



Annual Report

XIIth Session of the Scientific Steering Group

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Oceanographic
Commission



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SSG for 2017 and Participants List

The composition of the IOCCP SSG in 2017 is shown in Table 1 below. This table also acts as a participants' list as far as SSG members are concerned. Contact details and full affiliations of listed SSG members can be found on the IOCCP website (Contacts' tab). Additional participants are listed in Table 2.

Table 1. SSG members for 2017

Name (Gender)	Home institution	Country of residence	Expertize	Participation in the 12 th Session of the IOCCP SSG
Toste Tanhua (Co-Chair, M)	GEOMAR	Germany	Framework for Ocean Observing	Attended
Masao Ishii (Co-Chair, M)	JMA-MRI	Japan	Ocean Interior Observations	Attended
Richard Feely (M)	NOAA - PMEL	USA	Ocean Acidification	Attended
Michio Aoyama (M)	U. Fukushima	Japan	Nutrients	Attended
Björn Fiedler (M)	GEOMAR	Germany	Time Series	Attended
Douglas Connelly (M)	NOCS	UK	Instruments and Sensors	Attended
Siv Lauvset (F)	UiB	Norway	Ocean Interior Synthesis	Attended
Benjamin Pfeil (M)	UiB	Norway	Data Management	Attended
Rik Wanninkhof (M)	NOAA - AOML	USA	Underway CO ₂ Observations	Attended
Kim Currie (F)	NIWA	New Zealand	Ocean Surface Synthesis	Attended
Cristian Vargas (M)	U. Concepcion	Chile	Ocean Acidification	Did not attend

Table 2. Project Office staff and additional meeting participants

Name (Gender)	Home institution	Country of residence	Role	Participation in the Eighth Session of the IOCCP SSG
Maciej Telszewski (M)	IOCCP	Poland	IOCCP Director	Attended
Artur Palacz (M)	IOCCP	Poland	IOCCP Project Officer	Attended
Albert Fischer (M)	IOC-UNESCO	France	GOOS Director	Attended
Veronique Garçon (F)	LEGOS	France	SOLAS Chair	Attended
Samantha Simmons (F)	Marine Mammal Commission	USA	GOOS BioEco Panel Co-chair	Attended

Report

1. Introduction

The 12th Session of the IOCCP Scientific Steering Group was held on 6-7 February 2017, at the Roz and Cal Kovens Conference Center, Florida International University Biscayne Bay Campus, Florida, USA. The SSG meeting was held in conjunction with the IMSOO Workshop (<http://www.ioccp.org/more/224-imsoo>, 8-10 February 2016) attended by several SSG members, hence reducing travel commitments and increasing cost-effectiveness.

Over the 6 months period prior to the meeting, the IOCCP SSG discussed several fundamental elements of its structure and that included the strategy for chairmanship. The SSG decided that the expanding scope of the program (as expressed in the updated Terms of Reference presented further down in this report) to include several non-carbon biogeochemical Essential Ocean Variables in its coordination efforts, requires additional engagement of one of the SSG members to share the workload associated with chairing of IOCCP. In the light of this decision, Dr Masao Ishii was asked to step-up to a co-Chair position and he kindly accepted the role.

The two co-Chairs, Toste Tanhua and Masao Ishii, opened the meeting by welcoming all the attendees. Ten SSG members were joined by two Office staff and three guests as listed in tables 1 and 2. Additionally one remote participant joined the meeting for the morning of Day 2 (Hervé Claustre, CNRS-LOV, France). One IOCCP SSG member (Cristian Vargas) was unable to attend the meeting.

The co-Chairs thanked the attendees for joining the meeting and expressed gratitude for having the opportunity to hold a 2-day meeting (as opposed to one day a year earlier), thus enabling the Panel to discuss more thoroughly the many exciting developments related to IOCCP themes and efforts and events related to GOOS Biogeochemistry which had taken place over the year. Toste alluded to some of the past and upcoming events that shape the global perspective on requirements for ocean observing, which provide context for ongoing and future IOCCP activities. One such event was the verification of the 2016 GCOS Implementation Plan in Marrakech during the COP-22 in November 2016. IOCCP was heavily involved in writing the ocean chapters in the 2016 GCOS IP. The connection between climate and ocean observing systems is clearly on the intergovernmental agenda and with the COP decisions being implemented on the political and governance levels, IOCCP's contributions are going to be soon realized through a top-down (requirements-funding-implementation) structures on top of, traditional for IOCCP, bottom-up (scientific questions – observing capacities – information products) efforts. Moreover, the Chairs mentioned the UN Agenda 2030 and particularly its ocean related Sustainable Development Goal 14 (SDG14): *Conserve and Sustainably use the Oceans, Seas and Marine Resources for Sustainable Development* (<https://sustainabledevelopment.un.org/sdg14>). Toste pointed to the '[Ocean Conference: Our Oceans, Our Future: Partnering for the Implementation of SDG14](#)', to be held on 5-9 June 2017, in New York, USA, to which IOCCP community should provide organized and/or individual input to further the concepts (targets and indicators) allowing to progress the underlying science and monitoring efforts. Finally, Toste briefed the SSG on the recent developments with regards to the G7 Science and Technology Ministers setting ocean observation as a

priority for the future of the oceans. This process started with the meeting in Tsukuba in 2016, followed by the [Tsukuba Communiqué](#). Recommendations from the G7 Oceans and Seas Working Group for the ocean observing system are in the making.

With these high level political agendas and many exciting technological developments furthering our capacity to observe the intertwined complexity of the ocean systems, Toste suggested that the IOCCP take full advantage of all the opportunities for promoting ocean biogeochemistry observations as providing critical underlying information necessary for assessing the past, current and potential future variability, and potential impact of this variability on current and future human and nature wellbeing.

The remainder of this report summarizes the presentations and discussions held during the meeting. It does not necessarily follow the chronological order depicted in the meeting agenda but tries to divide the information provided during the meeting into subject-related chapters to enable a better implementation of the action items stemming from the meeting.

2. Update and Vision for Underway CO₂ Observations

General update

Rik Wanninkhof presented this theme. The international coordination of underway CO₂ measurements from ships under auspices of IOCCP is progressing well. We continue to focus on formalizing agreements and protocols for measurements, and looking ahead towards implementing new systems, alternative observing techniques and new observing platforms.

The SOCAT effort remains the central focal point of data collation and quality control efforts and we are using recommendations from SOCAT to establish further coordination and cooperation between measurement groups. Furthermore, we are advocating for sustained observation programs in different nations and unions. In particular, we are establishing protocols to quality control air XCO₂ measurements, and adding (and QCing) other biogeochemical sensors, in particular O₂, pH, and nitrate, in addition to improving quality control of temperature and conductivity/salinity measurements.

Future needs

Rik expressed a need for a concerted community effort to fully constrain the uncertainty, accuracy and performance characteristics of the new generation pCO₂ sensors that can be placed inline without need for gravity drain. There is an urgent need to assess whether the new and upcoming pCO₂ sensors are meeting rigorous requirements for data accuracy.

As a contribution to this effort, NOAA/AOML will allocate space on one of its ocean acidification cruises in the Gulf of Mexico (Ron Brown, 11 July-15 August 2017) for concurrent measurements using some of the new sensors. A full characterization of the inorganic carbon system will occur during the cruise with measurements following SOP protocols of pCO₂, DIC, T_{ALK}, and pH to facilitate comparisons. A particular focus will be on characterizing the accuracy and precision of the data of all underway pCO₂

systems. Free exchange of resulting data would be a requirement for participants. The ultimate goal would be to go beyond performing a good inter-comparison and look into details of resulting biases in order to pinpoint their culprits. A detailed report would be produced, perhaps combined with a report on ground-truthing of sensor data. Based on the results, the criteria for appropriate sensors and standardization should be updated in the SOCAT manual.

Rik suggested that IOCCP would produce the original announcement for such a comparison and be prepared to support any potential non-US participants should such request be made. Logistically, NOAA could accommodate 5-6 participating systems if they were not accompanied by personnel and around 3 systems if they were to be accompanied by personnel. One suggestion was that participants be selected based on their volume of SOCAT submissions, although those submissions are biased towards one method: IR detection. It was decided that initially established data producers would be contacted before other labs would be approached.

The request was discussed among the SSG. The Panel accepted the need and several members stressed the need for thorough analysis of results and publication of recommendations and conclusions. That was not the case in two intercomparison studies conducted 5-7 years ago. Rik stated that NOAA will most probably not be able to support the evaluation of the data coming out of the intercomparison. It was agreed that data evaluation would be an interesting and useful short science project.

Benjamin reported that the ICOS Ocean Thematic Centre discussed a ship-based inter-comparison in 2018 and suggested that IOCCP gets involved for reasons highlighted by Rik. It was also mentioned that within the EU H2020 AtlantOS project, there are funds available for inter-comparison type approaches, and that a best practices guide to underway pCO₂ sensors would be a very welcome product.

ACTION ITEM 1

Set up a call between the responsible SSG members to refine the IOCCP announcement for the comparison, with a necessary requirement for a report that will turn into a best practices guide. Coordinate the activity with NOAA. (Responsible: *Wanninkhof, Connelly, Tanhua, Telszewski*. Timeframe: *Immediate*. Financial Implications: *None to Medium*)

The second issue presented and discussed concerned the overall approach of IOCCP to coordination of the surface water CO₂ measurements. In addition to platforms most common historically: ships of opportunity and mooring based CO₂ sensors, critical mass of new autonomous platforms such as drifters, wave gliders, and autonomous sailing vessels has been in operation long enough to justify incorporation of related coordination activities into the IOCCP portfolio. The duties and activities of IOCCP should be adjusted to focus on *surface water observations* irrespective of platform rather than *underway observations* and *moored observatories* and perhaps *autonomous sensors' observations* separately.

To better reflect this subtle but significant change Rik proposed to change the name of the IOCCP Theme from 'Underway CO₂ Observations' to 'Surface Water CO₂ observations'. The proposal was endorsed by IOCCP. It was noted that the SSG experts for 'Surface Water CO₂ Observations' and 'Time Series Efforts' will have to consult each other on planned activities to avoid duplication of efforts within IOCCP.

ACTION ITEM 2

Update the IOCCP website to change the theme name from 'Underway CO₂ observations' to 'Surface Water CO₂ Observations' and broaden the coordination and communication responsibilities to all platforms taking surface measurements. (Responsible: *Wanninkhof, IOCCP Office*. Timeframe: *Immediate and ongoing*. Financial Implications: *None*)

Next, the presentation and discussion moved to the quality control procedures and the data reduction process related to recalculating fCO₂ values by individual operational groups as well as in SOCAT. Although the biases resulting from recalculating fCO₂ values from quantities measured can be very small, there is a need to further increase the uniformity of protocols to achieve the accuracy required to resolve various scales of the variability in the system. Even a small systematic bias could potentially lead to an incorrect trend estimate and locally even the sign of the signal (sink instead of source and vice-versa) could be estimated erroneously.

