



Briefing Paper

June 2017

Ocean Observing for Society – AtlantOS products and services

Message from the Editors

Sandra Ketelhake (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)

Jan-Stefan Fritz (German Marine Research Consortium)

The second AtlantOS briefing paper focuses on the societal benefits of ocean observing. The objectives guiding AtlantOS are spelled-out in the Essential Ocean Variables, which describe that information we need about the oceans to address most societal benefits. In order remain manageable in the project, specific societal benefit areas have been focused on as case studies. Overall, our aim is to link these cases so as to enhance and optimise the system overall, thus establishing a more fit-for-purpose system, which delivers key information and decision support tools for a variety of marine actors including for economic sectors. This paper presents examples of work being done in AtlantOS to link ocean observations with specific user needs and societal benefits. Figure 1 illustrates how AtlantOS supports the value chain in general. The vision of how AtlantOS will

serve key societal benefit areas is explained by Nadia Pinardi and Caroline Cusack. Kevin Horsburgh introduces a comprehensive world map being developed to increase safety along Atlantic Ocean coasts. Why a new paradigm for ship routing development represents a societal benefit is shown

by Gianandrea Mannarini. Finally, Patrick Lehodey presents the development of an operational forecast system for the Atlantic albacore tuna.

We hope you enjoy this second briefing paper. For questions to this paper or suggestions for future topics, please contact us at: atlantos@geomar.de

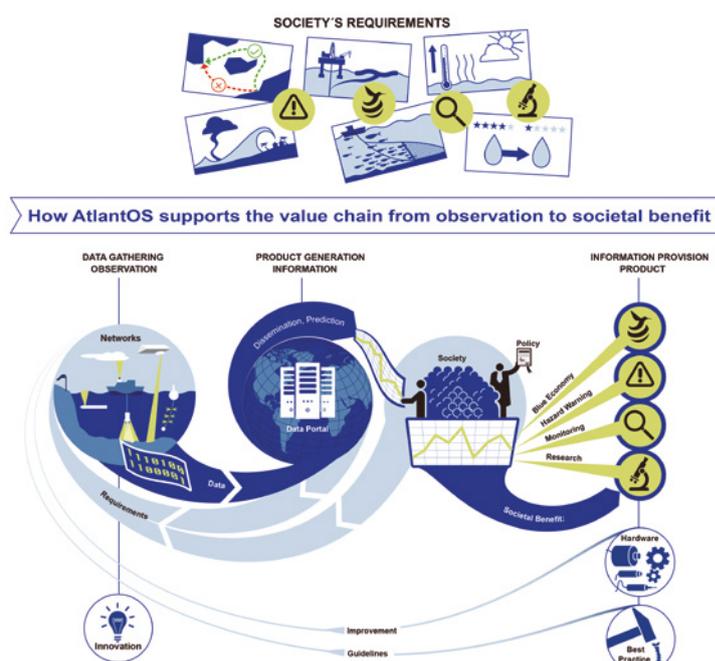


Figure 1: AtlantOS Value Chain, Credit: Martin Künsting

Achieving of societal benefits by using ocean observation, modelling and information

Nadia Pinardi (University of Bologna, Italy)

Caroline Cusack (Marine Institute, Ireland)

AtlantOS has the ambition of delivering a suite of end-user products/services targeted at marine issues of societal concern for Atlantic maritime nations. These products/services will enhance the safety of coastal communities and promote economic development in key emerging marine and maritime sectors through better decision support tools and integrated products/services, using ocean observations, modelling and information on human related activities. At the more political level, AtlantOS products/services will contribute substantially to the GEO Blue Planet initiative and the UN

Sustainable Development Goals 13 “Climate Action” and 14 “Life below water”. The main products/services developed by AtlantOS cover the following themes: disaster risk reduction (coastal flooding risk mapping, maritime transport efficient ship routing, harmful algal blooms, oil spill hazard mapping), resource assessment (offshore aquaculture, fisheries) and finally climate descriptors for environmental reporting. AtlantOS product/service prototypes, have a high level of technological readiness and use existing observational and modelling platforms such as the Copernicus Marine

Environment Monitoring Service (CMEMS) and the European Marine Observation and Data Network (EMODnet) data assembly portals. Integration of marine data from combined sources for end-user products has been a challenge within the marine and maritime communities for several decades. AtlantOS pilot products/services are tangible outputs from the integration of Earth observation, in-situ data systems and model analyses, reanalysis and forecasts to create useful products of value to blue growth priority areas.

