Project	AtlantOS – 633211
Deliverable number	D11.5
Deliverable title	1st AtlantOS progress report plus summary of external board meetings
Description	Prior to the 2nd annual AtlantOS meeting in month 14 a project progress report for the external project board – the International Scientific and Technical Advisory Board (ISTAB) - will be prepared to enable them to be as good as possible prepared for the meeting and to ensure consequently that AtlantOS receives as constructive as possible recommendations from the board. This report together with the external summary board meeting report, that will be requested from the ISTAB, will represent D11.5.
Work Package number	11
Work Package title	Management and Exploitation
Lead beneficiary	GEOMAR
Lead authors	Anja Reitz, all Work Package leaders and the ISTAB chairs Brad de Young and Eric Lindstrom
Contributors	All WP task leaders
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Comments	

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AtlantOS summary progress report for the external advisory boards June 2016

https://www.atlantos-h2020.eu/

Content

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1. Introduction

AtlantOS *Optimising and Enhancing the Integrated Atlantic Ocean Observing Systems* is a large scale EU Horizon 2020 research and innovation project contributing to the Trans-Atlantic Research Alliance and GEO (Group on Earth Observations). The project pools the effort of 57 European and 5 non-European partners (research institutes, universities, marine service providers, multi-institutional organisations, and the private sector) from 18 countries to collaborate on optimizing and enhancing Atlantic Ocean observing. It has a budget of € 20.5M for 4 years (April 2015 – June 2019) and is coordinated by GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (Prof. Dr. Martin Visbeck). The work is organised along work packages on: i) observing system requirements and design studies, ii) enhancement of ship-based and autonomous observing networks, iii) interfaces with coastal ocean observing systems, iv) integration of regional observing systems, v) cross-cutting issues and emerging networks, vi) data flow and data integration, vii) societal benefits from observing /information systems, viii) system evaluation and resource sustainability. Engagement with wider stakeholders including end-users of Atlantic Ocean observation products and services will also be key throughout the project.

Atlantic Ocean observation is currently undertaken through loosely-coordinated, *in-situ* observing networks, satellite observations and data management arrangements of heterogeneous international, national and regional design to support science and a wide range of information products. Thus there is tremendous opportunity to develop the systems towards a fully integrated Atlantic Ocean Observing System (AtlantOS) consistent with the recently developed 'Framework of Ocean Observing' (FOO). The FOO was outlined by a group of experts in charge to develop a strategy for the future to foster progress in sustained ocean observing considering the recognition that more integration across disciplines is needed. The FOO is responsive to user needs and societal drivers.

The **vision of AtlantOS** is to improve and innovate Atlantic observing by using the Framework of Ocean Observing to obtain an international, more sustainable, more efficient, more integrated, and fit-for-purpose system. The AtlantOS initiative aims to have a long-lasting and sustainable contribution to the societal, economic and scientific benefit arising from this integrated approach, by implementation beyond the project's lifetime. Advances will be achieved by improving the value for money, extent, completeness, quality and ease of access to Atlantic Ocean data required by industries, product supplying agencies, scientist and citizens.

The overarching target of the AtlantOS initiative is to deliver an advanced framework for the development of an integrated Atlantic Ocean Observing System that goes beyond the state-of–the-art, and can be sustained after the project's lifetime.

The sustainability will derive from the AtlantOS aims:

- to improve international collaboration in the design, implementation and benefit sharing of ocean observing,
- to promote engagement and innovation in all aspects of ocean observing,
- to facilitate free and open access to ocean data and information,
- to enable and disseminate methods of achieving quality and authority of ocean information,
- to strengthen the Global Ocean Observing System (GOOS) and to sustain observing systems that are critical for the Copernicus Marine Environment Monitoring Service and its applications and to contribute to the aims of the Galway Statement on Atlantic Ocean Cooperation.

The AtlantOS initiative contributes to achieving the aims of the Galway Statement on Atlantic Ocean Cooperation that was signed in 2013 by the EU, Canada and the US, launching a Transatlantic Ocean Research Alliance to enhance collaboration to better understand the Atlantic Ocean and sustainably manage and use its resources.

2. Abstract of project progress within the first 15 month

In this initial phase of the action efforts in work package 1 *Observing system requirements* were focused on collecting the existing requirements for the Atlantic Ocean observations in a consolidated way, drawing in particular on the work of the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS), in advance of refinements that will come through the course of the action through innovation activities across all work packages, as well as continued interaction with partners. The definition of the Observing System Simulation Experiments (OSSEs) to be carried out from mid-2016 to mid-2018 has been addressed.

Work package 2 *Enhancement of ship-based observing networks* improved the coordination between the GO-SHIP network and other hydrographic surveys and identified two lines for support laboratory services. A new autonomous titration system for total alkalinity (TA) has been completed and is now commercially available (CONTROS HydroFIA®TA), furthermore, there has been an expansion of pCO_2, temperature and salinity data collections in the Southern Atlantic. New technology in the form of a CTDF has been added to the Continues Plankton Recorder (CPR) and is now operational. Specifications of the fisheries acoustic data models (D2.2 *Fish Survey database and interface*) have been completed and software has been designed to align acoustic survey data with the data model of the ICES data centre. Seafloor data being collected from multibeam acoustics and are presently set up on ships without needing on-board technical support. Currently, discussions are underway to link EU and North American seafloor data.

Work package 3 *Enhancement of autonomous observing networks* has ordered Deep Argo Floats for Argo and new biogeochemical sensor implementation is on-going, data management procedures for biogeochemical variables have been strengthened. Preliminary tests have been carried out to extract sequence information from preserved sediment trap samples in the Fram Strait. The possibility to extract and sequence DNA from these samples has been successfully demonstrated, and perspectives on the optimization of these processes gathered for future evaluation. Ribocon's bioinformatics pipeline has been shown to provide workable results and detect issues in sequence length and quality. Several tests have served to establish a preliminary workflow with Ribocon as a precursor to defining standard workflows and bioinformatic pipelines that could serve as a blueprint for future omic-type observations in the Atlantic. Regarding the glider work, a new partnership with Brazil has been developed and a Glider Steering Team and a Glider Data Managment Team within JCOMMOPS as well as a glider Task Team within EuroGOOS have been established. Additionally, the European Aquatic Animal Telemetric Network has been launched. The online survey provides a useful overview of the European-based acoustic telemetric research community and their expectations towards an organised network.

Work package 4 *Interfaces with the coastal ocean observing systems* made progress on biogeochemical analysis and the planning of further shelf-wide cruises. Data processing of glider-derived biogeochemical data (from the 2015 Shelf Sea Biogeochemistry deployments) are nearly complete. A new observational campaign is planned for summer 2017. This will demonstrate across-shelf measurement capability over an extended section of the American shelf and Bay of Biscay. The *Shelf profiler and glider deployment meeting* (milestone 2) was hold in Brest in February 2016. Advances have been made towards a strategy for transatlantic sustained measurements in the coastal ocean, based on the strengthened forum for interaction between US IOOS, GOOS regional alliances and EuroGOOS.

Work package 5 *Integrated regional observing systems* started to establish regional contacts in the two regions of the North and South Atlantic Ocean in order to have the most general view on national programmes of ocean observations (open ocean and coastal projects) and the appropriate stakeholders to connect with. In order to reinforce the regional integration WP5 established a capacity-building programme by proposing dedicated cruises to Atlantic undergraduate, master and PhD students. The first of these took successfully place in March 2016. The involved groups in WP5 started to develop climate and ecosystem related observing analysis techniques to the two selected Atlantic Ocean sub-regions. The work on OSSEs and process models was lunched during a dedicated workshop co-organized with WP1 in December 2015.

The different regional studies have been discussed together with their potential for the basin wide integration.

Work package 6 *Cross-cutting issues and emerging networks is* focused on key capability gaps, and opportunities for improved efficiency and cost reduction for current observing system technologies and practices. The WP has created a roadmap for sensor and instrumentation development with input from companies, research organisations and operational groups across the EU and internationally. The resulting report and summary, has been welcomed and used by a wide range of stakeholders including ocean observers, regulators, industry and defense sector. It is also a live document and will continue to be added to and updated during AtlantOS and beyond. This It enables prediction of future technology capabilities and therefore development timelines for EOVs and observing systems. Technology programmes have been collaborated and coordinated through existing meetings and AtlantOS initiatives (e.g. Oceanology International 2016) leading to the development of metrology best practice, ocean observing system best practice, plans for shared use of infrastructure, development of agreed interface and data standards, and coordinated biological and biogeochemical instrumentation development. Furthermore, proof of concept samplers for biological and (meta)genomic observations have been completed.

Work package 7 *Data flow and data integration* built a set of matrices (i.e. Networks-EOVs, Networks-Integrators, Networks-platforms, Integrators-services, and Integrators-users) to identify possible gaps, propose solutions to reduce them and move towards those solutions and to have a complete and clear map of the current situation. Relying on existing international standards and protocols WP7 agreed and recommended on i) a list of Essential Ocean Variables (EOVs) across the Networks, ii) a minimum set of metadata common vocabularies to be used by all networks, iii) a minimum level of Near Real Time Quality Control Procedures for selected EOVs, and iv) basic services to distribute data. An action plan, involving data providers both Networks and Integrators, was decided to be finalised end of June 2016 aiming to harmonize the data management activities and enhance data flow and integration of existing data. A coordinated action for a shared strategy and complementary developments for monitoring and dashboard services have been developed, leading to a proposal for a dashboard service to show and taking into account the Network needs.

Work package 8 *Societal benefits form observing/information systems* produced the design of a Use-Case Specification and adopted the EMODnet Checkpoint assessment methodology for the AtlantOS Data Adequacy reporting. The Harmful Algal Blooms task group started to design a common framework for algal blooms bulletins between Ireland, Spain and Norway. The Coastal Flooding/Storm surges task group achieved a comprehensive statistical model of storm surge distribution together with initiation of an inter-comparison exercise with equivalent systems in the world. The Ship routing hazard mapping task group defined a starting grid for the Alantic minimization algorithm to model economic cost of marine voyages. The Reanalyses for Marine Strategy Framework Directive (MSFD) and ICES assessment task group identified potential target users for hands-on assessment and training in the use of the Copernicus Marine Environment Monitoring Service (CMEMS) products. The Operational real-time and forecast modelling of North Atlantic albacore tuna populations task group made progress in preparing a historical geo-referenced fishing datasets.

Work package 9 *System evaluation and sustainability* got familiarized with the two web-based monitoring systems JCOMMOPS and EMODnet to better define the scope and role of each partner subsequently, synchronization of both systems has been started. The JCOMMOPS dashboard based monitoring system can be adapted to provide the AtlantOS perspective and filter all information accordingly, while EMODnet is built already on the EuroGOOS perspective. Hence partners will naturally share the developments of the two deliverables: JCOMMOPS for AtlantOS and international view and EMODnet for EuroGOOS and European view.

Work package 10 *Engagement, Dissemination, and Communication* completed a comprehensive engagement, dissemination, and communication strategy for AtlantOS containing measures to be implemented both, during and after the project's lifetime. It became obvious during the first 15 month of

the action that the appointment of an Engagement Board (ENB) comprise of various stakeholders is challenging. It was proposed to simply appoint a reasonable number of individuals to a standing board for the entire duration of the project. This issue will be discussed during the GA meeting in Kiel. However, WP5 is cooperating with governments, industry and other stakeholders; one prominent example is the Organisation for Economic Co-operation and Development (OECD)-AtlantOS workshop on the economic potential of data from ocean observatories which will take place directly prior to the AtlantOS GA meeting. The AtlantOS webpage from the proposal phase was re-designed and improved and moved to its final state in November 2015; it is available at www.atlantos-h2020.eu. Between November 2015 and May 2016 an average of 1,200 visits per month from 102 countries visited the webpage.

Work package 11 *Management and Exploitation* organised the Kick-off meeting two month after the project's start in June 2015 in Brussels. Press releases about AtlantOS were published prior and post the Kick-off meeting. To promote AtlantOS information/splinter meetings have been organised in 2016 during i) the Ocean Science Meeting (OSM) in New Orleans, USA in February and ii) the European Geosciences Union GA in Vienna, Austria in April. Furthermore, to evaluate and foster global exchange regarding integrated ocean observation WP11 organised a Town Hall meeting on *Implementing Basin Scale In-Situ Ocean Observing Systems* during the OSM 2016 in New Orleans. Moreover, a session on *Improved maritime knowledge for Blue Growth and ocean governance* has been organised and conducted in cooperation with the European Commission Joint Research Centre at the European Maritime Day 2016 in Turku, Finnland. Regular telephone meetings between the project managers of AtlantOS and AORA-SA are conducted as well as face-to-face meeting of the coordinators where ever possible (i.e. during OSM 2016) to foster cooperation and target-oriented joint actions like e.g. the Coordination of South Atlantic Activities during the AtlantOS GA in June.

3. Work package progress reports

WP 1 Observing system requirements and design studies

Summary

The overall objective of WP1 is to iteratively apply the systems design processes of the *Framework for Ocean Observing* to provide a refined scientific system design for a Pan-Atlantic Observing system meeting societal objectives. Specific objectives are:

- To define the high-level requirements of Integrated Atlantic Ocean Observing System based on the GEO societal benefits and other international initiatives, providing a direct link to societal challenges related to the Atlantic Basin and the European Blue Growth strategy. These requirements will be translated into strategic recommendations about sustained monitoring of EOVs.
- To identify the gaps in existing Atlantic observing networks. This assessment will include an estimation of the cost of existing observing networks as well as the needed investments in regard to the identified gaps, and an evaluation of the readiness and feasibility of implementation of different observing technologies as guidance in systems design.
- To deliver guidance to improve existing elements and/or implement new components of the Integrated Atlantic Ocean Observing System using OSSEs and data assimilation to optimally merge in-situ and satellite observations with models.

The work in WP1 is divided into 3 tasks:

- Task 1.1: Defining the high level requirements
- Task1.2: Analysing the gaps and costs of existing systems and planned upgrades
- Task 1.3: Carrying out system design studies

In this initial phase of AtlantOS, effort was focused on collecting the existing requirements for Atlantic Ocean observations in a consolidated way, drawing in particular on the work of the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS), in advance of refinements that will come through the course of the project through innovation activities across all work packages, as well as continued interaction with partners.

The definition of the OSSEs experiments to be carried out from mid-2016 to mid-2018 has been addressed. An Atlantos OSSE workshop was organized in Toulouse from December 17 to December 18, 2015. Following the workshop, the different Task 1.3 groups refined their plans. They are summarized in the first Task 1.3 deliverable "Toward an improved design of the in-situ observing system for ocean reanalysis, analysis and forecasting: design of experiments" that was delivered end of April 2016.

Progress per Task

Task 1.1.

Task 1.1 focus on defining the high-level requirements of Integrated Atlantic Ocean Observing System based on the societal benefits of GEO and other international initiatives. At the January 2016 planning meeting the content of the report (D1.1) was decided and the input from the partners was delivered by the end of February. Unfortunately due to lack of personnel the finalization of the report has been delayed but is expected to be ready before the Annual Meeting in June.

Task1.2.

Work in Task 1.2 is divided up into two subtasks:

- Subtask 1.2.1: Following the initial definition of requirements for sustained ocean observations carried out in Task 1.1, the present capacities for ocean observing in the Atlantic shall be mapped in order to identify the critical gaps that need to be filled
- Subtask 1.2.2: A cost and feasibility study that will include an estimation of the cost of existing observing networks, the needed investments for filling the identified gaps, and an assessment of the readiness and feasibility of implementation of different observing technologies.

At a joint Task 1.1 and 1.2 planning meeting in January 2016 it was decided to concentrate Subtask 1.2.1 work on mapping important phenomenon's – physical and biogeochemical to observe, parameters that are observed today to monitor these phenomenon's and existing observation platforms. This strategy was chosen to be able to compare the results of Subtask 1.2.1 with the requirements for the future observing system as defined in Task 1.1 in order to identify gaps between in the existing Atlantic observing system.
Subtask 1.2.2 is at this stage in its very initial planning stage so work has been concentrated on collecting background information from similar studies.

Work has up to now been concentrated on:

- Map the important phenomenon's in the Atlantic (physical, biogeochemical etc) we want to address
- List the EOV's needed to monitor the individual phenomenon's
- List present instrumentation capable to measure the EOV's or lack of instrumentation; including a judgement of existing instrumentations impact and feasibility/fit for purpose (capability/limitations) in monitoring the individual phenomenon's
- Prepare an overview of existing activities to monitor the identified phenomenon's and to what degree the data are available in free and open databases. A preliminary report has been prepared to give an overview of what data is available in the EMODnet, CMEMS and JCOMMOBS databases, see figure.
- Funding of observing activities – this to start the cost study Subtask 1.2.2 - focus on source (government, research or private) and amount

Task 1.3.

