibration / adjustment points are not enough.
b. Substance matrix: seawater (Winkler's method overestimates dissolved oxygen in seawater: Iodate interference and its oceanographic implication. George T.F. Wong and Kuo-Yuan Li, Marine Chemistry, 2009, vol.115, n°1-2, pp.86,91)
c. Lack of understanding of optical sensors (optodes) behaviour (interferences, corrosion issues, interactions with some materials, …)

And for fluorometer there was an extended presentation explaining the reasons why they don't use pigment extraction of chl a but instead fluorescence. The main reasons are

1. Time consuming
2. Dependent on algae species
3. Dependent on algae physiology

Regarding the fluorescence calibration

Fluorescence	Range: depending on sensor / fluorophore	Current Procedure: calibration with fluorescein solutions

Issues:

a. Controls only the drift and the stability of measurement
b. Not the measurand to achieve (µg/l vs chlorophyll a or algae estimation)
c. No Certified Reference Material (no traceability)
d. pH influence on fluorescein
e. Sensor comparison impossible: sensor response dependent on technology
f. Lack of understanding of optode response (signal drift, noise, … interactions with parameters to be found

Regarding the Traceability of the calibration results it was pointed that there is:

1. No norm in technology
2. No representativeness (substance matrix, …)
3. No relation to SI units
4. Not universal in regard to the different technologies
5. No reference material or No reference method

The last part of the presentation was dedicated to the on going studies of the lab for each parameter.

Current calibration:

- Contact with accredited laboratories for acoustic Doppler current meter (Metas)
- Evaluate the calibration feasibility in the towing canal at Brest and in the water vein at Boulogne

Oxygen calibration:

- Characterization of an oxygen multi-level bench

  Stability:

  - < 0.5 µM within 1 hour
  - long stability levels (several hours)

  Lowest level: nearly 0%

  DO homogeneity: < 2µM (! first results)
- Hypox, Argo projects: Inter-laboratory comparison (Australia, USA, Germany (2), manufacturers).

Salinity calibration:

- Carry on the investigation on salinity effect
- Uncertainty budget (CIL?)
- ENV05 Ocean project (European Metrology Research Programme) : reference methods and standards

Turbidity calibration:

- Calibration protocols improvements on multi-parameter probes (YSI, OTT, NKE):

  Temperature influence

  Stirring effect

Fluorescence calibration:

- Calibration protocol studies on multi-parameter probes (YSI, OTT, NKE, Seapoint, Seatech): fluorophore effect
- In situ campaign studies (YSI, OTT, NKE, Seapoint, Seatech) with chlorophyll a extraction.

3.4 Discussion

George Petihakis (HCMR and WP4 leader) presented the issues/questions that arose from the questionnaires and the SYKE workshop mentioning that its part of JERICO to share calibration facilities and transfer know how and expertise.

Q1. *Should we organise another calibration workshop/seminar for Oxygen, Temperature, and Conductivity*?

All the partners agreed that it should be another workshop for Oxygen, Temperature, and Conductivity and It was mentioned that although these workshops cannot be consider as TNA's, so it weren't predicted, the added value is quite high. The workshop will be hosted in the calibration facilities of IFREMER in Brest at the second week of October, parallel to the Sea Tech Week. It was suggested to perform calibration experiments for temperature and conductivity (a short experiment with sensor comparison), for oxygen using both Aanderaa optodes and Seabird SBE 43 and for fluorometer in order to follow up the SYKE workshop.

Q2. *Can we identify potential trans-network nodes?*

It was mentioned that inside the JERICO network a large amount of money are spent for sensors calibration performed by the manufacturer although the results may not be the best for each partner application. The next question was, if we can identify some partners, with more experience accredited or not, as "reference" laboratories for each parameter. These laboratories can be used to calibrate reference sensors through TNA's and support with knowhow the rest laboratories of the network. The persons running these labs can be pointed as key person for the specific parameter. The conclusion was that there are trans-network nodes for calibration.