Rik emphasized that accuracy requirement for air-sea CO₂ flux calculation is of paramount importance, and he expressed the need for IOCCP to hold a dedicated workshop on data quality control and data reduction protocols in coordination with SOCAT representatives.

This activity would not be limited to ship measurements, but also include autonomous platforms. The workshop is envisaged as split into breakout groups addressing individual aspects contributing to data uncertainty: instrumentation, software, quality control, re-calculations. One specific issue that should be addressed with new autonomous vehicles is the lack of freely available relevant software packages. Simultaneously, it is imperative that a best practices document for groups and instrumentations already operating be available as soon as possible, hence the focus should be on the more established methods, acknowledging that the new developments will require constant revisiting of existing recommendations. Moreover, there is currently a need to harmonize the two existing data reduction systems used by the community. The Panel suggested that the two members of the community, heavily involved in the development and application of these protocols (Steve Jones, UiB, Bergen, Norway, and Dennis Pierrot, NOAA-AOML, Miami, USA), have a working meeting prior to the proposed workshop.

ACTION ITEM 3

Organize a workshop on data reduction protocols. (Responsible: *Wanninkhof, Currie, Pfeil, IOCCP Office*. Timeframe: *Feb. - May 2018*. Financial Implications: *High*)

The discussion continued in line with the above and it was proposed that the SOCAT "sanity checker" used during automated submission will be enriched with the ability to compare submitted and calculated xCO₂/pCO₂/fCO₂ in order to sieve out potential biases. It was also pointed out that a lot of the mooring data does not get submitted into SOCAT. This suggests that respective operators, for example the Ocean Observatories Initiative (OOI), do not use data reduction protocols at all (as currently SOCAT is the source of these protocols). It was proposed that Rik would reach out to OOI on behalf of IOCCP to request their data to be submitted to SOCAT, initiating the dialogue with Burke Hales (OSU, USA).

ACTION ITEM 4

Encourage wider use of data reduction protocols by mooring operators and include relevant tests in SOCAT sanity checker. (Responsible: *Wanninkhof (with Burke Hales), Pfeil (with Steve Jones)*). Timeframe: *Before June 2017*. Financial Implications: *None*)

The discussion then shifted to the outstanding Action Item 5 from XI SSG Report: ‘Coordinate the efforts to write and make publicly available the data-reduction software developed and improved by Dennis Pierrot.’ Rik explained that this software package was functional but not user friendly and required basic programming skills to use. Additionally, there is a concern about the level of support potentially required by the users once the software is made public. Despite these concerns, the need for this software in the community is large enough for the IOCCP to suggest that this software package, even if not in a perfect state, be made available online as soon as possible. Dennis Pierrot will be asked whether he would be prepared to provide a limited troubleshooting in an agreed formal or informal fashion.

ACTION ITEM 5

Dennis Pierrot's data reduction software to be cleaned up and uploaded to the IOCCP website. Rik to inquire from Dennis whether (and to what extent) his name could be listed as support for the software usage (Responsible: *Wanninkhof, IOCCP Office*). Timeframe: *Immediate*. Financial Implications: *None*)

Another proposal from Rik concerned the modification of Biogeochemistry EOVs. He argued that the Inorganic Carbon EOV (previously Carbonate System) might be a bit too general for some audiences, and he proposed that “surface water CO₂” and “air-sea CO₂ fluxes” be listed as separate EOVs. The scientific rationale for such a change is that these two surface measurements address a problem that is fundamentally different than inorganic carbon content in the ocean interior. Discussion of this proposal was deferred until the next iteration of the Biogeochemistry EOV list which is envisaged to happen before September 2019.

Next, the issue of insufficient atmospheric xCO₂ measurements was raised by Rik. He described the requirement for concurrent atmospheric CO₂ measurements especially in areas of highest oceanic CO₂ variability, e.g. on both the east and west coast margin of the Atlantic basin. Rik reminded the Panel that currently the “over the ocean” atmospheric xCO₂ measurements come mostly either from satellites or data assimilation efforts (Carbon Tracker, GLOBALVIEW-CO₂). Rik stressed that while satellites are getting better in getting column-integrated atmospheric CO₂ inventories, the problem with translating those to surface values remains. There is an urgent need to compare these estimates with matching measurements above the surface water, and to develop best practices for this kind of measurements and comparisons.

Also there is an outstanding issue of an independent quality assurance procedure for atmospheric xCO₂ measurements taken with the underway pCO₂. The development of a best practice manual for atmospheric measurements from ships and the need for an intercomparison experiment were discussed by the SSG. The Panel agreed with the importance of working towards resolving this issue. It was decided that the outstanding Action Item #9 from previous year be kept, and Rik and co-Chairs will engage with colleagues coordinating atmospheric measurements (e.g. Colm Sweeney). An initial indication a year earlier was to develop a protocol for an assessment of current capacity of SOOP-CO₂ operators, where a high accuracy system (e.g. PICARRO)

would be moved from ship to ship to compare the measurements with those made simultaneously by routinely used systems.

ACTION ITEM 6

Initiate and support developments (inter-comparison experiment, workshop) leading to higher quality atmospheric observations from SOOP-CO₂ (Responsible: *Wanninkhof, IOCCP Office*. Timeframe: *Ongoing*. Financial Implications: *Low*). *This is an outstanding action item #9 from SSG XI.*

Rik also alerted the Panel about an important upcoming communication opportunity related to Action Item 6. The 19th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT-2017) will be held back-to-back with the ICDC10 meeting. Strong representation of the oceanographic community is much needed at GGMT-2017 to talk about ocean surface measurements and atmospheric measurements from instruments installed on ships. Rik requested that IOCCP make a presence at that meeting. He reminded the Panel that the IOCCP was approached before the 18th GGMT meeting in 2016 by the organizers but we had to reject the invitation due to scheduling conflict. A short discussion followed resulting with a full approval of this request. IOCCP will send at least one representative to GGMT2017 and will advertise the meeting within the community hoping for spontaneous participation.

ACTION ITEM 7

IOCCP to send a representative to the 19th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT-2017), held on 27-31 August 2017, Empa Dübendorf, Switzerland. (Responsible: *Wanninkhof, IOCCP Office*. Timeframe: *August 2017*. Financial Implications: *Low*).

Another request put forward for IOCCP was to exchange letters of collaboration with partner organizations (research, coordination, funding) which are involved in surface measurements (for example: ICOS (EU), NCEI (US), NOAA (US), NIES (Japan), CSIRO (Australia), SOLAS (Int.), IMBER (Int.), PICES (Int.), GOA-ON (Int.)). Such letters would vary in form and formality depending on the procedures exercised by individual organizations, but their common goal would be to provide a concise statement indicating specific mutual benefit(s) stemming from collaboration between the two organizations. The SSG agreed that it would be beneficial to formalize our many collaborations and to create a portfolio of partners which benefit from / provide to specific services of IOCCP. Following a discussion on the optimal format of such letters, it was decided that the IOCCP Office will draft a Letter of Agreement between IOCCP and research infrastructures. The recent OBIS-MBON Letter prepared by GOOS BioEco Panel could serve as an example. The idea of drafting a Memorandum of Understanding (MoU) was discarded based on the fact that non-legal entities, such as IOCCP, cannot draft an MoU.

ACTION ITEM 8

Draft a Letter of Agreement between IOCCP and relevant research infrastructures. (Responsible: *IOCCP Office*. Timeframe: *2017*. Financial Implications: *None*).

Recruiting of ships for voluntary surface carbon measurements was also discussed in the light of ever-insufficient coverage of the global oceans. Rik highlighted the fact that shipping companies express growing interest in carrying instrumentation, and our community needs to become more proactive and engage in recruiting more vessels

for the SOOP-CO₂ programme. The two venues where such efforts should be voiced and discussed are the IOC-WMO JCOMM Ship Observations Team (SOT) and IOC-WMO JCOMM Observations Coordination Group (OCG). Ship recruitment is one of the tasks that need to be better coordinated for more efficient functioning of the surface carbon observing network. Another one is the availability of the information about the current status of the network as well as visualizations of relevant meta-information. Harnessing some of the services provided by the JCOMM Observing Platform Support Center (OPS) which provides coordination at the international level for many oceanographic observing networks was discussed over the past year. No conclusions were drawn to date, although it was agreed that the time to formalize the SOOP-CO₂ network is appropriate. Funding needs required for salary support for a JCOMMOPS officer in order of 0.25 FTE are the major obstacle at the moment.

It was agreed that IOCCP will be represented at upcoming SOT and OCG meetings and the above issues will be presented amongst other aspects of common interest between JCOMM and IOCCP.

ACTION ITEM 9

Present the IOCCP position on SOOP-CO₂ status and way forward at the 9th Session of the JCOMM SOT, 27-31 March 2017, London, UK, and 8th Session of the JCOMM OCG, 22-25 May 2017, Qingdao, China. (Responsible: *Wanninkhof, Telszewski*. Timeframe: *March-May 2017*. Financial Implications: *Low*).

A couple of outstanding documents from the XIth Session advocating the facilitation of underway CO₂ measurements were discussed, and plans to finalize them were made:

1. A pCO₂ system installation guide on ships, led by Tobias Steinhoff and Denis Pierrot (initial target delivery date August 2016). This document focuses on the considerable challenges of installation on ships and will provide guidance on do's and don'ts when installing. It will cover installation on research ships and on commercial vessels. The manuscript is being produced in collaboration with Charles Roman Battisti (UiB, Bergen, Norway) as part of ICOS. As of March 2017, the final draft is being circulated amongst the contributors.
2. A prospectus for ship's officers and crew, and ship owners initially lead by Ute Schuster (initial target delivery date August 2016). This document will serve as a "sales brochure" to inform all parties interested on the carrier's side on the reason for installation and overall scope of information gathered via the instruments. It will build on the efforts of several individual groups to provide this information in an appealing form to the prospective ships hosting underway systems. As Ute Schuster is no longer available to complete this task, volunteers are sought to lead it through the final stage.

To aid the timely completion and assure required efficiency of the final product, the SSG agreed to use some resources to hire a copy editing office to produce a visually attractive brochure with sufficiently informative content that speaks to general public. This action is viewed as complimentary to recruiting more commercial vessels as they are opening up to science.

ACTION ITEM 10

Write two advisory documents (installation guide for underway systems and prospectus for commercial partners) and publish on the IOCCP website and share with the community through other channels. Hire a copy editing specialist to produce the final brochure. (Responsible: *Wanninkhof, IOCCP Office in collaboration with Tobias Steinhoff (GEOMAR, Germany), Denis Pierrot (NOAA-AOML, USA), Roman Battisti (UiB, Norway)*). Timeframe: *early 2018*. Financial Implications: *Low*).

