| Joint European Research Infrastructure network for Coastal Observatory – Novel European eXpertise for coastal observaTories - **JERICO-NEXT** | |
|---|---|
| **Deliverable title** | 7th Ferrybox Workshop Jerico-Next meeting |
| **Work Package Title** | WP3 Innovations in Technology and Methodology |
| **Workshop Report** | WP2 – WP3 Common workshop on FerryBox |
| **Description** | Report after FB workshop #1 |
| **Lead beneficiary** | HCMR |
| **Lead Authors** | G. Petihakis, M. Potiris, A. Kalampokis, M. Ntoumas, L. Delauney |
| **Contributors** | |
| **Submitted by** | G. Petihakis – L. Delauney |
| **Revision number** | V1.0 |
| **Revision Date** | 03/08/16 |
| **Security** | Consortium Only |

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

| History | | | |
|---|---|---|---|
| **Revision** | **Date** | **Modification** | **Author** |
| 0.1 | 27 jul. 16 | First draft | G. Petihakis |
| 0.2 | 28 jul. 16 | revisions | I. Puillat |
| 0.3 | 1 aug. 16 | revisions | P. farcy |
| 1.0 | 3 aug 16 | Modifications accepted. Final version 1.0 | I. Puillat |
| | | | |
| | | | |

| Approvals | | | | |
|---|---|---|---|---|
| | **Name** | **Organisation** | **Date** | **Visa** |
| **Coordinator** | P. Farcy | IFREMER | 01 Aug 2016 | PF |
| **WP Leaders** | G. Petihakis – L. Delauney | HCMR – IFREMER | 27 Jul. 2016 | GP-LD |

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# 1. Executive Summary

The participants, activities and main outcomes of the JERICO-NEXT meeting held in Heraklion, Crete on April 6th, 2016, are presented.

Here are the main conclusions:

1. D2.3 can be a document with the contributions of the whole FB community including the EuroGOOS Task Team. The regional dimension of BP in different systems can be included (Rajesh Nair OGS).
2. The concept of a FB data base has been accepted by the consortium but the need for a Handbook is stressed. For end users the data will continue to flow through the existing channels ie Copernicus and EmodNet.
3. FerryBox whitebook: A governance plan was proposed: EmodNet funding similar to EuroArgo. Estimated sum for 15 FB systems plus annual support: 2 (investment) + 1 Million/€ (annually). The white paper will be distributed to partners.

## 2. Introduction

The JERICO-NEXT side meeting was held in Heraklion on April 6th, 2016 one day before the 7th Ferrybox Workshop that took place from April 7th to 8th, 2016. This meeting that joined the partners dealing with Ferrybox systems was attended by 19 participants from 10 institutions. The main outcomes of the side meeting were (i) a joint review of the state-of-the-art of Ferrybox observing systems in terms of technology, applications, maintenance, limitations, etc. and (ii) the coordinated planning of work in the different tasks relating to Ferrybox systems. These tasks involve JERICO-NEXT work packages WP2 on the harmonization for Ferryboxes, WP3 on technological and methodological innovations for biochemical parameters, WP4 on joint research activities for biodiversity and chemical contaminants and WP5 on the definition of Quality Control procedures for Frerrybox systems.

### 2.1. Objectives of the side meeting

The objectives of this JERICO-NEXT meeting were (i) to review the state-of-the-art of Ferybox systems and discuss new sensors/measuring techniques developments and their applicability for installation on the FerryBox systems, (ii) to coordinate the Ferrybox related joint task activities in the framework of the project and (iii) to point out the JERICO-NEXT Ferrybox activities related to the broader Ferrybox community and to identify how JERICO-NEXT can help the Ferrybox community.

This meeting addressed tasks relevant to the following JERICO-NEXT WPs:

- WP2 T2.2: Report on ongoing harmonization initiatives within the JERICO network for the following three key technology areas: Fixed Platforms, Ferryboxes and Gliders).
- WP3 T3.4: Microbial and molecular sensors.
- WP3 T3.5: Combined sensors for carbonate systems.
- WP4 T4.1: JRAP#1 (pelagic biodiversity)- Biodiversity of plankton, harmful algal blooms and eutrophication
- WP4 T4.3: JRAP #3: Occurrence of chemical contaminants in Northern coastal waters and biological
- Responses.
- WP5 T5.2: Integration of biological data.
- WP5 T5.3: Platform registration and metadata management system.

### 2.2. Participants/Institutions

| | |
|---|---|
| *Pierre Marrec* | ***MIO*** |
| *Melilotus Thyssen* | ***MIO-CNRS*** |
| *Soumaya Lahbib* | ***MIO*** |
| *Johanna Linders* | ***SMHI*** |
| *Jukka Sepällä* | ***SYKE*** |
| *Rajesh Nair* | ***OGS*** |
| *Andrew King* | ***NIVA*** |
| *Kai Sørensen* | ***NIVA*** |
| *Pierre Jaccard* | ***NIVA*** |
| *Loïc Petit de la Villeon* | ***IFREMER*** |
| *Katerina Vasileiadou* | ***HCMR*** |

| | |
|---|---|
| *Christina Pavloudi* | ***HCMR*** |
| *George Petihakis* | ***HCMR*** |
| *Patrick Gorringe* | ***EuroGOOS*** |
| *Gisbert Breitbach* | ***HZG*** |
| *Jochen Wollschläger* | ***HZG*** |
| *Patrick Farcy* | ***IFREMER*** |
| *Alkiviadis Kalampokis* | ***HCMR*** |
| *Manos Potiris* | ***HCMR*** |

## 3. Main report

The main points made by each speaker and the followed discussion are presented below. For more details, please refer to the corresponding file with the presented slides.