Q3. *Can we promote technical collaborations/partnerships?*

It was discussed the way to approach the sensors manufacturers in the Forum of Coastal Technology. The discussion focused on DO sensors and especially Aanderaa optodes and the issues that the majority of the partners face. Next it was mentioned the new RINKO DO sensor and its features and differences with the already existing oxygen sensors. Only a few partners are using this sensor at the present. Finally it was decided the preparation of a white paper for oxygen measurements, the problems we are facing as scientific network with the existing sensors (Aanderaa) and the needs and demands we have when it comes to new DO sensors. These issues will be under discussion with the sensor manufacturers in the Forum for Coastal Technology.

Q4. *For chemical sensors, can we arrange inter-calibration exercises between the involved institutions in order to assure a common lab quality?*

The experiences of the partners with different chemical sensors (NAS, SBE 43, PH sensors) were discussed and especially the lack of factory recommended calibration procedures. The partners performing their own calibration experiments for chemical sensors spoke about the challenges of these procedures. Apart from older chemical sensors the CO_2 sensors are arising but the partners that are currently using it are facing issues too and especially with their calibration. The meeting decided to point David Hyde (NOCS) and address him for issues regarding chemical sensors due to his previous large experience.

Recommendations concerning Best Practice in calibration

It was mentioned that Best Practice regarding calibration will need to identify different sensors and technologies and a key-person will be assigned for each parameter but all partners should contribute. The Ferry Box community Best Practice documents are good example of such a report.

The key persons for each parameter after the discussion are

Jukka Seppala	SYKE	Chlorophyll and turbidity sensors
Rajesh Nair	OGS	Temperature and conductivity sensors
Wilhelm Petersen	HZG	Chemicals sensors
Florence Salvetat	IFREMER	DO sensors

Their responsibilities include describing the best practice for the sensor calibration of each parameter or group of parameter, distribute the information, recommend methodologies and issue protocols. The result maybe general due to sensor/equipment differences but the recommended guidelines will be common for all partners. Also the meeting decided to expand the mailing list including partners and persons that weren't present at Rome workshop.

Plan of further actions towards the compilation of the D4.1 Report on existing facilities (M18 = Oct 2012) and D4.2 Report on calibration Best Practice (M36 = Apr 2014).

The Report on existing facilities will be based on the questionnaires so the most of the work is already done. The first draft of the Report on calibration Best Practice will be ready before the Crete meeting in October in order to circulate among the partners and have discussion at the meeting. This report will include key points for each group of parameters. There is a need to include also pressure sensors and current meters, even mechanical ones as partners still use them, but only IFREMER performs current speed calibration in a towing canal while the compass/ current direction calibration is performed only in few labs and industries across Europe.

4. Maintenance methods: biofouling (Session 3)

4.1 Review of the methods in use in JERICO

Marco Faimali (CNR) presented the preliminary results of the second questionnaire of WP4 on biofouling. The questionnaire was prepared by CNR with the contribution of the sub-task leaders (HCMR, SYKE) and OGS. It was sent to the partners at the end of November with deadline mid-December.