Finally, an update of the relevant page of IOCCP website was agreed as an action item for 2017.

ACTION ITEM 11

Update the relevant page on the IOCCP website including careful analysis of existing and missing content as well as connections to resources available elsewhere. (Responsible: *Wanninkhof, Palacz*). Timeframe: *2017*. Financial Implications: *None*. *This is an outstanding action item #10 from SSG XI.*

3. Update and Vision for Synthesis Activities: Surface Ocean

Kim Currie presented this theme.

Surface Ocean CO₂ Atlas (SOCAT)

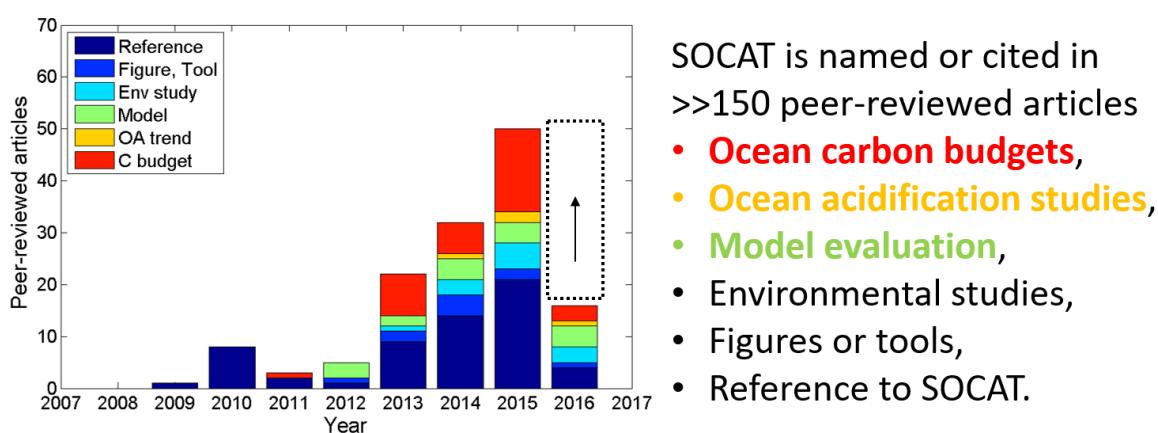
Version 4 of the Surface Ocean CO₂ Atlas (SOCAT) was publically released on 1 September 2016. Version 4 contains 18.5 million surface ocean fCO₂ (fugacity of CO₂) values with an accuracy of better than 5 µatm, plus calibrated sensor data with an accuracy of better than 10 µatm. These data have been provided by roughly 100 contributors, and cover the time frame 1957 – 2015. Data providers submitted their data using the new automated dashboard, which integrates the upload of data, metadata and other reports, with the data submission and preliminary data viewing allowing the data provider to do an initial assessment of their data quality. Version 4 includes individual data sets, synthesis and gridded data products, all quality controlled. The data submission, quality control and release of subsequent SOCAT versions will now become an annual activity, starting with SOCAT Version 4.

SOCAT Version 4 was presented at a number of scientific conferences, for example at the Air-Sea Gas Fluxes: Progress and Future Prospects meeting by Dorothee Bakker (Brest, France, 6-9 September 2016), at the ICOS Science Conference by Ute Schuster (Helsinki, Finland, 26-30 September 2016) and at the PICES (North Pacific Marine Science Organization) meeting by Maciej Telszewski (November 2016, USA).

Data submission for SOCAT version 5 ended on 15 January 2017. In total 642 data sets have been submitted or revised for version 5, including 582 data sets from ship-based measurement, 58 from moorings and 2 from drifting buoys. 169 additional data-sets had updated meta-data for previously submitted data. The quality control of the newly submitted and updated data sets is scheduled for completion at the end of March 2017. SOCAT V5 will be released in mid-June 2017 (aim) to suit the timing of ICDC10 and Global Carbon Budget. This will also mark the 10th Anniversary of SOCAT.

An ESSD (Earth System Science Data) 'Living Data' publication led by Dorothee

Bakker (Bakker et al., 2016) documents the methods and data sets used for the assembly of version 3 of the SOCAT data collection and compares these with those used for earlier versions of the data collection. This publication also documents the scientific applications and impact of SOCAT (Figure 1). SOCAT has been used in more than 150 peer reviewed scientific publications, plus numerous high-profile reports and PhD theses. Important applications of SOCAT include quantification of the ocean carbon sink and its variation, assessments of ocean acidification, and model evaluation. For evaluation of Earth system models, the SOCAT gridded product and a SOCAT-based data product are integrated with the ESMValTool. The SOCAT gridded product is also being integrated into the sixth generation of the Obs4MIPs (Observations for Model Intercomparison Projects) data repository. The Global Carbon Budget uses SOCAT data products to determine the oceanic carbon sink and its long-term variation. This estimate of the ocean carbon sink also enables quantification of the terrestrial carbon sink (Le Quéré et al, 2016).



SOCAT is named or cited in >>150 peer-reviewed articles

- Ocean carbon budgets,
- Ocean acidification studies,
- Model evaluation,
- Environmental studies,
- Figures or tools,
- Reference to SOCAT.

Figure 1. Applications of SOCAT in peer-reviewed publications (as of 22 April 2016, after Bakker et al., 2016).

Dorothee Bakker leads the global SOCAT committee, which meets virtually several times per year, with more frequent meetings of the data management team. The implementation of several strategic issues is under discussion:

- Platform type as a variable (to be available in version 5),
- The automation of metadata upload and metadata checks, following the transfer of CDIAC to NCEI (for version 6),
- Inclusion of atmospheric CO₂ measurements in consultation with the atmospheric community. Atmospheric CO₂ will not be quality controlled in version 5. The aim is to quality control the atmospheric CO₂ data, e.g. from version 6 onwards. Quality control of atmospheric CO₂ requires suitable metadata (on calibration) and quality control flag criteria, both to be developed in consultation with the atmospheric community.
- Inclusion of additional parameters. These additional parameters will be archived, but not quality controlled. The current thinking is that all additional parameters will be archived in the original data files at Pangaea (version 5 onwards). For a subset of these, notably parameters available in GLODAP(v2), the units used in GLODAP(v2) will be adopted. This subset of parameters in the prescribed units will be made publicly available in a separate file for each SOCAT release (from version 6 onwards). No quality control will be carried out on these additional parameters.
- Consultation with MEMENTO on surface ocean N₂O and CH₄ data.

Kim finished with making two points. First is that it appears that the effort required for producing an annual SOCAT update paper might be too high for those directly involved in writing and might also exceed the benefits of having the information updated annually in a peer-review form. An annual data update is what most users are interested in.

Second point is two-fold and reflects on the relationship between SOCAT and the Global Carbon Project. Kim explained that in the past the GCP had to use raw, non-QCed SOCAT data for its annual Budget due to the discrepancy in publishing times. Since the onset of the SOCAT annual release, timed also according to the GCP requirements, the GCP has access to QC'ed data prior to publishing their budget. A related issue of co-authorship on the annual Budget review paper offered to the submitters of raw SOCAT data was discussed between the two groups over the past year. An agreement for this "bilateral data policy" is that regional data and/or a significant amount of data per provider is used, then all the data providers should be invited as co-authors. With the automatic annual release though, there will be a reduction of the number of co-authors on the GCP papers, with submitters of new data to be prioritized.

Following Kim's presentation, the SSG discussed the status of SOCAT data submissions and living review paper published in ESSD. The SSG in particular expressed interest in: (i) knowing what is the ratio of data coming from autonomous sensors to that coming from standard ship-based measurements in SOCATv4 submissions and how this ratio is changing on an annual basis, (ii) adding assessments (e.g. UN World Ocean Assessment) to the list of documents that cite SOCAT, (iii) knowing when the next annual review paper on SOCAT was planned for, (iv) the quantitative role of SOCAT data in the Global Carbon Budget estimates.

Kim and Benjamin will discuss these issues with the rest of SOCAT leaders and will report back to IOCCP prior to or at the next SSG meeting.

ACTION ITEM 12

Work with SOCAT leaders and report back to IOCCP on the status and planned actions related to the four issues (i-iv above) raised by the SSG. (Responsible: *Currie, Pfeil*. Timeframe: 2017. Financial Implications: *None*).

ICDC10 Side Event

Kim has provided an update on an important outreach event sponsored by IOCCP to be held during the ICDC10 Conference at Interlaken, Switzerland in August 2017. The IOCCP workshop on "Marine Carbon and Biogeochemistry Data Management and Synthesis" will bring together the communities engaged in delivering to and using existing and planned marine carbon and biogeochemistry data products, such as the Surface Ocean Carbon Dioxide Atlas (SOCAT) or the Global Ocean Data Analysis Project (GLODAP).

Based on lessons learned during the development of SOCAT and GLODAP, the aim is to discuss (i) the challenges and opportunities related to connecting the carbon and biogeochemistry data currently available from several sources globally, and (ii) the need to build an integrated access point for different carbon and biogeochemistry data types from major observing platforms (ships, moorings, floats, gliders).

Moreover, the sessions will discuss a pathway towards extending the existing and planned data products beyond primarily carbonate chemistry measurements and into a full scope of Biogeochemistry EOVs, which in many cases are measured using novel sensor technology. The workshop will include presentations and discussions on marine data management and synthesis, with subthemes of carbon data management, SOCAT, GLODAP, time series data, and sensor data. These sessions will consider the logistics of expanding the existing programmes to non-carbon biogeochemical data.

IOCCP is the sole sponsor and organizer of this event. The workshop is planned for ca. 100 participants. More details are available from:

http://www.icdc10.unibe.ch/program/side_events_and_meetings/ioccp_side_event/.

ACTION ITEM 13

Finalize the organization and execute the IOCCP Side Event at the ICDC10 conference. (*Responsible: Telszewski, Currie. Timeframe: August 2017. Financial Implications: Medium*).

Finally, an outstanding action item from the XIth Session related to the update of the relevant page on the website was passed on for 2017.

ACTION ITEM 14

Update the relevant page on the IOCCP website including careful analysis of existing and missing content as well as connections to resources available elsewhere. (*Responsible: Currie, Palacz. Timeframe: Before next SSG meeting. Financial Implications: None*).

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4. Update and Vision for Ocean Interior Observations

Masao Ishii presented this theme focusing on three topics: GO-SHIP cruise plan, update of the GO-SHIP Manual, and the G7 recommendations for/from GO-SHIP and other networks.

