ALL-ATLANTIC OCEAN RESEARCH ALLIANCE

Creating an Atlantic Ocean Community by Implementing the Galway and Belém Statements

AA-DATA2030 Report:

All-Atlantic DATA & POLICY Forum

BUILDING AN ALL ATLANTIC OCEAN COMMUNITY
Implementing the Belém Statement

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ALL-ATLANTIC JOINT PILOT ACTIONS

Following a year-long collaborative process among more than 70 stakeholders at the Atlantic level, the All-Atlantic Ocean Research Alliance Multi-Stakeholder Platform, divided into 5 sub-multi-stakeholders platforms, identified more than 1000 initiatives towards strengthening marine research and innovation collaboration at the Atlantic level, 56 gaps and 79 needs/recommendations to achieve the All-Atlantic Ocean Research Alliance ambition, guided by a total of 20 Strategic Objectives, 20 Operational Objectives, and 10 Key Performance Indicators.

Based on these findings and on the idea of collaboration, alignment, and use of existing resources, they have developed six ambitious and long-term collaborative Joint Pilot Actions:

- **All-Atlantic Training Platform (AA-TP)**
- **All-Atlantic Aquaculture Technology and Innovation Platform (AA-ATiP)**
- **All-Atlantic Marine Biotechnology Initiative (AA-BIOTECMAR)**
- **All-Atlantic Data Enterprise 2030 (AA-DATA2030)**
- **All-Atlantic Blue Schools Network (AA-BSN)**
- **All-Atlantic Marine Research Infrastructure Network (AA-MARINET)**

This report was developed by the **All-Atlantic Data Enterprise 2030 (AA-DATA2030)** Joint Pilot Action, that aims at creating a one-stop, user-friendly transatlantic platform for gathering natural, social, and social-scientific data: The All-Atlantic Ocean Data Space (AAODS). AA-DATA2030 is supporting transatlantic information and data sharing in the spirit of 'open science' and the FAIR/CARE/TRUST principles. The establishment of the All-Atlantic Ocean Data Space will ensure that, in the future, all stakeholders have free access and can also contribute to relevant data, thus safeguarding sustainable stewardship of the Atlantic Ocean

This report is a deliverable in scope of JPA All-Atlantic Data Enterprise 2030, Task 2. Defining the Needs & Customizing the services for the All-Atlantic Ocean community. The task, aimed at organizing three workshops for stakeholder engagement: Workshop - 1 - Data and Policy forum (online); Workshop - 2 - Data Infrastructures and Stakeholders' Forum: focus on Roadmap for the implementation of the All-Atlantic Ocean Data Space (online); and Workshop 3: Focus on the Tropical and Southern Atlantic (and Southern Ocean): Workshop in presence in Buenos Aires, 28 November – 1 December 2022, (Organisation: UNLP, USP, CSIR, and ZMT). The latter workshop further contributes to include action items in the all Atlantic Roadmap, which focuses on South Atlantic data community. This report corresponds to AA-DATA2030 D2.1, Workshop 1.

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1. Agenda of the All-Atlantic DATA & POLICY Forum (Online) 31 May 2021 | 14:00 - 18:15 CEST

PROGRAMME
ALL-ATLANTIC DATA & POLICY FORUM
31 MAY 2021| 14:00 - 18:15

TIME (CEST)	
13:45 - 14:00	**ARRIVAL / JOINING THE FORUM**
14:00 - 14:10	**OPENING**
	Welcome notes
	• Olga Sato (Universidade de São Paulo) | Brazil • Nicolas Dittert (Konsortium Deutsche Meeresforschung / Leibniz-Zentrum für Marine Tropenforschung) | Germany • Nikki Funke (Council for Scientific and Industrial Research) | South Africa • Julie Reimer (All-Atlantic Ocean Youth Ambassador) | Canada
14:15 - 15:05	**PANEL 1: THEMATIC REGIONAL SESSION**
	North Atlantic, South Atlantic, Southern Ocean – Their importance with respect to global change
	Moderator: Rafael Sperb (Universidade Federal do Rio Grande) | Brazil
	• Alexandra Neyts (Technology and Innovation Platform) | Belgium / Norway • Gregory Foltz (National Oceanic and Atmospheric Administration | United States of America • Alberto Piola (Servicio de Hidrografia Naval and Universidad de Buenos Aires) | Argentina • Pip Bricher (University of Tasmania) | Australia • Ronald Buss de Souza (Instituto Nacional de Pesquisas Espaciais) | Brazil • Linwood Pendleton Centre for the Fourth Industrial Revolution - Ocean) | France / Norway
15:05 - 15:15	**COFFEE BREAK**
15:15 - 16:05	**PANEL 2: THEMATIC SCIENTIFIC SESSION**
	Fisheries, effects of emerging pollutants, impacts on society
	Moderator: Brad de Young (Memorial University of Newfoundland) | Canada
	• Jose Angel Alvarez Perez (Universidade do Vale do Itajaí) | Brazil • Paulus Kainge (Benguela Current Convention) | Namibia • Pedro Reis Costa (Instituto Português do Mar e da Atmosfera) | Portugal • Tarron Lamont (Department of Environment, Forestry and Fisheries) | South Africa • Valeria Guinder (Universidad Nacional del Sur - Consejo Nacional de Investigaciones Científicas y Técnicas) | Argentina

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16:05 - 16:15	**COFFEE BREAK**
16:15 - 17:05	**PANEL 3: SOCIETY AND OCEAN DATA SESSION**
	The role of data as a knowledge base for societal action and policy and management decisions
	Moderator: Roberto de Pinho (Ministério da Ciência, Tecnologia, Inovações e Comunicações) | Brazil
	• Marinez Scherer (Universidade Federal de Santa Catarina) | Brazil
	• Gilbert Siko (Department of Science and Innovation) | South Africa
	• Sakina-Dorothée Ayata (Sorbonne Université) | France
	• Anna Zivian (Ocean Conservancy | United States of America
	• Gabriele Pieri (Consiglio Nazionale delle Ricerche) | Italy
17:05 - 17:15	**COFFEE BREAK**
17:15 - 18:05	**TECHNICAL SESSION**
	Data infrastructures and services
	Moderator: Tina Dohna (Data Publisher for Earth & Environmental Science PANGAEA / Zentrum für Marine Umweltwissenschaften - MARUM) | Germany
	• Luiz Gadelha (Brazilian Marine Biodiversity Database / Laboratório Nacional de Computação Científica) I Brazil
	• Lucy Scott (International Oceanographic Data and Information Exchange - IODE / UNESCO) I Belgium
	• Mathieu Belbéoch (Joint Centre for Oceanographic and Marine Meteorological Observing Programme Support) I France
	• Sara Pittonet Gaiarin (TRUST-IT Services) I Italy
	• Wim Hugo (Data Archiving and Networked Services - DANS) | Netherlands
18:05 - 18:15	**CONCLUSION OF THE FORUM**
	Nikki Funke | Nicolas Dittert | Olga Sato

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AANChOR is a Coordination & Support Action project aimed to support the implementation of the Belém Statement. It has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818395.

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2. e-Report of the All-Atlantic Data & Policy Forum

1. Introduction

Under the umbrella of the [All Atlantic Cooperation for Ocean Research and Innovation (AANChOR-CSA)](#) Project, the All-Atlantic Data & Policy Forum was the kick off activity for the Joint Pilot Action ["All- Atlantic Data 2030"](#) developed under AANChOR's Work Package 5 (Common Standards for Data and Information Sharing), and took place in the run-up to the [All-Atlantic R&I for a Sustainable Ocean Conference](#).

The All-Atlantic Data and Policy Forum brought together panellists from across the Atlantic Ocean discussing and debating four topics that are pivotal to the future of Trans-Atlantic data and information sharing. All panellist presentations can be found here:

https://zmtcloud.zmt-bremen.de/index.php/s/2QF33OQst8JvkQs

Main Questions
- What is the importance of Atlantic Ocean scientific data in the context of global change?
- How will this data generate a solid and inclusive knowledge base for the development of solutions towards the achievements of the Sustainable Development Goals and for science policy and management decisions?

