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# **Evolving and Sustaining Ocean Best Practices Workshop**

15 – 17 November 2017

Intergovernmental Oceanographic Commission, Paris, France

## **Proceedings**

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## 1 Executive Summary

There is an ever-present need for the dissemination and uptake of best practices in the multidisciplinary field of ocean observation. However, the complexity of this domain and the diversity of its stakeholders make discovering relevant ocean best practices (OBP) a considerable challenge. The new paradigms of the information age - onboard processors, large memories, access to the internet and ubiquitous cloud resources opens new and significant opportunities to access and use best practices. Working across disciplines, the requirement for a trusted best practice discovery and access system includes: a web-accessible archive location; appropriate vocabularies or ontologies for improving discovery of best practices; and some means for a scientist or engineer to understand the background, provenance (including any certification) and value of a best practice. Best Practices within the System should cover the full value chain from sensors and platforms to modeling and analysis to data management and users.

The Best Practices Workshop, held in Paris, during November 2017, was organized by the Ocean Best Practices Working Group of the AtlantOS WP6.4 (<https://www.atlantos-h2020.eu/project-information/best-practices>) in collaboration with the ODIP II project ([www.odip.eu](http://www.odip.eu)) and the OceanObs RCN (<http://sites.ieee.org/oceanrcn/>) to better understand the needs of the ocean observing community in supporting the creation and dissemination of best practices. Over two and a half days, thirty-seven participants representing a wide range of international organizations. (see Appendix 1) contributed insightful recommendations for the structure, processes and implementation of the Ocean Best Practices System.

The workshop participants strongly agreed that there is a clear need for a consolidated open access repository for ocean observation best practices that would provide consistent access to a wide range of best practices. The participants recommended that there be a near term pilot in early spring 2018 as well as a full operational system in spring 2019 that makes practices more readily discoverable, easy to access and with granular search capabilities. Implementation of the system and its repository would be hosted and maintained by IOC/IODE.

Addressing a finer level of detail, the attendees identified specific technical and governance attributes of the OBP System (OBP-S). These included assignment of DOI to BP documents, use of ORCID identifiers for BP authors, open sharing of documents between the ocean best practice repository (OBP-R) and repositories of originating institutions/programs, with “ownership” of the BP retained by the originator. There are technical aspects to achieve these including the use of semantic-based discovery with an emphasis on machine readability of best practices as well as some means of identifying relevance and priority across the discovered best practices.

With the expanding observation community, traditional mentoring approaches, particularly in developing countries, need to be complemented by documentation of practices. Thus, there are social/outreach aspects for the OBP-S as well, including facilitating training, implementation of global scale peer review processes, routine information releases and presentations on advances and capabilities. The workshop participants acknowledged the value of peer review in motivating and recognizing the contributions to best practice documentation. During the workshop, the BPWG announced the initiation of a Research Topic “Best Practices in Ocean Observing” in the *Frontiers in Marine Science Journal/Ocean Observation Section*. The Best Practices Research Topic naturally complements the peer review processes of ocean observation expert communities; more detailed recommendations are provided in these proceedings.

Given the scope of the OBP-S, the challenge is to prioritize the initial work to assure its usefulness even in the early stages of implementation. Since Essential Ocean Variables (EOVs) are used to prioritize ocean

observing, one initial effort includes an examination of EOVS best practices. This will need to be supported by the GOOS panels for physical, biogeochemistry and biology/ecosystem disciplines.

The workshop produced a consensus for the steps forward, as documented in these proceedings. Near term priorities are: the implementation of a pilot system for users and feedback from the community on its efficacy; population of the repository with best practices, standard operating procedures and manuals; and the growth of the peer review process through the Frontiers in Marine Science Research Topic, “Best Practices in Ocean Observing”. Longer term, the sustainability of the capability under the umbrella of IODC, GOOS and JCOMM will need to be addressed.

Figure 1 Summary of Ocean Best Practices System and its benefits/impacts


## A Sustainable Future for Ocean Best Practices (OBP)

**BEST PRACTICES IN OCEAN OBSERVING: SCATTERED TREASURES**

High-quality procedures for observing the ocean represent years of methodological development by universities, private enterprises, and public research institutions. Unfortunately, many of the documents describing these “best practices” are scattered online, buried in institutional/project archives or simply lost.

**A FUTURE-FACING SYSTEM FOR HARVESTING SCATTERED TREASURES**

Guided by a broad community of ocean observers, the Ocean Best Practices System is building upon the IOC/IODE [oceanbestpractices.net](http://oceanbestpractices.net) to link together and disseminate these scattered best practice documents. The core of this evolving Ocean Best Practice System consists of:



A sustained, open access, and internationally recognized repository of best practices, standard operating procedures, manuals and similar documentation, hosted and curated by IOC/IODE, with a simple document deposition process and an intuitive user interface

Advanced indexing and search technology featuring DOI-based document identification, natural language processing, and semantic awareness

A Research Topic, Best Practices in Ocean Observing, in Frontiers in Marine Science where authors can describe their “best practices” and benefit from peer review, academic crediting, and high community visibility: [journal.frontiersin.org/researchtopic/7173](http://journal.frontiersin.org/researchtopic/7173)

The OBP System targets the full range of community identified “best practice” documents pertaining to any aspect of ocean observing, from the deployment of sensors to the construction of predictive models. Community support features that include feedback to authors, usage metrics, and links to associated training materials are also being implemented.

**BENEFITS**

<p><b>OBP USERS</b> benefit from consolidated access to best practices hosted in a reliable, living, and sustained system. OBP content can be easily discovered and compared using natural language search to find the best in the field among many practices. Notification services provide update tracking. Peer review mechanisms and community forums offer insight and commentary.</p>	<p><b>OBP CREATORS</b> benefit from content indexing by all major search engines as well as OAI-PMH compliant services (Google Scholar, Scopus, and OpenAIRE). DOIs are issued for citability and each submission can be described by a peer-reviewed paper in the <i>Frontiers in Marine Science</i>. Creators have simple insertion processes supported by templates. User metrics are provided.</p>
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## 2 Introduction and Objectives

There has been a rapid evolution of oceanography over the last century with the investment of nations for food sustainability, defense and science. The need for continuing investment is driven, in part, by the significant changes that have occurred as the human population has expanded and pressures on ocean resources mount. Understanding the paths to sustainable global ecosystems, as framed by the Sustainable Development Goals, engages a broad range of disciplines, not all conversant with each other's techniques and best practices. The tradition of academic mentoring based on tight networks of scientists and their students is not as effective in this era of expanded globalization of science. Combine this with the networked, data and information-rich environment of this age of globally interconnected science and significant challenges in the ability to survey and identify best practices emerge.

These trends suggest that the effective transmission of best practices is an increasing and pressing concern of global science. However, the process is still fragmented, and results are difficult to sustain. To address these challenges, BPs need to be accessible, reliably archived, searchable and comparable. How to do this in an effective and sustainable manner is being addressed by the Best Practices Working Group (BPWG), organized under the auspices of three projects, the Ocean Data Interoperability Platform (ODIP), AtlantOS and the OceanObs Research Coordination Network, with significant contributions from JCOMMOCG, IOC/IODE and IOC/GOOS and other organizations.

Building an operational Ocean Best Practices System (OBP-S) needs significant engagement by the ocean science and applications communities. Thus, a two-and-a-half-day workshop "*Evolving and Sustaining Ocean Best Practices Workshop*" was held on 15-17 November 2017 at the Intergovernmental Oceanographic Commission, Paris, France, (Miollis Building) – Rooms XII and XIII. It focused on the evolution and sustainment of Ocean Observation Best Practices.

The international workshop included a series of presentations, panels and smaller group breakout sessions, gathering 37 international experts working in the Ocean domain to define, as a community, the key elements of an Ocean Best Practice strategy, resulting system and associated implementation. The first day addressed requirements, current status of best practices and gaps as well as the conceptual approach for the full system. The second day reflected more detailed discussions of both the technical and the implementation strategy. The third (half day) considered longer term strategy and implementation updates based on the participant inputs during the workshop. The proceedings reflect the full scope of the workshop.

The workshop produced significant recommendations for both the technical and social aspects of best practice creation and use. The BPWG has adopted many of the workshop recommendations. These are identified in these proceedings (see section 12). The adapted OBP-S concept and implementation directions including updates of the IODE OBP Repository (OBP-R) are provided in Section 11.3. Thus, this workshop as reflected in the proceedings, is an important step in creating the long-term sustainable services to bring OPB use into the modern era.

### 3 Workshop Agenda

<b>15 Nov</b>	<b>WEDNESDAY</b>	<b>Speakers</b>
09:00	<b>Welcome</b> Introduction of participants (name and org)	Jay Pearlman IEEE; Albert Fischer GOOS
09:15	<b>BP Project Overview &amp; Objectives of the workshop (1)</b>	Jay Pearlman
	<b>Experiences and Challenges in Best Practices</b>	
09:30	<i>Sensors and Observations</i>	<i>Moderator: Patrick Farcy, IFREMER</i>
9:35	Sensors (2)	Ian Walsh, Seabird
10:11	Observatories (3)	Ana Lara Lopez, IMOS
10:37	Observation Networks (4)	Rik Wanninkhof, GO SHIP
11:04	Emerging technologies (sensors & platforms) (5)	Matt Mowlem, NOC
11:30	<b>Break</b>	
12:00	<i>Data Management</i>	<i>Moderator: Peter Pissierssens IODE</i>
12:05	Management of Multidisciplinary Ocean Research Data (6)	Cyndy Chandler, WHOI
12:40	SeaDataNet, EMODnet, AtlantOS (7)	Dick Schaap, MARIS
13:05	<b>Lunch</b>	
13:50	<i>Science and Analyses - Applications</i>	<i>Moderator: Derrick Snowden, IOOS</i>
13:55	Physics of the ocean (8)	Albert Fischer, GOOS
14:20	Biogeochemistry (9)	Maciej Telszewski, IO PAS, IOCCP
14:42	Biology and Ecosystems (10)	Daniele Ludicone, SZN
15:03	<b>Discussion Panel on the State of BPs</b> Global implications and directions – addressing near-term and long-term evolution – directions and challenges	<i>Moderators: Juliet Hermes, SAEON, JCOMM &amp; Emma Heslop, SOCIB, JCOMM OCG</i> Panel: Ana Lara Lopez (IMOS); Maciej Telszewski IO PAS, IOCCP); Rik Wanninkhof (GO- SHIP); Rachel Przeslawski (Geoscience, Australia); Mark Bushnell (IOOS)
16:03	<b>Break</b>	
16:33	<b>Proposed Community Infrastructure for End-to-End Management of Best Practices</b>	<i>Moderator: Cyndy Chandler, WHOI</i>
16:35	Overview and key developments infrastructure diagram to show the framework (11)	Cristian Munoz Mas, SOCIB
16:49	BP Document Template, Copyright/IP & Use BP Repository (12)	Pauline Simpson, CCMI/IODE
17:20	Discovery and access (Semantic Search) (13)	Pier Luigi Buttigieg, AWI
17:50	Journal partnerships for publication (14)	Jay Pearlman & Nina Hall, Frontiers in Science.
18:05	Adjourn	
20:00	No Host Dinner	
<b>16 Nov</b>	<b>THURSDAY</b>	
09:00	<b>Putting it all Together - Summary of Day 1 and Challenges</b>	Jay Pearlman
09:15	Charge to Break-Out groups	Pauline Simpson
09:30	Community engagement (education etc.) (15)	Juliet Hermes



09:45	<b>Break-Out session 1</b> – The end to end process	<b>4 Groups</b> – <i>Moderators</i> <i>Sensors</i> - Mark Bushnell. <i>Data and Downstream Processing</i> – Adam Leadbetter <i>Applications (Users)</i> - Frederico A. Saraiva Nogueira <i>Ocean Networks</i> – Derrick Snowden <i>Rapporteur</i> for each group from group's participants
11:20	<a href="#">Break</a>	
11:45	Break-Out 1 Session Reports and recommendations	Rapporteurs: <b>Sensors</b> - Eric Achterberg, <b>Data &amp; Downstream Processing</b> - Adam Leadbetter, <b>Applications</b> - Cristian Munoz, <b>Networks</b> - Juliet Hermes
13:00	<a href="#">Lunch</a>	
14:00	Break-Out 1 Session Reports continued	Ocean Networks
14:15	<b>Break-Out session 2</b> - Implementation directions	<b>4 Groups – Self Selected with mixed disciplines</b> <i>Moderators</i> = Yutaka Michida; Anna Lara Lopez; Eric Achterberg; Albert Fischer <i>Rapporteur</i> from participants
15:45	<a href="#">Break</a>	
16:15	Break-Out 2 session report and recommendations	<i>Rapporteurs:</i> Mark Bushnell, Pier Luigi Buttigieg, Laurent Delauney, Yutaka Michida,
17:15	Addressing final day - Sustainability	Jay Pearlman
17:20	Adjourn	
	Dinner on your own	
<b>17 Nov</b>	<b>FRIDAY</b>	
09:00	Moving Ocean Best Practices for Research and Applications to a New Dimension (16)	Nadia Pinaridi, Co-President of JCOMM
09:35	<b>Sustainability, Governance and Practical Implementation of Best Practices Framework</b>  <ul style="list-style-type: none"> <li>- Local Governance of BP process and policies</li> <li>- Community BP issuing orgs</li> <li>- Repository</li> <li>- Sustainability of BP repository and journal</li> <li>- Practical applications - addressing near-term boundaries</li> <li>- Capacity building (outreach and training)</li> <li>- Closing statement/recommendations</li> </ul>	<i>Moderator:</i> Emma Heslop  <b>Panel on Sustainability:</b> <i>Albert Fischer</i> <i>Nadia Pinaridi</i> <i>Peter Pissierssens</i> <i>Derrick Snowden</i> <i>Jay Pearlman</i> <i>Pier Luigi Buttigieg</i>
11:05	<a href="#">Break</a>	
11:30	<b>Implementation Plan</b> – Presentation and discussion (17)	Jay Pearlman, Mark Bushnell, Pier Luigi Buttigieg, Emma Heslop, Cristian Munoz Mas, Pauline Simpson
12:50	Expectations and Outcomes Questionnaire	Jay Pearlman
13:00	Adjourn	

## 4 Participants



Figure 1 Thirty-seven experts participated in the workshop. This figure shows thirty of the attendees.

Over the 2.5 days, 37 international ocean experts from International agencies, Programs, Projects and Organizations participated in presentations and panel discussions. Seventeen presentations were provided and are live linked below. A table of participants and their organizations are listed in **Appendix 1**.

## 5 Jay Pearlman - Best Practice Project Overview and Objectives



Jay Pearlman provided an overview of best practices (BPs) and workshop objectives, stating its vision and mission. He noted that the recently completed FIX03 project created many excellent BPs, but there was no place to archive them as the program ended. He pointed out that IODE serves as the home for an OceanBestPractices Repository. He hoped the Workshop would provide recommendations and obtain consensus for an implementation plan. He then quickly reviewed the agenda for the next few days, and introduced the core Best Practices Working Group members.

## 6 Day 1 - Experiences and Challenges in Best Practices

The workshop was convened at 09:00 and Jay Pearlman (Lead of the Best Practices Working Group) welcomed all participants. He noted the support provided to OBP by AtlantOS, ODIP, IODE, Oceans RCN and others. He introduced Albert Fischer (GOOS) who also welcomed all to UNESCO, stating the importance of Ocean Best Practices, and informing the workshop of logistical matters. The thirty-three participants on day one then introduced themselves.

### 6.1 Experiences and Challenges in Best Practices: Sensors - Patrick Farcy (Moderator)

The prime requirement of the ocean observing community is to acquire data and work with the best possible measurements. Sensors and observatories provide the foundation for this objective.

### 6.1.1 Ian Walsh - [Experiences and Challenges in Best Practices: Sensors](#)

Ian Walsh provided in his presentation a description of the instrument cycle, starting with sensor development all the way through deployment and recertification. Science and R&D is the start. Much of oceanography is lore and does not come with a documented background. Variability in the field will alter performance of instruments that start out the same.



He noted the gap in best practice documents due to the fact that academia does not recognize these documents as peer-reviewed papers. He discussed the challenges posed to industry by designing instruments, supporting customers long-term, and staying in business. He said a signal can be generated by the target, environment, and the instrument itself, and industry strives to minimize the latter. A good discussion followed addressing the lack of peer-reviewed BP documents, the lack of reward for generating them, and perhaps the need for a new paradigm.

The sensors are the tip of the iceberg. Quite a few operations are associated with them, including sensor development (research and engineering) co-design, production, and calibration. The sensor is then put into service (shipped, checked and used, possibly multiple times), undergoing occasional maintenance and recalibrated as appropriate. The data stream has its own emerging BP chain. All the steps are BP for physical structure of the sensor. This is not a trivial process. No training was provided before, but working with people expertise (moorings deployment, etc.). There was no background to refer to 15 years ago.

In response to Jay's introduction questions.

Key issues: sensors do not react the same way when put in the field as in the lab; there is a need for characterization of post-production and extreme conditions response, and they do not have a database to cover this; development of Quality Assurance/Quality Control (QA/QC) – uniformity is not necessarily what is required, but process which is mapped out is a priority.

Need for end to end system: this includes community-wide training and communication; Seabird provides communication outreach and training; training sessions are offered once a year at the Bellevue, Washington facility and once a year elsewhere; ad hoc training sessions are also provided for groups and institutions with community participation through outreach channels (eg talks, presentations etc).

Relevant Best Practices: multi point calibrations; reference units calibrated to standards and/or second methodology; post calibration statistics of the population of sensors. How are BPs maintained? Science and engineering teams are responsible during the instrument design and prototyping; science lead on calibrations; engineering lead during testing with science input. Most testing is during the build process as the “factory” is well instrumented to address sensor calibration and performance. Ideally, if the instrument is going to fail, it should fail in the factory.

Industry Responsibility - build stable, reliable cost effective instruments, innovate and respond to innovation, but they also need to stay in business. You may want to come back 5 years from now to address an issue and we need to still be in business to calibrate your instruments or answer questions.

Instrument Stability - We don't want there to be a change in signal in pressure, time and temperature,

Sustainable replication – There are advantages to building lot of units both to lower their costs and to have a population base for performance statistics.

Temporal stability. Are changes in the sensor output due to instrument changes, environment or the oceans characteristics being observed? An example is the potential impact of ascent rates and sampling for Argo floats. Ian provided a specific example of impacts in his presentation. He recommends that

sometime during the instrument and platform history, comparisons of transmitted data with raw data from recovered floats be done. This would help to sharpen the transmitted data to avoid losing important information. The methodology is transforming bad data into less bad data.

### Questions/comments

- *Maciej Telszewski* – related to the point made “working on BPs or SOPs documents takes time and effort and is not rewarded in academia.” Maciej asked if there have been any discussions as to how to reverse the paradigm and how non-peer reviewed BPs would benefit the community and be rewarded. Ocean observing systems data sets currently operate within an academic environment of a 2-5-year timespan.
- *Rik Wanninkhof* – GO-SHIP has a hydrographic manual, but it has not been published (is on the web). Have they been rewarded? Not other than love from the community. Peer reviewed e-literature counts, grey literature doesn't. This is beginning to change. We have to be careful as we are putting a lot of pressure on ourselves with the peer review process. Rik turns down around 80-90% of requests for peer reviews. We need to move away from this. We are built on an academic model with clear criteria as to what is gauged as success. We don't have a good model. There is a set of JDOC (WOCE) procedures.
- *Cyndy Chandler*– nothing prevents us from coming up with a new paradigm; Put a DOI for each document, maintain a persistent repository, then there is an organic process that allows citation and widespread access. Number of citations could be a metric versus peer review
- *Ian Walsh* – a BP is not really a BP unless someone else executes it and replicates your results.
- *Frank Muller-Karger*– The lessons are sometimes more from worst practices and there are many.
- *Ian Walsh*– the worst part is mediocre results because it is not an obvious failure.