The latest GO-SHIP cruise plans

Information on recent and planned GO-SHIP cruises has been gathered in JCOMMOPS and is available at <http://www.go-ship.org/CruisePlans.html>. In 2016, seven reference sections (one in the Atlantic, two in the Indian, three in the Pacific, and one in the Southern Ocean) have been completed in addition to the total of 10 high-frequency and associated sections. South African and Brazilian associated sections in the South Atlantic were connected coast-to-coast by German cruise on RV Meteor in spring 2016.

GO-SHIP cruise plans (submitted by 14 December 2016)

Year	Line	Segment	Nation	Status
Annual	AR28		UK	Next 2017
Annual	AR07	West	CANADA	Next 2017
Annual	SR01		UK	Next 2016-17
Annual	ARC02		CANADA	Next 2017
Annual	A23		UK	Next 2017
Annual	GSA-Samba		SOUTH AFRICA	Next 2016
Biennial	A25		FRANCE-SPAIN	Next 2018
Biennial	75	North	NORWAY	Next 2018
Biennial	GSA-Arctic		SWEDEN	Next 2018
Biennial	Davis		CANADA	Next 2017
2016	I08	South	USA	completed
2016	I09	North	USA	completed
2016	P18		USA	at sea
2016	P15	South	AUSTRALIA	completed
2016	P09		JAPAN	completed
2016	A12		GERMANY	funded
2016	SR04		GERMANY	funded, partial occupation
2017	A10		GERMANY	funded (follows 34.5 S)
2017	SR03		AUSTRALIA	funded
2017	P06		USA	funded
2017	P13		JAPAN	planned
2017	A02		IRELAND	planned
2017	P17	East	Japan	funded
2018	S4P		USA	funded
2018	A10		UK	funded (follows 24 S)
2018	I7	North	USA	planned
2018	P16	South	USA	funded
2018	MED01		GERMANY	planned
2018	A17		SPAIN	planned
2018	40	North	JAPAN	planned
2019	I08	North	JAPAN	funded
2019	I07	South	JAPAN	funded
2019	I06	South	USA	funded
2019	A13.5		USA	funded
2020	I09	South	AUSTRALIA	planned

Eighteen cruises have been planned for 2017 and beyond (11 funded) for reference sections. It is noteworthy that five cruises have been planned for the reference sections in the Indian Ocean for years 2018 to 2020. The I07N will be completed by the US and the rest by Australia and Japan. Ireland is planning to conduct A02 cruise, which has been accepted by planning commission for 2017 but still needs government confirmation.

Masao's presentation was followed by discussion focused on the planned shift of GO-SHIP lines in response to regional efforts and higher feasibility of running shorter lines. The A10 line was discussed in the context of problematic bathymetry which could force a northward or southward shift of the line. This argument is counterbalanced by the fact that the current location of the A10 line is optimal from the geostrophic perspective. Concerning the 24.5 line, UK was said to be keen on maintaining observations there. It was recommended that a more scientifically-rigorous cruise plan was designed to study this region. Moreover, it was noted that US GO-SHIP has more planned updates on their lines than presented by Masao. It was requested that Martin Kramp from JCOMMOPS be informed about that.

ACTION ITEM 15

To inform Martin Kramp at JCOMMOPS about the need to update the planned US GO-SHIP lines in the global GO-SHIP cruise plan. (*Responsible: Ishii, Wanninkhof. Timeframe: Immediate. Financial Implications: None.*)

Lastly, an issue of the use (or lack thereof) of nutrient Certified Reference Materials (CRMs) on GO-SHIP cruises was brought up. This discussion was continued and extended under the Nutrients theme.

Update of the GO-SHIP manual

GO-SHIP Repeat Hydrography Manual ("Hydro Manual") (<http://www.go-ship.org/HydroMan.html>) is now under considerations for the update. In its current edition (V1), a chapter dealing with the measurements of dissolved organic matter (DOM) is missing. The Hydro Manual also does not comprise Standard Operation Protocols for fluorescence or backscattering and they became urgently needed in the light of rapid development of the Biogeochemical Argo (BGC Argo). Rapidly increasing number of floats carry these sensors and operators often rely on GO-SHIP data for Calibration/Validation. Update of the macronutrients chapter is also ongoing, with Susan Becker (SCRIPPS, USA) leads this effort and completed the first draft as of February 2017. Public consultation of this chapter might be necessary so the document will appear on the SCOR WG 147 (COMPONUT) website prior to being submitted to GO-SHIP. Other chapters that might require an update and are assessed by relevant GO-SHIP members are: the chapter dealing with CTD methodology and ADCP chapter.

Martin Kramp in JCOMMOPS suggested moving all Hydro Manual files to IOC's International Oceanographic Data and Information Exchange (IODE) page (<http://www.iode.org/>) for greater visibility beyond the GO-SHIP community. GO-SHIP website would then provide only links into the IODE catalogue. Martin is to check whether this step would have any impact on document ownership, which must remain fully with GO-SHIP. The suggested solution was to discuss this topic at the upcoming JCOMM OCG meeting in May 2017. In any case, the Hydro Manual would not appear as an IODE report but rather as part of the IOC Technical Guides and Manuals Series. Furthermore, it was suggested that Dickson's Guide to Best Practices for Ocean CO₂

Measurements, and an Underway CO₂ Manual could also be published under the same series in the future.

ACTION ITEM 16

To communicate with Martin Kramp and Albert Fischer (IOC) about the potential publication of the updated GO-SHIP Manual and other guides for best practices in the field as part of the IOC Technical Guides and Manuals Series as the path forward for publishing guides and manuals for marine biogeochemistry. (*Responsible: Wanninkhof, Telszewski* *Timeframe: Immediate. Financial Implications: None*).

G7 initiative 'Future of the Oceans and Seas'

Masao and Toste gave a brief overview of the process leading to and resulting from a meeting of the Ministers for Science and Technology of Canada, France, Germany, Italy, Japan, the United Kingdom, the United States, and the European Commissioner for Research, Science and Innovation, which took place in Tsukuba City from 15 to 17 May 2016. In general, the Ministers supported the achievements of the UN Sustainable Development Goal 14 to conserve and sustainably use the oceans, seas and marine resources. In addition, they released a [Tsukuba Communiqué](#) where several actions relevant to IOCCP's mission were endorsed by the Ministers. "Tsukuba Communiqué" addressed "Future of the Seas and Oceans" recognizing "it is crucial to develop far stronger scientific knowledge necessary to assess the ongoing changes and their impact on economies", and recommended the technical Working Group to continue its work which will be monitored by G7 Ministers to assess progress and identify G7 country leads responsible for implementation of specific activities.

In response to a call for specific recommendations to be submitted to the technical Working Group, several observing networks and communities of practice provided their written recommendations. Masao focused in particular on GO-SHIP and Argo.

GO-SHIP developed a set of recommendations for national representatives prioritizing the following issues:

Priority 1: Sustained funding of the continuation of GO-SHIP including Secretariat support.

Priority 2: National support of GO-SHIP Data Centres.

Priority 3: Production of data products for informed national and international policy advice and decision making.

In addition, GO-SHIP committed to a strong transfer of knowledge activity in relation to high precision ocean measurements benefiting countries that are not yet members of the GO-SHIP consortium.

Recommendation from Argo addressed global warming, sea-level rise, ocean acidification, deoxygenation, and the oceans' absorption of greenhouse gasses as key societal issues, and proposed to establish deep and biogeochemical (BGC) arrays at regional scales in the short-term (1-3 years) and to progress to full global arrays in the long-term (5-10 years). Argo team also clearly stated that "Argo depends on GO-SHIP expeditions on research ships for float deployment opportunities, and to gather the reference data for ensuring float data are of suitable quality for climate research. Argo does not replace ship measurements: rather it complements them."

Recommendations from several other teams have been made. The most relevant to IOCCP's mission were the following: "Basin-scale observing (MOC in the Atlantic

Ocean)", "Deep Sea (Biodiversity)", "Fixed point observatories (OceanSITES)", "Glider", "Ocean chemistry and oceanographic cruises", "Ocean synthesis/reanalysis", "Pelagic marine plankton", "Satellites", "Sea-level", "Ships of Opportunity", "Southern Ocean (SOOS)", "Technology", ("Arctic" and "Tropical" are pending). Many of these recommendations address the issues of biogeochemical changes in the interior of the ocean in their key proposed actions and/or objectives.

Toste (a German national representative and official GOOS representative to the G7 Future of the Oceans and Seas Working Group) then proceeded with a more detailed account of the G7 initiative on sustainable ocean observations, its goals and opportunities for IOCCP. He specifically mentioned that G7 has an interest in producing more regular assessments on the oceans, akin to the ones made by IPCC on climate. A key requirement is to identify and mobilize the national funding for sustained observations, which means that requests for more operational-based funding schemes be put forward to national governments. Some specific recommendations drafted so far and of relevance to IOCCP consider a request for 2 person months for SOOP-CO₂ support, and 6 person months for GO-SHIP. Also, a dedicated GOOS G7 Office is in planning, with headquarters outside of the IOC but very related to ongoing GOOS activities. Such a structure would potentially enable new funds raised for IOCCP, GOOS BioEco Panel and observing network activities. The recommendations document is currently in an iterated review stage, and will be submitted to G7 national representatives later this year. Toste also pointed out that BGC Argo is on top of the list of specifications for implementation. Deep Argo, OceanGliders and SOOP-CO₂ are also of high importance to the Working Group on the priority list.

Toste added that FOO and EOVs concepts appear ubiquitously in the drafted documents, and they will be central to the implementation of these recommendations.

Finally, an outstanding action item from the XIth Session related to the update and expansion of the relevant page on the website was passed on for 2017.

ACTION ITEM 17

Update the relevant page on the IOCCP website including careful analysis of existing and missing content as well as connections to resources available elsewhere. Also consider creating additional sub-page for BGC floats and gliders. (*Responsible: Ishii, Connelly, Palacz. Timeframe: Before next SSG meeting. Financial Implications: None.*)

5. Update and Vision for Synthesis Activities: Ocean Interior

Siv Lauvset presented this theme. Siv's presentation focused on the following themes: (i) the GLODAP Reference Group: membership, ToRs, and workshop, (ii) GLODAP website hosting, (iii) next GLODAP release, (iv) GLODAP publications and citations, (v) GEO Carbon and GHG Flagship Initiative.

GLODAP Reference Group: membership, Terms of Reference and activities

To ensure the future of GLODAP, the IOCCP have begun working on putting together an international team of scientists – the GLODAP Reference Group – that will coordinate and lead the future versions of GLODAP. On November 25th 2016 there was a virtual meeting attended by Siv K. Lauvset, Are Olsen, Toste Tanhua, Carsten

Schirnack, and Maciej Telszewski. At this meeting a list of international scientists which we would like to serve as Group members was created and it was decided to draft a Terms of Reference (ToR) document outlining the work required of the Group.