Next Steps
- Build a coalition of stakeholders with common goals towards data and information sharing.
- Promote a governance approach and guidelines on how Atlantic Ocean natural and social science data, including indigenous bio-cultural knowledge, are collected, stored and managed.
- Launch the Roadmap for the All-Atlantic Ocean Data Space (AAODS).
- Release a White Paper providing recommendations for governments, enabling them to address critical issues arising from the need for sharing scientific data in an equitable and accessible manner.

The Vision
- To encourage the adoption of a data-driven mentality in scientific research, which will generate a good knowledge base for policy and decision making.
- To influence the development of guidelines and legislation focused on Atlantic Ocean data collection and use, thereby opening the door for the Trans-Atlantic adoption of common standards for information and data sharing in the spirit of 'open science' and the FAIR/CARE principles.

- To create a Trans-Atlantic federation of data infrastructures, in close collaboration with our sister projects, Atlantic brothers and other international initiatives.
- To make Atlantic Ocean data available through a web-based platform *All-Atlantic Ocean Data Space* (AAODS)*. The AAODS will provide maximum online availability and accessibility of data and contribute to wider efforts towards future ocean governance.
- To ensure that all stakeholders have free access to relevant data and contribute to the sustainable stewardship of the Atlantic Ocean for the global common good.
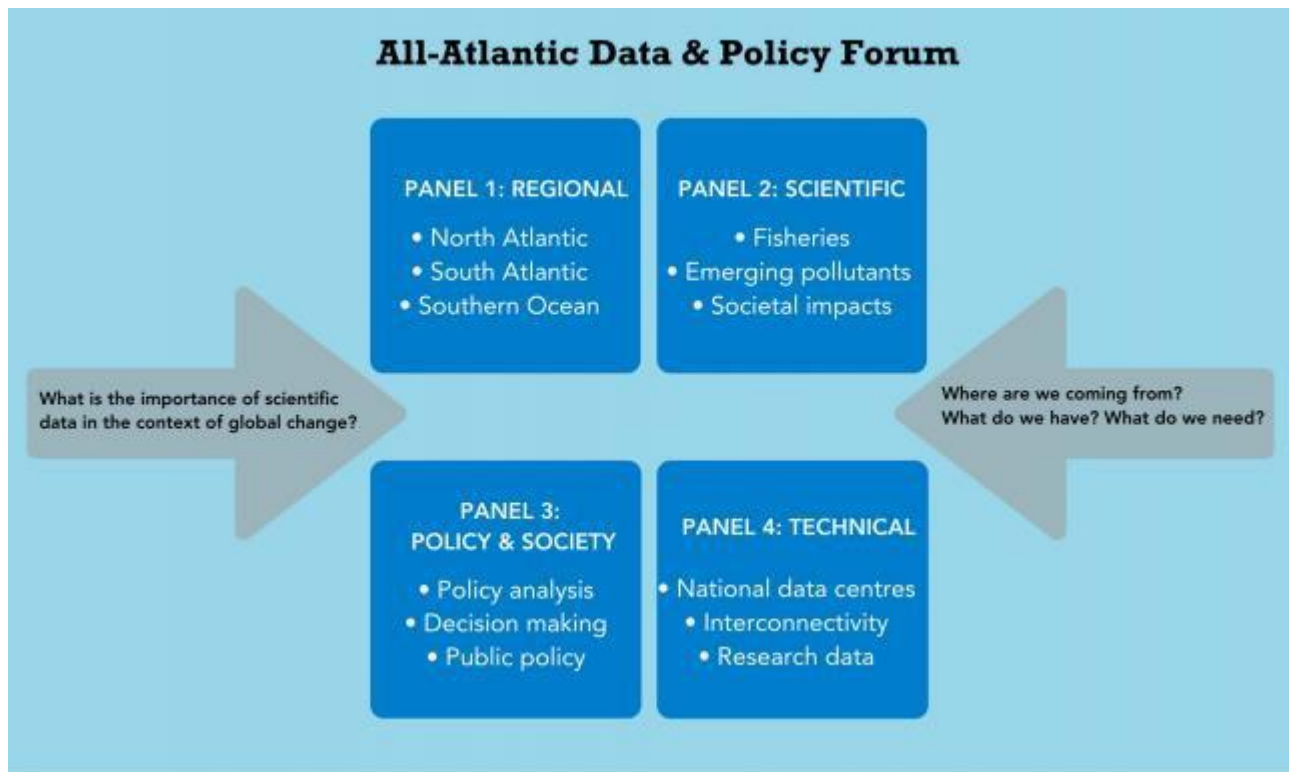
2. Welcome notes

— Olga Sato —

Welcome to the All-Atlantic DATA & POLICY Forum.

My name is Olga Sato and I am a professor and a researcher in Physical Oceanography at the Oceanographic Institute of the University of São Paulo, Brazil. It is my pleasure to announce the kick-off of the Joint Pilot Action for Work Package 5, the group of experts responsible for the Common Standards for Information and Data Sharing of AANChOR.

The Atlantic Ocean plays a relevant role in determining the climate of the planet. It is key to unravel the complex climate system which is formed by many components of our planet, such as the ocean, atmosphere, cryosphere, biosphere, among others. The South Atlantic Ocean is an important part of this system.

Scientists and research institutions from the South Atlantic neighbouring countries are very concerned about its circulation, and its impact on ecosystems, fisheries, pollution, human health, energy, navigation, etc. We have experts generating relevant knowledge and original works have been published in international journals of high impact. Nevertheless, one of the problems that we all face at different levels is the storage, maintenance and distribution of data. Oh yes, we have collected tons of data here, as individuals or institutions. But still the data are not accessible to everyone. In this sense, there is a huge gap between what is already accomplished in the North Atlantic and in the South Atlantic, and even between the West and the East of the South Atlantic.

To have a more comprehensive understanding of our planet, we have to monitor it, study it, make hypotheses, test them, get more data, use them, reuse them, and most importantly, make sure that what we learn today is useful for the future. Knowledge is cumulative and data are needed to assure that.

As I speak here today as a scientist, I know that our job is not done if what we have learned cannot be helpful for everyone. Data should be the way to engage the whole society: academia, global observing systems, industry, private sector, recreation, government and policy makers among others.

The data issue that we are going to address in the beginning of the Decade of the Oceans is not new. It is an old problem but we are seeking new solutions. And that's why we invited you to help us to shape a permanent solution.

Thank you. Enjoy and have a fruitful discussion. Now over to Nicolas Dittert

— Nicolas Dittert —

Dear colleagues,

My name is Nicolas Dittert. I am the Administrative Director of the Leibniz Centre for Tropical Marine Research ZMT in Bremen, Germany and I have been working in scientific data management for almost 30 years, from which you can roughly deduce my true age.

We are meeting here today for an All-Atlantic Forum in which we want to take a close look at issues of data, data standards, data exchange and – in particular – data as a knowledge base for political decisions.

We are meeting today across all borders, as the Atlantic Ocean and its biological, physical and chemical resources also know no borders. "Across all borders" also means that we have tried to fill the panels as balanced as possible: gender, origin, age shall not be of any importance.

My role today is to represent the North Atlantic. When the issue of climate change was politically activated in Europe, North America and Canada some decades ago, science began to look intensively at ocean circulation, atmospheric parameters, biodiversity. After all, the Gulf Stream turns its first pirouettes here, the Atlantic deep water is produced in the far north, and fishing has been highly dynamic on both sides of the North Atlantic for many decades.

Thus, large amounts of data were quickly created, and even then, the question of authorship and ownership of data arose. Is industry allowed to access scientific results free of charge? Does science have an original right to use data from private industries? While at that time the exchange of data in science still worked on personal demand, today we are facing the challenge of huge, heterogeneous amounts of data. But has the overall situation changed fundamentally in the last 50 years, or are we still confronted with the same questions?

I wish us a lively, content-rich discourse and exchange, and I wish us all a long-lasting stable All-Atlantic network of people and collaborations.

With these words, I call South Africa - Nikki: please!

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— Nikki Funke —

Good day everyone. My name is Nikki Funke and I'm a political scientist and senior researcher at the South African Council for Scientific and Industrial Research.