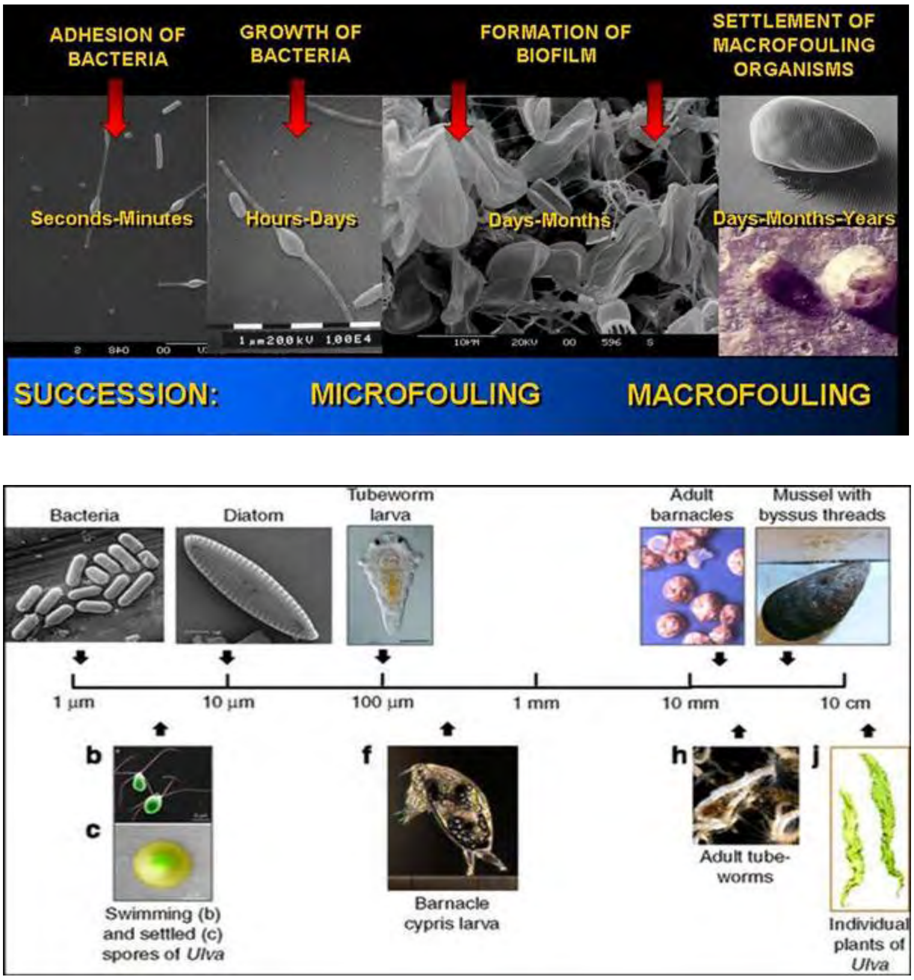
The questionnaire is made of two parts, a general part (A) and a part specific for each type of sensor (B). At present 16 of 18 partners completed the Part A and returned it together with 52 surveys related to the different sensor used (Part B).
Few partners met the deadline, and not all the questionnaires they sent were completed in all the parts. Replies were collected till mid-February so the analysis was possible only on the Part A.

Main results so far:

- Most popular sensors are for measuring **physical parameters:** 100% of partners use them, especially Temperature and Conductivity/Salinity.
- **Optical sensors** are used by the 67% of partners, mainly for measuring Turbidity and Fluorescence/Chlorophyll-a.
- **Chemical sensors** are the less used (28%), more diffuse ones are for Dissolved Oxygen and Nitrates.
- All the interviewees perceive the biofouling is a problem in the observing activity.
- **Impact of biofouling on planning and running the observing activities** is perceived at different extent by the interviewees. However, half of them consider it can be weighed as the 10% of the money and time invested in these activities. Four people refer a deviation of 10% between planned costs and actual costs, and only one the 20%. Five interviewees think that time spent to solve the problem of biofouling is greater than foreseen by 10% to 30%. From the information collected till now, it doesn't seem to exist a clear geographical correlation among answers.
- **Anti-biofouling techniques.** Passive techniques are preferred to active ones by 50% of interviewees. Among anti-biofouling techniques currently used mechanical devices (70% of interviewees) and uncontrolled biocide generation systems (70% of interviewees) are the most used while irradiation systems are not used at all.
- Mechanical devices are absolutely the ones believed to be the most effective. None of the different techniques listed in the questionnaire prevails as the possible greatest promise for the future.
- **Closed-path vs open-path systems.** The 87% of people think there are advantages using closed-path systems since they are easier to maintain, it is easier to obtain a good antifouling protection and the absence of light decreases the developmental rate of biofouling.
- The 80% of interviewees is not aware of any recurring differences in the extensions/distributions of the various types of biofouling (biofilm/slime, hard-fouling, soft-fouling) between physical, optical and chemical sensors (see comment below).
- Only 3 ideas were suggested by partners choosing/promoting/developing new antifouling systems specific for sensors: new energized bubble system for cleaning, keep sensor in deep water when not used, new engineered non-toxic AF paint.

Comment

The lack of a relationship between sensor category and biodiversity of fouling organisms is strange and must be better investigated also analysing the Part B of the questionnaire. The development of biofouling is highly influenced by the geometrical structure of the device and by the material/s it is manufactured. Moreover, a dependence on the geographical region and local environmental conditions is expected. The biofouling is a very complex biological phenomenon modulated by very diverse factors that influence the stages of development and interactions of many different organisms (Fig. 4.1).