### 3.1. Presentations' summary

*WP2 T2.2: Report on on-going harmonization initiatives within the JERICO network for the following three key technology areas: Fixed Platforms, Ferryboxes and Gliders).*

3.1.1. Discussion about update/upgrade of the latest version of best practice for Ferryboxes (Kai Sørensen, NIVA)

An overview of available commercial Ferrybox systems and core physical/biogeochemical sensors is given and discussed. Recently developed or under development sensors and systems are presented in more detail and examples of their application on Ferrybox systems is discussed. In particular, the biochemical parameters that the sensors/systems target are fluorescence from various sources, pH, nutrients and $CO_2$. Prototype systems of passive sampling for contaminants, especially for microplastics, are presented. Water samplers and above water sensors are also pointed as a viable option to increase Ferryboxes payload.
Three important categories of activities are identified for the successful operation of the new sensors/systems

- Planning and installation (Water inlets, Pumps, Electrical Considerations etc.)
- Maintenance and calibration
- Data management, processing and archiving

3.1.2. WP2: Discussion about common agreed criteria for the quality flags, extension to bio-optical parameters (P. Jaccard, NIVA)

Review of the background and experience from previous projects, and identification of existing problems, specifically regarding variable naming, unit usage, out-dated documentation, and little or no information regarding QC, methods, auxiliary parameters and calibration.
Quite a few new Chl sensors in the market (K. Sorensen, NIVA), new carbonate systems which is the field expected to have significant advancements in the future (K. Sorensen, NIVA), combine with Aerial CO2 in order FB's to become an ICOS member (K. Sorensen, NIVA)
Clean-up work needed, taking into account the science behind the sensors, the parameterization and calibration, but also the needs for centre level production, the seamless integration.
Proposal of QC flags, following the Argo Policy (The Argo quality flag is used as it is defined in MyOcean 2009 (P. Jaccard, NIVA), and also a full and detailed set of tests.
Adoption of QC levels, and development of a set of software tools to implement and automate the procedures. SMHI must work and deliver on the tool and present it during a WS – probably in September in Gothenburg.

*3.1.3. WP2: Leading task 2.2, responsibilities with regard to deliverable D2.3 (NIVA)*

In respect to FerryBoxes the report D2.3 should cover an overview of achievements in JERICO, the recommendations and level of compliance within the network, new challenges and gaps/bottlenecks in existing structures, and probable solutions for these.

**Proposal to move D2.3 from M30 to M42 [to be discussed in next steering committee] in order to include all the activities (Rajesh Nair OGS).**
**D2.3 can be a document with the contributions of the whole FB community including the EuroGOOS Task Team. The regional dimension of BP in different systems can be included (Rajesh Nair OGS).**

### 3.1.4. WP3: Combined sensors for carbonate system (Task3.5, NIVA)

The 3 subtasks are in the phase of developing and building (Months 1-12).
Task 3.5.1. Combined spectrophotometric pH and CO3 determination (NIVA – Emanuele Reggiani), the system is on the building blocks, with the pH sensor ready to go, and sensitivity measurements for the carbonate sensor need to be performed, as well as for the parts to be interfaced and properly controlled. System on schedule for M12 completion.
Task 3.5.2. Combined spectrophotometric pH and alkalinity determination (HZG – Willi Petersen) is still under development with multiple instruments being tested/developed and will be coupled to NIVA pH sensor from 3.5.1
Task 3.5.3. Combined electrode and spectrophotometric technology for high-accuracy, high-resolution pH determination (Ifremer/Fluidion – Laurent Delauney, Andreas Hausot, Dan Angelescu). Electronic parts have been tested and show excellent results, other parts are in the process of development with testing starting May-July 2016.
Possibility to include in the TNA activity (Andrew King NIVA).

### 3.1.5. WP4: JRAPs and FerryBox (JRAP#1 & JRAP#3) (SMHI, NIVA)

The FerryBox fleet provides a unique opportunity for a cost-effective monitoring strategy for coastal chemical pollution. 5 antibiotics have been routinely detected at ultratrace levels in marine water. Many substances measured for the first time in marine waters: FerryBox is useful for explorative studies on chemical pollution. Measured levels in the range of 100-50,000 pg/L: no problem with detection limits, while sampling costs are a negligible factor!
This year large scale monitoring activities are planned using FerryBox and ISCO sampler in at least 4 different ferries as a part of JRAP 3 within WP4 of JERICO-Next project. Exploratory monitoring will be rub to look for new contaminants (including antibiotics, pesticides, other pharmaceuticals, artificial food additives and personal care products).

### 3.1.6. Ferrybox roadmap and a common FB database (P. Goringe, FB Task Team)

The HF radar is a successful example of data integration (P. Goringe, FB Task Team). Leadership is missing in FB (P. Goringe, FB Task Team) but HZG proposed a Data Base management. This data base can have different data sets according to user. The data base will be for the FB operators since the info is tailored for the requirements of the operators. **The data base has been accepted by the consortium but the need for a Handbook is stressed. For end users the data will continue to flow through the existing channels ie Copernicus and EmodNet.**

### 3.1.7. The Ferrybox White Paper (F. Colijn, FB Task Team)

An initiative based on a meeting in Brussels at DGMARE office (13.02.2015) with Iain Sheperd (DGMare), Agnes Robin (DG Research & Innovation), Eric Buch (EuroGOOS), Patrick Gorringe (EuroGOOS), Wilhelm Petersen and Franciscus Colijn (HZG), Andrew King (NIVA), Jan Bart Calewart (EMODNET) attending to discuss the possibility for sustainable measurements based on FerryBox technology and experience. The work should be guided by the FerryBox Task team (EuroGOOS). In this **FerryBox whitebook** the achievements and needs for FerryBox systems will be presented in the form of short chapters (**1-2 pages**).

These will include:

- Regional and global long term time series based on FB observations,
- FB measurements as ground truth for satellite observations
- Use of FB measurements
  - for the fishing and aquaculture community,
  - by the scientific community including the use of FB data by modellers,
  - as an efficient alternative to current monitoring strategies
- Links between FB operators and the shipping industry
- Development of new sensors for (coastal) oceanographic observations (Innovation)
- Operational and investment costs of systems including maintenance
- Integration between different observational methods and FB (HF Radar, moorings, gliders, Euro-Argo, etc.)
- Need for environmental data from FB systems by the EEA for the MSFD
- Role of FB data in ocean acidification and impact of (coastal)oceans for $CO_2$ uptake from the atmosphere
- Links between FB systems and other (inter)national organizations
- Participating institutes, and groups; specific expertise
- Recommendations and governance of observational systems

**A governance plan was proposed: EmodNet funding similar to EuroArgo.**
**Estimated sum for 15 FB systems plus annual support: 2 Million/€ (investment) + 1 Million/€ (annually).**
**The white paper will be distributed to partners**.

## 4. Conclusions

During the meeting the progress in the various sub-taks was presented, and fruitful discussion took place, especially regarding the quality control, software development and database integration.

In the closing discussion points for future work came up, including:

- How can JERICO-NEXT help the FB community? (Patrick Farcy, IFREMER)
- Need for harmonization of units (Pierre Jacard IFREMER). Decided to discuss this in a special session during one of the upcoming WS.
- How can the JERICO Label be used in reality?
- Update the BP Deliverable with new methods
- Try to connect with the satellite community to use FB for calibration
- QC toolbox was endorsed and will be modified by SMHI
- JERICO NEXT WP5 will define specs for an EU database
- Need for more Plug and Play sensors, must be brought as an issue to manufacturers
- The future strategy as defined in the white paper can be included in the JERICO NEXT WP1 deliverable.