Welcome to this important event, at which we are sure to have a rich discussion on subjects ranging from data availability across the different parts of the Atlantic, to emerging pollutants, and to the importance of All-Atlantic data for decision-making and, ultimately, societal impact.

In this part of our welcome, we now briefly turn our attention to the importance of Southern Ocean scientific data in the context of managing global change, achieving the SDGs and supporting policy-and decision-making.

The Southern Ocean forms a pivotal part of the Earth system, because it links all of the world's ocean basins together. This makes it critical to understand its functioning and how it is likely to respond to changes in climate, and other natural and human influences. However, because of the expense of working in such a remote area, it remains one of the most under-observed parts of the ocean.

Only by effectively collecting, analysing, managing and sharing the data that help us understand the Southern Ocean, will we be able to effectively respond to the challenges it faces, including climate change, sea-level rise, ocean acidification, and the unsustainable use of marine resources.

I will leave it to our experts to further elaborate on this important topic. Now over to Julie Reimer…

— Julie Reimer —

Hello everyone! My name is Julie Reimer and I'm an [All-Atlantic Ocean Youth Ambassador](#) for Canada and a PhD Candidate from the Memorial University of Newfoundland. It is my absolute honour to be here with you today, among such a diverse and passionate group of people. With this in mind, I'd love to know more about who you are! So first, tell us where you're joining from. In an All-Atlantic group, I hope we have some representation from each region.

Poll question:
Where are you attending the forum from?

A) North America
B) Europe
C) Africa
D) South America

E) Antarctica - I'm a Penguin

Now that we have a sense of where you're joining us from, let's talk about the many different voices, perspectives, and expertise you bring. Which of these do you feel best describes you? I, myself, am a social scientist, though my early training is in ecology and I work with non-governmental organizations, so check the box that fits best today.

Poll question:

Which best describes you? I am a . . .

A) Natural or physical scientist
B) Social scientist
C) Policy maker or government representative
D) Ocean advocate or NGO professional
E) Ocean industry member

Because I'm a social scientist and a young person who is inheriting some of history's biggest ocean challenges, I want to take this space today to encourage you to think about data as an input to, and a reflection of, society. The data that we choose to collect, the ways we collect and manage it, and how we choose to use it could, literally, make the difference in the world. I want to challenge you today, through each of these panels as we discuss the importance of our Atlantic regions, ocean industries and impacts, societal action and policy, and the complexities of data, to think about how your data and research can be useful.

The UN Ocean Decade creates this huge momentum: the science we need, for the future we want. To make this link between science and the future, data have to accessible, user-friendly, and really linked to what ocean planners, managers, and communities need to bring about change. And I want to remind us that science is inclusive, it's natural science, social science, humanities, Indigenous and local knowledge, technology, governance, and management. I'm excited to listen to these panels, to ask tough questions, and to work together to rethink how we go from the science we need to that ocean we want. Getting there really all starts with you – and the data.

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3. Panel presentations

All presentations are available here: https://zmtcloud.zmt-bremen.de/index.php/s/2QF33OQst8JvkQs.

Panel 1 - THEMATIC REGIONAL SESSION

North Atlantic, South Atlantic, Southern Ocean: Their importance with respect to global change

Moderator: Rafael Medeiros Sperb

Rafael is presently a researcher and professor at the Oceanography Institute of FURG, Brazil. In the past, he has been responsible for the Brazilian Industrial Fishing Vessels Monitoring System (PREPS) and the National Fisheries Data Infrastructure development, among several other information systems for marine monitoring and conservation.

Speakers:

Alexandra Neyts

Alexandra is a Senior Adviser at the European Aquaculture Technology and Innovation Platform (EATiP), which is an officially recognised industry driven, multi-stakeholder network representing the sector. She is involved as a partner and sector representative in several European projects and cluster initiatives. One of those is a collaboration with Copernicus Marine Systems and EMODnet to develop opportunities for data sharing in aquaculture.

Abstract: Lack of available marine space for aquaculture and competition with other coastal activities hinder growth in many regions. Sustainability criteria, including those related to biodiversity conservation and climate change, are expected to increasingly set the agenda for aquaculture development. A stronger cross-national and –regional collaboration is recommended to reach a level-playing field for a predictable, evidence- and ecosystem-based aquaculture sector. We believe the potential of available satellite and high-resolution in-situ marine environmental data can be better utilised for the development of appropriate aquaculture governance and operation decision-making. Two regional workshops were organised for the use of marine data for aquaculture. There was a general understanding that different aquaculture production systems and sector activities require different data sets but that the availability of traceability systems and monitoring programmes is key.

We invite stakeholders across the Atlantic Ocean to collaborate and exchange best practices in the use of marine monitoring data for aquaculture, in connection with the corresponding AANChOR Joint Pilot Action.

Gregory Foltz

Greg is an oceanographer at NOAA's Atlantic Oceanographic and Meteorological Laboratory in Miami. His work focuses on understanding the role of the ocean in climate and extreme weather, and transitioning that research to improved operational forecasts and assessments. He is closely involved with the PIRATA program and with targeted ocean observations in support of Atlantic hurricane forecasts and research.

Abstract: Societal importance of the tropical Atlantic Ocean from a climate change perspective. Description of the current sustained observing system and its weaknesses. Summary of future observing system needs. Ideas for how data/information availability and integration can be improved.

Alberto Piola

Alberto is a seagoing physical oceanographer, heads the Ocean Dynamics Section at Servicio de Hidrografia Naval and is a Professor of Oceanography at Universidad de Buenos Aires (Argentina). He chairs the IMBER Data Management Working Group. Has published on the large-scale ocean circulation and fronts.

Abstract: My presentation will focus on the current state of oceanographic data availability in the South Atlantic, and will emphasize the relevance of timely information for science and decision-making processes.

Pip Bricher

Pip Bricher (rhymes with "richer") is the data officer for the Southern Ocean Observing System, where she is tasked with building an integrated data sharing system for all the nations who collect observations at the bottom of our earth. She's also a member of the Standing Committee on Antarctic Data Management and a co-chair of the POLDER working group that's trying to build federated metadata search for the polar regions.

Abstract: The Southern Ocean Observing System is a wildly diverse group of national and international programs, which makes a virtue of its limited resources, which force it to leverage existing data systems rather than building a new system of its own.

Panelists:

Ronald Buss de Souza

Ronald has a *BSc in Oceanography, MSc in Remote Sensing and PhD in Physical Oceanography. He holds a permanent position as a senior researcher at the Earth System Numerical Modeling Division of the Brazilian National institute for Space Research (INPE). He is also a member of the Southern Ocean Region Panel (SORP) of CLIVAR/Clic/SCAR and the national coordinator of PIRATA-Brazil project.*

Linwood Pendleton

Linwood is the Senior Vice-President for Science at the Centre for the 4th Industrial Revolution for the Ocean and a Professor at the European Institute of Marine Studies, in Brittany, France. He studies how and whether people use data to manage coastal and ocean areas.

Conclusions for Panel 1, by Rafael Medeiros Sperb:

Preamble:

The questions, conclusions and recommendations presented here were extracted from a pre-panel online meeting with all the panellists as well as from the Panel itself. These two encounters covered nearly two hours of discussions related to the topic of the Panel.

In the first meeting the panellists were informed that the All-Atlantic DATA & POLICY Forum forms part of the effort to produce a Roadmap for the All-Atlantic Ocean Data Space (AAODS) Joint Action and a White Paper providing recommendations for governments regarding scientific data sharing at international

level. It was highlighted that the Forum's outcome would guide two other stakeholder workshops (in Brazil and Africa) from which the final version of the Roadmap and WP should result. Therefore, they were encouraged to present, according to their experience and perception, needs and suggestions to eliminate or soften scientific data sharing problems in the Atlantic and Southern oceans.

It was also made clear to the panellists that the Joint Action was not an observation system and that there was no funding available for it under the AANCHOR CSA. Rather, it is an initiative to foster the Atlantic research community's integration through its sister projects (*Blue Cloud*, *iAtlantic*, *Mission Atlantic* and *AtlantECO*) as well as an attempt to orient future government investments towards data integration and sharing initiatives.

