Deep Ocean Observing Strategy (DOOS)

First Steering Committee Report

Released: --- 2017

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SESSION ONE: Introductions / Project Updates

DOOS TO DATE: Overview and Update

Lisa Levin (SC Co-chair), Scripps Institution of Oceanography

The DOOS SC-1 was attended by 15 members of the steering committee representing 8 countries (Appendix 1). Initial meeting objectives included determining project goals and status through OceanObs'19, discussing Task Team membership, terms of reference (ToR) and 24-month plans, generating an outline and assigning writing teams for the Science & Implementation Guide, discussing short- and mid-term Process Study sites and leadership, finalizing Sub-committee and Working Group Plans, reviewing large network liaison and/or engagement activities and evaluating funding opportunities and leadership activities (see Agenda, Appendix II).

The DOOS SC-1 sessions opened with an overview of the Project's science and societal motivators, followed by a review of DOOS activities and accomplishments since the scoping workshop in December 2016. The Key Science Questions (Appendix 3) were presented along with the DOOS Terms of Reference (ToR) (Appendix 4). To address these, the Project formation and subsequent structure were reviewed which include its four task teams and suite of working groups.

Task Teams	Sub-committees & Working Groups
• Biology and Ecology • Biogeochemistry • Physics • Data & Cyberinfrastructure	• Solid Earth • Capacity Building • International Policy • Large Project Liaison Team

Additional activities such as the development of the web site, the ongoing activities associated with the online inventory, and the further development of the interactive online map were presented. The presentation also gave an update on the revision of the Consultative Draft and the release of the DOOS 2016 Workshop Report. It was reported that several DOOS presentations and briefs have been given during the Project's inaugural year and that a Project slide set is available for download from the website (www.deepoceanobserving.org).

ROUNDTABLE: Targets for the Next Two Years

SC Members

One of the overarching goals of the SC-1 was to come to a common understanding of where SC members and stakeholders would like the Project to be at the time of the OceanObs'19 conference in September 2019 (http://www.oceanobs19.net). To this

end, each SC member and Project sponsor, Eric Lindstrom, provided insight into their, and their institution's goals for DOOS.

Responses reflected the multi-disciplinary aspect of the Project, and its objective to meet both science and societal needs. Given the initial focus of the Project is on the establishment of DOOS EOVs, a good deal of reflection focused on their importance and role for the Project going forward.

SC Member Briefs and Guidance Sought

Throughout the sessions a series of SC members presented briefs on projects or programs with which they are involved, and in some instance sought guidance from the SC.

SMART Cables: Bruce Howe

An overview of the "Science Monitoring And Reliable Telecommunications Climate Monitoring and Disaster Mitigation" – SMART Cables project (http://www.soest.hawaii.edu/NASA_SMART_Cables/) was provided along with the efforts currently underway. Discussion also focused on activities designed to align this work with the Framework for Ocean Observing (Framework) principles and processes leading up to OceanObs'19. It was suggested that the Azores may present an opportunity for concept maturation (See section on Process Studies).

Deep-sea Cal/Val Issues: Bob Weller

The challenge associated with the creation of data products that researchers will use is heightened once observations are moved to the deep sea. Despite a well designed array the transition into the deep creates new calibration and validation issues in determining the source of sensor temperature differences or variability; it is expected salinity measurements will create larger issues.

ACTION: Data TT to explore quality and provenance of OceanSITES data (in NDBC) and flag that which is relevant to the deep ocean. A key goal of this activity is to identify locations were data are currently not being collected but are needed to address key DOOS science questions, and to develop a plan for the deployment of 30 SB 37? Sensors available for use by the science community.

India Deep Mission: R. Venkatesan

The India Deep Mission project will have a focus below 700m focused on minerals, geo-hazards, and biodiversity. The project will employ a range of observing tools including over 20 moorings. The presentation concluded with an overview of the Indian Ocean Observing network today- and what is planned for the future, along with associated science questions. Data access issues were also discussed and it was clear that focus will need to be on international waters.

DOOS External Project Support/Endorsement: Lisa Levin

The need to have a process or protocol associated with requests for external group or project support from DOOS was discussed. It was agreed that the SC will have input into requests for endorsement. The requesting team will be called upon to have the endeavor meet certain, specific criteria; these criteria will be made available on the DOOS website. A letter will be drafted for modification when responding to individual requests.

ACTION: Leadership to create a list of criteria and a protocol for others seeking endorsement or engagement with DOOS. (Initial criteria to be collated by Karen, Eric, Paul, Bruce). This information will be reviewed and discussed as needed by the SC and placed on the website.

SESSION TWO: Task Team Status and Plans

The following session provided an opportunity for the newly formed Task Team (TT) Chairs to report on progress made during the previous four months (TTs were formed and leads identified during the 1 May 2017 video conference session.) The TT Chairs were asked to present on their draft ToR, membership, two-year goals and milestones.

Given the recent formation of these groups and the need to understand how DOOS can take advantage of the EOV work of the GOOS Expert Panels, several Actions were taken on how to best interface with this resource.

BIOLOGY-ECOLOGY TASK TEAM

Henry Ruhl (BioEco TT Chair / SC Co-chair), NOC

Given the evolving status of the GOOS BioEco EOVs, DOOS will focus its efforts on how it can take advantage of what has already been vetted by the GOOS Expert Panels and, in turn, improve DOOS specification by eventually providing specifications for additional EOVs (or additional specifications of existing EOVs) focused on the deep sea. For the EOVs known to be in common with GOOS, the TT will contribute deep-ocean relevant information to the GOOS produced specification sheets.