## 5. Annex: slides

## WP2: Discussion about update/upgrade of the latest version of best practice for Ferryboxes

Presenter: Kai Sørensen email: kai Sørensen@niva.no

Contributor(s):

Meeting name / place / country / dates

| Work package number * | WP2 | Lead beneficiary [10] | 23 - OGS |
|---|---|---|---|
| Work package title | Harmonization of technologies and methodologies - technical strategy | | |
| Start month | 1 | End month | 48 |

**Objectives**

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 like 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.

The activities constituting this WP will deal with the following:
• Organization, management and reporting (of harmonisation initiatives across the JERICO network);
• consolidation (of ongoing harmonization efforts in the JERICO project);
• extension (of these efforts to new systems and sensors);
• standardisation (of operations and processes within the JERICO network).

## Deliverable D2.3

D2.3 : Report on ongoing harmonization initiatives within the JERICO network for the following three key technology areas: Fixed Platforms, Ferryboxes and Gliders. [30]
Report on ongoing harmonization initiatives within the JERICO network for the following three key technology areas: Fixed Platforms, Ferryboxes and Gliders (lead: HCMR). The deliverable will also inform on the outcome and results of the workshop that will be dealing with its topic during the project.

## Report on best practice in conducting operations and maintaining D4.4

Grant Agreement n° 262584
Project Acronym: JERICO
Project Title: Towards a Joint European Research Infrastructure network for Coastal Observatories
Coordination: P. Farcy, IFREMER,
jerico@ifremer.fr, www.jerico-fp7.eu:

Authors: Petihakis G., Sorensen K., Hernandez C., Testor P., Ntoumas M., Petersen W., Mader J., Mortier L.
Involved Institutions: HCMR, OGS, NIVA, CSIC, AZTI, HZG, SMHI, CNRS
Version and Date: V1 - 27/02/2012

## Table of Contents
### 4. Ferry Box

Involved partners: NIVA, HZG, SYKE, CEFAS, SMHI, NOC, HCMR
Lead : NIVA
Authors: Kai Sørensen, Wilhelm Petersen, Michael Haller, Jukka Säppäle, Seppo Kaitala, Dave Sivyer, Bengt Karlson, Anna Willstrand, and Mark Hartman.



## Commercial systems

- 4H-Jena
- SubCtech
- Aanderaa
- GO-SYS

- Any new systems available?
- «Home made systems»

## Commercial sensor available for ferrybox installations I

- Core physical sensors: T, S and O

| Measurement principle | Sensor | Manufacturer | User |
|---|---|---|---|
| Pt 2000 | SBE Temp sensor 38 | Sea-Bird Electronics | SYKE, SMHI, NIVA, RNIOZ, MIO |
| PT100 | SBE 45 Micro TSG | Sea-Bird Electronics | NIVA,Cefas, HCMR |
| PT100 | EXCELL TSG | FSI, Now Teledyne RD Instruments | HZG, MSI, Cefas |
| aged thermistor | SBE 16 plus SeaCat | Sea-Bird | POL |
| aged thermistor and VISHAY reference resistor | SBE 48 hull mounted | Sea-Bird | NOCS |

| Measurement principle | Sensor | Manufacturer | User |
|---|---|---|---|
| cell resistance | SBE TSG 45 | Sea-Bird Electronics | SYKE, SMHI, NIVA, HCMR, MIO, Cefas |
| inductively | EXCELL TSG | FSI (USA) | HZG, MSI |
| cell resistance | SBE-21 | Seabird Electronics | RNIOZ |
| cell resistance | SBE 16plus SeaCat | Sea-Bird Electronics | POL |
| induction cell | CTG MiniPack | Chelsea Technologies Ltd | NOCS |
| induction cell | 3919B | Aanderaa | NOCS |

| Measurement principle | Sensor | Manufacturer | User |
|---|---|---|---|
| Optical by dynamic luminescence quenching | Optode (Mod 4835 or 3830) | Aanderaa | SMHI, Cefas NIVA, HZG, NOCS, HCMR |
| Clark electrode | COS4-2 | Endress & Hauser (Germany) | HZG |

- New and more sensor?

## Commercial sensor available for ferrybox installations II

- Core BGC sensors: Chl-a and turbidity

| Measurement principle | Sensor | Manufacturer | User |
|---|---|---|---|
| Chl-a fluorescence | ECO FLNTU | WETLabs (USA) | SYKE, SMHI, |
| Chl-a fluorescence | Chlorophyll-a fluoro-meter (SCF) | SeaPoint Sensor Inc | Cefas, RNIOZ |
| Chl-a fluorescence | TriOS MicroFlu | TriOS (Germany) | NIVA, SYKE, HZG |
| Chl-a fluorescence | Scufa II | Turner design (USA) | HZG, HCMR, MSI |
| Chl-a fluorescence | CTG Mini-Tracka II | Chelsea Instruments Ltd | POL |
| Chl-a fluorescence | CTG MiniPack | Chelsea Instruments Ltd | NOCS |
| Chl-a fluorescence | Turner C3 | Turner | NOCS |
| Chl-a fluorescence, excitation by different wavelengths | AoA | Bbe (Germany) | HZG |

| Measurement principle | Sensor | Manufacturer | User |
|---|---|---|---|
| light scattering (blue) | ECO FLNTU | WETLabs | SYKE, SMHI |
| light scattering 880 nm | Turbidity sensor | SeaPoint Sensor Inc | POL |
| light scattering 880 nm | Turbidity sensor | Polymetron sensor | NIVA |
| light scattering (blue) | Scufa II | Turner design (USA) | HZG, HCMR, MSI |
| light scattering (red) | CUS31-W2A | Endress & Hauser (Germany) | HZG |
| light scattering | Cyclops | Turner design (USA) | HZG |

- New and more sensor?

## Other fluoresence and absorption systems (some are now commercial) I

- cDOM fluorescense
- Phycocyanin
- Phycoerythrin

- New sensors?
  - Matriks fl_sensors

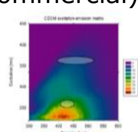


Figure 4.3.2. CDOM excitation-emission fluorescence matrix showing the location of CDOM fluorescence. Sample is from the Baltic Sea. Black ovals overlayed in data show approximate spectral ranges for two commercial fCDOM fluorometers, indicating that they measure different fCDOM components.