Finally, it was stressed that the aim of the Joint Action was not only about physical oceanography and observational data. Natural and social science data should be regarded as being as important as any other science data within the initiative. However, to keep things simple initially, the Joint Action should target emergent pollutants as its primary goal (test case).

General Perceptions:

The panellists agreed that the North and Tropical Atlantic oceans have better data management practices than the South. According to Gregory, good practices regarding ocean observation mean adopting common

formats (such as netCDF) and sharing data publicly in real time. Nevertheless, there is room for improvement in terms of making them more integrated.

Ronald emphasized this perception from the South Atlantic perspective, saying that in Brazil ocean data is scattered in different institutions and data management practices are rather weak. This situation makes it difficult to share/integrate local data with global data ocean infrastructures. He understands that Brazil has been more efficient in producing observational data than systemising and distributing it. There are few data centres and trained people for scientific data management, especially those with expertise on data and interoperability standards. Alberto corroborated this statement saying that even in highly research active countries in the South Atlantic such as Brazil, Argentina and South Africa, there are no real ocean data centres. Furthermore, what they have does not provide online access, even less in real time. Obtaining data in these countries is a bureaucratic process, usually based on request forms and waiting time.

The idea that some countries do not have and cannot afford to have their own data centres was argued by Pip in regard to her experience in the Southern Ocean. She understands that it should not be an excuse for not sharing data since there are lots of places where they could hand it over. It is a matter of fostering international collaboration. As such, she has brought up examples such as the National Centre for Environmental Information (USA) that holds lots of information for Australia or the Australian Antarctic Data Centre that is holding data for New Zealand.

Such examples should be common in an international collaboration environment. Nevertheless, they are, even when international policies and agreements are in place. Pip comments that in the waters south of 60 degrees south, under the Antarctic treaty, all signatories' nations are required to make their data available for sharing. Thus, there is a legal framework for data sharing. This data has been centralized in the NASA Earth Data Centre. However, 80% of what is in there has been provided by Australia and USA solely. There has been a long-standing attempt to change the culture around data sharing but it remains difficult to get hold of this data.

Linwood expanded this scenario to the global level. He said that an IODE project is studying, on a country by country basis, data sharing practices within the World Ocean Database and OBIS context. A preliminary assessment of the 150 ocean facing countries shows that the number of countries sharing data through the IODE has declined steadily to the point where, in 2018, fewer than 30 countries shared data with the World Ocean Database. Furthermore, Australia and the United States are responsible for 70% of it.

What are the reasons for this situation? According to Linwood, one explanation lies in the fact that nowadays an individual can easily share his/her data in the cloud without necessarily going through the

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national centres. It is not necessarily bad, as Pip pointed out. Considering that nowadays a researcher or institution can upload data almost anywhere on the Web (ex. Pangea), we are trying to encourage people to do so using (widely adopted) standards. Therefore, even when the data is in a "strange" place, as long as we know where to pick it up and it follows a standard, it is usable. It is much better than not being able to find it at all.

In some ways, it agrees with Alberto's statement that there is no hydrographic real time data available in the South Atlantic. Nevertheless, most data produced in the South end up in NOAA'S database and, with a delay, it is accessible. The question, then, should be whether this decline in the World Ocean Database has been accompanied by an increase in other ocean data repositories and data centres. If so, why are researchers choosing them?

Another reason would be that even in countries that have legislation stating that data should be open, organizations/institutions that produce them are severely underfunded. This causes a long delay in data delivery to those who can provide data worldwide in an open way (official repositories). Alberto sees it as a rather political issue. From his point of view, governments should fund and provide human resources that can carry the responsibility. He mentioned that for hydrographic data, NOAA has successfully been doing that for a long time. But in the early days it was badly done. "We need to knock on the politicians' doors, because only they can solve this issue. We should provide our governments reasons for sharing data. We need to motivate data sharing in a very proactive way. We need to spread the word that it is beneficial for all. It is a tremendous challenge that I do not know the best strategy".

In Brazil we usually follow the complicated route, according to Ronald's experience. We do not have the simplest, the most essential data, such as historical sea temperature maps. Thus, it is not only a matter of sharing ocean data but defining what is the basic information that must be produced and released to the public. And from that, we develop more complicated things. Good data management practices would be an essential step to improving this situation.

An efficient data management starts with consistent practices for collecting data. It should be given sufficient emphasis, even when the practices are simple. On one hand, data managers should meet and be where the scientists collect data, work, and get to know their disciplines to support them. On the other, data managers are generalists. They are hardly ever able to interrogate or criticize data. They need scientists for that. Pip argues that a healthy relationship between data managers and scientists would remove some of the burden from scientists while properly orienting data managers in their work.

This relationship becomes even more important when we consider that ocean data is a complex form of "transversal" data generated from and aimed at different disciplines. Standards for biodiversity, for instance, are quite different from oceanographic physical data as pointed out by Linwood when he raised the question "should we trust the data?"

Pip responded to this question with yet another subjective question: are you comfortable with the data? This reaction summarizes the idea that data quality fits the user's needs rather than being a measurable attribute of the data itself. But it is also a matter of comfort for the data provider, often related to security. In this regard, Linwood mentioned an anecdotal example he heard from military data managers. If they share raw data, even if it is from ARGO buoys, through artificial intelligence one could potentially track submarines. Therefore, for defence reasons they will not be provided as raw point data. However, they might be processed to gridded data in a proper resolution for scientific purposes. Linwood concludes with two questions: which forms should data be converted to for countries or organisations to feel comfortable sharing it? Should we demand point raw data or adopt gridded data in a proper research resolution?

From a commercial point of view, some sectors need high resolution data. But mainly in coastal waters, according to Alexandra. She acknowledges that understanding the impacts and setting priorities and recommendations for aquaculture is a key element for sustainability (procedures that could be replicated in other sectors). These actions are closely related to marine data and the sector is not aware of what exists in terms of data (such as in Copernicus and EMODnet). Therefore, education is also a point of concern. Education and capacity building, according to the panellists, are crucial elements in the data sharing realm.

Individual Perceptions:

Alexandra Neyts:

➔ Ocean data demand is essential for cross-regional data infrastructures existence and maintenance;

➔ There must be incentives and benefits for data sharing, especially for industrial and commercial sectors; and there are

➔ Essential issues regarding data sharing that must be addressed to achieve success:
   ◆ Well established policies for confidentiality and data privacy;
   ◆ Correct temporal and spatial resolution and accuracy for data users;
   ◆ Data quality assurance (documentation, format, units, uncertainty level, etc);
   ◆ Interoperability for prompt data use;

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- ◆ User-friendly data infrastructure; and
- ◆ Data users training.

Gregory Foltz:

➔ Ocean data obtained by sustained monitoring programmes is highly needed due to:
  - ◆ The increase of extreme events frequency;
  - ◆ Ocean acidification;
  - ◆ Expansion of oxygen minimum zones and its impact in marine life; and
  - ◆ Fish stocks migration and diminishment because of ocean warming.

➔ There is no baseline integrated data on ocean observation programmes for biological and fisheries in the tropical ocean. Small programmes exist but there is no integration; and

➔ Essential issues to be addressed for data sharing improvement:
  - ◆ Funding:
    - ● To make data available more regularly;
    - ● To foster integrated access to data;
    - ● Include data management costs into the observation programmes;
    - ● Funding agencies should require data to be made available according to FAIR principles and have DOI; and
    - ● Not enough explicit funding for data management (if one has to choose more science or data management he will choose more science)
  - ◆ Governance:
    - ● To assure that data is made available more regularly and in a sustained and efficient way;
    - ● To cope with new sensors and platforms that create new data formats (avoid the risk of data not being found/used); and
    - ● The need for a fully supported centre/organization to create and maintain a searchable database.
  - ◆ Capacity building.

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Alberto Piola:

➔ Knowledge of ocean masses and circulation relies on observational data, including satellite data which has facilitated recent studies in global scale;

➔ The South Atlantic is the crossroads of the oceans' circulation and plays a key role in these

➔ processes, as well as in the global climate;

➔ Valuable economic resources, like fisheries, are subject to ocean masses and circulation;

➔ Based on World Ocean Atlas data it is possible to identify data gaps in the South Atlantic:

◆ There is an imbalance between physical and biogeochemical variables (micronutrients – nothing sophisticated);

◆ A time delay in data availability is critical for advising and decision making.