Another major focus of activities will be on the identification of the scientific and societal needs that require sustained observation (Pressures EOVs, see below). This analysis will be conducted within the context of which international conventions address these EOVs and which stakeholders are most engaged in their measurement. The TT will then evaluate which observations require maturity and identify next steps.

The proposed TT membership was presented. Additional representation from the pelagic community was suggested. The group will conduct quarterly teleconferences and report outcomes to the SC. The focus in 2018 will be on coordination with GOOS related to EOV specifications and reaching agreement on others that may be unique to the deep sea. The relevant expert panel is the Biology & Ecosystem Panel, current co-chairs Nic Bax and Sam Simmons, http://goosocean.org/index.php?option=com_content&view=article&id=79&Itemid=273

ACTION: Add pelagic representation to the TT membership

- *Note: TT ToR and Membership will be posted online once finalized*

BIOGEOCHEMISTRY TASK TEAM
Felix Janssen (BGC TT Chair), AWI

The BGC TT near-to-mid term overall focus will be to first finalize membership and work with members to define EOVs suitable for the deep ocean. This work will be conducted in the context of the work already done for this discipline by the GOOS Biogeochemistry Expert Panel, chair Toste Tanhua, http://goosocean.org/index.php?option=com_content&view=article&id=80&Itemid=275

More specifically, the BGC EOVs identified at the DOOS Workshop were presented. The next steps are to complete their specifications for the deep sea. It remains to be determined whether or not sediment chemistry, contaminants, plastics, light level, or turbidity should be included in the consideration; whether or not respiration and labile organic matter should be merged into existing EOVs (i.e. oxygen, POM).

Where necessary the DOOS BGC TT will create expert groups to further complete GOOS specification sheets, or to generate specification sheets for deep-ocean specific EOVs. Further consideration will be given to providing greater depth detail for existing GOOS EOVs (and associated platforms), identifying gaps in observations, and opportunities for platform sharing.

Discussion also focused on how best to collect community input on the EOV development and how to disseminate results once compiled. It was discussed whether a community-comment spreadsheet (made available online), the DOOS SIG, or a scientific paper (possibly for OceanObs '19) is the optimal mechanism for this process.

ACTION: Finalize BGC EOV TT membership

- *Note: TT ToR and Membership will be posted online once finalized*

PHYSICS TASK TEAM

Bruce Howe (Physics TT Chair), University of Hawaii, Manoa

For Physics, in addition to the societal climate issues, deep-ocean DOOS EOVs are required to address scientific questions related to turbulence, bottom pressure, geothermal and bottom boundary fluxes. As with the other EOV TTs this group will work with the GOOS Expert Panel to contribute deep-ocean specific content to the EOV specification sheets. The relevant expert panel is the Ocean Observations Panel for Climate (OOPC), co-chaired by Bernadette Sloyan and John, Wilkin, see http://goosocean.org/index.php?option=com_content&view=article&id=124&Itemid=281

The list of proposed members was presented in addition to a timeline leading to end of year 2019. Near term activities will focus on a review and revision of existing EOV material. The drafting and review of the mixing/turbulence and bottom fluxes

EOVs will be ongoing through mid-2019. The TT will also have the ongoing task of reviewing and preparing papers for OceanObs '19 beginning in mid-2018.

ACTION: Finalize Physics EOV TT membership

ACTION: Articulate Physics EOV TT OSSE needs and promote them within the modeling community; most specifically within GODAE GOV.

- *Note: TT ToR and Membership will be posted online once finalized*

CROSS DISCIPLINE TASK TEAM ACTIONS

Given the TTs are newly formed and creating their initial plans, there are several Actions in common. Some of these will require a 24-month timeframe.

GOOS Actions
ACTION: Fully understand the overlap of DOOS and GOOS EOVs and create a plan for having DOOS EOVs taken under consideration by the GOOS Panels. As appropriate, make modifications to the GOOS EOV spec sheets. (Additional concerns may be given to societal needs and policy implications.) ACTION: Establish DOOS liaison within each TT for the parallel GOOS panel. Assure DOOS representation at GOOS panel meetings. (R. Weller for Physics, R. Wanninkof for BGC, TBD for BioEco).
DOOS Interactions
ACTION: Determine whether a 'Pressures EOV' quantification survey should be conducted focused on the deep ocean; with an outcome on gap identification rather than a priority list of pressures. (This would be modeled after the GOOS Panel now under consideration.) ACTION: The EOV TTs should draft a prioritized short list of what they need most from the Data TT. ACTION: Draft matrix aligning EOV TT activities with DOOS key science themes. ACTION: EOV TT will seek representation from a modeler with a focus on seeking advice on requirements, measurements, and data ACTION: Prepare EOV TT contributions to the Science and Implementation Guide
Products and Communications
ACTION: Generate plans for EOV TT activity, community comment, and outcomes. (An initial consideration should be the spreadsheet generated for the BGC TT.) ACTION: Publish EOV spec sheets unique to the deep ocean. As appropriate be prepared to address the need for additional DOOS EOVs in a white paper. ACTION: Draft Technology Readiness Level (TRL) tables in association with the EOV specification sheets. ACTION: Determine abstracts and papers to be developed for Ocean Obs '19 submission.

DATA & CYBERINFRASTRUCTURE TASK TEAM

Karen Stocks (Data & Cyber TT Chair), Scripps Institution of Oceanography

The DOOS Data TT session focused on the importance of promoting access to deep ocean data and information products through the FAIR principles (findable, accessible, interoperable, and reusable). These principles will be strongly encouraged especially for data required to address DOOS priority processes and phenomena.