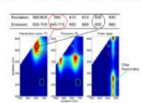


Figure 4.3.5. Excitation emission fluorescence matrix for phycocyanin containing cyanobacteria (left), phycoerythrin containing cyanobacteria (middle) and phycobilin lacking green algae (right). Fluorescence of phycocyanin: excitation 620 nm and emission 655 nm, fluorescence of phycoerythrin: excitation 560 nm and emission 570 nm (with secondary emission at 650-680 nm) and fluorescence of Chlorophyll a: excitation 400-660 nm (due to accessory chlorophylls and carotenoids) and emission at 680 nm. The table above figure shows the wavelength settings of commercial phycocyanin fluorometers. Some of the phycocyanin fluorometers match exactly the phycocyanin fluorescence peak (yellow circle) and have a minimal influence from other pigments, while some fluorometers are influenced by phycoerythrin or chlorophyll fluorescence, or both (red ellipse).

## Other fluoresence and absorption systems (some are commercial) II

- Fluorescence induction techniques
  - FRRF and PAM
- Multichannel fluorescence sensor

- Anything new here?
- Any new experience

Fig 1.3.6. Fast repetition fluorometer tested in lab (left, Chelsea Instruments) and installed on FerryBox system (Photon Systems Instruments).

Figure 4.3.7: AlgaeOnlineAnalyser bbe moldaenke.

## Other fluoresence and absorption systems (some are commercial) III

- Intergrated cavity absorption meter
  - PSICAM (OSCAR)

Figure 4.3.8. Flow-through PSICAM developed at HZG.

- New sensors/systems on the marked?

## New sensor and systems

- LISST 100x With flow through cuvette
  - Particle size
  - Laser
- Flow cytometry incl. imaging systems (JARP1)

- Hydrocarbon fluorescence (PAH)
  - ENVIROFLU

- New and more sensor?

## Marine carbonate systems

- The headspace equlibrium systems and IR-detektor
- Membrane based and either solid state or IR-detector
- pH systems based on absorption and fluoresence
- Alkalinity based on titration to a given pH
- New are CO3 and combination of sensors (pH+pCO2)+ Alk (NEXOS)
- More from the JARP's



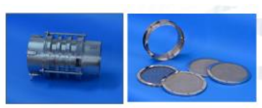
## Nutrients analyser

- PO4, NO3, Sio2, NH4
- Optical NO3 sensors
  - Several on the marked
- Anything new?
- Who has experience for long term run?

Figure 4.5.1: Micromac 1000 of Systea S.p.A. Nutrient analyser.

## Passive sampling for contaminants

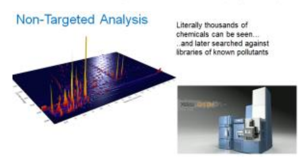
- Some prototype available
  - NIVA (Chem Mariner)
  - CEFAS (4H-Jena)
- New and more systems?
  - Microplastic
  - 3 Stage sampler

## Sampling for more advanced laboratory analysis

- Target and non-target

Figure 4.7.1 Automatic water sampling fon TransPaper.




Luca Nizzetto

## Above water sensors

- Wind
- Weather stations
- Above water reflectance

Figure 4.8.1. Installation on a ship of opportunity in Skagerrak. Radiance sensors can be mounted at different place on the ship.

## Ferrybox infrastructure, planning and installations

**4.9. FerryBox infrastructure planning and installation**

4.9.1. Shipping company
4.9.2. Ship type
4.9.3. Ship route
4.9.4. Ship Regulations
4.9.5. Water Inlet
4.9.6. Pump
4.9.7. Valves and water supply lines
4.9.8. Choice of System
4.9.9. Electrical Considerations

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## Ferrybox maintenance and calibration

**4.10. FerryBox system maintenance and calibration**
4.10.1. System and sensor maintenance
4.10.2. Sensors and instruments calibration and QA

## Ferrybox data managemens, processing and archiving

**4.11. FerryBox data management and processing**
4.11.1. Data management for different parameters
4.11.2. Data flow and quality control (QC) for automated measurements
4.11.3. Data flow and quality control for measurements from water samples collected
4.11.4. Data management and QC developed in MyOcean

**4.12. Data Archiving and dissemination**

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

JERICO next

Discussion about common agreed criteria for the quality flags, extension to bio-optical parameters

Presenter: Pierre Jaccard, NIVA (pierre.jaccard@niva.no)

Contributor(s):
Kai Sørensen, Marit Norli, Dag Hjerman, Andrew King
NIVA

Jerico-NEXT / Heraklion / Greece / 06.04.2016

## Background

- Work during MyOcean projects
- Ongoing work in INSTAC CMEMS
  - NIVA
  - SYKE
  - ACRI
- Compatibility
- Jerico-NEXT

## Review of existing portals

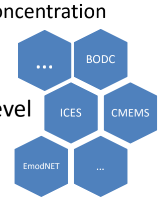
- Using different names
- Using different units
- Outdated documents/links
- Too little or no information about
  - QC
  - Methods
  - Auxiliary parameters
  - Calibration

## Names/Units

| varname | par_unit | par_longname |
|---|---|---|
| FLU2 | milligram/m3 | Fluorescence |
| FLU2 | mg/m3 | CHLOROPHYLL_A_FLUORESCENCE |
| FLU2 | mg/m3 | fluorescence |
| FLU2 | relative unit | fluorescence_of_chlorophyll_A |
| FLU3 | FFU | Fluorescence |
| FLUO | relative unit | Fluorescence |
| FLUO | milligram/m3 | Sea Point Fluorescence |
| CPHL | milligram/m3 | Total chlorophyll-a |
| CPHL | volts | Total chlorophyll-a |
| CPHL | ug/l | Total chlorophyll-a |
| CPHL | milligram/m3 | Chlorophyll-a total |
| CPHL | mg/l | CHLOROPHYLL-A_TOTAL |

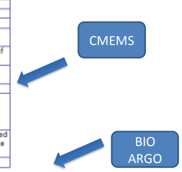
## Clean Up Work

- Science behind sensors
  - Chl-a Fluorescence vs Chl-a concentration
  - Auxiliary parameters
  - Methods and calibration
- Filter at production center level
- Seamless integration
- Introduce an uncertainty




## Flags

| Code | Meaning | Comment |
|---|---|---|
| 0 | No QC was performed | - |
| 1 | Good data | All real-time QC tests passed. |
| 2 | Probably good data | - |
| 3 | Bad data that are potentially correctable | These data are not to be used without scientific correction. |
| 4 | Bad data | Data have failed one or more of the tests. |
| 5 | Value changed | Data may be recovered after transmission error. |
| 6 | Not used | - |
| 7 | Nominal value | Data were not observed but reported. Example: an instrument target depth. |
| 8 | Interpolated value | Missing data may be interpolated from neighbouring data in space or time. |
| 9 | Missing value | - |




The Argo quality control flag application policy is used. Then, the QC flag value assigned by a test cannot override a higher value from a previous test. A value with QC flag '4' (bad data) or '3' (bad data that are potentially correctable) is ignored by the quality control tests.