Pip Bricher:

➔ Research data curation must be professionalized and improved before we can effectively share data;

➔ Funding for data management is a key issue:

◆ The rule of thumb is that 10% of research funding will pay for effective data management; and

◆ A bit of money spent on data management renders dividends for all.

➔ Governance:

◆ Common ways for sharing metadata is crucial;

◆ Having data in a data portal (webgis mappable data) where people can see their data is a huge incentive for data sharing. It supports building up a community; and

◆ Long standing attempts to change the culture around data sharing, even when there are international agreements to structure that, still remain without significant results.

Conclusions:

There is a consensus among the panelists that scientific ocean data management must be conducted by professionals, enabling scientists to focus on science and knowledge construction. Therefore, a fair amount of research funding should be channelled towards data management, including capacity building. Not only science should reap the benefits of ocean data production and sharing. Ocean information and knowledge must reach society in any and every possible beneficial form. Data sharing, in particular, is an issue that requires much more than standards and protocols. Underlying this issue, culture and good research

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practices must assure data quality and its (prompt) availability. At the top, policies and long- term financial resources must provide structure for data curatorship and sharing.

Panel 2 - THEMATIC SCIENTIFIC SESSION

Fisheries, effects of emerging pollutants, impacts on society

Moderator: Brad deYoung

Brad holds the Robert A. Bartlett Professorship in Oceanography at Memorial University. He takes an approach involving experimental work at sea, data analysis and numerical modelling. His research interests include coastal and open ocean systems, climate dynamics, ocean ecology and fisheries oceanography. He has led national and international science programmes and many regional and strategic initiatives. He is a principal investigator in the Ocean Frontier Institute, an autonomous vehicle development project funded and is the international lead for the AtlantOS programme. He is interested in developing a long-term, sustainable approach to ocean observation.

Speakers:

Jose Angel Alvarez Perez

Angel Perez is a professor at University of Vale do Itajaí (UNIVALI), southern Brazil. He has focused his research on the study of deep-sea ecology, biodiversity and anthropogenic impacts, including fishing and mining. He is currently a member of the iAtlantic Project, acting as the SW Atlantic region coordinator.

Abstract: My presentation showcases experiences where management-induced collaborations between science and fishing and oil & gas industries have greatly expanded the capacity to produce data and assessments of marine ecosystems off Brazil.

Paulus Kainge

Paulus is a Chief Scientist in the Ministry of Fisheries and Marine Resources (MFMR), based at National Marine Information and Research Centre (NatMIRC) in Swakopmund, Namibia. He heads research on demersal/deep-sea resources, conducting stock assessment and providing scientific advice and recommendations used for policy formulation of conservation measures on the sustainable utilization of marine resources and protection of marine biodiversity. Paulus is a former Chair of the SEAFO SC, and currently the Chair of the BCC Demersal Working Group, conducting research on transboundary stocks and providing scientific recommendations and advice on a spectrum of possible management scenarios to the

Ecosystem Advisory Committee (EAC) of the BCC. He holds a PhD Degree from the Technical University of Denmark (DTU).

Abstract: Some key studies from fisheries data collected in the BCLME region (BCC), infrastructure and gaps (future needs) - The BCC has a regional data and information management policy that provides guidance on sharing and exchange of data by the region. This policy is entrenched in the Convention Text, mainly Articles 4 & 8, and is aimed at driving data and information sharing and exchange, with the support from regional data Working Group. Consequently, regional WGs on various aspects are established by the Ecosystem Advisory Committee (EAC) in terms of Article 9(3) of the Convention, for the purpose of providing scientific recommendations and advice on a spectrum of possible management scenarios to the EAC or other management or governance bodies of the BCC. These data culminated in several key studies, which included the confirmation of the transboundary nature of the hakes through biomass surveys and genetics, age & growth determination and validation and modification of stock assessment practices in the region. The data also contributed to Marine Spatial Plan developments and identification of EBSAs in the BCLME. However, challenges still remain in standardization of data collection methods, capacity to conduct stock assessment, analysis and interpretation of results, as well as presenting scientific advice and recommendations for policy formulation.

Pedro Reis Costa

Pedro received his PhD degree in Marine Biology and Ecology from the University of Lisbon (Portugal, 2006). He has been a Researcher at the Portuguese Institute of the Sea and Atmosphere (IPMA) since his appointment in 2009. He is mainly interested in the study of harmful algal blooms (HAB) and the transfer of marine toxins in the food web, including their fate and toxicological potential in marine/estuarine environments.

Abstract: Emerging marine toxins in Europe: the risk of ciguatera in NE Atlantic - Ciguatera fish poisoning (CFP) is one of the most devastating food-borne illnesses caused by fish consumption. Ciguatoxins (CTXs) are potent neurotoxins, some are synthesized by benthic dinoflagellates Gambierdiscus and Fukuyoa that are transmitted to fish by grazing and predation, and other CTXs are products of fish metabolism.

Gambierdiscus and Fukuyo are endemic to tropical and sub-tropical regions which coincides with the world's highest incidence areas of ciguatera, namely the South Pacific, Indian Ocean and Caribbean Sea, where an estimated number of 50,000 persons are affected per year. Recently, new occurrences of Gambierdiscus in temperate areas have been concomitant with the detection of toxic fish and CFP incidents in non-endemic areas. Incidents of hHuman poisoning in the Madeira (Portugal) and Canary Islands (Spain) have raised attention about the emergence of new marine toxins that were not traditionally monitored by

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seafood safety authorities and revealed how unprepared scientists, managers and stakeholders were. The toxigenic dinoflagellates are now regularly observed in European waters, such as the Canary Islands, Madeira and the Mediterranean Sea. The CFP cases in Europe have led to the implementation of monitoring programmes and fisheries restrictions with considerable impact on local economies. In this presentation, the main ciguateric areas of the NE Atlantic are identified and the management approaches used to deal with this emerging threat are discussed in terms of challenges posed to scientists, regulators and local populations.

Panelists:

Tarron Lamont

Tarron is a Physical Oceanographer based at the South African Department of Forestry, Fisheries and the Environment in Cape Town, South Africa. Her work focusses on investigating the influence of large-scale circulation variability on the ecosystem functioning of Southern African shelf regions.

Valeria Guinder

Valeria is a Researcher at the National Scientific and Technical Research Council (CONICET), Argentina, since 2013, working at the Argentine Institute of Oceanography (IADO) and Universidad Nacional del Sur (UNS) in Bahía Blanca. She specializes in microbial plankton ecology in coastal ecosystems, continental shelves and fronts in the SW Atlantic (Patagonian Shelf), with a focus on phytoplankton community structure and biodiversity, including harmful algal blooms. She combines observational plankton and biogeochemistry data with remote sensing, to assess the environmental drivers of phytoplankton distribution and microbial carbon fluxes.

Conclusions for Panel 2, by Brad de Young:

Fisheries around the world are under stress for many different reasons. Overfishing is the primary direct impact with most fisheries presently being fished beyond a safe point. There are however many additional stressors influencing fish stocks including changes in water conditions related to climate change and pollutants, primarily in coastal waters. Quite obviously, fisheries involve people who conduct the fisheries and those working in the processing, shipping and sales of fish and fish products. The scale and form of fisheries vary widely around the world from small artisanal fisheries, to large-scale 'industrial' fishing using large ships, and vary in locale from the coastal out to the open ocean.

Emerging pollutants have their source on land and their immediate impact is on the coastal ocean but they do also have a much larger geographic impact. Harmful algal blooms (HABs) which are increasing in spatial

scale and frequency, as a result of pollution, have a direct impact on coastal resource use, such as beach-use, but also substantially impact fisheries.

Fishery systems are a direct part of society, linking humans to the ocean ecosystems that we are degrading. Climate change and the growing direct extraction of fish from the ocean, from the coastal to the open ocean, is influencing these fisheries upon which we rely for food and livelihood. Many people also live near the ocean and so rely on these fisheries systems for many other things beyond food, for example for sport and for relaxation.