### 6.1.2 Ana Lara-Lopez - [Experiences and Challenges in Best Practice: Observatories \(IMOS perspective\)](#)



Australia's Integrated Marine Observing System (IMOS) is a national scale, sustained observing system established in 2006. It has supported the development of physical, biogeochemical and biological observational time series, across oceanic and coastal waters. IMOS has applied a “data-centric” definition of research infrastructure, which has enabled it to invest in the full cost of infrastructure all the way from sensors to the delivery of quality-controlled data. Early establishment of best practices in data management and partnering with the ocean and coastal modeling community has ensured data are used. However, some issues need resolving and a review of IMOS data quality assurance and quality control (QA/QC) procedures at the whole program level

was undertaken to understand if the IMOS current approach is the most effective and efficient. This review summarized the current status of the QA/QC procedures across IMOS from the perspective of the essential ocean variables. This review was the first step for IMOS in developing and implementing “Best Practices” across the IMOS Program.

IMOS is funded by the Australian government as a National and collaborative research infrastructure. It provides systematic, open access to data and collects and builds time series in Australia. IMOS has sixty-four nodes organized in communities and 6 science nodes, 1 for open ocean and 5 regional nodes. They have 10 technology-based facilities.

Australian ocean data network predates IMOS but previous to IMOS everyone thought it was good but no one put money into. IMOS invest 10% of annual budget into open access data management. Data goes into the Australian Ocean Data Network (AODN) as netcdf files This is not enough, as there is a need to have value added products (managers don't know how to use netcdf!) such as the IMOS ocean current value added end product!

Relevance and impact - They are trying to engage industry: oil and gas, mining, consultancy, fisheries.... To do this, IMOS and AODN need to have valuable products, not only data files. Real-time data to predict currents, for example. To set directions moving forward, a forum for operational oceanography facilitates exchanges between industry and scientists.

IMOS is also part of GOOS, keeping tabs on the developments of physical EOVS and the GOOS BioEco panel EOVS.

Challenges.

- The data uptake and use is under-recorded. IMOS relies on facilities to tell them if it is being used in research. They know that industry uses their data but don't know how much. They are looking for ways to measure the real impact.
- IMOS is collaborative and works with several institutions, getting together universities, state and federal government. QA/QC for example has no standard across members of a same facility. For national moorings, there are multiple organizations and they have different protocols which may not be documented. Ana looked across the organizations to address convergence. There is no incentive to document procedures and Ana is looking to put the protocols in contracts and the implementation of templates to ease the work involved in submitting best practices.
- A review of all IMOS QA and QC was performed and several recommendations arose: Facilities without written protocols should produce one; centralisation of QA/QC should be considered; publication of data in peer review journal is good practice; implementing and developing a set of standard automated test similar to QARTOD for near real-time QC and in general is recommended; make calibration results from sensors available through the AODN Website and add uncertainty flags.

Next Steps.

- An implementation plan for each recommendation has been drafted and some recommendations are starting to be implemented.
- Additional activities undertaken:  
QC summit will be held every year; sampling videos are produced by the National Reference Station (NRS). Animal tracking: QC procedures developed this year, documented and submitted to Nature scientific data. Benchmarking BP nationally and internationally.

### Questions/comments

- *Patrick Farcy* - Is it easy to share BP with national institutes?
- *Ana Lara-Lopez* - For some facilities, it is easier than others (those with many partners). IMOS still has conversations about minimum requirements, etc. It is not trivial. It is important starting conversations and having everyone onboard to decide about procedures.
- *Rik Wanninkhof* - Any thought about targeting?
- *Ana Lara-Lopez* - IMOS Main Users are researchers. Creating fora (operational oceanography for example) is a manner of targeting. The modeling community is also included in IMOS. We are targeting little by little. Originally, the forum was by invitation only. It will be expanded as opportunities arise in fishing or other industries.
- *Rik Wanninkhof* - What about outreach?
- *Ana Lara-Lopez* - We have a data network and members of IMOS must travel to NZ to start operating systems. We are also hosts for data management.

### 6.1.3 Rik Wanninkhof - [Experiences and Challenges in Best Practices: Sensors and Observations Observation Networks](#)



Rik Wanninkhof (NOAA/AOML and co-chair of GO-SHIP) spoke about observation networks, focusing on GO-SHIP. He reviewed the elements of an observing network, which include having clear needs, sustained funding, common protocols and standards, data/metadata documentation, clear accuracy & precision requirements, and robust data management & distribution system. The Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP) program is ship-based, conventional oceanography that conducts transect reference lines and provides data for model calibration/validation. Reference lines are high quality, calibrated physical and BioGeoChemical (BGC) measurements of the water column to: determine natural and anthropogenic changes on decadal timescales; changes in transport; reference for autonomous measurements (eg Argo); act as a decadal anchor point for physical and BGC fluxes.

#### Goals:

- data for model calibration and validation.
- carbon inventory and transports
- heat and freshwater storage
- deep and shallow water mass and ventilation
- BGC cycling
- calibration of new sensors
- The required data and metadata include:
  - level 1 data: EOV and ECV
  - level 2 data: data highly desirable. benefits from co-measurements
  - level 3 derived measurements. Biological parameters, new methods rate measurements

There are three classes of GO-SHIP observations: EOVs; highly desired; and new/ancillary measurements. Rik noted a subtle distinction between BP and SOP. Rik stated the GO-SHIP desires to retain intellectual editorial control of their SOP document. Anyone wishing to join a GO-SHIP cruise must provide an SOP for their activity. The following discussion addressed coordination, partnering, and ship availability.

In order to be a GO-SHIP line you have to do all the level 1 GO-SHIP measurements (also called “core” data), then level 2 measurements are highly desirable as augmentation and addition for the science objectives. Level 3 data are ancillary measurements that often benefit from being taken in conjunction with core.

SOP manuals are expert reports and guidelines, as there is a concern in the community about being overly prescriptive. It’s a goto manual if you want to execute a GO-SHIP parameter. They want to maintain control of the manual.

Data management consists of a rapid and open data exchange. Data management begins pre-cruise. There is a lot of on-board data management with some cruises having a data manager on-board. There is a need to correct mistakes early on and protect data integrity. There is a strict timeline for data submission. One leaves the cruise with preliminary dataset and within 6 months the core parameters are made available to the community. With level 2 and 3 data, in order to join the cruise, there is the need for a written SOP.

There have been surprising changes in decadal time-scales. Ocean is more connected to the atmosphere than thought before. We need extremely good measurements and well-calibrated instruments. There is a strong interest in multinational efforts. Few nations are capable to do core to the level required.

## Challenges

We often fail to acknowledge and explain the need for observational goals. We have to have everything sustained for ocean networks, yet we cannot plan our resources looking 20 years in the future. Protocols and standardization are required. Also there is a need for clear accuracy and precision requirements depending on the observing needs. Data management and distribution system is also an important element here. Challenges include ship time, coordination, SOP maintenance (“volunteer effort”), funding, and establishing a balance between sustained operations and new research.

Thus, the challenges faced with GO-SHIP are that the program

- Requires big ships that are costly and break down.
- Finds coordination is difficult in multi-national.
- Needs SOP documentation onboard.
- Needs sustained funding of operations, data management, research.
- Retain a balance between sustained operations and new research.

## Questions/comments

- *Patrick Farcy*– we need a best practice for sustained funding!
- *Eric Delory* – sharing of ships? In AtlantOS we work on sharing capacity for new technologies and sustained operations.
- *Rik Wanninkhof* – In the US, we have joint funding between NOAA and NSF. We exchange personnel, decide which ship to use. Global class ships are built overseas (China, Australia, UK, South Africa). We need to work with these countries, but coordination is difficult.
- *Eric Achterberg* – AtlantOS had a workshop in Gran Canaria last year and the recommendation was to expand the Ocean facilities exchange group within Europe. It doesn’t involve money but is about bartering, so they are thinking of extending this across the Atlantic. This could be done through one of these programs or, e.g. JCOMMOPS to maintain capacity and ships programs.
- *Maciej Telszewski* –The GO-SHIP Manual was published in 2007 as a working manual. Updates on core sections have recently occurred. How much do the SOPs change in time?
- *Rik Wanninkhof* – It has been a working manual since 2007 so it is 10 years old. The updates are, for example, a major update on nutrients due to a group looking specifically at this area. Some methods (tried and tested e.g. Winkler titration) won’t need updates, but new technologies and new measurements will need to be updated (eg chlorophyll and particles).
- *Maciej Telszewski* - perhaps it should be called the best practices!!

### 6.1.4 Matt Mowlem - Experiences and Challenges in Best Practices: Emerging technologies (sensors and platforms)



Matt Mowlem (Head of Ocean Technology and Engineering at NOC) addressed emerging technologies (sensors & platforms). He started with an overview of experiences and challenges and then discussed technology readiness levels (TRL). He suggested borrowing and learning from other disciplines such as chemistry, biology, healthcare, marine, aerospace, automotive, lab-instrumentation. The work is often done by small teams with significant academic input or engineering efforts. Matt recognized the need for BP, starting with the initial design of an instrument and then on to sensor reliability, and

the use of certified reference materials (CRMs). Deployments drive pace, placing pressure on quality/best practice or cost.

He then discussed the cost of best practices, the implementation of which may be cost-prohibitive to some entities because of equipment and metrology requirements, the levels of accuracy versus requirements, duplication and competition among groups, duration of instrument development (~10 years or more is not uncommon), and documentation of test failures.

Matt then came back to the concept of Technology Readiness Levels (TRL). These are used to define how mature the technology is: research and prototype at level 1 through 4, then “valley of death”, followed by the transition to commercial at levels 7 through 9. Matt’s group takes the technology through the development cycle with lots of feedback and testing. The levels have definitions, but there is some judgement in the quantitative maturing assessment.

A best practice has been developed internally for the design phase. It includes formal requirements capture, review and documentation, which can be difficult to extract from the scientific community. Then comes the development of specifications and the realization, with validation in a range of environments.

Design quality needs to be managed. It includes: database design using the latest techniques, tools and practices and documentation. Peer review (both internal and external), is done later on in the process as well (e.g. inter-comparisons) typically prior to or as part of formal test specifications and impartial review of pass/fail; documentation and analysing failures and deriving lessons learned.

Reliability is part of the requirements. It is embedded in the design process, and test specifications. Evaluation techniques include value chain (shipping to getting out of box to prepping, etc.), fault trees, expert judgement, failure mode, effects and criticality analysis (FMECA). Reliability BP includes data driven targeted reliability; redundancy: software and hardware duplication; interfaces and third party hardware reliability specification; testing and validation; record keeping, failure analysis and feedback into design. These are traditional elements of reliability planning and analyses in many engineering fields.

Sensors development considerations include: design, reliability, quality; requirements; literature of BP; community BP in relevant ocean disciplines such as physics, nutrients and carbonate chemistry. Regarding sensor BP, figures of merit are needed for inter-comparisons and these are generated by users and are not consistent. Cross-physical characteristics that can result in interference, e.g. pressure and temperature need to be addressed and resolved. Mechanisms of transition to new best practices: Accuracy, precision and drift, the way these are generated are pretty much up to the user: be honest about interferences eg effect of matrix, temperature, pressure...; lifetime (power, consumables, biofouling); lab characterisation; field test versus benchmarking (and feedback); demonstration vs BM (and feedback); extensive field operations (and feedback). Sensors BP - Use CRMs/standards to do in situ quality control. BP should include before and after deployment calibration (not the case for Argo). Sensor and platform operating together can change the way the two function separately. Thus, although the comments are focused on sensors, the bottom line is that the system level implementation must also be addressed.

### Questions/comments

- *Cyndy Chandler* - Who wants to declare that their BP is best. The best is often expensive and prohibitive. So, it is good to have metrics for assessing e.g. this is the best because...criteria. So we could have good, better, best. This depends on the operating environment.
- *Matt Mowlem* – The UK government is funding overseas research to get more data about coasts and the open sea, perhaps without ship time but rather by providing technology that allows observations to get started.



- *Maciej Telszewski* – Very relevant – Andrew Dixon once said that good data is only good when it meets the requirements set by those collecting data. If a country cannot collect the data to the high standards, then they should not. However perhaps our data precision is too high.
- *Cyndy Chandler* – data should be reported with accompanied QA and QC – so it is of a known quality. Andrew Dixon also points out fitness for purpose. So it is for the person looking for data to decide whether they need these requirements. Metadata allows us to make an uncertainty analysis of the data and this will allow uses to make their own decisions.
- *Eric Achterberg* - CMRs : the cost of things such as bottles are stopping many labs from making certain measurements.
- *Emma Heslop* – Are there other structures out there (aside from marine) that provide a good example of BP?
- *Rik Wanninkhof* – Around the world there are often several groups working on similar technology. Should it be part of BP to scope the community to see who is working on similar parameters.
- *Matt Mowlem* – Some are in direct competition, others share nicely. It is complicated, but easier in academic sphere. There is no point developing technologies if they're not going to become commercial. There does need to be a discussion among the main development groups around where we can collaborate.
- *Rik Wanninkhof* – is there proper recognition in the community at large of the failure rate of developing a new instrument as well as how long it takes from design to getting equipment in water. Typically 10 years in development for a vehicle. More like 20 years for gliders to become operational. Like BP, it is a bit of a thankless task in getting these systems off the ground.
- *Matt Mowlem* - EOV have been successful in showing why the technologies are needed, but not necessarily the feasibility. People are using this with a gap analysis of technologies. The EOV requirements are still driven by what we can currently do operationally and there is further interaction around what could be done with new sensors.
- *Mark Bushnell* - how many resources do you put into documenting failures?
- *Matt Mowlem* - We are interested in documenting failures. There have been some good examples – both from panels and also lessons learned documentation. It is a challenge to learn such lessons in implementation.

## 6.2 Experiences and Challenges in Best Practices: Data Management - Peter Pissierssens (Moderator)

Data Management plays an essential role in connecting the user with data. There have been a lot of changes in the last decade as more automation with machine interfaces has been introduced into the repositories and connectivity through the internet has expanded. The science research community has been recognizing the need for cross-disciplinary data in dealing with global scale challenges and this has again impacted the data management needs and capabilities. These areas are discussed in the following presentations.

### 6.2.1 Cyndy Chandler - [Management of Multidisciplinary Ocean Research Data](#)

Cyndy Chandler (WHOI) addressed the management of multidisciplinary ocean research data. By data, the meaning includes both data and information. It is, in fact, the management of multidisciplinary research digital research objects, so data is one example of digital research objects (DROs). DROs are digital representation of data, publications, software, authors, etc. DROs need to be characterized in order for them to be discovered and used. Characterizing DROs is paramount to a restful and sustainable digital ecosystem. Cyndy described the biological & chemical oceanography data management office (BCO-DMO) and

discussed the objectives for data management: making data findable, accessible, interoperable, and re-usable (FAIR, <https://www.force11.org>). See also <https://www.w3.org/TR/dwbp>). She noted, as have others, the challenge that can be found in using the term “best practices”, and that practices are still emerging. In fact, Standard Operating Procedures may already be considered as a best practice by methodology developers. Most practices are shared through exchanges at workshops and the discussions are iterative from workshop to workshop. GO-SHIP has examples of SOPs. QA is done first, QC is done after. Use early data exposure as an approach and allow the community to give feedback – it is labelled as pre-QC. Use quality-controlled vocabularies and Persistent Identifiers. Identify authorities for different steps in the management of different sections. What are the objectives for the management of all of this information? The objectives are to meet requirements for sharing research results –these come from funding sources (requirements set by project managers of regional, national, and global projects – such as the AtlantOS project for example). A researcher needs to understand what the requirements are;



Optimize time required to prepare research results – who does what? minimize duplication of effort; tools and procedures.

Support transparency of the research process – enable reproducible results; enable re-use of data and code; enable discovery, access and re-use of digital research objects; manage data and information throughout the full life cycle of the research project from ‘proposal to preservation’. Cyndy provided a list of recommendations (these are more ‘guidelines’ than actual rules).

Data policy has been shown to be a really good idea (written and disseminated throughout the group), eg Geotraces, Atlantos etc. In many cases, data management plans (at individual investigator level or project-based) are required by funders. The plan should include sampling and analytical protocols, including quality assurances and control process. These will help to optimize time required to prepare research results while globally spreading results to different types of audiences. The benefits to this approach include:

- knowing who does what
- minimizing duplication of effort
- machine-to-machine exchange.
- tools and procedures. Make process easier to enable machine-to-machine process.

The way to a more productive environment is to share data early & freely, provide substantial metadata, use terms from controlled vocabularies, and use persistent identifiers such as DOI & ORCID Also, leverage efforts with partners. Cyndy closed with a quote from Peter Norvig of Google - “More data beats clever algorithms, but better data beats more data”. Discussion followed regarding differing levels of data management, potential management gaps, present status of use of persistent identifiers.

Challenges:

- Limited resources (time and money). Solutions – partnerships, communities of practice, eg IODE is a great place to find other people facing the same challenges. Research Data Alliance is another organization where you can engage people from other disciplines facing perhaps the same challenges.
- Managing change and the rate of change – when rules, expectations, technology are all changing rapidly.

Solutions

- attending workshops like this or larger professional society meetings, communicating challenges and solutions, finding and cooperating with people and forming collaborations.

**Questions/comments**

- *Rik Wanninkhof* - you didn't mention the structure of data management. Are there any big gaps in the whole data management enterprise?
- *Cyndy Chandler* - one of the big gaps is data. For BCO-DMO, if they see something unusual, they will flag the data or metadata and then hand it back to the investigator to suggest they relook at it.
- *Rik Wanninkhof* - How do these different levels of data management interact and are there gaps?
- *Cyndy Chandler* - There can be gaps from the proposal of the research project all the way to the archive and release to users. This is different for different communities and even countries. We try to address this from the BCO-DMO perspective. We have an investigator who goes to sea and collects data, submits data, publishes and archives (this is the full cycle). Having done all of this, for the data BCO-DMO manages, each of those 8 stages as separate entities and also endeavours to handle each cycle as a whole. Semantic technologies and persistent identifiers are used to connect them all. As long as we are publishing our content in alignment with the scholex framework, DOIs will make everything discoverable.
- *Frank Muller-Karger* - Good that you mentioned a BP principle is to share data openly and early. A large part of community does not do this and students are not taught to do this. How can we get to the point where this is a good/best practice?
- *Cyndy Chandler* - It often involves carrots and sticks. Carrots are generally more effective. There are impacts when a funding agency requires data be shared. NSF will not accept proposal unless the data management plan says where data will be shared and they follow up on this. This approach works but is not the best. As the senior scientists mentoring student's behaviours changes then the students they are mentoring will also change. US are implementing that: if investigators get DOIs on their datasets they are getting recognised for this. There is a change in people's perceptions.
- *Maciej Telszewski* - do you know for a fact that if you have a DOI on your dataset and you go back to your institute and try to find everything to do with institute, would the information be found?
- *Cyndy Chandler* - We need to put an infrastructure in place to enable these connections to be made. So you should be able to do this, as you get places that follow best practices of assigning DOIs resources. It is critical that people who assign DOIs understand why they do this. DOI is an identifier; it is the metadata supporting it that is the key.

