



Proceedings

OceanObs Research Coordination Network
Portland, Oregon
February 11, 2018

Editors

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Table of Content

1	Executive Summary	3
2	Introduction to OceanObs RCN Meeting	4
2.1	OceanObs RCN Meeting Objective.....	4
2.2	Meeting Agenda	5
2.3	The Ocean Observations Research Coordination Network (OceanObs RCN). 6	
2.4	Details About the PI and CO-PIs.....	7
3	Acknowledgements	8
4	Presentations Summary.....	9
4.1	Jay Pearlman – Introduction to the Agenda.....	9
4.2	Vision for Ocean Observing.....	9
4.2.1	Bob Houtman - Ocean Science Directions / Decadal Survey	9
4.2.2	Peter Haugan – The ocean we need for the future we want.....	10
4.3	Eric Lindstrom, NASA, OceanObs 19 (16 –20 September 2019, Honolulu, Hawaii).....	12
4.4	Strategic Integration of Biology in Ocean Observing System.....	14
4.4.1	Carl Gouldman, IOOS; Implementing the GOOS BioEco variables into Regional Alliances	14
4.4.2	Ana Lara-Lopez, IMOS – Integration of Biology	16
4.4.3	Gabrielle Canonico IOOS MBO The Marine Biodiversity Observation Network.....	17
4.4.4	Michael Wise – ONR, The Marine Mammal and Biology Program	18
4.5	Oceans in a Social Context.....	18
4.5.1	Emily Smart, Blue Planet – Ocean Observations for Societal Benefits	18
4.5.2	Linwood Pendleton, WWF, The Case for Conservation Strategies.....	19
4.6	Interdisciplinary Research Panel	23
4.6.1	Jay Pearlman, IEEE - Implementation of Multi-Disciplinary Sustained Ocean Observations (IMSOO).....	23
4.6.2	Anya Waite, SCOR P-OBS Working Group.....	24
4.6.3	Francisco Chavez, MBARI – VOICE, Oxygen Minimum Zones, EBUS	25
4.6.4	Lisa Levin, UCSD, Deep-Ocean Networks (DOOS / DOSI / INDEEP)	26
4.7	Data and Information Management.....	27
4.7.1	Ward Appletans, Biological Data Management in the Ocean Biogeographic Information System (OBIS)	27
4.7.2	Rebecca Koskela, University of New Mexico, Data One	29
4.7.3	Jay Pearlman, IEEE – Evolving And Sustaining Ocean Best Practices.....	30
4.8	Short Subjects	31
4.9	Frank Mullen-Karger, Closing Comments.....	31
5	Appendix I – RCN Meeting attendees	32

Ocean Observations Research Coordination Network (OceanObs RCN)

In conjunction with the AGU Ocean Sciences Meeting (OSM), Portland, Oregon, Sunday

February 11, 2018

Location: Oregon Convention Center, D137-D138

<https://agu.confex.com/agu/os18/meetingapp.cgi/Session/37990>

1 Executive Summary

The 2018 OceanObs Research Coordination Network (RCN) meeting sought to advance links between research networks and operational users, to facilitate the delivery of critical information to stakeholders. The meeting was held on February 11, 2018, in conjunction with the Ocean Science Meeting (OSM). The meeting aimed at proposing a viable strategy to integrate critical biological observations, including biodiversity observations, into multidisciplinary ocean observing systems. The meeting included a mixture of presentations, panels and informal discussions.

Important opportunities have emerged that require coordination of the community to realize larger outcomes than possible from individual programs. Among these are:

- The NSF Ocean Observatories Initiative (OOI);
- The “International Decade of Ocean Science for Sustainable Development” now approved by the United Nations and to be organized by the Intergovernmental Oceanographic Commission (IOC);
- The Global Ocean Observing System (GOOS) and its regional associations such as the US Integrated Ocean Observing System (IOOS) and the Australian Integrated Marine Observing System (IMOS), which are taking aggressive steps to incorporate biological observations; and IOOS is working to adopt standards for the archival and distribution biological observations used by the Ocean Biogeographic Information System (OBIS).
- The Marine Biodiversity Observation Network has established close links with the Group on Earth Observations (GEO) and the IOC, including GOOS and OBIS, to further promote integration of biological observations into global observing systems, and has developed a roadmap for the complementary Essential Biodiversity Variables (EBVs) of GEO BON and Essential Ocean Variables (EOVs) of GOOS;
- The RCN has organized a number of workshops that seek to integrate such technologies for multi-disciplinary observations, and some this effort is now focused through SCOR Working groups seeking practical integration into observing systems such as GO-SHIP and OceanSITES, spanning the globe from surface to the deep ocean;
- Animal tracking: Technology is advancing for tracking large animals

- Remote and in situ sensing technologies, including new remote sensing technologies and in situ sensors, are evolving yet there need to be significant progress to bring costs down and deploy these new technologies more broadly geographically to enable global assessments of marine biodiversity and ecosystem services.
- New data and information systems are being implemented, including repositories for Best Practices, and these need to be linked and the community needs to be aware of them.

A paradigm shift is required to ensure that societal needs are met through ocean observations; this will require additional attention on datasets that inform observing systems on human pressures and needs, and on ocean uses and their value to society. Agencies around the world, including NASA in the USA are spearheading the organization of the OceanObs'19 conference, which is the next in a series of conferences held once every ten years and which have in the past had significant impacts on oceanographic efforts worldwide. These and other efforts need to be synergized as 2018-2019 is an important timeframe for agencies, institutions, and community involvement.

2 Introduction to OceanObs RCN Meeting

2.1 OceanObs RCN Meeting Objective

The 2018 OceanObs RCN meeting was held in conjunction with the Ocean Sciences Meeting, at the Oregon Convention Center, on Sunday February 11, 2018. The meeting sought to advance links between research networks and operational users, to facilitate the delivery of critical information to stakeholders. The meeting objective was to propose a viable strategy to integrate critical biological observations, including biodiversity observations, into multidisciplinary ocean observing systems.

A goal was to obtain input from leaders and operators of observing systems to contribute to a white paper for input to the OceanObs'19 meeting (September 2019, Honolulu, Hawaii). This included identifying promising new technologies and promoting their cost-effective development. It also included a discussion of a Decade of Ocean Science for Sustainable Development (2021-2030), being defined by the UN/IOC (<https://en.unesco.org/ocean-decade>), for balancing ocean observations, science, use, and conservation requirements.

2.2 Meeting Agenda

Time	Subject	Session Chairs and Presenters
8:30 am	Coffee and Registration	
9:00	Welcome and Introductions	Jay Pearlman
9:15	<u>Vision for Ocean Observing</u> Ocean Science Directions / Decadal Survey (Sea Change (2015-2025))	Chair: Jay Pearlman Bob Houtman / NSF Ocean Sci.
	IOC / Decade of Observation	Peter Haugan / chair of the IOC
10:15	Morning Break	
10:45	<u>OceanObs'19</u> Update	Eric Lindstrom
11:15	<u>Strategic integration of biology into the ocean observing system</u> Implementing the GOOS BioEco variables into Regional Alliances Recommendations for implementation Marine Biodiversity Observation Network (MBON) Animal Tracking Networks (international perspective)	Chair: Frank Muller-Karger Carl Gouldman / IOOS Ana Lara-Lopez / IMOS Gabrielle Canonico / IOOS Michael Weise / ONR
12:30	Lunch	
1:30-2:05	<u>Oceans in a societal context</u> Human dimensions of ocean observing The case for conservation strategies	Chair: Jay Pearlman Emily Smail (U Maryland/ <i>Blue Planet</i>) Linwood Pendleton (WWF, Duke U.)
2:05-3:15 pm	<u>Interdisciplinary Research Panel</u> IMSOO follow-on Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS SCOR WG) Eastern boundary upwelling systems (EBUS SCOR WG): diversity, coupled dynamics and sensitivity to climate change Variability in the Oxycline and its Impacts on the Ecosystem (VOICE) The Deep Ocean Observing Strategy and the Deep-Ocean Stewardship Initiative	Chair: Jay Pearlman Patricia Miloslavich and Jay Pearlman Anya Waite, Alfred Wegener Institute, Germany and Emmanuel Boss, Univ. Maine, USA; Francisco Chavez, MBARI, USA, Ivonne Montes, Peru; Ruben Escribano, Chile F. Chavez, MBARI, USA; Maciej Telszewski, IOCCP Poland; Johannes Karstensen, GEOMAR, Germany Lisa Levin; Scripps Inst. Oceanog., USA
3:15	Afternoon Break	
3:30	<u>Data and Information Management</u> Biological data management in the operational ocean observing system DataOne Best practices – observations and data management	Chair: Frank Muller-Karger Ward Appeltans, UNESCO IOC/OBIS Rebecca Koskela / DataOne Jay Pearlman and Cyndy Chandler
4:30	Short Subjects – Hot topics open mike	Jay Pearlman (moderator)
5:00	Concluding Remarks	Frank Muller-Karger
5:15	Adjourn	