The TT will also align activities according to the GOOS Framework by identifying, evaluating, adopting, and recommending appropriate best practices, standards for data, metadata, and technologies for deep ocean data retrieval and management; particularly in instances where deep ocean data presents distinct requirements.

An early activity will be to identify the state of deep-ocean data availability and identify gaps with respect to the GOOS EOV data. To complement this process the TT will identify users of deep-ocean EOV data and conduct an analysis of their requirements and priorities. As such the TT will develop feedback mechanisms linking users and data managers.

Several suggestions were provided on additional TT membership in order to ensure representation from across the observing and modeling communities. Guidance was also provided on how to ensure that upcoming audit activities constitute a manageable endeavor and result in outcomes that are of maximum value to the community.

ACTION: Modify ToR to remove 'observatory operator' phrase, add language to encompass current and historic data, and bringing together various data sources

ACTION: Continue resolving Data TT membership based on SC-1 articulated gaps. (Examples include linkages to OceanSITES, GO-SHIP, Argo, Deep Argo, BGC Argo AtlantOS, IODE, WIGOS, SOOS, IOC Decadal Research Writing Team, and TPOS 2020.)

ACTION: Draft a statement on unique or distinct requirements for deep-ocean meta data and data products.

ACTION: Create statement on what metadata and best practices activities are being conducted by other groups that are most relevant to DOOS.

ACTION: Explore and act on appropriate linkages to the NOAA Ocean Exploration activities.

ACTION: Create a scoping statement and plan for responding to the Workshop request to conduct a deep-ocean data audit including aggregators, protocols, standards, QC, etc.

ACTION: Identify deep-ocean data needs and use for one EOV per disciplinary TT. This will be complimented with EOV specification sheet information that identifies the EOV's science and societal need, sampling requirement, observation techniques, desired data and utility. The EOVs will be nominated by the EOV TT Chairs.

- *Note: TT ToR and Membership will be posted online once finalized*

SESSION THREE: Process Studies

This discussion focused on the rationale for conducting process studies or projects that will assess/exercise/demonstrate the interdisciplinary EOV implementation. It was articulated that they would align with the Framework by focusing on EOVs, technology, and/or data product maturation. It was agreed that these efforts will seek to take advantage of existing infrastructure, where possible and to maintain a strict focus on the scientific and societal interest of DOOS.

CCZ LOCATION

Lisa Levin, Scripps, and Patrick Heimbach, University of Texas at Austin (SC Co-chairs) Standing in for Craig Smith and Sandor Mulsow

The idea for work in the Clipperton-Clarion Zone (CCZ) was first presented at the 2016 DOOS Workshop. Sustained observations of a range of EOVs (from the sea surface to the abyssal seafloor) at or near CCZ locations would help address key scientific questions relevant to TPOS 2020 (another GOOS Project), DOOS carbon-cycle studies, deep pelagic ecosystems responses to deoxygenation, acidification and human activities, and importantly the impacts of deep-sea mining and bottom trawling. Some discussions on physical observing are underway with the International Seabed Authority.

AZORES LOCATION

Marina Carriero-Silva (Guest Presenter), AIRs

The Azores International Research Center's (AIR Center) project goal is to develop an international cooperation platform, dedicated to integrated research in the areas of climate, earth observation, energy, space and oceans, involving Portugal, Brazil, Canada, USA, South Africa, Angola, Morocco. The area hosts an extensive infrastructure and offers ready access to process study sites of interest to DOOS.

SARGASSO SEA LOCATION

Kristina Gjerde, IUCN

This region could leverage outcomes from a network of international partners led by the Government of Bermuda, including UK, USA and intergovernmental agencies (IUCN, ISA) aiming to advance the recognition of the importance of the Sargasso Sea and promote the protection of this high seas region in accordance with the Law of the Sea Convention. This area has a wealth of long-term information but is somewhat lacking in ecosystem research. A current stumbling block is low interest level from the regional biological station (?? Bermuda Biological Station??).

OOI Northeast Pacific

SC members identified opportunities afforded by OOI, in particular its Northeast Pacific cabled observatory node. Funds may be available to run a workshop that identifies existing capabilities and map them into DOOS science questions, requirements, and interdisciplinary EOVs.

DISCUSSION

Led by: Kristina Gjerde, IUCN

A lengthy discussion followed the presentations. It was agreed that there exists a need to focus on maturing deep-ocean EOVs, technologies, and data projects. There is a desire to have these efforts be multi-disciplinary and to maintain the unique requirements of DOOS as a primary outcome, done by maintaining a solid link(s) to DOOS Science Questions.

Additional ideas were explored:

- Explore the agreement of common sensor packages and deploy them strategically to address unique DOOS requirements
- Explore other existing observing efforts (tsunamis) and suggest DOOS-specific requirements to compliment the work underway
- A process study will be developed to take advantage of the temperature and salinity sensors at WHOI

ACTION: SC Membership to agree on desired Process activity and create short briefs on proposed activities and justification as related to DOOS Science Questions.

ACTION: Provide OceanSITES with DOOS requirements for placement of t/s sensors – possibly for consideration at the upcoming OOPC meeting in 2018. This will be led by a committee of Weller, Heimbach, Janssen, Venkatesan, Song, Carreiro-Silva (SC-1 guest presenter)

SESSION FOUR: Engagement

A session on DOOS engagement with groups active in the deep sea and funding managers was also held. The format was question and answer featuring David Legler (NOAA's Climate Program Office) and Eric Lindstrom (NASA Program Scientist). The focus on this session was to help ensure DOOS's relevance to key members of the deep-sea community and agencies that are actively engaged in supporting related programs, projects, and missions.