## 6.2.2 Dick Schaap, Sylvie Pouliquen and Valerie Harscoat - [SeaDataNet, EMODnet and AtlantOS](#)

Dick Schaap (MARIS) discussed infrastructure at SeaDataNet, EDMODnet, and AtlantOS. He estimated total cost of Euro 1.4 billion for ocean and meteorological data acquisition and management. He described



SeaDataNet as a pan-European effort for marine data management, connecting 110 data centers, using ISO 19115 – 19139 metadata standards, and enabling data download in netCDF4 and Ocean Data View (ODV) formats. Dick introduced the National Geographic Data Center (a DataCloud project) and described EMODnet, as well as giving examples of the improvements to data products. He discussed AtlantOS, specifically data management under work package 7. During Q&A the discussion addressed the potential for merging of data management efforts.

SeaDataNet (SDN) is built around national ocean data centers (NODCs) and focuses on developing standards and services. Data are collected by governments, research institutes and private sector. Data addresses physics, geophysics, chemistry, biology, etc.

SeaDataNet (SDN) is a typical example of starting small with a few NODC and then growing with data providers, as well as expansion of data collections. He showed what can be done as data is used for applications. There have been clear advantages of working with the originators of the data in order to manage the data first hand, as opposed to just googling for datasets.

Prominent SDN services include common data index (CDI) data and a discovery and access service. CDI data are based upon ISO standards and supported by SDN common vocabularies; data are downloaded in ODV and NetCDF standard formats. The products catalogue has metadata, which follows ISO standards and they are downloaded in NetCDF4 standard format. There is also a browser (product viewer service). Network of directories include the use of controlled vocabularies and metadata. The new SeaDataCloud project is innovating the above SDN standards and services: updating and further developing standards (vocab, data formats, sensor web enablement profiles, new data types, mapping of data output)

EMODnet – a European initiative for an overarching European marine observation and data network driven by marine knowledge 2020 and blue growth. SDN qualified as a leading infrastructure for EMODnet data management component and is driving services in EMODnet. He gave the example of EMODnet bathymetry, and also the example of AtlantOS part of Work Package 7: data management with a main objective to ensure that data from diverse in situ observing networks operating in the Atlantic are readily accessible and useable to the wider community, international ocean science community, and other stakeholders in this field (and demonstrate impact of models and products)

BPs for data management recommendations - for BP in data management: use OGC standards; use of ISO standards; use of ODV and NetCDF; use controlled vocabularies; use of transformation (brokering) services for providing possible other flavours for metadata and data; use of interoperability solutions for connection to other infrastructures.

#### Questions/comments

- *Rik Wanninkhof* – he is overwhelmed by the number of networks and number of groups involved. Do you foresee a merging of networks or interoperability and common networks?
- *Dick Schaap* – there is already merging in Europe, and by using common standards, which are being advocated. Globally, there are national networks, then collaboration can be done at a high level. Technical developments such as SWE are moving forward.
- *Frank Muller-Karger* - we have a number of organizations working in their own fields, whereby the data is merged into common infrastructures.

### 6.3 Applications of Science and Analyses - Derrick Snowden (Moderator)

#### 6.3.1 Albert Fischer - [GOOS and Best Practices](#)

Albert Fischer (GOOS) provided a presentation about GOOS and best practices. GOOS is a voluntary and not a regulatory body. He reviewed the existing GOOS Framework for Ocean Observing Process and the essential ocean variables (EOV, see [goosocan.org/eov](http://goosocan.org/eov)). In this context, Albert discussed the value chain of ocean observations. He provided a description of the GOOS steering committee, the GOOS Regional Alliances, and the IOC technical guide series. He compared the regulatory material (manuals) versus voluntary guidance material (guides). During Q&A, the prioritization of BP was questioned and the answer was to start with the EOVs. There was a discussion about the use of handles vs. DOIs, where documents reside, and how they are discovered. IOC has not yet minted DOIs and they are looking into it.



GOOS includes: the area of climate; operational services; ocean health; and the Framework for Ocean Observing (FOO). For the GOOS best practices, the FOO takes a systems view, looking at requirements definitions (why they're building an observing system), collaboration and outputs within the context of a voluntary, collaborative systems approach.

In defining requirements an important concept is EOVs. It is essential to have both a high environmental impact and high feasibility for making the needed measurement. Why is the focus on variables? This is a long term strategy as requirements will be relatively long lasting while the underlying observations and technologies may change over time.

Sustained ocean observations sit in a long value chain which lead to societal benefits. They include research & innovation (both forecast systems and services), sustained ocean observations, data management, scientific research, assessments and societal benefits. From this perspective, the value chain maps out the creation of benefits in terms of how climate, real-time services and ocean health relate to societal benefits, scientific issue/application etc.

GOOS has evolved a governance structure to support the FOO and coordination of ocean observations (<http://www.gooscean.org>). There is a GOOS Scientific Committee with scientific oversight, observations coordination and project development. It is comprised of three scientific oversight panels: physics and climate; biogeochemistry; and biology/ecosystem. The observation coordination is performed by the JCOMM program (observations area) and also by the GOOS regional alliances; project development is both regional and thematic – TPOS 2020 and others. JCOMM coordinates networks that are independently managed. GOOS is voluntary and not regulatory. There is no enforcement, unlike example from WMO/meteorology, which has 2 types of guidance – these are manuals, which are regulatory and guides that are voluntary.

Albert showed an example of the EOv and network specification sheet, emphasizing how new types of observations come into the observing system. There are differences in the technical guide and series e.g. the manual on sea level measurements and interpretation: radar gauges volume V that was published in 2016, available in English, French and Spanish. Example from a biological-ecological EOv – live coral best practice material. So, regional guidance material exists – it is different, adapted to observer capacity and to ecosystems; it will not harmonize in the near term, because of the importance of continuity; inter-comparison is planned so that analysis can be maintained consistently. The impacts move beyond inter-comparison to facilitating interoperability.

Why BP quality and interoperability? For climate record (inter-comparability) for operational streams (interoperability: ensuring timeliness and metadata for real-time data streams); for assessment/ocean health (inter-comparability). BPs are really useful for new entrants and capacity development; BP and observing guides are widely used by emerging ocean observers, through direct contact with network teams. BPs also provide Guidance for government procurement processes – documentation of scientific requirements.

GOOS and JCOMM observation BPs at present are managed/maintained primarily by observation networks (focus on platforms/sensors); How can we promote BP more widely? There are ongoing discussions on process, ownership and promotion.

### Questions/comments

- *Jay Pearlman* – You mentioned requirements in your introduction as an essential part of the value chain. This is true. How do we prioritize the potentially large list of requirements?
- *Albert Fischer* – prioritize with a focus on EOVs
- *Rik Wanninkhof* - how do you envision the IOC technical series and what they are trying to achieve?
- *Albert Fischer* - What the technical series does is give it an intergovernmental stamp.
- *Rik Wanninkhof* - Does it have a DOI number?
- *Peter Pissierssens* - The technical series are available online and hence have a handle. A persistent URL is the same as a DOI, but perhaps not as searchable.
- *Rik Wanninkhof* – how do you link IOC tech series relates with what is done elsewhere?
- *Albert Fischer* – something published in IOC has more weight

- *Peter Pissierssens* – documents that are in the IODE repository already have a handle
- *Juliet Hermes* –DOI versus handles (DOIs are handle-based)
- *Maciej Telszewski* – There is a proposal from the biogeochemistry community. It will be detailed in the next presentation. Here is an overview.

With many more observations now, there is a need for guidance regarding how to make these observations. Documents include user manuals, Standard Operating Procedures (SOPs: one parameter, 1 platform), BPs (guides), reference manuals, standards and guides for BPs. Semantics needs to be addressed. The documentation is rarely complete and the mix of sensors and platforms may require different methods or practices. This leads to a set of recommendations looking forward to agree on and implement a structured database for existing documentation. This includes developing a BP registration scheme that leads to DOI allocation and which makes it discoverable and comprehensive. This is necessary and administratively light.

- *Maciej Telszewski* - suggests developing a multi-lingual media resources (he does 30 people/\$100K at present). Use video training including full data cycle – One hour document costs \$60K to produce. There is a dissolved oxygen document as an example.
- *Pauline Simpson* - Ana and Maciej talked about videos – OBP is a multimedia repository. Videos can be accommodated.
- *Eric Achterberg* – typically, video cost is 50-100K.
- *Maciej Telszewski* – at this price, it is still cost effective per user.
- *Rachel Przeslawski* - asked about updating videos and commitments to keep them current.
- *Frank Muller-Karger* - Others are having registries such as GEOBON. How do we benefit through cross- collaboration? Tools developed by MBON (in a box).
- *Pier Luigi Buttigieg*– If we can join communities, there can be benefits and this should be pursued.

### 6.3.2 Maciej Telszewski - [Manuals, guides, standards and references: a proposal to organize and present](#)

Maciej Telszewski (IO PAS, International Ocean Carbon Coordination Project - IOCCP) discussed a proposal from the GOOS biogeochemical (BGC) panel for manuals, guides, standards, & references. He provided a description of several types of documents, and then showed the large effort involved in creating BPs for each step of each EOVS observation for each manufacturer of a sensor. There is a wide range of challenges in moving forward, e.g. semantics needs to be addressed. Completeness of documentation is rarely achieved and the mix of sensors with platforms may require different methods or practices.



Maciej presented the details of the proposal coming from the BGC community to organize manuals from developers and users, SOPs, BPs and standards and references. The group should consider and agree upon the following definitions/criteria.

The user manual from either developers or users should be clear, easy to use and includes deployment.

Standard operating procedures should be very comprehensive, addressing a single parameter and a single platform description; they describe methods in a generic/theoretical sense and not nuances of specific design. These are used a lot in BGC.

Best practices (guides/manuals) include practical knowledge plus elements of the two above categories; they are often developed for a specific environment, phenomenon or platform.

(Certified) reference materials and standards provide trusted reference for calibration and quality control (very important in terms of BGC)

EOV relevant survivable, procedure - for one variable you have numerous steps including: BP for deployment and sampling; data retrieval and formatting; calibration/validation; reference materials and standards; primary quality control and (near) real-time and delayed mode; secondary quality control. This mega table creates a lot for one person wanting to do the measurements. Then, following this, there is the selective approach of the sensors chosen and so could cause a whole new component of the table.

There is not enough money in the whole system to sustain the different activities so we are merging all the time. Matt referred to sensors that can handle 10 different observations and we don't have BPs for handling the new generation.

The following recommendations should be considered by the BP Working Group:

Agree upon and implement a structured database for existing web-based documentation. The database, has to be searchable and actively updatable. Documents can reside in the database but can be duplicated from the original locations. IOC would be a good home for the database.

Develop a BP registration scheme – BP will be/have been published/made available in a variety of ways; agree upon a non administratively-heavy method.

Develop multilingual media resources allowing new users to follow practical and theoretical steps across vertical and horizontal categories in the proposed structure – summer schools filmed and IP'ed to be distributed; deployment/recovery activities filmed and IP'ed to be distributed; video tutorials made for data quality protocols implementation; all combined with references to the BP.

### Questions/comments

- *Pauline Simpson* – OBP repository accepts any format, so videos may be also included.
- *Eric Achterberg* – NeXOS had a video as part of the project and it costs a similar amount, how do we make it cost effective? How do you update a video? This needs to be taken into account.
- *Frank Muller-Karger* - online tags which guide a user to a specific method or solution. On the repository, how do you find a method that leads you to a solution?
- *Pauline Simpson* - within the OBP repository, there are standard functions, but you will hear in Pier Luigi's presentation about the specific knowledge guiding increased discovery and access to BP.
- *Pier Luigi Buttigieg* - if we can link communities that are generating BPs, talking about the same things, and doing similar analyses, then we can suggest they interact over this. We need to have a conversation about how we join the two groups as we have, for example, both GEO and IOC funded by same governments.

### 6.3.3 Daniele Ludicone - [Ocean health & Next generation \(Holistic\) Oceanography](#)

Daniele Ludicone (SZN) presented the next generation of oceanography. He commented on the complexity of biological and ecosystems observations and analyses, discussed the potential of genomics and the rush for supporting platforms, and the resulting Tara Oceans database. He listed challenges such as the creation of reference genomes, and noted the support of the G7 working group.



With the focus on Ocean Health, there is an increased need for ocean information to meet a growing range of societal challenges. Daniele introduced the assessment of the marine ecosystem status - the EU Marine Strategy Framework Directive's Good Environmental Status. Setting priorities in observations is needed. Daniele has done cruises focused on biology/DNA and genomics. There is a need for both a roadmap and test procedures – which is the focus of TARA oceans (<https://www.embl.de/tara-oceans/>).

The future of the oceans G7 initiatives goes towards real time monitoring and satellites, but is not ready for biology. We need to observe the organisms. Genomic revolution allows taxonomy in organisms. We can work on single DNA and have meta-genomes (requires a lot of work to reconstruct the DNA). There is a rush for new technology using moorings and robots.

#### Challenges:

- The need to redesign sampling protocols. Biology covers a lot of time-scales.
- The need for a roadmap towards robotics.
- Redesigning (refining) physical and chemical sampling to match biology.
- Start the long path toward automated observations.

#### Questions/comments

- *Rik Wanninkhof* - G7 is 7 countries- how do you envision this connecting to a larger audience. There are also capacity building actions in other countries, as well as through GOOS.
- *Ana Lara Lopez* - How would you match the physical and biogeochemical sampling?
- *Daniele Ludicone* - No idea! But if you want to understand photosynthesis and the genomics behind it, the response will depend a lot on the time of the day that you take the measurements. Most of the genes work like this so we need to measure things over 24 hours. Take samples at midday and midnight for example.
- *Jay Pearlman* - How do you envision maturing this approach so that it becomes routine?
- *Daniele Ludicone* - This is what we are trying to organize in the G7 initiative. We are trying to move towards the most sustainable approach. Did the G7 commit any resources to support this? At the moment there are resources for the workshops and meeting; additional resources probably will happen in the form of bilateral agreements.
- *Matt Mowlem* - There is cooperation between Japan and the UK for low TRL instruments. It is a million on each side.
- *Pier Luigi Buttigieg* - AWI has a microbial observation component in the Arctic program. They are looking at how to calibrate this type of thing. The genetic components include measuring one thing but also integrating many different variables. So it leads us to think about what other bio/geo/physical measurements can be made.
- *Ana Lara-Lopez* - agreed with Pier Luigi and they are beginning this work with IMOS.

## 7 Discussion Panel on the State of BPs - Global Implications and directions

Juliet Hermes, Emma Heslop (Moderators)

**Panel Members:** Rik Wanninkhof (GO-SHIP); Ana Lara-Lopez (IMOS); Rachel Przeslawsk, (Geoscience, Australia); Mark Bushnell (IOOS); Maciej Telszewski (IO PAS, IOCCP)





The following questions were provided to the panel:

1. How can you best document BP when they're constantly evolving?
2. How can we link BPs across variables and platforms? What is a good area for inter-comparison across platforms, are there specific procedures that can be acknowledged and widely used? Is this feasible?
3. Will there always be one best practice, or maybe several options depending on resource availability, but leading to a similar standard of accuracy/error range for the observation?
4. What are the global implications of adopting a visible system of BPs? If we do not work together and create a coordinated set of best practices for ocean observing, what will happen?
5. What is the long term-goal and what near term things we can do to get there?

## Panel discussion

The panel started by addressing the evolution of BPs. The discussion below also includes contributions and questions by participants not on the panel.

- *Maciej Telszewski* – technology is constantly evolving but there are no new techniques for measurements
- *Rachel Przeslawski* – Genomics DNA is very dynamic
- *Mark Bushnell* – evolve slowly and cautiously
- *Ana Lara-Lopez* – communication and feedback are encouraged particularly in evolving fields.
- *Rik Wanninkhof* - Part of the issue is that BPs are fragmented and at different levels. The basic level of BPs is common sense (instrument may not operate well upside down for example). Then, as you move to higher levels, the BPs are organized by hierarchy. What is the operational need that is required? What precision and why? Are best practices dependent on specific requirements? EOVS specification sheets have the requirements statement and can be associated with best practices. The community is struggling with what can be done with autonomous sensors and what cannot. It can be a huge effort. How can we move beyond anecdotal and be simple enough to be read and understood. Video? Will they be effective?
- *Ana Lara-Lopez* - Can there be a minimum set of requirements applicable for BPs (clean sensor, turn on, etc)?
- *Frank Muller-Karger* - are best practices too broad and how can adoption be encouraged?
- *Cristian Munoz* - using TRLs might be beneficial to the BP process. BPs need to be institutionalized.
- *Peter Pissierssens* - Do we understand the BP definition. We should agree on the definition
- *Pauline Simpson* - read two OBP definitions from her presentation. BP is a method or technique that has been shown as a superior, etc.
- *Frederico A. Saraiva Nogueira* – He suggested reading the definition from Jay's paper. Albert talked about manuals (WMO) versus guides (oceanography); IOC has a key role in this process.
- *Rik Wanninkhof*– We are in a revolutionary stage with new sensors and techniques where we have no experience. It is a mistake calling something a BP, before we have procedures that have been verified.
- *Jay Pearlman* - Perhaps we should have multiple levels of BPs? Two things need to be addressed: Can we reach consensus on what a BP is, and what levels of maturity do we need?
- *Peter Pissierssens* - Decide what a BP is: What definition do we agree on?
- *Matt Mowlem* - There should be different levels of BP or SOP depending on expected criteria.
- *Derrick Snowdon* - standards in engineering are a good thing to think about. We should understand the requirements. Large glider operators have 80% return versus smaller operators who have 50%. Why not transfer knowledge between groups?
- *Ana Lara-Lopez* - suggests definition should include the concept of fit for practice.
- *Maciej Telszewski* - a BP is one thing that we tend to call a User Guide. We should also define other categories of documents.

- *Rik Wanninkhof* - some people claim to follow certain SOPs and they do not in reality. One needs to ensure that people who cite BPs actually are following them.
- *Ian Walsh* - It happens all the time. The mistake may come from any of the actors involved, technician, scientist, PhD student, etc.
- *Rik Wanninkhof* – It is evident that we clearly need better documented procedures.

### Discussion on BP definition

- *Maciej Telszewski* – there are a couple of smaller categories of documents in addition to BP.
- *Matt Mowlem* – suggested the shortest definition: A documented practice which optimally achieves the requirements of the application.
- *Jay Pearlman* – He asked for inputs to be coordinated and reviewed Friday morning (see 1.10. Recommendations)

## 8 Proposed Community Infrastructure for End-to-End Management of Best Practices

Cyndy Chandler (Moderator)

For the following presentations, questions were deferred after each presentation to allow an integrated series of presentations from the Best Practice Working Group on their System recommendations.

### 8.1 Cristian Munoz Mas - [Overview and key developments infrastructure diagram to show the framework](#)



Cristian Munoz Mas started his presentation with a brief history of oceanographic technology development, which led to the proposal to develop a BP repository. He showed review possibilities, BP levels, mentioned the use of templates, and potential steps towards. This included a structure and flow process for incorporation of BP into the OceanBestPractices Repository (OBP-R). The basic objective is to create a sustainable and easy to access repository. A big challenge is community engagement. Another obstacle is effective discovery. The BP System is not interested in controlling documents, just trying to help people discover and access them. In this presentation, Cristian also talked about the roles within the project. Details of major elements of the system were provided in the presentations which follow.

### 8.2 Pauline Simpson - [Best Practices: Documentation, Publishing and Promotion](#)

Pauline Simpson, representing IODE, started her presentation by describing why it is important to document and publish Best Practice documents and then covered the BP Document Template, Copyright/Intellectual Property and Use, and the [OceanBestPractices Repository](#) (OBP-R) (including the review process).