# QC Test



**2.3 Quality control Tests**

Control of the calibration equation
Mixed Layer Depth estimation
Profile depth
Range test
Spike Test
Non Photochemical Quenching (Xing, 2012)

MyOcean

BIO ARGO

Review continuously

QC on uncertainty

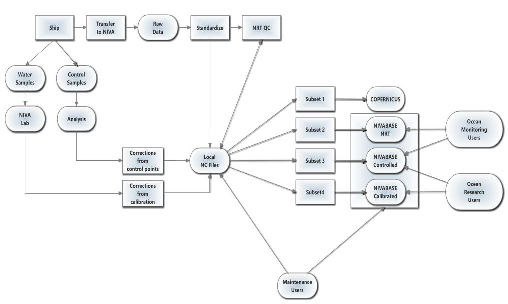
# Jerico

- QC Levels
  - L0 ~ RT
  - L1 ~ Field Controls
  - L2 ~ Lab Samples
  - L3 ~ Review
- Full and partial sets
  - Rather define products?

RT

DM

BIO ARGO




# Ferrybox Tools

- SMHI (python)
- Any other?

Open
Extensible with Modules
Documentable

- Managed by a team of developers from partners
- Forum creation (github)
- Setup should start now

**Task 5.5: Enhancement of Quality Control procedures for sensor based biochemical data (M1-M40)**
**SMHI**, NIVA, HZG,Ifremer, SOCIB, HCMR, SYKE,OGS
Establishment of procedures or best practices for the Quality Control procedures that are applied on biochemical data
recorded by sensors attached to the existing platforms, both in real-time and delayed-mode.

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

*The "FerryBox" in Task 2.2 (WP2)*
**Responsibilities with regard to Deliverable D2.3**

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

Contributor(s): Kai Sorensen (NIVA, Norway), Pierre Jacard (NIVA, Norway) & Wilhelm Petersen (HZG, Germany)

7th FerryBox Workshop JERICO-NEXT Meeting/Heraklion, Crete/Greece/06 April 2016

**What is Deliverable D2.3?**

*Report on ongoing harmonization initiatives within the JERICO network for the following three key technology areas: Fixed Platforms, FerryBoxes and Gliders.*

## Points for dicussion (#1)

**What I think the Report should cover with respect to FerryBoxes?**

- *Overview of FerryBox achievements in JERICO.*
- *What was recommended, what has been done and level of compliance within the JERICO network.*
- *What's missing – gaps/bottlenecks which were overlooked the first time or new challenges*
- *Strategies or solutions to fill these gaps/bottlenecks.*
- *Other?*

## Points for dicussion (#2)

**How should FerryBoxes figure in the Report?**

- *Technology (Available systems)?*
- *Thematic (Best Practice, Quality, etc.)?*
- *Other ideas?*

## Points for dicussion (#3)

**Structure?**

- *If "Technology": based on systems or manufacturers (capabilities, capacity for expansion, costs, ease of use, etc)?*
- *If Thematic (update/upgrade of Best Practice, Quality, extension to bio-optical parameters, etc.)?*
- *Other ideas?*

## Points for dicussion (#4)

**The management of the FerryBox part of D2.3**

- *Who can take the lead?*
- *Is the actual due date of the Report, M30 (February, 2018) too early, seeing that the project ends in M48?*
- *Other?*

*Thank you for listening!*

This project has received funding from the European
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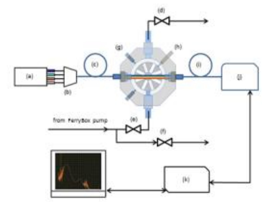
**WP3 Task 3.5 Combine carbonate sensors**
**3.5.1.** Combined spectrophotometric pH and CO3 determination (NIVA – Emanuele Reggiani)
**3.5.2.** Combined spectrophotometric pH and alkalinity determination (HZG – Willi Petersen)
**3.5.3.** Combined electrode and spectrophotometric technology for high-accuracy, high-resolution pH determination (Ifremer/Fluidion – Laurent Delauney, Andreas Hausot, Dan Angelescu)

**Timeline**
Month 1: virtual introduction and discussion
***M1-12: build and develop each sub-task (we are here now)***
M13: meet virtually to discuss individual efforts
M15: JRAP 5 carbonate sensor comparison workshop?
M18-24: trials and testing on FerryBox

# Subtask 3.5.1 (NIVA)

- Combined system still on the building blocks, spectrophotometric pH sensor ready to go (thymol blue)
- Sensitivity measurements for carbonate sensor need to be performed ($PbCO_3$)
- Parts need to be interfaced and properly controlled, especially the UV source
- On schedule for M12 completion



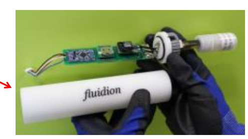
# Subtask 3.5.2 (HZG)

- Total alkalinity determination using m-cresol purple indicator, 50 ml samples (Hydro-FIA from Contros)
- TA range 2100-2600, salinity range ~20-37
- Still under development with multiple instruments being tested/developed
- Will be coupled to NIVA pH sensor from 3.5.1

# Subtask 3.5.3 (Fluidion / IFREMER)

Progress Highlights:
**Task No. 7**
Electrode electronics has been tested and independently verified. The lab indicates excellent linearity and repeatability of the sensor over the range of temperature 0.0 degC – 25.0 degC and pH 7.2 - 8.8
**Task No. 8**
Microfluidic Mixing Circuit (meta-cresol purple; pathlength = 1.5 cm, volume < 1 µl) and Reagent Regulator have completed the clean room fabrication run and have been delivered to Fluidion for testing.

Forward Plan (next 6 months):
**Task No. 9**
Microfluidic mixing will start to be tested in the Fluidion lab to optimize the mixing process and ratio.
**Task No. 10**
Testing and initial calibrations of the optical system is scheduled to start in May 2016
**Task No. 11**
Integration of the optical and electrode systems will begin in July 2016




# JRAP #3: FerryBox-based MONITORING OF CHEMICAL POLLUTION IN COASTAL WATERS

Luca Nizzetto I NIVA I Luca.nizzetto@niva.no

Kai Sørensen (NIVA), Miroslav Brumovsy

## Coastal chemical pollution: a (very short) introduction

**44** substances considered under WFD and MSFD

**5,000** substances listed as «High production volume»
over 1000 T per year

**300,000** chemical substances in the global markets
140,000 covered by some regulation.

**95 million** substances so far discovered and registered
CAS

**$10^{60}$ substances**

**(and therefore potential environmental contaminantss) can be obtained merely starting from 30 atoms of C, N, O and S**

## Coastal chemical pollution: a (very short) introduction

**Policy demand for contaminant monitoring:**

MSFD Descriptor 8: «Concentration of the priority contaminants, measured in the relevant matrix (such as biota, sediment and water) in a way that ensures comparability with the assessments under Directive 2000/60/EC"

Other international treaties: e.g. Stockholm Convention on Persistent Organic Pollutants

**Scientific demand for contaminant monitoring**

Discovering new contaminants.
Tracking sources
Understanding contamint environmental behavior
Define lists of priority substances for regulation

## OUR SCOPES

Over 100,000 km coast line in Europe. Innumerable sources of contaminants

How do we set a cost-effective monitoring strategy?