(a)

(b)

Figure 4.1 – Temporal (a) and dimensional (b) scale of biofouling development in marine environment
(from M. Faimali)

4.2 Biofouling protection for marine sensors

Laurent Delauney (IFREMER) reviewed methods for protecting sensors by biofouling. He showed several examples of biofouling action on different sensors and after different times of deployment. Materials and shape should be chosen very carefully in order to reduce fouling attachment (flat and smooth surfaces are better than rough ones and cavities).

<u>A question about biofouling and sensor's design must be added to the questionnaire</u>.

Biofouling modifies optical properties (window opacity, interference, etc.) in optical sensors and membrane permeability in membrane-based sensors (pH, oxygen, etc.). Consequences are loss of sensibility, drift and variation in response time.

This problem must be treated as long as autonomous measurement longer than 1 week is involved. This especially applies to fluorescence sensors, see for instance Figure 4.2 where data from protected and unprotected sensors are compared. Note the drift which started also in the protected sensor's signal as a consequence of a failure of the biofouling protection system after a power supply interruption of about 1 week.

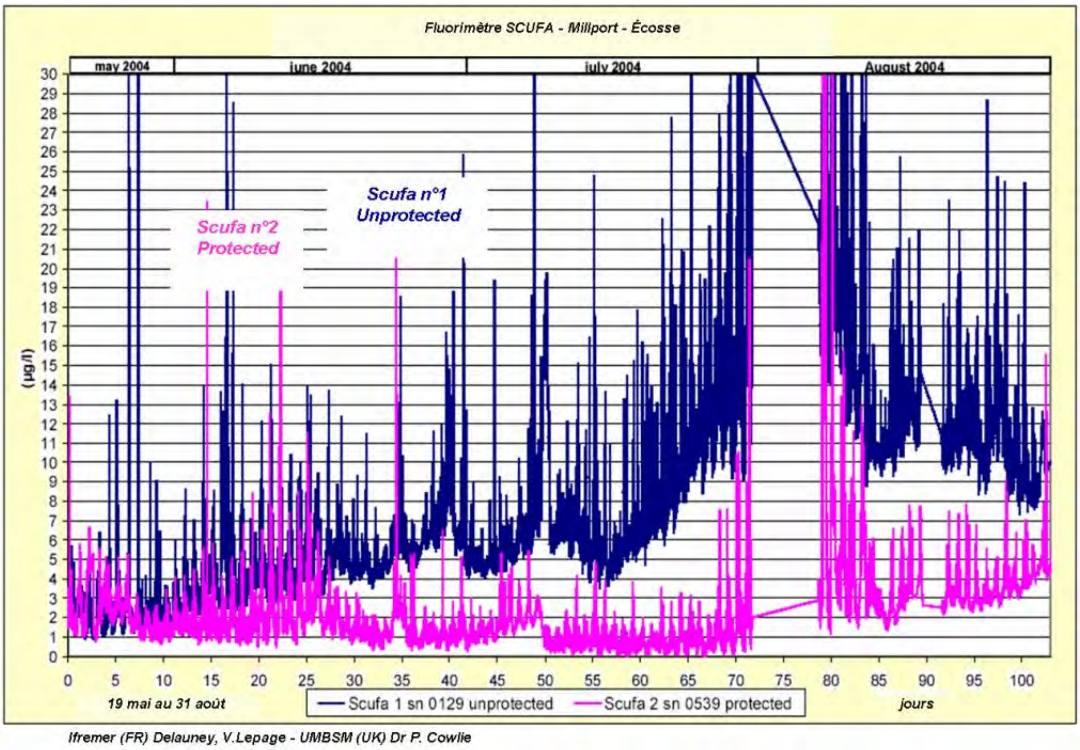


__Figure 4.2 Figure 4.2 –__ Biofouling effect on an in-situ fluorometer exposed by 100 days (from L.Delauney)

Objectives of a biofouling protection system:

- must delay the biofouling effect on the response of the measuring system for at least 1 month in severe conditions (estuary, low depths, high insolation) and for 3 months in average condition;
- should last for at least 6 months in deep sea observatories;
- should be compatible with autonomous energy supplying devices (batteries);
- must be adaptable quite easily on existing instrumentation;

- must not affect the measurements produced.