**BP Document Template** – Pauline discussed how the BP document templates were created in collaboration with the community, to support submission and completeness of Best Practice. She showed the benefits of using the template, adding that she hoped the workshop would provide input to the template design. It was appreciated that one size does not fit all, but that there are core/essential sections that should always be included in a BP Document. However, the recommended templates cannot be overly prescriptive and must be based on community needs. BP authors should be able to add



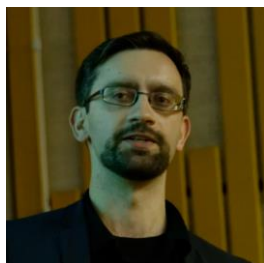
what sections they need themselves. It is acknowledged that organizations may have their own templates. A completed Document Data Sheet in the front of the BP Document provides all the metadata required by the repository. Use of a template format provides for improved discovery and there is value in casting BP documents into a common format as is done by virtually all individual journals of methods or compendia of SOPs.

**Copyright/IP and Use Permissions** - Pauline stressed the importance of use permissions, noting that copyright is now automatically assigned without being claimed, so the position of the IP community is that the policy is ‘All Rights Reserved’ unless otherwise indicated. She introduced Creative Commons licenses and recommended their use in BP documents – leaving a user in no doubt on how the BP content can be legally re-used.

**OceanBestPractices Repository** - the BPWG vision included a sustainable repository archive for ocean BP. The OBP-R is hosted and maintained by the IODE of IOC/UNESCO and was offered and accepted as the repository of choice for the project. Pauline outlined the evolution of the repository at IODE: from a JCOMM Catalogue of Best Practices to a repository for OceanDataPractices and, most recently, OceanBestPractices. She showed an example of how Best Practices documents can be deposited into the OBP-R (good (meta)data in, good data out) and explained the search options either through using the community structure or by search and filter functions. An enhanced semantic search interface will be offered (discussed in Pier Luigi Buttigieg’s presentation which follows). She described the roles associated to the repository – ranging from user to administrator and outlined the silicon, silver, gold, and platinum tags and their meanings, ie indicating metadata and peer review status. [Editor note: these terms were changed as part of the workshop recommendations presented on the last day of the workshop]. Pauline displayed the repository use and search statistics and showed the web analytic outputs available. She stated that it was planned to implement Google analytics and Altmetrics in the near future. Pauline finished by listing the benefits for organizations, programmes, projects and others that are depositing their best practice documents in the OceanBestPractices Repository:

- Permanent and securely hosted open access repository
- Provenance of IODE of IOC/UNESCO
- Repository indexed by all major search engines – aid discovery
- Repository harvested by Google Scholar, Scopus etc - greater BP promotion
- Deposit in OBP complies with Funders Mandate for open access;
- Repository offers persistent identifier, unique URI;
- Repository offers metrics down to the document level,
- Document records can be exported to bibliographic software or other formats

### 8.3 Pier Luigi Buttigieg - [Technologies for discovery and access for Ocean Best Practices](#)



Pier Luigi Buttigieg (AWI) discussed technologies for discovery and access. He presented approaches for semantic search, natural language processes as well as wiki-based options that are existing techniques used elsewhere, but not yet integrated into BP discovery. He lamented the creation of pdf documents, which greatly reduce interoperability and automated processing. He discussed the development of metrics to quantify the level of document FAIRness (see <https://www.force11.org/group/fairgroup/fairprinciples>), and described how interoperability could be improved. He described the importance of links and ontologies, and identified entities already employing semantic web and smart protocols. He then described automated methods to tag and retrieve documentation.

In the frontiers in arctic marine monitoring (FRAMS) microbial observatory component, AWI would like all data coming in be linked to protocols, global agendas, societal benefits etc. BP are usually retained in pdf

format. Documents in pdf are essentially invisible to the machine interactions environment. As a scientist going into the field and looking for a BP, you may find some, but not others.

What is the Ocean Best Practice System (OBP-S) mission: a framework for a FAIRer future for BPs. Pier Luigi talked about FAIR principles. For example for data should “be findable” as well as ‘accessible’, ‘interoperable’ and ‘re-useable’ are the core of the FAIR principles. What are the core enhancements needed to achieve this? Take a best practice and put it into the OceanBestPractices repository. Can we link to the BP from inside and outside the repository? We can link the metadata when it is appropriately formatted, not all meta data is complete or even in readily accessible format. What is the OBP-S concept and how will it work? For example, sensors operate in certain environments, in certain regions, with certain chemicals. Pier Luigi introduced the pyramid from data to Wisdom (Data, information, knowledge, wisdom). He then added weak semantics (glossaries, thesauri, controlled vocabularies, data models, taxonomies, ontologies (strong semantics) and ontology (a machine and human readable logical representation). Semantic understanding is difficult. For example, sea surface temperature - (SST) is measured at the surface but what is the boundary layer and is it both above and below the surface?

An ontology is a controlled, logically structured representation of reality that is both human and machine readable. Ontologized knowledge is queryable and can guide information and data mobilisation. It is a searchable, living, semantic layer. There is an urgent need to federate and align existing efforts in the ocean science domain for coherence, stable and cross-domain semantics. By interlinking BP collections with a queryable knowledge base, you may be able to say something like “get me all BPs where an optode is used to sense the concentration of oxygen”.

In conclusion, coordinated knowledge management linked to the evolution of BPs will make them FAIRer. We’re on the way to upgrading the international BP repository for ocean observing community. It’s up to us as a community to shape standards enabling FAIRness to be relevant to ocean observing use cases. It will take a concerted effort to align linking our processes for a step into the future.

#### 8.4 Jay Pearlman & Nina Hall - [Best Practice Peer-Reviewed Research Topic](#)

Jay Pearlman (IEEE) and Nina Hall (Frontiers in Science) discussed a Best Practice for Ocean Observing peer-reviewed Research Topic, within the Frontiers in Marine Science/Ocean Observation Section for publication. Jay described the motivation for the effort and the criteria used to select Swiss-based Frontiers in Science for the partnership. Nina highlighted the attributes that make Frontiers unique, such as a clear, open and interactive review processes. She noted the journal provides a lot of flexibility in furthering the topic of Best Practices in Ocean Observing, and that it will be a continuing series with the first deadline in April 2018. Jay listed the research topic foci, providing the web link (<https://www.frontiersin.org/research-topics/7173/best-practices-in-ocean-observing>). He noted that it is now open for submissions, solicited reviewers, and highlighted the open forum for discussion on the site.



How do you implement processes such that the community can recognize a BP? A potential approach is through peer review processes. Peer reviews, if they are not already done in a project among the project experts, may be either a community journal or an expert panel of the OBP repository. There may be overlaps in the membership of the expert panel and reviewers for the journal.

The benefits of engaging a broader ocean observing community, academic and others include: recognition for BP contributions; an open and easy access resource available for the community, broad exposure to new processes; and a practical forum for debate and convergence.

The Journal selection criteria were as follows: well recognised; open access; affordable; linkable to BP repository; provision of a forum as an opportunity for dialogue; broad participation in BP reviews. *Frontiers in Marine Science* was chosen. *Frontiers* was founded in 2007 to provide open access with creative commons. Content decisions at ‘*Frontiers in...*’ are made by active scientists /researchers. Editor and reviewer names are acknowledged in published papers. *Frontiers* editors collaborate with authors to improve their papers in an interactive (and transparent) forum. Due to automation during peer review, there are approximately 90 days from submission to acceptance. It is also very well cited. *Frontiers in Marine Science* was launched in January 2014 and the Best Practices Research Topic was started in November 2017. The research topic will be kept open so anyone can submit a manuscript at any time. Topic editors are handlers and will invite reviewers. As soon as a manuscript has gone through peer review it will be published.

The BP research topic foci include the following items and more: design of observatories, logistics and operation procedures; sensor design; and measurements methodologies. See the link at [Frontiersin.org/research-topics/7173/best-practices-in-ocean-observing](https://Frontiersin.org/research-topics/7173/best-practices-in-ocean-observing) for a complete list.

In conclusion, Best Practices in Ocean Observing Research Topic (RT) is soliciting papers in best practices methodologies. The research topic is also building a reviewer team and looking for volunteer reviewers. The Research Topic is an open forum for discussion and debate. Readers and reader feedback are encouraged.

## 9 Day 2 - Reflections, Breakout Sessions

### 9.1 Jay Pearlman - Putting it all together: Summary of Day 1 and Challenges

Reflections from Wednesday session of the BP Workshop:

- A definition of Best Practices was addressed, and inputs and comments were requested.
- BP come in many forms depending on the community and any of the formats can provide the essential attributes of a BP document.
- BP responds to a requirement and thus best practices will vary depending on the application and observation environment.
- We need to provide benefits and added value to motivate the community. These benefits, for example include supporting peer-review, tagging of BP documents for improved discovery, complementing the work of existing projects, providing permanent identifiers such as DOIs.
- The OBP Repository is totally open access and based on the FAIR principles. The same best practices can reside in more than one repository with linkages between such repositories highly recommended.
- Outreach is an essential element of a best practices system as well as training. Such training needs to be supported by the originating community that developed the best practice.
- There were a number of recommendations during the initial presentations. These included: (1) addressing the handling of BP ownership and intellectual property so that the BP developer guides the development and evolution of the BP; initial case studies should include the EOVs.
- Challenges between formal structure and innovation. We need a balance between them
- A discussion about peer review and possible alternative models suggests that a continuing evolution of the community culture (academic) would support further uptake of best practices
- There could be benefits from applying maturity levels (such as TRLs) to BPs. How do we mature things? Perhaps CMMI models could provide guidance.
- Is a BP only related to one instrument or measurement or is it more in a high level?
- There are gaps in the BP process. One area noted was QA/QC. Another is the ability to consistently access BP in a consistent and interoperable manner. This can come from “tagging”, the use of DOI and a more uniform process of description (through templates)

## 9.2 Juliet Hermes - [Community engagement \(education etc.\)](#)



Juliet works with the JCOMM Observations Coordination Group (OCG) networks and partner networks to identify and promote the development of standards and best practices (observing, data models, QC, data distribution) and coordinate documents, identify and support gaps, catalogue and review them. Integrate cross network methodologies by EOV.

The OCG is proposing a method to archive, disseminate and review the BPs and methods to encourage and monitor compliance and assist with training. They work with the following networks:

- Data Buoy Cooperation Panel (DBCP), Global Drifters, TAO,
- RAMA, PIRATA, regional buoy networks,
- Ship Observations Team (SOT): VOS (surface obs), SOOP (XBT),
- Global Sea Level Observing System: Global Tide Gauge Network,
- Argo: Profiling floats,
- OceanSites: Fixed site moorings,
- GO-SHIP: Sustained hydrographic sections,
- International Ocean Carbon Coordination Project -pCO<sub>2</sub>, and
- Other ocean carbon observations.

In addressing community engagement, activities being addressed include documentation, dissemination, reviewing, publishing BPs and outreach/training. An example may be supporting intergovernmental best practices across facets of the community, such as purchasing equipment, calibration, and consumables. Feedback provided is integrated into existing BPs.

There are many questions still – for example, who will request updates? Will there be a help desk? Who takes ownership? It is desirable to integrate across network methodologies by EOVs, looking at emerging as well as established programs.

### Questions/comments:

- *Dick Schaap* – Do we document how JCOMM table would work for the way networks are operating? Do we want to document a specific best practice?
- *Juliet Hermes* – We are addressing specific best practices
- *Dick Schaap* - Students don't address data management – they only think of Google. They are not aware of networks being operated. We should be approaching schools.
- *Jay Pearlman* - Perhaps, massive open online courses could be a vehicle
- *Peter Pissierssens* – OceanTeacher serves this function

## 10 Breakout Sessions

### Summary of Breakout Session Comments (Individual Group reports in Appendix II)

Pauline Simpson provided the introduction for the Breakout sessions of Thursday. The aim of these breakouts was to review by means of a set of questions: 1) The end to end process, and 2) contribute to the direction and implementation of the best practice process. To do this effectively we needed inputs based on participant's expertise in elements of the end-to-end observation of the oceans.

The breakouts each had four groups that met separately. Each group had a moderator leading the discussion and a rapporteur recording the meeting for reporting to the plenary.

**BREAKOUT 1: The Process** - *Is the end-to-end process proposed suitable for your domain needs?*  
(User-based needs/system requirements)

*Moderators and Rapporteurs:*

1. *Sensors* – Mark Bushnell, moderator and Eric Achterberg rapporteur;
2. *Data & Downstream Processing* - Adam Leadbetter, moderator and rapporteur;
3. *Applications (users)* - Frederico Saraiva Nogueira, moderator and Cristian Munoz, rapporteur;
4. *Ocean Networks* - Derrick Snowden, moderator and Juliet Hermes, rapporteur, **combined** with Data & Downstreaming.

Questions and aggregated group responses are provided below:

**Documenting BP - Template process**

*Questions:*

- *When you develop your BP what are the underlying assumptions (use - Open Access, Creative Commons etc; are exemplars provided; is Peer Review done?)*
  - *What are the problems in documenting BP?*
  - *How would you use a template containing core section headings to which you could add your own additional sections?*
- 
- BPs should preferably not be created by one agency or person, others will catch issues (not just multiple users but multiple creators)
  - Due diligence: gather examples of existing templates, either adopt or base the core OBP template on those.
  - The template should include a field to links (for externally hosted schemas and other web resources).
  - We should strongly encourage persistent URIs with an ORCID
  - Need for a BP must be identified
    - is a NEW BP needed or does an existing one need an update?
    - if there is a need, due diligence that standards don't already exist
    - if they do, engage that community if change is needed
    - Internet Engineering Task Force - RFP / RFC plus Current Best Practice -Both are cited
    - Research Data Alliance
    - WG outputs
    - List of sponsors / contributors – generators of trust...
  - Data management plans - harvest existing checklists and templates (Digital Curation Centre, IODE manual, DataONE, etc.) - consult with others to come up with consensus on recommendations.
  - Data discoverability and accessibility sections in some SOPs (Rachel notes)
  - The templates should also have a FAIR section, asking how each aspect is addressed.
  - Have field for next expected update/review date
  - Extensibility of the template - how do we manage this?
  - Ticket systems are not really supported
  - Should be easy to add a section; agreement that the formatting restrictions are acceptable

- Have a data formats field which OBP can mine and present stats on
- Additional metadata fields in DDS
  - How have you addressed FAIR principles?
  - Do you have a Data Management Plan?
    - Information management in DMPs...
  - The BP may be a “surface document”
  - Links to other documents, other BPs
  - Annex information
  - Links to other resources (use case – support the BP reqt.)
    - GitHub
    - Notebooks
- But how to maintain URLs...
- Recommendations for BP in data management are: use OGC standards; use of ISO standards; use of ODV and NetCDF; use controlled vocabularies; use of transformation services for providing possible other flavours for metadata and data; use of interoperability solutions for connection to other infrastructures.

### **Validating BP - Peer review process through repository and/or journal article**

#### *Questions:*

- *Is your BP document/s always peer-reviewed (external or internal) before being issued? Do you have criteria for BP peer reviews?*
  - *What benefits would a peer review process by volunteer community experts within the repository process provide? A peer review journal?*
  - *To have a Platinum tag the BP should be peer reviewed. How important is that to you and to others*
- How long will it take?
  - Is nice to submit first, and then internal review, and then external review use both always
  - Peer-review involves no costs and give credit to reviewers and creators
  - Review/consolidate the Peer Review tagging in repository

### **Disseminating your BP Document**

#### Contributing to a Repository (OBP) as part of dissemination

#### *Questions:*

- *What problems do you perceive in contributing your BP document to a repository?*
  - *Human resource to deposit*
  - *Metadata*
  - *Semantic tagging*
  - *Open access*
  - *...*
- Getting agreement and consensus within creator group
- Promoting BPs internally and externally
- Measuring relevance and success
- Granularity
- Longevity in the face of no funding for sustainability (must be stated)
- Support from organisational leadership
- Sufficient levels of careful peer review



- BPs should preferably not be created by one agency or person, others will catch issues (not just multiple users but multiple creators)
- Scope
- Don't overburden with metadata - minimal fields and extended
- Tech support: what is the bandwidth
- List of supported formats
- e-mail for help
- Browser compatibility
- Multiple repositories - Submission burden: many submit to other repos (ICES, IODE, etc) - can we reduce submission burden? harvest contents with DOIs/URLs provided in the template. Ping and link to the BPs and check the md5 hashes on the docs in other repos to poll for updates. Interesting opportunity to compare records of the same BP across the web: report if they are different
- Translate to English in order to submit it is a problem - translation costs money. Need experts for translation. Repository should accept docs in IOC languages (UNESCO + Chinese+ Arabic). Man hours to translate documents are a constraint.
- Copy, editing, proofreading, and editorial work, type setting is very time consuming too. Might not be mandatory in silver but may be required in Gold tag.
- Support that full metadata is compulsory
- *Semantic tagging* - It is a big issue for anybody. We need to index the document, issues with copyright. Dissemination level is public, direct agreement on the capacity of indexing

- *What requirements do you have of a Best Practices Repository?*

- *What changes/developments would you recommend for OceanBestPractices?*

- Best Practice definition
- Repository content scope to be expanded to include SOPs, Manuals Guides, Handbooks, etc.
- Repository has dropdown box to indicate BP, SOP, etc.
- DOI to be allocated to each BP (if it does not already have one?)
- Multi-lingual repository interface (MT)
- Efficient search engine.
- Simple metadata management.
- Easy findable website.
- Versioning systems to trace changes and approval of changes. Implies there are credentials implemented that gives rights of access to only authors and no one else. Lead author that moderate inputs in the forum if moderating is accepted in the process.
- Could be like Wikipedia
- Improvements –
  - Improving criteria for becoming BP
  - Need to implement maturity levels. Scale from 1-5. Producer needs to make a self-assessment on the maturity level. Forum could be a good tool to improve maturity of the BP.
- EOV as Search term option in repository; working with organizations that are developing similar capabilities, starting with a couple of EOVs. It would be good to map networks and who is doing what. Engage standards organizations in phase 2
- Metadata must indicate status
- Commenting fields on each BP page to enable feedback is useful, notify submitters (keep in mind that spam may occur, so moderation may be needed). Submitters could choose whether they want public/private feedback or opt out if they have no bandwidth

- FAQ section
- Link data BPs to the part(s) of the process (sampling, downstream, planning,) - offer some controlled terms for these
- *What other repository/s do you deposit in?*
  - JCOMM-OPS and Eurocean
  - Support IODE OceanBestPractices as the global archive (but BPs can be deposited into other archives)

### **Promoting BP – Methodology**

#### *Questions:*

- *What are the available channels of communication (email listserv, blog, newsletter, projects, LinkedIn SIG Group...)*
- *What works best for you?*
- *Is training part of your promotion portfolio?*
- Open Access (CC-BY), All flavours of CC v4 are suited for data, code needs other consideration-- Allow all choices under CC v4
- Publish article in Frontiers announcing the repo so it's citable
- Citation recommendations for the repo contents
- FAQ section (+ user guides and interface help text)
- Be clear that there will be separate routes for submitters and users
- Video Tutorials
- Summer Schools - training
- Comments by identified users count
- One-page flyer on a BP
- One-page flyer/brochure on the repository – tailor for users and submitters
- Promotional videos on BP repo
- Social media presence link with Frontiers – ResearchGate, Twitter, LinkedIn
- Community listservs, email lists
- Post on things like Ocean Teacher and other relevant sites.
- Infographics.
- Direct to users and submitters separately.
- Feedback comments - Opt-in/out
- Feedback Comments – with moderation
- Feedback - Users – like / thumbs-up
- Newsletter – regular

### **Sustaining BP – Updating**

#### *Questions:*

- *Do you update your BP Documents – is there a regular review period?*
- *Is there an aging impact on the value of a BP?*
- *Would you take responsibility for ensuring that the OceanBestPractices record reflects the current status of your BP Document?*
- *If a new BP is offered, what is the criteria for a new BP to replace an existing one?*
- *What problems do you perceive for sustaining/updating your BP?*

- Link to other versions of BP (? should OBP keep all versions forever)
- Updates get new DOIs
- Replacing/updating old BPs should be up to the contributor – yes (person expert in the matter and/or legal organization) - the repo should not set the criteria centrally
- Problems in Updating
  - Interest of users
  - duration of activity,
  - substitution equipment,
  - lack of need of the BP.
  - lack Resources and funding.
- Issuing Agency to have a reminder to query if update available, in progress
- Link to code repositories and datasets - ping show if these links are live when the last update was
- Ping links provided in the template and check if they're live - if not, then badges on the BP landing page will indicate this and the submitters will be notified
- Parse a template field which asks when the BP is valid until. Auto reminder email about upcoming review date - the contributors to mark if the doc is still current. If this is not provided, email every year or so.
- IETF (internet engine task force) called their documents Best Current Practice and coupled them with a Request For Proposals/Comments to identify needs
- Version control
- Criteria for replacing
  - Full day discussion.
  - Reviewers should take part of the decision. Needs to involve users and producers. Independent assessment.
  - Hydrographers are reluctant to change, conservatives. Don't change a procedure until you clearly know why it was implemented.
- Currency of documents – clearly label particularly obsolete or superceded
- Managing broken links
- PIDs
- Obvious requirement but process not in place yet. Fix03 is moving into EMSO that will be in charge of updating the documents. There are MM assigned.
- Desirable to put in the document.
- Aging concept - Depends on the discipline, field of application. A concept changes slowly. Equipment changes very fast.