Task 1.3 is divided in 5 subtasks:

- Subtask 1: Toward an improved design of the in-situ observing system for ocean reanalysis, analysis and forecasting: physical variables (Mercator Ocean, Met Office, CLS, ECMWF, CMCC)
- Subtask 2: Toward an improved design of the in-situ observing system for ocean reanalysis, analysis and forecasting: biogeochemistry and carbon variables (CNRS, Met Office, Mercator Ocean)
- Subtask 3: Use of statistical techniques for identifying an optimal observational network for enabling ocean carbon system estimates (CNRS/LSCE, University of Exeter)
- Subtask 4: Design of the Integrated Atlantic Ocean Observing System to support climate prediction and detection of change (Met Office, NOC)
- Subtask 5: Coordination (Ifremer)

Work carried out during the first year of the project was dealing with the definition of OSSEs to be carried out from mid-2016 to mid-2018. An Atlantos OSSE workshop was first organized in Toulouse from December 17 to December 18, 2015. The main workshop objectives were to define key network questions and agree on detailed experimental (OSSE) design to address them. The workshop was very useful to discuss main learnings of past OSSEs works, define Atlantos OSSE plans (e.g. what are the main network evolution options to be tested?), identify joint actions between Atlantos groups (e.g. sharing same nature runs to represent the "ocean truth") and synergies between OSSEs work carried out in Task 1.3 and Task 5.3. The workshop report and presentations are available on the Atlantos WWW site. Following the workshop, the different Task 1.3 groups refined their plans. They are summarized in the first Task 1.3 deliverable "Toward an improved design of the in-situ observing system for ocean reanalysis, analysis and forecasting: design of experiments" that was delivered end of April 2016. This report gathers all the work planned for all subtasks of Task 1.3 to assess possible extensions of the Atlantic in situ observing network. The assessment will be performed using different approaches to increase the robustness of the conclusions.

Cooperation and interaction with other projects and initiatives

Particularly in this initial phase, this work package has drawn from ongoing work by the panels of the Global Ocean Observing System (GOOS) focused on global requirements for climate, operational ocean services, and ocean health. In the area of the climate, requirements are set in cooperation with the Global Climate Observing System (GCOS). A parallel project to AtlantOS, the *Tropical Pacific Observing System in 2020* project has similar objectives for a different and more specific geographic region, and its approaches in developing observing network scenarios have provided some inspiration for AtlantOS.

The Group on Earth Observation's Blue Planet Initiative has the objective of demonstrating and delivering societal benefit from sustained ocean observations, and WP1 leaders have spent substantial effort in this reporting period engaging with this initiative so that it adds value to ongoing effort. The AtlantOS contribution to Blue Planet comes through innovation in the requirements and in the sustained governance and implementation of Atlantic observations, and their identified connection to societal benefit, including those areas defined by GEO's Societal Benefit Areas.

Contact was established with the Atlantic Ocean Research Alliance Co-Ordination and Support Action (AORAC-SA, BG14 action) through IOC / AtlantOS representation at its first Board meeting, which took place 9 December 2015 in Brussels. It was agreed that ongoing close coordination with the AtlantOS project and the Ocean Observation research theme / work package of the AORAC-SA would be mutually beneficial.

Task1.2. Cooperation with EMODnet, CMEMS and JCOMMOPS on existing observations

Task1.2. NOAA on economy of ocean observations

Task 1.3. Cooperation with GODAE OceanView (OSEVal Task Team) at international level and other EU projects involved in OSSEs (e.g. E-AIMS, JERICO Next, SANGOMA)

Achieved main results

D1.2*: "Toward an improved design of the in-situ observing system for ocean reanalysis, analysis and forecasting: design of experiments"* delivered April 2016

WP 2 Enhancement of ship-based observing networks

Summary

WP2 is focusing on improving, expanding, and integrating ship-based observations undertaken by existing observing networks. It includes oceanographic research vessels through the GO-SHIP network (Task 2.1) and the Ships of Opportunity Program (SOOP) (including Carbon-VOS, SOOP, and Ferryboxes; Task 2.2), both of which provide physical and chemical EOVs. It also includes the continuous plankton recorder measurements (CPR; Task 2.3) by the Sir Alistair Hardy Foundation for Ocean Sciences (SAHFOS), acoustic fish data on abundance, distribution and community structure collected during national surveys and coordinated by ICES (Task 2.4), and finally, sea floor mapping undertaken by various nations for various purposes, including as a measure of habitat potential for biological organisms.

WP2 held its initial meeting at the Institute of Marine Research in Bergen, Norway, on 10 November, 2015. It was attended by the WP2 chair and co-chair and by representatives of each Task Teams, including all Task Team leaders but one. Information on all Tasks was presented in terms of what had been accomplished up to that point and the plans for the coming year. Coordination and cooperation between the various tasks and with other WPs were discussed to ensure that we are on schedule for the deliverables promised.

Progress towards the WP2 objectives is being achieved in a number of key areas. The various WP2 Task Teams have been implementing improvements aimed at increasing cooperation and improve monitoring efficiency.

Progress per Task

Task 2.1 GO-SHIP

To help improve coordination between GO-SHIP repeat hydrography and other relevant hydrographic surveys in the Atlantic, a beta version of a tracking system for GO-SHIP lines has been set up at JCOMMOPS, http://www.jcommops.org/board, and is being tested by the community. Interaction between the AtlantOS task 2.1 lead, the GO-SHIP community and JCOMMOPS is ongoing through the GO-SHIP coordination office, by a person-to-person meeting in Galway, and quarterly teleconferences.

Based on the above consultations, Task 2.1 identified two lines where the support laboratory service will have the largest impact, both scientifically (filling observational gaps) and by expanding the network to nations and groups that to date have participated little in the GO-SHIP network. The first is the A02 section, running from Ireland to Canada, which is a core line in the international GO-SHIP plan but has not been occupied in its entirety for more than a decade. Task 2.1 is engaged with the Irish partners to organize an occupation of this line in the 2017 on the Irish RV Celtic Explorer, with a mix of scientists from the Canadian and Irish partners and the support labs from AtlantOS. The second line crosses the South Atlantic from Brazil to South Africa. These nations are regularly repeating parts of this line but so far no continent-to-continent occupation has been planned. Despite AtlantOS encouragement and interest from both nations, it seems neither country has the resources to carry out the survey. The current plan is to apply for ship-time on a German ship, and occupy the complete line with participation of Brazilian and South African scientists, in addition to the AtlantOS support labs.

Task 2.1, as planned, is in the process of setting up processing facilities for ship-board ADCPs. In addition, they have started with initial software development to support efforts to enhance quality assurance, timely data delivery, and inclusion of interior ocean biogeochemical data into a data product. This activity will ramp up during 2016 with intense field testing during the occupation of the OVIDE line.

Task 2.2 Ships Of Opportunity Program (SOOP)

Coordination has been a primary object of this Task. Work is underway in maintaining SOOP operations on merchant vessels in the Atlantic (North, tropical, including South Atlantic), however, this is mostly restricted to thermosalinograph data with the exception of XBTs launched from two ships in the North Atlantic subpolar gyre. On two of the vessels in the tropical Atlantic, this is coupled with work on pCO_2. On the VOS (Voluntary Observing Ship) Nuka Arctica (AX01), this is coupled with work on ADCP and pCO_2. A graduate student has been hired (jointly between UiB and IMR) and was trained on CODAS at the Graduate School of Oceanography at the University of Rhode Island in order to process the historical and ongoing ADCP data from the Nuka Arctica. Work is ongoing to validate data from XBTs and TSGs in the subpolar gyre, to maintain/monitor the ship network in the tropical and South Atlantic, and to examine the coherency between XBTs, Argo floats and ADCP along AX01. Discussions have begun on how to coordinate in near-real time the different operations on the Nuka Arctica. This vessel is both active in Carbon-VOS, SOOP (for TSG, XBTs and ADCP) and Ferrybox and the operations involve different partners of AtlantOS, NOAA and other US institutions. Earlier validated data are being combined to determine how successful past monitoring was in providing coherent time variability of upper ocean heat and salinity transport and if it can be improved. Comparisons will also be carried out from the data collected by SOOP and Ferrybox on the ferry, Norrhona.

New technology is being developed within this Task. Since the beginning of AtlantOS, further development of the autonomous titration system for Total Alkalinity (TA) has been underway, with laboratory and field testing and refinement undertaken at KM CONTROS. The system is now commercially available as CONTROS HydroFIA® TA. A PhD student began work in May 2016 for further laboratory and field testing of the HydroFIA system and its deployment on an existing SOOP line in the North Atlantic (between Europe and North America). Extended laboratory and field testing is planned with the first full sea trial planned for December 2016 during a R/V Meteor cruise across the South Atlantic Ocean from Capetown in South Africa to the Falklands. This cruise will feature underway (pCO_2, TA) and discrete (DIC, TA) measurements of carbonate system parameters allowing for an over-determination of the system and therefore enhanced possibilities of testing for internal consistency. Smaller field deployments out of Kiel are planned prior to the cruise. Deployment of the HydroFIA system on the existing SOOP line across the North Atlantic is planned for the first half of 2017 and it is hoped to start autonomous operation soon after.

Since the start of AtlantOS, the ICOS Ocean Thematic Centre (OTC), hold 2 Monitoring Stations Assembly (MSA) meetings in Bergen involving all European groups working within the VOS network. An agreement was produced on the quality and assessment of the SOOP data, instrumentation and best practices. This work will classify the performance of the SOOP lines, which instrumentation to use, and assess the different protocols of quality control and flagging of data. This information is collected in the ICOS step 2 labelling document and will also apply to AtlantOS cruises.

The information exchange position for the SOOP programme was filled it will ensure information exchange and communications within the SOOP, FerryBox and Carbon-VOS networks, and to improve the coherence and reliability of SOOP network performance, information exchange on equipment, and availability of vessels and data flow.

PML has successfully deployed instrumentation (Dartcom system comprising head-space equilibration with non-dispersive infrared detection) during the Atlantic Meridional Transect cruise in the South Atlantic (autumn 2015). They have further field-tested a prototype pCO_2 optode sensor (Aanderaa Data Instruments A.S.) in the North Atlantic during winter 2015 alongside established instrumentation. Initial results show that the optode sensor gave unrealistic values for pCO_2 (Figure 2.1). A report will be written and given to Aanderaa. Following extended calibration and conditioning, it is planned that this instrument will re-deployed in the South Atlantic in autumn. 2016.

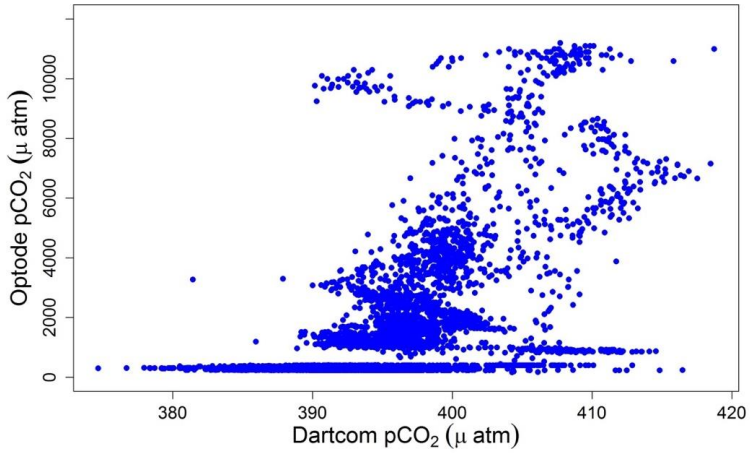


Figure 2.1: Initial inter-comparison of a prototype optode sensor and established instrumentation (Dartcom system).

AtlantOS has enabled ongoing discussions on sampling design, information exchange and instrumentation improvements with academia and industry at a number of forums (e.g. European Geosciences Union meeting, April 2016; Integrated Carbon Observing System Ocean Thematic Centre meeting, May 2016). As a result of these discussions we are currently upgrading components of our established instrumentation (Peltier-dryer) in order to improve automation.

NERC has begun measuring carbon dioxide using membrane and showerhead instruments on the Roscoff Bay of Biscay Ferry-Box route. Here a SubCtech membrane based instrument was compared with the General Oceanics showerhead system. However, the SubCtech flooded and was returned for repair. It has just been fitted back into the Ferry-Box and will be operational soon.

A membrane comparison during underway sampling on-board the James Clark Ross has been purposed for the Atlantic Meridional Transect (AMT26) cruise this autumn. Equipment is available to run duplicate membrane carbon dioxide sensors (pro-oceanus CV). These will be run alongside the PML underway system on-board the JCR to make the membrane/showerhead methodology comparisons. Underway samples will be collected and preserved for later analysis at NOC. These endeavours will provide carbonate data (Dissolved Inorganic Carbon, Total Alkalinity and direct carbon dioxide measurements) in the rarely sampled South Atlantic.

SNOMS (SWIRE and NOC Monitoring System) equipment will be installed on a China Navigation vessel in June 2016. Hydrographic and oxygen sensors are in triplicate, with duplicate carbon dioxide sensors in the main body of the instrument. Although this is not measuring in the Atlantic many of the procedures we are developing for quality control of Ship of opportunity data are directly applicable to AtlantOS.

Task 2.3 Continuous Plankton Recorder (CPR)

SAHFOS has been working towards optimizing the Continuous Plankton Recorder (CPR) surveys including exploring the use of new technology. New remote CTDF units have been deployed with the CPRs and are now operational on numerous Northern European Shelf routes which include the major European ecoregions such as the North Sea, Celtic Sea, Irish Sea and the English Channel. The new CTDF units are capable of transmitting the data back to SAHFOS upon haul out of the CPR. This is facilitating more rapid processing and analysis of the data.

To more rapidly determine zooplankton abundance from the CPR samples, a Macrocam has been purchased and is currently being tested in its ability to automatically count zooplankton. The results will be compared to standard methods to determine the reliability of the Macrocam. In addition, faster

quantitative molecular assays of key harmful plankton and pathogens using molecular techniques is being tested in the English Channel using the Water and Microplankton Sampler (WaMS) that fits within the Continuous Plankton Recorder (CPR) device.

Development of a number of Essential Ocean/Biological Variables (EOV/EBV) for monitoring the assessment of marine biodiversity and ecosystem health for the North Atlantic is underway. In addition, comparisons are being made between hydrographic data on the CPR surveys with other instrumentation, such as Ferrybox data.

Task 2.4 Fisheries and zooplankton observations

The aim of this task is to assemble national fisheries acoustic data on pelagic fish stocks into a common database, which will be held by ICES and accessible to all. The specification of the ICES acoustic database, and of missing functionality of DATRAS has been completed (Milestone 2.4.1). This has also lead to an update in the ICES metadata standard for acoustic data. The standard has been submitted to the ICES publication pipeline and is currently in final review. This work has been done by ICES with input from IMR, HAV, IFREMER and ICES expert groups. ICES has implemented the core acoustic component of the data model e.g. upload, download of XML and CSV data including XSD validation. Currently the Schematron validation and the acoustic vocabularies are being completed, and the next step will be adding the acoustic metadata following the revised acoustic metadata standard. The first tests will start in September (progress can be followed at: http://acoustic.ices.dk).

IMR has modified the StoX software for use in several ICES acoustic surveys. The software system is aligned with the data model at the ICES data centre and will soon be implemented. The software is released under GNU open source licence and can be downloaded from http://www.imr.no/forskning/prosjekter/stox/nb-no.

Task 2.5 EuroMapApp

Seafloor data are being collected from multibeam acoustics and are presently set up on ships without needing onboard technical support. All that is required for the multibeam to be turned on and the data tapes collected at the end of the survey. The aim is to collect all available seafloor data, to combine it, make the raw data freely available and produce high resolution bottom charts of the seafloor available online. Discussion have been held to link the EU holdings with those in the US and in Canada to cover as much of the Atlantic as possible. Previously acquired seafloor data as well as present data are being processed and will be place online. The task is encouraging cruises that are not dedicated to mapping to run their multibeam sensors in order to acquire the bottom data on as many cruises as possible.

Achieved main results

Task 2.1: Coordination between the GO-SHIP network and other hydrographic surveys has been improved; 2 lines have been identified for support laboratory services; and software development is underway to support data quality assurance, timely data delivery and development of a data product from ocean biogeochemical data.

Task 2.2: Coordination of carbon, ADCP, Argo and XBT networks is well underway; a new autonomous titration system for total alkalinity (TA) has been completed and is now available commercially (CONTROS HydroFIA®TA); and there has been an expansion of pCO_2, temperature and salinity data collections in the South Atlantic and other measurements on various lines are being pursued.

Task 2.3: New technology in the form of a CTDF has been added to CPR and is now operational; instrumentation is being tested to automatically count zooplankton; and molecular techniques to rapidly identify harmful plankton and pathogens is being tested.

Task 2.4: Specifications of the fisheries acoustic data model has been completed (http://ices.dk/marine-data/Documents/Specification%20of%20the%20acoustic%20database.pdf); the ICES acoustic metadata standard has been revised; and software has been designed to aligned acoustic survey data with the data model at the ICES data centre, which will soon be implemented.

Task 2.5: Seafloor data are being collected from multibeam acoustics and are presently set up on ships without needing onboard technical support; discussions are underway to link EU and North American seafloor data; and previously acquired but unprocessed seafloor data are being processed.

WP 3 Enhancement of autonomous observing networks

Summary

Within the AtlantOS (Optimising and Enhancing the Integrated Atlantic Ocean Observing Systems) H2020 project, the work package 3 is dedicated to development of existing autonomous observing networks. We promote the use of the most cost-effective way to measure Essential Ocean Variables and the integration of all mature autonomous observing networks. It is based on innovative platforms with multidisciplinary sensor modules such as gliders, drifters, moorings, floats and tagged mammals.

This work package is built on both sides of the Atlantic on existing capacities for autonomous observing networks. It improves the systematic collection of ocean observations recorded in-situ, and will enhance integration with other observational systems, including ship-based platforms and remote sensing.

The objective for the autonomous ocean observation technologies is to reduce the costs of in-situ ocean observation, but so far there is a need to optimize them to integrate the biological and ecosystem dimensions into observing systems.

Due to the large area of responsibility of WP3 the different task only will be named and the main results will be represented in the end.

Progress per Task

Task 3.1 – Argo

Argo is an international array of 3000 profiling floats that measure temperature & salinity throughout the deep global oceans, down to 2000 m. It is the single most important global in-situ observing system for the Copernicus Marine Service. Euro-Argo counts about 750 floats, the Biogeochemical-Argo and Deep-Argo floats are currently deployed for global and regional ocean observations.