Siv presented the proposed list of GLODAP Reference Group members to be invited as soon as the terms of reference are finalized. She requested input on two names to fill the void for the Pacific and South American region. She also commented on the ill-balanced ratio of male to female members of this group. After an all-Panel discussion, the SSG responded with specific suggestions to fill the regional gaps and increase the gender balance amongst the invited colleagues.

Siv then emphasized the need to develop a strategy for obtaining funding for the GLODAP Reference Group IT infrastructure and activities (mainly technical workshops), without which the planned work will not occur. IOCCP will continue to help support the latter but cannot be held solely responsible for securing all the financial support.

As far as the initial GLODAP Reference Group activity is concerned, it was agreed that holding a technical workshop at which new adjustments will be agreed is the way forward. However, holding it this calendar year, as a side event to the ICDC10 for example, was deemed premature. Such a 2-day, technical workshop should not be organized until proper group structure is set up, and adjustments tables are made available. The GLODAP Reference Group would mostly be a virtual meeting group, but for each GLODAP product release, one face-to-face meeting should be planned to discuss adjustments. Co-locating the first technical workshop with Ocean Sciences Meeting in Portland in February 2018 was regarded as potential possibility.

In terms of the leadership, discussions were held with regards to specific members of the group. It was decided that most probably two co-Chairs should be selected immediately, one of whom will be Are Olsen to assure the continuity of leadership. The Reference Group will inform the community about its decisions as soon as possible.

ACTION ITEM 18

To complete and formalize the composition of the GLODAP Reference Group and to finalize the Terms of Reference. (*Responsible: Lauvset, Telszewski, Tanhua. Timeframe: Immediate. Financial Implications: None.*)

ACTION ITEM 19

To provide financial and logistical support to a technical workshop if one will be organized during the current intersessional period (potentially coincided with OSM 2018). (*Responsible: Lauvset, Telszewski, Palacz. Timeframe: On demand. Financial Implications: Low to Medium.*)

GLODAP website hosting

A discussion was initiated on web hosting of the GLODAP project and data products now that CDIAC Ocean was discontinued. University of Bergen bought the domain www.glodap.info but needs around 5,000 USD for the initial website set up. While the newly funded EU project RINGO can ensure maintenance of the website activities for the next 4 years, it cannot be used to set up the CMS initially. Benjamin has requested that the IOCCP Office provides support for that within its website services.

An in-depth discussion followed on whether IOCCP should take responsibility for

ensuring sustainable access to both SOCAT and GLODAP products which are IOCCP's core data products. The Panel agreed that taking such an administrative responsibility would send a positive message of IOCCP providing leadership in curating these two extremely important products, without claiming sole ownership. Furthermore, taking leadership on this front would be beneficial to all contributors through direct and much stronger association with GOOS via the Biogeochemistry Panel as well as increased visibility via IOC communication channels with its Member States. This view was supported by several SSG members, the SOLAS Chair and the Director of the GOOS Office present in the room. None of the other contributors are likely to offer resource to take such leadership.

However, it was agreed that IOCCP Office does not have the human resources to run the websites, and that IOCCP should not spend its funds on setting up CMS for either GLODAP or SOCAT. The priority is thus now for glodap.info to have GLODAPv1 and GLODAPv2 on there and not only on the NCEI website.

Also the new GLODAP website is not a data archive, and so there remains an issue regarding archiving of cruise data files post-CDIAC. Hopefully this will be resolved as part of the Biogeochemistry GDAC, but the IOCCP needs to be prepared to inform and advise the community. Strong coordination between the Interior Ocean Observations and Interior Ocean Synthesis themes in the IOCCP SSG is needed.

ACTION ITEM 20

To relocate GLODAPv1 and GLODAPv2 onto the www.glodap.info site. (*Responsible: Pfeil. Timeframe: mid-2017. Financial Implications: None*).

ACTION ITEM 21

Investigate and utilize procedures for GLODAP and SOCAT to become core IOCCP and GOOS (Biogeochemistry) data products. (*Responsible: Pfeil, Telszewski, Fischer (GOOS) in consultation with SOCAT and GLODAP leaders. Timeframe: 2017. Financial Implications: None*).

Next GLODAP release

It was agreed that scheduling the next release of GLODAP for 2017 is not realistic. More realistic is to publish in mid-2018 with all of 2017 data, considering that the new GLODAP Reference Group meeting will likely not take place before Ocean Sciences Meeting 2018 (February, 2018). It was noted that Siv and Toste published a software for Quality Control for GLODAP, but this tool was not developed for the online data handling. At the University of Bergen there is funding in the EU project RINGO for a programmer (to be hired in the first half of 2017) that will work on creating the future GLODAP data product files. This programmer will also be responsible for developing an online QC tool, based on the Lauvset and Tanhua (2015) Matlab code. Such an online tool will reduce the work effort needed to QC new cruises and determine adjustments, but before it is in place the process of producing the next update (GLODAPv2.2018) will be quite labour-intensive for the Reference Group.

GLODAP publications and citations

The SSG wanted to hear if the GLODAP datasets would be published as annual update papers similar to SOCAT, or whether single users were encouraged to publish their own individual datasets. While the users are strongly encouraged to do the latter,

there is obviously an advantage in publishing GLODAP synthesis products papers in parallel, e.g. due to secondary QC performed.

Siv expressed her dissatisfaction with the way the GLODAP products are cited. Specifically, the NDPs are cited instead of the ESSD articles. The community needs to move away from NDPs (which are not used by NCEI anyway and therefore already are a thing of the past). The reference used for the data synthesis products should be the publication in a data journal (ESSD in this case). It was suggested that GLODAP prepares a Data Policy similar to the one of SOCAT and that IOCCP will disseminate this information to the community.

ACTION ITEM 22

To construct and widely disseminate a GLODAP Data Policy. (*Responsible: Lauvset, Tanhua, IOCCP Office. Timeframe: 2017. Financial Implications: None.*)

Other

As a general remark, followed by a discussion, Siv directed the Panel's attention to the fact that quite a few synthesis activities are ongoing at the moment, which are mostly interior ocean (GLODAP, OA, time series). There is a danger of duplicated effort, which we as a community should strive to avoid. The IOCCP SSG needs to advocate the relevance and highest quality of these synthesis activities so that their utility to users is assured. GLODAP and SOCAT can be regarded as gold standards for assuring data quality at all stages of the synthesis product development. IOCCP should encourage the rest of the community to keep to that standard for everyone's benefit. Dick has specifically emphasised the fact that data quality costs money and that neither of the two existing synthesis products were directly funded. Proper funding level is the only way forward for the existing and newly developed data synthesis products.

At the end of Siv's presentation she focused on a couple of outstanding actions from the previous annual meeting. Last year's Action Item 16 (*Facilitate activities increasing ocean interior data consistency and improved data quality*), is being and will continue to be taken care of within the newly funded EU project RINGO, which is funded for 4 years until 2021. Last year's Action Item 17 on updating the website has been moved over to this year.

ACTION ITEM 23

Update the relevant page on the IOCCP website including careful analysis of existing and missing content as well as connections to resources available elsewhere. (*Responsible: Lauvset, Palacz. Timeframe: Before next SSG meeting. Financial Implications: None.*)

6. Update and Vision for Time Series Efforts

Björn Fiedler presented this item. He divided the presentation (and hence the discussion) into five separate issues presented below.

Communication and coordination with US OCB OTC & IGMETS

The aim of this effort is to better interconnect IOCCP Time Series activities with the US OCB Ocean Time Series Committee (OTC) in order to combine efforts and avoid redundancies. The OCB OTC has a strong focus on the US time series programs but has also engaged in many international activities in the past. During a meeting with the former OTC chair (Susanne Neuer) it was agreed that both programmes will frequently update each other on time series related developments. OCB is interested in the status of the EOVS development within IOCCP and how this potentially interconnects with the time series community. It was agreed that the IOCCP SSG expert for time series will join one of the next regular OCB OTC meetings in order to push forward the exchange of information between OCB and IOCCP. Topics that might be addressed during the meeting are a potential time series data product, plans & ideas for the OceanObs'19 Conference and the most recent status of the development of EOVSs.

ACTION ITEM 24

To strengthen information exchange with OCB and IGMETS regarding coordination of activities, with the FOO and EOVS concepts kept in perspective. Attend the OCB Time Series Committee meeting to present IOCCP work and strategy. *(Responsible: Fiedler, IOCCP Office. Timeframe: Ongoing. Financial Implications: Low).*

ACTION ITEM 25

To offer assistance to OCB Office regarding revival of the TS mailing list, with strong emphasis on the fact that the community needs to be aware that this mailing list was developed to serve the global community rather than focus on any individual region. *(Responsible: Fiedler, Palacz. Timeframe: Ongoing. Financial Implications: None).*

Biogeochemical Time Series metadata base and online map

The IOCCP page for Time Series efforts was significantly updated. In the process it was decided to promote the ship-based time series sites by developing a concise mapping tool that illustrates the global distribution of stations around the globe. The map should also highlight the distribution of specific EOVSs that are being measured at different stations. The metadata behind this visualization will be compiled from different sources of metadata that exist (OCB, IGMETS, GOA-ON). A need for stronger coordination with OceanSITES was noted in order to establish the details of biogeochemical observations on moorings. A first version of this meta database has been harmonized already in Bergen and will be maintained there in the future. An early version (Figure 2) of this map already exists and will be published once it is finalized and approved.