2.3 The Ocean Observations Research Coordination Network (OceanObs RCN)

The Ocean Observations Research Coordination Network (OceanObs RCN) provides a forum for a broad, multi-disciplinary dialogue about how ocean information can be placed more effectively in the hands of those that need it, when they need it. This RCN has worked since 2012 to connect ocean research networks with operational users to facilitate the delivery of critical information to stakeholders. A primary goal of the RCN for the 2017-2022 period is to promote the integration of critical biological observations into multidisciplinary ocean observing systems. This includes identifying and promoting the development of new cost-effective technologies, both for observations and data management (including data delivery). The approach should take advantage of current and planned observing platforms to expand observations.

The OceanObs RCN activities are coordinated by Dr. Frank Muller-Karger (Principal Investigator) at the University of South Florida, Dr. Jay Pearlman (Co-PI, University of Colorado), Dr. Dawn Wright (Co-PI, Esri), and Dr. Linwood Pendleton (Co-PI, Global Lead Ocean Scientist and World Wildlife Fund, European Institute of Marine Studies, and Duke University's Nicholas Institute for Environmental Policy Solutions). USF serves as the host institution for the RCN.

We are working to facilitate exchange among all of the major ocean data players - NSF, NASA, the U.S. Integrated Ocean Observing System of NOAA, the Australian Integrated Marine Observing System, with those who really need data to manage the oceans. Active participation includes working groups at the Scientific Committee on Oceanic Research (SCOR), the Ocean Biogeographic Information System (OBIS), and the Global Ocean Observing System (GOOS) of the Intergovernmental Oceanographic Commission (IOC).

A major goal is to bring user needs and solutions to the OceanObs'19 meeting in September 2019 in Hawaii. The international community that collects ocean observations for operational and maritime applications will meet with ocean researchers from around the world. The OceanObs RCN plans to hold a number of workshops between now and then to frame issues within the context of sustainability of observing systems, broadening interdisciplinary cooperation, simplifying the exchange of ocean data and information, promoting standards and interoperability concepts, and facilitating the delivery of critical information to stakeholders. The RCN will continue to stimulate collaboration across disciplines at an international level. The dialogue with industry ensures that ocean observations have broader impact and value, especially in the new blue economy.

The OceanObs RCN is establishing a Steering Committee, whose members will review strategic planning and set goals for the activities in the RCN. They will guide discussions in formulating recommendations for national and international organizations that have direct interest in ocean observations.

For more information contact: Frank Muller-Karger / carib@usf.edu

2.4 Details About the PI and CO-PIs

Frank Muller-Karger, University of South Florida, led the NSF-sponsored CARIACO Ocean Time Series program from 1995 to 2017. He is the principal investigator of a five-year, National Ocean Partnership (NASA, NOAA, BOEM) project to develop a Marine Biodiversity Observation Network (MBON) in collaboration with US agencies and the GEO BON. Dr. Muller-Karger has conducted extensive work on ocean remote sensing.

Jay Pearlman, Professor Adjunct of the University of Colorado and Fellow of the IEEE, has extensive background in space-based and in situ measurements as well as advanced information systems including building of space-based instruments and co-leading international science teams. He was the PI of the first OceanObs RCN. He is active in international activities such as AtlantOS, NeXOS, IEEE OES and the Oceans of Tomorrow.

Dawn Wright is chief scientist of Esri, adjunct professor of Geography and Oceanography at Oregon State University, and a fellow of the AAAS and the Geological Society of America. She has partnered with scientists over the past 20 years to expand the use of geographic information system (GIS) technology to analyze terrains, ecosystems, and habitats. As Esri Chief Scientist she is charged with strengthening the scientific foundation for Esri software and services, while representing Esri to the national and international scientific community. She is recognized for her research on mapping and tectonics of the ocean floor and for her leadership in adapting GIS to the marine environment.

Linwood Pendleton is an environmental economist and holds the International Chair of Excellence at the European Institute for Marine Studies, part of the Laboratory of Excellence in Brest, France. He is a Senior Scholar at Duke's Nicholas Institute for Environmental Policy Solutions (NIEPS), and the director of the Marine Ecosystem Services Partnership – an initiative of Duke University's Nicholas Institute for Environmental Policy Solutions that helps facilitate communication about the human uses of marine ecosystem services. He was the Acting Chief Economist for the National Oceanic and Atmospheric Administration (NOAA) from 2011-2013. Dr. Pendleton's focus is on the economic dimensions of marine ecosystem services.

OceanObs RCN Steering Committee:

<u>Steering Committee</u>	<u>Affiliation</u>
Simon Allen	Spatial Analytics Australia, Australia
Peter Edwards	NOAA, Silver Spring
Elva Escobar	Universidad Nacional Autonoma de Mexico, Mexico
Albert Fischer	IOC GOOS, UNESCO
René Garello	Télécom Bretagne / GEO Blue Planet
Paul Holthus	World Ocean Council
Tim Moltmann	University of Tasmania, Australia
Peter Pissierssens	IOC IODE, UNESCO
Sophie Seeyave	Plymouth Marine Laboratory, UK / GEO Blue Planet
Martin Visbeck	GEOMAR, Germany
Iain Shepherd	European Commission (Fisheries)

3 Acknowledgements

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Ben Best, Patricia Miloslavich, and Enrique Montes.

Any opinions, findings, and conclusions or recommendations expressed in these proceedings are those of the contributors only.

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4 Presentations Summary

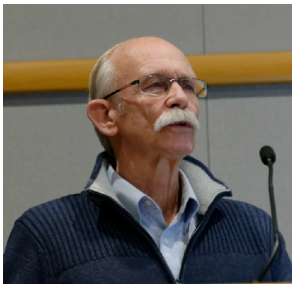
4.1 Jay Pearlman – Introduction to the Agenda



Around the room introductions (see attendance list in Appendix I)
Jay Pearlman introduced the objectives of the day starting with visions and opportunities for the next decade, then looking at some of the challenges in maturing ocean biology forward. Jay reported on the IMSOO workshop a year ago and the related activities that have emerged in its three focus areas (boundary currents, oxygen minimum zones, plankton communities). All of these activities must be supported by a strong data management and user interface capability.

4.2 Vision for Ocean Observing

4.2.1 Bob Houtman - Ocean Science Directions / Decadal Survey



Bob Houtman acknowledged the international component of the RCN. NSF is working with the ocean sciences community to identify the focus areas for research and infrastructure that are needed for the ocean sciences.. In moving forward, NSF is not driving the priorities but responding to the community. The “Decadal survey” of Ocean sciences (“Sea change”) addressed the period from 2015 to 2025. Bob’s presentation discussed the rationale for the survey and the balance between funding in infrastructure and research. The Sea Change report was commissioned by NSF due to concerns by the research community about the balance between core research and operations. The percentage of research grants evolved from 62% in 2000 to 46% in 2014.

