

## **4.0 INFRASTRUCTURAL ACTIVITIES**

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#### 4.1 IOC/SCOR International Ocean Carbon Coordination Project, p. 4-1

Tantua, Fennel

#### International Ocean Carbon Coordination Project Progress Report for SCOR, August 2014



The complexity of the marine carbon cycle and its numerous connections to carbon's atmospheric and terrestrial pathways means that a wide range of approaches have to be used to establish carbon's qualitative and quantitative role in the global climate system. The International Ocean Carbon Coordination Project (IOCCP) coordinates a highly diverse set of activities and facilitates the development of globally acceptable strategies, methodologies, practices and standards homogenizing efforts of the research community and scientific advisory groups, as well as integrating the ocean biogeochemistry observations with the multidisciplinary global ocean observing system. This report highlights main activities of the IOCCP between September 2013 and August 2014.

### Projects and Major Activities

#### The Surface Ocean CO<sub>2</sub> Atlas (SOCAT) Project

IOCCP's coordination of the Surface Ocean CO<sub>2</sub> Atlas ([SOCAT](#)) continues as an activity carried out by a dedicated subset of the international marine carbon research community. SOCAT aims to improve access to surface water CO<sub>2</sub> data by regular releases of quality-controlled, synthesis and gridded fCO<sub>2</sub> (fugacity of carbon dioxide, similar to partial pressure) data products for the global ocean and coastal seas. SOCAT version 1 was publicly released in 2011, version 2 in 2013. Version 2 has 10.1 million surface water fCO<sub>2</sub> data from 2,660 data sets between 1968 and 2011.

About 1,940 files with data from 1957 to 2013 have been submitted for version 3 between July 2013 and March 2014. Most data providers followed requests from SOCAT and the wider marine carbon community to submit data directly to CDIAC. The data submissions include many updates of data submitted to earlier SOCAT versions (990 files), as data providers have implemented recommendations and feedback from SOCAT quality control. Roughly 950 new files, corresponding to 4 million fCO<sub>2</sub> values, have been submitted. About 550 of the 950 files originate from 2011 to 2013. Version 3 extends the data set to December 2013 and includes CO<sub>2</sub> measurements from alternative sensors and platforms.

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Quality control for version 3 will be carried out from September to November 2014. New features in the version 3 quality control system will include 1) Check-boxes will correspond to the criteria for data set quality control flags; 2) A data set quality control flag can only be submitted if the corresponding check-boxes have been ticked and a text comment has been entered; 3) The Expocode of the cross-over data set must be specified for submission of a data set flag of A; 4) Adding a quality control comment without submitting a data set quality control flag will be possible.

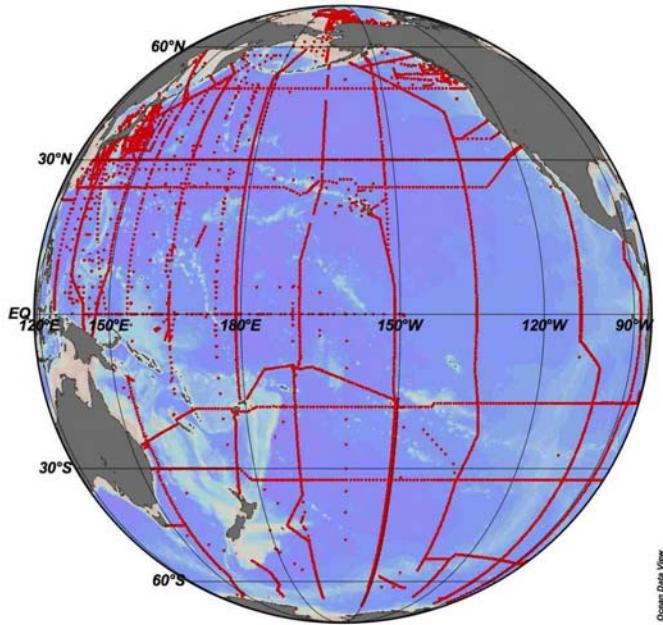
SOCAT carries out quality control for surface water fCO<sub>2</sub> only. Sea surface temperature (SST) and salinity are only checked insofar as this is relevant for (re-) calculation of surface water fCO<sub>2</sub>. Salinity and SST in SOCAT data products have not been fully quality controlled. SOCAT urges data providers to provide fully calibrated, high-quality salinity and SST data.

The SOCAT Automation team continues to work, with strong IOCCP support, on implementing an automated data submission and data quality control system. From version 4 onwards, scientists will be able to upload and submit their data directly into the SOCAT quality control system. As part of the upload, an automated ‘parameter range check’ will be run to find obvious errors in the data. Data providers will have access to visualizations of their data for identification and correction of quality issues in the data. Tools in the automation system will enable the scientists to inform the system about the parameters and units in their uploaded files. Plots of cross-overs with other data sets can be seen in the Preview Dataset part of the dashboard. Adherence to standardized metadata formats will be required. Tools and guidelines for entering, editing and checking metadata will be distributed as soon as the system is ready to use. The automation system for data upload is scheduled to be available in late 2014 or early 2015 for SOCAT version 4.

### **Ocean Interior Data Syntheses**

In the current reporting period, the IOCCP coordinated the completion of two major activities related to production and release of ocean interior carbon data synthesis products: a public release of the PACIFic ocean Interior CArbon (PACIFICA) Database in October 2013 and final quality-control efforts before the release of the Global Ocean Data Analysis Product version 2 (GLODAP v2).

PACIFICA was an international collaborative project supported by IOCCP and the North Pacific Marine Sciences Organization (PICES) for the data synthesis of ocean interior carbon and other related variables in the Pacific Ocean. The PACIFICA database was publicly released in October 2013 at two websites: the CDIAC website (<http://cdiac.ornl.gov/oceans/PACIFICA/>) and PICES website prepared by MIRC (Japan) for PACIFICA (<http://pacific.pices.jp/>).



No launch event was held, but colleagues directly involved in PACIFICA as well as IOCCP SSG members and PICES S-CC section members gave launch presentations at several meetings. The database includes original cruise data files from the total of 272 cruises, including those conducted between the late 1980s and 2000, but not stored in GLODAP, as well as those of CLIVAR/CO<sub>2</sub> Repeat Hydrography and other new cruises from the 2000s. A table of suggested adjustments has also been provided to account for the analytical offsets in the data of dissolved inorganic carbon, total alkalinity, salinity, oxygen, and nutrients (nitrate and nitrite, phosphate, and silicic acid) for each cruise as a result of the secondary quality-control procedure. The adjusted PACIFICA data product is available from the above websites.

Two final workshops, in Gröningen in October 2013 and in Bremen in January 2014, focused on teasing out the precise correction for the remaining parameters, to accomplish the secondary quality control of GLODAPv2. The GLODAPv2 database will be a collection of individual data sets from approximately 800 cruises covering the entire ocean. Once released, it will complement SOCAT and will allow for global analyses of ocean carbon dynamics in the entire water column.

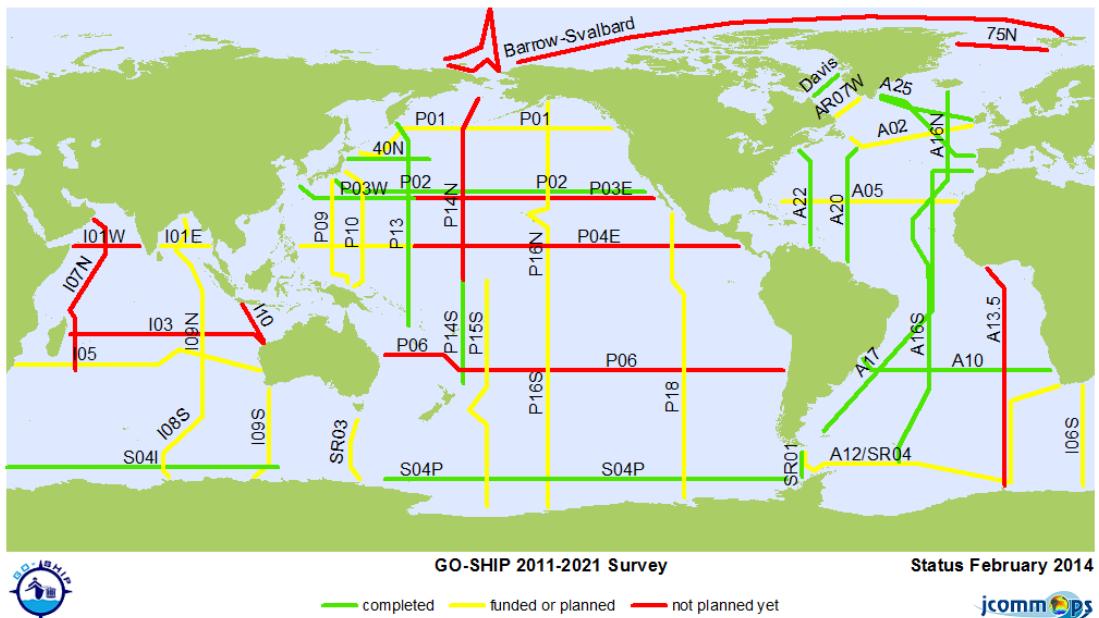
Ultimately GLODAPv2 will evolve into an international routine global data synthesis project, releasing global quality-controlled data products on a fixed schedule (3-5 years frequency is discussed at the moment).

### **The Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP)**

The 3<sup>rd</sup> decadal global reoccupation of GO-SHIP sections has begun. Sections A20 and A22 (in the Atlantic) and P02 (in the North Pacific) have been completed already. Information on the status of national plans is being actively gathered to pinpoint potential gaps in funding for sections. Also, a set of web-based documents is being developed to aid the coordination of the global repeat. Information on the parameters that will be collected on each voyage, approximate number of

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available berths and more will be captured and distributed among national representatives and GO-SHIP subscribers.



During the past year GO-SHIP was represented at several planning meetings (SOT 7, OCG, POGO, IMOS,...). It is clear that the program visibility has improved. The committee has expanded to include representatives from all participating nations and representatives of strategically important nations with untapped interests in repeat hydrography.

This report only represents ocean interior data taken under the GO-SHIP. There are many other ocean interior data collected that are not part of GO-SHIP and are not captured in a coordinated way. Many of the non-GO-SHIP cruises take place in biogeochemically very important coastal regions where warming, deoxygenation and acidification signals are directly related to future human well-being. As such cruises do not meet GO-SHIP requirements, the data are often shelved and are not included in global syntheses. Starting now, IOCCP will focus its coordination efforts on these non-GO-SHIP hydrography efforts at the expense of GO-SHIP coordination in order to make sure that as many of them as possible measure the largest possible set of essential ocean variables and that the data collected are of required quality and stored in widely recognized data archives. (GO-SHIP is managed by a separate group, but IOCCP has assisted them in the past.)

### **The International Group for Marine Ecological Time Series (IGMETS)**

Shipboard biogeochemical time series represent one of the most valuable tools scientists have to characterize and quantify ocean carbon fluxes and biogeochemical processes. They provide the long, temporally resolved datasets needed to characterize ocean climate, biogeochemistry, and ecosystem change. Stationary biogeochemical time series provide a highly resolved temporal dataset which is relevant only at a local scale, and generally cannot be extrapolated to larger regions. When multiple time series are combined, regional and global variability can be examined

via large spatial-scale analyses, which can allow us to detect and interpret linkages between climate variability and ocean biogeochemistry, and ultimately improve our understanding of marine ecosystem change. There is an extraordinary, unexploited strength in numbers with respect to ocean time series.

An effort led by IOCCP, IOC and the U.S. Ocean Carbon and Biogeochemistry Program (OCB) has identified >160 ship-based, biogeochemical time series throughout the globe. The International Group for Marine Ecological Time Series (IGMETS) seeks to integrate a suite of in situ biogeochemical variables from time-series stations, together with satellite-derived information, to look at holistic changes within different ocean regions, explore plausible reasons and connections at a global level, and highlight any locations of especially large changes that may be of special importance. Over the last 12 months, IGMETS continued the effort started by the November 2012 International time-series methods workshop: Global Intercomparability in a Changing Ocean. This includes maintaining the permanent website, as well as keeping the network connected by distributing opportunities of collaboration, news articles, etc. A summary of results from the workshop was presented at the 2013 OCB Summer Workshop at WHOI (H. Benway). Efforts are also being made to encourage time-series operators to share their data, but this is an exercise that is still in the works and as for now the outcome is uncertain.