Increasing Atlantic Ocean coastal safety – Developing a comprehensive world map of storm surges

Kevin Horsburgh (National Oceanographic Centre, UK)

Coastal flooding represents one of the major challenges of global climate change for humanity. Storm surges and oceanic waves are the major cause of extreme sea levels, causing devastating coastal impacts around the world. Storm surges caused by mid-Atlantic weather systems can increase sea levels by 4 m and hurricane surges can be as high as 10 m. In the US in 2012, Hurricane

Sandy caused 106 deaths and damages exceeding \$60 Billion. Within the AtlantOS project we are improving methods for estimating extreme sea levels around the Atlantic and more widely. We will develop a comprehensive world picture of storm surge distribution for both tropical and extra-tropical cyclones. We have already published new understanding about how storm surges and

high tides interact, providing proof that any storm surge can occur on any tide. This is a big step forward for estimating the statistics for extreme water levels. Our work also provides the systematic best practice to identifying storm surges from a tide gauge record – and long-term high-quality sea level observations are a vital part of any coastal observing system.

We are now using a global tide-surge computer model to apply our storm surge analysis technique to global model results, and then combine with the tide gauge data. The

final product will be a map of storm surge climate that will enhance the safety of coastal communities, in the Atlantic and worldwide, by providing the information needed for

cost-effective coastal defences and emergency response to severe coastal flooding.

Towards a new paradigm for ship routing

Gianandrea Mannarini (Euro-Mediterranean Center on Climate Change, Italy)

Contemporary maritime shipping is shaped by the increasing demand for global transport of goods, the scientific awareness of the environmental impact of human activities, and the enhanced predictive capacity of the geophysical system, based on networking of the observational assets as well as on their combination into high-resolution operational systems. These three factors influence the degree of control that we have in economic efficiency, environmental impact reduction and human safety in the search for always-fitter maritime routes. To address this challenge and to achieve the related opportunities, AtlantOS seeks to deliver some of the observational data required for carrying out reanalysis models that produce multi-dimensional wave and current fields. These will in turn be used as an input for an algorithm to extract cost-efficient ship routes in the Atlantic. In order to compute safer routes, the AtlantOS routing will consider both static (such as shoals) and dynamic (such as parametric roll on container ships) safety constraints. A five-element modelling paradigm will be followed in the implementation of this ship routing model (cf. figure 2):

- 1. Open-science:** Open-data

policies, open-source software licensing and open-review publications are needed for enabling high-quality knowledge-based research products. [VISIR](#), on which the AtlantOS ship routing will be based, is a general public licensed open-source model.

- 2. User-centric perspective:** As part of the open innovation paradigm, living-lab approaches and stakeholders' involvements are increasingly employed tools for shaping both definition and development of research activities in early design stages.
- 3. Sounder validation:** As research products become openly accessible tools built around the end-user, a deeper validation will be required, making a more intense use of analytical benchmarks, method inter-comparisons, and verification with field experiments.
- 4. Interoperability:** Following the work done for geospatial data, a [standard route-exchange format](#) has been recently published and will also facilitate inter-comparison studies.
- 5. Model-service decoupling:** Distributed knowledge from open-science and

modular approach from interoperability will break the "all-in-house" chain from model development to service provision. Ship routing models deriving from open research will provide a valuable platform for commercial enterprises aiming to deliver specific applications.

Following this paradigm, the AtlantOS task on ship routing will help to achieve a maritime transport system that is resource-efficient, more climate and environmental friendly and, most importantly, safer for humans.