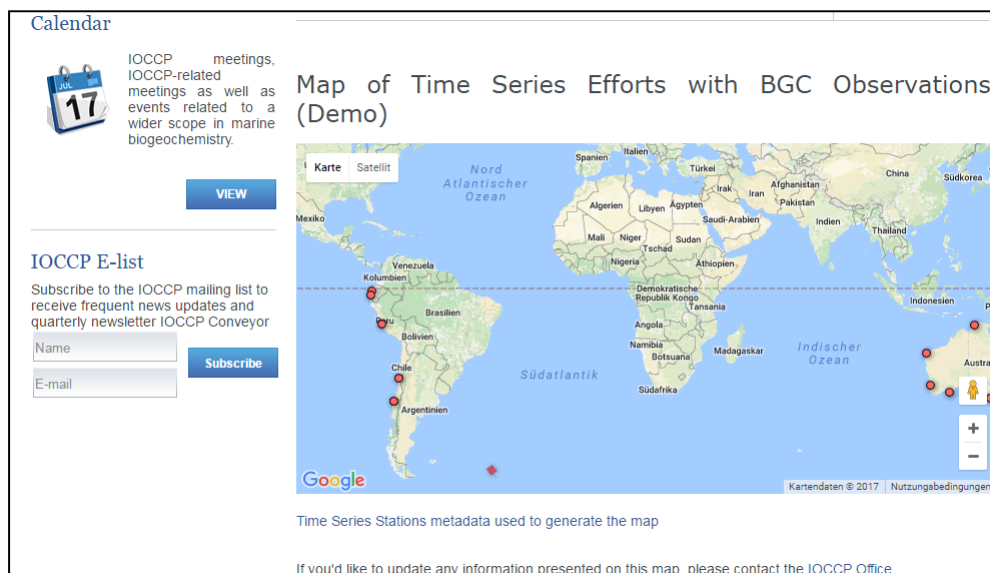


Figure 2. Demo map of time series efforts with biogeochemical observations

ACTION ITEM 26

Working with JCOMMOPS and OceanSITES gather the missing metadata information for moored time series. Publish the online map of existing time series sites with basic metadata information. (*Responsible: Fiedler, Palacz. Timeframe: 2017. Financial Implications: None.*)

Time series data synthesis products

Bottle data from ship-based time series stations are not systematically fed into data synthesis products such as GLODAP or SOCAT. At the same time, there are no uniform quality control (QC) procedures for time series data in place within the time series community. Recommendations were made following the OCB/IOCCP time series workshop in 2012 in Bermuda ([Report](#)). However, the focus during the workshop was mainly on the analytical methods to be used for time series observations.

Data syntheses products are becoming ever-more informative and with the increased use of autonomous platforms and sensors as part of a global ocean observing system, the value of synthesis products for end-users will increase even further. These assets will rely on quality control (QC) procedures similar or identical to those developed for GLODAP and/or SOCAT. Furthermore, ship-based time series stations are also under pressure to create more visibility and demonstrate societal benefit in order to ensure continuation of these observations in the long-term. SOCAT is an excellent example for how a community-driven effort can create such visibility and thereby contribute towards sustaining an observational network.

Concurrent developments and improvements of handling bottle data and partial automatization of QC routines as part of GLODAP and SOCAT will be highly beneficial for the development of a ship-based time series data product. The time series community could piggyback on this infrastructure and the experience that exists within GLODAP and SOCAT. Björn proposed that IOCCP support the development of such a data product within the ship-based time series community. The idea of a community-driven time series data product should be discussed amongst major time series sites with IOCCP coordinating such a process. Björn also proposed that a scoping meeting could be organized in 2018 (once the data handling infrastructures were developed).

During such a workshop a working group would be formed to pursue the development of relevant data product(s).

A discussion that followed this part of the presentation focused on the subject of potential unique products that could be developed. A couple of ideas gathered the most nods amongst the Panel members: annual and seasonal cycles of several parameters and trends in these cycles in various regions of the ocean.

ACTION ITEM 27

To organize a workshop for main ship-based time series observatories around the globe (10-15 participants) with the goal of scoping the work towards time series data synthesis products. (*Responsible: Fiedler, Pfeil, IOCCP Office, SSG as needed. Timeframe: before end of 2018. Financial Implications: Medium to High*).

Coordination of activities in Africa

Björn reminded the Panel about a severe lack of observations of the marine environment along the African coastline, in particular for biogeochemical EOVs. At the same time there is a need for more coordination of research activities and more communication between regional research communities. GOA-ON is strongly engaged in building the observing community in the region via a variety of pathways and IOCCP is an integral part of these efforts. As a result of these activities the OA-Africa group has been initiated just recently. Björn highlighted the importance of IOCCP continued involvement in order to support proper implementation of future biogeochemical observations around Africa. One suggested opportunity would be the organization of a side event during an international marine science symposium which will be held in Nov. 2017 in Cape Verde. This symposium will be attended by several scientists from West Africa as well as from Europe and South and North America. Björn suggested that IOCCP could support travel of representatives from South and/or East Africa as well as from the recently formed OA-Africa group to join this symposium and an associated side event (2-3 persons in total). Such a side event should consist of presentations of regional initiatives for identification of potential synergies. Participants could also work on establishing regular communication pathways between regional efforts.

In the discussion that followed it was noted that GOOS Africa has virtually no funding and very little influence on what happens in the region and therefore such a top-down model does not seem to work in that region. On the other hand, there are now at least two EU projects occupied with coordinating observations in West Africa. Also South Africa works on linking with both West and East Africa. And finally, GOA-ON networking efforts seems to start bringing fruit already so it is perhaps inadequate to claim that there is lack of coordination in Africa.

Regarding Björn's request to contribute to the networking event in November 2017, SSG decided to hold on with until a more concise description of the activity is provided.

An inter-laboratory comparison assessing the quality of seawater carbon dioxide measurements

Following the previous inter-comparison, a lot of demand was created to repeat the exercise and Andrew Dickson informed the community that he will repeat the experiment most likely in 2017. IOCCP decided to take an active approach in

supporting interested participants and the SSG agreed that IOCCP should inform Andrew Dickson about modest funds being available to support labs in need. The strategy for distribution of these funds will be discussed with Andrew and based on his prior experience.

ACTION ITEM 28

To contact Andrew Dickson and inform him about availability of funds to support the inter-laboratory pCO₂ comparison. (*Responsible: IOCCP Office. Timeframe: Immediate. Financial Implications: Low*).

Finally, an outstanding action item from the previous session related to conceptualizing a strategy for efficient utilization of ship-based time series needs to be attended to during the coming months.

ACTION ITEM 29

In collaboration with major related programs and projects draft a (10-year) strategy for ocean time series observatories including strong emphasis on socio-economic aspects and based on the use of novel, cost-effective technologies wherever appropriate. (*Responsible: Fiedler, Connelly, IOCCP Office, input from SSG. Timeframe: Before next SSG meeting. Financial Implications: None*).

7. Update and Vision for Ocean Acidification

Richard Feely reported on ocean acidification (OA) activities related to IOCCP. As our involvement in OA is focused on coordination of large scale observations, we fulfil our mission mainly through the GOA-ON (4 IOCCP SSG members seat on the GOA-ON Executive Council), through collaboration with the IAEA-based OA-ICC and through coordination and communication with national OA-related observing programmes. Dick divided his talk according to the above order. In the report below we also add contribution from Cristian Vargas who could not attend the meeting but shared a written report focused on developments in Latin American community.

Global Ocean Acidification Observing Network (GOA-ON) (www.goa-on.org)

The Global Ocean Acidification Observing Network (GOA-ON) continues its effort to enhance the capacity and design of the global OA observing network and to provide coordination and implementation strategy for that design. Part of the specific focus of GOA-ON (driven by IOCCP members) which is in line with the IOCCP mission has recently been to define: ecosystem and goal-specific variables; spatial and temporal coverage needs; observing platform-specific recommendations; data quality objectives and requirements; and develop GOA-ON synthesis products.

During the latest intersessional period GOA-ON focused on the following efforts:

- continued development of the GOA-ON Implementation Plan to increase the observing network worldwide with training courses and scoping/scientific meetings in Inhaca, (Mozambique), Ensenada, (Mexico), Helsinki, (Finland), San Diego, (USA) and Fortaleza, (Brazil).
- help to build sound policy to identify, manage, and adapt to OA through improved science-communication at the local, regional, national, and international level. GOA-ON initiated and supported communication of OA science in formal and informal educational settings through the production and

dissemination of educational materials to target policymakers, students, and the public;

- support to a newly formed GOA-ON Biological Working Group to develop theoretical frameworks and research strategies to better understand these complex relationships as well as identify essential biological observing parameters to be monitoring the in situ effects of OA on marine organisms;
- development of and support to the communication and coordination of OA observing efforts within “pier2peer” (http://goa-on.org/GOA-ON_Pier2Peer.html) and “regional hubs” collaborations, that will serve to increase capacity and define regional science and policy needs for GOA-ON data and products;
- help to set up a GOA-ON Secretariat that will ensure that GOA-ON interests are represented in international policymaking and integrated at the local, regional, national, and international levels; and
- help to develop the GOA-ON data portal (<http://portal.goa-on.org/Home>).

In the discussion that followed this part of Dick’s presentation he emphasized that the biggest impact that IOCCP might have on OA observations is to help with conceptualizing, developing and implementing OA-related synthesis product(s). He expressed his concern with the difficulty in getting financial support for data synthesis products as well as obtaining adequate information from end users (e.g. policy makers) on what the exact requirements for such product(s) are. He suggested a dedicated meeting to discuss issues like: types of the products we need, how are they going to be produced, how is that going to be funded? For example, does a global map of pH and, eventually, a map of change in pH over time, meet the expectations of policy makers or national/regional managers? Within GOA-ON there is capacity to produce data synthesis products for both water quality and climate study uses but GOA-ON (with strong IOCCP leadership) must take responsibility for providing advice on requirements for such products based on several issues, for example the quality of measurements which will determine the types of platforms and sensors with which we will try to augment the current observing system.

In response, the SSG agreed that data synthesis products for OA-related parameters are badly needed. The Panel also suggested that IOCCP must rely strongly on its scientific partners (SOLAS, IMBER, CLIVAR) to take that step of driving the generation of new information products. The Panel found encouraging the fact that the new CLIVAR Science Plan is calling for exactly that. Additionally, the discussion developed around the potential overlaps between synthesis products-related activities in relevant themes of IOCCP. If possible such activities (or at least scoping workshops) should be combined.

ACTION ITEM 30

In collaboration with major related programs and projects (SOLAS, IMBER, CLIVAR, GOA-ON, GOOS Biology & Ecosystem Panel) organize a working meeting to identify most needed data synthesis products related to OA that could be implemented on a regular basis. *(Responsible: Feely, Vargas, IOCCP Office with help from SSG as needed. Timeframe: to be determined as soon as possible. Financial Implications: Medium).*

The Ocean Acidification International Coordination Centre (OA-ICC)
(<https://www.iaea.org/ocean-acidification>)

The OA-ICC, operated by the Agency's Environment Laboratories in Monaco, is working to communicate, promote and facilitate global activities on ocean acidification. It serves the scientific community and science users (policy makers, the general public, media and other stakeholders). Focusing on international activities that are not currently funded at national or international levels, its role is to support activities related to global actions on ocean acidification. These include increasing local capacity in OA observations, enhancing collaboration between natural and socio-economic sciences, exchange of students and scientists, joint experiments, definition of best practices and curating an open-access bibliographic database.