The next step leading to better integration of ship-based biogeochemical time series aims at compiling a “Biogeochemical Time-Series Compilation Report” (sponsored by IOC and IOCCP). The first meeting was held in St. Petersburg, Florida on March 4-6, 2014. This report seeks to integrate selected variables measured at ship-based biogeochemical time series sites to look at holistic changes within different ocean regions, explore plausible reasons and connections at a global level, and highlight any regions of especially large changes that may be at greater risk.

Beyond IGMETS, the IOCCP Time-Series section has also strengthened its ties with OceanSITES. IOCCP participated in the OceanSITES Scientific Steering Committee Meeting in Seoul, Korea in May 2013 and a discussion was held on how to improve the synergy between IOCCP and OceanSITES, and how they can complement each other. OceanSITES is very interested in adding biogeochemistry to its moorings, and is planning a “global” MOIN (Minimalist OceanSITES Interdisciplinary Network) meeting in late summer 2014. The results from this meeting would be of interest for future IOCCP activities, and thus IOCCP will continue to communicate with OceanSITES.

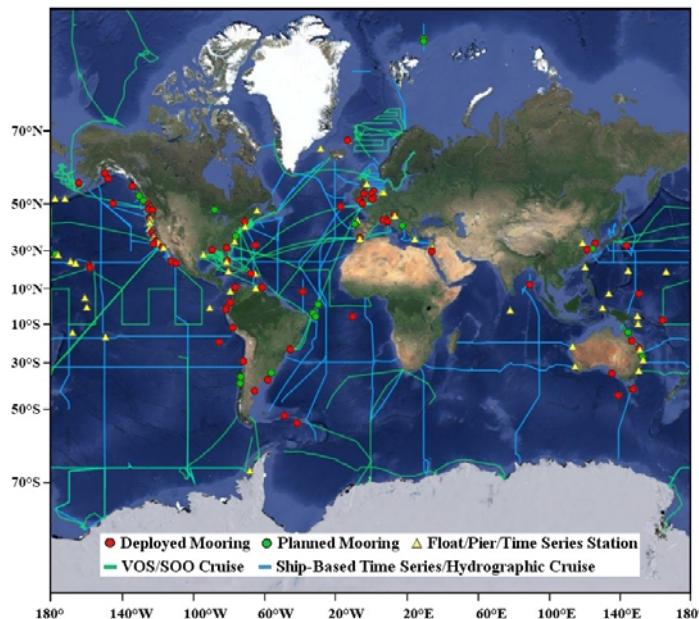
Finally, IOCCP is working with the WMO in its annual Greenhouse Gas Bulletin. IOCCP’s chair (Toste Tanhua) was approached by the Atmospheric Environment Research Division (WMO) with a request for contribution to the division’s annual Greenhouse Gas Bulletin (GGB). The GGB will feature a new ‘oceans’ page where ocean pCO<sub>2</sub> and pH will be included. Seven moored and ship-based time series, which provide high-quality, high temporal resolution information, were selected based on historical records to be highlighted on this first bulletin. Depending on the reception of this publication, subsequent bulletins can feature other time series or repeat hydrography data, showcasing to the scientific community, managers and general public the usefulness of time-series data and the changes that our ocean has undergone in only a couple of decades in response to anthropogenic forcing factors.

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### The Global Ocean Acidification Observing Network (GOA-ON)

The GOA-ON effort continues to develop the optimal observing system to detect ecosystem impacts of ocean acidification (OA) in various large-scale ecosystem types, including Tropical, Temperate, and Polar Regional Seas; Warm and Cold-water Corals; and Nearshore, Intertidal and Estuarine Habitats.

A GOA-ON website <http://www.goa-on.org/>, has been developed to include the latest version of the interactive map of global OA-related observing activities. The map represents the best information available on the current inventory of global OA observing, and provides a tangible means for increasing awareness and coordination between network partners and others with interests, as well as access to OA data being collected around the globe.



The GOA-ON Requirements and Governance Plan has been finalized and is available from the GOA-ON website. It provides both broad concepts and key critical details on how to meet the goals of these newly designed observing network. In particular, it defines the Network design strategy; ecosystem and goal-specific variables; spatial and temporal coverage needs; observing platform-specific recommendations; data quality objectives and requirements; initial GOA-ON products, outcomes, and applications; GOA-ON's proposed governance structure; and Network support requirements. It also specifies roles of each organization involved in GOA-ON.

Specific roles of IOCCP in GOA-ON:

- Take responsibility for international coordination of biogeochemical observations included in GOA-ON implementation plan;
- Lead the development of essential ocean variables for ocean acidification for biogeochemistry and support the development of essential ocean variables for ocean acidification for biology; and

- Support data dissemination thru the world ocean data centers.

Richard Feely and Maciej Telszewski are both members of the GOA-ON Executive Council.

### **The Integrated Framework for Sustained Ocean Observing (FOO) – Biogeochemical Essential Ocean Variables**

During the last 12 months, the IOCCP led the efforts of the Biogeochemistry Panel of GOOS. Great progress was made towards developing a community-vetted set of Essential Ocean Variables. Several international experts gave support to the work of the Panel and a wide range of ocean users is being consulted for their input into the final list. Tasks accomplished so far include the following:

- (i) compilation (and update as needed) of the available information on societal and scientific requirements regarding marine biogeochemistry parameters necessary for inclusion into the FOO as EOVS;
- (ii) consultation with programmatic and institutional partners on their requirements for the multidimensional feasibility assessment of the proposed parameters. It is important that observing, modeling and sensor/instrument developing communities continue being involved;
- (iii) a multidimensional feasibility assessment of the proposed parameters built on the FOO recommendations and a written summary of the results for inclusion into the Global Climate Observing System Implementation Plan; and
- (iv) a summary publication of the multidimensional feasibility assessment of the marine biogeochemistry parameters necessary for inclusion into the FOO as EOVS.

After an initial pooling of experts and a period of collective work coordinated by IOCCP aimed at tasks (i) and (ii), the IOCCP (through funds received from the Global Ocean Observing System (GOOS)) organized an expert meeting, which was carried out in conjunction with the Biology and Ecosystem Panel meeting.

The First Technical Workshop of Biogeochemistry and Biology and Ecosystem Panels was held in Townsville, Australia on 13-16 November 2013. During this workshop, the GOOS Biogeochemistry Panel sought advice from technical experts to assist with tasks (iii) and (iv). Authors of the FOO specifically point out to the fact that a large part of the current global ocean observing system is driven by climate observing requirements. The reality is that there are more societal and scientific drivers for ocean observations than climate (and weather). Guided by the FOO, discussions about additional scientific questions and societal benefits that require sustained ocean observations were the first step in the EOF-defining process. The following three overarching requirements, each divided into two main questions, were agreed upon and became the baseline for further considerations:

1. The role of ocean biogeochemistry in climate
2. Human impacts on ocean biogeochemistry
3. Ocean ecosystem health

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In the second step, efforts focused on listing the necessary measurements needed to address each question. Unless specifically mentioned, during this phase the attention focused on the variable itself and not as much on the required frequency or resolution of each measurement. This aspect was the subject of considerations during the development of the EOV Specification Sheets (SS). The readiness of the measurement was also taken into account. The FOO specifically requires including all measurements considered critical, even those that are not feasible for implementation at the moment due to technical obstacles. By doing so, the FOO process seeks to trigger innovation by advocating development of technologies needed for the fit-for-purpose observing system. Also, no division between coastal and open ocean was made, as this aspect will also be reflected in the SS with regards to measurement frequencies, resolution, etc. Experts from modelling and observing communities were active throughout the process during this phase of the workshop. It is envisaged that the future EOV consultation process will also include both communities.

The assessment leading to the final list of 9 EOVs was based on the feasibility versus impact scoring and expert discussions and is described in the draft report available from IOCCP website. The FOO proposes assessing each EOV according to its readiness level in three categories: Requirements Processes, Coordination of Observational Elements, and Data Management and Information Products. All these, plus much more meta-data type of information divided into several subcategories, are included in the newly developed EOV Specification Sheet. Specification sheets for each Biogeochemical EOV are also available from IOCCP website: <http://www.ioccp.org/foo>.

Currently, IOCCP is in the process of implementing comments and requests from individual experts who responded to our call announced through our website, during the Town Hall meeting organized during the OSM'14 in Honolulu, USA, and during the Webinar given by Tanhua and Telszewski last June (fully recorded webinar with Q&A session is also available from our website). Very soon we will submit the proposed list of biogeochemical EOVs to several programs and panels for approval (e.g., GO-SHIP, CLIVAR, IMBER, SOLAS, IOCCG, GEOTRACES and more). Following the programmatic consultation phase, the GOOS Steering Committee will be asked to approve the final set and the GOOS-approved set of EOVs will be presented at the IOC General Assembly in 2015 for endorsement. At this stage the list will be “frozen” and updates will be performed every several years (to be specified).

### Publications (IOCCP SSG members in blue)

Bakker, D. C. E., [B. Pfeil](#), K. Smith, S. Hankin, [A. Olsen](#), S. R. Alin, C. Cosca, S. Harasawa, [A. Kozyr](#), Y. Nojiri, K. M. O'Brien, [U. Schuster](#), [M. Telszewski](#), B. Tilbrook, C. Wada, J. Akl, L. Barbero, N. Bates, J. Boutin, W.-J. Cai, R. D. Castle, F. P. Chavez, L. Chen, M. Chierici, K. Currie, H. J. W. De Baar, W. Evans, [R. A. Feely](#), A. Fransson, Z. Gao, B. Hales, N. Hardman-Mountford, M. Hoppema, W.-J. Huang, C. W. Hunt, B. Huss, T. Ichikawa, T. Johannessen, E. M. Jones, S. Jones, Sara Jutterstrøm, V. Kitidis, A. Körtzinger, S. K. Lauvset, N. Lefèvre, A. B. Manke, J. T. Mathis, L. Merlivat, N. Metzl, A. Murata, T. Newberger, T. Ono, G.-H. Park, K. Paterson, D. Pierrot, A. F. Ríos, C.L. Sabine, S. Saito, J. Salisbury, V. V. S. Sarma, R. Schlitzer, R. Sieger, I. Skjelvan, T. Steinhoff, K. Sullivan, H. Sun, A. J. Sutton, T. Suzuki, C. Sweeney, T. Takahashi, J.