The NSF infrastructure program was developed through listening to the needs of the scientific community to achieve their goals. Projects funded: building of R/V Sikulliaq ice breaker and upgrading of Alvin submersible. See sfos.uaf.edu/sikulliaq. HOV Alvin upgraded & operational 2014. For the Ocean Observatories Initiative (OOI), there are 4 global high latitude sites, 2 coastal arrays, cabled array. (OceanObservatories.org). Regional Class Research Vessel (RCRV): construction has started and will be over a period of 2017-20 with delivery ‘20-’22. Investment in IODP (International Ocean Discovery Program) expansion (IODP) is also underway. Sea Change identified science objectives and these were aligned with the research priorities of NSF:

- Sea level change
- Coastal and estuarine oceans
- Ocean and climate variability
- Biodiversity and marine ecosystems
- Marine food web.

Recommendations on budget were based on assessments with the community who ranked the priorities. Sea Change recommended that the Academic Research Fleet (ARF) be reduced by 5%, IODP by 10%, OOI by 20%. The report was released in 2015, and NSF immediately started to implement the changes in ARF and IODP. For OOI, they decided to go ahead and deploy the 2 global arrays and implement the reduction during the operations and maintenance phase which starts this year.

Bob summarized the research focus on physical, chemical and biological oceanography, geology and geophysics and the scopes and approach on each. He stressed the goal of incorporating state of the art technology, which was not available previously, into the RCRVs.

OOI has over 750 instruments. Also within the OOI program, NSF has opened the possibility of putting up proposals to improve instrumentation for different research areas. They have made the decision of removing the buoy at the Argentinean site and the Southern Ocean buoy off of Chile was partially removed.

Questions

How do we reconcile conflicting points of view between gaps and the priority of sustained observations?

Response: OOI is a fixed program and additional sensors have to come through proposals.

For cable observatories, how do you relate with the Canadian efforts?

Response: There is no connection from a funding perspective between the USA and Canadian observatories. However, there is significant collaboration and exchange of information in operations, data and management. One of the most promising connections is in the area of data sharing and by sharing best practices and using the same standards. Bob indicated that there is no proprietary data in OOI.

4.2.2 Peter Haugan – The ocean we need for the future we want



There are significant objectives for ocean observations in the next decade, including science to help the ocean support the 2030 agenda. The “International Decade of Ocean Science for Sustainable Development” was approved by the UN General Assembly (UNGA), and the Intergovernmental Oceanographic Commission (IOC) is to draft the implementation plan for the decade and invited input from UN-Oceans and its participants.

(See UNGA-72 Omnibus Resolution on Ocean Affairs and Law of the Sea 6 December

2017.)

Approval was achieved in less than 2 years – the decade will go across and beyond the UN, to expand to managers, society, industry, and all sectors. “Ocean science for the future we want” is to have a period of 2 to 2 and one half years to work on the planning.

The goals include:

Goal 1: To generate the scientific knowledge and underpinning infrastructure and partnerships needed for sustainable development of the ocean.

Goal 2: To provide ocean science, data and information to inform policies for a well-functioning ocean in support of Agenda 2030.

Strategic objectives include:

- Knowledge of the ocean for Sustainable Development
- Evidence for ecosystems-based management
- Save lives and reduce risks from ocean-related hazards
- Enhance observing networks, infrastructure, technology
- Scientific and technical capacity and education, ocean literacy
- Partnership, cooperation, coordination, and communication,

This decade is an historic deal involving world leaders and oceanographers with IOC and partners to set the strategic direction. The preparation phase: to include governance, structure, engage and consult the community, resource mobilization, and communication with stakeholders.

Timeline for the next 3 years: establish an Ad Hoc planning group, consultation with member states, involvement in parallel events happening worldwide (e.g. IPCC, 'OceanObs'19, WOA-2, 2nd UN Oceans Conference in 2020)

Planning group terms of reference – gives the components needed for the IP – provides the formal framework for the world leaders to support the plan.

Potential massive-scale projects: e.g. complete mapping of the seabed, deep ocean observations and research, oceanographic capacity development, ocean observations across disciplines (biology, physics, biogeochemistry),

Who will benefit, centered on “scientific knowledge”, will be the civil society, science community, governments, UN processes, users/providers of marine technology.

Take home messages:

2018-2019 is the time for agencies, institutions and community involvement.

How can ocean sciences be developed to better serve the 2030 agenda, not only SDG14.ss, education, literacy, outreach!

Questions and discussion

How will ecosystem based management (EBM) be implemented?

Response: Try to build the case that by improving the ocean observations we will be able to provide the required information to successfully improve EBM – the principle is that it must be adopted.

How to expand observations to the “south”?

Response: Observing systems are needed and this message must be conveyed to high-level politicians.

Climate change was recognized earlier, microplastics is being recognized today. Micro plastics is an example of how the public opinion may influence initiatives, how involvement from the community can drive more science.

Does IOC have a view on the issue of geo-engineering?

Response: IOC does not have a formal policy in this area. IOC initiated the sequence of CO₂ conferences, but despite the connection between IOC and scientists involved in this research, there is no policy in the IOC regarding these issues. IOC prefers to keep itself “under the radar” of these kind of policies and continue to support the science.

4.3 Eric Lindstrom, NASA, OceanObs 19 (16 -20 September 2019, Honolulu, Hawaii)

The OceanObs conferences happen every 10 years. The previous two were in



Europe. The main outcome of 'OceanObs'99 was the coordinated system for physical climate and carbon. The main outcome of 'OceanObs'09 expanded the range of communities and produced the framework for ocean observing. For OceanObs'19, the objective is to further develop effective strategies for a sustained, multidisciplinary, and integrated ocean observing system, and to better connect user communities and observers. From a user community's

standpoint, they would like to engage operational users, national and local authorities as well as researchers in both the public and private sectors in all aspects of ocean observing. Regarding international engagement, the objective are closer interaction to improve governance arrangements, supporting observing networks, data flows and derived products and their use in ocean affairs.

The societal benefit themes will be examined by their relationship to Ocean Observing and how information products can be best supported through the observing system theme OceanObs'19 will build on the Framework on Ocean Observation (FOO). It is expected that one of the outcomes of the conference will be an upgrade of the FOO (“FOO 2.0”) with lessons learned in the last decade.

The conference coordinators rely on the following community-based committees:

Program Committee - “The input to the conference”

- Co-chairs: Sabrina Speich (France), Tony Lee (USA), Minhan Dai (China), Sanae Chiba (Japan)
- Members Selected: 17 Global experts
- Staff support from Nicholas Rome and Kruti Desai (US IOOC)

Local Organizing Committee - “Executing the event.”

- Co-chairs: Bruce Howe (U.Hawaii) and Jim Potemra (U.Hawaii)
- Staff support from Andrea McCurdy, Michelle McCambridge, Melanie Russ (UCAR/CPAESS)

Sponsor Committee - "Guiding the output from the event"

- Co-chairs: Eric Lindstrom (USA), Martin Visbeck (Germany), Weidong Yu (China)
- Representation from main intellectual and financial sponsors
- Staff support from Katy Hill (WMO)

Executive Committee - "Coordination"

- Constituted from the ALL Co-Chairs

Only decisions that cannot be decided within the committees will be elevated to the executive.