## **BREAKOUT 2: Implementation directions**

*Rapporteurs:*

Mark Bushnell, Pier Luigi Buttigieg, Yutaka Michida

Questions and aggregated group responses are provided below:

### **Initial Operating System**

*What are the core capabilities that should be implemented initially? See also Breakout 1 Repository requirements*

- Corpus of BP documents. startup collection of documents (+)

- Central repository of BP with DOIs (+)
- User friendly search interface. Seamless submission. (+)
- Standard metadata structure for multimedia, docs. (+)
- Objects with tagged content using standard ontologies and controlled vocabularies. (+)
- Group of committed partners, alliance of the willing that work as providers. (+)
- Coordination of Pilot project of IODE-GOOS-JCOMM (and associates)
- Workflow arrangements for each partner.
- Capability by each nominated partner to enter documents.
- Promotion
- Managing the data: Supplier group?, Incurring persistence of document, incurring version management, link to the document and a DOI pointing to the page that contain the BP and all the metadata.
  - By March 2018 Assign DOIs (but cost is an issue). Template should transition from draft to operational form. Queue and status for submitted documents. Option for feedback (opt in), especially needed during formative state. Taxonomy of different document types to be submitted should be established. Consider how well-established SOP/BPs should be treated, we suggest leaving it to the community to manage peer review.
- Improved FAIRness of repo, especially findability (+)
  - Interoperability with other BP-like archives
- Allow creation of collections by editors or users
- Needs a persistent and responsive service desk (+)
- Curation of submitted content (spam filtering etc)
- Search capacities; Ensure cross-facet searches (+)
- Cross-linking with other DOIs (pinging and checking md5s important, dates of last update, email when changes or deletion detected) (+)
- We need the DOIs to be referenced - needs coordination with WoS, TR, etc. There's no guarantee that these will be harvested. Also needs journal editors and reviewers to request these citations. (+)
- Automatic import of references GOOS EOVS (and other variable schemes EEMs, EBVs,...) records - widget to allow cross refs with other
- Login with ORCID – no new accounts
- Feedback is useful, but once a critical mass is achieved (careful with likes and dislikes), the elective feedback with opt in or opt out is useful here. Good place for BP submitters to gather feedback for round 2. No opt out is also an option, as it's still a chance to gather. (+)
  - Plug in a stack-overflow commenting system with vote up vote down (lots of enthusiasm for this)
- Facets to search across:
  - sensors
  - data
  - platform
  - organisation
  - EOVs
  - region, location
  - scale
  - ecosystem
  - phase in the process - prep to observe, deployment, data gathering, ...
  - objective of collection of BPs
  - metric EBVs
  - ocean processes and hydro/cryo/geoforms
- DOIs for collections of BPs that users can specify (shopping cart style)- create a DOI for collections

- Things to emphasize:
  - international promotion / visibility
  - long-term archive and DOI issuing
  - IOC international branding
  - relative permanency
  - cross linking to other BPs from other groups
  - an outward facing BP often leads to more thorough authoring of BPs/SOPs
  - acknowledgement of contributors (engineers, scientists)

*Should we start with sensors, ocean applications and data management or a different priority area?*

- Three of these, also include platforms (+)
- => all in parallel
- But you need a critical mass.
- Depends on the submissions and interest

*Initial pilot focus areas – should we look at BGC, physics or a different discipline, or look at specific EOVs (such as temperature at 10m)?*

- Let's see what people bring under platforms/sensors
- EOVs (+)
- Physics : T°, Sea Level height, Waves (+)
- Biogeochemistry
- Ocean Color (surface),
- Biology
- Plankton, zooplankton, biomass, diversity
- Depends on the submissions, but...
  - Ocean observers that need assurance that some sort of standard practice has been used
  - Regulatory bodies that need assurance BPs are being followed
    - Voluntary beta testers from this meeting and close/invited participants.
  - Open up once the core functionality has progressed and makes a good initial impression, wider community.

*What exemplars would be good to look at for the initial operating capability? (see also above question)*

- Physics : T°, Sea Level height, Waves (+)
- BioChemistry: Ocean Color (surface),
- Biology: Plankton, zooplankton, biomass, diversity
- Fundamental physical EOVs (+)
- Systems that are powered by knowledge graphs such as the Monarch Initiative

*How should the elements of peer review be integrated into a seamless process?*

- Ask first who has process/workflow
- Those who do not have process: need to adopt process. Journal could provide peer review. Peer review have 3 options: (i) community/programme peer review; (ii) journal; (iii) internal review.
- Do we need this really? The BP will be written by the specialist!
- The BP can be very specific to an area (O2 in Costa Rica region in comparison to O2 in Baltic ?), so NEED criteria to review the BP !
- Data Quality controlled BP is difficult to review
- Number of person (projects) that use the method?

- Peer review is part of the queue mentioned above, and the process should be transparent.
- Allow status tags to be bumped up if the submitter lets us know about their internal review processes and they are accepted (by who? A review committee?) as equal quality/stringency
- Avail of Frontiers processes for those BPs that have a journal-level description

## Key Metrics

### *How do we know/monitor the use of BP that have been published in a repository*

- Statistics of downloads and geographic information. (+)
- Also need to know who accesses the data. (+)
- Encourage users to cite the BPs (+).
- Use case
- Verification
- => gives evidence to stamp the BP to a next level
- Citation metrics on the DOIs (journal and repo) (+)
- Eventually likes and dislikes depending on community that is assembled (+)
- Cross links with other forms of documents (+)
  - e.g. GOOS endorsed practices will be in the repo, EOVS spec sheets will be in a DB which can be linked directly to the BP DOI, create widgets that list these through API calls

### *How do we encourage the use of BP across platforms and disciplines?*

- Marketing strategy – see also profile above
- Establishing network by publishing the info to newsletter (GOOS, GRA, Summer schools, IOC, IODE...) (+)
- And for the users ! => Information given to the European projects ! ! !
- Tell reviewers to look for best practices in the references. (+)
- Communicate with steering committees of observing communities.
- We need to be clear on the links and differences between GEO, GEO BON, MBON, and the OBP - how do they coordinate? Where do users submit? Do we cross archive?
  - Rachel notes that GEO BON wants to collect SOPs in the BON in a Box model
  - DEFINITE need to coordinate. Managed redundancy is very useful, must be automatic to prevent massive time and labour costs needs (+)
- The values of permanence etc. were acknowledged as encouraging: stable reference
- Making stuff painless for people with BPs, taking the management burden off them (+)
- If convinced participants can spread the word and submit docs
- Assemble a list of organizations that support the initiative. The big ones are on the website, but it's good to show that smaller or national groups around the world are using it (+)
- Flyers promotional material, standard conference promotional, (+)
- OceanObs 19

### *What is the most effective means of feedback?*

- There is already a repository feedback box and helpdesk, suggest likes, surveys, mails from registered users (+)
- Survey refers to repository not the BP?
- Suggest feedback box for BP; If people can comment on it... we will have a feedback (stars system and comment) (+)
- Share on social media.
- Keeping track of feedbacks for the IOC.

- See above (Fischer)

### *Cases for testing – what initial and stable use cases should be used for monitoring and assessing new features (specific BP to go through the “system”)*

- Stress test (GO-SHIP manual)
- Ask Mark for the DO QARTOD
- Fix03 manual
- pCO<sub>2</sub> manual
- Use the CO<sub>2</sub> cookbook to test

## Community Engagement

### General comments

- The benefits for contributors and users should be clear and disseminated to seed engagement
- Do we need a critical mass of BPs before approaching the community? (+)
  - 200 docs exist at the moment, not all up to date, a bit scary due to variation in quality, detail, etc
    - The metadata, tagging, and search interface is essential to support searching and categorization to help users make sense of this
    - Agreement that the first impression is essential - clean, faceted interface is required to make that impression (+)
    - Rachel agrees to be beta tester for submitting new documents in a standard way, happy to use the system and see if it engages her (and her community)
- The participants of this meeting are the core group to build a fresh document store (+)

### *What are efficient methods of training and promoting BP? Is this discipline/platform specific? Can there be knowledge transfer between platforms/sensors?*

- Link with OceanTeacher, videos (team with other orgs like IMOS), summer schools, MOOCs, science workshops (+)
- Newsletter of RIs and EU project, etc.
- Training should be a part of what the BPs are about (+)
- Reach out to training organizations and encourage them to use the BPs in the system, also list orgs that can train others in a given BP
- Perhaps ask submitters to add information on who to contact for training info (or ask them to submit details on summer schools etc)
- Incorporate videos into the BP repo.
- More human resource and financial support is required to extend and support teaching. Interfacing with groups which already do this and need source material would be advisable. (+)

### *What are the community priorities in the implementation?*

- Don't know yet. (hopefully what we answer under “What are the core capabilities that should be implemented initially”).
- Depends of the community
- Operational vs research, coastal vs open ocean
- Harvest competency questions from different groups, announce what we are doing and that we are listening to their needs. Needs to be done through the network from this workshop to solicit focused and quality input.
- E.g. some groups would want specific info on precision/accuracy, calibration procedures, etc. need minimal and then recommended metadata for different communities (MIXS model)

*Relations with organizations carrying out observations (how do repositories relate and interface),  
Input from end users as to their issues in the use of metadata and data from BP (eg data assimilation)*

- Priority for those active in the field, need to interlinked with the BP repository. Through them they may reach out to wider community

*Support of the observation community in using best practices (needs for training, or perhaps interactions with well-established groups and a help desk)*

- Technical training (+)

*Input from end users as to their issues in the use of metadata and data from BP (eg data assimilation)*

- It must be simple to use (BP Submission and good search engine), ergonomic, etc (+)
- Comment box within repository (but don't expect too much), user groups, social media such as ResearchGate & LinkedIn and engage early career participants, town hall with food and potential for funding. (+)

*Other outreach – eg reviewers for journal, presentations, oceanobs19*

- Journal comment -thinking is that the repo would have more content,
- Frontiers articles can envelope many submission
- Scientists can work on papers, technical staff on the methods
- Journal may be used to collect a range of BPs under one overall description

## **Longer-term Operation (Development) Needs**

*What are the priority steps moving beyond the initial operating capability?*

- Link BP to standards process of IODE and others
- Automate the process as much as possible
- Sustainability, maintenance, use and growth, integration into existing network (+)
- Establish management, sustainability, & funding. (+)
- Decide on languages and multilingual support
- A consortium to be created for yearly (?) alignment
- Create partnerships with national, regional, and international reporting frameworks. For example, the Good Environmental Status MSFD - 11 descriptors, everyone doing it differently, ICES is figuring out how to report on this, every country reporting differently. Offer the repo as a place to coordinate these (create national collections), important to reach out to the right component of e.g. ICES.

## **11 Day 3 - Keynote Address; Panel Discussion; Summary**

### **11.1 Nadia Pinardi - [Moving Ocean Best Practices for Research and Applications to a New Dimension.](#) Keynote Address**



Nadia Pinardi (Co-President of JCOMM) introduced the Neil Armstrong & Albert Einstein, and Judy Benign oncologist Youtube clips and suggested we look at them (linked in her presentation). She discussed the three steps associated with delivering ocean societal benefits – input data, generic information, and then customized products & services. She noted that each of these steps must be coordinated internationally and



using best practices. She described OBP as an activity that proposes international standards for methods, procedures, and techniques for oceanographic observations. She showed WMO examples of WMO technical regulations, manuals, & guides. She proposed the start of a pilot project, coordinated by IODE-GOOS and in close coordination with JCOMM, all of IOC should contribute, and that ODIS consider OBP from inception. She also proposed that OBP might become the body to develop regulations.

Ocean value-added chain - from observation to application

- input data systems: satellites, argo; regional observing systems; ocean-sites; GLOSS, etc.
- generic information services: data products; forecasting; analysis; and reanalysis system;
- customized products: Copernicus marine environment system (CMEMS); Intermediate users (and value added work which they bring in) such as Maritime safety, disaster risk management, marine pollution
- societal benefits: products for sustainability; justification should be based on actual verification.

From observations to applications, there are BPs in each step of the value chain.

*For observations:*

- Allow broader and faster operationalization of mature observing technologies
- Sustain an incremental development approach of platforms/sensors guided by documented scientific past knowledge.

*For generic services:*

- Allow forecast inter-comparison, future multi-model ensemble methodologies
- Increase the intermediate user uptake (netcdf to data is complicated)

*For Customized services:*

- Widen market potential
- Allow a fair competition giving means to show compliance to procurement tenders. Many times, it is not easy to prove compliance with specifications. With BP or standards such as ISO, you will be selected on that basis on, obvious transparency, and on fair competition.

Ocean BP who is it for? Users include:

- Researchers
- National ocean agencies involved in ocean monitoring
- Operational, generic ocean services
- Blue economy sectors
- Citizen science and literacy

The above list needs to be prioritized according to the different phases of OBP implementation.

OBP is an activity that addresses international standards and demonstration of community practices for methods, procedures, and techniques in oceanography. OBP will facilitate worldwide cooperation in the establishment of networks of stations for the making of oceanographic observations. Think of a system equivalent to the WIS system for WMO - this would be part of a new ocean data information system (ODIS). OBP is important now that the concept of the ODIS is included within the IOC strategic development discussion.

Useful examples include:

- WMO regulatory material. Technical regulations, manuals, guides. Technical regulations should be the future goal.

Steps into the future:

- Start a pilot project
- Pilot project coordinated by IODE-GOOS-JCOMM; committed partners for specific target users and use-cases.
- Ensure all IOC programs contribute to setting requirements and ODIS; considers OBP since its inception
- Develop OBP on the 3 components of value chain from the beginning
- IOC should be asked to coordinate and define process of endorsement of OBP standards (including best practices) by member states. For OBP, it is important to start thinking how IOC will work in this direction.
- OBP should contribute to SDG goals
- OBP should contribute to the blue economy strategy
- Within the next 10 years, OBP should become a full component of ODIS and a component for regulatory material
- OBP could become an organization that develops ocean data regulatory material (ISO-like organization?)

This vision of the future is comprehensive in that it looks to IOC as a leadership and coordinating organization to move forward with facilitating observations, data and information which is supported through global scale best practices. Questions on the presentation were deferred to the panel discussion which followed the presentation.

## 11.2 Sustainability, Governance and Practical Implementation of Best Practices Framework: Panel Discussion - Emma Heslop (Moderator)



### Panel Members:

Peter Pissierssens; Derrick Snowden; Nadia Pinardi; Albert Fischer; Pier Luigi Buttigieg; Jay Pearlman

The panel addressed a variety of questions, such as governance, resource opportunities and sustainability. An overview of the discussion follows.

*Peter Pissierssens* - suggested that a partnership evolve, responsible for a bottom-up approach to the workflow; each organization would nominate an individual point of contact.

*Derrick Snowden* - suggested starting with a low bar of entry and noted the challenges of managing multiple observational entities. He identified several near-term milestones that the OBP effort might leverage.

*Jay Pearlman* - requested hearing what two things people might undertake in the next few months to one year to further OBP efforts. He concurred with the benefits of having a user facing capability in the near term

*Pier Luigi Buttigieg* - noted the planned use of advanced technology and the natural linkage to research activities. He noted that the System will rely on advances in technologies. One needs to provide a framework and encourage collaboration. Top-down governance has multiple levels. Harmonizing these approaches is required for the global system to work. People need to realize they are all part of the same mission. Pier Luigi also suggested that some traceability be established to SDGs, using the underlying technology.

*Albert Fisher* - indicated that GOOS has no regulatory mechanism to force countries to participate. In oceanography, the user community is very broad and diverse (scientific research, assessment, forecast, etc). This provides a top-down view on approach to best practices. Readiness is important, so is the first outlook to the future. He suggested looking at how other entities obtain support, such as the Open Geospatial Consortium (OGC).

*Jay Pearlman* - reviewed the business model of OGC, saying contributions from companies was a primary mode and such contributions followed the economy closely.

The panel noted the distinction between development of standards (long, tedious process) and documentation of best processes (already existing, in use, and only perhaps requiring documentation).

*Nadia Pinardi* - identified the need for governmental support of OBP, and said that the growth of OBP can support the establishment of international coordination without necessarily waiting for that coordination to occur first. There is a need to start from the beginning. The Ocean community is not different from the meteorological community. Successful meteo examples have been resourced internally. She also said that a fully developed OBP pilot project should be ready to present to entities such as IOC Assembly within two years or less. She had to learn and find value in ISO in her activity. We should see how other regulatory organizations work. We need to do a good job in first phase and gain recognition. Funding is a serious issue for the second phase. She concluded with the need to be pro-active and meet with the EU community directorate and with private setups to find funding.

*Albert Fischer* - suggested looking at integrating into IOC in about 18 months from now.

*Peter Pissierssens* - also agrees with Nadia and Albert about the IOC Assembly. Later Peter said to the participants that IODE is committed to seeing this move forward.

*Derrick Snowden* - agreed that we should have some material quickly. There should be milestones at 18-24 months

*Peter Pissierssens* - recommended that the OBP System start as a community effort with modest resources so it does not become too formal too early. Meteorology has formal offices with 200 people. Ocean community is more diverse. ODIS cannot do it yet – it will be four years for policy to firm up. In the early phase of BP, we should consider showing use through citation.

For the ocean community, research and upgrades are vital. We need to understand relations between local and regional BP, which have many facets and national approaches and governance. Albert agrees and then noted that the work shown clearly needs to reflect collaboration.

*Jay Pearlman* – he noted that Standards organizations have business models that can be quite diverse. OGC uses a partnership model where companies put money. ISO sells standards documentation and uses volunteer contributions for standards formulation (as does OGC use volunteers). If we develop facilities and capabilities, these models may not apply. As an alternative model, global banks for developing countries could contribute funds to the operations.