Tjiputra, N. Tsurushima, S. M. A. C. van Heuven, D. Vandemark, P. Vlahos, D. W. R. Wallace, R. Wanninkhof and A. J. Watson. **2014**. An update to the Surface Ocean CO<sub>2</sub> Atlas (SOCAT version 2). *Earth System Science Data*, 6, 1–22, 6, doi:10.5194/essd-6-69-2014

Suzuki, T., [M. Ishii](#), [M. Aoyama](#), J. R. Christian, K. Enyo, T. Kawano, R. M. Key, N. Kosugi, [A. Kozyr](#), L. A. Miller, A. Murata, T. Nakano, T. Ono, T. Saino, K. Sasaki, D. Sasano, Y. Takatani, M. Wakita and C. L. Sabine. **2013**. PACIFICA Data Synthesis Project. ORNL/CDIAC-159, NDP-092. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee. doi:10.3334/CDIAC/OTG.PACIFICA\_NDP092

## Workshops and Meetings

**5<sup>th</sup> Session of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM)'s Observation Coordination Group (OCG), Silver Spring, MA, USA, 5-7 September 2013.**

Representatives of most observing networks forming the Global Ocean Observing System, as well as those serving operational needs of marine meteorology, reported on the status, issues and challenges for their particular network. This bi-annual meeting provides a platform for cross-fertilization as well as drawing interdisciplinary, multiplatform strategies. Particular issues discussed included (but were not limited to):

- Network status – measured against requirements with details of variables (scales, accuracies, application)
- Metrics - definition and implementation progress
- Standards and best practices (draft and documented)
- Evolution of network/new technologies/sensors
- Logistics and resource issues
- Capacity building opportunities/requirements
- Issues and challenges, ideas for integration, way forward

IOCCP continues to advocate the needs of biogeochemical measurements being implemented throughout the system. Many of the participating networks were developed with ocean physics and meteorology in mind, and it is crucial that the needs for interdisciplinary knowledge are explicitly expressed and actions are taken to gradually equate the proportion of observations made with specific disciplines in mind. All the meeting information including background documents and PowerPoint presentations can be downloaded from the meeting website: [http://www.jcomm.info/index.php?option=com\\_oe&task=viewEventRecord&eventID=1194](http://www.jcomm.info/index.php?option=com_oe&task=viewEventRecord&eventID=1194)

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### **First Technical Workshop of the GOOS Biogeochemistry and Biology and Ecosystem Panels, Townsville, Australia, 13-16 November 2013.**

Co-organized and co-funded by IOCCP (through its GOOS contribution), the First Technical Workshop for Biology and Ecosystem and Biogeochemistry Panels, Townsville, Australia on 13-15 November 2013 aimed at establishing an enhanced information base across the multidisciplinary (biology, biogeochemistry and physics) range of ocean system components, which is an essential contribution towards critical policy development and management decisions on ocean and coastal resource sustainability. The Workshop was co-sponsored by the European Commission FP7 Project ‘GEOSS Interoperability for Weather, Ocean and Water (GEOWOW)’; the Australian Institute for Marine Science (AIMS) and the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO).

The outcomes of this workshop were described in the FOO section above and in more detail in documents available from IOCCP website. It is worth adding that throughout the Workshop, GOOS Biology and Ecosystems and Biogeochemistry Panels’ cross-cutting issues were identified and there were some preliminary discussions about them in joint sessions of the two panels. Both Panels agreed that these issues require further discussion and integration to ensure synthesis between the two groups. This is especially the case with definition and monitoring of eEOVs associated with ‘ecosystem services’ and ‘habitats’. Some topics for joint discussion were identified and include the question ‘will changes in the ocean impact on habitats/trophic levels in general, or impact on the physiology of species?’ It would also be useful to facilitate collaboration between the Panels through some of the Candidate Pilot Projects.

In terms of modelling, the challenge for the GOOS Biology and Ecosystems Panel is to contribute the relevant biological variables for the Biogeochemistry models. In the past, the scarce biological information available has not been satisfactory for biogeochemistry models. There is the possibility that biological data may help better regionalise/localise the closure term for biogeochemistry models. However, the overall question remains for modellers to close the gaps between the requirements for both the biology and biogeochemistry needs. How this will be accomplished needs further discussion with the modelling community and representatives from both GOOS Biology and Ecosystems and Biogeochemistry Panels.

### **10<sup>th</sup> Plenary Session of the Group on Earth Observations (GEO-X) & GEO Ministerial Summit, Geneva, Switzerland, 15-17 January 2014.**

The IOCCP represented the interests of the marine biogeochemistry community at various negotiation tables that met during the GEO Plenary Session. Specifically the 2015-2025 GEOSS (Global Earth Observation System of Systems) Implementation Plan was negotiated and was initially (as well as historically) missing sufficient representation of the ocean biogeochemistry component of the Earth observing system of systems. Two-hour negotiations led to creation of a small ad-hoc working group tasked with reacting to this deficiency.

IOCCP was also a co-convenor of the Global Ocean Acidification Observing Network side event aimed at involving the GEO community in implementation of this important component of GOOS.

Finally, an EU Horizon 2020 session concentrating on ocean-related calls was held, followed by a meeting of a newly formed consortium (AtlantOS) aiming at proposing research and coordination answering to the appropriate call. IOCCP is involved in this proposal and seeks 2 years' funding for the Project Officer to complement the work of the Project Director, as it was the case before March 2012.

**17<sup>th</sup> biennial Ocean Sciences Meeting including IOCCP (co-) organized side meetings and side events, Honolulu, HI, USA, 22 February – 2 March 2014.**

The list of meetings with significant IOCCP involvement is rather long and it was indeed a very busy and productive period. In chronological order they were:

1. 9th Session of the IOCCP Scientific Steering Group, 22 February
2. Global Ocean Ship-based Hydrographic Investigations Program Panel Meeting, 23 February
3. 17th biennial Ocean Sciences Meeting, 23-28 February
  - a. IOCCP Town Hall Meeting on Biogeochemical EOVs, 25 February
  - b. GO-SHIP/IOCCP Town Hall Meeting on the Future of Repeat Hydrography Program, 26 February
  - c. Workshop on Nutrients Standards in Open Ocean Observing, 27 February
4. Global Ocean Observing System Executive Committee Meeting, 1-2 March

The first two meetings are described in separate reports in great detail. The Town Hall meeting on Biogeochemical EOVs was attended by more than 100 colleagues across disciplines and gave us an opportunity to provide the wider oceanographic community with a short status update on the tasks related to IOCCP's role in the FOO, but most importantly IOCCP sought community input on the EOV proposal drafted over the previous 3-4 months. Several specific questions were addressed and noted for further consideration and lively discussion moderated by Toste Tanhua clearly showed that the community is very interested in this topic. Audience members were invited to consult a draft EOV Report and 9 Specification Sheets, one for each proposed EOV, posted on IOCCP's website (<http://www.ioccp.org/foo>) and provide their input regarding any aspect of the exercise so that the FOO implementation becomes a truly open and transparent process through community consultations.

As for the other two town-hall sessions, IOCCP SSG members were directly involved in running/moderating discussions and IOCCP was mentioned on several occasions, but IOCCP did not sponsor them directly. Reporting on these should be sought from session organizers.

The GOOS Executive Committee includes 10 people (all chairs or executive officers of the 3 GOOS disciplinary panels and the GOOS SC itself). OceanObs'09 called for much more interdisciplinary GOOS and there are several challenges to this goal. This very focused meeting aimed at developing an interdisciplinary observing strategy for prompt implementation, addressing the challenges that often require changes in culture within disciplines, but are absolutely necessary for the efficient development of the multidisciplinary global ocean observing system.

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### **Global Ocean Acidification Observing Network Executive Council Meeting, Paris, France, 26–27 May 2014**

The effort of the Global Ocean Acidification Observing Network (GOA-ON) to develop the optimal observing system to detect ecosystem impacts of ocean acidification on various types of ocean ecosystems, and in the context of other stressors, started two years ago and this was the first meeting of the 11 (out of 17) members of the GOA-ON's Executive Council (Council membership: [http://www.goa-on.org/GOA-ON\\_Contacts.html](http://www.goa-on.org/GOA-ON_Contacts.html)). Further work is still needed to refine detailed protocols for relevant biological observations on a habitat- or region-specific basis. The potential scope for such observations is extremely wide.

International OA data sharing arrangements were proposed, based on defined data and metadata standards and open access to observing data, and will be disseminated throughout the community in the near future for consultation and approval. While the ocean carbon community has a relatively mature data-sharing process, it is recognized that the addition of coastal sites, as well as biological and ecological data to this framework will take time and effort to structure.

The GOA-ON website, <http://www.goa-on.org/>, has been finally developed (and discussed in detail during the meeting) to include the latest version of the interactive [map](#) of global ocean acidification observing activities. Future actions of the Network include facilitating additional measurement efforts in geographic areas of high concern, together with associated capacity building; strengthening of linkages with experimental and theoretical studies; maintaining and extending communications with the ocean observing community; establishing effective and quality-controlled international data management and data sharing, through distributed data centers; and encouraging the development of synthesis products based on GOA-ON measurements. All this will require that the Network secure the necessary level of support and resources to achieve these actions.

### **Surface Ocean CO<sub>2</sub> Atlas (SOCAT) Community Event Workshop 10 at IMBER OSC, Bergen, Norway, 23 June 2014.**

The participants discussed opportunities and challenges for SOCAT. Topics included:

- 1) Acknowledgements and credits for data providers and funding agencies,
- 2) Collaboration with the Global Carbon Project,
- 3) Measuring the success of SOCAT, and
- 4) Plans for SOCAT science.

One measure of success is that SOCAT has been cited or named in more than 38 peer-reviewed scientific publications (2014 – 15; 2013 – 18; 2012 - 2; 2011 – 1; 2010 – 1; 2009 - 1) and 3 book chapters (2014). This list of peer-reviewed, scientific publications will be made available on the SOCAT website. SOCAT data products are used for a variety of scientific studies, notably process studies, quantification of the ocean carbon sink, its seasonal, year-to-year and decadal variation and the initialisation and validation of ocean carbon cycle models. An example is the Surface Ocean pCO<sub>2</sub> Mapping Intercomparison (SOCOM). The OceanGHG Flux project

(<http://www.oceanflux-ghg.org>), a European Space Agency project, heavily relies on SOCAT. The Global Carbon Project used one data product based on SOCAT version 2 in its 2013 Global Carbon Budget and will use four such products for the 2014 Budget (Le Quéré et al., 2014). The Community Event updated SOCAT scientists on recent progress, welcomed new members, enabled discussion of SOCAT strategy and informed the SOCAT agenda for the next 24 months. The full meeting report will be available from SOCAT and IOCCP websites in early September.

## Project Office

### IOCCP Scientific Steering Group Meeting

The Ninth IOCCP Scientific Steering Group meeting was held on 22 February 2014, immediately preceding the 2014 Ocean Sciences Meeting in Honolulu, USA. Toste Tanhua (Chair) was joined by seven members of the SSG, the Project Director and three guests representing partner projects and organizations. Two SSG members could not attend the meeting; one joined by Skype. Updates on activities in nine themes coordinated by IOCCP were followed by discussion of the short- to medium-term future outlook within each theme. This session, focusing on activities presenting opportunities for IOCCP involvement through taking leadership or providing coordination to already existing structures, resulted in drafting of several action items to be implemented during the 12-15 months following the meeting.

IOCCP has secured enough funding pledges to organize its first ever Sensor Summer School, to be held in late Spring 2015 in Sweden. Bringing together 30 trainees and 10 teachers, the course is designed to enhance the global ocean observing system by training the next generation of marine biogeochemistry sensor users. Details will be soon announced through IOCCP website.

IOCCP has also agreed to take responsibility for international coordination of the Global Ocean Acidification Observing Network (GOA-ON). That includes co-hosting of the GOA-ON website and providing direction for the technical coordinator; leading the development of essential ocean variables for ocean acidification for biogeochemistry and supporting the development of essential ocean variables for ocean acidification for biology; and supporting OA data dissemination through the world ocean data centres. IOCCP will continue to support the SOCAT automation effort that will allow data generators to automatically submit and quality control their data, drastically increasing data submission promptness. Several modelling communities, including Global Carbon Project, expressed their interest in including quality-controlled surface ocean CO<sub>2</sub> data in assessments of the state of global climate such as Global Carbon Budget and climate projections as IPCC assessment reports and so on. Finally, IOCCP agreed to get involved in drafting of several technical publications regarding instrument installations, time-series data compilations and protocols and procedures related to usage of biogeochemical sensors. Full meeting report listing all the agreed actions and their justification will be available shortly on IOCCP website.

Finally, IOCCP will very shortly ask SCOR for approval of proposed changes in the project's SSG. Most of them come as standard rotations and a couple are dictated by member's shift of current scientific involvement.

## Future Directions

IOCCP will execute specific actions developed during the Ninth Session of the Scientific Steering Group (22 February 2013, Honolulu, USA). In addition, more general actions will be taken to meet new challenges dictated by changing needs of marine biogeochemistry community. During the course of the next year IOCCP priorities will include the following.