White papers will be developed to articulate the status of the observing system and outlook for the next decade. The process this time is based on lesson learned from the past conferences; there will be abstracts first, will be reviewed by the program committee. The abstracts are due by March 15. Following the short review and feedback, selected abstract authors will be requested to submit white papers, possibly organizing them around themes and therefore, joining groups who submitted separate abstracts on similar themes. The abstracts/white papers should:

- Address connections between end users and providers
- And one or more of the following:
 - Emerging science concepts that require multidisciplinary sustained observations
 - Advances in open data and information sharing and info management systems
 - Requirements for sustaining and enhancing ocean observing capabilities
 - Improved processes to better support research and operations
 - Development of new observing technologies and networks
 - Innovative ocean observing system design and evaluation
 - Best practice of ocean observing and information delivery
 - Strategies to address social and economic needs
 - Value of ocean observing and priority setting
 - Observation-model synthesis.

A journal will be identified for publication of these papers before the conference.

OceanObs'19 is looking for financial sponsors – there will be different sponsorship categories. NASA is the major sponsor as well as NSF. This is a work in progress at the moment.

What are the outcomes Ocean Obs19 is looking for?

A decade of vision for ocean observing: Enhanced coordination, innovation, link to SDGs, strengthening user engagement; effective governance combined with user perspective. Information of lessons learned of FOO is being compiled for FOO 2.0. What is needed near-term? Send your ideas to any member of the ExCom.

Questions:

How do we set the requirements to be more inclusive?

Response: GOOS has three sector-oriented panels, for physics based on climate requirements, BGC based initially on carbon and extended to other elements, and the most recent, the biology and ecosystem. GOOS has a process to consider the requirements. OceanObs role will be to pass information to GOOS on identified new requirements for GOOS. OceanObs'19 will be better prepared to build new connections for discussions in the long term, reaching out beyond the scientific community.

How will other sectors be involved in the conference?

Response: The committee will identify and track "superusers" and attract them to the community. The Conference needs to continue to raise the funds to be able to invite these stakeholders.

How will OceanObs connect to the Decade of the Ocean?

Response: A strong, visionary observing system will feed into the Decade as a key partner, but the Decade will include much more science. Many of the observations are funded by science. OceanObs should not play the role of the Decade, nor should it be made an intergovernmental meeting. This does not preclude side meetings to involve policy actors and to feed positively to the decade. Does OceanObs'19 include coastal observations?

Response: When GOOS was reorganized under the FOO, the networks included both the coastal and the open ocean.

4.4 Strategic Integration of Biology in Ocean Observing System

This session focuses on the strategic integration of biology into the ocean observing systems:

- Carl Gouldman: Implementing the GOOS BioEco variables into Regional Alliances
- Ana Lara-Lopez: Recommendations for implementation
- Gabrielle Canonico: Marine Biodiversity Observation Network (MBON)
- Michael Wise: Animal Tracking Networks

4.4.1 Carl Gouldman, IOOS; Implementing the GOOS BioEco variables into Regional Alliances

In the US legislations, IOOS is a national system under federal agencies. It contributes to GOOS as one of the regional alliances, with a mission within societal areas. They work as a team with IOOC as one of the players, contributing to GOOS, and GEO (AmeriGEOSS and GEO BON).

- Coastal component (EEZ): 17 federal agencies and 13 regional partners
- Global component: US contribution to GOOS (completed at 63%)
- Canada is implementing an Ocean Obs System
- IMOS (Australia) chairs the GOOS
- GOA-ON (global ocean acidification observing network)

IOOS Regions: IOOS has committees, as for example gliders, radars, and acidification.



IOOS is organized by regions (11 regions) that work with state, local and tribal governments, industries, academia, stakeholders. They have just written a strategic plan for the next 5 years that has been released – it has a new set of core variables, (biology upgrade) which include physics, biogeochemistry, biology & ecosystems. The biological variables from

the US task team are included.

IOOS is a team sport. Carl showed several examples of links between US agencies and the GOOS BioEco EOVs. There is an issue on the definition of “operational” as different agencies will have different perspectives but there is the need to agree on what is the best operational way to make the measurements to deliver the information.

Harmful Algal Bloom (HAB) sampling includes use of the Environmental Sample Processor (ESP), collection of razor clams for toxin testing, ship-based sampling, beach plankton samples and modeling of currents and water properties based upon weather forecasts (WRF) and river and other inputs.

The ESP is an automated biosensor that collects and analyzes water samples every few days and transmits the data back to researchers. Developed by the Monterey Bay Aquarium Research Institute and supported by an IOOS Ocean Technology Transition Grant, the ESP is deployed in the Pacific Northwest and the Gulf of Maine to measure potentially harmful phytoplankton species and the toxins they produce.

Pacific Northwest Harmful Algal Bloom Forecast Goes Operational. [Real-Time HABs](#), funded by the National Centers for Coastal Ocean Science and the National Marine Fisheries Service, integrates data from the U.S. Integrated Ocean Observing System (IOOS®) and is hosted by the Northwest Association of Networked Ocean Observing Systems (NANOOS, an IOOS regional association). The HAB Bulletin is a compendium of observed data – water and organism samples for toxic species and domoic acid and model data. – The LiveOcean model forecasts are used for circulation and ocean properties, winds and weather forecasts. These affect upwelling and transport of organisms. HF radar monitor ocean surface currents – again for transport, longer-term upwelling and El Nino indices. The bulletin provides a textual interpretation and guidance for shellfish managers.

The model- and observation-based HAB forecast is supported by data from IOOS, the University of Washington’s LiveOcean model, sampling by state and tribal groups, and other real-time observations. The bulletin also uses data from the ESP,

deployed near the Juan de Fuca eddy, a known HAB "hot spot." Additional note: CO-OPS also transitioned the Lake Erie HAB forecast to operations in 2017.

4.4.2 Ana Lara-Lopez, IMOS – Integration of Biology

IMOS focuses on strategic integration of biology into the observing systems. It is funded to collect ocean information for research by the Australian government, providing open data for everyone to use and re-use without restrictions. It was established in 2006.



IMOS organized the marine community into an open ocean node and six coastal/shelf nodes covering Australia. Facilities include Argo floats, moorings, tracking, integrated across the three disciplines (physical/Biogeochemical/Biology and ecosystem).

They conduct observations of ocean color, plankton (phyto/zoo), benthos, nekton, marine mammals. Some were initial targets of IMOS and some happened organically by suggestions of the scientific community (e.g., microbes and ichthyoplankton). The operational agency is the Bureau of Meteorology.

IMOS was recently reviewed (10 years of the program), and one of the outcomes was the integration with the modeling community who are now part of IMOS (~2012). Another is eReefs (providing information of the Great Barrier Reef), also passive acoustics using Ships of Opportunity.

IMOS has also developed value-added products. For this they have worked with e.g. Marine park authorities to ask them their needs. One of the requests was based on migration of mammals for better management of parks. Plankton have also been used for "state of the environment".

They are also working with HABs to try to establish a warning program to be used by the aquaculture industry (abalone, salmon, etc.).

Next in line: eDNA - providing water samples and ichthyoplankton (in trial to develop best practices).

Questions

The value of integrating the observations with modeling was highlighted. One of the advantages is that modeling in the coastal space translates into predictions, which allow management.

How is the calibration and inter-calibration organized around so many platforms?

Response: IMOS is a joint venture of different facilities, and one of them (CSIRO) makes the calibration and QC/QA across the nodes based on the EOVs.

Models are also being used for predictions in the open ocean with management applications. These are used by the ISA, also potentially the BBNJ, and the climate system. In Australia, the open ocean data is used by fisheries management.

4.4.3 Gabrielle Canonico IOOS MBO The Marine Biodiversity Observation Network

MBON is part of IOOS and is integrating biology into the marine observing systems.