*Frank Muller-Karger* - noted that most communities (disciplines) will stay in their silos. He stressed the need to find ways to connect to socio-economic products to bring communities together. At the top level, there is a need to provide connections to communities, and to make interdisciplinary regulations. It is not easy for IOC to go to NSF, but there are other opportunities, such as OceanObs19. Use these opportunities to focus attention. Addressing Societal Goals, including interfaces with SDGs, would help in providing value and visibility.

*Rajesh Nair* - suggested also addressing the European MSFD with an emphasis on providing methods that are traceable.

*Nadia Pinardi* - returned to the idea of a Pilot, which should help with the coordination IODE-JCOMM-GOOS-and Blue Planet. Guidelines for oceanographic instruments and inter-calibrations exists for partnerships of different countries through JCOMM. When voluntary support works and the plan can be developed, we can have official statements to provide to partners and other organizations taking onboard regulatory roles in the second phase.

*Cyndy Chandler* - would like to be able to search the repository based on an Essential ocean variable term and obtain a knowledge representation of all the OBPs. She suggested working with organizations that are developing similar capabilities, starting with a couple of EOVS. It would be good to map networks and who is doing what. Engage standards organizations in phase 2.

A number of workshop participants continued stressing the importance of working together as a community in order to obtain resources in preparation for the second phase of the project. There is a need for cooperation between IOC, IODE, GOOS, and JCOMM, for example, regarding co-design, and interdisciplinary work. There is the possibility to bring this effort to the IOC Assembly in early 2019.

This includes both bottoms-up and top down approaches. Testing is also important.

The Moderator closed the Panel Discussion by noting that technology may play a key role, and that practical implementations are needed.

### **11.3 Jay Pearlman, Mark Bushnell, Pier Luigi Buttigieg, Emma Heslop, Cristian Munoz Mas, Pauline Simpson - [Implementation Plan Updates and Steps Forward: BP Workshop Panel](#)**

The BPWG, which includes the panel participants and others, reviewed the inputs from the presentations and breakout groups. These inputs resulted in changes to the implementation plan to reflect the priorities of the workshop participants and the organizations they represent. Changes to the flow process include:

#### **11.3.1 Process updates from workshop discussions**

The recommendation of the workshop participants was to increase the documents types to be included in the repository to standard operating procedures, manuals and other practices documentation. The types of documents reflect the practices of different organizations. The key to acceptance in the repository is that the submitting organization indicates that the practices represent recommended or “best” practices developed by the organization. All these document types will be referred to as “best practices documents” in the following discussion.

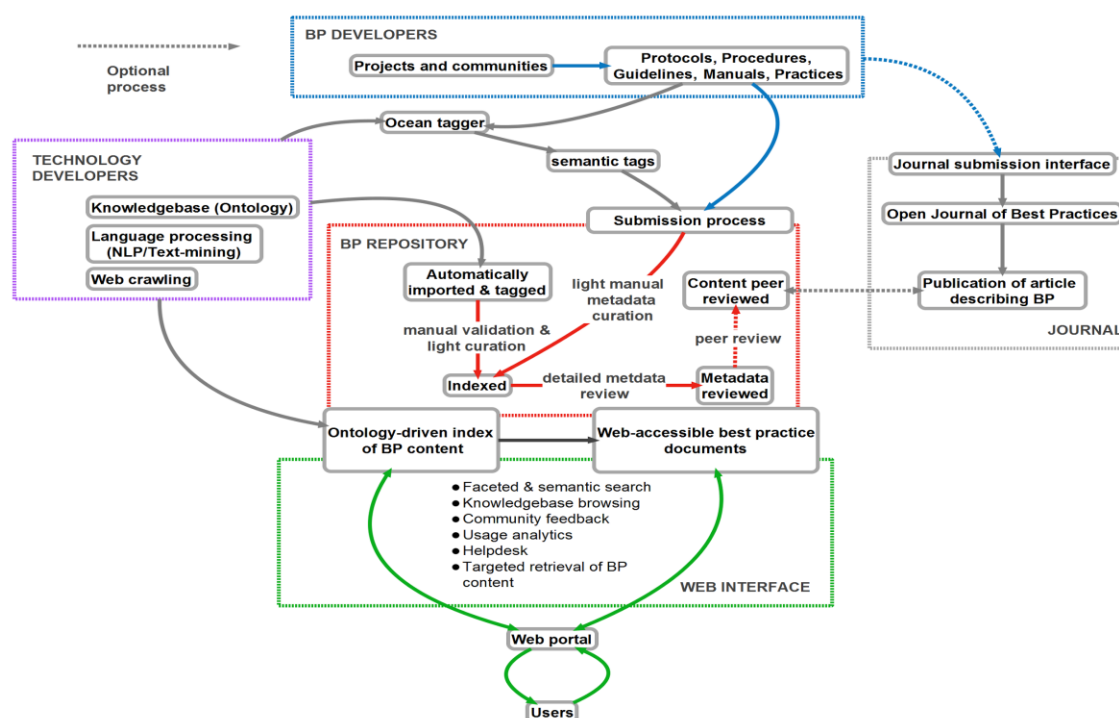
The process levels (see Figure 2 below) have been renamed to reflect the level of metadata and content review in the various document categories. The categories are: indexed; Metadata reviewed; and content peer reviewed.

- *Indexed* includes a light review of metadata completeness to include the ability to index the document in the repository.
- *Metadata review* includes detailed examination of the document metadata to assure completeness of the description and conformance with the information requested in the document templates. In some

cases, the submitting organization will be asked to supplement the metadata information originally provided or metadata will be updated by the repository staff based on information available from the best practice document. Generally metadata review does not include BP document content review

- *Content peer review* includes peer review of the content either by an OBP expert panel or through the Frontiers in Marine Science Research Topic “Best Practices in Ocean Observing”. If the BP has already undergone peer review in its submitting community and this is indicated in the submission, additional peer review may not be required. Peer review criteria will be defined by the *RT* editors and the ODP leads.

Figure 2: Process for sustainably archiving and accessing Best Practices



In the updated Best Practices Flow diagram, given in *Figure 2*, the knowledge base includes the capabilities for semantic indexing and tagging of document text for enhanced discovery. The initial tagging will be done through keywords and text vocabularies. In phase 2, natural language processing will be implemented.

### 11.3.2 Best Practice Definition

Following an extended discussion of what is a best practice earlier in the workshop, the participants agreed to the following operating definition of a 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.*

An addendum recognizes that 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 as a community best practice.

### **11.3.3 Underlying Assumptions in the BP System**

For the OBP repository, the OBP System will follow open practice principles aligned with the FAIR objectives of findability, accessibility, interoperability and reusability. This includes open access as well as other attributes. This approach enables multiple coordinated locations for a best practice document as well as an intellectual property approach where the BP developer retains ownership of the content.

### **11.3.4 Peer Review**

The three methods of peer review will be coordinated and, where appropriate, interlinked. The methods are (1) project or program review prior to contributing the best practice to OBP; (2) peer review through submission to the “Best Practices in Ocean Observing” Research Topic; and (3) OBP expert panel review. The review process for the journal will be run through the Frontiers organization (<https://www.frontiersin.org/>) and will be addressing review modes including traditional methods of journal peer review as well as complementary reviews with community input. Provision is thus being made for community dialogue as part of the BP system. Details will be addressed early in 2018.

### **11.3.5 Implementation**

The implementation of the OBP System will be done in two phases. In phase 1, there will be a Pilot that will provide many of the attributes of the BP system and a modest BP library in the OBP repository. This includes semantic-based search and keywords/tagging, DOIs for BP documents using either existing DOIs or assignment of new ones, an updated interface for users to improve discovery and access, interoperability of ODP registry with other BP archives, a simple BP submission process including availability of templates, a help desk for users and suppliers and provision for feedback.

Phase 2 will expand the capabilities of phase 1 with the addition of natural language processing supporting discovery, a more complete collection of BPs, implementation of an Ocean Knowledge Tagger to support advanced tagging of documents in the ODP repository and developing BP documentation.

Both phases will be done with collaboration across the ocean observation community. The collaboration emphasizes partnerships between major organizations. This would allow the leveraging of infrastructure developments from other activities and disciplines. There will be community engagement from both research and operations programs for testing and evaluation at various stages of development. The OBP efforts will include outreach to major projects to provide updates on status and encourage inputs for performance improvements.

### **Benefits of the Best Practice System**

Benefits to OBP Users include:

- Living, Sustained, Comprehensive System for Ocean Observing Practices
- Ocean-Oriented Natural Language User Interface
- Fast, Customizable Advanced Search
- Open Access with alerts
- Traceable Community Reviews including Peer Review options

Benefits to OBP Contributors include:

- Permanent archiving through Internationally recognized UNESCO/IOC – IODE hosting
- Indexed by all major search engines – improving potential for global dissemination and increased citations/use
- Content harvested by Google Scholar, Scopus, OpenAIRE, etc. (OAI-PMH compliant)
- User friendly and speedy submission process

- DOI for each document
- Curation and quality control of metadata
- Peer Review options
- Research Topic/Journal for visibility/citation opportunities
- Use, search, and citation metrics
- Community engagement and feedback
- Complies with funder mandates

### Discussion/comments

- *Jay Pearlman* - asked for reflections from participants if there is something missing or needs change.
- *Frank Muller-Karger* - The process seems to be a one-way flow to the users but users may put requirements to developers. There also has to be some requirements through UNESCO/IOC. How can we effectively engage developers and socioeconomic community.
- *Pier Luigi Buttigieg* - The fact is developers and users share the technology. Some of those overlap with socio-economic community.
- *Jay Pearlman* - Providers are also offering requirements and reflections on the use. For socio-economic benefits, the environmental info alone has impacts on economic decisions. NOAA, NASA, USGS are making contributions in this area and there is a mechanism to approach and work through NOAA.
- *Albert Fischer* - AtlantOS has part of the resources needed for this effort and for addressing socioeconomic opportunities.
- *Jay Pearlman* - With respect to added value of ocean observations for society, activities that improve efficiency are also important. There is real opportunity to set a foundation for improved interoperability.
- *Peter Pissierssens* - Ocean Knowledge Tagger is another area of contribution to the ocean community.
- *Cyndy Chandler* - metrics should be available for contributor for funding purposes.

Any objections and concerns for diagram as a tool to keep going forward?

- *Ana Lara-Lopez* - Include detail about intercomparisons also.
- *Jay Pearlman* - we need to define a category/clearly defined processes for that. Also industry contribution would be another area to address.
- *Frank Muller-Karger* - Stories of success in infographics would be good.
- *Jay Pearlman* - OBP repository evolves and need use cases that are test cases too.

Concerns about us moving forward?

- NO

BP document template. How much energy should we put on it?

- *Cyndy Chandler* - nobody will write a new one in the next months so this is a good time to start the template distribution.
- *Pier Luigi Buttigieg* - disseminate that with new material, we should consider the template for better technology search performance.
- *Ana Lara-Lopez* - second that. Having template is very useful. Having both options is good.

Capabilities in near future. Feedback?

- *Derrick Snowdon* - we need ways to keep group activity going. An example would be a list of documents that we have been talking about during the workshop.
- *Peter Pissierssens* - partnerships must be established as a priority
- *Emma Heslop* - short-term collaboration of inputs, through update emails every month.
- *Peter Pissierssens* - training on BP creation, submission, establishment, etc needs to be addressed.
- *Jay Pearlman* - We would like to acknowledge GOOS collaboration and contributions in organizing this workshop. We will plan a follow-up meeting in the future.
- *Emma Heslop* - A townhall will be held in February at the Ocean Sciences Meeting (Feb 14 at 12:30).
- *Jay Pearlman* - there will be a workshop at Oceanology International in London during March 2018. There are training sessions. We'll keep people up to date.
- *Frank Muller-Karger* - RCM meeting available too. It is being held on Sunday, Feb 11 in Portland.
- *Jay Pearlman* - EMSO, oceans tomorrow, etc. Need people to collaborate in order to reach out to big projects.
- *Peter Pissierssens* - Peter made a commitment from IODE and office in Ostendee to the OBP implementation and operation.
- *Jay Pearlman* - Jay thanked all for the commitments!!

Jay Pearlman and Albert Fischer thanked the participants for a production workshop and for their individual contributions to the discussions and recommendations. Jay thanked GOOS for hosting the workshop.

## 12 Recommendations from the Workshop Presentations and Discussions

As discussed earlier in this document, breakout sessions were conducted with the purpose of obtaining guidance from the practitioners on the proposed end-to-end OBP process and on the implementation plan. These inputs were needed to ensure that the outcomes from the Best Practice Working Group (BPWG) were fit for purpose. Outcomes from the individual breakout sessions were integrated and prioritized, leading to the recommendations summarized below for selected OBP system elements. The listing is separated into two phases (Phase 1 and Phase 2), reflecting the planned schedule. The prioritization takes into account the schedule of the primary projects supporting the OBP tasks. For example, the ODIP II project will finish at the end of March 2018, thus activities related to that project will be prioritized for completion by March 2018. Similarly, activities associated with the AtlantOS project will need to be completed by March 2019.

### 12.1 Repository – March 2018

An initial repository will be implemented in the near term, as a pilot and will be available by March 30, 2018. Users of the repository will include both BP providers and researchers looking for Best Practices. The following capabilities will be addressed:

- 1) The repository will be populated with a sufficient number of OBP entries for users to want to use the system. A critical mass of approximately 500 entries will be considered adequate
- 2) Interface to the repository will be clean and easy to use
- 3) BP providers will include a BP definition, request a DOI, and enter a number of new metadata fields. Automated metadata ingestion from the template will be implemented where applicable. Metadata field examples are as follows:
  - i. SDG relevance
  - ii. Next review date – BP contact will be automatically notified when review is due
  - iii. Data format to allow collection and interpretation of metrics



- iv. Maturity level (hardware and/or BP) dropdown: 0=Undocumented; 1=Used by your organization only; 2=Peer Reviewed; 3=Used by a second organization; 4=Used by multiple organizations; 5=Widely used over many years. It should be noted that GOOS EOVs have readiness levels that could be used.
  - v. Field (dropdown) to identify BPs, SOPs and other documents with scoping to define each.
- 4) Semantic-based faceted searches will be provided for BP users regarding the following elements: objective of BP, ocean processes, sensors, data, platforms, organizations, EOVs, SDGs, regions and locations, scale, ecosystem, end-to-end process phase (such as preparation to observe, deployment, or data gathering). EOVs will be covered by semantic tagging, or repository metadata field.
  - 5) Detailed Statistics/Metrics will be based on Google analytics, or altmetrics (Citation metrics from commercial biblio databases);
  - 6) Peer Review
    - i. Define Peer Review criteria for BP (extract from Journal criteria)
    - ii. Peer Review process should be time-limited with reporting on progress
    - iii. Peer Review Request/Decline - Yes/No new metadata field and automatic notification to OBP management
  - 7) A help capability will be provided, including answers to frequently asked questions (FAQs)
  - 8) Content for About section for web interface
    - i. Branding of repository, ie impeccable provenance
    - ii. FAIR section on repository interface to show how each aspect is addressed
  - 9) Feedback/comment box on each BP record - submitter choose if they want the comments to be public or private feedback (team should decide this week)

## 12.2 OBP Document Template

The use of a template to assist in the development and documentation of an Ocean Best Practice is addressed below. Predefined templates containing core section headings could be expanded with inclusion of other headings as appropriate. Examples of such templates might include those related to sensor and platform topics, those related to data management, and those related to applications. The following template requirements were identified:

- 1) Templates need to be completed to prepare for distribution by March 30, 2018.
- 2) The following template elements need to be included in the core section of the template, or are already a part thereof
  - a. The Sensor Maturity Level (TRL) needs to be added to the core level sensor template
  - b. The Sustainable Development Goals (SDGs) are already a part of the core Template
  - c. The existence of a Data Management Plan (DMP) is added to the core section of the template
  - d. A training section with contact information is already a part of the core section
  - e. Reference to other BPs are already included in the core section of the template
  - f. Links have already been added to the code and data repositories
- 3) The following fields either need to be added to, or have already have been added to the Document Data Sheet (DDS)
  - a. Include the Review Date Field (Note: this is already included)
  - b. The Data format field needs to be added to the DDC
  - c. Implement a self-assessed BP maturity level, on a scale from 1 to 5, and incorporate as part of the DDS
  - d. Include Essential Ocean Variables (EOVs) to the DDS. Note that a readiness level has been identified for the GOOS EOVs

- e. Include an ORCID for authors and editors identified in the DDS template; please note that this is already done
- f. Manage links by exercising those links provided in DDS and BP document and notifying the submitter if links are broken. This will be addressed by text mining.

### **12.3 Community Engagement**

1. Partner with big organizations
2. Partnership with other BP WG – e.g., International Quiet Ocean Experiment (IQOE) ; RDA; Steering Groups of ocean observing communities; Cross collaboration with GEOBON (BON in a Box?)
3. Ensure link to BP new interface circulated to ocean observations community
4. Publish article in Frontiers announcing the repository so its citable
5. BP Community listserv
6. Try to get funders to require BP as deliverable as well as DMP
7. Try to get reviewers to look for BP in references
8. Videos
9. Newsletter
10. Social media
11. One-page flyers for OBP
12. Training
  - a. Offered or identified where
  - b. Video tutorials
  - c. MOOCS - Massive open online courses
  - d. Contact training organizations
13. Town Halls and community sessions
14. Request Conference Organizers to have permanent BP session
15. Conference Papers, presentations
16. Advertise Success stories
17. Advertise benefits and added value to the community
18. Use Surveys

### **12.4 Repository March 2019**

Follow-on capabilities for the repository will be implemented over the following year, and piloted by March 30, 2019. Users of the repository will include both BP providers and researchers looking for Best Practices. The following capabilities will be added:

- 1) Multi lingual repository (available in DSpace but would need customizing translation)
- 2) Inform IODE standards process of BP submission
- 3) Establish management (including Advisory Group), sustainability and funding
- 4) Automatic import of references from GOOS EOVS records (and other variable schemes EEMs, EBVs...) – widget to allow cross refs with others
- 5) Cross links with other forms of documents e.g. GOOS endorsed practices will be in the repository, EOVS spec sheets will be in a database which can be linked directly to the BP DOI – create widgets that list these through API calls

DOIs for collections of BP that users can specify (shopping cart style); as necessary, create a DOI for a single document or for a collection.? There should be a capability for Saved Search but this will not have a DOI for the saved search. There will be a URL for a collection.