### **IOCCP Sensor Summer School**

In recent years, ocean technology has come to the aid of scientists by providing them with cost-effective tools that can take measurements of essential biogeochemical variables autonomously, for example, by sensors on autonomous platforms. These autonomous measurements are complementary to efforts carried out by traditional ship-based sampling, with the aim of improving data coverage worldwide. Yet, despite these options becoming more readily available, there is still a gap between the technology (investigators and technicians that deploy these technologies) and end-users. This results from a lack of training, lack of in-depth knowledge, and lack of community coordination. There is also a disconnect between data gathering by autonomous chemical sensors and data quality, which is a major obstacle as these sensors are already being deployed on autonomous platforms in several different projects in several ocean areas. Indeed, the Panel for Integrated Coastal Observation (PICO-I) pointed out that while some of the required technologies are mature, implementation on a global scale may be limited by lack of common standards and protocols and/or calibrated and validated algorithms for translating data into useful information.

To this end, the IOCCP will hold its first course on autonomous biogeochemical sensors, with the aim to promote and enhance the utilization of these sensors, and to teach users common best practices of use and data reporting. IOCCP is the ideal coordinating body to help organize such a course, as the key word in the current era is ‘global’. The need for such a course was identified by the scientific community, which felt that there exists an urgent necessity to address the usage of autonomous biogeochemical sensors to carry out time-series work, complement existing autonomous platforms, expand our current observational network, and ensure that the data being collected can serve both scientific and societal needs. While many biogeochemical parameters cannot yet be directly characterized to the accuracy and precision required for climate research, there are several autonomous sensor technologies that can measure some essential biogeochemical variables with the quality required, and they are mature enough to be implemented within regular monitoring platforms. These technologies include oxygen, sensors, nutrients, carbon dioxide and pH. There is also a need to integrate (and standardize) sensor methodologies, including quality control, data reporting and calibration protocols. A ‘global biogeochemical sensor network’, which fills the gaps that exist in ocean observing, is needed to understand changes in marine biogeochemical cycles and ecosystems. Such a network should be integrated with existing sampling programs so that it has the necessary synergy to make it useful to address current scientific objectives. Incorporating autonomous sensors into existing platforms that take regular, high-quality, discrete measurements (i.e., time-series stations) is also one approach to validation.

A Summer course on “Instrumenting our oceans for better observation: a training course on biogeochemical sensors” is being planned for May 2015 in Kristineberg, Sweden. A goal of the course will be to generate a “Best Practices” guide, which will provide easy-to-follow steps on

usage (including preparation, deployment, recovery and basic data reporting, processing and quality) of autonomous biogeochemical sensors. The guide will include topics such as:

- a. Essential instrument know-how (instrument communication, sensor data QC, biofouling prevention, etc.)
- b. User recommendations
- c. Site-specific recommendations
- d. Troubleshooting
- e. Data management, quality and reporting

Most (90%) of the funding (~85,000 USD) has been raised to cover the cost of the course. Selection of the scientific advisory committee (SAC) was finalized in May 2014. This should provide enough time for the development of course activities. In parallel, several instrument manufacturers have already been contacted and have responded with interest in participating in this activity. The course will be advertised in September 2014, and the selection of participants is expected to be announced by early January 2015, in order to provide enough time to obtain necessary travel documentation. The first draft of the ‘best practices’ report is expected to be completed by the end of summer 2015 and the final document to be available to the community by the end of 2015. Future planning on follow-on activities will occur after this date. More details can be obtained directly from the IOCCP Project Office.

### **Argo/GO-SHIP/IOCCP Joint Science Meeting**

The GO-SHIP and IOCCP Panels have suggested that it seems to be a good time to connect directly with the core Argo community and exchange scientific ideas, discuss challenges and potentially start a long-term collaboration leading to a better mutual understanding between those working with the technological aspects and those whose main motivation lies in answering scientific questions.

An ad-hoc meeting-organizing group was formed, consisting of representatives of all communities and including Toste Tanhua and Maciej Telszewski. A wider science advisory committee is being formed and will include several marine biogeochemist and modellers. Email discussions started in May 2014. Galway (Marine Institute, Ireland) was chosen as a venue for the meeting of this group. As for dates, the meeting will most probably be held during a week adjacent to that reserved for the SOLAS OSC (7-11 September 2015). Registration fee will cover the meeting costs and roughly 150 delegates are expected to attend.

The initial energy was spent on these basic logistics and the scientific program will be developed shortly. Some subjects of potential interest were already expressed and include the following:

- Synergistic science
  - Combining temporally sparse but exact along-track repeats (GO-SHIP) with spatially/temporally distributed data (Argo)
    - Use of Argo to inform representativeness of GO-SHIP
  - Analysis/uncertainty of WOCE/CLIVAR/GOSHIP cross-section transports Basin-scale inventories

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- Biogeochemical inventories (Bio-Argo, GO-SHIP, surface observations)
- Upper half of ocean volume (Argo)
- Lower half of ocean volume (Deep Argo and GO-SHIP)
- What is the ocean general circulation ?
- Calibration of Deep Argo data using GO-SHIP data
- Calibration of Bio Argo data (especially oxygen) using GO-SHIP data
  - Insights into Deep/Bio Argo design from analysis of GO-SHIP data
  - What is the signal? Time and space scales.
  - What is the noise?
  - What can we learn from the most frequently-repeated GO-SHIP lines?
  - Moored data may also be useful here.

### **Optimizing and Enhancing the Integrated Atlantic Ocean Observing System**

Searching for diversification of funding to bring the Project Office back to 2 FTEs, IOCCP became involved in a proposal answering the EU Horizon 2020 call for projects related to coordination and enhancing the ocean observations in the Atlantic Ocean. The proposed project called AtlantOS covers a wide range of topics and disciplines, including several directly related to the core mission of IOCCP. If successful, IOCCP will be able to employ a Project Officer for up to 3 years depending on the final level of EU support. Currently, AtlantOS has been the only remaining proposal invited to the second stage of evaluation. A final decision will be announced in November 2014.

Although the tasks listed below have to initially be regionally focused, their scope is by all means global and the idea is to apply newly developed procedures and ideas to the global coordination efforts. Similarly, we plan to apply already-tested tools to play our role in AtlantOS effectively.

The IOCCP committed to delivering results in four Tasks:

#### **Task 1: Identification of major scientific and societal challenges that require sustained ocean biogeochemistry variable observations in the Atlantic Ocean region.**

We will facilitate a formal and coordinated international dialogue between the observing community, the societal stakeholder community (representatives of policy-making entities across European administration with interest vested in marine environment) and the funders as to what ocean observing requirements for marine biogeochemistry exist in the Atlantic. The IOCCP will compile the available information on societal and scientific requirements for long-term observations assuring the sustained development of the human population within the region.

The observing system based on selected requirements has to provide information allowing sustained ocean services and improving our response capabilities to issues impacting human health and security. These requirements will also have to reflect the needs of the policy-making community so that information collected through observations will generate a strong evidence base for decision-making.

A coordination office will be tasked with developing a portfolio of online and in-person communication paths for all involved stakeholders. The end result for this objective will be a set of requirements allowing the European nations and other nations with vested interests in the region to fund biogeochemical observations, which tackle the greatest societal and scientific needs.

**Task 2: Identification of biogeochemical Essential Ocean Variables (EOVs) for the Atlantic Ocean observing system and multidimensional feasibility assessment of the observing system capabilities based on proposed EOV's and available infrastructure.**

Through consultation and negotiation with scientific and societal stakeholders, IOCCP will establish a set of biogeochemical Essential Ocean Variables (EOVs) needed to address the existing scientific and societal ocean/climate-related issues highlighted for the Atlantic Ocean.

In the process, we will consult with programmatic and institutional partners as well as representatives of all observing networks across the AtlantOS on their requirements for the spatial, temporal and resolution requirements. We will also gather information on national capabilities, aspirations and impediments within the EU and throughout other coastal states of the Atlantic region to identify gaps and opportunities.

Each observational network, and to some extent it is valid for national systems, supports the measurement of a range of variables with different time and space sampling resolution and accuracy, and intrinsic tradeoffs based on strategy and capacity. We propose to perform a multidimensional feasibility assessment of the proposed EOVs with observing, modeling and sensor/instrument developing communities involved. Such an assessment, built on the FOO recommendations, will allow establishing the current state of the Atlantic Ocean observing system for biogeochemistry and its fitness-for-purpose by highlighting duplications, gaps, cross-fertilization opportunities and more.

**Task 3: Coordination of technological improvements in the observing system elements and end-user training on the usage of new observing technologies**

We propose to aid the development and full integration of new technologies into the Atlantic Ocean observing system in two ways: first by coordinating the development of standards, best practices guides and data-quality protocols for new observing technologies for biogeochemistry and second by hands-on training of the European and Pan-Atlantic end-users to provide capability enhancement into the future.

There exists an urgent necessity to address the usage of autonomous sensors to carry out observations across a range of platforms and expand our current observational network, and ensure that the data being collected can serve both scientific and societal needs. It is imperative that an integrated Pan-Atlantic observing system is developed, one in which all nations, especially those less developed, are actively involved so that they directly contribute to and benefit from ocean observations.

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### **Task 4: Support for system optimization at the data and information flow level and the information production and delivery-to-user level.**

As the outputs of AtlantOS, data and information products will be the interface between our work and its users. Many modeling, data assimilation, synthesis, and assessment activities that will provide added value to observations have to meet specific user requirements for information. Ocean information products will have to support both research and decision-making in diverse areas such as climate studies and adaptation, disaster warning and mitigation, commerce, and ecosystem-based management.

There is a need to quantify and optimize how clearly and completely all biogeochemical EOV data sets compiled under AtlantOS are identified, described, and documented. In addition, we propose to develop data-usage metrics to reflect the level of demand for and breadth of uses for different data and information types. Such quantification will allow for improvements in data access, quality, and products. Such metrics, tested within AtlantOS, could then be promoted globally and become an integral part of the continuing cycle of assessing and updating the requirements, the measurement approaches and the data and information products themselves.

## 4.2 Southern Ocean Observing System (SOOS)



**SOOS**  
SOUTHERN OCEAN  
OBSERVING SYSTEM

### THE SOUTHERN OCEAN OBSERVING SYSTEM

### ANNUAL REPORT

### TO THE SCOR EXECUTIVE COMMITTEE

**2014**

The Southern Ocean influences climate, sea level, biogeochemical cycles and biological productivity on a global scale. Many of the most difficult and pressing issues faced by society—how to mitigate and adapt to climate change and sea-level rise, how to manage the effects of ocean acidification, and how best to conserve marine resources and biodiversity—cannot be addressed effectively without improved understanding of Southern Ocean processes and feedbacks and their sensitivity to change. The most urgent research challenges in the Southern Ocean often span traditionally separate scientific disciplines. The Southern Ocean Observing System (SOOS) provides the sustained, integrated, multi-disciplinary observations required to meet these challenges.

SOOS is a joint initiative of SCAR and SCOR, and is endorsed by POGO, WCRP-CLIVAR, and WCRP-CliC.

SOOS was officially launched in August 2011 with the opening of the International Project Office (IPO), hosted by the Institute for Marine and Antarctic Studies, University of Tasmania. A Scientific Steering Committee (SSC) of 16 international members oversees the strategic development and implementation of SOOS activities and products.

The SOOS Executive Officer presented SOOS activities to the SCOR Executive Committee at the November 2013 SCOR meeting in New Zealand. This report provides an update on activities from November 2013 until the end of May 2014. SOOS welcomes all comments and suggestions on the activities identified herein. All acronyms external to SOOS are defined in section 6.

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## 1. PROGRESS ON THE SOOS IMPLEMENTATION PLAN

### 1.1 Development of the SOOS 10-year Detailed Implementation Plan

During the first two years of SOOS, strategic activities were generally defined through a combination of needs outlined in the *Initial Science and Implementation Strategy* (see [www.soos.aq/index.php/products/soos-products?view=product&pid=1](http://www.soos.aq/index.php/products/soos-products?view=product&pid=1)), discussions at the annual SSC meetings, and development of work plans for each of the 6 SOOS Science Themes. Following the publication of the SOOS 20-year Vision ([www.soos.aq/index.php/products/soos-products?view=product&pid=19](http://www.soos.aq/index.php/products/soos-products?view=product&pid=19)) in 2013, we are now better placed to identify the trajectory of activities and products required to achieve our vision of an integrated, multidisciplinary and sustainable observing system for the Southern Ocean.