Laurent described the methods in use at IFREMER, whose strategy is to get closer and closer the measurement interface:

- the global protection used in the MAREL system, where the sensors are packed togheter and flushed with biocide (pumping is needed);
- the local protection in which biocide is localised as close as possible to the sensing element (no pumping is needed);
- the coated window protection, a new approach developed by them for optical sensors, consisting in an interface modification where the glass window is coated with a specific material in order to generate biocide on the surface.

Existing biofouling protection methods for oceanographic sensors:

- Mechanical Protection:
  - sweepers (e.g. Hydro Wiper by Zebra-Tech, NZ),
  - shutters (e.g. Opto Shutter by Zebra-Tech, NZ),
  - Copper Biofouling Protection for optical sensors. Hydroshutter is a copper cell with copper shutter built around the sensible part developed by Hobilabs. The Hydroshutter is controlled by an external unit that opens and closes it. The instrument must be customised in order to build the copper cell. The cell is not completely immune to biofouling, the internal part of the cell is sufficiently protected, but the external part is colonized after time from deployment.
- Biocide tablets (e.g. TBT by Seabird). it is not a green approach since it is based on a poison.
- Seawater electrolysis. It is an active system used by IFREMER in the past 5 years. It is simple (an electrode, a power system and cables) and easy to manage and install. One can turn on and off to avoid interference with the measurements and the energy needs are limited. It is promising but there are still some problems to solve. A detailed description of the method and results from performed tests were also presented.

The choice of a method can be driven by different aspects:

- Hardware matter :
  - robustness (vs depth of use),
  - mechanical complexity,
  - easiness of adaptation to the existing instrument,
  - level of integration.
- Metrological aspect :
  - adverse effect to the measured parameter,
  - possibility of turning on and off the system.
- Economical aspect :
  - availability on the market,
  - price.

4.3 Impact of Biofouling on infrastructure and data: some cases from partners' experiences (different environmental conditions)

Carlos Castilla (SOCIB) presented some slides on the effect of biofouling on instruments installed at different shallow depths in a buoy that remained deployed 14 months without any maintenance.

Laurent Coppola (CNRS-INSU) described the anti-biofouling system installed on the EOL buoy to protect the profiler. The system adopts two methods: one is preventive and based on chlorination by electrolysis, the other is curative and based on mechanical brushing. After each cast, the profiler enter a garage and both the methods are applied. The system was validated during 4 years in water, and tests performed to evaluate performance and frequency of the operations.

Detlev Machoczek (BSH) shortly reviewed the methods they are using.
Mechanical methods: scrubbers, flaps, rotating grindstones. Problems: reliability.
Chemical methods: poisons (tributylcinchydride,TBT). Problems: harmful to environment and difficult to handle safely.
He showed several examples of problems caused by macrofouling on installation in the Baltic Sea, and the impact on data acquired.

4.4 Discussion

Stefania Sparnocchia and ***Marco Faimali*** (CNR) led the discussion with the main objective of highlighting practices used and define future actions to take towards the compilation of the deliverable D4.3 "Report on biofouling prevention methods" due on April 2014 (Month 36).

Q1. As sensors by different manufactures use different techniques and construction geometries, can we identify which are the most reliable?

Generally speaking, the sensors that have simpler geometry (flatter interfaces, no cavities, no appendages, etc.) are the best to treat both with preventive and curative methods.

Identifying an absolute most reliable method is not possible, since it depends on the strategy behind the measurement:

- the type of sensor and measurements method (for instance, copper protections are good for optical sensors but not for others);
- the materials the sensor is made of;
- the particular environment (deep or shallow water, north or south, different organisms);
- power consumption and availability;
- other hardware arguments (see previous presentation by L. Delauney).

Q2. Dissolved oxygen sensors are commercially available which are claimed to be relatively immune to biofouling, can we test this?