Tasks 3.1. consists of these three subtasks: 3.1.1 Deployment of Bio-Argo and O_2-deep floats and improvement of the network capabilities, 3.1.2 Argo Dataset production: Real-time data-management and delayed-mode qualified dataset for O_2, Chlorophyll *a*, backscattering and NO_3 and 3.1.3 Organisation of the post-AtlantOS Bio-Argo and Deep-Argo sustainability in the context of the Euro-Argo ERIC.

Task 3.2 OceanSITES biogeochemistry

The network of fixed-point biogeochemical observatories addresses major observational gaps in terms of variables central to the MSFD. In particular, time series data will be obtained on biological EOVs such as zooplankton, phytoplankton, particles and metagenomic diversity to assess the structure and function of the biological communities**.** Progress to date on this task has been made in purchasing equipment,

employing staff, and developing analytical capability. This is to address the three associated deliverables (3.8, 3.13 and 3.17) and other work described in the DOA.

Tasks 3.2. consists of these two subtasks: 3.2.1 Network enhancement (personnel, equipment procurement and analytical capability preparation), 3.2.2 Data flux.

Task 3.3 - Ocean Sites Transport

The great value of Transport Mooring Array (TMAs) is the acquisition of long time series of volume, heat & freshwater fluxes in key locations of strong flows, all of which are related to the Atlantic meridional over-turning circulation. The TMAs enable the reliable estimate of these fluxes, including long time-series in the deep ocean**.** The challenge is to conduct the *research and innovation activities* necessary to increase performance and efficiency of the observing system, building on existing capacities around the Atlantic and also to fill the observational gaps through the optimization of existing systems by better coordination, harmonization and integration and the use of new ocean observation technologies.

Tasks 3.3. consists of these three subtasks: 3.3.1 Create and present network overarching products and analyses, 3.3.2 Network enhancement/Technical Innovation, 3.3.3 Technical enhancement of a TMA site for data safety & cost efficiency.

Task 3.4 Glider

Gliders are ideal platforms to fill the observational gap with autonomous surveys between the open ocean and the coastal/shelf. The “Everyone’s Glider Observatory” (EGO) initiative deals with scientific, technological coordination around field operations and data management. Gliders are considered as innovative platforms able to welcome multidisciplinary sensor modules.

Tasks 3.4. consists of these three subtasks: 3.4.1 Toward glider app' for public dissemination, 3.4.2 Consolidation of Atlantic EGO Network Activities Report, 3.4.3 Eastern boundaries survey

Task 3.5 – PIRATA

PIRATA network is principally composed with 18 met-ocean buoys in the Tropical Atlantic. Their maintenance induces yearly dedicated cruises ensured by Brazil, US and French partners. The meteo-oceanic ATLAS buoys observations (oceanic: temperature and salinity from the surface down to 500m depth; meteorological: wind, air temperature, precipitation, radiations at the surface) are daily transmitted via ARGOS and made available in quasi-real time through internet.

One first priority was to ensure the yearly servicing of the PIRATA network, as successfully achieved thanks to a close collaboration between partners (US/NOAA, Brazil/INDP & UFPE, France/IRD) that ensure the yearly dedicated cruises. As not expected at the early stage of AtlantOS, PIRATA decided to progressively replace the classical ATLAS meteo-oceanic systems by new T-FLEX systems from 2015. These changes induce the insurance that new sensors can be installed on T-FLEX, keeping in mind that new sensors have to be installed to relevant positions/depths, from a scientific point of view. In April 2016, the new AtlantOS sensors have not been yet installed. But additional measurements have however being carried out, thanks to different collaborations and opportunities. Also, thanks to AtlantOS (and the EU PREFACE program too), some data sets (acquired during French PIRATA cruises form several years but not treated yet) have begun to be treated and validated.

Tasks 3.5. consists of these two subtasks: 3.5.1 Network enhancement, 3.5.2 Data flow.

Task 3.6 – Surface Drifters

In subtask 3.6.1 “Network enhancement“ the work carried out has started to patch the gap in terms of sea-surface observations made by drifters in the Tropical South Altantic, for water temperature, air pressure, and currents. At time of writing, EUMETNET has deployed 19 drifters so far, and 17 are still operating.

Subtask 3.6.2 “Data from AtlantOS funded drifting buoys” are sent in real-time onto the GTS (BUFR template TM315009). Near real-time quality controls are performed every day as for EUMETNET buoys and from there archived into major international archives. Measurements are acquired by AOML and MEDS for delayed mode distribution. Discussions are ongoing on the possible set up of a JCOMM GDAC for drifting buoys at Coriolis (interaction with WP7).

Subtask 3.6.3 “Network sustainability” deliver, that Eumetnet may be able to provide 13 drifters per year for the South Atlantic, at the end of AtlantOS, if studies show beneficial impacts.

Task 3.7 European Animal Telemetry Network (EATN)

The Ocean Tracking Network (OTN) is a world leader in the use of acoustic telemetry and currently maintains the world’s two most extensive telemetry lines in the western Atlantic continental shelf, with coastal deployments in South Africa and Angola, and in preparation for Brazil.

Tasks 3.7. consists of these three subtasks: The first subtask 3.7.1 Creating and developing the network - the European Tracking Network (ETN), now being termed the European Aquatic Animal Telemetry Network (EAATN), was launched during the first year of AtlantOS. Furthermore, subtask 3.7.2. Establish key ‘acoustic lines’ in Europe and expand operations to the open ocean and 3.7.3. Leverage resources to European researchers to acoustically tag valued species.

Cooperation and interaction with other projects and initiatives

An international partnership and long-term agreements with the Euro-Argo members for the organization and funding of these new phases of Argo are under development. Once the strategy document is adopted, the Euro-Argo Implementation Plan will be written. It will describe how the strategic plan will be applied, with the respective contributions of the national facilities and the ERIC specific ones. This plan will be discussed inside Euro-Argo member states, and the implementation regarding AtlantOS will be discussed with the teams implicated (UPMC-LOV, Ifremer, etc). The release of the first version of the Implementation plan is scheduled for the end of 2016. UPMC with several AtlantOS partners has submitted a Marie Curie ITN project ‘Argonauts” on Bio-Argo development, based on cooperation. Another international consortium on Biogeochemical-Argo is under development. AtlantOS has been presented to the EU-FP7 project MicroB3, Simon Claus outlined how Micro B3 integrates well with the recently started H2020 project AtlantOS. Many scientists collaborating in MicroB3 are also collaborating in AtlantOS. The gliders community has strong interaction with ENVRI+ H2020 project through the development of collaboration with marine research Infrastructure such as FIXO3, EuroARGO, EuroGOOS and the satellite community. Data collected by the AtlantOS drifters have been circulated to WP7. The value of data collected has also been considered for impact study analysis in WP7 and will be proposed as candidate impact studies to EUMETNET Observation Scientific Expert Team (Obs-SET). EAATN is intimately linked to the OTN initiative, and has collaborated directly during year 1 to develop the actions undertaken. The collaboration with EMODNET and Lifewatch through VLIZ for the database hosting was also developed during year 1. OceanSITES is collaborating with related programmes such as UK-OSNAP, NACLIM.

PIRATA interacts with several international projects and initiatives:

- It is an important component for the observations carried out in the frame of the EU PREFACE program. PREFACE ensured the resources for the purchase of a 2nd buoy needed to maintain the met-ocean buoys located off Congo at 6°S-8°E, that is now ensured from 2013. The yearly servicing of this buoy constitutes Milestones for PREFACE. Also, PREFACE made possible the installation of a new ADCP mooring at 0°N-0°E, achieved during the PIRATA-FR26 cruise (initially expected in 2015), and its maintenance also constitutes Milestones for PREFACE. Such a mooring, along with the two other ones already serviced at 23°W-0°N and 10°S-0°N by PIRATA (with contribution of GEOMAR for the one at 23°W), will allow some current measurements at three longitudes along the equator, needed for the EUC studies. This new ADCP mooring should be maintained several years, and could contribute to a new extension of PIRATA (if funding and human resources make this possible).
- PIRATA SSG endorsed the future installation of 9 additional T/C sensors at 8°N-38°W, 4°N-38°W and 0°N-35°W proposed by FUNCEME (Fortaleza) in Brazil. These additional sensors will increase the vertical resolution of the temperature and salinity observations at these locations, from the surface until 140m depth. They will be installed on new T-FLEX system (from 2017 or 2018) and will contribute to the future extension of PIRATA.
- PIRATA contributes to a 5 years US program (Oregon State University, Corvallis, USA ; PI: Jim Moum) supported by NSF through the servicing of turbulence sensors (Xpods) installed from 2014 at 23°W-0°N and 10°W-0°N (5 on each mooring between 20m and 80m). Such sensors are yearly serviced during the PIRATA-FR cruises.
- PIRATA contributes, from 2014, to the OTN program (Dalhousie University, Halifax, Nova Scotia, Canada; through the installation and yearly servicing of acoustic receivers (OTN), installed at the 18 PIRATA buoys (one per site at 200m depth). This operation could be continued in the future.
- PIRATA contributes, from its early steps, to ARGO and CORIOLIS, through the deployment of ARGO profilers. 6 profilers were deployed during the last PIRATA-FR26 cruise, three of them with double programming (so allowing some profiles every two days during three months from the surface down to 300m depth).
- PIRATA-FR also contributes from 2005 to ARGO through the realization of 0-2000m depth CTD profiles*, i.e.* down to the depth of ARGO profiles, made available for the ARGO profilers' data calibration.
- During the last PIRATA-FR25 (March-April 2015) and FR26 (March-April 2016) cruises, PIRATA-FR contributed to the Meteo-France participation to AtlantOS (WP3.6) through the deployment, in the eastern Tropical Atlantic, of 16 (1 in 2015 and 15 in 2016) drifting buoys (SVP-B) and 3 SVP equipped with a 0-80m chain with temperature sensors (in 2015).
- PIRATA also contributes to CORIOLIS and data dissemination in real time through the transmission in quasi-real time of CTD and XBT profiles carried out during the dedicated cruises. During the last PIRATA-FR25 (March-April 2015) and FR26 (March-April 2016) cruises, a total of 58 CTD and 179 XBT profiles obtained in the eastern tropical Atlantic have been transmitted.

Achieved main results

For Argo, Deep Argo Floats have been ordered, new biogeochemical sensor implementation is on-going, data management procedures for biogeochemical variables have been strengthened.

For Ocean site biogeochemistry, preliminary tests have been carried out to extract sequence information from preserved sediment trap samples in the Fram Strait. Targeting phylogenetic marker genes, these data are needed to better understand the microbial component of biogeochemical processes in the

water column. The possibility to extract and sequence DNA from these samples has been successfully demonstrated, and perspectives on the optimization of these processes gathered for future evaluation. Additionally, Ribocon's bioinformatics pipeline has been shown to provide workable results and detect issues in sequence length and quality. Numerous important methodological points and decisions were informed by this work, including (i) the need for a common extraction protocol to generate eukaryotic and prokaryotic DNA, (ii) the requirement to choose between different primer sets, each with somewhat different phylogenetic coverage, to amplify eukaryotic DNA, (iii) an estimation of the sequencing depth/effort required to detect the key groups of eukaryotic organisms with varying proportional abundance, (iv) the importance of internal replication and cross-validation of the results and (v) the need to make transparent and improve the quality control of sequence data prior to submission to Ribocon's pipelines or general release. These tests have served to establish a preliminary workflow with Ribocon as a precursor to defining standard workflows and bioinformatic pipelines that could serve as a blueprint for future omic-type observations in the Atlantic. The future products of these approaches will provide a baseline for partners in the network to compare their results to, supporting clear dialogue towards future improvements. Importantly, workflow modularization will allow partners to interact with Ribocon's data products at multiple points, thus permitting innovative variations without the need to duplicate effort and resource use.

Regarding OceanSITES transports, it was agreed that the data server to be used for archiving the high level TMA products will be the Ocean Sites archive.

For gliders, the main results are the development of tools for data management, a new partnership with Brazil has been developed; and a Glider Steering Team and a Glider Data Managment Team within JCOMMOPS as well as a glider Task Team within EuroGOOS have been established.

The drifting buoys have been deployed in an area normally devoid of such platforms and a novel salinity sensor is nearing integration into drifting buoys.

For PIRATA, None new sensors initially announced have been deployed yet (ie new sensors purchase and installation: see above). However several activities and actions have been achieved and initiated (see above)

For EATN, the main result achieved in year 1 was the launch of the EAATN. The online survey provided a useful overview of the European-based acoustic telemetric research community and their expectations towards an organized network while allowing EAATN to reach that same community as a starting point. The workshop allowed over 50 researchers to discuss the future network objectives and structure. The database and the hired technician are two main assets to offer to the network members starting in year 2. Initial definition of EOVs was achieved. Several project proposals of EAATN members are already being developed/approved during year 1 that include aquatic telemetric activities and use EAATN/OTN as supporting infrastructure.

WP 4 Interfaces with coastal ocean observing systems

Summary

Progress has been made towards all objectives in WP4. The progress made on biogeochemical analysis and the planning of further shelf-wide cruises represents significant progress towards D4.3. A new observational campaign (under Task 4.2) is planned for summer 2017. This will demonstrate across-shelf measurement capability over an extended section of the Armorican shelf and Bay of Biscay. More widely, progress has been made in Task 4.4 towards creating a permanent forum for transatlantic cooperation and sustainability of observing networks. The first deliverable for Work Package 4 Task 4.3,

a Sea level observing site catalogue for the South Atlantic, has made good progress and is due at the end of December 2016. Task 4.1 (Gap analysis and critical assessment of coastal observing systems) is being specifically targeted at a side meeting of the June 2016 General Assembly.

The biogeochemical analysis and the planning of further shelf-wide cruises (Task 4.2) represent significant progress towards D4.3. There was a workshop at Ifremer, Brest, in February 2016 that achieved Milestone 2 “Shelf profiler and glider deployment coordination meeting”. Advances have been made towards a strategy for transatlantic sustained measurements in the coastal ocean, based on the strengthened forum for interaction between US IOOS, GOOS regional alliances and EuroGOOS (D4.4) by the activities under Task 4.4. Gap analysis and critical assessment of coastal observing systems will be the focus of a WP4 side meeting at the forthcoming AtlantOS GA in June 2016. The first deliverable for Work Package 4 Task 4.3, a Sea level observing site catalogue for the South Atlantic, is on target and due at the end of December 2016.

Progress per Task

Task 4.1 Gap analysis and critical assessment of coastal observing systems

The main actions during 2015-2016 were dedicated to setting up the organisation of crosscutting activities in WP4 tasks and between tasks (mainly Tasks 4.1 and 4.2). From these discussions, a common strategy has been proposed through in situ experiments in 2017 (glider deployment) and related scientific investigations on cross-slope exchanges in the Bay of Biscay. These analyses and more specifically the AtlantOS dedicated Gap Analysis (task WP4.1) will be driven by a post-doctoral fellow (co-funded by AtlantOS and Ifremer) starting in November 2016.

Task 4.1 for “Gap analysis and critical assessment of coastal observing systems” remains in progress with no organised dedicated meeting during this first year but valuable initial discussions with JERICO (FP7) and JERICO-NEXT (H2020) participants have been initiated. As a ground material, the deliverable D1.11 from JERICO (FP7) project, entitled "The joint European Research Infrastructure Network for Coastal Observatories: Achievements and Strategy for the Future", is considered. Discussions and analyses for the Task 4.1 will then be launched in 2016 at the WP4 side meeting organised before the General Assembly in June 2016. Ifremer attended a Europe-Canadian cooperation meeting in Barcelona the 1st week of November 2015.

Task 4.2 Optimised shelf physical and biogeochemical sampling

Data processing of glider-derived biogeochemical data (from the 2015 Shelf Sea Biogeochemistry deployments) are nearly complete. The analysis has placed a strong focus on deriving accurate measurements of dissolved oxygen to understand the best means of sampling the long term oxygen dynamics of shelf seas and to monitor oxygen levels vital for ecosystem sustainability in shelf seas. The initial analysis has led to two poster presentations (one national, one international) and two papers in advanced stages of preparation.

A new observational campaign is being planned for summer 2017, linking the NOC and Ifremer contributions. We propose to demonstrate across-shelf measurement capability over an extended section of the Armorican shelf and Bay of Biscay to enhance understanding of physical and biogeochemical shelf sea functioning during summer stratified periods, when seasonal heating acts to isolate a bottom mixed layer from the ocean surface. During stratification, biogeochemical processes lead to enrichment of this bottom layer through remineralisation and provide the potential for removal of carbon and nutrients biologically fixed in the highly productive shelf seas to be removed to the deep ocean. The work will identify the physical and biogeochemical mechanisms controlling horizontal and

vertical exchange over a shelf system and to quantify the impact of this exchange on biogeochemical pathways during summer months.

Task 4.3 Harmonised Sea Level Data Flow

The first deliverable for Work Package 4 Task 4.3, a Sea level observing site catalogue for the South Atlantic, is due at the end of December 2016. Work started on collating the information for the catalogue in November 2015, by looking at the stations listed in several international data centres. The data centres considered were the Permanent Service for Mean Sea Level (PSMSL), the University of Hawaii Sea Level Center (UHSLC), the Intergovernmental Oceanographic Commission (IOC) sea level station monitoring facility and the European Marine Observation and Data Network (EMODnet) Physics portal. A list of contributing organisations was created to establish European Directory of Marine Organisations (EDMO) codes, which feeds into Work Package 7.