- Clever use of existing multipurpose coastal infrastructures
- Further development of sampling devices and sensors
- Developing/Testing /demonstrating effective procedures/equipments

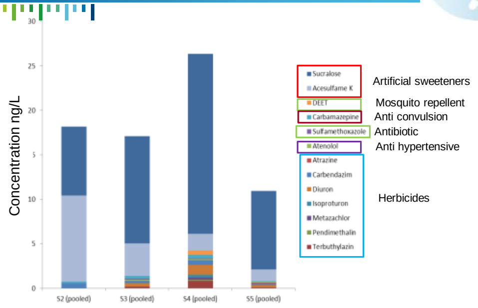
The FerryBox fleet: a unique opportunity!

## Case study 1


- ***Lysbris ferry in the North Sea***
- ***5 selected sampling areas***
- ***Sampling using ISCO automatic water sampler***

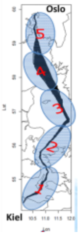
## Sample processing

## Detection of artificial food additives Pharmaceuticals, Antibiotics, personal care products, pesticides



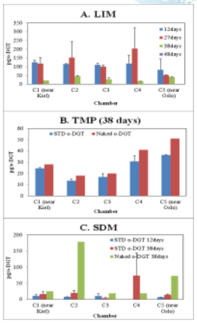

## Case study 2: Passive samplers on Ferrybox

**O-DGT: RESULTS**




**5 antibiotics routinely detected**
**At ultratrace levels in marine water**

**Work in progress!**




## What we have learned

Many substances measured for the first time in marine watera: FerryBox is useful for explorative studies on chemical pollution

We measured levels in the range of 100-50,000 pg/L: no problem with detection limits.

Sampling costs for both are a negligible factor!

## Upcoming JRAP 3 activities: April-June 2016

EuroGOOS European Global Ocean Observing System

# The FerryBox Whitebook
# Franciscus Colijn and Willi Petersen
# HZG, Geesthacht, Germany

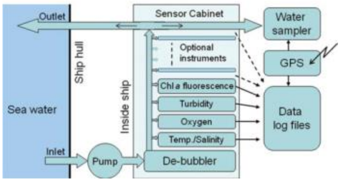
7th FerryBox Workshop
Heraklion, April 6th 2016

EuroGOOS European Global Ocean Observing System

## Ferries and container ships as monitoring platforms

**core parameters measured by all systems:** salinity, temperature, turbidity, chl-a fluorescence

**biogeochemical parameters:** oxygen, pH, $pCO_2$, irradiance, nutrients, algal pigments, CDOM, discrete and passive samplers






## FerryBox pros and cons

**Advantages**
- Cost effective (no costs for the platform)
- Real-time/near-real-time data
- High spatial and temporal resolution (repeat transects)
- Often covers regions of socioeconomic importance
- "Friendly" environment for the system
  - No energy limitations
  - Good for testing/operating new sensors that may be less robust, or sensors/ samplers that have high energy or sample size requirements
  - Easy maintenance and antifouling measures
- Water can be sampled/preserved for advanced analysis in the lab


**Limitations**
- Data limited to the transect
- No depth profiles, unless XBTs are used
- Voluntary ships/routes can change



## Applications for FerryBox-based observations

Measurements → Activities

- Real-time ocean obs. (T, S, irradiance/reflectance)
- Real-time meteorological obs. (T, humidity, wind, radiance)
- Satellite products validation (T, reflectance/radiance, Chl-a)

**1) Operational oceanography and weather** (industry, government, research)

- Macronutrient concentrations
- Phytoplankton biomass and community structure
- Ocean acidification ($pCO_2$, pH, alkalinity, $CO_3^-$)

**2) Climate change, ocean acidification**
**3) Ocean productivity, C cycling**
**4) Management of fish stocks**
(research, government, industry)

**5) Water quality framework directives** (government, research, industry)

- Pollutants and emerging contaminants, microplastics
- Environmental quality: $O_2$, high T, eutrophication, contaminants (MSFD/WFD indicators)
- Molecular and microarray techniques (harmful algal species, aquaculture parasites/viruses, contaminants etc.)

**6) Aquaculture**
**7) Human health**
(industry, government, research)

- Sensor and sampler development

**8) Technology and innovation** (industry, research)



## The FerryBox Task Team

***www.ferrybox.org***

FerryBox Routes


**15th of December 2014 Brussels**

**Team members:**
Franciscus Colijn (HZG, DE; chair)
Wilhelm Petersen (HZG, DE; chair)
Kai Sørensen (NIVA, NO; co-chair)
Andrew King (NIVA, NO; co-chair)
Patrick Gorringe (EuroGOOS)
Seppo Kaitala (SYKE, FI)
Bengt Karlson (SMHI, SE)
Urmas Lips (MSI, EE)
George Petihakis (HCMR, GR)
Loic Petit De La Villeon (IFREMER, FR)
Henning Wehde (IMR, NO)



## Aims of the FerryBox Task Team

- Coordinate and continue FerryBox observations (currently most of the activities are funded by research funding)
- Secure the sustainability of the European FerryBox network
- Increase the network of routes in regions of poor coverage (e.g., in the Mediterranean Sea)
- Promote productive partnerships with industries involved with ferry and shipping industries
- Further standardization of FerryBox operation (in terms of data acquisition, quality control and data handling etc.)
- Implement new and innovative sensors towards more biogeochemical variables (nutrients, carbonate system…) with regard to issues such as eutrophication, toxic algae (biosensors), ocean acidification, and C cycling
- Integration of FerryBoxes with *other observation platforms* and *research activities* in the European Marine Services and contribution to European Ocean Observing system (EOOS).