In 2016 the OA-ICC managed to compile a bibliographic database of over 3300 references, and provided a biological database of organism responses to ocean acidification (Yang et al., 2016). The OA-ICC Data Compilation on the biological response to ocean acidification was regularly updated and present experimental data from more than 600 papers in 2016. The OA-ICC continued its work to enhance capacity and support emerging collaborative networks in areas where it is needed the most and where ocean acidification data are scarce. The OA-ICC supported researchers from developing countries in Africa, Asia, Latin America and Europe to participate in the new Technical Cooperation (2016-2019) Inter-regional OA Project to help build the capacity to measure and study ocean acidification. The OA-ICC also supported the GOA-ON training courses in Inhaca, Mozambique, 8-12 March 2016 and Ensenada, Mexico, 5-10 September, 2016. The OA-ICC provides a daily updated news stream at: news-oceanacidification-icc.org. It provides data compilation at: <http://tinyurl.com/oaicc-data> and it provides a bibliographic database at: <http://tinyurl.com/oaicc-biblio>.

During the short discussion that followed this part of the presentation, the SSG inquired whether there is no overlap between the activities of GOA-ON and OA-ICC. Dick ensured the SSG that there is no redundancy in the parallel efforts of OA-ICC and GOA-ON when it comes to capacity building or any other activity. The two entities provide an example of very good collaboration. In order to obtain sufficient resources to fund the workshops and training courses, one must alternate between GOA-ON, OA-ICC, IOCCP and others. Each organization has its major priority when it comes to funding OA in general and individual activities are very often co-funded by a combination of sponsors depending on the specific aspect of the activity. Dick mentioned that the response to training courses is almost overwhelmingly positive and requests for follow-ups come mostly from developing countries, and are focused on the equipment needs and training on using the equipment.

Finally, Artur Palacz reminded the Panel that one action item from the previous session related to updating the IOCCP page dedicated to OA needs to be attended to in the coming intersessional period.

ACTION ITEM 31

Update the relevant page on the IOCCP website including careful analysis of existing and missing content as well as connections to resources available elsewhere. (*Responsible: Vargas, Feely, Palacz. Timeframe: Before next SSG meeting. Financial Implications: None*).

The remainder of the OA section comes from a written report submitted by Cristian Vargas prior to the meeting. His report focuses on activities implemented for the benefit of the Latin American community.

During 2016 the Latin-American community continued to focus on formalizing agreements and defining protocols for pCO₂ measurements in Latin-American countries in the framework of the Latin-American Ocean Acidification Network (LAOCA). The LAOCA Executive Council (EC) met for the first time in June 2016 in Lima, Perú. The main focus of this meeting was to define an action plan for the period 2016 – 2017. The EC discussed the need for structuring a regional network of carbon chemistry observations in Latin America. Special attention was given to countries with scarce or no capacity to observe carbon chemistry in both coastal and open ocean (e.g. Ecuador and Colombia). During the past six months, a clear community effort for supporting a regional program of carbon chemistry (pH/pCO₂) observation in the coastal ocean has crystalized, with proposals submitted to various national and international funding bodies.

A group of LAOCA members lead by Dr. Luis Alberto Acosta (Colombia) is working on a review paper focused on pH/pCO₂ measurements and biological response of marine organisms upon changing carbon chemistry conditions, in the context of Latin American region. Once published it is hoped to help increase the visibility of LAOCA in the international scientific community, and more importantly, it is hoped to allow for an informed design of the local observing system with consideration of the heterogeneity of habitats in the region (i.e. upwelling, estuaries, mangroves, fjords, oxygen minimum zones, etc.). To strengthen the motivation in the community, the LAOCA EC plans to engage national and regional funding bodies by producing a short version of this synthesis-paper, which will be used for outreach purposes. This effort follows on from a more national activity where a group of Chilean scientists have published (Vargas et al. 2017) a meta-analysis of all pCO₂ measurements from coastal time-series, characterizing the carbon chemistry dynamics in different environments, including river plumes, upwelling areas, estuaries and fjords, and their implications for local adaptation and adaptive plasticity in marine invertebrates.

Technical training focused on data quality control has also been recognized as a major gap by the LAOCA EC. This critical gap has been successfully addressed through actions under the strong support of IOCCP. In December 2016, the IOCCP and the International Atomic Energy Agency (IAEA), with co-sponsorship from the Millennium Institute of Oceanography (IMO), organized a hands-on Technical Workshop on Carbonate System Measurements at the Universidad Autónoma de Baja California, in Tijuana-Ensenada, Mexico. Eight Latin-American countries participated in this workshop, involving 14 participants who significantly strengthened their analytical capacity for carbon chemistry measurements (e.g. spectrophotometric and potentiometric pH, total alkalinity, dissolved inorganic carbon, and measurements using autonomous sensors (SeaFET, SeapHOX)). The workshop focused on hands-on laboratory experience where instructors (Andrew Dickson, James Örr, Todd Martz, Jose Martín Hernandez-Ayón, Maciej Telszewski and Cristian Vargas) taught the workshop participants the appropriate high-precision chemical techniques and protocols related to carbonate system measurements. Additionally, lectures on the design of the observing system, data management practices and carbonate system calculations were included to allow the participants to understand a wider context of making measurements and collecting data.

This also allowed identifying the existing analytical strengths and weaknesses among the different research groups in Latin America. Based on that experience, it is assumed that precision and accuracy of carbonate chemistry measurements meets globally accepted requirements in at least five countries in the region (i.e. Argentina, Brazil, Mexico, Peru and Chile). LAOCA is planning an inter-calibration exercise among these working groups, which will most probably happen in the first half of 2017. Alternatively, these laboratories will participate in the inter-calibration exercise being organized by Andrew Dickson during 2017.

LAOCA has finally launched its website (<http://laoca.cl/en/>). The website content provides all the information about the network, members, participants, mission, objectives, governance plan, activities and organization of events. The website also links LAOCA with other international programs such as GOA-ON, IOCCP, OA-ICC and IMBER.

Finally, LAOCA is organizing its first scientific symposium to be held in Buenos Aires, Argentina, in October 2017. The symposium themes will include:

- Ocean acidification observing systems
- Modelling and regional projections of ocean acidification in Latin-American
- Physiological and ecological impact of ocean acidification: from organisms to ecosystems
- Human dimension of ocean acidification research

The Symposium is sponsored by IAEA and the Millennium Institute of Oceanography (IMO). IOCCP's input to the Symposium programme would be highly appreciated. Potential topics could include data management themes, observing system design including Essential Ocean Variables and data quality aspects.

8. Update and Vision for Nutrients

Michio Aoyama presented this theme. He started by updating the SSG on the follow-up to the 2015 inter-laboratory calibration exercise. '*IOCCP-JAMSTEC 2015 Inter-laboratory Calibration Exercise of a Certified Reference Material for Nutrients in Seawater*' was published online in June 2016 as IOCCP Report Number 1/2016 and ISBN 978-4-901833-23-3. The report was printed and 2 copies were sent to each participating laboratory in December 2016, one for the participant and for the library of the Institute/Organization/University.

Michio updated the Panel on the action plan following the publication of the report. From the report itself it seems clear that at present the comparability among the participants of the 2015 I/C exercise is quite similar with previously obtained comparability in 2012 I/C study as well as previous I/C studies. To improve comparability of oceanic nutrients data the following is proposed:

- Continue the series of Inter-laboratory Calibration Experiments to observe how the performance of the community changes following the introduction of CRMs for nutrients.
- Specifically for nitrate, several laboratories reported results that were significantly lower than the expected value, suggesting that for this particular measurement there is still a wide margin for improvement. To remedy the

situation a 'Silicate workshop' is planned at NIOZ (Netherlands) in November 2017 by SCOR WG#147.

- Interactive discussion with participating laboratories on how to continue and improve the Inter-laboratory Calibration Experiments is planned. Michio plans to send out a questionnaire to all the participants with questions designed to improve the effectiveness of future inter-comparisons.
- A scientific paper which will analyze the details of the results of the 2015 IOCCP-JAMSTEC I/C is also planned.

Following this update, Michio asked the IOCCP to confirm its commitment to co-sponsor the next inter-comparison exercise which will most likely take place in late 2017. The Panel confirmed IOCCP's commitment.

ACTION ITEM 32

Support the organization of and contribute financially to the follow-up inter-comparison activity to be performed in late 2017 / early 2018. (*Responsible: Aoyama, IOCCP Office. Timeframe: Before April 2018. Financial Implications: Low to Medium*)

The discussion then shifted to the distribution of CRMs. The IOCCP was asked to encourage the purchase of new CRMs (<http://www.jamstec.go.jp/scor/>). The response from the community has so far been very poor. Based on the questionnaire filled by 74 laboratories prior to production process, the initial demand was assessed to be at the order of 3000 bottles per year. So far (18 months after bottling of the first batch), 137 bottles were ordered by 7 laboratories. The CRMs are currently 60% cheaper than initially thanks to a subsidy grant aimed at increasing the use of CRMs. The CRMs have an official shelf-life of 72 months, but in reality are thought to be of unchanged concentration through a 10-year period. Michio stated that in the updated Nutrients chapter (currently finalized) of the GO-SHIP Manual, the use of nutrient CRMs will be listed as a Standard Operating Procedure. Another suggestion from the SSG was to effectively enforce the use of CRMs by stating that any cruise that does not use CRMs will not qualify as a Level 1 GO-SHIP cruise. The IOCCP Panel unanimously recommends the use of Nutrients CRMs, and expressed hope that this becomes an absolute requirement on GO-SHIP cruises as soon as possible.

ACTION ITEM 33

Issue a letter from IOCCP recommending the use of nutrients CRMs on GO-SHIP cruises and guiding the community to the appropriate website for purchase of these CRMs. (*Responsible: Aoyama, IOCCP Office. Timeframe: As soon as possible. Financial Implications: None*)

9. Update and Vision for Instruments and Sensors

Doug Connelly presented this item, with most of the Panel contributing to a major discussion related to the organization of the Second International IOCCP Sensor Summer Course.

As was the case last year there have been some important developments in the field of sensor technology development for addressing aspects of the carbon system and nutrients. The Shell ocean discovery XPRIZE (<http://oceandiscovery.xprize.org/>) is moving forward and after the initial proposals the final number of competitors selected

is 25 teams from around the world. Oversight of this competition will continue. The Alliance for Coastal Technologies (ACT) are running the nutrient challenge and the competition is in the final stage of field testing and data analysis, oversight of this project will continue.

A special topic on Sensors for Autonomous Ocean Observations has been launched as part of the *Frontiers in Marine Science* journal. Community uptake so far has been encouraging and we will report in the Conveyor when papers of particular relevance to IOCCP and the community will be published. As has been highlighted previously there is not a real community around the development of sensors for the marine environment. We will continue to try and engage with the separate groups to develop a community, a widening of the scope of the IOCCP to cover nutrient and other marine sensor developments may help this.

The EC funded projects under the 'Oceans of Tomorrow' (OoT) and the AtlantOS project are continuing and are reviewed below. Some of the work from SenseOCEAN was covered in the IOCCP Conveyor No 36 (October 2016) as a summary of the field trials of the first integrated sensor package for pH. All these projects will be monitored to identify relevant outputs and findings.