The Project membership was encouraged to focus on creating coordinated and detailed plans for advancing the goals of DOOS. The articulation of these desired early activities allows for program managers to begin advocating for these limited scope endeavors well before they can be funded. Over time this practice promotes a strategy making it possible to fund smaller efforts as opportunities arise; these may take the form of research projects or technology development efforts associated with the deep sea.

In conjunction with these activities it was also suggested that engagement and advocacy efforts should focus on the facilitation of funding opportunities that fit within the DOOS 10-year strategy. Regular communications with national and international coordination bodies (e.g. ISA, IOOC and JCOMM OCG) were encouraged. A particular focus on alignment and advocacy within DOOS-relevant conventions, international assemblies, and groups such as GOOS were also suggested.

ACTION: Create a plan to identify research funding, engage conventions, articulate decision-making drivers that will lead to sustained funding.

ACTION: Determine the best way to link with large programs with an interdisciplinary focus while avoiding the need for additional meetings.

ACTION: Determine if there is a desire for a TT focused on technology development related to deep-ocean needs.

ACTION: Update Go-SHIP on deep observing activities being conducted by in the BGC and BioEco disciplines.

SESSION FIVE:
Science and Implementation Guide (SIG)

GOALS

Lisa Levin, Scripps Institution of Oceanography

At the DOOS 2016 Workshop it was agreed that the Project would create a Science and Implementation Guide (SIG). The overarching objective of the SIG is to set the stage for prioritizing activities for the next 10 years while enabling observations that address the Project's Science Questions requiring study over much longer time scales. In part, the document's content will be built upon the content existing in the DOOS Consultative Draft V5-1 and the Workshop Report released earlier in 2017.

More specifically the SIG will focus on developing a deep-ocean observing strategy that involves coordinating the work of programs, and identifying where gaps exist and improve coordination. On a more visionary scale it will articulate what is wanted for deep-ocean observing for the next 50 years. Throughout the Guide, requirements will be traceable from the DOOS Science Questions to EOVs, to best practices for platform identification and deployment, to data accessibility and use. The document will address what are required measurements for the next 5-10 years and provide a roadmap for achieving these goals; resulting in the articulation of concrete examples of how to get from studies or examples to an integrated part of the sustained global system.

SIG OUTLINE AND WRITING ASSIGNMENTS

Executive Summary	L. Levin, P. Heimbach, H. Ruhl
I. Introduction and Rationale	
A. Development of DOOS/historical and future (2pp)	**L. Levin**
B. Societal Drivers for Deep Ocean Observing (3pp)	**N. Le Bris, A. Soule**
C. Rationale and Science Questions/Challenges (introduce key areas conceptually or by example) (5pp)	**K. Katsumata, S. Song, M. Carreiro-Silva, F. Janssen, N. Le Bris**
D. Policy Drivers and International Legal Context (2pp)	**K. Gjerde**
II. DOOS Goals and Objectives	**P. Snelgrove, L. Levin, S. Baumann-Pickering, S. Song, P. Heimbach**
A. Vision (1pg)	**P. Snelgrove**
B. Terms of Reference and Beyond (2pp)	**Levin/Heimbach Ruhl**
C. Roadmap outlining DOOS Strategy + Timeline (2pp)	**Levin/Heimbach Ruhl**
D. DOOS Users and Stakeholders (2pp)	**Levin/Heimbach Ruhl**
E. Relationship and contribution to GOOS (1pg)	**Levin/Heimbach Ruhl**
F. Relationship to other programs, entities, networks (IOC, DOSI, TPOS, ATLANTOS)	**McCurdy**
III. EOVs: Physics, Biogeochemistry, Biology/Ecosystems (and other key measures [IBNE]) (10pp)	**H. Ruhl, B. Howe, F. Janssen**
IV. Platform, Sensor, Network Distribution, and Exportability (4pp)	**Howe, R. Venkatesan, B. Weller, A. Soule**
V. Inventory of Deep Ocean Observing (2pp)	**COL, L. Smith, H. Ruhl, F. Janssen, K. Katsumata**

A. Science Questions (ability to answer) (1pg)		**H. Ruhl, F. Janssen, K. Katsumata**
B. Data accessibility (1pg)		**K. Stocks, B. Weller**
A. Technique Maturation and new technology needs (1pg)		
VI. Data Policy and Management	**K. Stocks**	
VII. DOOS Approaches and Actions - Target Outcomes - Advocating for Deep Ocean Observations		
A. **Project concepts (answering science questions and new observations) (2pp)**	P. Heimbach	
B. **Hotspots, opportunities, gaps, and priorities relative to science questions (1pg)**	N. Le Bris	
C. **Process studies -- concept and philosophy (2pp)**	Weller, N. Le Bris	
D. **Pilot or Demonstration Projects Concepts, EOVs, and other key measures (2pp)**	P. Heimbach, M. Carreiro-Silva, C. Smith (Axial/ONC) D. Kelly, R. Snelgrove	**Howe, R. Venkatesan, B. Weller, A. Soule**
E. **Mobile platforms (2pp)**	Soule, Howe	
VIII. Coordination Activities		
A. **Criteria of a DOOS project (1pg)**	Criteria team	
B. **Communication Hub /Facilitation/Consultation including data management (1pg)**	L. Levin, COL, K. Stocks	
C. **Community Engagement (newsletter) (1pg)**	COL	
D. **Capacity Building (1pg)**	R. Venkatesan, N. Le Bris	
E. **Policy Linkages (e.g., SDG 14, BBNJ, ISA, FAO etc.) (1pg)**	K. Gjerde, L. Levin, R. Venkatesan, B. Howe	
IX. Moving Forward (2pp)	L. Levin, H. Ruhl, P. Heimbach	

SESSION SIX: Sub-committees / Working Groups

This session focused on areas that have been identified by the SC as warranting focused attention and activity. These may one day lead to more concerted efforts.