What is now needed is the development of an *Implementation Plan*, which will detail the required activities and products (both theoretical and in the field), and align these with a realistic timeline. This Implementation Plan must also articulate the funding and infrastructure requirements for the planned activities. A clear and realistic Implementation Plan, whilst remaining flexible, will prevent “mission drift”, provide continuity in direction and enable clear pathways of engagement for the scientific community.

The 2014 meeting of the SSC (sponsored by SCOR and SCAR) will focus almost entirely on the development of the Implementation Plan. It has become clear over the last year, that much of SOOS activities thus far have focussed on addressing gaps in the scientific priorities and knowledge. However, these activities are secondary to the key objective of SOOS, which is to design an observing system and enhance current observation efforts. The SOOS Executive Committee will be asking the SSC to identify key activities that are needed to focus our efforts towards observing system design and enhance field activities, and will also suggest a new governance structure that is required to facilitate and coordinate implementation of the plan.

It is intended that the draft Implementation Plan will be available from the SOOS website by the end of 2014. SOOS will be inviting feedback from its sponsors and endorsers following the development of this plan, following which SOOS may seek publication of the proposed Implementation Plan for exposure to the international research community.

### 1.2 Southern Ocean Air-Sea Fluxes Initiative

At the 2013 SSC meeting in China, the SSC identified air-sea fluxes (across all disciplines and systems) as being a priority gap in Southern Ocean observations. As a first step towards addressing this issue, SOOS has identified an international core group of people to help define the objectives of the initiative and to organise a workshop.

The Organising Committee comprises Sarah Gille (Chair, Scripps, USA), Alberto Naveira Garabato (NOC, UK), Mark Bourassa (FSU, USA), Eric Schulz (BOM, Aus), Simon Josey (NOC, UK), Matthew Mazloff (Scripps, USA) Hiroyuki Tomita (JAMSTEC, Japan), Andrew

Lenton (CSIRO, Aus), and Carol Anne Clayson (WHOI, USA).

The workshop objectives are to:

- 1) Consolidate information concerning the current state of air-sea flux observing efforts in the Southern Ocean;
- 2) Discuss where the critical gaps are and what current and emerging technology may be used to address the gaps'
- 3) Discuss synergies between the in-situ data, satellite data and modelling communities, and how such synergies can be better exploited to mutual benefit; and
- 4) Develop a realist strategy for improving key flux measurements on a range of time scales.

Still in the planning stage, this workshop will likely take place in Europe in Spring 2015. Initial discussions are taking place with SOLAS and CliC to identify common interests. The organising committee is in the process of identifying a potential host, as well as additional funding and sponsorship for the workshop. At present, the two likely locations include Bern, Switzerland (if funding is sought from the International Space Science Institute), or in Kiel, Germany (if funding is sought through SOLAS from GEOMAR). The SOOS IPO currently plans to contribute 10,000 AUD towards this workshop, although this is dependent on continuation of existing IPO sponsorship in 2015.

All information on this initiative, including a link to download the workshop prospectus, is available from the SOOS website ([www.soos.aq/index.php/science/air-sea-fluxes](http://www.soos.aq/index.php/science/air-sea-fluxes)).

### **1.3 Satellite Data Initiative**

Satellite data products are an integral component of SOOS and our requirements for data are only going to increase through time. In 2012, the WMO Polar Space Task Group ([www.wmo.int/pages/prog/sat/pstg\\_en.php](http://www.wmo.int/pages/prog/sat/pstg_en.php)) contacted SOOS and highlighted that they needed to hear a strong, consolidated user voice to ensure that Southern Ocean remote-sensing requirements are being met and incorporated into strategic planning of future missions.

In addition to this, at the 2012 and 2013 SSC meetings, it was apparent that there are many issues with accessing satellite data and understanding what data are available, as well as many significant issues with calibration and validation of Southern Ocean satellite data.

In order to address the above-mentioned issues, SOOS has instigated the development of a Southern Ocean Satellite Data Initiative.

The objectives of this initiative are to:

- 1) Identify existing and planned Southern Ocean satellite data products and to make this information known to the greater scientific community.
- 2) Identify new products that could be produced from existing data (e.g., improved

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- algorithms and byproducts).
- 3) Communicate SOOS data requirements to data providers (including long-term requirements) with one, consolidated user voice.
  - 4) Enhance satellite data validation efforts.

In March 2014, SOOS joined CliC and the WMO PSTG and invited the Southern Ocean community (science, logistical, etc.) to contribute to a survey on Southern Ocean Satellite Data Requirements. This survey will provide an avenue for users to articulate their requirements (across all disciplines and spatial/temporal scales) and the results will be compiled into a Community Report that will be submitted to WMO PSTG as the consensus view on our data requirements. The survey closes 30 May 2014. The SOOS IPO is in the process of hiring someone with satellite data expertise to compile this information. We are expecting a draft of the report to be available from the SOOS website by the end of 2014.

For more information on this initiative, and for a link to the survey, visit the SOOS website ([www.soos.aq/index.php/science/satellite-data](http://www.soos.aq/index.php/science/satellite-data)).

### **1.4 Identification of Essential Ocean Variables (EOVs) and Ecosystem Essential Ocean Variables (eEOVs)**

A key objective of SOOS is the design of a multidisciplinary and sustainable observing system. As a first step towards this objective, we need to select those parameters, or Essential Ocean Variables (EOVs), that will provide us with the information needed to detect, track and attribute (either directly or using models) change in the physical, biogeochemical and biological systems of the Southern Ocean.

EOV activities of the last year have focussed predominantly on identification of ecosystem Essential Ocean Variables (eEOVs) (for details of other EOV activities see section on Collaborative Activities). In 2013, SCOR led SOOS's successful proposal to ICSU for funding for a workshop on *Identifying ecosystem Essential Ocean Variables for measuring changes in marine ecosystems*. As reported to SCOR EXCOM in Nov. 2013, this globally focussed workshop was modified to focus solely on the Southern Ocean in an effort to avoid duplication with the GOOS Biology Panel activities.

The workshop was hosted by Oscar Schofield (SOOS Co-Chair) of Rutgers University in March 2014. Nearly 30 international scientists attended, and invitations were extended to representatives of GOOS, the GOOS Deep Ocean Observing System (DOOS), U.S. Integrated Ocean Observing System, IOCCP, IOCCG, GEO BON, IndiSeas, SCOR, SCAR, CCAMLR, Palmer LTER, US AMLR, IMBER and APECS, although not all could attend.

Significant preparation occurred prior to the workshop to develop a process that the community could agree was the correct path for firstly identifying the candidate eEOVs, and then prioritising them. The process designed by the Framework for Ocean Observing and the outcomes of the GOOS Biology Panel were used as a basis for this work. Key outcomes of the workshop were highlighted in the official report to ICSU (which will be made available on

the SOOS website at [www.soos.aq/index.php/science/ecosystem-variables](http://www.soos.aq/index.php/science/ecosystem-variables)) and include a community-agreed definition of an eEOV, an agreed level for eEOVs within the hierarchy of ecosystem properties, identification of the overarching ecosystem parameters that the eEOVs should address, and some key examples of candidate eEOVs.

The workshop participants are currently expanding the list of candidate eEOVs. In parallel, SOOS has submitted a SCOR Working Group proposal to support the next steps in the process; using the defined candidate eEOVs to design a Southern Ocean biological observing system.

## **1.5 National Activities and Capabilities Initiative**

A key issue highlighted by the SSC during the 2013 SSC meeting is that we do not have a good understanding of the observations that are being collected routinely by all nations (at sea and from Antarctic bases). This then, makes it difficult to properly identify gaps. We also do not have a clear picture of the funding structure and process across all Southern Ocean nations, the research infrastructure and capabilities of nations, the key data repositories and policies, the dominant shipping tracks, and the strategic science plans for their Southern Ocean research. In addition to this, many nations have fishing fleets that regularly fish the Southern Ocean, and in some cases nations also must undertake fish stock monitoring surveys for CCAMLR reporting. This information is important because fishing vessels are potential opportunistic observation platforms.

This initiative will compile information on national capabilities and activities and produce a user-friendly, Web-based product that will enable all users to search and identify national efforts. It will utilise the existing communities of CCAMRL, COMNAP, POGO, SCAR and SCOR to gather the information, and will also likely be an important information source for these communities. It is hoped that such information can be used by researchers in the planning of research proposals, and will enable greater cross-utilisation of national infrastructure and capabilities.

Actions on this product so far have been preparatory in nature. The IPO has outlined the requirements for the product, worked to secure financial support for its production, and identified an appropriate person to carry out the work. Some information relevant to this product has already been collected through the SOOS Asian workshop and resulting publications. This initiative will officially start in July 2014. SCOR has provided funds to enable SOOS to produce this product. Where possible, open-source visualisation tools and in-kind IT support will be used to display the information online. The information will be compiled by Dr. Tom Remenyi from the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC, Hobart, Australia), who will be contracted by SOOS to produce this product.

More information will be available on this initiative on the SOOS website under “Activities”, after it has officially started.

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## **1.6 Under Ice Initiative**

A workshop was held on this initiative in 2012, but activity has stalled mainly due to the lack of time that the leaders have to put towards it. However, over the last year they have been working on development of the Under Ice Strategy, which was presented to the SOOS SSC at the June 2014 SSC meeting.

See [www.soos.aq/index.php/science/under-ice](http://www.soos.aq/index.php/science/under-ice) for more information.

## **1.7 Standardised Methods and Protocols Initiative**

Multiple methods can be used when measuring or monitoring ocean variables and parameters. However, not all methods produce observations that are equal in quality and precision, and variability in methods can lead to significant comparability issues. For measurement of many variables, international standards and protocols exist, but this information can be difficult to access and is widely distributed across many websites. In many cases, users are unaware that standards exist.

The objective of this initiative is to compile all available internationally agreed standards and make the information easily accessible. During this process, any observations that do not have a consensus standard methodology will be identified, and the requirements for developing standards will be assessed.

Action on this initiative has been preparatory. Funds have been provided by SCOR to produce this product, and the SOOS IPO has outlined the requirements for the product and identified an appropriate person to carry out the work. This initiative will officially begin in July 2014, and in-kind support of any additional production costs (e.g., website programming) will be sought. Dr Tom Remenyi (ACE CRC) has been hired to carry out this work.

More information will be available on this initiative on the SOOS Website under “Activities”, after it has officially started.

## **1.8 Priority Observations Task Group**

The Priority Observations Task Group (PO-TAG) is being coordinated by Tosca Ballerini, the APECS representative on the SOOS SSC.

The objective of PO-TAG is to identify the observations that are critically lacking in the Southern Ocean, and highlight those that could be made quickly/cheaply underway on ships (and hence could in theory be done from tourist ships, resupply ships as well as research ships), or from, for example, small inflatable boats deployed from coastal Antarctic stations. This information will be useful to nations seeking to leverage more effort from their existing operations and make more significant contributions to SOOS without necessarily increasing infrastructure.

Since November 2013, numerous observation communities and experts in the fields of physics, biogeochemistry and biology have been contacted for their input on this product.

A spreadsheet of information is currently being compiled and includes information on key observations of sea ice, ice shelves, carbon, water properties, and the biology of plankton, top predators and benthic organisms. As expected, it has been easier to identify priority measurements for physics and biogeochemistry than for biology. At the Rutgers workshop on eEOVs for the Southern Ocean, it was suggested that PO-TAG should create an online survey to solicit input from the greater biological Southern Ocean community on what and how to measure biological parameters. The members of PO-TAG will discuss the merits of this survey over the coming months. The SOOS IPO and PO-TAG will also discuss the most effective way to visualise the information collected.

### **1.9 Data Management Sub-Committee**

The SOOS Data Management Sub-Committee (DMSC) comprises 14 international members who represent various topical and national data centres ([www.soos.aq/index.php/data/dmsc](http://www.soos.aq/index.php/data/dmsc)). Dr. Kim Finney (AAD, Australia) was an SSC member and DMSC chair from 2012 until March 2014, when she rotated off due to new work commitments. Steve Diggs (CCHDO, USA) has been a member of the DMSC since 2012, and was approved in early 2014 by the SOOS EXCOM to replace Kim Finney on the SSC and DMSC Chair.