The most fundamental gap in our understanding and management of fisheries systems remains data. Not only do we collect too little data, we do not make good use of the data that we do collect. It is clear that we need to collect better data but equally importantly, we need to share these data more effectively and ensure that those in society, from fish harvesters to fishery managers, have better access to critical data to understand and manage a resource upon which we rely so critically.

The discussion covered a wide range of topics and considered both challenges and successes from around the Atlantic. From Brazil, there was a presentation about the benefits of collaboration between fisheries groups and the offshore oil development company Petrobras. Working together, they were able to enhance data sharing and organization to fill gaps in the monitoring and observation of fishery activity and ocean conditions.

For the Benguela Current region we heard of the benefit of a formal inter-national, inter-governmental agency that supports the coordinated collection and sharing of fisheries and oceanographic data between Angola, Namibia and South Africa. There remain many challenges even with such international cooperation. The standardization of data collection, the full sharing of the data and capacity development to enable data collection are all issues that require further effort.

The growing frequency of Harmful Algal Blooms (HABs) has led to an expansion of their impact beyond shell fisheries to finfish with the growing occurrence of ciguatera poisoning in fish which has now been found in many different regions around the world. There is good local monitoring for HABs but little international coordination or sharing of data.

It was noted that our ocean data collection systems have traditionally focused on physical and chemical data but have paid much less attention to biological data. Nations have also been less willing to share fisheries data, even within the country, thereby limiting our ability to make some of the needed linkages, or to develop an understanding of how fishery systems are changing. In some regions, there has been good organization work to share fisheries data, such as ICES in the Northwest Atlantic, and the Benguela Current

Convention (BCC) off southwest Africa. The public-private sector example in Brazil also offers a pathway to enhanced data collection and sharing.

Panel 3 - SOCIETY AND OCEAN DATA SESSION

The role of data as a knowledge base for societal action and policy and management decisions

Moderator: Roberto de Pinho

Roberto is a Senior STI Policy and Indicators expert and Data Scientist. He is a member of the United Nations Group of Experts for the third cycle of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects (Regular Process) and member of the Advisory Group of the OECD' s International Survey of Science (I SSA). He is a Senior Science and Technology Analyst at the Brazilian Ministry of Science, Technology and Innovation, currently working at the General Coordination for the Ocean and Antarctica. His publications include co-authorships in chapters & articles of the Global Ocean Science Report 2020, The Journal of Technology Transfer among other journals, OECD Working Paper Series, and scientific conferences & books.

Speakers:

Marinez Scherer

Marinez is an associated professor and the coordinator of the Integrated Coastal Management Laboratory at the Federal University of Santa Catarina. She is also a trainer for marine spatial planning in several countries and her main research interests are on ecosystem-based management and integrated coastal and marine management.

Abstract: My presentation will cover the topic: Ecosystem Services as a communication tool for societal engagement and policy-making. I will discuss the need for ecosystem-based knowledge/data to engage stakeholders and demonstrate to them the importance and need for conservation and rational use of natural resources. Based on this data, gathered from science and traditional knowledge, I will show some practical examples on how to apply it in public participation and policy-making processes.

Gilbert Siko

Gilbert is the Director of Marine and Polar Research, Palaeosciences at the Department of Science and Innovation, where he implements research strategies guiding the development of research capacity and human capital development. He served in the IOC EPG for the UN Decade of Ocean Science for Sustainable Development 2021-2030.

Abstract: Research Data Contributing towards South Africa's Economy: Operation PhakisaOceans Economy. Concisely, the talk is about the use and interpretation of research data for societal needs as well as informing policy formulation.

Sakina Dorothée Ayata

Sakina-Dorothée is Associate Professor in marine ecology at Sorbonne University (SU), France. She works at the Laboratoire d'Océanographie de Villefranche sur Mer, and uses numerical tools (including statistics and modelling) to better understand the structure and the functioning of life in the ocean. She is co-head of the FORMAL team (From ObseRving to Modelling oceAn Life) of the Institute of Computing and Data Science (ISCD) of Sorbonne University. FORMAL aims to develop new methods to analyse and combine high throughput data in oceanography, especially omics and imaging data, and to improve existing marine ecosystem models.

Abstract: Data is collected at an increasing rate to record the state of the oceans and document marine ecosystems. How can it be used to address societal challenges? In this presentation I will first discuss how ocean big data can be used to define and monitor marine protected areas (MPAs). I will then give two examples of how marine data can be exploited for societal needs. The first example will illustrate fruitful collaboration with MPA's stakeholders to exploit imaging data of marine plankton. The second example will depict the use of satellite and ARGO float data for outreach activities.

Panelists:

Anna Zivian

Anna is Senior Research Fellow at Ocean Conservancy, supporting and advising Ocean Conservancy's science-based programs. Anna is also co-chair of the Ocean Knowledge-Action Network Development Team, working on bringing knowledge to action. She is currently focusing on issues of ocean climate change governance, plastics and climate, and equity and justice.

Gabriele Pieri

Gabriele, from the Institute of Information Science and Technologies of the National Research Council of Italy, is the Coordinator of the Horizon-2020 Project NAUTILOS: a project aiming to unlock the critical knowledge contained in the ocean through a new approach to sea and underwater technologies for innovative and cost-efficient ocean observation.

Conclusion of panel 3, by Roberto de Pinho:

Introduction

The Society and Ocean Data Session was intended to discuss the role of data as a knowledge base for societal action and policy and management decisions. To accomplish this goal, an underlying question was posed in the preparation for the session:

"In your view, what are the most pressing issues, barriers to, or actions we could take towards increasing the use of Ocean data and knowledge in society and towards increasing knowledge of the role that knowledge and data can have?"

This question was intended to serve as a loose guide for the discussions instead of being directly addressed, in recognition of the broad scope defined by many possibilities in the intersection of Ocean data and society.

Many of the issues to be discussed in this session appeared in previous ones. Some of these issues were the need to address a wider user community, to consider the social sciences, the need for intermediate users to provide a crucial service in providing context for the information and the role of data managers.

For policy makers, many questions are evident such as how to provide infrastructure but they also include how to make sure that evaluation policies are aligned with the provision of Ocean Data and how to better provide services.

It was also noted that many of the issues, challenges and opportunities related to Ocean Science data are general in nature and are also discussed in the broader context of Science Data. In thinking about the future, as noted by Luis Fernando Sayão, from the Brazilian National Atomic Energy Commission in a previous event[1], the same way that we do research on specimens that were kept in the 19th Century, we have to think of data having the same potential of being analyzed in the future with techniques and for purposes that we do not yet know.

Dr. Marinez Scherer presented Ecosystem Services as a communication tool for societal engagement and policy-making. There is a need for ecosystem-based knowledge/data to engage stakeholders and demonstrate to them the importance and need for conservation and rational use of natural resources. Some practical examples, gathered from science and traditional knowledge, were shown on how to apply it in public participation and policy-making processes.

Why use ecosystem services as a connection between ecosystems and human beings? Ecosystems structure and biophysical processes lead to ecosystem functions, which, in turn, lead to functions. From there, we get to services, and services can be linked to benefits. With that, we can start to understand these

connections and use them as a communication tool. This is really important for Marine Spatial Planning, for instance. In analysing different activities, one can observe the services required and the harm caused to the ecosystems by each activity and draw an interlinked picture. In this framework, ecosystem-based information becomes a valuable tool for making better decisions.

One relevant application of Ecosystem Services as a policy-making tool was presented. It was used to address the decision of which category a protected area should receive.

Ecosystem Services as a tool can elicit trade-offs and increase the value added by ocean data by increasing its policy-making applicability and providing visibility for its value in support of the benefits of ecosystems to society. This can be used to improve communication and public engagement.

Dr. Gilbert Siko presented Operation Phakisa Oceans Economy as an example of Research Data Contributing towards South Africa's Economy. The talk concerned the use and interpretation of research data for societal needs as well as informing policy formulation.