Dr Lesley Rickards attended the Fourteenth session of the Group of Experts for the Global Sea Level Observing System in India, in October 2015. The representatives from Chile and South Africa submitted national reports to the meeting which contained important metadata regarding their sea level networks. However, no other South Atlantic countries contributed to the meeting, but we will use the GLOSS contact list to request information from the other member countries. Dr Rickards gave a presentation on Data Rescue which highlighted data in Africa and South America that were in need of digitisation and could contribute to long records in these data sparse regions. Since the meeting it has emerged that there are data in a paper format, in need of rescue from historical tide gauges along the Brazilian coast. There is interest in working these records up to international standard and funding available to do so.

The second deliverable in Work Package 4 Task 4.3 is due in March 2018. The report on Sustained transatlantic coastal observations should describe a harmonised data management plan for all Atlantic tide gauge data, building on current activities. One of the regional alliances that BODC are a partner in is the EMODnet network and Dr Rickards has attended EMODnet Physics meetings. The overall objective of EMODnet Physics is to provide access to archived and near real-time data on the physical conditions of European seas and oceans and to determine how well the data meets the needs of users from industry, p/ublic bodies and science and the meeting was to review progress. Sea level is one of the parameters, and so it was useful to see how much data has been received (both real time and delayed mode), and from where, what, if any, issues have been encountered, and what we can learn and apply to the South Atlantic.

Task 4.4 Non-EU cooperation and sustainability issues

Progress has been made securing the contribution of EuroGOOS to drive the long term goal of creating a permanent forum for transatlantic cooperation and sustainability (of observing networks). A meeting was held in February 2016 with Mario Tamburri from the US Alliance for Coastal Technologies (ACT-US NOAA funded partnership) to scope out a formal link between the US ACT-US and the European Forum for Coastal Technologies (FCT). Also, in February 2016 (at AGU Ocean Sciences in New Orleans) EuroGOOS (Glenn Nolan) met with Zdenka Willis (chief of NOAA Integrated Ocean Observing System) to scope out initial steps to establish a formal link between the EU and USA by formalising links with coastal observing initiatives around the Atlantic basin including links between EuroGOOS ROOSes, and the regional operational oceanographic systems in the US and Canada.

Achieved main results

The progress made on biogeochemical analysis and the planning of further shelf-wide cruises represents significant progress towards D4.3. There was a workshop in Ifremer, Brest, in February 2016 that

achieved Milestone 2 “Shelf profiler and glider deployment coordination meeting”.

WP 5 Integrated regional observing systems

Summary

Within the AtlantOS H2020 project, the work package 5 is dedicated to showcase the power of integrated trans-Atlantic observing to provide information necessary to cope with global challenges such as climate change, increased pressures on natural resources, and global-scale hazards. This objective will be achieved by focusing in particular regions of the Atlantic Ocean, one on each hemisphere - the subpolar North Atlantic and the subtropical South Atlantic Ocean, where multiple observational efforts are operational and initiated by national, European, and international partnerships. Both regions have productive high-seas fisheries and play important roles in the Atlantic Ocean overturning circulation and the marine carbon cycle. It takes advantage of existing independent ongoing observing programmes and it is meant to integrate the fragmented observations and build an international partnership towards a basin-scale consolidation. The WP is organized to focus on two overarching research and monitoring topics: climate change and ecosystems evolution. Ecosystem research is active in many European and international countries embedded in sustained national fishery observing strategies and associated with well-designed observing capabilities and international bodies such as FAO (and subgroups), NAFO, ICES, and OSPAR which monitor and advise these efforts. Not only for fisheries but other socioeconomic relevant topics (e.g. acidification, hydrological cycle, carbon sequestration) climate observing programmes are operational since decades and advanced through the WCRP core project CLIVAR. However, the integration of activities beyond the local scale and beyond the scientific core questions is in general missing. Therefore, our efforts focus in an enhancement of integration and further consolidation that entails a basin/large-scale networking of systems, the need for an opportunistic development of the observing systems (e.g. guest sensor, sampling, accuracy), the improvement of data utilization and the data availability.

This WP is working mainly along three axes: (1) a baseline study on ocean observing, (2) the applications of climate and ecosystem related observing analysis techniques to the two selected Atlantic Ocean sub-regions in order to prepare for basin scale and later global scale assessments, and (3) the optimization of ocean observing by means of OSSEs and process models. While working regionally, WP5 in link with WP2, WP3 and WP6 has definitively the potential to facilitate improved observational logistics (e.g. ship and platform sharing) to make sampling more complete and efficient as well as to promote the innovation potential in exploiting collocated physical, chemical and ecological data to support an improved assessment of fish stocks and their reaction to climate change and the use of process models to create new information as well as products with improved quality/accuracy, when compared to the current system.

WP5 started to establish regional contacts in the two regions of the North and South Atlantic Ocean in order to have the most general view on national programmes of ocean observations (open ocean and coastal projects) and the appropriate stakeholders to connect with. In order to complete the baseline study on ocean observing we have participate to multilateral “Atlantic” meetings and organized two. We are also working on the organization of a wider workshop on the regional Atlantic observing (subpolar North Atlantic and subtropical South Atlantic) in 2017 where national and international research groups, research institutes, government officials responsible of national research and technology, food security and fisheries are invited with the objective to work on observing capabilities, integration and coordination.

In order to reinforce the regional integration WP5 established a capacity-building programme by proposing dedicated cruises to Atlantic undergraduate, master and PhD students. The first of these took successfully place in March 2016. The involved groups in WP5 started to develop climate and ecosystem related observing analysis techniques to the two selected Atlantic Ocean sub-regions. As agreed during a joint workshop in 2015, in order to lay the foundation for the establishment of the various indices, task members are developing coherent and coordinated diagnostics. Preliminary results are available and regional demonstrators are under way. The work on OSSEs and process models was lunched during a dedicated workshop co-organized with WP1 in December 2015. The different regional studies have been discussed together with their potential for the basin wide integration. The effective modelling work for WP5 is starting this year.

Progress per Task

Task 5.1 – Assessment and Coordination of Regional Observing

In this task we assess the current and emerging status of observational programmes and projects in the context of climate and ecosystems in two sub-regions of the Atlantic Basin. We are also evaluating the potential to connect the ocean observing across projects (e.g. RAPID, SAMOC, OSNAP, NACLIM, GO-SHIP, PREFACE, VITALS, Global Carbon Project, etc.), observing systems (e.g. Argo, OceanSITES) and across agencies (FAO, ICES, NAFOS, OSPAR). Besides individual network or more general meetings we [CNRS, GEOMAR] are organizing one joint conference to consolidate the networks in order to create a pan-hemispheric coordinated observing effort [that is our first deliverable, D5.1]. The activity involves experts on ocean observation and modelling from both sides of the Atlantic Ocean, for both areas of interest and it includes multidisciplinary topics. They are PIs of international observing initiatives and panel members of international programmes such as CLIVAR and ICES [CNRS, MEOPAR, WHOI, MCTI, CSIR]. Particular attention is given to sustainability of the ocean observing systems related to these initiatives.

Achievements: The work on the local/regional observing status assessment started as soon as the project was launched. We have organized many *ad hoc* visits to and interactions with local partners and national/local parties during the entire period since the project beginning. In particular, we have taken part or organized various meetings all around the Atlantic basin (Argentina, Brazil, Morocco, South Africa, Spain, UK, USA).

We are gathering an increasing number of national research contacts and we are expanding our research collaborations through research projects and networks. We have been successful in inviting many regional South Atlantic and North Atlantic research actors to the coming WP5 meeting in Kiel (end of June 2016): we are expecting about 60 participants from all over the Atlantic. We have started the process of the organization of a formal workshop in the second half of 2017 to achieve a wider integration. This point will be specifically discussed and decided during the WP5 meeting in Kiel.

In parallel, the started networking is taking form of formal collaborations in terms of network integrations, coordination of observations, collaboration on platforms deployments, in particular in the South Atlantic.

During the IUGG Meeting in Prague (Czech Republic, July 2015), and again at Ocean Sciences 2016 (New Orleans, USA, February 2016), many discussions between North and South Atlantic open-ocean observing programmes and national/local researchers have issued in partnership commitments for observations strategy, observing platform deployments, capacity building in observing, data analysis and modelling.

In 2015 we have submitted a proposal for dedicated cruises across the South Atlantic to give the opportunity to "Atlantic" undergraduate, master and PhD students to embark and receive a formation on ocean observations, oceanography-climate topics (including aspects in physics and biogeochemistry) and work on South Atlantic/pan Atlantic research topics. The first cruise took successfully place in March 2016 on the German RV Meteor. It left Cape Town (South Africa) on February 29 and reached Rio de Janeiro (Brazil) on March 18 with on board 15 students from 11 Atlantic bordering countries. Another cruise will take place in December 2016.

Task 5.2 Application of regional ocean observing: climate and ecosystem

This task is concerned with the integration of observational data (in-situ and satellite) for exploratory product generation on a regional scale and related to climate and ecosystems. Climate related products are grouped around overturning volume-, heat-, freshwater- and carbon transport and sea surface temperature measurements and ecosystem related products are grouped around primary productivity, carbon export, and nutrient cycling. This investigation complements the operational product generation, as performed in WP7 and WP8. In particular, the work undertaken goes beyond the already existing regional foci of analysis and attempt to apply similar analysis techniques to both focus regions (subpolar North Atlantic and subtropical South Atlantic) during a period with intense in-situ observation activities and linked to task 7.2. Through the application to both regions we will be able to detect potential gaps in the ocean observing via the observational data and complementing the system-analysis work that is undertaking within this WP under task 5.3.

Achievements: A first work has been achieved to provide to the modeling community benchmarks on the circulation, heat and carbon budgets in the Atlantic. In the last months IFREMER has constructed a total Dissolved Inorganic Carbon (DIC), Antropogenic Carbon (Cant) and natural Dissolved Inorganic Carbon budgets in the eastern subpolar North Atlantic. These results demonstrate for the first time from in situ data that the Antropogenic Carbon is accumulating in the eastern subpolar North Atlantic without affecting the natural carbon cycle. This new analysis will be subsequently applied at other latitudes, namely in the Subtropical South Atlantic in the coming year.

This will be possible namely by the repetition of the 24°S repeated hydrography for which UK has recently (March 2016) invested approximately 10 million Euros in Southern Ocean National Capability program, with a focus on the Atlantic Sector. McDonagh is the National Oceanography Centre (NERC-NOC) lead for this project that will include a repeat hydrographic section at 24°S. The analysis of this section will make part of the NOC (NERC) contribution to AtlantOS. Analyses of variability at 24°S from Argo floats have been initiated as well as collaborations with Brazilian partners (Campos and Sato at USP) to work on the western boundary variability from Brazilian moorings there. This aligned funding and international collaboration will improve and build on the work that NERC-NOC is funded to do in AtlantOS.

NERC-NOC (McDonagh) is also a formal collaborator on a recently funded (April 2016) NOAA proposal, lead PI, Alison Macdonald at WHOI and co-PI Molly Baringer at NOAA-AOML that will analyse existing observations and models to understand the South Atlantic Circulation with a focus on the deeper ocean. This international collaboration will strengthen the analysis that NERC-NOC is funded to do in AtlantOS.

Through NOC, NERC has also invested in Argo floats with biogeochemical sensors and Deep Argo floats that will be deployed in the South Atlantic sector of the Southern Ocean. This includes 18 floats with a 2000 m capability and a combination of oxygen and oxygen plus pH sensors, and 13 floats that will sample the ocean deeper than 2000 m, including 4 with oxygen sensors. Approximately half of these will

be deployed in the AtlantOS domain and will contribute to the analysis that McDonagh will contribute to AtlantOS.

Task 5.3 - Regional Observing system simulation experiments and process modelling

The objective of this task is to investigate the defined "optimal sampling" through the OSSE approach. The application is on regional scales (subpolar gyre in the North Atlantic and the subtropical gyre in the South Atlantic) with increased resolution and an extended parameter portfolio (complementing the basin scale activities in WP1). This activity will provide recommendations for the resolution and sampling of observing systems relative to predefined skills. The skill is defined via the overarching topics climate and ecosystems. Complementing the large scale, statistical optimization approach via OSSEs (WP1) we will develop an ecosystem module that utilizes multiple in-situ and satellite data as input to derive predictions for different trophic levels including fish and has the potential to be implemented into the routine services supported by a future Integrated Atlantic Ocean Observing System. With physical and biogeochemical variables becoming available in real-time, the real-time monitoring of marine resources relying on the development of ecosystem models is envisaged.

Achievements: One of the main objectives of AtlantOS-WP5 is to improve the observational sampling for the monitoring of climate variability in the Atlantic Ocean, in relation with nonlinear ocean dynamics. It will assist in the design of ongoing and upcoming regional field experiments in this basin, anticipating how to "best" achieve the observations of key variables and processes, in terms of spatio-temporal coverage and dynamical nature.

We have started the design of one of the numerical-to-observations approach. We investigate observations and a pioneering ensemble of long numerical simulations performed within the ANR/PRACE OCCIPUT project. It consists in a 50-member ensemble of global ocean/sea-ice simulations (1/4° resolution) that were slightly perturbed initially and driven by the same atmospheric variability between 1960 and 2015. The ensemble mean provides an estimate of the atmospherically-forced variability, the ensemble dispersion of the chaotic variability. We will characterize at various scales the forced and chaotic (co)variabilities of dynamical and thermodynamical fields in the subtropical South Atlantic and over the basin, their possible imprint on local and distant observational data (altimetry, Argo, RAPID, etc), and propose improvements, extensions, or alternative uses of the existing observed data.

Achieved main results

- Following IUGG Meeting in Prague (Czech Republic, July 2015), and Ocean Sciences 2016 (New Orleans, USA, February 2016) discussions between North and South Atlantic open-ocean observing programmes have issued in partnership commitments for observations strategy, observing platform deployments, capacity building in observing, data analysis and modelling.
- NERC-NOC is formal collaborator on a recently funded (April 2016) NOAA proposal that will analyse existing observations and models to understand the South Atlantic Circulation with a focus on the deeper ocean.

WP 6 Cross-cutting issues and emerging networks

Summary

This work package develops technology and observing system practices that enable multiple observing networks to produce more data that are better targeted at stakeholder, user and customer requirements whilst reducing overall cost. To further improve efficiency and impact it coordinates engagement of

international expertise and dissemination of best practice. The tasks in WP6 are focused on key capability gaps, and opportunities for improved efficiency and cost reduction for current observing system technologies and practices. It specifically targets sensors and instrumentation as these are key (and currently limiting) in enabling widespread biogeochemical and biological observations using existing ocean platforms (vehicles / infrastructure). In this reporting period WP6 has produced a sensors and instrumentation roadmap. This has been welcomed and used by a wide range of stakeholders including ocean observers, regulators, and industry and defense sector. It enables prediction of future technology capabilities and therefore development timelines for EOVs and observing systems. We have collaborated and coordinated technology programmes through existing meetings and AtlantOS initiatives (e.g. Oceanology International 2016) leading to the development of metrology best practice, ocean observing system best practice, plans for shared use of infrastructure, development of agreed interface and data standards, and coordinated biological and biogeochemical instrumentation development. We have completed proof of concept samplers for biological and (meta)genomic observations. We have organised a joint workshop into sustained cost-effective observing systems for the Atlantic Ocean and a workshop for metrology best practice for Trace Element measurement (18-20th July 2016). Within the reporting period we have reached a wide demographic of the oceanographic community through community building at international meetings, contributions from EC projects, HEI, industry and academia.

Progress per tasks

Task 6.1 Sensors and new instrumentation

In this task the roadmap for sensor and instrumentation has been development with input from companies, research organisations and operational groups across the EU and internationally. The resulting report and summary, which includes links to more detailed technical information for each technology, is an open-access document. It is also a live document and will continue to be added to and updated during AtlantOS and beyond. This will be a powerful tool for assessment of feasibility of measurement of parameters for future ocean systems and will therefore feed into updating and extension of EOV lists. It is also a powerful tool for instrumentation manufacturers and ocean observation technology developers and users. We have delivered this roadmap, on request, to several key stakeholders, including a group of over 70 UK companies, and the Royal Navy.

We have also, through engagement with existing sensor development programmes (such as those funded the EU FP7 Oceans of Tomorrow projects), assisted the development of sensor for pH (TRL 7), pCO_2 (TRL 6/7), Dissolved Inorganic Carbon (TRL4), Total Alkalinity (TRL4), fast oxygen (TRL7), and Nutrients (TRL7). This includes laboratory development, testing and preliminary demonstration trials. Linking to WP3 and WP4 demonstrations include integration of these new sensors onto submersible including coastal and deep sea gliders and profiling floats (for the Argo array / Bio Argo initiative). These activities include collaborations between AtlantOS partners.

To support the emerging networks (see T6.5) in biodiversity and (meta)genomics we have developed water and filter samplers to proof of concept. This includes demonstration of the use of preservatives to enable the sampling and archiving of RNA and DNA on filter samplers. We have demonstrated that it is possible to preserve for up to 6 months, RNA and DNA with sufficient quantity for later quantitative analysis. We have also developed (detailed 3D CAD) prototype filter samplers for cellular eDNA and microbial (meta)genomic analysis using 0.2 μm pore size filters. The concept enables 1000 individual filtrand samples each from typically 5 L of seawater. The device is compact and could be deployed from observatories, or larger autonomous vehicles. It is currently in manufacture prior to proof of concept testing. We have also begun the work of creating assays and adapting the operation of the existing

Environmental Sample Processor instrument (a sampler (32 or 132 samples) and in situ molecular / genomic analyser) so that it can be used for eDNA analysis. This work links to WP3 and particularly the implementation of genomic measurements into existing observatory platforms. Here two potential test sites have been identified that have long-term (>10yrs) records of archived pre-existing comparator samples (sediment trap samples): PAP, NE Atlantic, Fram Strait, Atlantic-Arctic gateway. Postdoc has been recruited who is developing standardized workflows for –omic observations.