As reported in 2013, SOOS has been working with the NASA GCMD to develop a Metadata Portal. This is currently in beta testing phase and will hopefully be officially released before Autumn 2014. In addition to the testing of the portal, the release date is dependent on the development of the Metadata Portal Cookbook (see also section 3.2), which is presently in planning phase.

The SOOS data Web pages are overdue for a significant update and this will be coordinated by Diggs and his team at CCHDO. This will include a more dynamic supply of links and information on Southern Ocean data repositories. We are in the final stages of securing an agreement with NSF (funders of CCHDO) for in-kind support of IT and programming help to develop and maintain data components of the SOOS website and advance other areas where possible.

Steve Diggs and the SOOS IPO have recently organised the 2<sup>nd</sup> DMSC meeting, which will be held alongside SCAR in Auckland, on 29-30 August 2014 (see also section 4.3). This workshop will be hosted and sponsored by the National Institute for Water and Atmospheric Research (NIWA) and the SOOS IPO will contribute funds to cover travel costs of attendees.

### **1.10 Collaborative Activities**

There are many international organisations and programmes of relevance to SOOS Objectives; where possible, SOOS works with these communities in the organisation of activities and delivery of products.

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## ***SOOS/COMNAP Task Group***

As reported in the 2013 report to SCOR, SOOS was invited by the Council of Managers of National Antarctic Programs (COMNAP) to hold a workshop at its annual meeting. The objectives of this workshop were to identify collaborative projects that SOOS and COMNAP could work together on. Following a very successful workshop, SOOS and several COMNAP members put forward a proposal for a several activities to the COMNAP EXCOM. Unfortunately, none of the proposed activities were approved.

Following this, COMNAP has developed a Task Group comprising national representatives who are interested in working further with SOOS. This Task Group is being led by Rob Wooding (AAD, Australia). Although several meetings have taken place between Rob and the SOOS Executive Officer, no proposed actions have progressed.

SOOS will continue to communicate activities and requirements to COMNAP and the Task Group, as COMNAP represents an important community, particularly with regard to future planning of logistics and infrastructure for the SOOS Pilot Study. COMNAP will also be an important community to include in the development of the National Capabilities and Activities product (see section 1.5).

## ***POGO***

In 2013, SOOS was invited to hold a workshop alongside the POGO Annual Meeting in Hobart, Australia (Jan. 2014). Given the potential of POGO members to allocate the resources and support of their institutes, SOOS developed a workshop that was focussed on identifying specific actions for POGO institutes to become more involved in SOOS. We proposed that POGO institutes work with SOOS to develop a multi-national funding bid on one of two field initiatives. Although supportive in principle, POGO members did not commit their institutes to developing a funding proposal.

Several proposed Action Items were approved and are outlined below:

- A) 2.1.1.** Sustain Action Item 7 from POGO-14 and support the growth of the SOOS Metadata Portal. Action: POGO members.
- B) 2.1.2.** Work with SOOS, ODIP, COMNAP, JCOMMOPS to coordinate the various ship schedule databases; support population of the ODIP shipping database with information on Southern Ocean activities. Action: Secretariat and Executive Committee.
- C) 2.1.3.** Provide POGO endorsement for the Southern Ocean Carbon and Climate Observations and Modelling (SOCOM) project. POGO Members encouraged to take part in the project by deploying additional floats with biogeochemical sensors in the Southern Ocean. Currently, only USA, UK, Australia, Argentina, Brazil, South Africa and Switzerland participate. Action: Chair to write letter of support. Members to investigate potential participation in the project.

SOOS is in the process of following up these Action Items with POGO and the relevant communities.

### **CCAMLR**

SOOS has a strong connection to the Convention for the Conservation of Marine Living Resources (CCAMLR). Andrew Constable (SOOS Vice Chair) is an Australian representative to CCAMLR, and the Executive Officer regularly meets with Keith Reid (CCAMLR Science Officer) to discuss collaborative activities.

In 2013, CCAMLR was involved in the development of candidate eEOVs and supported Keith Reid to attend the SOOS eEOV workshop in the United States. In addition to this, the SOOS Executive Officer met with Andrew Wright (CCAMLR Executive Secretary) to discuss CCAMLR contributions to the SOOS Satellite Date Requirements survey (See section 1.3). Also discussed was the potential for joint CCAMLR/SOOS projects through the “Antarctic and Southern Ocean Internship” as part of the Masters programme at IMAS, University of Tasmania.

### **IAATO**

The use of tourist vessels as platforms for collecting observational data has great potential. SOOS has plans to work with the International Association of Antarctic Tourist Operators (IAATO) to identify mechanisms by which this might be achieved. It is expected that once SOOS has moved further forward in the design of an observing system, we will be better placed to prioritise and *quantitatively* articulate our requirements.

In 2014, SOOS SSC member Dan Costa initiated discussions with IAATO, specifically on identifying tourist activities in the Antarctic Peninsula region.

### **GOOS, DOOS, OOPC**

Several international initiatives are starting to address the issue of identifying EOVs. SOOS is working with those communities, where possible, to avoid duplication. For example, GOOS and IOCCP recently held a workshop to identify candidate EOVs for biogeochemical systems. Several SOOS SSC members were present at this meeting and it is intended that over the course of the next year, SOOS will use the GOOS outcomes to define biogeochemical EOVs specific to the Southern Ocean. SOOS also intends to, where possible, work with OOPC in the identification of physical oceanographic EOVs (although there has been no activity to report on as yet). Further, the GOOS Deep-Ocean Observing System (DOOS) is being developed and, where relevant, SOOS will work with this community to achieve complementary objectives. A DOOS representative also attended the SOOS eEOV workshop.

### **ODIP**

The Ocean Data Interoperability Program (ODIP) is an international initiative to contribute to the removal of barriers hindering the effective sharing of data across scientific domains and international boundaries.

Roger Proctor (SOOS DMSC) made SOOS aware of this initiative in early 2013. As a key product of ODIP, they will be “Establishing deployment and interoperability between Cruise Summary Reporting systems in Europe, US, and Australia, making use of GeoNetwork, towards interacting with the POGO portal.”

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SOOS has plans to work with ODIP to develop a Southern Ocean component to the Cruise portal. This was highlighted at the January 2014 POGO SOOS workshop and although action has more recently stalled on this, it is hoped it will be reinvigorated at the upcoming DMSC meeting.

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## 2. OTHER ACTIVITIES

### 2.1 Communication Activities

#### *Website*

The SOOS website ([www.soos.aq](http://www.soos.aq)) was developed in early 2012 and was based almost entirely on the SOOS *Initial Science and Implementation Strategy*. Since this time, the direction and focus of SOOS has been clarified and activities have developed, so the website structure and content is outdated. The SOOS Executive Officer is in the process of a complete overhaul of the structure and content of the website, in order to provide better information on activities and products and details on how the community can be involved. SOOS encourages everyone to provide feedback on the website to ensure it stays up to date and relevant.

#### *Newsletter*

In 2013, SOOS developed a new digital newsletter (see Resources on SOOS website), which updates the SOOS community on all IPO and SOOS activities and products. Where possible, we also obtain short articles from endorsed projects, and other relevant international programmes to keep our community informed of broader activities. The newsletter is generally produced quarterly. One issue has been produced since the last report to SCOR; the second issue for 2014 will be published in the second week of June.

#### *Publications*

Two SOOS publications have recently been accepted for publication in the journal *Advances in Polar Science*. These publications are the key outcomes of the 2013 SOOS Asian Workshop:

- 1) Swart, S. et al., in press - *Advances in Polar Science: The SOOS Asian Workshop: Exploring possibilities for collaboration.*
- 2) Liu, J. et al., in press - *Advances in Polar Science: The SOOS Asian Workshop on Southern Ocean research and observations.*

#### *Meetings*

The SOOS Executive Officer has represented (and presented) SOOS at several international meetings since Nov 2013:

- POGO Annual Meeting (Jan. 2014, Australia)
- POGO Communications Workshop (Jan. 2014, Australia)
- Australian Meteorological and Oceanographic Society Conference (Feb. 2014, Australia)

- Ocean Sciences Meeting (Feb. 2014, USA)
- Sea Ice Symposium (Feb. 2014, Australia)
- IMOS Annual Planning meeting (Feb. 2014, Australia)
- International Programme of Antarctic Buoys (IPAB; Mar. 2014, Australia)
- SOOS eEOV Workshop (Mar. 2014, USA)

Upcoming meetings include the SOOS SSC meeting (Norway, June 2014), the SCAR Open Science Conference (NZ, August 2014), the SCAR Delegates Meeting (NZ, August 2014), and the SOOS DMSC meeting (NZ, 29-30 August 2014).

SOOS SSC members have also represented SOOS at several other international meetings. The official list will be compiled at the upcoming SSC meeting in June 2014.

## **2.2 Reports**

SOOS was asked by SCAR to provide a report on recent activities to the 2014 Antarctic Treaty Consultative Meeting. Mike Sparrow from SCAR will present the SOOS report. SCOR will be notified (through the SCAR Secretariat) of any issues or comments of relevance raised by ATCM members.

SOOS will also prepare a report for presentation at the 2014 CCAMLR meeting, as it has done in previous years.

## **2.3 Endorsed Projects**

SOOS provides endorsement for individual research projects, large national and international research projects, national and international collaborative and coordination programmes, and data management initiatives.

SOOS has endorsed two research projects since November 2013: A joint project between Korea and Sweden “Towards an improved heat budget for the floating glaciers in Antarctica”, and another multi-national project titled “The compact-Polar Optical Deployment System (C-PODS)”. More details on these and other endorsed projects are available from the SOOS website at [www.soos.aq/index.php/science/endorsed-programmes](http://www.soos.aq/index.php/science/endorsed-programmes)).

## **2.4 Sponsorship Prospectus**

SOOS needs to increase its sponsorship base, not only for direct funding of the IPO, but also in-kind support (e.g., of personnel and experience), and short-term funding of activities such as workshops) or products. SOOS also needs a mechanism by which it can acknowledge institutes, organisations or programmes that contribute with field efforts so that they themselves identify as direct contributions to SOOS (e.g., SOCOM).

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In early 2014, SOOS was contacted by David Carlson, Chief Editor of the journal *Earth System Science Data*. David was interested in contributing his time to help further SOOS in whatever way required. Due to his extensive experience in developing processes and avenues for sponsorship and support (through his previous position as International Polar Year Executive Director), David is now helping SOOS to develop a Sponsorship Prospectus that will highlight the rationale for supporting SOOS, clearly articulate the benefits, and encompass a multitude of support structures available to institutes and organisations. Since agreeing to help produce this product, David has been offered the WCRP Executive Director position. It is yet to be discussed how his new position may affect his capacity to provide support for this product development.

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## **3. MANAGEMENT, GOVERNANCE AND FUNDING**

### **3.1 IPO Support and Sponsorship**

#### ***IPO Hosting***

The International Project Office (IPO) is hosted and sponsored by the Institute for Marine and Antarctic Studies (IMAS) of the University of Tasmania. This hosting includes Executive Officer salary, office on-site costs, and an annual contribution to office running costs. Hosting of the IPO is contracted until mid-2016.

#### ***IPO Sponsorship***

The IPO relies on annual sponsorship to provide the financial support for all office costs and IPO activities. In 2013-2014, the following organisations sponsored the IPO: Australian Antarctic Division (AAD), Antarctica NZ/NZ Antarctic Research Institute, and IMAS. The AAD has been severely affected by government funding cuts and it is unclear whether they will be able to support the IPO for the 2014/2015 financial year.