CAPACITY BUILDING

-R. Venkatesan, National Institute of Ocean Technology Ministry of Earth Science, India
-Nadine LeBris, University of Pierre et Marie Curie, France

An overview of potential capacity building activities was presented. It was agreed that an optimal place to begin is with a review of clearinghouses maintained by groups such as DOSI and INDEEP. As appropriate the next step may be to then bring additional resources to these efforts.

Focus may be on providing examples on how to reach the interest of young professionals through data training and its use in management, and through technology transfer, with a keen emphasis on developing nations.

ACTION: Reach out to other groups to determine what type of training is being conducted with a deep ocean theme- with a particular focus on POGO, INDEEP, DOSI, IODP. Compile a list and make available on the website.

ACTION: Approach POGO about collaborative training or capacity building opportunities.

SOLID EARTH COMMUNITY

Adam Soule, WHOI

This effort will focus on the promotion of DOOS within the Deep Submergence Science Community (DeSSC). Conversation will be designed to invite discussion on evaluation and integration of observing systems, coordination of pilot projects and process studies, and other deep-sea community observing needs. More specifically DOOS will also be promoted at the Environmental Monitoring for Deep-Sea Mining Workshop and at the upcoming (Dec. 2017) AGU Town Hall. Both activities will seek input from academic researchers, intergovernmental entities, industry experts, and policy scholars as the SIG creation gets underway.

The wide range of potential solid earth partner groups or organizations was also presented. The discussion then shifted to what DOOS can do for this community such as guidelines on high-priority data collection targets, formation of supporting EOVs, community building, operational opportunities, and providing access to policy makers for marine conservation.

The recently released NSF call on Advancing Frontiers in Seafloor Science and Engineering was also discussed. Further guidance on the roll or benefit to DOOS will be provided.

ACTION: Support the AGU Town Hall through a more wide understanding of relevant groups and activities. (Felix will get more on Deep Carbon outputs / Eric will enlist support of researchers at NASA.)

ACTION: Based on Adam's guidance, respond as appropriate to the NSF Seafloor research call.

ACTION: Connect with Mermaid group (F. Simons, Princeton)

NATIONAL POLICY
A paragraph on National Academies Report on Ocean Observing and possible implications for or link to DOOS is being drafted.

INTERNATIONAL POLICY

Kristina Gjerde, IUCN

The expansive arena of international policy within which DOOS might engage was presented, including regulatory and conservation groups. DOOS was encouraged to maintain a connection to the seabed mining industry, and fisheries groups as well as the new BBNJ Treaty. DOOS was also encouraged to become an observer at the ISA and attend some of its sessions.

The Project was encouraged to gain more exposure and support for efforts such as SDG-14, the UNFCCC, IPCC (contribution encouraged to IPCC AR6), participate in the World Ocean Assessment, be mindful and supportive of the potential IOC Decade of the Ocean (2020-2030), and to work with the G7 groups focused on the seas.

DOOS was advised that if there exists a goal to attend sessions and assemblies, it is helpful to gain access to the delegates prior to the physical meetings (and when the level of engagement warrants), maintain active engagement with key players and groups.

ACTION: Create an engagement plan for generating exposure at events and activities related to SDG/SDG-14, WOA, Decade for Ocean Research (proposed), G7 Future of the Seas and Ocean

ACTION: Explore becoming an observer at the ISA assembly. Determine if an SC member will attend. (Paul expressed some willingness)

ACTION: Hold an information briefing about deep-ocean observing and ecosystems for ISA delegates that reside and work at the UN in New York. Emphasize needs relative to ISA decision making and environmental mandates.

SESSION SEVEN: DOOS Next Steps

The meeting was adjourned without setting a date and location for the SC-2. The group agreed it would monitor progress over the next 6-10 months and determine the need for a meeting. The interim session focus will be on the EOV development work and the writing for the SIG. It was agreed that one or more meetings may be held as conference calls.

Distributed Project Office (DPO) ENGAGEMENT SUPPORT

McCurdy, UCAR

In addition to the activities already named in this Report, several follow on activities for ongoing engagement was articulated. The DPO will support the follow-up for these activities.

ACTION: Review list of DOOS online inventory respondents, determine gaps and take action to reach non-respondents and fill in gaps.

ACTION: Make the content and utility of the online Inventory map more visible as a tool for locating and accessing data and data sets.

ACTION: Create a standard DOOS poster for use by SC members at conferences and meetings.

ACTION: Generate a Frequently Asked Questions document for the website.

