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Blueprint for an Integrated Atlantic Ocean Observing System

The oceans play vital planetary roles in the global climate system and biosphere, providing crucial resources for humanity including water, food, energy and raw materials. The ocean is the seventh largest economy in the world, with goods and services from coastal and marine environments amounting to US $2.5 trillion each year. Our growing use of the oceans poses challenges for environmental management and for our social and economic dependence on ocean resources. To conserve and protect our oceans, especially in the context of climate change, it is crucial to track and understand large-scale interactions within and among ocean regions as well as the resulting impacts on land. Improved observation of our oceans is necessary for informed decision-making directed towards ensuring sustainable ocean practices. There is a compelling need to develop a sustainable, internationally-coordinated and comprehensive ocean observing system to assess current trends and predict future scenarios to support ocean management.

To improve our stewardship of the ocean, and prepare for, or avoid future hazards, we need better Ocean observations and understanding. Until now, observation has been conducted through loosely-aligned arrangements of national and international efforts. We lack coordination, bringing together the data from many sources: buoys measuring wind and waves, ships surveying fish stocks, and satellites providing the view from above. We waste time, money, and energy by not working together. We need to integrate data sustainably and efficiently. Observations should not be used only by a single person or group. Instead, we should share them widely to obtain the greatest value.

These problems are not new. We have a Framework for Ocean Observing, a guide to help us decide what to measure, but it lacks practical application. We have some idea of what we should do but struggle with how to do it. We need an improved system to gain the crucial knowledge necessary to respond to significant ocean changes that are coming. For example, protecting coastal communities from storm surges by measuring tides and wave patterns. The **Blueprint for an integrated Atlantic Ocean Observing System** should go beyond the state-of–the-art and provides a vision for Atlantic Ocean observing in the next decade. It should integrate existing ocean observing activities into a sustainable, efficient, and fit-for-purpose system. The observing system should be ambitious, multi-national, multi-sectoral and purposeful but not prescriptive. It must include capacity development and emphasize the role of resource mobilization for observations of the entire Atlantic Ocean. The system should support and enhance new partnerships between science, service, private sector and civil society.

Internationally, ocean observation has primarily been coordinated through the Global Ocean Observing System (GOOS) cosponsored by IOC-UNESCO, ICSU and WMO. GOOS is also a contribution to the Blue Planet initiative of GEO and benefits from and is supported by numerous other national and international programs and projects. GOOS and its partners are working to develop and implement effective ocean observing capacities and trying to manage and if possible minimize the complexity of the current systems. In 1999 and 2009 the global ocean observing community came together to share and articulate its global and integrated ambition for ocean observing. The next OceanObs Meeting is planned for fall 2019 in Hawaii.

The Blueprint Team will develop simultaneously two documents that should live on their own but should also refer to each other:

1. A vision document (~ 40 pages) covering the broad case for why the community should work towards and invest in ocean observing. It defines the principles of the system, how partners could contribute and present the benefits that will be derived from an effective ocean observing system
2. A longer, more detailed implementation document (~ 60 – 80 pages), pointing to the operational challenges and approaches and offers guidance as how to implement the ocean observing system and the roles of different partners. In looking forward to the 2030 ocean observing system, there should be some clarity as to the scale and characteristics of the system and the modes of governance and collaboration.

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A rough timeline for the work is:

- **End of February 2018**: First version of the BluePrint vision document
- By the **15th of March 2018** the BluePrint Team will submit two abstracts for the Ocean Obs'19 meeting
- By **mid-May 2018**: First version of the BluePrint implementation document
- **Summer or autumn of 2018**: Release of first public draft of both documents for comments and feedback

Vision document

I. Vision – why, what do we have and where do we want to be in 2030

- Definition of term 'ocean observing system'
- Identifying and define target groups, define the intend, scope and area which is covered, describe the value chain, links to SDGs
- Identifying North and South Atlantic as target region
- Blue Economy / Public good / Societal Benefit Areas
- Opportunities of private sector partnerships
- Value of observing system (references needed)
- Hint towards ocean observing system governance