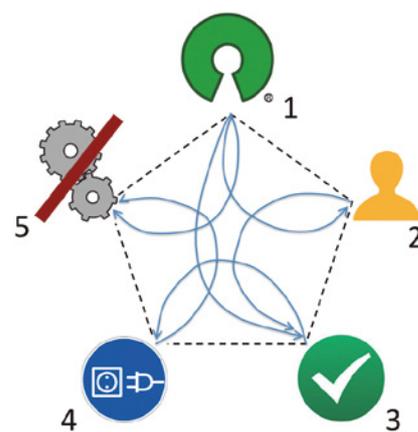


Figure 2: The five-element paradigm of modern ship routing. The arrows show the relationships among paradigm elements

SEAPODYM – Developing an operational forecast system for Atlantic albacore tuna

Patrick Lehodey (Collecte Localisation Satellites SA, France)

Fisheries regulations need to rely on the best available scientific advice to ensure that fish stock exploitation levels remain sustainable over the long term. Fish population dynamics models are essential tools used to estimate fishing impact and provide key indicators of exploitation, for example the Maximum Sustainable Yield (MSY). Research is progressing to provide a new generation of models including data about both fisheries and the impact of environmental variability with explicit detailed spatial representation. This is made possible with the continuous progress on monitoring key oceanic variables with both in situ and satellite data, that are then assimilated in numerical models describing realistically the physical and biogeochemical states of the ocean. One demonstration is proposed in AtlantOS with the application of the SEAPODYM model to the case of Atlantic albacore tuna population and fisheries. SEAPODYM (Spatial Ecosystem And Population Dynamics Model) simulates the change in abundance over

time and space of a target fish species by age class from larvae to oldest adults and can distinguish between fishing impact and natural variability (environment and climate). The different fisheries are described according to their characteristics (fishing gear, strategy, size selectivity, etc...) and their catch included to measure the fishing impact. The operational system should help to improve real-time monitoring of fishing activity and stock assessment analyses. It can assist in designing

research sampling and collect of fishing statistics, and in fighting against illegal, unregulated and unreported (IUU) fishing activity by pointing on potential critical areas to control. It will help also to better understand changes in catch rates due to environmental variability. Finally, the system can be used in a hindcast mode to simulate and analyse the impact of various management scenarios including spatio-temporal measures (e.g., Marine Protected space and no-fishing zones).

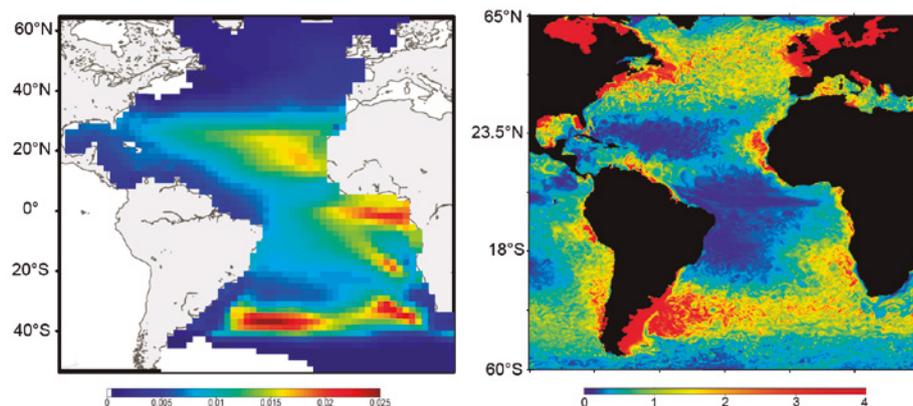


Figure 3 – The AtlantOS SEAPODYM operational forecast system for the Atlantic albacore tuna is calibrated on a $1^\circ \times$ month grid over historical period 1980-2010 (left: adult albacore distribution in May) and is downscaled to the operational configuration at higher ($1/4^\circ \times$ week) resolution (right: surface micronekton biomass on week 22-29 Mar 2017), using Mercator-Ocean physical fields (temperature and current) and primary production derived from satellite ocean colour data.

The H2020 EU project AtlantOS pools the effort of 57 European and 5 non-European partners from 18 countries to collaborate on optimising and enhancing Atlantic Ocean observing. The project has a budget of € 21 Million for 4 years (April 2015 – June 2019) and is coordinated by GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany (Prof. Martin Visbeck).

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