## Setting up /promotion of the FerryBox group

| Action | Term | Who |
|---|---|---|
| ToR and roadmap | AC | HZG, NIVA |
| Create LOGO (based on existing FB community logo?) | IP | HCMR, HZG |
| Core group definition, adding strategic members | IP | HZG, NIVA |
| Upgrading and/or updating existing webpage (www.ferrybox.org) | AC, IP | HZG |
| EMODnet Phase 3: promoting FerryBox activities in that context<br>Coordination<br>To fill gaps in key places<br>Supporting funding of existing systems | ST | EuroGOOS |
| Seek funding for joint/coordination activities<br>Prepare a COST ACTION proposal | ST | EuroGOOS + Everybody |
| Identify other funding possibilities for network activities (H2020 CSA) | IP | Everybody |
| White paper: Status and achievement of FerryBox activities | IP | FB-TT |
| Reporting FerryBox Task Team activities | ST | HZG, NIVA |

AC: Achieved IP: In progress
ST: Short term Actions (<1-2 years)
MT: Mid-term Actions (> 2 years)



## Towards providing a framework to FerryBox operators

| Action | Term | Who |
|---|---|---|
| Optimize website for the group<br>Subtasks:<br>- Information about existing FB lines (routes, parameters, instruments etc.)<br>- Organization of the information in the webpage (news, links with key webpages…)<br>- Define topics | IP<br>AC<br>IP<br>IP | HZG, EuroGOOS |
| FerryBox workshops every 1.5 years | ST | FB-TT, (next HCMR) |
| Other participation in between (for example in JCOMM, EGU…) | IP | everybody |

AC: Achieved IP: In progress
ST: Short term Actions (<1-2 years)
MT: Mid-term Actions (> 2 years)



## Towards common European recommendations

| Action | Term | Who |
|---|---|---|
| Reporting on existing European and national projects (work plan, results…) | ST | FB-TT |
| Intensify contacts with other groups operating SoOPs (ICOS, JCOMM-SOT…) | IP, ST | FB-TT, HZG |
| Identify existing activities in other countries outside Europe | ST | |
| Template for key research questions around the use of FerryBox systems | ST | |
| Complete the inventory (data management procedures, applications, stakeholders achieved, which kind of funding…) | ST | |
| How to recover the need from the different kind of users (workshops…) – related to the format | St | |
| Identify specific added value of FerryBox products that can be useful for specific stakeholders | ST | |
| How to coordinate FerryBox activities/measurements to address long-term environmental change | MT and beyond | |

AC: Achieved IP: In progress
ST: Short term Actions (<1-2 years)
MT: Mid-term Actions (> 2 years)



## Terms of Reference

- Develop the European FerryBox network and assist the standardization of FerryBox operations, data and applications, including:
  - All applications of FerryBox Systems (physical, chemical, biological parameter etc…)
  - Common procedures on operation, quality control and data handling of FerryBox systems (link to best practise in EU projects JERICO and JERICO-NEXT)
  - Implementation of new upcoming probes and sensor systems
  - Applications in combination with other technologies (including satellites, fixed platforms, gliders, numerical modelling…)
- Act as the European component in the global community using ships of opportunity (e.g. JCOM-SOT)
- Ensure the integration of FerryBox networks in the European Operational Oceanographic Services and contribute to the development of the European Ocean Observing System (EOOS)



## Terms of Reference cont….

- Ensure data availability via the EuroGOOS ROOS data portals including data quality procedures
- Foster dialog between operators and end-users on:
  - Data structure, format and dissemination (interoperability of datasets)
  - Quality control procedures
  - Validation procedures
  - Technological solutions
- Be a framework for operators to:
  - Operating a common website
  - Share success stories and difficulties
  - Provide and exchange open source tools (data analysis, applications…)
  - Promote scientific synergies for key questions
  - Fill gaps and looking for complementarity with other technologies or modelling products
  - Promote joint proposals through networking (e.g. create synergies between different local consortium INTERREGs…)



## White Paper

- An initiative based on a meeting in Brussels at DGMARE office (13.02.2015) with Iain Sheperd (DGMare), Agnes Robin (DG Research & Innovation), Eric Buch (EuroGOOS), Patrick Gorringe (EuroGOOS), Wilhelm Petersen and Franciscus Colijn (HZG), Andrew King (NIVA), Jan Bart Calewart (EMODNET) attending to discuss the possibility for sustainable measurements based on FerryBox technology and experience. The work should be guided by the FerryBox Task team (EuroGOOS).
- In this **FerryBox whitebook** the achievements and needs for FerryBox systems will be presented in the form of short chapters (**1-2 pages**).

## White Paper cont…

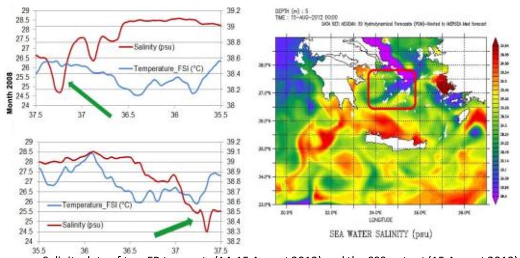
14 Chapters

- **Chapter 1:** Regional and global long term time series based on FB observations
- **Chapter 2:** FB measurements as ground truth for satellite observations
- **Chapter 3:** Use of FB measurements for the fishing and aquaculture community
- **Chapter 4:** Use of FB data by the scientific community including the use of FB data by modellers
- **Chapter 5:** Use of FB systems as an efficient alternative to current monitoring strategies
- **Chapter 6:** Links between FB operators and the shipping industry
- **Chapter 7:** Development of new sensors for (coastal) oceanographic observations (Innovation)
- **Chapter 8:** Operational and investment costs of systems including maintenance
- **Chapter 9:** Integration between different observational methods and FB (HF Radar, moorings, gliders, Euro-Argo, etc.
- **Chapter 10:** Need for environmental data from FB systems by the EEA for the MSFD
- **Chapter 11:** Role of FB data in ocean acidification and impact of (coastal)oceans for CO2 uptake from the atmosphere
- **Chapter 12:** Links between FB systems and other (inter)national organizations
- **Chapter 13:** Participating institutes, and groups; specific expertise
- **Chapter 14:** Recommendations and governance of observational systems



Examples

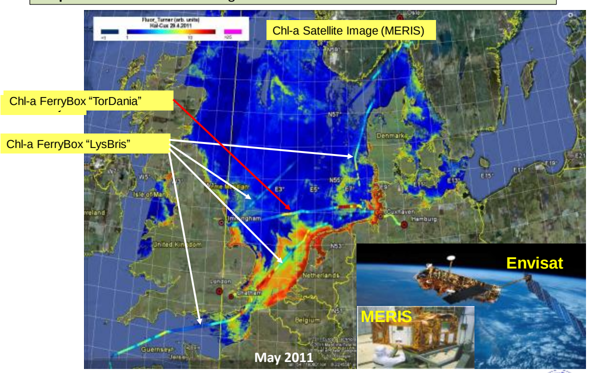
**Chapter 1:** Regional and global long term time series based on FB observations




Salinity data of two FB transects (14-15 August 2012) and the SSS output (15 August 2012) of the Operational POSEIDON Aegean Sea Model. The salinity minimum near the island of Milos is an indicator of Black Sea Water (BSW) flowing in the Aegean Sea.