Task 6.2 Common metrology and best practices

This task is developing existing centres of gravity to develop common metrology techniques and best practice (including standards) for measurement of priority EOVs ensuring dataset accuracy, precision and reliable intercomparisons between different technologies, laboratories, sampling locations and times. To disseminate and promulgate these best practices the tasks feeds into T6.4 (see below) and is also running a series of workshops. The first of these will be delivered 18-20th July 2016 at the University of Plymouth UK and will focus on Trace Element measurement. The course will draw on the considerable expertise and investment in metrology best practice by the GEOTRACES community. Further workshops in development include: genomic observatories, nutrients and oxygen sensor observations, carbonate chemistry sensors measurements. The production of best practice manuals will follow each of these individual workshops and will be made available for free on-line dissemination (open access).

Task 6.3 Shared infrastructure

In support of deliverable Integrated Atlantic Ocean Observing System *shared infrastructure report* work has concentrated on landscaping possibilities for sharing infrastructure. Principally this will be through interactions at different levels, from scientists to community leads, and also preparing the means for discussion of these possibilities.

Interactions and interviews have taken place at the following events (collected statements will be used to describe the landscape in the above named deliverable):

- FixO3 General Assembly transnational access workshop – Brussels – Oct 2015
- Oceanology International 2016 (Collab. with FP7 NeXOS and FixO3 activities) – London – Mar 2016
- Canada-Europe Working Session on Oceans – Institute of Marine Sciences, Barcelona – Nov 2015
- AGU General Assembly - AtlantOS WP6 and RCN OceanObs meeting, San Francisco – Dec 2015
- AGU Oceans – WP6 meeting and stakeholders meeting, New Orleans – Feb 2016
- Sensors and Observing systems workshop – PLOCAN, Gran Canaria – May 2016

Task 6.4 Best practice on observing systems

Activity in this reporting period has focused on building and integrating the existing communities to maximise international collaboration and dissemination of observing system best practice. We have established links with GEO, POGO, and ocean networks (e.g GOOS/EuroGOOS, Argo, GROOM, JERICO) including all disciplines including physical oceanography, biology and biogeochemistry. We have established a route to publishing and dissemination of best practice and lessons learned through GEO registries and have begun gap analysis, collating and extending the existing portfolio available from and to the networks and communities. Contributions have been sought from the oceanographic community at international conferences and meetings (e.g. Ocean Sciences, Feb 2016 and Oceanology International, Mar 2016).

Task 6.5 New and emerging networks

D6.2 (Roadmap for emerging networks): This will include a business case and an implementation plan detailing the governance, internationalization, coordination, metrology practices and technologies to be developed over a three and ten year timescale. This will address gaps (e.g. biogeochemistry, (meta)genomics) and opportunities. There is a side meeting at the annual meeting where we will engage the emerging networks and capture plans for the delivery of the implementation plan. Currently there are number of disparate emerging networks that will benefit from a centralized view and this Deliverable for AtlantOS will do that.

Cooperation and interaction with other projects and initiatives

There has been extensive engagement with the EU Oceans of Tomorrow (OoT) projects. A special session for these projects, arranged through AtlantOS at Oceanology International 2016 at the Excel centre in London (15-17/03/2016) provided a platform for dissemination to largely operational and industrial exhibition attendees. Eight out of the nine projects attended as did a number of related projects, such as BRIDGES[1]. The workshop exposed and developed the impact of their outputs and provided an opportunity to develop plans for interoperability of interfaces and data standards. This has established a continuing dialogue on cross cutting issues. The roadmap for sensors and instrumentation was also discussed and promoted and cross-project discussions were held regarding new and emerging networks.

Through the landscaping undertaken in support of Task 6.3 (Shared infrastructure) several projects have contributed both directly and indirectly. To name a few: AORA-CSA, NeXOS, FixO3, OceanObs RCN (USA/NSF funded). Collaboration is taking place with AtlantOS WP3 on the organization of a workshop focusing on sustained cost-effective observing systems for the Atlantic Ocean (further details in V b).

Douglas Connelly (Task 6.5 lead) now sits on the Scientific Steering Group (SSG) of the International Ocean Carbon Coordination Project and will ensure that the activities of AtlantOS are represented and collaborations between the two projects are ongoing. We are currently in the process of identifying those scientists in the wider observing communities that are involved with biological, genomic and meta-genomic networks.

Achieved main results

- Coordination with Oceans of Tomorrow projects has extended the list of sensor and instruments addressing priority EOVs and has made it accessible to the science community. This list can now be worked through in terms of performance assessment and compared to demand so that EOVs (which combine demand/need and ability to measure) can be re-evaluated.
- The Sensors and instrumentation roadmap report has been developed and finalisd. We have since received enquiries from UK Royal Navy for collaboration and received positive feedback from the ocean observing community.
- The first international workshop on metrology standards has been arranged (July 2016) for Trace Element Metrology.
- Flagship projects, methods or initiatives, proposed for shared infrastructure have been identified. Examples include Cross-basin sharing of infrastructure for animal tracking technologies, transnational access and bartering methods for testing new technologies and VOS Ship design requirements to include new sensor systems at an early stage.
- Proof of concept for new water and filter sampler technology completed.

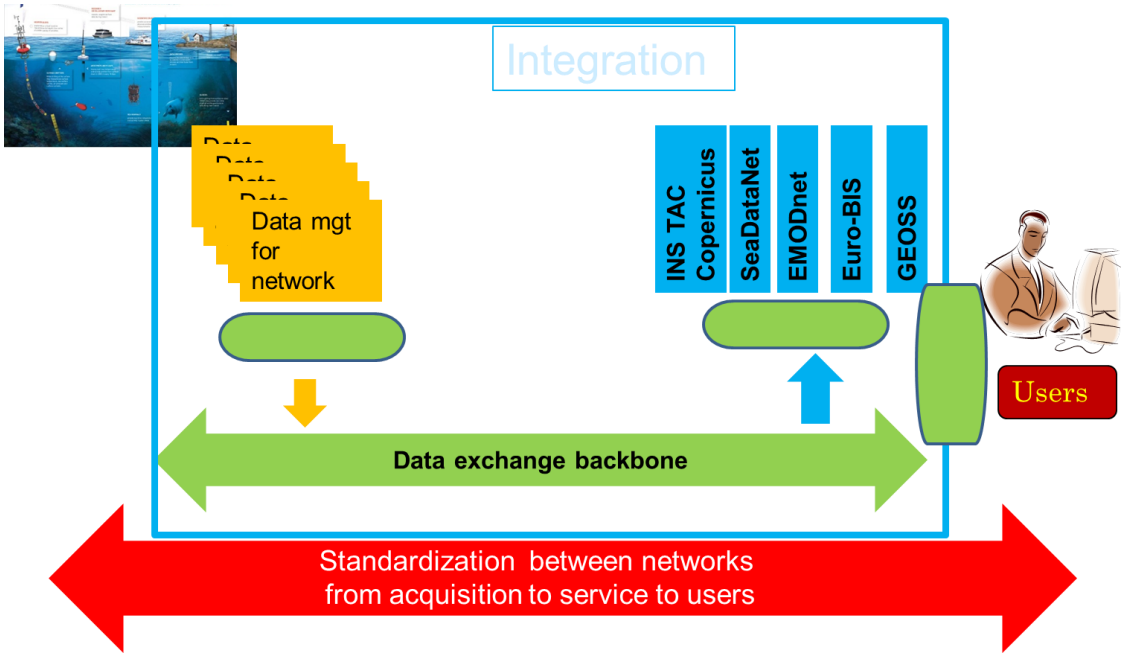
[1] http://www.bridges-h2020.eu/

WP 7 Data flow and data integration

Summary

The overall objective of WP7 within AtlantOS project is to ensure that data from different and diverse in-situ observing networks operating in the Atlantic are readily accessible and useable to the wider community, international ocean science community and other stakeholders in this field. To achieve that, the strategy in WP7 is to move towards an integrated data system within AtlantOS that [Task 7.1] harmonises work flows, data processing and distribution across the in-situ observing network systems, and [Task 7.2] that integrates in-situ observations in existing European and international data infrastructures (Copernicus Marine Service, SeaDataNet NODCs, EMODnet, EurOBIS, GEOSS) so called Integrators. The further tasks of WP7 aims [Task 7.3] to demonstrate the operation of the Integrated system, [Task 7.4] to assess the impact of AtlantOS observations in models through Copernicus and [Task 7.5] to develop and deliver ocean products derived from these observations both for research and for applications. During the first period of the project only the first two tasks 7.1 and 7.2 were active.

To facilitate the access to the Atlantic observations and avoid "mixing pears with apples", it was first necessary to agree on (1) the EOVs list and definition across the Networks, (2) a minimum set of common vocabularies for metadata and data description to be used by all the Networks, and (3) a minimum level of Near Real Time Quality Control Procedures for selected EOVs.



The European data system for AtlantOS -
line green and red are the interfaces addressed in WP7

The WP7.1 and WP7.2 tasks kick off meeting took place on 9th June 2015 in Brussels with the objectives to:

- Agree on the data management principles that are described in WP7 DoA
- Clarify what needed to be set up to reach the harmonisation and integration goals taking into account what already existed
- Clearly define who does what in task 7.1 and Task 7.2.

During the first six months, a set of matrices (Networks-EOVs, Networks-Integrators, Networks-platforms, Integrators-services, Integrators-users) were built to (1) identify possible gaps, propose solutions to reduce them and move towards those solutions, and (2) to have a complete and clear map of the situation at the beginning of the AtlantOS. This work raised that the data acquired by the different in situ observing networks contributing to the AtlantOS project are processed and distributed using different methodologies and means. Depending on the network data management organization, the data are either processed following recommendations elaborated by the network teams and accessible through a unique portal (FTP or Web), or are processed by individual scientific researchers and made available through National Data Centres or directly at institution level. Some datasets are available through Integrators, such as Copernicus or EMODnet, but connected through ad-hoc links.

Relying on existing international standards and protocols, and dealing with data harmonisation and integration objectives, we ended in early December to agreements and recommendations on:

- a list of EOVs across the Networks
- a minimum set of metadata common vocabularies to be used by all networks
- a minimum level of Near Real Time Quality Control Procedures for selected EOVs coordinated by CNRS for T, S and Current, UPMC for Chl and Nitrate, Ifremer for O2, NERC for Sea Level and UiB for Carbon
- basic services (discovery, viewing and downloading) to distribute the data

Then the second WP7.1 and WP7.2 meeting held on 3-4 December 2015 in Paris focused on the developments that needed to be achieved for data management and data integration

- the definition of a data exchange backbone to facilitate discovery, viewing and downloading by the users
- the recommendation of several tools to help Networks plugging their data on this backbone and facilitate integration in the Integrators
- the enhancement of existing services to the users for data discovery, viewing and downloading to ease access to existing observations

An action plan, involving data providers both Networks and Integrators, was decided for the next 6 months, from December 2015 to June 2016. The objectives of the second working phase were:

- for data harmonization of the data management activities (WP7.1): finalize the mapping of existing Networks metadata to Integrators vocabularies (EDMO, SeaDataNet Vocabularies), validation of RTQC recommendations by all the Networks
- for data flow and integration of the existing systems (WP7.2): enhance network data integration in SeaDataNet and Copernicus integrators, enhance discovery services both for platforms and products at network level, integrator level and EU level, enhance monitoring and dashboard services (EDMOnet and JCOMMOPS) to show AtlantOS

Progress per tasks

In the rest of the WP7 report when the word Networks is used it means the following institutes: GEOMAR for GOSHIP and Sea floor Mapping, University of Exeter for SOOP, SAHFOS for CPR, ICES for Fish+plankton, Ifremer for Argo, NERC for OceanSites, CNRS Glider, EUMETNET for Surface drifter. Similarly when the word Integrators is mentioned it means Ifremer for Copernicus Marine Service (CMEMS), Ifremer, Maris and NERC for SeaDataNet, Maris, EuroGOOS , ETT and VLIZ for EMODnet, UNIHB for GEOSS, ICES and VLIZ for EurOBIS.

Task 7.1 Data harmonization of the data management activities

The first activity of task 7.1 has been the production of the data management plan (DMP) for AtlantOS. The DMP contains essential elements for the work of WP7 in general and particularly in regards to harmonization as it describes the data that will be authored and how the data will be managed and made accessible throughout the lifetime of AtlantOS including the types of data to be managed, the standards that would be applied, for example format and metadata content, provisions for archiving and long-term preservation, access policies and provisions and quality assurance. In this way, the DMP sets the framework for harmonization of data produced during the AtlantOS project and includes essential guidelines for 1) Standardization approach, 2) Data exploitation and reuse strategy 3) Principles of access and sharing - the AtlantOS joint data policy. Task 7.1 has the overall goal of improving the foundation for successful data-exchange and data processing relying on Atlantic data from the research infrastructures involved oceanic data by harmonization the procedures by which the exchange and processing is undertaken.

Task 7.1 focuses specifically on EOVs that are acquired by multiple networks. As EOVs in a scientific context is a relatively new concept including aspects from biology, biogeochemistry and physics; the individual parameters and their characterization as EOVs took some time. At two WP7 meetings, EOVs were presented and debated in the context of AtlantOS and the data available from the AtlantOS networks including validation of individual parameters as being major or additional/complementary. An inventory of Standardized Scientific Variables measured by the WP2-WP3-WP4 Networks (so called *Networks-EOVs matrix*) was performed for 3 fields 'Physics', 'Biogeochemistry' and 'Biology/ecosystems', relying on existing EOVs and ECVs lists from GOOS. The outcome hereof will set framework for the EOVs which are subject to the future harmonization activities in WP7.

Networks and Integrators agreed on a minimum and essential set of applicable standards ensuring cross platforms coherence and some actions have been undertaken to move towards this:

- all **platforms** should have a unique identifier that will be either WMO or ICES code for ships
- **metadata** used by the networks should be "mappable" on standard vocabularies existing and EU (SeaDataNet) or international (CF or WoRMS for Taxa). In this first period, BODC has built and validated with the Network representatives a vocabulary matrix for AtlantOS EOVs.
- each time an **institution** is used in a Data File the EDMO code (European Directory of Marine Organisations) should be added. MARIS has worked on completing the EDMO catalogue with the Networks inputs and on enhancing EDMO by bringing in simple hierarchy to facilitate the search in list on portals.
- **QC information** will be attached to the data both Quality flags that can be mapped to SeaDataNet flag scale and whenever known processing level information ("qualified in RT using automated procedures" or "processed in delayed DM by Scientist")
- **Distribution means**: provide an FTP service at the level of network data management as the minimum delivery service. Additional services such as WEB services can also be provided but are not mandatory.

Concerning the metadata for platform type and sensors, it was agreed that it was an issue to be solved at Network level and that harmonization across networks was not seen as a priority. Nevertheless, a recommendation to implement sensorML for sensors whenever possible will be issued in partnership with other projects such as ODIP2, ENVRI+, SeaDataCloud (if accepted).

WP7 intends to give recommendations for the improvement of the harmonization for all data available from the e-infrastructures under the AtlantOS framework by producing a report on recommendations on

data harmonization (D7.1). This reports shall include recommendations for common vocabularies and data formats including minimum required metadata as well as standardization of near real-time quality control procedures for a core set of EOVs. The recommendations shall build on the guidelines and landscape developed through the DMP. Furthermore the assessment of data availability and accessibility is currently in planning.

Moreover, a minimum level of Near Real Time Quality Control Procedures have been recommended by the experts for the selected EOVs (T, S , Current, O2, Chl, Nitrate, Sea Level, Carbon) and Network representatives have validated them. The sea level procedure will be finalise before the end of 2016.

To support the harmonization process on the trans-Atlantic level AtlantOS partner UNIHB was invited to present the AtlantOS data management concept as part of the Ocean Data Management Expert Forum (Montreal, Nov 18-19, 2015). A number of starting points to improve data sharing had been identified that build up on existing national and international initiatives that integrates cross-disciplinary harmonized data management concepts with the user requirements for reliable forecasts. On an international level initiative close link with EC projects such as ODIP, ENVRI+, EMODnet, Copernicus, SeaDataNet are necessary to set the foundation for the harmonization process within AtlantOS and enhance discovery and access for data generated by public authorities.

Task 7.2 Data flow and integration of the existing systems

To define what are the developments needed we started from the **description of the present situation**. Two surveys resulting in two summary matrices were carried out by IFREMER since the kick off meeting in June 2015 to describe **1) what exists at Network level** (platform descriptions matrix) and **2) what is the integration status of Networks in Integrators** (Networks-Integrators matrix). These two matrices were built by the task 7.1 team with the collaboration and validation of both Network representatives from WP2, WP3 and WP4, and Partners representing the Integrators (Ifremer, MARIS, ETT, VLIZ, MARUM-UniHB).