#### ***In-Kind Support for IPO***

SOOS receives in-kind support for various activities/services. The Australian Integrated Marine Observing System (IMOS) has provided in-kind office support (e.g., printing, fax, general office supplies) since 2011. Several organisations contributed in-kind sponsorship for the first time in 2013/2014:

- Tasmanian Partnership for Advanced Computing (TPAC) agreed to provide 1.5 weeks/year website programming support.
- Department of Economic Development, Tourism and the Arts, Tasmanian Government provided 3 months administration/workshop organisation support (Dec.–Mar.)
- The University of Gothenburg is providing support for a portion of Anna Wåhlin's time to be dedicated to SOOS for the duration of her appointment as Co-Chair.
- NSF has recently agreed to provide up to 1 month programming and IT support for the SOOS website and other activities, coordinated through Steve Diggs (SOOS SSC member) at the CLIVAR and Carbon Hydrographic Data Office (CCHDO, USA)

The SOOS IPO is working continuously to increase support for the IPO. Discussions are taking place as outlined below:

- IMOS may soon also provide in-kind Finance Officer support to take care of all financial administration duties for the IPO.

Although in-kind support is very useful to the IPO, it is imperative that we have continuation and if possible, growth in the existing levels of direct financial support. To this end, the IPO is developing the Sponsorship Prospectus (as outlined above under Other Activities). All information on sponsorship is available at [www.soos.aq/index.php/about-us/sponsors](http://www.soos.aq/index.php/about-us/sponsors).

### **3.2 Additional Sources of Funding**

SOOS has obtained additional funding to cover the production costs of several key products that would either take a considerable length of time for the SOOS IPO to produce, or would simply not get produced. SCOR has been the major supporter of these products.

#### ***Metadata Portal Cookbook (Product funded by SCAR/SCOR)***

Due to the significant level of support provided by the Chinese hosts, the 2013 SOOS SSC meeting did not use all the funds allocated to it by SCAR and SCOR. The remaining funds (3000 USD) have been redirected to support production of the SOOS Metadata Cookbook – an instruction booklet that provides detailed information to data providers on how to contribute to the Metadata Portal (which is hosted by NASA GCMD). SOOS IPO has identified an experience data manager (Dave Connell, AAD Australia) to develop the cookbook. Steve Diggs (SOOS DM Chair) is currently working to identify requirements for this cookbook and to communicate these to Connell. He will provide a quote for the work to SOOS IPO and SCOR, and following approval of this Connell will start development of the cookbook.

#### ***National Capabilities and Activities (Product funded by SCOR)***

As outlined above in section 1.5.

#### ***Standardised Methodologies (Product funded by SCOR)***

As outlined above in section 1.7.

#### ***Report of Southern Ocean Satellite Data Requirements***

Outlined above in section 1.3. SOOS is in discussion with SCAR as potential contributors of funds for delivery of this report. The SOOS IPO will cover any remaining costs from the IPO budget.

### **3.3 IPO Office Staff Changes**

Since 2011, the SOOS IPO has been located at the main University of Tasmania campus with the Integrated Marine Observing System (IMOS). At the end of 2013, the SOOS IPO moved to the newly built IMAS building on Hobart's waterfront. SOOS is now co-located with IMAS

staff and students, IMOS, and the ACE CRC.

In 2013, the IPO hired a communications officer on a casual basis for 4 hours a week, to take care of day-to-day communications activities and to undertake activities such as the website update. Unfortunately, the person hired was ineffective and is therefore no longer employed by SOOS. The IPO is presently considering whether to hire someone else to cover these activities.

## **3.4 Annual Reports to Sponsors**

As part of its hosting by IMAS, SOOS provides monthly written reports to IMAS, and also meets monthly with the IMAS Deputy Director, to report on activities and discuss plans. These reports are not available online, but can be made available by request. Although frequent, the written reports are brief and the in-person meetings are very useful in ensuring SOOS remains visible and relevant to IMAS.

A SOOS report to SCAR is being prepared and will be presented by the Executive Officer at the upcoming SCAR Delegates Meeting in August 2014.

## **3.5 Scientific Steering Committee Membership**

### ***Changes to SOOS Executive Committee***

From 2011–Dec. 2013, SOOS was led by two Co-Chairs; a physical science co-chair Mike Meredith (BAS, UK) and a biological sciences co-chair Oscar Schofield (Rutgers, USA). In January 2014, Mike Meredith stepped down from co-chair position due to new work commitments (he remains an SSC member). Anna Wåhlin (Gothenburg University, Sweden) was elected by the SSC (and approved by SCAR and SCOR) to replace Mike Meredith as physical sciences co-chair.

During this process, it became apparent that SOOS needed greater continuity in leadership. It was agreed that a Physical Sciences Vice Chair and Biological Sciences Vice Chair would also be elected. The Vice Chairs would also be represented on the Executive Committee and would automatically become the next Co-Chairs. Sebastiaan Swart (CSIR, South Africa) and Andrew Constable (AAD, Australia) were voted in as the Physical and Biological Vice Chairs, respectively.

### ***Changes to existing SOOS SSC membership***

SOOS is presently led by an SSC of 16 international members (representing 10 different countries), nearly all of whom are founding members. SSC membership is for a maximum of two 3-year terms, with the second term being on invitation from the Executive Committee, subject to approval by SCOR and SCAR. Because nearly all existing members started at the same time, the second term of inaugural members will vary, in order to stagger the off-rotation of members and prevent a mass exodus in 2017. In April 2014, existing SSC members were asked to consider how many years they would like their second term to be (0–3) and enough

early rotations were obtained to ensure an appropriate rotation scheme. The structure has been approved by SCOR/SCAR.

#### ***Call for Nomination of New SSC Members***

In early 2014, SOOS announced a call for nominations for new SSC members. Specifically, SOOS wanted nominations for new members with expertise in a) Ocean-Ice sheet interactions, b) Cyberinfrastructure and C) Data Assimilation. New positions could potentially be made on the committee to incorporate this expertise.

In addition to this, SOOS selected new members to replace existing members who will rotate off at the end of this year.

Sixteen nominations were received from scientists working in 9 countries. New members will not begin their official term on the committee until the beginning of 2015. SCOR and SCAR approved Matthew Mazloff (Scripps, USA) Jean-Baptiste Sallee (CNRS, France) Mike Williams (NIWA, NZ) SangHoon Lee (KOPRI, Korea)

*Table 1: Dark blue represents current year, 1 = first term, 2 = second term.*

Name	Country	2012	2013	2014	2015	2016	2017
Bronte Tilbrook	Australia	1	1	1			
Steve Rintoul	Australia	1	1	1			
Angelika Brandt	Germany	1	1	1	2		
Alberto Naveira Garabato	UK	1	1	1	2	2	
Jiping Liu	China	1	1	1	2	2	
Steve Ackley	USA	1	1	1	2	2	
Parli Venkateswaran Bhaskar	India	1	1	1	2	2	2
Dan Costa	USA	1	1	1	2	2	2
Michael Meredith	UK	1	1	1	2	2	2
Anna Wåhlin (Co-Chair)	Sweden	1	1	1	2	2	2
Oscar Schofield (Co-Chair)	USA	1	1	1	2	2	2
Mauricio Mata	Brazil	1	1	1	2	2	2
Sebastiaan Swart (VC)	S. Africa	1	1	1	2	2	2
Steve Diggs	USA			1	1	1	
Andrew Constable (VC)	Australia			1	1	1	
Matthew Mazloff	USA			1	1	1	
Jean-Baptiste Sallee	France			1	1	1	
SangHoon Lee	Korea			1	1	1	
Mike Williams	NZ			1	1	1	

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## 4. PLANNED FUTURE ACTIVITIES

[NOTE: SOOS annual activities are generally defined at the annual SSC meetings. Therefore, many of the future activities will be decided at the upcoming meeting in June.]

### 4.1 SOOS Scientific Steering Committee Meeting

The 2014 SOOS SSC meeting was held in Tromso, Norway (18-20 June), hosted by the Norwegian Polar Institute. The majority of the meeting was focussed on planning and development of the SOOS Implementation Plan, reporting of national and scientific activities, discussions on sponsorship and funding, and clarification of SOOS governance and the roles of the Executive Officer and SSC members.

The minutes from this meeting will be available online by the end of August (see [www.soos.aq/index.php/about-us/ssc/meeting-minutes](http://www.soos.aq/index.php/about-us/ssc/meeting-minutes)). Ed Urban attended this meeting to represent SCOR.

SCOR and SCAR are providing funds to support the travel of SSC members to this meeting. Initial estimates of the cost for this meeting were underestimated mainly due to a large national event being held in Tromso at the same time as the meeting, which has significantly increased the costs of accommodation and within-Norway airfares. Because of this, the SOOS IPO will contribute between 5,000–10,000 AUD towards the meeting.

### 4.2 Implementation Plan

The most important activity planned for the 2014/2015 year is the development and publication of the SOOS Implementation Plan. Many of the details of this plan will be scoped during the June SOOS SSC meeting. The report will be made available in its entirety as a document in pdf format, and also as separate activities and timelines on the SOOS website. The activities identified in the Implementation Plan will form the basis of the large majority of actions for 2014/2015.

### 4.3 SOOS Activities alongside SCAR Open Science Meeting

The SOOS Executive Officer and several SSC members will be attending the SCAR Open Science Meeting.

#### *SOOS Biology Town Hall*

SOOS SSC members will be hosting a lunch-time information session or Town Hall, to inform SCAR participants of the recent and upcoming activities in the SOOS Biology Theme. In particular, SSC members will outline the process and outcomes of the SOOS eEOV workshop and highlight some of the candidate eEOVs.

### ***SOOS Scientific Session***

SOOS is convening a scientific session titled “Observing Antarctica and the Southern Ocean”. This session is being convened by the Executive Officer, SangHoon Lee (KOPRI), and Craig Cary (Terrestrial expert, NZ). Twelve oral and 10 posters have been accepted for this session.

### ***SOOS Data Management Sub-Committee Meeting***

Several SOOS DMSC members are involved in SCAR data management activities, and therefore it is opportune for SOOS to hold a DMSC alongside the SCAR meeting. This meeting (29-30 August) will be hosted and sponsored by NIWA (through Mike Williams) and will be attended by 10 of the DMSC members. The SOOS IPO has budgeted 10,000 AUD to support attendees to travel to this meeting.

## **4.4 Products and Activities**

Many of the activities and products outlined in section 1 will continue to develop during 2014/2015. Updates on all activities will be provided on the SOOS website.

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## **5. IMPORTANCE OF SCOR SUPPORT**

SCOR has been the most significant supporter of SOOS activities over the last year. This support is not only financial, but also through the unfaltering guidance and advice provided by the SCOR Executive Director. SOOS would like to acknowledge and thank SCOR for this continued support. It is fundamental to our success.

SOOS also acknowledges the support provided by SCOR for the annual Scientific Steering Committee meeting, and requests that this support is continued for 2015. Continuation of the support for the SSC meeting will ensure participation by all SSC members, which is imperative for planning and implementation of SOOS objectives. SCAR also provides support for the annual SOOS SSC meeting and continuation of this support for 2015 will be requested at the upcoming SCAR Delegates meeting in August 2014. The location and timing of the 2015 SSC meeting is not yet decided, but due to issues with the 2014 SSC meeting and an increase in SSC member numbers, the budget will be one of the main considerations in determining the location of the next meeting.