### 13 Appendices

Appendix 1: Participants

Appendix II: Breakout Sessions

Appendix III: Acronyms

#### Appendix I: Participants

<b>Eric Achterberg</b>	<u>GEOMAR</u>
<b>Laura Beranzoli</b>	INGV/EMSO
<b>Mark Bushnell</b>	CoastalObsTechServices/IOOS
<b>Pier Luigi Buttigieg</b>	AWI
<b>Aurelien Carbonniere</b>	IFREMER
<b>Cyndy Chandler</b>	WHOI
<b>Laurent Delauney</b>	IFREMER
<b>Eric Delory</b>	PLOCAN
<b>Patrick Farcy</b>	IFREMER
<b>Vicente Fernández</b>	EuroGOOS AISBL
<b>Albert Fischer</b>	UNESCO/IOC – GOOS
<b>Nina Hall</b>	Frontiers in Science
<b>Juliet Hermes</b>	SAEON/JCOMM
<b>Emma Heslop</b>	SOCIB/JCOMM
<b>Adi Kakodkar</b>	UNESCO/IOC – IODE
<b>Adam Leadbetter</b>	Marine Institute, Ireland
<b>Ana Lara-Lopez</b>	IMOS

<b>Daniele Ludicone</b>	Stazione Zoologica Anton Dohrn
<b>Yutaka Michida</b>	University of Tokyo, Atmosphere and Ocean Research Institute
<b>Matt Mowlem</b>	National Oceanography Centre, UK
<b>Frank Muller-Karger</b>	University of South Florida
<b>Cristian Muñoz Mas</b>	SOCIB
<b>Rajesh Nair</b>	OGS
<b>Michael Ott</b>	UNESCO/IOC – GOOS
<b>Francoise Pearlman</b>	IEEE
<b>Jay Pearlman</b>	IEEE
<b>Nadia Pinardi</b>	University of Bologna
<b>Peter Pissierssens</b>	UNESCO/IOC – IODE
<b>Rachel Przeslawski</b>	Geoscience Australia
<b>Frederico A. Saraiva Nogueira</b>	Directorate of Hydrography and Navigation, Brazil
<b>Dick M.A. Schaap</b>	MARIS
<b>Catherine Schmechtig</b>	CNRS/INSU
<b>Pauline Simpson</b>	IODE/CCMI
<b>Derrick Snowden</b>	NOAA/U.S. IOOS
<b>Maciej Telszewski</b>	IOCCP
<b>Ramasamy Venkatesan</b>	NIOT, India
<b>Ian Walsh</b>	Sea-Bird Scientific
<b>Rik Wanninkhof</b>	NOAA/AOML

## Appendix II – Breakout Sessions – Individual Group Reports

<b>BREAKOUT 1: The Process</b>	<b>GROUP 1: Data and Downstreaming</b> Adam Leadbetter, (moderator and rapporteur); participants: Cindy Chandler, Nadia Pinaridi, Dick Schaap, Francoise Pearlman, Rachel Przeslawski, Emma Heslop, Pier Luigi Buttigieg, Yutaka Michida, Pauline Simpson	<b>GROUP 2: Applications</b> Frederico Antonio Saraiva Norgueira, (moderator,) Cristian Muñoz, (rapporteur); participants: Eric Delory, Cristian Muños, Nina Hall, Adi Kakodkar	<b>GROUP 3: Sensors</b> Mark Bushnell, (moderator); Eric Achterberg (rapporteur); participants: Ian Walsh, Laurent Delauney, Jay Pearlman, Rajesh Nair, Daniele Ludicone	<b>GROUP 4: Networks</b> Derrick Snowden, (moderator), Juliet Hermes, (rapporteur); participants: Frank Muller-Karger, Ana Lara-Lopez, Patrick Farcy, Vincente Fernandez, Catherine Schmechtig
<b>Documenting BP - Template process</b>				
<p><i>When you develop your BP what are the underlying assumptions (use - Open Access, Creative Commons etc; are exemplars provided; is Peer Review done?) What are the problems in documenting BP?</i></p>	<p>Underlying assumptions:</p> <ul style="list-style-type: none"> <li>- There must be a need identified</li> <li>-- is a NEW BP needed or does an existing one need an update</li> <li>- if there is a need, due diligence that standards don't already exist</li> <li>-- if they do, engage that community if change is needed</li> <li>- Open Access obvious, FAIR compliance</li> <li>- Usage by many or particular communities: qualify why this is the case (cost-effectiveness, technical quality, etc) align to the needs identified.</li> <li>-- Reality check: people do care WHO not just how many are using something - the BP repo could track who's using what without</li> </ul>	<ul style="list-style-type: none"> <li>• Keywords are documentation and standardization.</li> <li>• From journal, how to define BP done by institutions, partners, industry. What should go through peer-review and what not.</li> <li>• BP sources may disappear and we need a central repository that may be permanent like UNESCO or similar. Some national institutes funded by states may be also a vehicle for storing documents.</li> <li>• licensing is important aspect.</li> </ul>	<ul style="list-style-type: none"> <li>• In response to the first question, there are no issues with documenting BPs; they should be open access and promote interoperability</li> </ul>	<p>Ana – template is useful for new BPs but not for existing ones. IMOS are going to use the template as the bones of implementing the writing of new BP. This is really positive; it means that the BPWG has achieved something useful!!</p> <p>Perhaps just focus on one template.</p> <p><b>RECOMMENDATION:</b> GOOS should work with IODE to ensure the BP for EOVs are archived/accessible.</p> <p>Don't let the two diverge!</p> <p>This is what is being done within JCOMM! And also what Ana has done for IMOS.</p> <p>There are cross cutters eg the SOPs but the IMOS doc doesn't focus on this.</p> <p>We can have BP for EOVs, data management etc but not for systems.</p>

	<p>-- Comments by identified users count</p> <ul style="list-style-type: none"> <li>• support from organisational leadership</li> <li>• sufficient levels of careful peer review</li> <li>• BPs should preferably not be created by one agency or person, others will catch issues (not just multiple users but multiple creators)</li> </ul>			<p>We need to acquire data from the different sensors to process and intercalibrate. One link missing is that between sensors and data. Eg ferrybox, there are practices as to where you put the hole to pump the water, do we need a temperature system near the hole. These BP to use the sensors are very important.</p> <p>Each observing networks are writing this.</p> <p>Recommendation: Each platform requires an SOP and we need to consider how this links to the EOVS being measured.</p>
<p><b><i>How would you use a template containing core section headings to which you could add your own additional sections?</i></b></p>	<ul style="list-style-type: none"> <li>• Due diligence: gather examples of existing templates, either adopt or base the core OBP template on those.</li> <li>• The template should include a field to links (for externally hosted schemas and other web resources). We should strongly encourage persistent URIs with an ORCID</li> <li>• Data management plans - harvest existing checklists and templates (Digital Curation Centre etc, IODE manual, DataONE) - consult with others to come up with consensus on recommendations.</li> <li>• Data discoverability and accessibility sections in some SOPs (Rachel notes)</li> <li>• The templates should also have a FAIR section, asking how each aspect is addressed.</li> <li>• Have field for next expected review</li> <li>• Extensibility of the template - how do we manage this?</li> <li>• Ticket systems are not really supported</li> <li>• Should be easy to add a</li> </ul>	<ul style="list-style-type: none"> <li>• We could put in template a link to more specific documents, references that are essential for the application in particular.</li> <li>• 80% of metadata is basically the same for any application</li> </ul>		

	<p>section; agreement that the formatting restrictions are acceptable</p> <ul style="list-style-type: none"> <li>• Have a data formats field which OBP can mine and present stats on</li> </ul>			
<p><b>Validating BP - Peer review process through repository and/or journal article</b></p>				
<p><i>Is your BP document/s always peer-reviewed (external or internal) before being issued? Do you have criteria for BP peer reviews?</i></p>	<ul style="list-style-type: none"> <li>• How long does it take?</li> </ul>	<ul style="list-style-type: none"> <li>• Is nice to submit first, and then internal review, and then external review.</li> <li>• Use both always.</li> <li>• Have to confirm about new formats to be published.</li> </ul>	<ul style="list-style-type: none"> <li>• Peer review- most BPs are being peer reviewed, some formally and most informally. It would be better to have a more formal process.</li> <li>• We did not discuss the journal because the focus is on general BPs such as how to make an oxygen measurement.</li> </ul>	<p>Journal and DOI are good incentives. But who will be the reviewers? In Europe we take one methodology and then get the whole community to review the process. However, in Europe if they are writing the document they can't review it, so open the communication to cross review between countries or programs.</p>
<p><i>What benefits would a peer review process by volunteer community experts within the repository process provide? A peer review journal?</i></p>	<ul style="list-style-type: none"> <li>• Is the extra step in publishing in Frontiers worth it?</li> <li>• Thinking is that the repo would have more content,</li> <li>• Frontiers articles can envelope many submission</li> <li>• Scientists can work on papers technical staff on the methods</li> </ul>	<ul style="list-style-type: none"> <li>• Higher quality of document in the end.</li> <li>• Credit to the reviewers and contributors.</li> <li>• Peer-review involves no costs and give credit</li> </ul>		<p>Technicians and scientists should be reviewers as. It is fit for purpose so you need scientific oversight. Might it be possible that if, eg one GOOSRA comes up with a process then get other GOOSRAs to review.</p> <p>Eg HF Radara uses good practices from IOOS and are writing their own BP based on this.</p> <p>Recommendations: Use cross program mechanisms to review documents.</p> <p>"How do we get networks to agree on processes as to how they deal with their data. Some people</p>

<p><i>To have a Platinum tag the BP should be peer reviewed. How important is that to you and to others</i></p>		<ul style="list-style-type: none"> <li>• Never heard about this ranking BP documents. We need to consolidate the procedure of ranking BP documents.</li> </ul>	<p>Platinum tags indicating peer-review has been done. – for an expert this is not so important but for a PhD student this is important to help illustrate standards</p>	<p>won't write scientific data papers nor will they write big documents. Limnology and oceanography opened a new journal on methods. But maybe publish a document on BP</p> <p>Confusion as to the peer review process, need to clarify that to publish in the Journal you need to have a link to a BP in the repository.</p>
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**Disseminating your BP Document : Contributing to a Repository (OBP) as part of dissemination**

<p><i>What problems do you perceive in contributing your BP document to a repository?</i></p> <ul style="list-style-type: none"> <li>• <i>Human resource to deposit</i></li> <li>• <i>Metadata</i></li> <li>• <i>Semantic tagging</i></li> <li>• <i>Open access</i></li> </ul>	<ul style="list-style-type: none"> <li>• Don't overburden with metadata - minimal fields and extended</li> <li>• Tech support: what is the bandwidth</li> <li>• list of supported formats</li> <li>• e-mail for help</li> <li>• browser compatibility</li> <li>• Submission burden: many submit to other repos (ICES, IODE, etc) - can we reduce submission burden? harvest contents with DOIs/URLs provided in the template. Ping and link to the BPs and check the md5 hashes on the docs in other repos to poll for updates. Interesting opportunity to compare records of the same BP across the web: report if they are different</li> </ul>	<ul style="list-style-type: none"> <li>• Metadata – Compulsory. you can't have good results from bad data. Metadata is important in this process.</li> <li>• Semantic tagging - It is a big issue for anybody. We need to index the document, issues with copyright.</li> <li>• Dissemination level is public, direct agreement on the capacity of indexing</li> </ul>		<p><b>RECOMMENDATION:</b> Repository searchable by EOV, by network, by platform. Repository needs a good structure! The big part of the work will be done by the repository people, they need to find reviewers etc etc. So it's good for the people who simply have to provide the BP. Semantics is really important. Eg what is the definition of 'coastal'</p>
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<p><i>What requirements do you have of a Best Practices Repository?</i></p>		<ul style="list-style-type: none"> <li>• Efficient search engine.</li> <li>• Simple metadata management.</li> <li>• Easy findable website.</li> <li>• Improving criteria for becoming BP</li> <li>• Need to implement maturity levels. Scale from 1-5. Producer needs to make a self-assessment on the maturity level. Forum could be a good tool to improve maturity of the BP.</li> <li>• Versioning systems to trace changes and approval of changes. Implies there are credentials implemented that gives rights of access to only authors and no one else. Lead author that moderate inputs in the forum if moderating is accepted in the process.</li> <li>• Could be like Wikipedia.</li> </ul>		<p>there are many answers!          What is the meaning of operational oceanography          Many definitions.          Repository has to be better than google!          Back to reviewers who needs to accept the BP?          Is the repository for BP or practices as well?          Recommendation: Portal needs some way to gather community input for the utility of the document          TRL is one way to gain confidence; this can be set initially by reviewers and authors. The community can then use this and it can be tracked and then get comments back such as after 100 excellent comments the technical readiness level gets raised.          This is perhaps applicable for eg microbial where the readiness level is not there. But SST may be a different.          If the repository didn't have a way of giving a gold standard, would you still use it? Is it a requirement or a nice to have feature?          I want to start an observing system, how do I know which BP is the</p>
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<p><i>What changes/developments would you recommend for OceanBestPractices?</i></p>	<ul style="list-style-type: none"> <li>• WE WANT DOIs!</li> <li>• Drop down to declare what kind of document it is, BP, SOP, etc</li> <li>• Link data BPs to the part(s) of the process (sampling, downstream, planning,) - offer some controlled terms for these</li> </ul> <p>Note the last revision and trigger reminders to state that when the submitter must confirm currency</p> <ul style="list-style-type: none"> <li>• Commenting fields on each BP page to enable feedback is useful - notify submitters (keep in mind that spam may occur, so moderation may be needed). Submitters could choose whether they want public/private feedback or opt out if they have no bandwidth.</li> <li>• Link to other (versions of) BPs - indicate if everything in sync</li> <li>• IETF (internet engin task force) called their documents Best Current Practice and coupled them with a Request For Proposals/Comments to identify needs</li> <li>• Ping links provided in the template and check if they're live - if not, then badges on the BP landing page will indicate this and the submitters will be notified</li> <li>• Getting agreement and consensus within creator group</li> <li>• promoting BPs interally and externally</li> <li>• measuring relevance and success</li> <li>• granularity</li> </ul>	<ul style="list-style-type: none"> <li>• Improving criteria for becoming BP</li> <li>• Need to implement maturity levels. Scale from 1-5. Producer needs to make a self-assessment on the maturity level. Forum could be a good tool to improve maturity of the BP.</li> </ul>		<p>best BP for me?          Recommendation: The first step is to have it accessible in one place with a useful structure. Also important that contact people are listed with their BP so people can contact them.          Still a bit confused about how one would choose the best BP. But is this actually likely? There are probably only going to be 1 BP or perhaps 2-3 max. Also need to remember if, eg you're looking for oxygen, measuring oxygen on a glider will have a different BP to measuring oxygen on a ship. What if you have 4 different sensors? ACT alliance for coastal technology – evaluate the sensor against the manufacturer specifications NOT against each other.  <b>RECOMMENDATION:</b> ACT comparisons are part of the repository.  <b>RECOMMENDATION:</b> Categories of documents: User manual; Standard operating procedures (generic but very comprehensive and descriptive); best practices (guides/manuals – practical knowledge, often developed for a specific environment); certified reference materials and standards (eg trusted reverence for calibration and quality control).  <b>RECOMMENDATION:</b> EOV spec sheet needs a link to the repository where you can find the SOP, BP, standards etc.</p>
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	<ul style="list-style-type: none"> <li>• longevity in the face of no funding for sustainability (must be stated)</li> <li>• support from organisational leadership</li> <li>• sufficient levels of careful peer review</li> <li>• BPs should preferably not be created by one agency or person, others will catch issues (not just multiple users but multiple creators)</li> <li>• Scope</li> </ul>			
<p><i>What other repository/s do you deposit in?</i></p>		<ul style="list-style-type: none"> <li>• JCOMM-OPS</li> <li>• Eurocean</li> </ul>		
<p><b>Promoting BP – Methodology</b></p>				

<p><i>What are the available channels of communication (email listserv, blog, newsletter, projects, LinkedIn SIG Group...)</i></p>	<ul style="list-style-type: none"> <li>• Open Access (CC-BY), All flavours of CC v4 are suited for data, code needs other consideration</li> <li>• Allow all choices under CC v4</li> </ul>	<ul style="list-style-type: none"> <li>• ResearchGate for discussions</li> </ul>	<p>Make a permanent topic (core topic) in a conference such as oceans.</p>	<p>GRAs would be good          LinkedIn has been useful for Quartod (as per Juliet's presentation!)</p>
<p><i>What works best for you?</i></p>	<ul style="list-style-type: none"> <li>• Publish article in Frontiers announcing the repo so it's citable</li> <li>• DOIs for all BPs</li> </ul>	<ul style="list-style-type: none"> <li>• LinkedIn and twitter</li> <li>• email groups. Newsletters (monthly digest)</li> </ul>		
<p><i>Is training part of your promotion portfolio?</i></p>	<p>Citation recommendations for the repo contents</p> <ul style="list-style-type: none"> <li>• Rachel's groups are doing promotional videos on the facts that we have a BP repo - link with Frontiers social media presence.</li> <li>• Post on things like Ocean Teacher and other relevant sites. Infographics. A4 flyers and brochures. Direct to users and submitters separately.</li> <li>• FAQ section</li> <li>• Be clear that there will be separate routes for submitters and users</li> </ul>	<p>Yes is part of the promotion portfolio</p>		
<p><b>Sustaining BP – Updating</b></p>				

<p><b><i>Do you update your BP Documents – is there a regular review period?</i></b></p>	<ul style="list-style-type: none"> <li>• Version control of templates much needed</li> <li>• Updates get DOIs</li> <li>• Clearly label obsolete or superceded BPs</li> <li>• Link to code repositories and datasets - ping show if these links are live when the last update was</li> <li>• Replacing old BPs should be up to the contributor - the repo should not set the criteria centrally</li> <li>• Parse a template field which asks when the BP is valid until. Near that date, auto-email the contributors</li> </ul>	<ul style="list-style-type: none"> <li>• Obvious requirement but process not in place yet. Fix03 is moving into EMSO that will be in charge of updating the documents. There are MM assigned.</li> <li>• Desirable to put in the document.</li> </ul>		<p>Very field specific as to how often you update it. RECOMMENDATION: incentive is necessary to write and submit to the repository, a DOI is an incentive! IOC should issue DOIs. The system should only issue a DOI if there is not one inputed. RECOMMENDATION: Coordinate with group within GEO who have a largely empty tool created to map methodologies to observation requirements</p>
<p><b><i>Is there an aging impact on the value of a BP?</i></b></p>	<p>to mark if the doc is still current. If this is not provided, email every year or so.</p>	<ul style="list-style-type: none"> <li>• Depends on the discipline, field of application. A concept changes slowly. Equipment changes very fast.</li> </ul>		
<p><b><i>Would you take responsibility for ensuring that the OceanBestPractices record reflects the current status of your BP Document?</i></b></p>		<ul style="list-style-type: none"> <li>• As a producer YES definitely strongly advisable (person expert in the matter and/or legal organization).</li> </ul>		
<p><b><i>If a new BP is offered, what is the criteria for a new BP to replace an existing one?</i></b></p>		<ul style="list-style-type: none"> <li>• Full day discussion.</li> <li>• Reviewers should take part of the decision. Needs to involve users and producers. Independent assessment.</li> <li>• Hydrographers are reluctant to change, conservatives. Don't change a procedure until you clearly know why it was implemented.</li> </ul>		

<p><i>What problems do you perceive for sustaining/updating your BP?</i></p>		<ul style="list-style-type: none"> <li>• Interest of users</li> <li>• Duration of activity,</li> <li>• Substitution equipment,</li> <li>• Lack of need of the BP.</li> <li>• Lack Resources and funding.</li> </ul>		
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<p><b>BREAKOUT 2: Implementati on directions</b></p>	<p><b>GROUP 1:</b> Eric Achterberg (moderator); Mark Bushnell (rapporteur) participants: Derrick Snowden, Cindy Chandler, Rajesh Nair, Vincente Fernandez, Daniele Ludicone, Ian Walsh</p>	<p><b>GROUP 2:</b> Ana Lara-Lopez(moderator); Laurent Delauney (rapporteur); participants: Patrick Farcey, Maciej Telscewski, Catherine Schmechtig, Dick Schaap, Adam Leadbetter.</p>	<p><b>GROUP 3:</b> Yutaka Mishida (moderator &amp; rapporteur); participants: Peter Pissierssens, Pauline Simpson, Nadia Pinardi, Adi Kokodkar, Jay Pearlman, Cristian Muñoz</p>	<p><b>GROUP 4:</b> Albert Fischer (moderator); Pier Luigi Buttigieg (rapporteur), participants: Juliet Hermes, Frederico Antonio Saraiva Norgueira, Francoise Pearlman, Rachel Przeslawski, Emma Heslop</p>
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**Initial operating capability**