The supposed "immunity" has to be verified. There are sensors that auto-calibrate their measurements during the usage (e.g. optode). So data are also corrected by the biofouling effect, and the "immunity" could be only an artefact.

A discussion followed on how to test this, and the following actions were suggested:

A1. Check what is already done in the literature and ask to manufacturers.

A2. Compare measurements with Winkler data from samples taken during maintenance cruises, it will be good to have long time series of data to analyse.

Maybe D. Machoczek will be able to present some result at the next meeting in October from data acquired by BSH for nearly two years in some stations at different depths using optode sensors and periodic Winkler samples.

Partners having such data are invited to do the comparison and present results at the next meeting in October.

Additional problem: how to distinguish in the data the electronic drift of the sensor by the biofouling effect?

Q3. Can we plan a common biofouling experiment?

There are no dedicated funds for this activity in JERICO, and this is a great limit in planning any experiment.

Discussed possibility (to be better designed and evaluated after a costs analysis):

1 - An experiment to identify the biodiversity of fouling assemblages at different areas, at different season. It could be the basis to evaluate targeted anti-fouling approaches.

CNR could send biofouling settlement panel to selected partners (3- 4 test sites, different geographical area), and receive them back at scheduled deadlines (each month or other time-limit, considering also the season) for the analysis (biofouling characterization). Duration: at least one full year.

Problems: costs (shipping of biofouling settlement panel and sampling of panels, costs for the analysis including man power), most platforms are visited only every 3-6 months.

2 – Testing different type of sensors in the same platform, or the same sensors treated with different anti-fouling protection systems.

L. Delauney referred that work as been done under the BRIMOM Project(1) for most common sensors and methods described in this workshop. It will be interesting to test new systems (e.g. nano-coating, ultrasonic technology, UV irradiation).

M. Faimali suggested to look also to new promising technologies developed in other sectors, e.g. irradiation systems (US), transparent siliconic paints, new nanostructure paints developed for the navy sector.

Next actions:

A1. Check the literature and talk with industry, also to explore the possibility of exporting methods from other sectors.

A2. Invite SMEs developing coating and other technology, also from other sectors, to participate to the second TNA call to test their methods.

A3. Invite them at the first meeting of the Forum for Coastal Technology.

A4. Plan a new project to submit to next FP7 calls.

(1) Biofouling Resistant Infrastructure for Measuring, Observing and Monitoring – BRIMOM
EC proposal EVR1-2001-00034
Ref. http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=5906862

4.5 Actions for deliverable D4.3

G. Petihakis suggested to add to the report a section on best practices and to identify key persons with good experience on particular sensors to write recommendations.

W. Petersen suggested also to refer to the report from the EU project BRIMOM from 2002-2005 (contract no. EVR1-CT-2002-40023). It is not clear if the report is accessible, and it was proposed that Patrick Farcy will ask to the BRIMOM coordinator or the Commission access to this report.

5. Conclusion

Schedule for the next months until the G.A. in October

- Partners who have not yet sent back the questionnaires will be asked to do within the end of March/April (HCMR).
- The questionnaire will be sent also to associated partners (main partners are asked to indicate them to CNR).
- Integrate the questionnaire with suggestions of improvement received by partners (first the suggestion already received by Delauney in his talk) and ask everybody to answer the news questions (CNR, HCMR).
- Final analysis of the questionnaire (CNR).
- Search what is available from the literature, starting with a bibliography list (CNR with the help of partners)
- Define a plan of the first biofouling experiment (see 4.4 - Q2) to propose to the partners, evaluating also the feasibility (CNR).

Key persons who could help with information and best practices: Laurent Delauney, Wilhelm Petersen and someone from the glider community.

Patrick Farcy concluded the workshop giving information on two calls within the next FP7-Oceans of possible interest for JERICO:

OCEAN 2013.2 – Innovative multifunctional sensors for in-situ monitoring of marine environment and related maritime activities.

OCEAN 2013.3 – Innovative antifouling materials for maritime applications.

He also advised on the next joint JERICO/GROOM workshop on Gliders to be held in Mallorca from 22 to 23 April 2012: Glider operations in Europe: scientific, technical and operational challenges.