Three demonstrations are ongoing: Santa Barbara Channel, Arctic, and National Marine Sanctuaries (Florida Keys, Flower Garden Banks, Monterey Bay). Funding in the amount of approximately \$17M is provided by NASA, NOAA, BOEM, NSF, and industry. IOOS is responsible for full-time leadership. Partners include: USGS/OBIS-USA (very active on the data management site and also through OBIS); Smithsonian/Marine, GEO US and global partners.

MBON established a formal agreement with GOOS BioEco and OBIS with the goals of strengthening biological observations in a coordinated and sustained way to the best of the organization's capabilities. They are currently organizing a Pole-to-Pole Workshop in partnership with AmeriGEOSS: End-to-End Coastal Ecology: Marine Biodiversity from the Field to the Cloud. Praia do Cabelo Gordo, São Sebastião, Brazil, August 6-10, 2018.

Gabrielle introduced some tools and products available coming from the US-MBON: Data Portal V2.0 / "Data storytelling" (informs on indicators, info graphics, habitat conditions) open source / Dynamic Seascapes / Collaboration with EMUs and ECUs

In partnerships with the global community, they aim to be the marine biodiversity arm of Blue Planet. Also in with G7, GEO, AmeriGEOSS, AtlantOS, CBD and others.

They are making progress with OBIS for joint biodata training (IOOS/OBIS) and are also working with imaging/deep learning, eDNA, exploring user needs, and trying to identify a path (and resources) to achieve sustained biological observations.

Questions:

It is important to get the spatial and temporal variability – where is the science of understanding ecosystem dynamics?

Response: MBON is a contribution to that larger approach to ecosystem-based management. MBON takes a holistic approach, looking across diverse taxa, not only targeted species (for fisheries, for example). Since we cannot measure everything and everywhere, what is it that we need to do to get to the point?

4.4.4 Michael Wise – ONR, The Marine Mammal and Biology Program

The Animal Tracking Network (ATN) vision is to create and build an alliance on animal telemetry, to conduct baseline observations, and then manage the data. Many data formats are centralized in a data center.



ATN works at the region level, identifying priorities and gaps, building capabilities with its partners to support the regional needs and working towards finding the means to support those needs. In the US, there are 9 agencies doing telemetry, which they would like to integrate. Plans for 2018, 2019-2021 involve different phases on how to implement the observations, maximizing information within limited resources, scaling up to an operational environment, meeting the need of organizations doing the tagging work, and promoting the use of animals as oceanographers, sentinels for climate change. This includes a push to develop technology, such as cheaper tags.

The topic of animal as oceanographers has been around for some time. There have been major developments in the sensors for animals (e.g. CTD) that are available commercially. Data on CTD observations using animal telemetry are significant in the Arctic and Southern Ocean. Telemetry data used in fisheries applications, which can help to identify stock boundaries and critical habitats among other applications.

Questions:

As Argo increases, how is this telemetry data needed?

Response: Telemetry allows for collection of data on specific habitats.

Have there been efforts to expand towards larger scale to pick up fish / noise / etc.?

Response: There have been examples in which the tagged animals provide data used for fisheries.

4.5 Oceans in a Social Context

4.5.1 Emily Smart, Blue Planet – Ocean Observations for Societal Benefits



Blue Planet is a voluntary network of ocean observers, stakeholders, agencies, managers, etc., connecting users to providers and increasing user engagement. They are trying to make a “seascape” of the ocean observing community for users - who is doing what and where?

An example of this was the recent Caribbean SDG Workshop (January 2018 in St. Vincent and the Grenadines) which addressed implementing and monitoring the SDG’s evolution in the Caribbean with a focus on the role of the ocean. The goal is to work with the local stakeholders to identify requirements at a level of specificity, which does not scare tourists – e.g. water condition in beaches.

The Caribbean workshop was a pilot for future workshops in other regions (Cape Verde, Portugal). UNDP in Barbados provides support for regional projects 4m (Multipurpose Marine Monitoring Mechanism). Engagement with the GOOS Caribbean alliance (IOCARIBE) and other regional agencies to establish a pilot monitoring program – a first priority was on invasion of Sargasso, and oil spills. The 4th Blue Planet symposium will be held in Toulouse, France July 4-6, 2018.

Questions

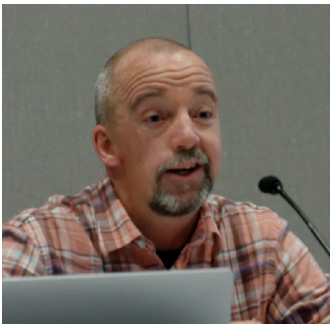
What are the metrics of success of the project?

Response: Blue Planet would like to see the pilot observing programs to turn into a sustained system. We want operational product; implementation and governance may be problematic in the Caribbean.

There was a question about Citizen science applications, such as I-naturalist – build on something that exists or tailor it. World Bank might be interested in contributing to this.

Response: We are aware of I-naturalist.

4.5.2 Linwood Pendleton, WWF, The Case for Conservation Strategies



Conservation is not primarily about biodiversity, environmental quality, or ecosystems. At its heart, conservation is about *managing people*. But, when we think about data needs for ocean conservation and management, especially ocean observing, we rarely think about people first. Yet, it is only with data about people that we can begin to explain the “so what” of the biological and physical data we collect. How can we explain the importance of ocean color, sea surface temperature or LIDAR data without linking it somehow to people? How can we explain why we need to greatly expand ocean observation to include biodiversity data unless we can show how these data reflect changes in the ocean that are relevant to people?

Conservation action is almost always focused on getting people to care about nature and to subsequently change their behavior – to reduce human impacts on nature and the environment, to restore lost ecological function, and to steward nature.

To be effective, conservation professionals and scientists need to know:

How do people change nature?

How do changes in nature affect people?

How does conservation action change human behavior and thus nature?

To understand these statistical relations between humans and nature, especially at large scales, there are 3 key challenges we face as conservation scientists:

1. *How do we identify the key biodiversity and oceanographic data we need?*
2. *What human data do we need and where is it? And*
3. *How can we link human data w/ biodiversity and oceanographic data?*

To address these challenges, we must:

- 1) Find ways of *linking existing global data sets on human dimensions with biodiversity and oceanographic data systems (e.g. GOOS, MBON)* – we need a global observation network for data on humans, we need GEOSAPIENS. There is already a lot of data on people – where they are, what they do, their economic activities and social development. It is collected by the World Bank, UNDP, WTO, CIA, NASA, Columbia University, and other organizations. FAO has global data sets on fishing and *Collect new and better human data*, relevant to ocean systems, at finer resolutions that help us analyze and model specific human dependence on specific ecosystems and their states. We could improve the quality and quantity of human ocean data by just including human data when we are designing environmental and biodiversity data collection. Think of all the data about ocean nature that we have that is missing its human element. We have: a) more data on reef fish than reef tourists and fishers, b) more data on beach bacteria than beach goers. We need a spatial database of digger days and more!
- 2) Collect human data keeping in mind how we will analyze it in the context of ocean observing data. We rarely collect data on *human pressures* at a resolution that helps understand how changing population and demographics and economic activity affect ecosystem health or biodiversity. We should be collecting human related data at similar temporal and spatial scales that we collect environmental and biological data. Without these data, we are unable to quantify the “so what” of ecosystem change and biodiversity loss. A lack of data on human dependence on coral reefs, at large scales, means we don’t know *what the human impact of the recent two years of mass coral bleaching was*, nor do we know *how people responded to mass coral death?* Routinely we are unable to *evaluate* effectively the cause and effect relationship of the conservation activities we undertake.
- 3) Increase knowledge *about what is happening in the most remote places* - like the high seas (where illegal fishing, whaling, and pollution are key human issues) and the deep-sea. We end up managing those activities for which we have a lot of data – like looking for your keys under the lamppost.

From a conservation perspective, waste of data is a big problem in Conservation science. There is a lot of ocean observation data we will never use or data we can’t use. Not all data are equally useful, yet all data have a cost - a cost to collect, to

process, to manage, archive, and disseminate.