Then, during the second WP7 meeting (December 2016) the decision was made that the first priority for WP7.1 was to concentrate the work of participants (Partners and Network representatives) on **1) the enhancement of discovery services (catalogues)** and **2) the enhancement of integration in Integrators** and **3) Monitoring and dashboard services to show AtlantOS.**

Cooperation and interaction with other projects and initiatives

- Copernicus Marine Service , and it's In Situ Thematic center that build the necessary in-situ products for the European Copernicus Marine Service
- EmodNet Central portal and Physics and biology lots
- SeaDataNet Network of National Data Centres that collects, archive and distribute in situ data mainly from research activities
- ENVRI+ that aims at creating a more coherent, interdisciplinary and interoperable cluster of Environmental Research Infrastructures across Europe project . Collaboration is on the implementation on the European cloud of a "Data delivery service to scientific users' using the Copernicus In Situ TAC data
- JERICO-Next project for data integration concerning WP4 networks and monitoring/dashboard services
- ODIP2 project that is setting the foundation for the harmonization process at International scale between European, American and Australian partners

Achieved main results

Agreements and recommendations have been achieved on:

- a list of EOVs across the Networks involved in WP7
- a minimum set of metadata common vocabularies to be used by all networks
- a minimum level of Near Real Time Quality Control Procedures for selected EOVs (T, S , Current, O2, Chl, Nitrate, Sea Level, Carbon)
- basic services (discovery, viewing and downloading) to distribute the data
- A started process involving Integrators and Networks to enhance
- existing discovery services at Network, Integrator or EU level (EDMO platform catalogue, Sextant product catalogue, DOI)
- integration of "missing" data in Integrators (SeaDataNet, Copernicus)
- for monitoring and dashboard service, a coordinated action involving ETT, JCOMMOPS and Ifremer for a shared strategy and complementary developments, leading to a proposal for a dashboard service to show and taking into account the Network needs.

WP 8 Societal benefits from observing/information systems

Summary

During the reporting period WP8 activities have progressed steadily. The WP8 milestone was achieved at Month 9 (1 month delay with respect to schedule) that consisted in a meeting to discuss among partners the common working protocols. An important outcome of the meeting was: 1) the design of a Use-Case Specification Document; 2) the adoption of the EMODnet Checkpoint assessment methodology for the AtlantOS Data Adequacy reporting.

The seven Pilot actions/end-use cases show progress as follows: 1) For Task 8.1 Harmful Algal Blooms, the partners started to design the common framework for algal blooms bulletins between Ireland, Spain and Norway. 2) For Task 8.2 Coastal Flooding/Storm surges, progress towards a comprehensive statistical model of storm surge distributions has been achieved, together with the initiation of an inter-comparison exercise with equivalent systems in the world. 3) For Task 8.3 Ship routing hazard mapping, progress has been made to understand vessel propulsion systems to model economic cost of marine voyages and a starting grid for the Atlantic minimization algorithm has been defined. 4) For Task 8.4 Oil spill risk mapping and disaster risk reduction best practices, progress has been made in the understanding of the statistical distribution of coastal oil pollution as a function of oil spill release points for a test case in the Atlantic coastal areas of Portugal, now to be extended to the whole Atlantic. 5) For Task 8.5 Offshore Aquaculture siting work has been devoted to review the previous achievements from similar products and services in Spanish, Norwegian and Ireland's Atlantic coasts. 6) For Task 8.6 potential target users have been identified for hands-on assessment and training in the use of CMEMS products. 7) For Task 8.7 Operational real-time and forecast modelling of North Atlantic albacore tuna populations, progress has been made in the understanding of different input environmental marine condition data sources (reanalyses) and prepare the historical geo-referenced fishing datasets for the study.

Progress per Task

Task 8.1 Harmful Algal Blooms

In this task in-situ and satellite data will be amalgamated in a decision support system. Several AtlantOS HAB expert early warning systems and oceanographic products have been developed with others planned for later in the project. A product specification "living" document was drafted and will be discussed in detail at the next WP8 meeting. Over the last year, weekly bulletins were published online for Ireland (www.marine.ie/Home/site-area/data-services/interactive-maps/weekly-hab-bulletin), no operational HAB bulletins yet for Spain; link to oceanographic products: www.indicedeafloramiento.ieo.es and HAB maps for Norway (http://algeinfo.imr.no). Other activities in this task include preparation for future stakeholder consultations. Questions have been formulated for semi-structure interviews to take place at the Galway Seafest and Irish Sea Fisheries Board conferences and public open days in June and the biomarine Business Convention that takes place in Oslo in October 2016. The aim here is to get feedback on the current systems in place, to collect the main customer needs (i.e. aquaculture industry) along with additional information on the wider community (government and public) on HAB forecast needs. This planned activity will help us demonstrate to other WP 8 task leaders how to go about end-user engagement for their use-cases.

Task 8.2 Coastal flooding/storm surges

We have made significant progress towards a comprehensive statistical model of storm surge distributions and have submitted a key paper to GRL (see scientific publications, later). We examined the role of the tide in modulating skew surge – an important proof that has not previously been systematically explained, despite its importance for coastal extreme sea levels. We show that the height of the tide has no modulating effect on the skew surge (i.e. at a given location any storm surge can occur on any tide). This is important and timely for scientific and engineering reasons: policy makers and coastal protection agencies are currently revising extreme sea level projections following the fifth assessment report (AR5) of the IPCC. Understanding the relationship between skew surge and tide will ensure that correct impacts conclusions are drawn. Our work will improve the extreme value analysis for storm surges, tides and waves: refinement of joint probability techniques is in scope for future work under Task 8.2.

We have also made progress towards a global storm surge climatology building on the work of the IOC/WMO JCOMM Expert Team for Waves and Coastal Hazards (ETWCH) forecasting systems (chaired by the Task leader). At the second JCOMM International Storm Surge Symposium (Key West, Florida, 2015) we initiated a global storm surge model intercomparison project as a priority work area for the Expert team. This project will evaluate an emerging class of global tide-surge models from the Netherlands, UK, Australia and Canada. Future work in this Task will provide a consistent climatology of global surges from NCEP/NCAR re-analysis data, thus provide a consistent global pattern of storm surge analysis (and also from climate models).

Task 8.3 Ship routing hazard mapping

Since the summer of 2015, a preliminary literature investigation on vessel propulsion modelling has been carried out. This will be needed for modelling the economic cost of marine voyages. Also, a survey of available reanalysis data for currents, waves, and winds has been completed. After the technical meeting in Ravenna, a description of the targeted products from Use Case "Ship routing hazard mapping" has been prepared. So far, a time-dependent implementation of several graph search methods has been realized. They have been validated vs. the consolidated results by VISIR ship routing model. The comparisons show that the computational performance has improved by more than an order of

magnitude and that a better scaling with problem size has been achieved. In the next months, the activities will be started for creating a convenient numerical grid for solving the optimization problem in the Atlantic Ocean.

Task 8.4 Oil spill hazard mapping and disaster risk reduction best practices

The aim of Task 8.4 is to map the oil spill hazard due to accidental (e.g. foundering, collisions, etc.) and operational (e.g. engine leakages, tank washing) spills in the Atlantic basin, followed by the quantification of the uncertainties in the estimates. The first step taken in Task 8.4 was to review the available literature in hazard mapping, list the identified shortcomings found and to propose solutions that will guarantee a robust and objective hazard mapping for the Atlantic basin.

A pilot study area (Algarve, Portugal) was defined in order to test, in a smaller scale, the hazard mapping method. This first experiment consisted on developing a methodology to compute the oil spill hazard and its uncertainties relying on its actual statistical distribution and in accordance with the present knowledge in oil impacts on the coast. The obtained results (Sepp Neves et al., 2016) were encouraging and the new method will be scaled to the Atlantic basin. Additionally, the main potential users for the targeted products developed in Task 8.4 and their major needs were listed based on the available literature. The gathered information was used to propose three targeted products, their format and their spatial-temporal coverage.

Task 8.5 Offshore aquaculture siting

The first deliverable from this task is due at project month 24. The work is on the way and there are no delays to report. Suggested methods and work already undertaken to identify potential offshore aquaculture sites off the Spanish, Norwegian and Ireland's Atlantic coasts were presented at the AtlantOS WP8 First Technical Workshop held in Ravenna, Italy, 18-20 January 2016. The methods and results presented on the workshop are discussed in the MS1 WP8 technical workshop report; available on the AtlantOS website.

Task 8.6 Reanalyses for MSFD and ICES assessments

The bulk of the work on this task involves assessment of the impact of improved open ocean boundary conditions (arising from the AtlantOS observing system) on shelf seas reanalyses/forecasts. This work will be carried out later in the project to allow time for input from WP 1.3, which will assess the impacts of AtlantOS observations on the open ocean boundary conditions (Task 1.3). In the meantime, two extended end user visits are planned which will allow those users to develop detailed hands-on experience with using CMEMS reanalysis products to inform MSFD and ICES assessments. Potential users have been identified and the visits are expected to take place during the period October 2016-March 2017.

Task 8.7 Operational real-time and forecast modelling of North Atlantic albacore tuna populations

Driven by realistic real-time and forecast outputs of operational ocean circulation models (CMEMS/Mercator-Ocean GLORYS reanalysis and PSY3 configuration, 1/4° and 7 days resolution), a spatial dynamics model of Atlantic albacore is developed to simulate the distribution of the species under the influence of both fishing and environmental variability. The sensitivity of the model outputs to the physical drivers, especially the 3D currents (Fig. 8.1), will be tested while the interest of the approach will be investigated through interviews to various stakeholders of the fishery and its management. Atlantic albacore is exploited by surface fisheries (EU fleets in the north) targeting mainly immature fish, and longline fisheries targeting adult albacore (Fig. 8.1). Despite uncertainty, most of stock assessment

studies indicate that the adult (spawning) stock is overfished. ICCAT is managing the stock and has set Total Allowable Catch (TAC) for the Northern and Southern stocks.

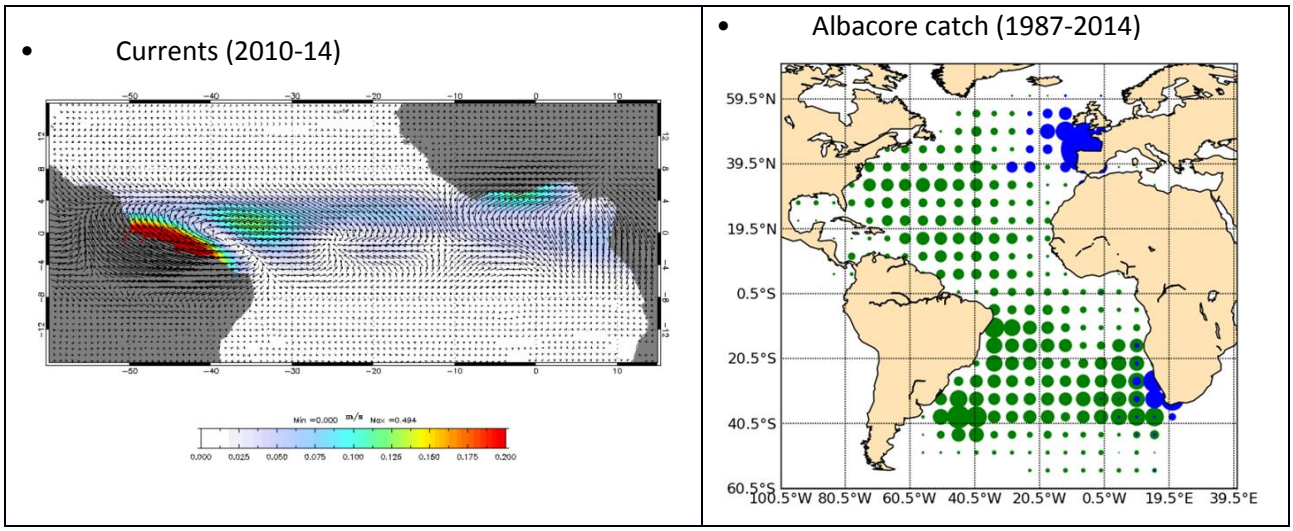


Figure 8.1: a) Difference between average surface zonal currents (2010-14) from Mercator-Ocean operational model PSY3v3 and ECCO reanalysis in the Equatorial Atlantic Ocean. b) Geographic distribution (5ºx5º) of albacore mean annual catch by major gears for 1987-14 before raising to nominal catch (based on ICCAT database). Longline in green and surface gears (bait boats and trolling boats) in blue.

The first ongoing step is to prepare the historical geo-referenced fishing dataset available from ICCAT (*Fig. 8.1*) to run the model and rebuild the history of the population, then allowing the initialisation of the operational model. Four major fisheries of the southern stock, namely the surface bait boat fleets of South Africa and Namibia, and the longline fleets of Brazil and Chinese Taipei, are added to the previous 14 fisheries defined for the northern stock (EU project Euro-basin; Lehodey et al 2014). Geo-referenced catch and effort data are being raised to the level of total nominal catch declared by each country to ICCAT to account for all the fishing mortality.

The model parameterisation achieved at coarse resolution for this species (Lehodey et al. 2015; Dragon et al 2015) will be downscaled to the higher resolution of the GLORYS ocean reanalysis. Previous and new version of the reanalysis will be tested and the impact on predicted fish catch distribution analysed.

Task 8.8 POGO-AtlantOS collaboration on ocean products

The POGO activities within AtlantOS has been busy setting up the Cruises and Workshops in which some to the funding will be used to fund Scholars for Training on Climate and Ocean as part of the remit of Atlantos for Shipboard Training. We are also examining ways to include it on the cruise of the Meteor.

Cooperation and interaction with other projects and initiatives

WP8, and in particular Task 8.1, connected with and exchanged knowledge with NOAA and the University of California, Santa Cruz via a joint MI-NOAA-UC Santa Cruz workshop on HAB nowcast / forecast of HABs workshop hosted at the Marine Institute on 11 January, 2016. WP8, in particular Task 8.7, is connected with the Copernicus service evolution GREENUP project (2016-17) and the EU H2020 MESOPP project. Both projects are focusing on the modeling of micronekton, a key component of the ocean ecosystem. Micronekton is used in the tuna model (WP8.7) to drive the spatial dynamics of the species (movement towards feeding grounds and predation effect on larvae). The objective of GREENUP is to demonstrate the interest of this new product for the CMEMS catalogue to better address the

Marine Resources area of benefit. MESOPP is a project in cooperation with Australian and European partners to use acoustic data for calibration and validation of the micronekton model.

WP8, and in particular Task 8.4, is connected with the US-NSF Hazards-SEES project (2016-2018) coordinated by Prof. Peacock and Prof. Lermusiaux of MIT (Boston) where new methods are studied to compute hazards due to advection of natural and anthropogenic material in environmental flows.

WP8 connected to the GEOSS European Project Workshop thus starting the interaction with the various European groups involved in marine activities. WP8 is strongly connected with EMODnet Checkpoint activities (see http://www.emodnet.eu/ under "Sea Basin Checkpoints") because WP8 co-leader is coordinator of one of the Checkpoints and developers of the Data Adequacy strategy and reporting. WP8 adopted the EMODnet Checkpoint methodology for the assessment. Interactions with the EMODnet Checkpoint have started, in particular the Atlantic and Mediterranean Sea basin activities. EMODnet is a DGMARE programme. WP8 is and will be tightly connected to the Copernicus Marine Environment Service (CMEMS) data delivery and in fact will rely on such delivery for most of its products. An important connection will be developed in the next year with WP7 activities where impact of AtlantOS observations will be inserted into the CMEMS products. The connection of WP8 with POGO has started (see report for Task 8.8)

WP8 will be strongly connected to the IOC-WMO Joint Committee for Oceanography and Marine Meteorology (JCOMM, http://www.jcomm.info/) and in particular its Service and Forecasting Systems Program Area (http://www.jcomm.info/index.php?option=com_content&view=article&id=22&Itemid=37) since the WP8 co-lead is co-president of JCOMM and the Task 8.2 Lead is also Chair of the "Expert Team on Waves and coastal hazards forecasting systems". The connection between innovative products from WP8 and JCOMM will be a high priority throughout the project.

Achieved main results

The first meeting of the WP8 partners was held at the University of Bologna in Ravenna (IT) between 18 and 20 of January 2016. The meeting aims were to:

- raise awareness of the AtlantOS overall strategy and its connection to WP8 work;
- define and harmonise the working practices between the participants;
- discuss the assessment criteria for the end-user products.

First of all the overall general strategy for value-added, user-driven products was elucidated and discussed among the partners. It was recognised that the reference European framework where the monitoring assessment is carried out on the basis of end-user products is EMODnet Checkpoints and the partnership decided to follow the Standard Operating Practises that will emerge from these groups. The value adding chain from observations to end-user products is long and requires traceability of the processes used to develop the products and to devise careful assessment criteria that are already being developed by EMODnet. In order to align as much as possible with the EMODnet principles, the partners decided to adopt ISO principles for product quality assessment. The work starts with the definition of the inputs, data sets and the user requirements for each Pilot Action and ends with the application of assessment criteria to the products (fitness for purpose indicators) and to the input data sets (fitness for use). The main result of the discussion was the definition of a standard Use Case Product Specification Document the first version of which will be completed in June 2016 and then updated regularly to contain the description of the products, the input data sets and the methodology to produce them in addition to the description of the potential impacts.