**Chapter 2:** FB measurements as ground truth for satellite observations

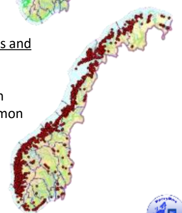



e.g., Petersen et al. (2008) *Estuar Coast Shelf Sci*



**Chapter 3:** Use of FB measurements for the fishing and aquaculture community

Environmental conditions at Atlantic cod spawning grounds
~0.5 million tons landed in 2014
~50% of Atlantic cod catch

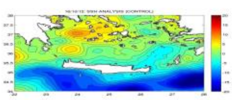


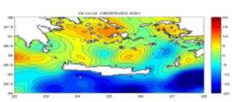
Monitoring for HAB blooms and parasites/viruses
>1000 aquaculture sites
>1 million tons/y in salmon
~50% of global farmed salmon

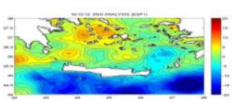
FAO report; Norwegian Fisheries Directorate



**Chapter 4:** Use of FB data by the scientific community including the use of FB data by modelers







SSH field (in cm) for 16 October 2012 corresponding to:
a) the analysis of CTRL experiment
b) the satellite observations
c) the analysis of FB experiment.

The CTRL is totally missing the anticyclone at the east although it is present and well-formed as it is evidenced by the satellite SSH observations.

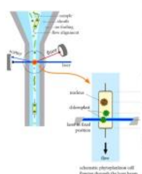
With the assimilation of FB the feature is introduced in the model solution

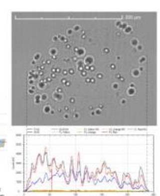


**Chapter 7:** Development of new sensors for (coastal) oceanographic observations (Innovation)

E. Reggiani (NIVA)

Spectrophotometric pH sensor
- Stable and high precision
- Adaptable for titration-based pH measurements





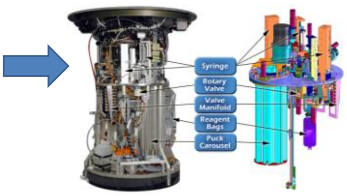
Cytobuoy/Cytosense

Imaging flow cytometry
- Particle size up to ~1 mm
- Images and spectra for each particle
- Can use multiple excitation/ detection wavelengths

**Chapter 7:** Development of new sensors for (coastal) oceanographic observations (Innovation)

Low-tech autosamplers to advanced sampling systems for biologically and chemically-relevant measurements

Refrigerated autosampler




ISCO Inc.; MBARI ESP

Environmental sample processor



**Chapter 8:** Operational and investment costs of systems including maintenance

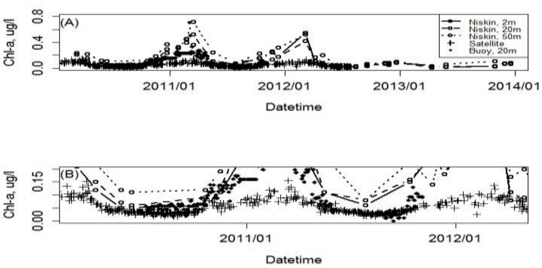
JERICO D4.5 Running costs of coastal observatories - http://www.jerico-fp7.eu/deliverables/d4-5-running-costs-of-coastal-observatories

| | Annual routine operations | | | Annual total operations | | |
|---|---|---|---|---|---|---|
| | Total | Mean (€) | As % of mean | Total | Mean (€) | As % of mean |
| Variable operations | | | | | | |
| consumables (cables, anchors, batteries, chemicals etc.) | 18,941 | 2,368 | 14% | 38,941 | 4,868 | 23% |
| telecommunication costs | 4,776 | 597 | 3% | 4,776 | 597 | 3% |
| spare parts | 16,500 | 2,063 | 12% | 16,500 | 2,063 | 10% |
| repair of sensors and Ferrybox devices | 21,250 | 2,656 | 15% | 27,415 | 3,427 | 16% |
| replacement of sensors and Ferrybox devices | 24,750 | 3,094 | 18% | 29,088 | 3,636 | 17% |
| large overhaul costs (where not already included in other categories) | 6,176 | 772 | 4% | 6,176 | 772 | 4% |
| operational centre consumables | 15,625 | 1,953 | 11% | 15,625 | 1,953 | 9% |
| calibration costs | 11,671 | 1,459 | 8% | 11,671 | 1,459 | 7% |
| boat hire | 6,250 | 781 | 5% | 6,250 | 781 | 4% |
| transportation of equipment | 11,773 | 1,472 | 9% | 11,773 | 1,472 | 7% |
| **Total** | **137,712** | **17,214** | **100%** | **153,845** | **21,027** | **100%** |
| Fixed operations | | | | | | |
| rents | 0 | 0 | 0% | 0 | 0 | 0% |
| waste disposal/service charges from institute | 118 | 15 | 0% | 118 | 15 | 0% |
| data centre costs | 72,780 | 9,098 | 46% | 72,780 | 9,098 | 46% |
| insurance | 12,500 | 1,563 | 8% | 12,500 | 1,563 | 8% |
| routine maintenance contract | 12,500 | 1,563 | 8% | 12,500 | 1,563 | 8% |
| devaluation total (platform infrastructure, sensors, equipment) | 61,597 | 7,700 | 39% | 61,597 | 7,700 | 39% |
| **Total** | **159,495** | **19,937** | **100%** | **159,495** | **19,937** | **100%** |
| **Grand Total** | **297,207** | **37,151** | | **313,340** | **40,964** | |

*Table 4.8 The annual routine and total operations costs associated with running Ferrybox systems*



**Chapter 9:** Integration between different observational methods and FB (HF Radar, moorings, gliders, Euro-Argo, etc.






EuroGOOS European Global Ocean Observing System

FERRY BOX

Next meeting FerryBox Community
7th FerryBox Workshop
7-8 April 2016 HCMR, Heraklion, Crete, Greece

FerryBox Task Team




## Sustainable governance of FB Systems

- Investment by EMODNET
- Continued financing for 5 years by EMODNET
- Comparable mechanism as EU- ARGO
- Estimated sum for 15 FB systems plus annual support : 2 (investment) + 1 Million/€ (annually)
- Organisation FB TT? EuroGOOS?, ROOSes?