ACTION: Provide input into the GOOS Strategic Plan prior to its approval by the WMO Congress

ACTION: Create a web calendar with DOOS related meetings and sessions:

- Ocean Exploration Forum: October 2018
- GODAE: November 2018
- AGU: December 2018
- POGO: January 2018
- OSM 2018: February 2018
- OOPC: February 2018 Feb
- AAAS: May 2018
- World Conf on Marine Biodiversity: May 2018
- Pices: June 2018 Effects of Climate Change on the World’s Oceans
- Int’l Deep sea biology Symposium Sept. 2018

APPENDICIES

Appendix 1: DOOS SC-1 Attendees

- Lisa Levin, Co-Chair
- Patrick Heimbach, Co-Chair
- Henry Ruhl, Co-Chair
- Simone Baumann-Pickering
- Kristina Gjerde
- Bruce Howe
- Felix Janssen
- Katsuro Katsumata
- Nadine LeBris
- Sun Song
- Adam Soule
- Karen Stocks
- R. Venkatesan
- Bob Weller
- Paul Snelgrove
- Marina Carreiro-Silva
- Andrea McCurdy, Project Manager
- Nick Rome
- Kruti Desai

Appendix 2: DOOS SC-1 Agenda

DEEP OCEAN OBSERVING STRATEGY

DOOS SC-1
Provisional Agenda

Overarching Objective:
Determine Desired Status of DOOS at OceanObs '19
(16-20 Sept. 2019)

Event Dates: 25-26 September 2017

Location: 1201 New York Avenue, NW
Washington, D.C. 20005

Hotel: 10 Thomas Cir NW,
Washington, D.C. 20005

Preparation: -Each member asked to bring a list of deep ocean activities that you, your organization, or your nation is involved in
-Co-Chairs will work individually with presenters as appropriate

Suggested background materials:

- DOOS Terms of Reference (http://www.deepoceanobserving.org/about/doos-terms-of-reference/)
- DOOS 2016 Workshop Report (http://www.deepoceanobserving.org/reports/dec-2016-workshop-report/)
- DOOS Consultative Draft (http://www.deepoceanobserving.org/reports/consultative-report/)
- Framework for Ocean Observing (http://www.oceanobs09.net/foo/)
- Ocean Obs '19 Conference Website (http://www.oceanobs19.net/)

25 Sept: Sessions and Presentations

Time	Item	Presenter / Lead
8:30: Start (continental breakfast)		
Session One: Introductions / Project Overview / Ocean Obs ' 19 Goals		
8:30	Welcome and Member Introductions	Levin/ SC Members
9:00	DOOS TO DATE: Overview /Workshop Actions/ Formed Project Structure/ Distributed Project Office (DPO)	Co-Chairs/McCurdy
9:30	Roundtable: Targets for the next 2yrs (OceanObs'19)	SC Group Discussion
Session Two: Task Teams *Suggest: 15 min. presentation & 15 min. discussion* - Terms of Reference -TT Membership -Where will the TT be by OceanObs '19 -Steps and Needs		
10:00	Biology-Ecology Task team	Ruhl
10:30am Break (coffee and light snacks)		
11:00	Biogeochemistry TT	Janssen
1:30	Physics Task Team	Howe
12:00	Data Task Team	Stocks
12:30	Other TT Suggestions	Co-Chairs/SC Discussion
1:00-2:00 One Hour Lunch (catered onsite)		
Session Three: Pilot/Demonstration Project(s) Overview and Characteristics - Ownership, Timeline, Next Steps		
2:00	Overview of Pilot project goals and features	Heimbach
2:30	- CCZ Pilot Site - AIR Pilot in Azores - Sargasso Sea/COVERAGE -Next Steps	-Leads (TBD) -Carreiro Silva (15 min) -Gjerde (15 min) -All
*3:30	-Small breakouts/working groups	-SC Members
Session Four: Engagement		
*3:30	Co-Chair Brief to IOOC (at OL)	Co-Chairs
4:00: Break (beverages and light snacks)		
4:30	Questions & Answer/Discussion: Funding, Coordination, Liaison, Inter-Agency Advice	Co-Chairs & IOOC Co-Chairs: Houtman, Legler, Lindstrom (TBC)
5:30	Wrap up and Reflection	Ruhl
6:00: Close / Non-Hosted Dinner (TBD)		

*=During this half hour SC members will continue working on Pilot/Demo ideas while Co-Chairs brief the IOOC on DOOS (the IOOC will also be meeting at the OL offices in DC) www.iooc.us

26 Sept: Sessions and Presentations

Time	Item	Presenter / Lead
8:30: Start (continental breakfast)		
8:30	Recap / Agenda Modifications	Levin/SC Group Discussion
Session Five: Science and Implementation Guide (SIG)		
9:00	-Further Develop/Approve Guide Outline -Agreement on Scope, Contributors, Audience, Sponsors	Co-Chairs
10:30 Break (coffee and light snacks)		
11:00	-SIG Timeline -Writing Assignments and Teams -Ideas on review cycle(s)	Co-Chairs
Session Six: Sub-Committees/Working Groups		
11:30	Capacity Building: -Overall Objectives -Plans for Obs19 -Needs from SC	Lebris, Venkatesan (TBC)
12:00-1:00 - One Hour Lunch (catered onsite)		
1:00	Solid Earth Community -Overall Objectives -Plans for Obs19 -Needs from SC	Soule
1:30	UN Voluntary Engagement (e.g., SDG-14, BBNJ, IOC other)	Co-Chairs/SC Group Discussion
2:00 Break (beverages and light snacks)		
Session Seven: DOOS Next Steps		
2:30	TT and Leadership 12-mo Actions and milestones including: - TT integration -Obs'19 White paper abstracts and publications - Post OcObs'19 vision -Conference sessions and briefs	All: Given the importance of this session members are strongly urged to schedule return travel in order to participate in this final agenda setting exercise
#3:30: Sessions Closed		