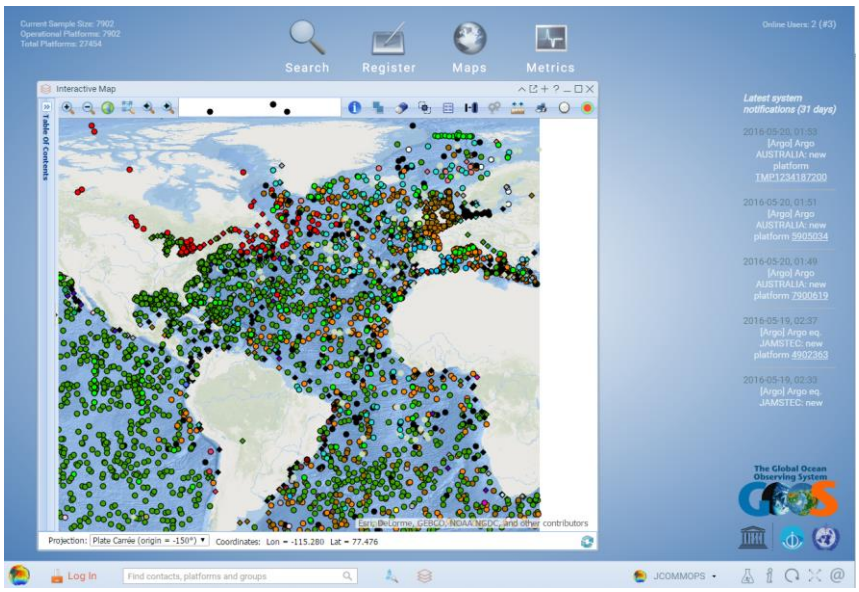
WP 9 System evaluation and sustainability

Summary

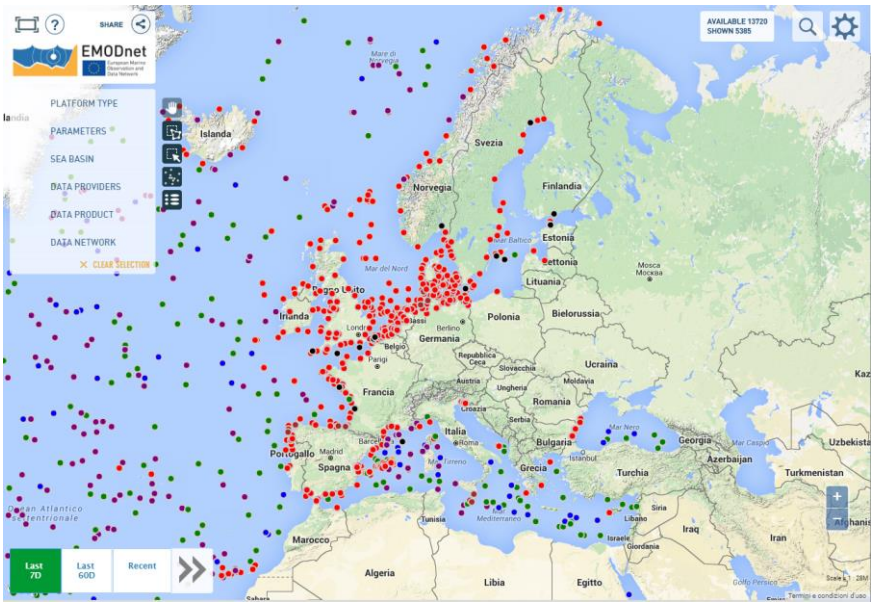
WP9 objectives are to provide quantitative and near real time information of the state of the in-situ Atlantic Observing System (task 9.1), to analyse and properly document for each EOV the adequacy of the current observing and information system (task 9.2) and to develop a long-term sustainability plan for Integrated Atlantic Ocean Observing System based on existing plans of international partners, European Member States as well as key European initiatives (task 9.3). For the first reporting year, only Task 9.1 was active and reporting is thus limited to Task 9.1. Objectives for the first year of Task 9.1 was to specify two WWW based monitoring tools for 1) the European (including coastal/regional regions) and 2) the international contributions to the Atlantos in-situ observing system. The data flow (real time and delayed mode/climate) monitoring is organized in relation to WP7. Seascape should organize the links with EMODnet. Partners of the work package 9.1 have met once in JCOMMOPS office during the first year of the Task. This first year have been used mainly to get familiarized with the two systems and better define the scope and role of each partner. Two rather mature web based monitoring systems (JCOMMOPS and EMODNET/ETT) are operational (see below) and synchronisation between both systems has started. JCOMMOPS dashboard based monitoring system can be adapted to provide the AtlantOS perspective and filter all information accordingly, while EMODNET is built already on the EuroGOOS perspective. Hence partners will naturally share the developments of the two deliverables: JCOMMOPS for AtlantOS and international view and ETT for EuroGOOS and European view. IOC via JCOMMOPS will operate the first system while EuroGOOS will operate the second one.

A first key requirement is that developed monitoring tools should be embeddable in other websites which will ease i) cross integration and ii) integration in various web portal, as appropriate.

EMODNET portal gathers a number of key metadata on observing systems coordinated by JCOMMOPS (through its API) and integrated these partially in its web based system. It is to be noted that the EOV perspective is under progress on JCOMMOPS side (not available yet for all networks) and will be available very soon to EMODnet. On another hand, JCOMMOPS has no plan yet to include coastal observing system in its system.



http://www.jcommops.org



http://www.emodnet-physics.eu

Partners have agreed to share the expertise:

- JCOMMOPS will provide indicators on network status (inside perspective)
- EMODNET/ETT will provide indicators on data usage (outside perspective).

Eventually both systems will share the monitoring tools within their interfaces and fuel final websites for AtlantOS and EuroGOOS context. Performance indicators are being defined by JCOMMOPS within JCOMM/GOOS and individual networks context. See below. JCOMMOPS will keep on implementing the defined and agreed (within networks) performance indicators in its web based system and partners will meet in July in Brest/JCOMMOPS to write the specifications of the integrated indicators for AtlantOS and EuroGOOS perspectives, from this base template.

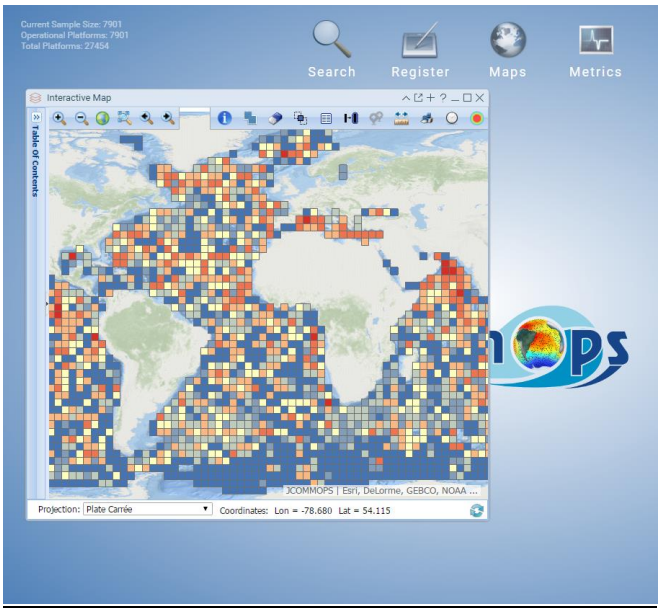
Advanced and technical presentations of the two system capabilities will be exposed. Partners have also participated in the work of the WP7 to make sure data and metadata flows will be harmonized with WP9.1. Given the level of progress of the two web based monitoring system, the partners are optimistic with regard to the follow up of the joint work.

	Targets	Initial	Global	Deep	Bio
IMPLEMENTATION	Activity	Nb of active units in the design targets = 3000, 4400 , 1000, 900			
	Operationality	Nb of operational units vs targets within the design			
	Intensity	Nb of units deployed (t -365) within the design targets =750, 1100, 250, 225			
	Coverage (Yearly)	Nb of well sampled 3X3 grid element over last calendar year. See coverage maps			
	Coverage (monthly)	Nb of well sampled 3X3 grid elements over last month			
DATA FLOW	Delivery	Nb of operational vs registered units			
	Quality (TEMP, PSAL)	Nb of profiles flag='A' vs total (last month)			
	DM Processing	Ration DM/DM eligible profiles			
	Timeliness (FR, US)	Nb of profiles distributed within 24h (last month)			
INSTRUMENTATION	Reliability (75, 150)	Nb of platforms surviving 75 or 150 cycles vs total deployment date [t-750; t-1115] or [t-1500; t-1865]			

	Indicator	Initial	Global	Deep	Bio
IMPLEMENTATION	Activity	113	90	2	31
	Operationality	112	88	2	30
	Intensity	106	84	6	31
	Coverage (Yearly)	70	55		
	Coverage (monthly)	54	43		
DATA FLOW	Delivery		94		
	Quality (TEMP, PSAL)		93, 91		
	DM Processing		69		
	Timeliness (FR, US)		85, 84		
INSTRUMENTATION	Reliability (75, 150)		75, 48		

Very good | Good | Average | Bad

Examples of performance indicators defined for the Argo networks being implemented on JCOMMOPS website



Example of coverage performance indicators defined for dynamic networks (floats, drifters, ships).

Achieved main results:

- initial meeting done
- initial web based monitoring systems developed by JCOMMOPS and ETT, and operational
- performance indicators defined in each network (progress for objective 8)

Impacts:

- cooperation of international/European initiatives
- speed up of performance indicators definition
- cooperation and convergence on existing web based monitoring systems

WP 10 Engagement, Dissemination, and Communication

Summary

The objectives of this WP are to:

- Implement a structured dialogue with the users of marine data and information from observatories
- Encourage interested actors to consider the future of observatories and their place in the Atlantic area in order to cultivate and further develop a dynamic 'ecosystem' of actors and activities around an Integrated Atlantic Ocean Observing System
- Take a proactive role to structure the exchange between the observatory communities in Europe, the US and Canada as well as other user groups
- Disseminate the concrete results of work completed in WP1-9 as well as actively engage the potential users of data and information from observatories in both commercial and public sectors
- Implement communication activities

In this reporting period, WP10 has laid the groundwork that will allow project results to be disseminated and discussed with stakeholders.

Progress per Task

Task 10.1 AtlantOS Engagement Strategy

With the inputs provided by all partners in this task, KDM completed a comprehensive engagement, dissemination, communication strategy for AtlantOS (short: Engagement Strategy) [D10.1] containing measures to be implemented both, during and after the project. The main aim was to develop a strategy that is shared by all key partners across all relevant WPs and both in Europe and across the Atlantic.

At the launch of AtlantOS, a plan was presented to appoint an Engagement Board (ENB) comprised of various stakeholders. The aim of the ENB was to advise AtlantOS on how best to embed *in situ* ocean observations in broader economic and societal value chains facilitate advocacy for ocean observing and help with resource mobilisation. Following a broad consultation of all Work Package leaders as well as various discussions in the AtlantOS Executive Committee and WP10, it became clear that there were a number of challenges with the proposal to simply appoint a reasonable number of individuals to a standing board for a duration of 4 years. Some problems included:

- The ENB membership would be static and could not be amended to reflect the changing interests, priorities or needs of AtlantOS.
- It was difficult to agree on 11 persons reflecting all the various relations existing between AtlantOS partners and outside stakeholders.

Despite these difficulties, AtlantOS has moved ahead and is cooperating with governments, industry and other stakeholders across Work Packages. One prominent and specific example is a cooperation with the OECD and outside experts to reflect on the economic potential of data from ocean observatories. To date, the effort has been successful, with a high-level expert group meeting for a first scoping workshop on 27-28 June 2016 in Kiel Germany. (see Task 10.5.)

In addition, it is proposed that a small group of high-level experts from public and private sectors will be invited to an Engagement Meeting. Rather than being a formalized Board with a permanent membership, a series of meetings will be held focusing on specific issues of interest to AtlantOS and invited experts may vary. A first such meeting could take place toward the end of 2016. Issues of core interest to AtlantOS should be presented and discussed. In addition, this meeting could possibly take place in conjunction with a full AtlantOS/OECD high-level expert meeting on the economic potential of ocean data or an adequate opportunity in Brussels. Details will be discussed and formally decided at the AtlantOS AGM in Kiel in June 2016.

Task 10.2 Best Practices in Stakeholder Engagement, Data Dissemination and Exploitation

Seascape made considerable progress towards the writing of a first draft of the report “Best Practices in Stakeholder Engagement, Data Dissemination and Exploitation” [D10.5] due on month 18. This has entailed undertaking some preparatory desk work to understand what the stakeholder engagement process implies and how it must be developed in the life cycle of a project. As a result of this desk work, a methodology has been adopted to answer the following questions regarding the engagement process:

- Identification of the reasons for engaging with stakeholders and setting a vision for AtlantOS (WHY). This is linked to the strategy developed in Task 10.1.
- Mapping of the stakeholders, with a comprehensive categorization, and identification of their needs (WHO).
- Screening the most important ocean observatories currently in place, with a view to identify current successful stakeholder engagement tools used by observing communities (HOW).

Amongst them, special attention has been paid to data portals, since they are the main tool to provide access to the data, products and services generated by the observatory. In this sense, a data portal can be considered as one of the most powerful engaging tools, especially for users. A compilation of portals has been produced, containing more than 300 entries of marine data portals operating at several levels: global, regional and national.

Task 10.5 Exploring the Economic of Observatories

Significant progress has been made in preparing a potential study by the OECD on the economic potential of data from ocean observatories. A scoping workshop for this study will be held to coincide with the 2nd AtlantOS Annual General Meeting from 27-28 June 2016. Specific institutions involved include: OECD Directorate for Science and Technology, NOAA, the London School of Economics, and the Institute for Ocean Research Exploitation (Canada) in addition to AtlantOS.

Task 10.7. Web-based and social media communication

Blue Lobster designed and development the AtlantOS webpage in cooperation with WP11 and populated it with initial project content. The website was launched in November 2015 and is available at www.atlantos-h2020.eu. Further content is continually being added.

A) Key design elements of the website include:

- A flexible and simple to use navigation system to allow users to easily find information about the AtlantOS project.
- A top 'slider' to allow publicity and rapid access to information of specific interest to website visitors.
- Summary information about the AtlantOS project and links to further information.
- A map displaying the project partners and associate partners.
- A call-to-action to invite potential external partners to engage with the project.
- Upcoming events and latest news to keep visitors updated on the latest project developments.
- Links to the project Social Media activities.

B) Features of the website include:

- Content pages, News section, Events section
- Calendar of all events (project specific, global and other dates of interest)
- Event booking and management system
- General Contact form
- Form to invite external partners to connect
- Email distribution lists, a Social Media integration
- Secure log in areas for partners and administrators
- Project newsletter and Work Packages subscription facility
- Map displaying the locations of partner's organisations and external partner locations.
- Media section of the website to obtain common graphics / documents for the project

C) Security / Access to information

A multi-tiered security layer has been implemented to the site. Categories of users have been created to ensure that content and site access is available to the appropriate groups. The user categories are: Public User (unregistered), Registered User, Project User (A person directly funded / engaged in the project), Project Administrator (A role reserved for management by the project coordination team. Same access

as a Project User but with the ability to add extra features that should not be generally available), Administrator (Reserved for technical administration of the website).

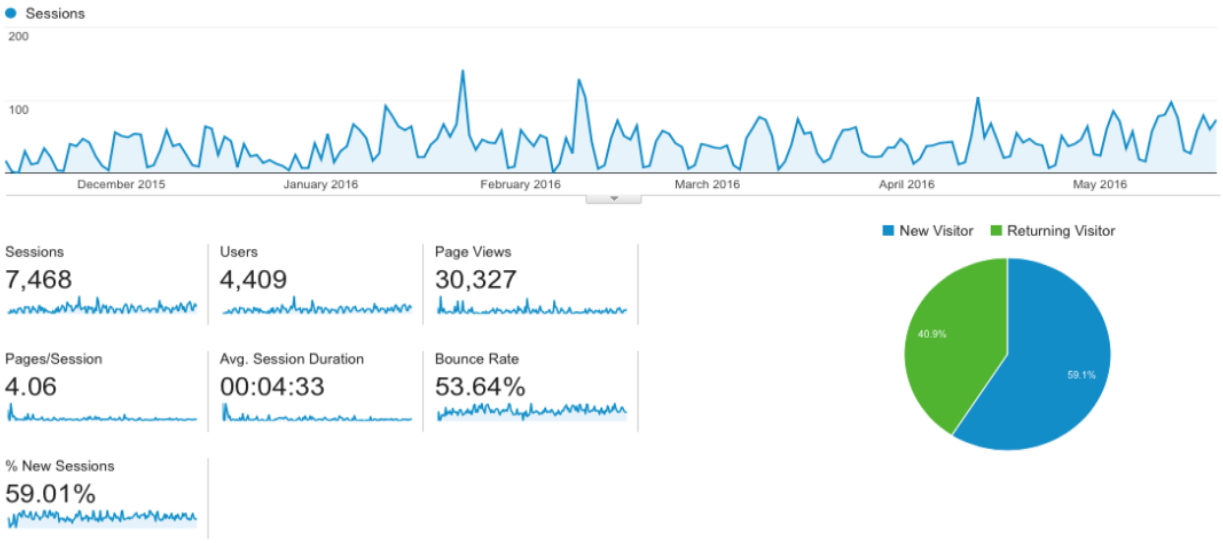
D) Social Media Integration

A dedicated project Twitter account (@AtlantOS_H2020) and a Facebook page (https://www.facebook.com/AtlantOS-H2020-1501607506834224/?fref=ts) have been created and styled in a similar fashion to the website. The Twitter account has 1,110 followers (as at 20th May 2016). Over 90% would be considered 'high-quality' in that their profiles are in some way science / industry related.

E) Website Statistics

The following statistics represent website access between 13th November 2015 – 19th May 2016.

- Average month visits: ~ 1,200
- Geographic location: from 102 countries
- Top 10 countries: UK, Russia, Germany, France, US, Spain, Belgium, Italy, Ireland, Portugal
- Device: Desktop: 93.5% Mobile / Tablet: 6.5%



Google Analytics data for the atlantos-h2020.eu website, 20th May 2016

Screen print of the atlantos-h2020.eu website homepage in December 2015.

Achieved main results

AtlantOS Engagement Strategy (Deliverable 10.1.) has been submitted.

WP 11 Management and Exploitation

Summary

WP11 provides scientific and administrative management of the project to ensure all aims of the project are efficiently and effectively met, on time and with the resources budgeted providing that knowledge and innovation are properly managed. The Project Coordination Unit (PCU) effectively reports and communicates within the project, between the partners and stakeholders and between the consortium and the European commission.