"Phakisa" means "hurry up" in Sesotho, and based on previous data, a number of potential ocean growth areas were identified and four were prioritized: (i) Marine Transport and Manufacturing, (ii) Offshore Oil and Gas Exploration, (iii) Aquaculture, and (iv) Marine protection services and ocean governance. One important aspect of the last area was to make sure that Ocean Research Data provided support for the other three areas.

This contributed to aligning the policies with the broader South African socio-economic aspirations, which are directed by its Constitution. South Africa has one of the largest exclusive economic zones in the world and plans to extend its jurisdiction further.

One of the results of the initiative was the development of the Oceans & Coastal Information Management System (OCIMS). The development includes the provision for the use of remote sensed, in-situ, ex-situ, modelled and contextual data in models that will ultimately inform/enable planning, decision making, coastal management, situational analysis, action, search & rescue operations, disaster management, compliance & enforcement. The plan for remote sensed data contemplates the use of nanosatellites.

As a direct impact of the project, 20 new Marine Protected Areas were identified.

The presentation from Dr Sakina Dorothée Ayata addresses the question of how increasingly available data on the state of the ocean can be used to address societal challenges. To this effect, it provides examples of how marine data can be used for societal needs. The first example refers to the use of marine plankton imaging data in a fruitful collaboration with stakeholders of marine protected areas (MPAs), showing how

ocean big data can be used to define and monitor MPAs. The second example depicts the use of satellite and ARGO float data for outreach activities.

In the context of research on MPAs, ocean data can be used to protect biodiversity by (i) identifying biodiversity hotspots for the identification of new MPAs and (ii) quantifying the efficiency of MPAs in monitoring efforts. Biodiversity hotspots can be identified by (i) mapping plankton diversity, using in-situ imaging and sequencing, and (ii) identifying biodiversity hotspots that are most sensitive to climate change, using species occurrences databases combined with niche modelling.

To monitor MPAs, new bioindicators based on the automatic acquisition of high through-put data can be defined from satellite, acoustic and genomic data. Satellite and acoustic data can also be used to monitor illegal vessels and fishing. For instance, in the monitoring of the Parc Naturel Marin Iroise, imaging data was used to describe the seasonal and interannual fluctuation of plankton abundance. The result was enabled by the existing expertise in plankton imaging that relies on an extensive imaging database and a machine learning classification tool.

Ocean data acquisition can be coupled with outreach activities. In the second example presented, the "adopt a float" programme, students adopt an underwater robot and follow it through its scientific voyage.

Dr Anna Zivian started by highlighting the role of the Social Sciences, taking Marine Spatial Planning as a prime example. MSP shows us how stakeholders and the public can contribute with data and knowledge and towards the understanding of the need for the use of knowledge. The role of Social Sciences is not only in showing how you can make your data more accessible, but it is instrumental in the development of research projects by enabling co-development of the research questions and co-implementing decisions.

She also highlighted the importance of equity and justice, especially in addressing the blue economy, and the need to also consider the social and economic contexts of projects. There is also here a critical role for the Social Sciences.

As an example, projects like the AANChOR project can help understand how different data sources can come together and be integrated, including biocultural, ecological and local knowledge, as well as bring

together users and data providers. This is achieved due to the breadth of people contributing to the project. It is a regional example of the global potential of the Decade of Ocean Science for Sustainable Development.

Dr. Gabriele Pieri put into context the project NAUTILOS and its goals of having better resolution data. Their first measure was to work on cost effective sensors for existing platforms, enabling long lasting observations, coupled with the provision of numerical and simulation models. One of their goals is to have

their data integrated into existing ocean data integrators, instead of being yet another data source. Cost effective sensors also contribute to another of their goals: providing new tools for citizen science initiatives.

General discussion

Dr Scherer, reacting to the panelists, agreed and added that there is a need to really interact with the local communities. In many instances, what we may perceive as clear is not actually so. It is much easier for them to talk about benefits than it is to talk about ecosystem services. However, as we have seen, it is possible to link benefits with services and to the ecosystem and then show the need to work together in preserving the ecosystem. It is important to have the engagement of communities not only at the end of projects, lest we lose a lot of valuable information.

Dr Linwood Pendleton, building on previous comments, pointed out that (i) there is a huge heterogeneity in capacity in citizen scientists. There are some that are quite professional, using quite sophisticated tools, including professional sailors. And, (ii) beyond having that, there is the issue of building trust in the data that we have. Participation helps build trust. Proliferation of automated means of collecting data will require new ways of building trust. One strategy is to complement existing data with data that is tangible and collected by real people.

Dr Siko emphasized the importance of partnerships with the broader community and the private sector. Often the private sector has been collecting data for a long time, like the oil & gas sector. These data should be utilized instead of duplicated. South Africa managed to establish a partnership with the off-shore oil & gas sector to enable them to cooperate with academia, providing them data and opportunities to go out to sea. Researchers have a platform where they identify the kind of data that they need. The community as well can assist in monitoring efforts.

A final question was raised on the need for complementary services and roles, such as the roles of data managers and of those responsible for providing data with context, and how to best provide them, either by research teams themselves or by specialized entities. Dr Scherer related the question on the need for balancing direct research activities with communication efforts. For her, the answer is both. There should be external help to support the efforts conducted by researchers in these specialized tasks, such as communication.

Final remarks

The session provided several examples on how data can be used to address societal challenges and of initiatives to bring the research and ocean data closer to stakeholders and the community. These can be further supported and replicated as part of ocean science policy-making. The role of social science was

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emphasized for its importance throughout the development of research projects. Some issues and points of attention were raised that need to be addressed towards increasing the use of ocean data and knowledge in society.

Panel 4 - TECHNICAL SESSION

Data infrastructures and services

Moderator: Tina Dohna

Tina Dohna is a Scientific Project Manager for the PANGAEA Data Infrastructure at the MARUM Institute, Bremen. With a research background in marine ecology and molecular methods to study marine populations, she has in recent years worked with EU Research Infrastructures on strategies for data dissemination and sharing, both through EU projects and RDA participation. Another focus has been the development and implementation of Persistent Identifiers (PIDs) to ensure FAIR data archiving and publication practices with a view on the full data life cycle. She leads the Data Management work package for the Horizon 2020 iAtlantic Project, which has a strong focus on implementing workflows for data sharing through European and global data portals for the international project consortium, sister projects and other relevant initiatives.

Speakers:

Luiz Gadelha

Luiz is a postdoctoral researcher at the Cheminformatics and Computational Metabolomics Research Group in the Institute for Analytical Chemistry and at the Fusion Research Group in the Faculty of Mathematics and Computer Science at the Friedrich-Schiller-University Jena, Germany. He is responsible for integrative research data management in the Cluster of Excellence Balance of the Microverse. He is also currently on leave as a Researcher at the National Laboratory of Scientific Computing (LNCC), in Brazil, where he started working in 2004. He has a D.Sc. degree in Computer and Systems Engineering from the Federal University of Rio de Janeiro (UFRJ), obtained in 2012, which included a doctoral internship at the University of Chicago. His main areas of research are scientific workflows, provenance, reproducibility, parallel computing, and scientific databases. He has been involved in the design and implementation of biodiversity databases such as the Brazilian Biodiversity Information System (SiBBr) – the Brazilian GBIF node, the Wildlife Health Information System (SISS-Geo), and the Brazilian Marine Biodiversity Database (BaMBa). Previously, he also implemented a provenance management system for the Swift parallel scripting system.

Abstract: The presentation describes the history of the Brazilian Marine Biodiversity database (BaMBa), its current status, challenges, and perspectives.

Lucy Scott

Lucy is a marine scientist with over 20 years' experience in twelve countries, mainly in the African region, on LME, GIS, and data and information projects. She has a Master's degree in Ichthyology and has previously been the science and data manager on the Agulhas and Somali Current LME Project. She is currently Project Manager of the Ocean InfoHub Project.

Abstract: The presentation gives a very brief introduction to the Ocean InfoHub project, and one of its core activities, which is the development of an Ocean Data and Information Systems Architecture.