#=OL Conference room will be available until 5:00

Appendix 3: DOOS Science Questions

- What is the role of the deep-ocean in the Earth's energy imbalance and land-sea water redistribution on annual to decadal time scales? This includes closing the heat and fresh water budget, the warming and freshening of the deep ocean, and their contribution to sea level change.
- How are natural and anthropogenic variations in climate connected to the global overturning circulation and its variability? This includes linkages with variations in deep and bottom water formation rates and water properties, circulation and deep- ocean mixing, geothermal heating, and impacts on deep sea ecology.
- How does deep pelagic ecology respond to natural variation and multiple climate change stressors, including warming, deoxygenation, acidification, changes in biological production, as well as industrial activities?
- How might such changes influence the function of the solubility and biological carbon pumps, continental slope nephloid layer transport and the sequestering of carbon in the deep ocean, and the supply of organic carbon food supplies to deep-sea communities?
- What drives variations in seafloor fluxes of heat, nutrients, tracers, oxygen and carbon? How are these quantities connected to greater ocean dynamics? This includes the longer-term links between seafloor fluxes and greater oceanic physical and biogeochemical properties.
- How might natural and anthropogenic change influence the functional importance of animals and microbes in the deep sea and at the seafloor? What environmental variations do they experience in space and time? This includes consideration of benthic storms and currents, turbidity, T, pH, O2, and POC flux. This will inform spatial planning and impact assessment for seabed mining, bottom trawling and oil and gas extraction.As a GOOS Project, DOOS will be aligned with the Framework for Ocean Observing (Framework). In 2012 the GOOS adopted the Framework as a guide for GOOS activities and alignment. The purpose of the Framework is to assist in the development and delivery of an integrated ocean observing system fit for many purposes.

Appendix 4: DOOS Terms of Reference

1. Build understanding on what is most important to observe.

- Identify important science and societal questions and relevant variables for stakeholders o Identify the high priority processes and phenomena in the deep ocean to observe

2. Provide a hub for integration opportunities:

- Act as an agent to coordinate existing deep observing activities across disciplines to form a systematic, sustained deep-ocean observing system.
- Act as an integrator to create linkages among appropriate research, intergovernmental, industry, regulatory and funding agencies to achieve deep-ocean societal objectives through science.
- Foster observing activities at community identified multi-use, multi-disciplinary sites, representing different key biogeochemical and ecological regimes and questions.

3. Coordinate observations to:

- Utilize existing platforms for new sensors or integration of physical, biogeochemical and biological sensors in order to improve observing efficiency.
- Document the state of deep-ocean observing
- Identify standards and best practices for observing the deep sea

4. Develop deep observing requirements

- Identify the EOVs specific to the deep ocean and add deep-ocean specifications to existing GOOS EOVs
- Identify gaps (knowledge, geographic, variables, technical, data) and emerging systems relative to the key science and societal questions

5. Build readiness in observing technology and techniques

- Promote new technology developments and assess their suitability to address key scientific questions, management issues, or early warning of ocean hazards/extreme events.

Appendix 4: SC-1 Tracked Actions

ACTION SC-1.1: Data TT to explore quality and provenance of OceanSITES data (in NDBC) and flag that which is relevant to the deep ocean. A key goal of this activity is to identify locations where data are currently not being collected but are needed to address key DOOS science questions, and to develop a plan for the deployment of 30 SB 37 sensors available for use by the science community.

ACTION SC-1.2: Leadership to create a list of criteria and a protocol for others seeking endorsement or engagement with DOOS. (Initial criteria to be collated by Karen, Eric, Paul, Bruce). This information will be reviewed and discussed as needed by the SC and placed on the website.

ACTION SC-1.3: Add to Biology-Ecosystem pelagic representation to the TT membership

ACTION SC-1.4: Finalize BGC EOV TT membership

ACTION SC-1.5: Finalize Physics EOV TT membership

ACTION SC-1.6: Articulate Physics EOV TT OSSE needs and promote them within the modeling community; most specifically within GODAE GOV.

ACTION SC-1.7: Fully understand the overlap of DOOS and GOOS EOVs and create a plan for having DOOS EOVs considered by the GOOS Panels. As appropriate, make modifications to the GOOS EOV spec sheets. (Additional concerns may be given to societal needs and policy implications.)

ACTION SC-1.8: Establish DOOS liaison within each TT for the parallel GOOS panel. Assure DOOS representation at GOOS panel meetings. (R. Weller for Physics, R. Wanninkof for BGC, TBD for BioEco).

DOOS Interactions
ACTION SC-1.9: Contact main GOOS EOV panel to introduce DOOS concepts and objectives, and agree how DOOS input might be taken into the panel.

ACTION SC-1.10: Determine whether a 'Pressures EOV' quantification survey should be conducted focused on the deep ocean; with an outcome on gap identification rather than a priority list of pressures. (This survey would be modeled after the GOOS Panel now under consideration.)

ACTION SC-1.11: The EOV TTs should draft a prioritized short list of what they need most from the Data TT.

ACTION SC-1.12: Draft matrix aligning EOV TT activities with DOOS key science themes.

ACTION SC-1.13: EOV TT will seek representation from a modeler with a focus on seeking advice on requirements, measurements, and data

ACTION SC-1.14: Prepare EOV TT contributions to the Science and Implementation Guide

ACTION SC-1.15: Generate plans for EOV TT activity, community comment, and outcomes. (An initial consideration should be the spreadsheet generated for the BGC TT.)

ACTION SC-1.16: Publish EOV spec sheets unique to the deep ocean. As appropriate be prepared to address the need for additional DOOS EOVs in a white paper.
ACTION: Draft Technology Readiness Level (TRL) tables in association with the EOV specification sheets.

ACTION SC-1.17: Determine abstracts and papers to be developed for Ocean Obs '19 submission.