Progress per task

Task 11.1 Project management

The PCU at GEOMAR Helmholtz Centre for Ocean Research Kiel, consisting of the coordinator, its deputy, the manager and a financial assistance is managing the project using effective management procedures.

- Prior to the start of the action it was setting up the consortium agreement (CA) and had it signed by all beneficiaries. The CA regulates the consortium, rules for participation, ownership and access to key knowledge.
- The PCU provides administrative, financial, and legal support to all partners involved during the implementation of the action. Currently, AtlantOS is about to close its first amendment procedure to allow for unforeseen subcontracting to provide for the joint workshop with the OECD on the Economic Potential of Ocean Observatories prior to the GA meeting in Kiel (see WP10 report). The 2nd AtlantOS GA meeting including the OECD-AtlantOS workshop, a Biodiversity and Fisheries workshop and 10 WP and task meetings prior and post the GA has been organized for the time from 27 June to 1 July 2016.
- Internal information is so far provided via the webpage (the intranet [deliverable D11.1, in cooperation with WP10] as well as the news and calendar part of the public part), starting this summer we will implement a biannual online action newsletter.
- The PCU prepares the project periodic reports, reports for the external boards, the general AtlantOS presentation (ppt, poster, flyer etc.) and is highly involved in communication activities to promote the action and its findings. It prepared and continuously updates i) a general power point presentation, ii) poster, iii) Term of Reference (one pager), and iv) a fact sheet for AtlantOS which is available for download on the webpage, v) provides continuous news and event material for the webpage and organizes information meetings about the action at e.g. the Ocean Science Meeting 2016 in New Orleans, USA in February and the European Geoscience Union 2016 GA meeting in Vienna, Austria in April. The PCU is further more in regular contact with the AtlantOS project officer to ensure continuous information exchange.
- The external project boards, currently, only the International Scientific and Technical Advisory Board (ISTAB) (see WP10 regarding the challenges to install the Engagement Board). The ISTAB members have been invited, a short bio of each member is available on the webpage. 10 of the 12 ISTAB members accepted our invitation to participate our GA meeting in Kiel, to receive a personal briefing followed by an ISTAB meeting. Subsequent to the GA meeting they will provide the PCU with their written scientific advice. Prior to the GA the external boards receive a *summary progress report* (deliverable D11.5).
- The PCU further provides for regular meetings of the Executive Board (EB) and the Steering Committee (SC) (see chapter on science management and governance). Both internal boards have regular meetings at least at each GA meeting, additional the EB had a web conference meeting in November 2015 prior to the AGU Fall Meeting 2015 in San Francisco. During AGU Fall

Meeting 2015 there was furthermore an informal face-to-face meeting of some work package leaders to discuss prevailing issues. During OSM 2016, in February, a SC meeting was organized to discuss prevailing issues regarding science strategy and project progress. Since the beginning of the action the PCU keeps an action item list that is continuously evaluated, updated and assessed during each EB and SC meeting to keep the boards involved in controlling the progress of the action. Regular telephone meetings between the project managers of AtlantOS and the Atlantic Ocean Research Alliance Cooperation and Support Action (AORAC-SA) are conducted as well as face-to-face meeting of the coordinators where ever possible (i.e. during OSM 2016) to foster cooperation and target-oriented joint actions like e.g. the Coordination of South Atlantic Activities during the AtlantOS GA in June.

- Support to scientific communication has been provided by the organization of the Town Hall meeting *Implementing Basin Scale In-Situ Ocean Observing Systems* during the OSM 2016 in New Orleans to evaluate and foster global exchange regarding integrated ocean observation. Moreover, a session on *Improved maritime knowledge for Blue Growth and ocean governance* has been organised and conducted in cooperation with the European Commission Joint Research Centre at the European Maritime Day 2016 in Turku, Finnland. AtlantOS further contributed to the GEO European Project Workshop (GEPW-10) in May/June 2016 in Berlin, Germany with a session focussed on the different steps that have to be taken to allow for a better integration of global ocean observing activities into the GEOSS framework and the optimisation of ocean monitoring and data sharing capabilities.

Task 11.2 Knowledge and innovation management

Management of knowledge and innovation in AtlantOS is of high relevance. The focus here is on the role and synergies between beneficiaries expertise, competence, capabilities, and how partners will protect and share, manage IPR and actual exploitation. The exploitation plan (EP) is drafted and still going through several iteration rounds but will be submitted as deliverable D11.3 by the end of June. However, it will continuously be updated before the end of each reporting period.

In cooperation with WP7 the Data Management Plan (DMP; deliverable D11.2) has been developed in compliance with the guidelines given on data management in Horizon 2020. The DMP will such as the EP evolve during the lifetime of the project and represent the status of the actions reflection on data management.

Achieved main results

- Adoption for the AtlantOS consortium agreement
- Successful implementation of the AtlantOS kick-off meeting
- AtlantOS information meetings during OSM 2016 and EGU 2016
- Implementation of the ISTAB
- Continuous communication and cooperation with AORAC-SA including planning of joint actions
- Accomplishment of the Town Hall meeting on *Implementing Basin Scale In-Situ Ocean Observing Systems* during OSM 2016 and the workshop *Improved maritime knowledge for Blue Growth and ocean governance* during EMD 2016.
- Development of the Exploitation Plan

4. Science management and governance

The AtlantOS governance structure is designed to allow fast flow of information between the partners, the stakeholders and the European Commission. It has four different levels i) daily project management, ii) executive, iii) decision making, and, iv) advisory level with specific roles.

Daily project management: The Project Coordination Unit (CPU) at GEOMAR will be in charge of the management of the project. The team includes the **coordinator** (Prof. Martin Visbeck), his **deputy** (Johannes Karstensen), the **project manager** (Anja Reitz) and a **financial assistant** (Anja Wenzel). The work package leaders and co-leaders are in charge of the scientific management of the work on work package level. Each work package has several tasks which are led by the task leaders, they are in charge of the progress of the task and if required interaction with related task leaders / work package leaders.

Executive level: The **Executive Board** (EB) is the supervisory body of the execution of the project. It reports to and proposes decisions to the General Assembly and is responsible for their execution. The board comprised of the coordinator and five members of the Steering Committee: Kate Larkin, Sabrina Speich, Matthew Mowlem, Albert Fischer, Pierre Yves Le Traon.

The coordinator Martin Visbeck and his deputy Johannes Karstensen have the responsibility of the overall scientific coordination of the project and function together with the manager Anja Reitz as liaise with the European Commission on behalf of the consortium.

Decision making level: The **General Assembly** (GA) is the ultimate decision-making body of the consortium. It is responsible for taking key decisions for the project as a whole based on proposals of the EB. It is comprised of one representative of each project partner and is chaired by the coordinator.

Advisory level: AtlantOS has internal and external advisory boards. The internal boards are comprised of members of the consortium and the external boards are comprised of external experts and members of the stakeholder communities. They directly advise the EB and indirectly the GA on their specific matters of competence.

The (internal) **Steering Committee** (SC) is comprised of all work package and co-leaders and chaired by the coordinator. It makes propositions for the proper implementation of the project to the EB. The (internal/external) **Gender and Diversity Committee** (GDC) raises gender and diversity awareness within the consortium. It will develop a Gender and Diversity Action Plan and gives advice to the EB on its implementation. The board comprised of Nadia Pinardi, Albert Fischer, Sandy Thomala, Janice Trotte. The (external) **International Scientific and Technical Advisory Board** (ISTAB) will evaluate and advise on the project's scientific approach and orientation. It will further ensure that the project is properly linked to other programmes. The board is comprised of selected key international experts with a scientific high-profile. The (external) future Engagement Board (ENB) will engage industry, government and other relevant stakeholders at a high, strategic level advising on future actions to be implemented by the observatories community. The role of the board is to support the project in gaining new ideas on how to efficiently engage with stakeholders, attract more users, identify ways to improve usage of data and information from society to science and vice versa, and advise on innovation management issues.

5. Publications

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First Report of the International Scientific and Technical Advisory Board (ISATB) to AtlantOS

The International Scientific and Technical Advisory Board of AtlantOS met for the first time at the 2nd Annual Meeting of AtlantOS held on 29-30 June 2016 in Kiel, Germany. The ISTAB met in the morning of 28 June (10:30 – 12:00) with the Executive Board of AtlantOS and then met on its own in the afternoon following lunch. The following members of ISTAB attended the meetings in Kiel:

1. Moacyr Araujo- Brazil
2. Molly O. Baringer - USA
3. Angelika Brandt - Germany
4. Maria Paz Chidichimo - Argentina
5. Peter Croot - Ireland
6. Brad deYoung - Canada
7. Alexandra Giorgetti - Italy
8. Eric Lindstrom – USA
9. Murray Roberts – United Kingdom
10. Oscar Schofield - USA

Two members of the ISTAB – Isabelle Ansorge (South Africa) and Suzanne M. Carbotte (USA) – were unable to attend the meeting.

At the morning meeting with the Executive Board, the ISTAB was provided with an overview of AtlantOS. In advance of the meeting we were also given the annual summary reports from each Work Package (WP) of AtlantOS. In the afternoon, the ISTAB discussed general impressions and considered how it would best add value to AtlantOS. While it was agreed that specific advice, for example comments on the detailed operations within a work package, would be useful, it was agreed that offering strategic advice on the direction and activities of AtlantOS would be the approach that would offer the greatest value to the program. Our discussion, in advance of the AtlantOS meeting, led to a focus on two issues of concern:

- The Work Packages could be better integrated and could be working together more effectively than they appear to be at present. One possible integrating strategy would be to develop activities that cut across the WPs. For example, there could be an activity directed towards integrating the measurement programs on the Meridional Overturning Circulation (OSNAP, RAPID and SAMOC) that would cut across many of the present WPs.
- The goal of developing an AtlantOS Blueprint for Atlantic Observing, a grand vision for integrating the Atlantic communities, is a bold and appropriate initiative for AtlantOS. The development of this Blueprint will require bringing together many different communities – north and south, east and west,

governmental, academic and private sector. It would be best to start with an open invitation to the community rather than to begin with a too prescriptive model. It would therefore be best to begin by carefully considering the process necessary to bring the communities together with AtlantOS, and others, playing the role of stimulating the process rather than taking sole ownership of it.

At the close of the Tuesday afternoon discussion, the ISTAB decided to work with two co-chairs – Brad deYoung and Eric Lindstrom – who agreed to lead the ISTAB. Afterwards, B. deYoung and E. Lindstrom met with the Executive Board to let them know the outcome of the meeting, the structure of the ISTAB and to provide informal commentary on the two issues raised above. It was considered important to offer such advice in advance of the meeting, to give the AtlantOS team an opportunity to adjust their meeting plans based upon this early advice. It was noted by the ISTAB that the AtlantOS meeting did change in response to our raising of the two issues note above. There was additional commentary on interactions between the Work Packages apparent in the presentations and the approach to the discussion and presentation of the Blueprint plan was made much more open and less prescriptive.

On the Thursday afternoon, the ISTAB met after lunch to discuss its impressions and to consider advice that it could offer to the AtlantOS team. We began with our positive impressions. We enjoyed the meeting and felt that it was well organized. We were impressed with the range and breadth of activities presented. While we did note some gaps and issues, we recognize that this is just the end of the first year of a very large and diverse program. Given that AtlantOS is in the early stages, we felt that it was important to provide critical advice and suggestions to assist this developing program. We talked through various issues and again agreed that the focus of our recommendations would be on strategic advice. We make the following recommendations:

1. The AtlantOS project aims to integrate and optimize the most important components of Atlantic Ocean Observing Systems (OOS). The difficulty lies in the large number of existing initiatives at different levels of maturity and scope, from regional to national and international. Although the participating institutions are more well-known to the scientific community, the AtlantOS partners can be easily confused within the large family of program acronyms, making it difficult to identify specific links and the particular project contributions. It could be helpful if AtlantOS could clarify its own contributions to the development of OOS relative to all the other players. The ISTAB **recommends** the development of a summary roadmap allowing those interested to quickly and easily identify: (a) the links between the different participants and OOS considered under AtlantOS; (b) the different modes of AtlantOS' contributions to the development and integration of OOS in the Atlantic ocean.

2. The ISTAB appreciated that presentations paid more attention to links with other WPs than was apparent in the annual reports but still felt that there could be greater connectivity between the Work Packages. The greatest potential for AtlantOS lies in the integrated program and while it is important that each Work Package is successful the greater success of the overall program requires that the WPs work together more substantially than at present. While encouraging joint action is helpful, the ISTAB strongly **recommends** that consideration be given to specific activities or actions that will bring the Work Packages together around one or more areas of common focus.

3. We noted that there is some North-South activity in WP5, but in general there seems insufficient participation from South Atlantic countries in the other WPs. North-South participation and engagement needs enhancement. There is an enormous appetite from nations in the South Atlantic to participate, an enthusiasm that was expressed several times at the meeting. The ISTAB **recommends** that AtlantOS should seek more opportunities to encourage South Atlantic engagement. There are many different issues that could be considered in encouraging North-South activity including for example capacity building, and program coordination.

4. As large as AtlantOS is as a program, there are of course gaps that cannot be covered directly within the program. The ISTAB recognizes that such gaps are inevitable but perhaps they can be opportunities to form partnerships with other teams working in these areas. The particular gaps that we have identified as opportunities for collaboration are:

    a. The gap around benthic activity in AtlantOS could be filled by alignment with two funded programs of Horizon 2020 – ATLAS and SponGES. ATLAS is a trans-Atlantic project that focuses on deep-water Atlantic ecosystems (including cold-water corals, sponge grounds, seamounts and vents). It adopts new ways of working spanning natural through to social science with the needs of marine industries and policy makers at the heart of its objectives. As an example, WP1 of ATLAS is grounded in the physical oceanography of the AMOC and provides underpinning data on the overturning circulation to allow ATLAS to examine the implications of altered AMOC strength on deep Atlantic ecosystem connectivity and function. The objective of SponGES is to develop an integrated ecosystem-based approach to preserve and sustainably use vulnerable sponge ecosystems of the North Atlantic. The SponGES consortium, an international and interdisciplinary collaboration of research institutions, environmental non-governmental and

intergovernmental organizations, will focus on one of the most diverse, ecologically and biologically important and vulnerable marine ecosystems of the deep-sea - sponge grounds - that to date have received very little research and conservation attention The ISTAB **recommends** that AtlantOS reach out to ATLAS and SponGES to seek opportunities for collaborative activities.

b. Marine Spatial Planning - The ISTAB **recommends** that AtlantOS establish links with experts in Marine Spatial Planning (MSP) with regard to how outputs from AtlantOS could inform the relevant stakeholders with regard to MSP in the Atlantic (e.g. contact ATLAS and NUI in Galway). In particular WP4, WP5 and WP8 would benefit from identifying how the outputs of their work can feed into MSP activities of the EU (i.e. MSFD) and all countries along the Atlantic rim. Another opportunity for AtlantOS lies in the development of Marine Protected Areas (MPAs) in particular with a focus on the idea of a network of MPAs a topic well suited to AtlantOS' large-scale view.

c. Ocean acidification is being addressed in many different communities and could become a central issue in the marine environment in the coming decades. The ISTAB **recommends** that AtlantOS reach out to the wider ocean acidification observation community by establishing direct contact between the project and the Global Ocean Acidification Observation Network (GOA-ON) co-chaired by Libby Jewett (NOAA) and Bronte Tilbrook (CSIRO). This could be facilitated through existing collaborations between AtlantOS partners and GOA-ON.

5. The issue of engagement is central to the success and long term legacy of AtlantOS. In this respect, the ISTAB noted the efforts AtlantOS was making to establish an engagement board and recognised the issues that had been raised with regards to its composition and function. It is clear, however, that as engagement is an issue for everyone connected to AtlantOS it should be conducted at all levels across the AtlantOS network. The ISTAB **recommends** that engagement between individual WPs and stakeholders should be encouraged and recorded (e.g. AtlantOS Information day for the Maritime industry, stands at trade expos/conferences, expedition blogs, Citizen Science activities). The proposed links to the H2020 projects involving Ocean Literacy are seen as extremely beneficial in regard to connecting to the general public.

6. Work Package 6, on Crosscutting Issues and Emerging Networks, is focused on identifying key capability gaps, opportunities for improved efficiency, and cost reduction for current observing system technologies. To date the group has created a snapshot for sensor and instrumentation development with

input from companies, research organizations and operational groups across the EU and internationally. This is a good first step and the group is now in a position to identify the focus, given the range and rate of change in the technologies, for the coming years. The ISTAB was interested in understanding the next priorities and the potential engagement strategies within and external to the AtlantOS program. The ISTAB **recommends** that the WP work to define and clarify the desired legacy of this effort at the end of the AtlantOS program. Identifying this will allow them to focus efforts on the key high value technical opportunities.

7. In reviewing WP7, on Data Flow and Data Integration, ISTAB members were struck by the generic character of the plan to date for data and integration. The plan as presented provides an excellent roadmap for managing data however it seems too generic as it could apply to any major project. The ISTAB **recommends that** specific realistic priorities, actions, and outcomes be developed for AtlantOS as they would be of great interest and should be the next step.

8. The precise target of WP8, on Societal Benefits from Observing/Information Systems, was not very clear. It is not the role of AtlantOS to provide services. Papers are being prepared on "concept" services. Such visionary activity is valuable. However, the ISTAB **suggests that** the most valuable activity for the WP might be "reverse engineering" popular existing services to clearly identify the role of Atlantic observations in those services (and identification of observing gaps that handicap those services).

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