Sara Pittonet Gaiarin

Sara is a Senior Project manager at Trust-ITsince 2010 & she coordinates the http://Blue-Cloud.eu Project, where she focuses on user uptake, & Blue-Cloud's impact on Open Science, Open & FAIR Data and Research Data Management. A former journalist, she has a Master's degree in International& Diplomatic Sciences from the University of Trieste, Italy. She manages the implementation of complex digital marketing strategies combining her Project and Resource Management skills in the context of EU Open Science communications R&D projects supported by the European Commission. For her commercial &industry-led clients, she rolls-out intensive, user-driven marketing strategies with an eye to aggregating communities and user adoption of research results. She is currently the deputy coordinator for the European Space Agency (ESA) Business in Space Growth Network (BSGN) contract and acts as Marketing and Outreach Manager for delivering FAIR data principles in Europe, entitled FAIRs FAIR.

Abstract: The presentation reverts around the Blue-Cloud project and its federation aspect.

Panelists:

Mathieu Belbéoch

Mathieu Belbéoch is the Lead of the OceanOPS, the joint IOC-WMO Centre for oceanography and marine meteorology. OceanOPS is a strong part of the international GOOS coordination core team and is established in Europe in Brest/France within Ifremer. He has been supporting the sustained ocean observing systems for two decades and developed the OceanOPS structure (formerly known as JCOMMOPS) from an embryo state to a firm operational Centre.

Wim Hugo

Wim is Chief Technology Officer of DANS. Previously - CIO of SAEON. Recent assignments include work for ACTRIS, Fair'sFair, and ISC WDS. Research interests include Research Graphs, evidence-based decision support, and automation of compliance in the scientific value chain. Until recently: ILTER Information Management Committee Chair, WDS Scientific Committee Vice-Chair. Active in RDA, GEO. CoreTrustSeal Board Member.

Conclusion of panel 4, by Tina Dhona:

Conclusions for Panel 4 were drawn from the panel presentations by Luiz Gadelha (BaMBa), Lucy Scott (IOC Ocean Info Hub) and Sara Pittonet (BlueCloud) and the discussion involving the whole panel, including Wim Hugo and Mathieu Belbeoch, as well as a precursor meeting between all panel participants and the moderator.

There are big differences in the infrastructure implementation maturity between Europe, US, Japan, Australia, China and the rest of the world. However, problems that we face do not lie in technology or even governance or policies, as standards exists and well-functioning infrastructures can be used as examples for countries with less mature implementations. **The biggest bottleneck here is the lack of human capacity to assimilate all the information and to ingest and implement it**. A roadmap for countries, repositories and institutions is a good idea. It can be expected that progress will in some cases be very slow, but this activity should be very inclusive to ensure that there is engagement from as many participants as possible, even if requirements and standards are not fully implemented. The roadmap can help countries who want to move to a higher level of operations and also provide something data repositories or institutions can take to their funding environment. The roadmap could then aid countries scientists to explain what development they are aiming for, what steps they will need to take and what hurdles they will need to overcome to become operationally more mature. It would also be very valuable to ensure that the roadmap explains the benefits that come with such a development.

While the system is mainly implemented by research, the data component of research projects is often not well defined or funded. Every observation in a research project should come with a clear pass way for the data, that should fuel existing data units around the Atlantic. From discussions in other panels, we can conclude that 10% of the total project budget for data management can be regarded as a good ballpark figure for explicit funding.

If we aim to build a system of systems, the maturity of each component of the system needs to be further developed. Without this, data portals of any form will not be able to provide what they envision in terms of data and services. Data teams are needed to prepare the data adequately at the underlying data nodes, so that the data can be used further up in the system. Currently, there is a clear lack of human capacity to develop the underlying infrastructures adequately. However, this is an important investment, because if data can easily be shared across the system and is used by others, this can help sustain the observations. The more users of the data, the larger the interest to sustain these observations. The lack of human capital in the form of trained long-term curation and technical staff and local data stewards is a problem that is not regionally restricted, but affects many nations around the Atlantic, including European countries.

Most Atlantic Ocean observations are made by northern countries and in the North Atlantic. This is a huge bias in terms of data coverage, participation and investment and we need to focus on rebalancing this bias. Several presentations from other panels also illustrated this problem. The challenges around this bias are very large but it is also an opportunity to forge new partnerships outside of those who are already engaged. Projects like the BlueCloud and the Ocean Info Hub project are crucial for building new networks of actors and providing opportunities to take on larger tasks together.

Another important issue that was also discussed in other panels is that we are not yet using the huge data potential available from civil society and the private sphere. One key issue here is that existing nodes are too weak to absorb this data. Nodes need to be prepared to handle and properly curate data from e.g.

NGOs, private shipping companies, industry exploration etc. These stakeholders are often willing to share data but need support in handling, sorting and preparing the data as there are rarely any funds available for this from their side. GOOS and OceanOBS are conducting a survey to map the available data nodes to their locations. The landscape of data nodes is very complex and this exercise will help to foster a more balanced maturation of the landscape and help users to find places for their data.

Infrastructures like BaMBa (presented by Luiz) in Brazil and SAEON in South Africa illustrate that outsourcing of data management and publication services by governmental structures is highly effective. Building nationally funded data archives and data services is a very promising way forward in providing reliable, user friendly and long-term sustainable structures, which can consolidate already existing infrastructure. By building a strong foundation first, we can ensure that functionally more advanced services for data from disparate sources can be offered and portals can fulfil their full potential.

BUILDING AN ALL ATLANTIC OCEAN COMMUNITY
Implementing the Belém Statement

AANChOR is a Coordination & Support Action project aimed to support the implementation of the Belém Statement. It has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 818395.

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4. Conclusion of the forum & way forward

— Nikki Funke —

Thank you for a very rich and varied Forum with interesting discussion points and a wealth of additional comments in the chat!

Particular points that stayed with me are the importance of professional data managers to professionalise and standardize data sharing and management, and design thinking specialists and science interpreters/translators to assist with the design of research and translation of data for the benefit of end-users and stakeholders. A multitude of interesting points was also raised about the nature, availability and accessibility of social science data and local knowledge – something which we will have to engage with some more going forward.

We will now take forward all of the information that was contributed today as a rich and valuable input to the development of the Road Map for the All-Atlantic Ocean Data Space and related activities, and will contact you if we would like to continue the discussions based on the notes of this Forum.

Enjoy the rest of your day/evening!

— Nicolas Dittert —

Dear colleagues,

Europe and Africa chose the best time of day and were able to spend a regular working day in our conference. Some got up in the particularly early hours of the morning, others were still with us after a very long working day. I am very grateful to all of you for your active participation!

We heard and learned a lot about data in different corners of the Atlantic Ocean. We heard about the opportunities and challenges of acquiring natural and social science data. And the structures and infrastructures behind the data made our last panel stand out.

For me, a great wish has come true: many Atlantic people have exchanged ideas, shown interest and mutual understanding today.

A second aspect that has moved me for a long time has been addressed several times and illuminated from the most diverse perspectives - we have not yet found the secret recipe today: how do we manage to get political stakeholders to formulate THEIR intrinsic interest in data as a knowledge base for their

decisions in such a way that WE create data products that are ultimately highly relevant to politics and easily accessible? Then it is only an organisational question to hire and implement whole hordes of data stewards who then offer their service to science in regional and national and thematic data centres that not a single data is lost anymore.

That is perhaps our next step.

We will now go through the discussions and chat to summarise the key messages from today, which we will then share with the United Nations Decade of Oceans, the European Commission and other stakeholders.

My big thanks go to Ana and Nikki for the great organisation, to Olga for chairing this forum, to the panellists for preparing their sessions so extraordinarily. And a big thank you to all of you for your open discussion and sharing of thoughts.

All the best - Olga, your closing words!

— Olga Sato —

Thank you very much to all moderators, speakers, panellists and contributors for this forum.

I would like to assure you that these discussions will not stop here. We appreciate the ideas and suggestions brought up here, they will be essential for the implementation of the All-Atlantic Ocean Data Space.

To engage everybody is our mission.

I would like to thank Nicolas Dittert and Nikki Funke for sharing this coordination.

I would like to give special thanks to Ana Rei from the Leibniz-Zentrum. Without her support and always timely help, this event wouldn't be possible.

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