Quite often we end up without the crucial data we need to make sound conservation *decisions*? Why the *mismatch*?

1) We frequently fail to use collaborative processes that *start with the user*, and works backwards. Far too often the paradigm is: *Collect Data, Process Data, Build a Data Platform, Distribute or Disseminate Data, and Use Data*. People who manage ocean observation data systems often find themselves trying to “sell” the data we’ve already decided to collect for other reasons.

2) It is not easy to collaborate. We don’t usually have ocean observation people, social scientists, and conservation scientists together in the same places. In France, these people aren’t even in the same universities! So, at the new International School of the Sea (ISBLUE) we’ve tried to remedy this by creating a co-working space that sits outside of any one university or department. We have thematic co-working days: Tech4Whales, Mangrove Mapping, Data Assimilation, etc.

3) Users often don’t know *where to find data*, we are often one or two steps removed from the original data.

4) Users don’t know *how to deal with the large quantities, huge variety, and uneven quality of data* that can vary in terms of time, space, and quality (messy data).

Building more and more data platforms, built by data providers, is not the answer. People don’t think about their data needs in the same silos in which data are provided. People think about data needs starting with problems first and then work towards data. Data navigation tools need to follow the same approach.

Just having more data, more access to data, and more analytical power is not enough. We need to humanize the way we interact with data. What we really need are more *data curators*, information scientists that can work with end users to find, access, and process data in meaningful ways. New, light touch data interfaces (API) offer advantages, making it easier to curate data, and to easily be configured to data user needs. These platforms don’t house data, but draw on existing databases. So, they are never out of date. The key is to design them for different uses and users – in other words use these systems to curate the data.

Too often ocean observation data providers struggle to come up with a single paradigm to link users and data. *There is no universal paradigm to link data producers and users.* It depends on the user, not the data. The key is build many paradigms and light touch platforms that are built from the bottom up to determine the relationship that links users, distributors, processors and producers of data (in that order). Then we must create systems that allow us to

coordinate data provision across different user-driven groups and interdisciplinary projects, *without slowing them down*.

The key to making ocean observation data useful is to have the *right data in the right place at the right time*. That doesn't mean collecting more and more data; it means being smarter about what we collect and when and where. We know that data by itself doesn't change behavior, but data that can back-up experience can change behavior. We need to be prepared to document changes in biodiversity and its impact on people in a way that moves the public and corresponds to large changes in biodiversity like the recent mass coral bleaching.

To collect smarter data, we need to work more with *behavioral scientists* to figure out what data will make a difference: when, and how. Ultimately, data are used to inform human decisions. Shouldn't we work more with people who study human decision-making? *What is holding us back?* Right now, we are limited only by our imagination. Too often we still use simple models that represent our view of how the planet works and how ocean data link to people. We have to free ourselves from old theoretical models that don't describe how nature really works but are simply tools to help us understand nature. We need to do a better job of mining the huge abundance of data we have. We have to digitize the reams of historical data that are out there,

We have to harness the internet of things to give us more real time pictures of change and where to act. We need to use drones, auvs, and nano-satellites to plug the wholes in our data and monitoring.

Finally, we need to recognize that there are a lot of data sources out there that we haven't even considered using. In the early part of the century, everyone was making apps that people could use to record nature, but these apps draw on hundreds or perhaps thousands of people. We can do better. We need to make better use of passively collected data, collected in real time, by the 3 billion smart phone users, traffic cameras, surveillance videos out there collecting data we never use.

Artificial intelligence, informatics, behavioral sciences and other fields could help ocean scientists unlock new ways of using all of these data, but these people don't often come to conferences like this. We need to figure out how to bring new brains into our work.

To close, we should:

- 1) Start the design & monitoring of data collection with users to collect the right data.
- 2) Ask social scientists and behavioral scientists to help identify the right ocean observation data, at the right time, in the right place.

- 3) Train and employ data curators and use light-touch curation platforms.
- 4) Continue to digitize historical data and use non-traditional sources of data.
- 5) Use machine learning to deal with messy data and to explore relationships that don't necessarily fit our mental models.

Questions:

How do we deal with privacy when collecting human data?

Response: The level of data that needs to be collected is not really related to private issues. There can be a balance between the need for privacy and the need for data.

Do social data and social science need more context?

Response: Much human data is there but it needs to be "digged" (e.g. people carry cell phones that provide their location at all times).

What data needs to be collected from humans related to the deep sea?

Response: Some examples - ship traffic, deep sea trawling...

4.6 Interdisciplinary Research Panel

4.6.1 Jay Pearlman, IEEE - Implementation of Multi-Disciplinary Sustained Ocean Observations (IMSOO)

The "Implementation of Multi-Disciplinary Sustained Ocean Observations (IMSOO)" workshop was supported by (NSF, NOAA, NASA, GOOS), and conducted in February 2017. The need for multidisciplinary observations, was focused on three themes: plankton communities, oxygen minimum zones and boundary currents. The core objective was to look at an integrated perspective of interdisciplinary ocean sciences. Building on the established societal and scientific requirements expressed in the EOVs, the workshop participants identified near-term innovation priorities for observing platforms and sensors to enable multi-disciplinary observations. They also identified programmatic and professional connections between existing and emerging observing networks that will increase multi-disciplinary observations. See the Report in GOOS website (GOOS Report #223.)

Outcomes and recommendations of the workshop and its follow-ons will be setting the stage for OceanObs19 contributions:

- A series of planning and implementation meetings and workshops planned for 2017 and 2018.
- New capabilities and new observation systems must build on existing capabilities, e.g. addition of water sampling for biological measurements to repeat hydrography surveys.
- Need for a blueprint of a multidisciplinary backbone observing system for broader implementation, including a generic design process.

- Need for common use of existing standards and best practices for data management, creation of best practices manuals and similar documentation.

Jay highlighted one of the desired IMSOO family products, a draft the implementation plan (IP) for the observation of plankton communities and the main components of the IP (mission, vision, methods, best practices, societal impact and benefit, requirements, etc....). A workshop of the Plankton community will be held at the University of California, in Santa Cruz, CA on June 25-27, 2018 – *“Implementation plan for a sustained, multidisciplinary global observing system of plankton communities”*

Questions:

How is the social component going to be addressed?

Response: Anya Waite will provide context within the P-OBS discussions.

4.6.2 Anya Waite, SCOR P-OBS Working Group



Anya provided a summary of the discussions held during the first workshop of the P-OBS WG of SCOR, the day before. Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS) is the focus of SCOR Working Group-154

General: To identify best practices (technologies and sampling protocols) and technical feasibility to incorporate plankton measurements into global ocean observing

platforms (initially GO-SHIP and for expansion into the mooring array of OceanSITES). The terms of reference include

1. **Identify current technologies** (sensors as well as water sample analysis) that *can* be integrated into existing observing infrastructure to provide input and guide studies of plankton for marine ecosystem and biogeochemistry studies.
2. **Provide the necessary details** associated with every technology/measurement proposed (e.g., power, cost, and human effort).
3. **Document potential applications**, including science case studies and lists of publications, and document measurement protocols. Develop adequate protocols when these are not available.
4. **Identify synergies** with specific measurements done from other observing programs (e.g., BGC-Argo, space-based measurements, Continuous Plankton Recorder surveys) to provide cross-calibration and a better representation of the 4-D distribution of the parameters measured.
5. **Identify technological limitations** and/or gaps, and identify areas of priority investments to develop and implement the required observation technologies and tools for specific needs.

6. **Increase awareness** of the availability of biological oceanographic datasets internationally and identify barriers to their access and use, particularly *in developing nations*.