## **6. ACRONYMS**

AAD: Australian Antarctic Division

ACE CRC: Antarctic Climate and Ecosystems Cooperative Research Centre

APECS: Association of Polar Early Career Scientists

ATCM: Antarctic Treaty Consultative Meeting

BOM: Bureau of Meteorology

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CCAMLR: Commission for the Conservation of Antarctic Marine Living Resources  
CCHDO: CLIVAR and Carbon Hydrographic Data Office  
COMNAP: Council of Managers of National Antarctic Programs  
CSIRO: Commonwealth Scientific and Industrial Research Organisation  
DMSC: Data Management Sub-Committee  
DOOS: Deep Ocean Observing Strategy  
FSU: Florida State University  
GEO BON: Group on Earth Observations Biodiversity Observation Network  
GEOMAR: Helmholtz Centre for Ocean Research  
GOOS: Global Ocean Observing system  
IAATO: International Association of Antarctic Tourist Operators  
ICSU: International Council for Science  
IndiSeas: Indicators for the Seas  
IMAS UTas: Institute for Marine and Antarctic Studies, University of Tasmania  
IMBER: Integrated Marine Biogeochemistry and Ecosystem Research  
IMOS: Australian Integrated Marine Observing System  
IOCCG: International Ocean Colour Coordination Group  
IOCCP: International Ocean Carbon Coordination Project  
JAMSTEC: Japan Agency for Marine-Earth Science and Technology  
KOPRI: Korean Polar Research Institute  
NOC: National Oceanographic Institute  
NSF: United States National Science Foundation  
ODIP: Ocean Data Interoperability Platform  
OOPC: Oceans Observations Panel for Climate  
Palmer LTER: Palmer Station Long-Term Ecological Research  
POGO: Partnership for Observation of the Global Oceans  
SCAR: Scientific Committee on Antarctic Research  
SOCOM: Southern Ocean Carbon Observations and Modeling  
SOLAS: Surface Ocean-Lower Atmosphere Studies  
TPAC: Tasmanian Partnership for Advanced Computing  
US AMLR: United States Antarctic Marine Living Resources  
WCRP CLIVAR: World Climate Research Programme Climate Variability and Predictability  
WCRP Clic: World Climate Research Programme Climate and Cryosphere  
WHOI: Woods Hole Oceanographic Institute  
WMO PSTG: World Meteorological Association's Polar Space Task Group

### 4.3 Data Publication Activity

Urban

This activity is focused on the use of data publication approaches in ocean sciences and to test various ways to implement data publication. The project had its beginning in 2006. The activity is managed by representatives from SCOR, the International Ocean Data and Information Exchange (IODE) of IOC, the British Oceanography Data Centre, the U.S. National Oceanic and Atmospheric Administration, and the MBL-WHOI Library. The activity continues to test and implement two approaches, linking data to traditional research publications and creating places where data not associated with publications can be stored and accessed by the broader community. The group created a “cookbook” in 2013 describing the two approaches:

[Leadbetter, A., Raymond, L., Chandler, C., Pikula, L., Pissierssens, P., Urban, E. \(2013\) Ocean Data Publication Cookbook.](#) Paris: UNESCO, 41 pp. & annexes. (Manuals and Guides. Intergovernmental Oceanographic Commission, 64), (IOC/MG/64)

This document is intended to be updated as more experience is gained from implementing its recommendations. Future work of the group will focus on helping new data publication sites become established. Members of the group continue to develop the approaches and to make presentations in various venues about the current status of data publication globally.

The group has held two conference calls in 2014, but there are no plans for an in-person meeting in 2014. Cyndy Chandler co-chaired a workshop on data management prior to the IMBER Open Science Conference in June 2014 and Ed Urban gave a presentation on data publication during the workshop.

## 4.4 IAPWS/SCOR/IAPSO Joint Committee on Seawater

**Morozov**

This group is a successor to SCOR/IAPSO WG 137 on Thermodynamics and Equation of State of Seawater. The group meets opportunistically when attended related meetings and has oriented its work around sub-topics, as shown below. SCOR funding is occasionally required for one of the Executive Committee members to represent the group at a meeting of the International Association for the Properties of Water and Steam (IAPWS) or other organization.

Report to SCOR and IAPSO on JCS Activities July 2013-June 2014

### Membership

#### Executive

Rich Pawlowicz (Chair)	Canada
Rainer Feistel (Vice-chair)	Germany
Trevor J. McDougall (Vice-chair)	Australia

#### Salinity/Density Subgroup

Frank J. Millero	USA
(Rich Pawlowicz)	Canada
Steffen Seitz	Germany
Hiroshi Uchida	Japan
Stefan Weinreben	Germany
<i>Youngchao Pang</i>	<i>China-Beijing</i>
<i>NEW MEMBER</i>	

#### pH Subgroup

Maria Filomena Camoes	Portugal
Andrew Dickson	USA
Petra Spitzer	Germany

#### Relative Humidity Subgroup

Olaf Hellmuth	Germany
Jeremy Lovell-Smith	New Zealand

#### Thermodynamics

(Rainer Feistel)	Germany
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#### Numerical Modelling and Applications

(Trevor J. McDougall)	Australia
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#### Software

Paul Barker	Australia
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#### Industry Representatives

Paul Ridout (OSIL)	UK
Barbara Laky (Anton Paar)	Austria

### Meetings

JCS met as a full group for several workshops at the 2013 International Conference on the Properties of Water and Steam (Greenwich, UK, Sept 2013). For each workshop, a set of tasks were defined in support of efforts to make SI-traceable definitions for seawater salinity, pH, and the relative humidity of moist air. Partial meetings of the Salinity/Density and pH subgroups also took place at the ENV05 final meeting (Berlin, June 2014) to discuss these tasks.

### Activities

- (1) Sept 2013 – JCS workshops on Salinity/density, pH, and RH and 2013 International Conference on the Properties of Water and Steam (Greenwich, UK, Sept. 2013)
- (2) Sept. 2013 – Seabird Electronics releases TEOS-10 support for their SBEDataProcessing software (assistance PB).

- (3) Nov 2013 - RF circulates draft of BIPM position paper.
- (4) Dec 2013 – release of v3.04 of GSW toolbox (includes gas solubilities and many sea-ice-related functions) (PB,TM)
- (5) April 7-11 2014 - RP attends BIPM/CCQM meeting (includes other members of pH and salinity./density subgroups) to work on SI traceability
- (6) May 19-23 - RF attends BIPM/CCT meeting (includes other members of RH subgroup) to work on SI traceability.
- (7) May 2014 - RF circulates draft of BIPM position paper.
- (8) June 16-17 2014 – EURAMET ENVO5 project has workshop (Berlin), many ENVO5 members are also in JCS, discussions of pH/salinity (also attending, RP, HU, AD).
- (9) June 23-27 2014 – IAPWS Annual meeting (Moscow), OH report, edit and re-release of ICRN 16 on Properties of Seawater

#### **Web site**

[www.teos-10.org](http://www.teos-10.org) is getting 1,500-2,000 visitors per month with 24,574 “unique views” since Oct. 2010.

<b>Web site Item</b>	<b>Unique downloads June 2011-June 2013</b>	<b>Unique downloads June 2013-June 2014</b>
Manual	920	360
Getting Started	879	362
Slides	704	284
Primer	584	197
GSW_MATLAB_v3_0	1,920	1,102
GSW_FORTRAN_v3_	366	222
GSW_C_v3_0	202	84
GSW_PHP	-	55
SIA_VB_V3_0	72	100
SIA_FORTRAN_V3_0	59	118

#### **Other Progress**

1. TM working with several modelling groups (MOM, NEMO) to add TEOS-10 support.
2. FM preparing paper summarizing all open-ocean density anomaly measurements.
3. RP/FM carry out density anomaly measurements in N. Pacific (Line-P program).
4. HU and FM continuing measurements of density in SSW batches.

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## Papers published

1. Kretzschmar, H.-J., Feistel, R., Wagner, W., Miyagawa, K., Harvey, A.H., Cooper, J.R., Hiegemann, M., Blangetti, F.L., Orlov, K. A., Weber, I., Sinch, A., and Herrmann, S., The IAPWS Industrial Formulation for the Thermodynamic Properties of Seawater, Desalination, doi: 10.1080/19443994.2014.925838 (2014).
2. IAPWS Certified Research Need – ICRN 16, Thermophysical Properties of Seawater, revised and re-issued June 2014, International Association of the Properties of Water and Steam (2014).
3. McDougall, T.J., Barker, P., Feistel, R., Galton-Fenzi B. K., Melting of Ice and Sea Ice into Seawater and Frazil Ice Formation, *J. Phys. Oceanogr.*, 44, 1751-1775, (2014)

## Papers in Preparation

- (1) Metrological challenges for measurements of key climatological observables: Oceanic salinity and pH, and atmospheric humidity, R Feistel, R Wielgosz, S A Bell, M F Camoes, J R Cooper, P Dexter, P Fisicaro, D P Gatley, A H Harvey, M Heinonen, O Hellmuth, N Higgs, H-J Kretzschmar, J W Lovell-Smith, T J McDougall, R Pawlowicz, S Seitz, P Spitzer, D Stoica and H Wolf. (Position paper on future cooperation activities between BIPM and IAPWS, to be published in *Metrologia*)
- (2) Kretzschmar, H.-J., Feistel, R., Wagner, W., Miyagawa, K., Harvey, A.H., Cooper, J.R., Hiegemann, M., and Herrmann, S. (proposers): Advisory Note No. 5: Industrial Calculation of the Thermodynamic Properties of Seawater. The International Association for the Properties of Water and Steam, Greenwich, UK, September 2013, in preparation
- (3) Fiestel, R., Lovell-Smith, J., Hellmuth, O., A Virial equation for the Fugacity of Water in Humid Air, for *Int. J. of Thermophysics*.

R. Pawlowicz

JCS chair, July 15, 2014

## 4.5 GlobalHAB

**Urban, Enevoldsen**

The SCOR Executive Committee decided not to extend SCOR's support for GEOHAB as a research project, but because of community and sponsor interest was asked to consider acceptance of a new infrastructural program focused on harmful algal bloom issues. This item will report the outcome of the discussions of the SCOR Executive Committee.

As noted previously, IOC (through IPHAB) endorsed the GEOHAB SSC proposal to transition GEOHAB to a project called GlobalHAB. At the 2013 SSC meeting, the SSC developed a mission statement for GlobalHAB and revised the draft Terms of Reference:

- GlobalHAB is an international coordinating group that facilitates and encourages cooperation on scientific research addressing Harmful Algal Blooms (HABs) in a changing world to accelerate scientific advances, leading to improved understanding, prevention, and mitigation of HABs.
- GlobalHAB will benefit from input via IOC-IPHAB, SCOR working groups, other international groups such as ISSHA, GEO; and will encourage direct participation by individual scientists.
- GlobalHAB does not directly coordinate national research projects, does not establish national research agendas, and does not directly provide research funding.
- GlobalHAB will not explicitly continue GEOHAB Core Research Projects, but will pursue topics of interest that were identified within the CRPs.

### GlobalHAB Draft ToR:

The Scientific Steering Committee of the GlobalHAB programme will

1. Develop an Addendum to the GEOHAB Science Plan and a GlobalHAB Implementation Plan based on the GEOHAB Synthesis and submit it to the GlobalHAB sponsors by June 2016.
2. Coordinate and manage GlobalHAB activities and projects in accordance with the amended GEOHAB Science Plan and the GlobalHAB Implementation Plan.
3. In coordination with GlobalHAB sponsors, identify gaps in knowledge, technology, and capabilities required to improve understanding, prevention, and mitigation of HABs, and encourage targeted activities to fill those identified gaps.
4. Review progress on GlobalHAB activities over time and initiate new GlobalHAB activities in priority areas in accordance with the amended GEOHAB Science Plan and GlobalHAB Implementation Plan.
5. Foster framework activities to facilitate implementation of GlobalHAB, including dissemination and information tools.
6. Promote and facilitate comparative and interdisciplinary research on harmful algal blooms by providing coordination and communication services to national and regional research groups, encouraging explicit affiliation with GlobalHAB.
7. Serve as the coordinating organization for implementation of HAB activities in observational/modeling systems such as GEOSS, GOOS, and the GOOS Regional Alliances.

8. Collaborate, as appropriate, with intergovernmental organizations and their subgroups (e.g., IAEA, ICES, IOC/FANSA, IOC/ANCA, IOC/WESTPAC/HAB, IOC/HANA, PICES, UNEP/NOWPAP), and within related research projects (e.g., LOICZ, IMBER).
9. Report regularly to SCOR, the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB), and the global HAB research community on the state of planning and accomplishments of GlobalHAB, through annual reports and, as appropriate, the GlobalHAB Web site, a GlobalHAB Newsletter as part of Harmful Algal News, special sessions at scientific meetings, and other venues.
10. Interact with GlobalHAB sponsors and other agency sponsors to stimulate the support of GlobalHAB implementation.

SCOR was requested to approve GlobalHAB as an activity to provide infrastructural support to the international HAB community. This would be consistent with the interests of SCOR and of the U.S. National Science Foundation, a long-time supporter of GEOHAB (through SCOR).

SCOR is awaiting confirmation that NSF will provide support for GlobalHAB and the SCOR Executive Committee will discuss GlobalHAB in closed session before the main SCOR meeting.