ACTION SC-1.18: Modify Data TT ToR to remove 'observatory operator' phrase, add language to encompass current and historic data, and bringing together various data sources

ACTION SC-1.19: Continue resolving Data TT membership based on SC-1 articulated gaps. (Examples include linkages to OceanSITES, GO-SHIP, Argo, Deep Argo, BGC Argo AtlantOS, IODE, WIGOS, SOOS, OOI, IOC Decadal Research Writing Team, and TPOS 2020.)

ACTION SC-1.20: Draft a statement on unique or distinct requirements for deep-ocean meta data and data products.

ACTION SC-1.21: Create statement on what metadata and best practices activities are being conducted by other groups that are most relevant to DOOS.

ACTION SC-1.22: Explore and act on appropriate linkages to the NOAA Ocean Exploration activities.

ACTION SC-1.23: Create a scoping statement and plan for responding to the Workshop request to conduct a deep-ocean data audit including aggregators, protocols, standards, QC, etc.

ACTION SC-1.24: Identify deep-ocean data needs and use for one EOV per disciplinary TT. This effort will be complimented with EOV specification sheet information that identifies the EOV's science and societal need, sampling requirement, observation techniques, desired data and utility. The EOVs will be nominated by the EOV TT Chairs.

ACTION SC-1.25: SC Membership to agree on desired Process activity and create short briefs on proposed activities and justification as related to DOOS Science Questions.

ACTION SC-1.26: Provide OceanSITES with DOOS requirements for placement of t/s sensors – possibly for consideration at the upcoming OOPC meeting in 2018. This will be led by a committee of Weller, Heimbach, Janssen, Venkatesan, Song, Carreiro-Silva (SC-1 guest presenter)

ACTION SC-1.27: Create a plan to identify research funding, engage conventions, articulate decision-making drivers that will lead to sustained funding.

ACTION SC-1.28: Determine the best way to link with large programs with an interdisciplinary focus while avoiding the need for additional meetings.

ACTION SC-1.29: Determine if there is a desire for a TT focused on technology development related to deep-ocean needs.

ACTION SC-1.30: Update Go-SHIP on deep observing activities being conducted by in the BGC and BioEco disciplines.

ACTION SC-1.31: Reach out to other groups to determine what type of training is being conducted with a deep ocean theme - with a particular focus on POGO, INDEEP, DOSI, IODP. Compile a list and make it available on the website.

ACTION SC-1.32: Approach POGO about collaborative training or capacity building opportunities.

ACTION SC-1.33: Support the AGU Town Hall through a more wide understanding of relevant groups and activities. (Felix will get more on Deep Carbon outputs / Eric will enlist support of researchers at NASA.)

ACTION SC-1.34: Based on Adam's guidance, respond as appropriate to the NSF Seafloor research call.

ACTION SC-1.35: Connect with Mermaid group (F. Simons, Princeton)

ACTION SC-1.36: Create an engagement plan for generating exposure at events and activities related to SDG/SDG-14, WOA, Decade for Ocean Research (proposed), G7 Future of the Seas and Ocean

ACTION SC-1.37: Explore becoming an observer at the ISA assembly. Determine if an SC member will attend. (Paul expressed some willingness)

ACTION SC-1.38: Hold an information briefing about deep-ocean observing and ecosystems for ISA delegates that reside and work at the UN in New York. Emphasize needs relative to ISA decision-making and environmental mandates.

ACTION SC-1.39: Review list of DOOS online inventory respondents, determine gaps and take action to reach non-respondents and fill in gaps.

ACTION SC-1.40: Make the content and utility of the online Inventory map more visible as a tool for locating and accessing data and data sets.

ACTION SC-1.41: Create a standard DOOS poster for use by SC members at conferences and meetings.

ACTION SC-1.42: Generate a Frequently Asked Questions document for the website.

ACTION SC-1.43: Provide input into the GOOS Strategic Plan prior to its approval by the WMO Congress

ACTION SC-1.44: Create a web calendar with DOOS related meetings and sessions:

Appendix 5: Acronyms

BBL	Bottom Boundary Layer
BGC	Biogeochemistry
BCP	Biological carbon pump
C	Carbon
CCZ	Clarion-Clipperton Zone
CLIVAR	Climate and Ocean: Variability, Predictability and Change
CO2	Carbon Dioxide
COL	Consortium for Ocean Leadership
DOOS	Deep Ocean Observing Strategy
DOSI	Deep Ocean Stewardship Initiative
EOV	Essential Ocean Variables
FOO	Framework for Ocean Observing
GCOS	Global Climate Observing System
GOOS	Global Ocean Observing System
ICUN	International Union for the Conservation of Nature
INDEEP	International Network for Scientific Investigations of Deep-Sea Ecosystems
IOC	Intergovernmental Oceanographic Commission
IOOC	Interagency Ocean Observation Committee
IPCC	Intergovernmental Panel on Climate Change
ISA	International Seabed Authority
ITCZ	Inter Tropical Convergence Zone
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
MBARI	Monterey Bay Aquarium Research Institute
MPAs	Marine Protected Areas
NEPTUNE	NorthEast Pacific Time-Series Undersea Networked Experiments
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
ONC	Ocean Networks Canada
OOI	Ocean Observatories Initiative
POC	Particulate Organic Carbon
SDG-14	United Nations Sustainable Development Goal 14
T	Temperature
ToR	Terms of Reference
TPOS	Tropical Pacific Observing System
UCAR	University Corporation for Atmospheric Research
UNCESCO-IOC	United Nations Educational, Scientific, and Cultural Organization - Intergovernmental Oceanographic Commission
UNFCCC	United Nations Framework for Climate Change Convention
WCRP	World Climate Research Programme
WOCE	World Ocean Circulation Experiment