II. Meeting user needs

- Product development driven by user needs/requirements - distinguish between products for climate, operational services and ocean ecosystem functioning and ocean health
- Co-development of products with users - regular product iterations allowing for progressive end user engagement and product development rather than traditional top down approach
- Product value chain analysis to map path from observations to intermediate products and final services/products and determination of impact

- Infrastructures required for product development - identification of infrastructure/capacity gaps and barriers
- Integration of data flows into product development - related to end user and stakeholder engagement and also interaction with other observing systems
- Capacity building/knowledge exchange required for product development - examples from other fields e.g. climate services development
- Identification of delivery pathways and how reliability and sustainability can be addressed - regional information systems, support for developing nations

III. Assessing observing requirements to meet user needs

- Definition of EOVs and system design
- Show advantage of Framework for Ocean Observing

IV. Description of the current observing network of ocean observing

- Definition of term 'ocean observing network'
- Connect coastal with open ocean
- Platforms and Essential Ocean Variables link

V. Data flow and information integration

- Atlantic Data system as a "Data System of Data Systems"
  - Data work flows and management including interoperability requirements and tools to enhance and ensure data flow and sharing
  - Data access and sharing – ensure open and supported access (FAIR principles)
  - Include archival, storage
  - Potential of emerging IT technologies (Big Data ...) (The green Arrow in the WP7 figure)
- Reasons for data standardization and integration
- Importance of coordination among groups in the North and South Atlantic
- Need for application of common, standardized data sets
- How does ocean modeling, analysis and prediction complement observational and data management activities of an ocean observing system?
- Include the topics integration, synthesis and analysis
- Basin scale modeling and coastal modeling
- Capacity building to develop modeling capabilities where they are currently under-developed
- Model validation linked to research to improve models, understanding of data, and system design and operation

VI. Innovation and Capacity Building

- Define role for and benefits from innovation and capacity building
- Innovation includes technology development, operational deployment, information sharing and governance
- All aspects of the observational systems require and benefit from innovation
- Identify challenges requiring innovation and look towards opportunities
- Make the timeliness argument – we have the capability both in technology and management structures

- Make links to the Blue Economy both for the active involvement (e.g. technology development) and also the beneficial impact of an effective observing system (e.g. transportation, fisheries, offshore development, coastal recreational use)
- Consider more than just hardware
- Information issues new approaches to getting data e.g. citizen science and communication
- Some review readiness of existing technology - Technology/Data Collection/Information
- Sensor Innovation – note recent developments, flexibility of use
- Platform Innovation (endurance, data access – in particular near-real time)
- Data processing innovation; Data analysis and synthesis
- Information delivery, communications enhancements, enhanced remote access – apps and such
- Governance structures and new cooperative arrangements
- Use of citizen science for data collection

VII. Governance and Partnerships

- How could you even create governance (different levels: global, regional/national, basin-scale)
- Explain need and benefit of governance (e.g. secretariat)
- Describe as well EEZ issue and that partnerships are important with regard to the EEZ and observing activities
- Partnerships: Refer to Galway and Belem Accord as well as AORA group but this chapter should not state technical partnerships
- National, international, institutional and private sector (oil and gas, shipping, fisheries …)
- Opportunities for growth and expansion
- Next generation personnel
- Opportunities for citizen science

VIII. Opportunities looking forward to sustainability observing in 2030

- How is it going forward? How can the funding look like?
- Along the value chain relevant actors will need to be motivated to participate on a voluntary basis
- Recommendations review the adequacy of networks and readiness level and actions would be explained in implementation plan
- Principles with regard to ocean observation and focus on sustainability
- Link to implementation plan