The objective is to expend minimum effort and obtain maximum yield for a global Plankton observation (feasibility of incorporating biological measurements / instruments using well established global platforms as GO_SHIP and Ocean Sites). The SCOR WG established sub-working groups to review each of the technologies:

- Imaging – A. Waite
- Imaging Flow Cytobot – H. Sosik
- Acoustics – E. Boss
- Bio-optics – E. Boss
- Genetics - S. Gonzalez Acinas
- Particulate Organic Carbon / HPLC- H. Claustre
- Production and other rates - TBA

P-OBS is useful in the context of the requirements of GCOS for Essential Climate Variables (ECVs), and of GOOS for EOVs.

Question:

Modeling – talking specifically, what are the capabilities and data that the climate system needs?

Response:

Timelines: choosing mature technologies that are commercially available, it should be relatively quick.

How do they envision bringing the social dimension into the observations?

Response: As scientists, we all try to reach out in that direction, and decide what data are more important to know. It is just in the beginning of that conversation for biology –thinking more in terms of biodiversity changes - have they occurred and if so, to what can they be attributed? Core question: have there been measurable changes, and if so, what are they attributed to?

4.6.3 Francisco Chavez, MBARI – VOICE, Oxygen Minimum Zones, EBUS



The “Variability in the Oxycline and its Impacts on the Ecosystem (VOICE)” project is interdisciplinary with people from a broad range of geographic locations. The questions being addressed are how the oxycline changes and its impact on the ecosystem. VOICE spans several OMZs across the global ocean.

They had an initial workshop at MBARI, and the report available at the GOOS website:

(http://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=20324).

Variability in the Oxycline and its Impacts on the Ecosystem (VOICE)

- Multidisciplinary, geographically diverse
- Question being addressed: How do OMZs affect spatio-temporal distribution of biota?
- A possible application: low oxygen in eastern boundary currents

A SCOR Working Group was approved late last year entitled “Eastern boundary upwelling systems (EBUS): diversity, coupled dynamics and sensitivity to climate change”

Its Goals are to:

- Synthesize information
- Build a database
- Provide a comparative analysis
- Offer Strategic recommendations
- Do Socio-economic analysis
- Models currently don't do well, so WG will address this area
- Interesting boundary currents produce fish and are thus economically important as well as being sensitive to climate change
- Winds are sources of variability and so ocean-atmosphere dynamics must be included in the discussions and applications
 - Factors and impacts of Open ocean - shelf interaction are important. How to link coastal & open ocean? The scales are different and coastal analyses demand finer observations.
- Gaps and questions to be addressed include: How will global environmental change affect ecosystems?

4.6.4 Lisa Levin, UCSD, Deep-Ocean Networks (DOOS / DOSI / INDEEP)



Lisa introduces and informed the audience on three major deep ocean (deeper than 200 m) initiatives and how they address the issues raised on requirements and societal benefit.

There are many motivators such as heat budget, ocean circulation, climate change, biodiversity baselines, fishing, energy, minerals mining, genetic resources that have

impacts on the local ecosystem and environment of the deep ocean. There are also, societal conventions, including those of the UN, which must be considered.

The Deep Ocean Stewardship Initiative (DOSI) started in 2013. *DOSI seeks to integrate science, technology, policy, law and economics to advise on ecosystem-based management of resource use in the deep ocean along with strategies to maintain the*

integrity of deep-ocean ecosystems within and beyond national jurisdictions. Eleven working groups provide guidance to stakeholders, do capacity development, webinar series, go to climate negotiation meetings and try to educate managers and policy makers on deep sea issues. The Deep Ocean Observing Strategy (DOOS) is an international, community-based group focused on developing a roadmap that will lead to improved understanding of the state of the deep ocean with respect to baseline conditions, response to climate variability and response to human disturbance. Task teams across the three disciplines within GOOS are trying to develop pilot projects (e.g. Clipperton Fracture Zone). DOOS has liaised with the Solid Earth experts and others.

Terms of reference:

1. Build understanding of what is most important to observe.
2. Provide a hub for integration opportunities.
3. Coordinate observations.
4. Develop deep observing requirements.
5. Build readiness in observing technology and techniques.
6. Foster availability, discoverability and usability of deep-ocean data
7. Create a common community science implementation plan for deep-ocean observing that advocates for deep observations

They have done an inventory of deep-sea programs and are matching the deep EOVS between GOOS and DOOS for biology and ecosystems.

The International network for scientific investigations of deep-sea ecosystems (INDEEP): spins-off of the Census of Marine Life – this is a scientific program

Possible RCN interface include:

- Linking biodiversity to physical and biogeochemical observing in the deep ocean
- Links to ocean sustainability (SDG 14 commitments)
- Communicating with the scientific community, as well as industry, regulators and governments
- Translating science to public and policy makers
- Capacity building
- Unified questions and approaches heading into Ocean Obs 19 and the Decade for Ocean Science.

4.7 Data and Information Management

4.7.1 Ward Appletans, Biological Data Management in the Ocean Biogeographic Information System (OBIS)



With a focus on biological data management in the operational observing system, Ward provided background on the origin of OBIS from the Census of Marine Life to the IOC.

OBIS works through regional nodes connected to the observing community and to the QA/QC of the data. The process of data begins from the providers to the nodes and then to OBIS, where it is available to the community. OBIS has strengthened international collaboration between developing and developed countries (500+ publications citing OBIS). Data standards are being included now to capture more than species occurrence – developing new model to include abiotic measurements. Also developing standards in vocabulary.

It is one of the primary data sources for several UN processes, GOOS, DOSI, the CBD, etc. They are making the case that OBIS may incorporate different types of data (e.g. the Continuous Plankton Recorder (CPR), the Reef Life Survey, and others). The main contribution to science will be the data provided. There are important human dimensions in data sharing, and building trust. GOOS BioEco is currently in the phase of integration across programs and across disciplines and in devising the implementation plans.

We still lack the majority of species (estimate from Appeltans et al., 2012: 700,000-1 million). OBIS now has 120,000, and there are 240,000 described.

OBIS is building tools and products – R, Python, API, etc., to support the community. Capacity building is also really key; IODE became the focal point for the transfer of marine technology – one of the programs is the Ocean Teacher Global Academy – scaling up the activities of training (sponsored by the Government of Flanders through the IOC).

A US – IOOS Biodata training course was conducted 8-9 February, 2018 in Seattle. It finished with some recommendations: further development of standards; facilitating data transfer; evolving to semi-autonomous processing of data; developing QA/QC tools; developing fit for purpose credible data products; building end to end products with MBON and GOOS and upscale academia. Ward hopes that the interaction of OBIS with all the links becomes a two-way support, and feeds back to OBIS.

Questions:

Deep-sea data: many of the recent data coming from the deep sea are coming through images – can OBIS address this?

Response: OBIS is not yet ready to store images.

What is the technical architecture of OBIS?

Response: It is a central system. The OBIS nodes have the capacity and the server. Data is standardized according to international standards, and stored locally into one dataset.

A number of questions are being raised that reflect the changes in observation technology. For example, for video observations, how can we take advantage of video information (e.g. watch video and take snapshots of animals – OTN has a similar issue)?

How to incentivize people to share data?

Response: Make sure there is a good data citation to reference in the papers; encourage the citation of data; make the case to see the value of data.

Will OBIS encompass Virus, bacteria information?

Response: OBIS has bacteria if they have a name, but not yet ready to OTUs, but cannot remain behind as this evolves.

4.7.2 Rebecca Koskela, University of New Mexico, Data One



Data One is a federation of repositories – “Federation of Earth Science Repositories”. The data stays where it is, but the meta-data is harvested. There are 3 coordinating nodes (UCSB, University of New Mexico and University of Tennessee/Oak Ridge National Labs); replication of data allows the data not to be lost if the project goes away. Data One started in 2012 and is continuing. There are 43 member nodes and upcoming member nodes include GBIF and PANGEA. The goal is to make FAIR data possible

(findable, accessible, interoperable, reusable).