<p><i>What are the core capabilities that should be implemented initially?</i></p>	<p>By March 2018 Assign DOIs (but cost is an issue). Template should transition from draft to operational form. Maintain queue and status for submitted documents. Option for feedback (opt in), especially needed during formative state. Taxonomy of different document types to be submitted should be established. Consider how well-established SOP/BPs should be treated; we suggest leaving it to the community to manage peer review.</p>	<p>Populate the repository Give access to the BP Promote the BPs Managing the data: Supplier group? Implementing persistence of document, and version management; link to the document and a DOI pointing to the page that contains the BP and all the metadata.</p>	<p>Corpus of BP documents. Start-up collection of documents  Central repository of BP with DOIs  User-friendly search interface.  Standard metadata structure for multimedia, docs.  Objects with tagged content using standard ontologies and controlled vocabularies.  Group of committed partners, alliance of the willing that work as providers.  Coordination of Pilot project by IODE-GOOS-JCOMM (and associates)</p>	<p>Improved FAIRness of repository, especially findability  Interoperability with other BP-like archives  Allow creation of collections by editors or users  Easy to submit  Needs a persistent and responsive service desk  curation of submitted content (spam filtering etc)  relevant keywords  search capacities  cross-linking with other DOIs (pinging and checking md5s important, dates of last update, email when changes or deletion detected)</p>
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			<p>Workflow arrangements for each partner.</p> <p>Capability by each nominated partner to enter documents.</p> <p>Seamless submission/deposit process. (just take a few minutes to do)</p>	<p>We need the DOIs to be referenced - needs coordination with WoS, (Web of Science) TR?, etc. There's no guarantee that these will be harvested. Also needs journal editors and reviewers to request these citations.</p> <p>Automatic import of references GOOS EOVS (and other variable schemes EEMs, EBVs,...) records - widget to allow cross refs with other</p> <p>Ensure cross-facet searches</p> <p>Login with ORCID – no new accounts</p> <p>Feedback is useful, but once a critical mass is achieved (careful with likes and dislikes ), the elective feedback with opt in or opt out is useful here. Good place for BP submitters to gather feedback for round 2. No opt out is also an option, as it's still a chance to gather.</p> <p>Plug in a stack-overflow commenting system with vote up vote down (lots of enthusiasm for this_</p> <p>Facets to search across:</p> <ul style="list-style-type: none"> <li>-sensors</li> <li>-data</li> <li>-platform</li> <li>-organization</li> <li>-EOVs</li> <li>-region, location</li> <li>-scale</li> <li>-ecosystem</li> <li>-phase in the process - prep to observe, deployment, data gathering, ...</li> <li>- objective of collection</li> </ul>
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				<p>of BPs</p> <ul style="list-style-type: none"> <li>- metric EBVs</li> <li>- ocean processes and hydro/cryo/geoforms</li> </ul> <p>DOIs for collections of BPs that users can specify (shopping cart style)- create a DOI for collections</p> <p>Things to emphasize:</p> <ul style="list-style-type: none"> <li>- international promotion / visibility</li> <li>- long-term archive and DOI issuing</li> <li>- IOC international branding</li> <li>- relative permanency</li> <li>- cross linking to other BPs from other groups</li> <li>- an outward facing BP often leads to more thorough authoring of BPs/SOPs</li> <li>- acknowledgement of contributors (engineers, scientists)</li> </ul>
<p><i>Should we start with sensors, ocean applications and data management or a different priority area?</i></p>	<p>All three are appropriate; there is no reason to down select. Go where the action is!</p>	<p>All in parallel, but you need a critical mass.</p>	<p>Three of these, also include platforms</p>	<p>Depends on the submissions and interest</p>



<p><b><i>Initial pilot focus areas – should we look at BGC, physics or a different discipline, or look at specific EOVs (such as temperature at 10m)?</i></b></p>	<p>Focus on fundamental physical EOVs, especially if they are to be started by March 2018, but not to the exclusion of others.</p>	<p>Variables Physics, EOVs</p>	<p>Let's see what people bring under platforms/sensors</p>	<p>Depends on the submissions, but...</p> <p>Ocean observers that need assurance that some sort of standard practice has been used</p> <p>Regulatory bodies that need assurance BPs are being followed</p> <p>Voluntary beta testers from this meeting and close/invited participant.</p> <p>Open up once the core functionality has progressed and makes a good initial impression, wider community.</p>
<p><b><i>What exemplars would be good to look at for the initial operating capability?</i></b></p>	<p>See above</p>	<p>Physics : T°, Sea Level height, Waves Biogeochemistry Ocean Color (surface), Biology Plankton, zooplankton, biomass, diversity</p>	<p>Ask Pier Luigi</p>	<p>Systems that are powered by knowledge graphs such as the Monarch Initiative</p>
<p><b><i>How should the elements of peer review be integrated into a seamless process?</i></b></p>	<p>Peer review is part of the queue mentioned above, and the process should be transparent.</p>	<p>Do we need this really? The BP will be written by the specialists. The BP can be very specific to an area (O2 in Costa Rica region in comparison to with O2 in Baltic region for example) We need criteria to review the BP. Data Quality Control BP is difficult to review. What is the number of persons (projects) that use the method?</p>	<p>Ask first who has a process/workflow. Those who do not have a process should adopt one. There are 3 options for Peer review: (i) community/program peer review; (ii) journal; (iii) internal review.</p>	<p>Allow Status tags to be bumped up if the submitter lets us know about their internal review processes and they are accepted (by who? A review committee?) as equal quality/stringency</p> <p>Availability of Frontiers processes for those BPs that have a journal-level description</p>
<p><b>Key metrics</b></p>				

<p><b><i>How do we know/monitor the use of BP that have been published in a repository?</i></b></p>	<p>Tracking of DOIs</p>	<p>Track reference to the BP in publication. Use case Verification Provides evidence to move the BP to a next level</p>	<p>Statistics of downloads and geographic information.  Also need to know who accesses the data.  Should include citation metrics too. Through DOIs. We need to investigate this  Encourage users to cite the BPs.  Registration to receive update information, profile (will need development)</p>	<p>Citation metrics on the DOIs (journal and repository), see above  simple stats like downloads and views  eventually likes and dislikes depending on community that is assembled  Cross links with other forms of documents;  e.g. GOOS endorsed practices will be in the repository, EOVS sheets will be in a data base which can be linked directly to the BP DOI, create widgets that list these through API calls</p>
<p><b><i>How do we encourage the use of BP across platforms and disciplines?</i></b></p>	<p>Tell reviewers to look for best practices in the references. Communicate with steering committees of observing communities.</p>	<p>Establishing network by publishing the information to newsletters (GOOS, GRA, Summer schools, IOC, IODE); For the users, give the information to the European projects. What is the most effective means of feedback? Is it referring to BPs? Or to the repository? If people comment on it, we will have a feedback system (stars system and comment). Also share on social media. Keep track of feedbacks for the IOC.</p>	<p>Marketing strategy – see also profile above</p>	<p>The values of permanence, etc. were acknowledged as encouraging: stable reference  DOIs are very attractive  making stuff painless for people with BPs, taking the management burden off them  If convinced participants can spread the word and submit documents  Assemble a list of organizations that support the initiative. The big ones are on the website, but it's good to show that smaller or national groups around the world are using it  Flyers promotional material, standard conference promotional,  OceanObs 19</p>

<i>What is the most effective means of feedback?</i>			Options include feedback box and helpdesk, likes, surveys, mails from registered users	See above
<i>Cases for testing – what initial and stable use cases should be used for monitoring and assessing new features (specific BP to go through the “system”)</i>		Use the CO2 cookbook to test.	Stress test (GO-SHIP manual) Ask Mark for the DO QARTOD Fix03 manual pCO2 manual	
<b>Community engagement</b>				
<i>What are efficient methods of training and promoting BP?</i>	Is this discipline / platform specific? Can there be knowledge transfer between platforms/sensors? Methods recommended include videos, ocean teacher global academy, and science workshops.	WS, summer school, newsletter of RIs and EU project, etc.	Link with OceanTeacher, videos (team with other organizations like IMOSO, summer schools, MOOCS).	Training should be a part of what the BPs are about  Reach out to training organizations and encourage them to use the BPs in the system, also list organizations that can train others in a given BP  Perhaps ask submitters to add information on who to contact for training information (or ask them to submit details on summer schools etc)  Incorporate videos into the BP repository.  More human resource and financial support is required to extend and support teaching. Interfacing with groups, which already do this and need source material would be advisable.

<p><b><i>What are the community priorities in the implementation?</i></b></p>	<p>Relations with organizations carrying out observations (how do repositories relate and interface), Support of the observation community in using best practices (needs for training, or perhaps interactions with well-established groups and a help desk) Input from end users as to their issues in the use of metadata and data from BP (eg data assimilation) Comment box within repository (but don't expect too much), user groups, social media such as ResearchGate &amp; LinkedIn and engage early career participants, town hall with food and potential for funding.</p>	<p>It depends of the community: operational versus research, and coastal versus open ocean.</p>	<p>We do not know yet. (Hopefully what we answer under "What are the core capabilities that should be implemented initially").</p>	<p>Harvest competency questions from different groups. Announce what we are doing and that we are listening to their needs. Needs to be done through the network from this workshop to solicit focused and quality input. E.g. some groups would want specific information on precision/accuracy, calibration procedures, etc. need minimal and then recommended metadata for different communities (MIxS model)</p>
<p><b><i>Relations with organizations carrying out observations (how do repositories relate and interface)</i></b></p>		<p>Priority is for those active in the field. They need to be interlinked with the BP repository. Through them they may reach out to a wider community.</p>	<p>Support of the observation community in using best practices (needs for training, or perhaps interactions with well-established groups and a help desk)</p>	
<p><b><i>Support of the observation community in using best practices (needs for training, or perhaps interactions with well-established groups and a help desk)</i></b></p>		<p>Technical training</p>		

<i>Input from end users as to their issues in the use of metadata and data from BP (eg data assimilation)</i>		It must be simple to use (BP Submission and good search engine), ergonomic, etc		
<i>Other outreach – eg reviewers for journal, presentations, oceanobs19</i>				
<b>What are the longer-term operations (development) needs?</b>				
<i>What are the priority steps moving beyond the initial operating capability?</i>	Establish management, sustainability, & funding	The priorities include sustainability, maintenance, use and growth, integration into existing network.	Link BP to standards process of IODE and others	Decide on languages and multilingual support  A consortium to be created for yearly (?) alignment  Create partnerships with national, regional, and international reporting frameworks. For example, the Good Environmental Status MSFD - 11 descriptors, everyone doing it differently, ICES is figuring out how to report on this, every country reporting differently. Offer the repo as a place to coordinate these (create national collections), important to reach out to the right component of e.g. ICES.
<b>Breakout 2: Group 2 Discussions</b>				
<p><i>Pauline Simpson</i> - Should we have published criteria for peer review of best practices? If we have a respected community that does its own review, they should not have to go through peer review. For others, we need to have some sort of review. There should be some verification of a document uploaded</p> <p><i>Maciej Telszewski</i> - says that peer review is not verification.</p> <p><i>Nadia Pinardi</i> – if you think everyone will review a paper themselves, this is not the way the system works. The reviews are done by experts, whom we rely on. There is no alternative to that. In fact, both journal and community reviews are normal processes.</p> <p><i>Maciej Telszewski</i> - said that these are not issues with new best practices. He is looking at those that are in active use by the</p>				

observation community.

*Jay Pearlman* - says that all documents that have community review go to the platinum (i.e. peer-reviewed) level. This includes historical documents. If they have not undergone peer review, they go to the gold level. If the authors prefers to go to platinum, then they can ask for peer review, either through the journal or though the internal expert panel. Documents that do not have peer-review are not rejected.

**Breakout 2: Group 3** Overarching comments and initial discussion

*Nadia Pinardi* - IODE-GOOS should coordinate the pilot group. IODE provides infrastructures and data management, and GOOS provide projects and personnel. Pilot project IODE-GOOS.

*Jay Pearlman* - different roles would be assigned to each organization. There is a community that is already working on best practices that should and will be engaged. We need a logical construct for sustainability.

*Peter Pissierssens* - need secretariat that takes things forward. GOOS?IODE?

*Nadia Pinardi* - should be GOOS. If don't start from GOOS,... they are the community that will evolve things.

*Peter Pissierssens* - he wants people to pull the wagon.

*Jay Pearlman* - GOOS should carry part of load as partner but the load should be shared.

*Peter Pissierssens* - Organizations and programs to lead the process? IOC is too big, IODE is candidate and GOOS relates to operational oceanography.

*Jay Pearlman* - GOOS has always been core resource for observations. On the other side, there is a need for repository infrastructure and IODE matches with that need.

*Peter Pissierssens* - GOOS secretariat has lots of contacts, IODE not.

*Nadia Pinardi* - GOOS needs to be there as a name. We want, in the future, to make things go better and also to avoid duplicating systems, etc.

*Jay Pearlman* - What about IODE lead and training. GOOS R&D group, JCOMM for operations.

*Nadia Pinardi* - agree. Leadership for IODE.

*Jay Pearlman* - funding available and sequence. ODIP ends end March 2018 and AtlantOS March 2019. The objective is to have an initial operating capability by March 2018. That is recommended. By the end AtlantOS, there should be an operational capability.

*Pauline Simpson* - we wouldn't refuse any area or discipline in the ocean observation community.

*Jay Pearlman* - when you solicit documents from your community, we could start in the 3 pilot areas of sensors, data management and application to have an initial focus. This should include the underlying BPs in EOVs.

*Peter Pissierssens* - specific EOV?

*Nadia Pinardi* - you need to put platform in water that measures diverse EOVs. We should concentrate in EOV but also in sensors, instruments and platforms, because they are key.

*Jay Pearlman* - BPs are driven by requirements.

*Peter Pissierssens* - Bottom to top. WMO has process to process manual and guides. Mainly internal review system. We can ask ocean-focused organizations if they have their own process.

*Nadia Pinardi* - we have to have two systems because not everybody will go through the journal process. How do we match the two systems?

*Jay Pearlman* - There are three levels of inputs to the repository. level 1 examination of metadata completeness. level 2 tagging as well as complete metadata. Level 3 is QA of content (peer review). There are three paths for peer-review: Journal peer-review, internal OBP review by an expert panel and peer review by programs(GO-SHIP, SCOR,IOC,FixO3).

*Nadia Pinardi* - reviewing now is difficult.

*Peter Pissierssens* - we have no resources for reviewing, we need volunteers.

*Jay Pearlman* - We can reach out to partners like GOOS and JCOMM that may have the resources.

*Nadia Pinardi* - IODE has a similar system to WMO. We can ask to WMO.

*Pauline Simpson* - normally the documents have already been reviewed within the community that has created it.

*Nadia Pinardi* - The editorial board would choose a different one. If we receive Chinese document, we don't want to have only Chinese reviewers

**Breakout 2: Group 4** Overarching comments

We need to be clear on the links and differences between GEO, GEO BON, MBON, and the OBP - how do they coordinate?  
 Where do users submit? Do we cross archive?  
 Rachel notes that GEO BON wants to collect SOPs in the BON in a Box model  
 DEFINITE need to coordinate. Managed redundancy is very useful, must be automatic to prevent massive time and labor costs needs  
**On Community Engagement**  
 The benefits for contributors and users should be clear and disseminated to seed engagement  
 Do we need a critical mass of BPs before approaching the community?  
 200 docs exist at the moment, not all up to date, a bit scary due to variation in quality, detail, etc  
 The metadata, tagging, and search interface is essential to support searching and categorization to help users make sense of this  
 Agreement that the first impression is essential - clean, faceted interface is required to make that impression  
 Rachel agrees to be beta tester for submitting new documents in a standard way, happy to use the system and see if it engages her (and her community)  
 The participants of this meeting are the core group to build a fresh document store

### Appendix III – Acronyms

AODN	Australian Ocean Data Network
ATLANTOS	Optimising and Enhancing the Integrated Atlantic Ocean Observing Systems
AWI	Alfred-Wegener-Institute
BCO-DMO	Biological and Chemical Oceanography Data Management Office (WHOI)
BP	Best Practices
BPWG	Best Practices Working Group
CRM	Certified Reference Material
DNA	Deoxyribonucleic Acid
DOI	Digital Object Identifier
DRO	Digital Research Object
ECV	Essential Climate Variables
EOVs	Essential Ocean Variables
<u>EuroGOOS</u>	<u>European Global Ocean Observing System</u>
FAIR	Findable; Accessible; Interoperable; Re-usable [ data principles]
FIX03	Fixed point Open Ocean Observatory network
FMECA	Failure mode, effects and criticality analysis
FOO	Framework for Ocean Observation
FRAM	Frontiers in Arctic Marine Monitoring
G7	Group of 7: Canada, France, Germany, Italy, Japan and United Kingdom and the United States are the 7 largest advanced economies in the World.
GEOBON	Group on Earth Observations Biodiversity Network
GEOMAR	GEOMAR Helmholtz Centre for Ocean Research
GEOS	Global Earth Observation System
GEOTRACES	International Study of the Marine Biogeochemical Cycles of Trace Elements and Their Isotopes
GLOSS	Global Sea Level Observing System
GOOS	Global Ocean Observing System
GO-SHIP	Global Ocean Ship-based Hydrographic Investigations
GROOM	Gliders for Research Ocean Observation and Management
ICES	International Council for the Exploration of the Sea

IEEE	Institute of Electrical and Electronics Engineers
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
IMOS	Integrated Marine Observing System
IO PAS	Institute of Oceanology, Polish Academy of Sciences
IOC	Intergovernmental Oceanographic Commission of UNESCO
IODE	International Oceanographic Data and Information Exchange of IOC
IOOS	U.S. Integrated Ocean Observing System
ISO	International Standards Organization
JCOMM	Joint Committee on Oceanography and Marine Meteorology
JCOMM OCG	JCOMM Observations Communications Group
JERICO	Joint European Research Infrastructure Network for Coastal Observatories
MBON	Marine Biodiversity Observation Network
NeXOS	Next Generation Web-Enabled Sensors for the Monitoring of a Changing Ocean
NOC	National Oceanography Centre, Southampton, UK
NOAA/AOML	National Oceanic and Atmospheric Administration, Atlantic Oceanographic and Meteorological Laboratory
NODC	National Oceanographic Data Centre
NSF	National Science Foundation
OBP (OBP-R)	OceanBestPractices (Repository)
OCEANOBS	Ocean Observation [conference]
ODIP	Ocean Data Interoperability Platform
ODV	Ocean Data View format - <a href="https://www.bodc.ac.uk/resources/delivery_formats/odv_format/">https://www.bodc.ac.uk/resources/delivery_formats/odv_format/</a>
OGC	Open Geospatial Consortium
ORCID	Organization in the Research Community [individual researcher id]
PIRATA	Prediction and Research Moored Array in the Atlantic
QARTOD	Quality Assurance / Quality Control of Real Time Oceanographic Data
RAMA	Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction
RCN	Ocean Observation Research Coordination Network
SAEON	South African Environmental Observation Network
SOCIB	Sistema d'observació i predicció costaner de les Illes Balears
SOP	Standard Operating Procedures
SOOP	Ship of Opportunity Program
SZN	Stazione Zoologica Anton Dohrn Napoli
TAO	Tropical Atmosphere Ocean
TARA	Tara Oceans Project
TRL	Technology Readiness Level
UNESCO	United Nations Educational, Scientific and Cultural Organization
URI	Universal Resource Identifier
VOS	Voluntary Observing Ship
WHOI	Woods Hole Oceanographic Institution
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment

[end]