Implementation Plan Document

I. Overview and Introduction

- Motivation and explanation how to use the guide

II. Defining EOVs and System Design – Best Practices

- Phenomena discussion
- Regional, national and international requirements for ocean information
- Requires transparency of analysis, design and implementation

III. Best Practices for Network Implementation

- Describe and define roles of networks and links to users
- Look at global networks (coastal and ocean) and show Atlantic cooperation / capabilities within the global context (e.g. GO-Ship, Argo, Ocean Sites …)
- List of networks with link to readiness level (pilot network, network, emerging network) – would be helpful for funders
- Status, gaps, challenges, coordination: Strengths, weaknesses, main EOVs measured, opportunities and threats of each network/observing platform
- Articulate different responsibilities of networks as well as their different readiness levels
- Working from existing networks and taking a look at emerging networks
- Should be about structure (ships, vehicles, …)
- Recommendations should lead to proper networks
- Continuous monitoring of observing array (incl. risk analysis) JCOMM Ops or JCOMM OCG Report Card (+other metrics if available)

IV. Best Practices for Data Infrastructure

- See what is there and identify gaps; solution for gaps
- IOC standards
- Data information
- Role for private actors
- Develop/Maintain standards and best practices recommendations and ensure best practice procedures are known and followed
- Smart sensors potential
- Data quality management – quality analysis (QA) and quality control (QC)
- International coordination and data system authority
- Use of models to interpret data to create added value, produce new information
- Utility of data assimilation for hindcasts, nowcasts and forecasts
- Integration of different data types (e.g. biological with physical or biogeochemical)
- Integration of similar data types collected using different methodologies
- Data assimilation from different Atlantic observing systems
- Linking different model prediction systems (atmosphere, wave models, biological, physical, etc.)
- Use of both downscaling and upscaling techniques to improve models at local and basin scale

V. Best Practices for Capacity Building

- Capacity Building at basin-scale level but pointing out that the mechanisms could be different
- Coordination approach, show the many flavors of capacity building: technical, communication, training, …
- Capacity Building should not be seen as just a geographical issue
- Highlights in a box: what we want (set of best practices)

VI. Best Practices for Governance

- What aspects of governance are needed? What would it look like when we start from scratch? What needs to be mobilized and integrated? How do we do that?
- Different levels of governance, different scales which need a best practice guide

a) Global coordination: defining of EOVs, network characteristics, data issues – could be happen at GOOS level
b) Regional/national level: funding and implementation of ocean observation at local level
c) Basin-scale: focus lay here since the system is not clear so far.

- We need an assessment of what we have (review process) and what we want to have / what we need (gap analysis and evaluation)
- Look to the existing regional alliances and review strengths and weaknesses
- Demonstrate the different possibilities of partnerships / connect different communities to encourage working together
- Define opportunities for synergy, new partnerships, new user groups
- How much resources are needed?
- Group of states have functionality (need a legal status) – coordinating body like a secretariat would be useful

VII. Looking forward to 2030 / Conclusion and Outlook

- Refer to vision document
- Good info graphic is needed – produce a map of growth
- Show what could be done under moderate high funding – show products that would be developed
- Need feel-good-graphics (time series could be shown)
- Address the issue of capital vs. operational expenditures so that technology be both acquired and operated over the longer-term
- Institutional framework needs to include the myriad observation stations and technologies as well as offer a clear conceptual, institutional and programmatic framework
- Ensure an adequate economic assessment of the value-added of investing in ocean observing for funding and participating bodies in the Atlantic Ocean observing system
- Strengthen human capacities through scientific education and technical training in all matters related to the development, implementation, operation and use of different technologies, platforms and information systems
- Support funding bodies in their decision-making processes
- Secure sustainable funding for ocean observing in the Atlantic Ocean
- Plan of action to encourage voluntary contributions
- Maintain a list of ongoing and planned observation initiatives to provide both funders and the observation community an overview of all activities (help from JCOMMOPS)