The original emphasis was on environmental data. DataOne is now working with observation data, using globally unique identifiers (DOIs).

The following member nodes have oceanographic data: Partnership for Interdisciplinary Studies of Coastal Oceans; NOAA National Centers for Environmental Information Oceanographic Data Archive; Biological and Chemical Oceanography Data Management Office (BCO-DMO); Rolling Deck to Repository; Gulf of Alaska Data Portal; and Research Workspace.

A federated search is available across repositories. A search index is offered by Coordinating Nodes; easy search of content available across all participating Member Nodes. Evolution: “Make data count” - funded by the Sloan Foundation – facilitates the acknowledgement of data. At the level of collections and individual data sets, DataOne is making metadata quality improvements to facilitate discovery and access.

Data One has a web Provenance editor, which was deployed by the arctic data center. It provides the following benefits:

- Track data derivation history
- Track data inputs and outputs of analyses
- Track analysis and model executions
- Preserve and document software workflows
- Link all of these to publications.

Four key needs are being addressed:

- Discovery acquisition
- Practical tools for harmonizing heterogeneity
- Data and Practical Tools for Reproducible Science and Provenance
- An Empowered and Engaged Community.

Questions

What is the proportion of terrestrial to marine data?

What is the current relationship between DataONE and Earth Cube? Earth Cube started with the building blocks (bottom up) and DataOne is a coordinated development across its members. DataOne is still growing through building collaborations: still adding new repositories (in Australia, only have a terrestrial partner), would be interested in talking to IMOS for the marine data.

4.7.3 Jay Pearlman, IEEE – Evolving And Sustaining Ocean Best Practices

Jay reported on the best practices workshop, which was held in Paris in November 2017 and the development of a sustainable, open global repository for ocean best practices.

Best practices are one of the tools to support efforts that measurements and data are of high quality. Challenges for creating and using best practices include: quality of BP varies, inconsistencies in data and metadata formats, etc. A key to use of best practices is a process involving advanced discovery & access that will use natural language processing, semantics, web crawling, and semantic tagging. The developments also include a research topic: “Best practices in Ocean Observing” that is part of the Ocean Observations section of Frontiers for Marine Science. There is currently a call for papers. Another change is the assignment of DOIs and ORCIDs for the manual, guides, and papers. This will make search more accurate. A pilot system is coming soon in April 2018.

Benefits include: looking at a sustained system for ocean observing practices, ideally hosted by IOC, and with academic recognition through peer review.

Question

Who decides what is a best practice?

Response: This should be a community process. The experts in the observations networks and program will recommend best practices for their work. They will remain the key contacts with the best practices in the repository. The BP workshop converged on a definition of best practice:

“A community best practice is a methodology that has repeatedly produced superior results relative to other methodologies with the same objective.

To be fully elevated to a best practice, a promising method will have been adopted and employed by multiple organizations. Best Practices may come in any of a number of format types – best practices, standard operating procedures, manuals, operating instructions, etc. – with the understanding that the document content is put forth by the provider (originator) as a community best practice.” This sets the framework for the decisions.

Why not provide a semantic processing to deal with the data?

This is an interesting idea that warrants further discussion. For the semantic search for best practices, a key is a defined (and marine applicable) vocabulary. Such a vocabulary is being worked in the UK and at SeaDataNet and will be adopted.

4.8 Short Subjects

Heather Spence, AAAS fellow at DOE energy efficiency, water power tech office. The office is interested in hydropower, marine energy sources (waves, currents, tides): and is interested in marine energy to power ocean sensing devices.

Jan Newton: she was inspired by Peter's Ocean Decade talk. SDG 14.3 addresses marine acidity. GOA-ON met in Paris, looking at the development methodology on how to report GOA-ON integrating local, coastal, and global data, for physical and biology impacts. See GOA-ON.org goals:

- 1. Chemical status
 - 2. Biological impacts
 - 3. Data for modeling
-
- Gabrielle Canonico from MBON/IOOS mentioned the importance of global GOA-ON capacity building activities.
 - Emmett Duffy: MarineGEO is trying to develop simple, low cost sensors for students, citizen scientists, crowd-sourcing the identification of critters. It may be worth self-assembling a group interested in this, and learn best practices. Building capacity as well as having sustainable business model, [iNaturalist, Zooniverse, drones aerobotany] are some key activities
 - Gabrielle Canonico mentioned that the world conference on marine biodiversity is in Montreal at McGill Univ on May 17. This will include planning & strategic directions for global MBON.

4.9 Frank Mullen-Karger, Closing Comments



Frank thanked the attendees and noted that better links with social sciences would facilitate sustainable development of ocean in time for OceanObs'19.

The convening power is helpful to coordinate different groups nationally and internationally to work toward the paradigm shift required to ensure that societal needs are met through ocean observations. Other challenges that we need to keep in mind in planning for OceanObs'19 and beyond is revising the Framework for Ocean Observing as needed to meet this goal. Other challenges include focusing on developing cheaper technologies for better ocean measurements to satisfy user needs – this includes better biological and biodiversity measurements in the world's

ocean from the surface to the seafloor. Integrating biological observations into observing systems needs the engagement of the entire community as new concepts on Essential Ocean Variables (EOVs) and Essential Biodiversity Variables (EBVs) are refined for implementation. The RCN will continue to work with national agencies and relevant groups around the world to provide input for a successful OceanObs'19 conference and to further develop the strategies to implement a multidisciplinary ocean observing system that integrates biological observations. The RCN will seek to further organize efforts to address Sustainable Development Goals that require ocean information, and will work to ensure the US and other nations can achieve significant outcomes and participate in a meaningful way in the “International Decade of Ocean Science for Sustainable Development”.

5 Appendix I – RCN Meeting attendees

First name	Last Name	Organization
Simon	Allen	Spatialanalytics.
Clarisse	Anderson	SCCOOS/SIO
Ward	Appletans	UNESCO IOC/OBIS
Abby	Benson	USGS, OBIS
Ben	Best	USF
Charles	Boch	MBARI
Gabrielle	Cannonico	IOOS
Francisco	Chavez	MBARI
Xranxao	Chen	
Juanjo	Danobertia	EMSO Eric
Emmett	Duffy	Smithsonian
Carl	Gouldman	IOOS
Peter M	Hagen	Chair UNESCO/IOC
Jason	Hartog	CSIRO
Abdel El Rahssun	Hassun	CNRS Lebanon
Megan	Hepner	USF
Bob	Houtman	NSF
Reyna	Jenkins	ONC
Kim	Juniper	ONC
Rebecca	Keskela	Data One
Gerhard	Kuska	MARACOOS
Richard	Lampitt	NOC, UK
Ana	Lara-Lopez	IMOS
Lisa	Levin	SIO

Andrea	McCudy	UCAR
Karlie	McDonald	CSIRO
Patricia	Milosolavich	University of Tasmania
Enrique	Montes	USF
RU	Morrison	NERACOOS
Frank	Mullen-Karger	USF
Jan	Newton	NANOOS/UW
Francoise	Pearlman	CU/IEEE
Jay	Pearlman	IEEE
Linwood	Pendelton	WWF
Benoit	Pirene	ONC
Cinthia	Pye	JASCO
Anya	Reik	GEOMAR
Henry	Ruhl	NOC.UIS and Calcoos
Emily	Smail	NOAA
Derrick	Snowden	NOAA
Heather	Spence	AAAS Fellow - DOE
Larry	Surkan	West Ecology
Toste	Tanua	GEOMAR
Vardis	Tsontos	NASA/JPL
Jorge	Vazquet	Ocean Wright
Anya	Waite	AWI
Yixin	Wang	
Mike	Weise	ONR
Victor	Zykov	SOI