AtlantOS (<https://www.atlantos-h2020.eu>)

The AtlantOS project continues and recently produced a couple of documents of interest for the IOCCP sensor theme. These are: D6.1, *A Sensors and Instrumentation Roadmap* and D6.2, *The Roadmap for Emerging Networks*. For these and other AtlantOS deliverables please go to:

<https://www.atlantos-h2020.eu/project-information/work-packages/deliverables/>.

There is a deliverable as part of the project that deals with the development of best practice manuals for carbonate system parameters, nutrients and trace elements. It is important to link with these efforts for the benefit of the global community.

STEMM-CCS.

The "Strategies for the environmental monitoring and measurement of marine carbon capture and storage" project (<http://www.stemm-ccs.eu/>) has started and whilst at an early stage, is identifying a package of carbon system parameters to be used on a series of landers, and deployed on AUV's during the upcoming field deployments over the next 3 years.

Second International IOCCP Sensors Summer Course (2018)

Following this update, the focus of the Panel shifted planning of the Second International IOCCP Sensors Summer Course.

It was agreed that the organization of such a course is very demanding and IOCCP can only engage provided that co-sponsors can help with funding, and most importantly, with the organization of the event. Most of the funding (perhaps 70%) will be secured by IOCCP, and therefore, co-sponsorship will not be as critical as it was the case with the first course run in 2015. However, organizational help is required and concrete efforts need to start around June 2017 for the school to be run in June 2018. The Panel recognized that the IOCCP Office will be fully engaged in organizing the Sensors Course for 3-4 months prior to the event and therefore no other activities will be planned at that time.

IOC offered to help find avenues for funding the workshop, as well as to make available some of its infrastructure to capture the contents of the course, and replicate its outcomes around the world. A proposal to the Swedish Academy of Sciences will also be drafted by Toste.

The Panel agreed that it is essential to clearly define the scope of the workshop, and equally important to maintain that scope as partners become involved. Considering that IOCCP is downstream from sensor development activities, the focus of the course should be on the established sensors, and not on promoting cutting edge technology. It was also recommended that the course expands beyond moorings as sole observing platforms used for training. Use of sailing boats, floats and surface autonomous vehicles could be considered – though the latter would be challenging to deploy during the course, also depending on the course venue. Similarly, the scope of the course should reach beyond carbonate chemistry and include oxygen and nutrients as previously. The target audience for this course was agreed to include less experienced users, i.e. postdocs and late stage PhD students.

ACTION ITEM 34

Finalize and publish a Sensors User Guide based on the input compiled during and after the First International IOCCP Sensor Summer Course. (*Responsible: Telszewski, Tanhua, Palacz. Timeframe: July 2017. Financial Implications: None*).

ACTION ITEM 35

Prepare an outline (proposal) for the 2nd edition of the IOCCP Sensor Summer Course to be held in June 2018. Scope, general agenda, planned outcomes and logistics and initial description of partners need to be included. It's proposed that also oceanographic platforms utilizing autonomous sensors (fixed-point vs. mobile platforms) would become part of the scope so that a system design becomes part of the skill-set in the next generation of autonomous sensors' operators. (*Responsible: Connelly, Fiedler, Tanhua, Telszewski, Palacz. Timeframe: Outline ready by end of June 2017. Financial Implications: Low*).

ACTION ITEM 36

Organize and run the 2nd edition of the IOCCP Sensor Summer Course to be held in June 2018, providing the availability of the meeting venue. (*Responsible: Connelly, Telszewski, Palacz and additional volunteers from the SSG. Timeframe: June 2017 - June 2018. Financial Implications: Very High*)

ACTION ITEM 37

Extend the functionality and content of the Instruments and Sensors' page on IOCCP website to better cater the community needs. (*Responsible: Connelly, Palacz. Timeframe: On-going. Financial Implications: None*)

10. Update and Vision for Data and Information Access Services

Benjamin Pfeil presented this item.

SOCAT

Data for SOCAT version 4 which was published in 2016 was processed by staff from

the Bjerknes Climate Data Centre in Bergen. Data for SOCAT version 5 currently undergoes quality control and will be published in June 2017. Individual cruise files were archived at PANGAEA including original and enriched metadata. Concatenated files for SOCATv4 gridded and observational data were archived at CDIAC.

Since the data ingestion for SOCATv4 (late 2015) PIs have been using the SOCAT automation dashboard to contribute their data and metadata to the collection and the use of the automated system has been steadily increasing. The automation eases data submission and ensures initial automated quality control, and is favored by users – overall it enabled the global biogeochemistry community to channel and quality control their steadily increasing streams of data.

Nearly 600 data sets have been submitted to SOCATv5 – most submissions are data from recent years but SOCAT also successfully manages to rescue an impressive amount of data older than 7 years (around 20 % of all submitted data to SOCATv5). In addition, data and metadata already included is continuously updated. The above highlights the success of SOCAT and its unique standing within the global community. Staff from the Bjerknes Climate Data Centre also provided additional services on SOCAT e.g. ensuring data flow (including documentation) for the Global Carbon Budget.

ACTION ITEM 38

To coordinate and support work on data reduction software for SOCAT automation between Steve Jones at ICOS and Dennis Pierrot at NOAA AOML. (*Responsible: Pfeil, IOCCP Office. Timeframe: Ongoing. Financial Implications: Low*).

Global Data Assembly Centre for Marine Biogeochemistry

In early spring 2016 the IOCCP project office circulated the position paper on Global Ocean Biogeochemistry Data management (see <http://www.ioccp.org/index.php/data-and-information-management> for details). Feedback was overwhelming indicating the overall need of the described system. Respective data networks and archives holding marine biogeochemistry data were contacted and collaboration was established, whenever it was not yet in place. The Bjerknes Climate Data Centre submitted a proposal to the Research Council of Norway. The proposal directly refers to the needs as described in the position paper – feedback about funding is expected in late spring 2017. Pending the approval of funding, a Global Data Assembly Centre for Marine Biogeochemistry will be in place by 2019.

The GDAC will provide easy access to quality controlled Inorganic Carbon EOV/ECV from various data centers, observing networks, data networks, data products and integrated networks – relevant networks were approached and supported the proposal. The final aim is to have an overarching system that will build upon existing networks allowing non-competitive access to their services. Figure 3 indicates the structure of the GDAC with the main data centres, data products and networks involved. Letters of support were received from IOC UNESCO GOOS and IODE, UNESCO/SCOR's IOCCP, GEO's Carbon and GHG Initiative, GOA-ON, SOLAS, Global Carbon Project, GO-SHIP, AtlantOS, COPERNICUS, GDAC ARGO, EMODnet and the Norwegian Environmental Agency.

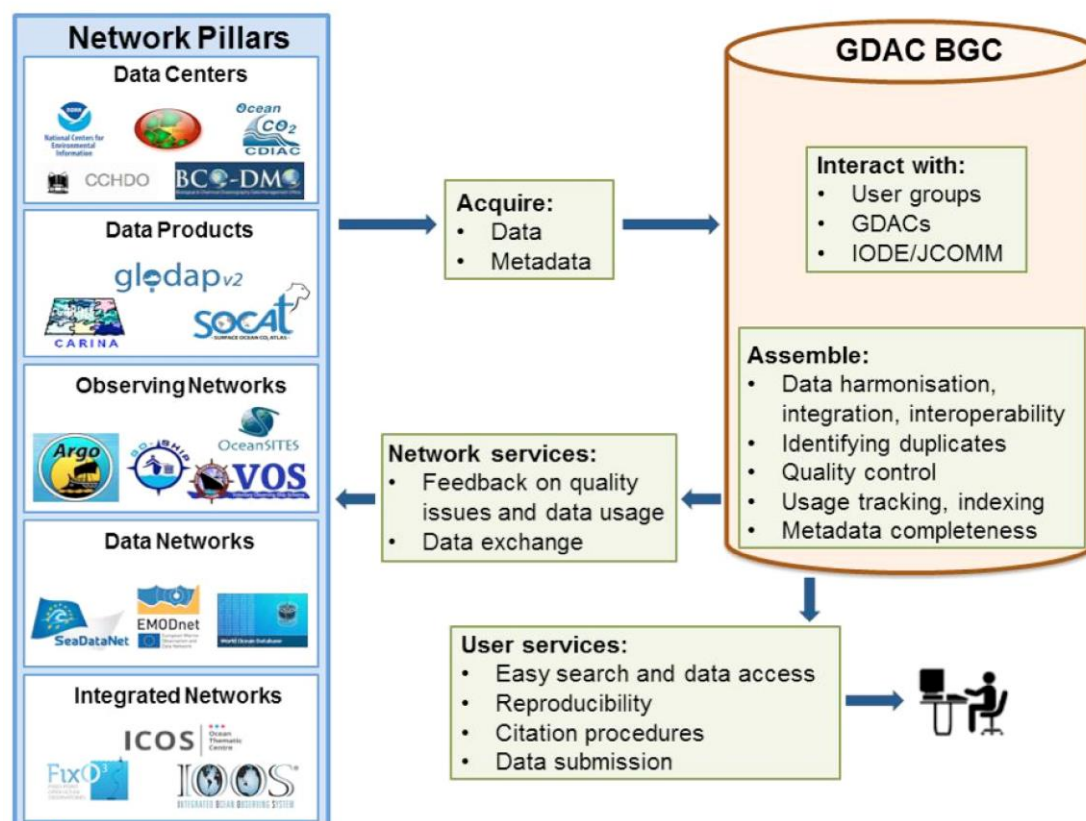


Figure 3: Anticipated structure of the Global Data Assembly Centre for Marine Biogeochemistry.

Transition of CDIAAC-Oceans to NOAA National Centers for Environmental Information (NCEI)

For several years the Ocean component of the Carbon Dioxide Information Analysis Center (CDIAAC-Oceans) has been hosted at the Oak Ridge National Laboratory (ORNL) and funded by the Department of Energy. In late summer 2016 the community was informed that CDIAAC, as it is currently configured and hosted by ORNL, will cease operations on September 30, 2017. Data will continue to be available through CDIAAC until that time but data transition plans were developed with DOE to ensure preservation and availability beyond 2017. It was decided that NOAA NCEI will host CDIAAC-Ocean's data inventory and personnel (Alex Kozyr). The new system was named NCEI Ocean Carbon Data System (OCADS) and will be responsible for hosting and providing access for ocean carbon data as previously done by CDIAAC-Oceans at ORNL. More information can be found at <https://www.nodc.noaa.gov/ocads/>. The long-term funding is not in place yet but NCEI ensured stability. IOCCP's data management official joined and advised at a US internal meeting on this transition topic in November 2016 at NOAA headquarters, where the long-term plan for biogeochemistry GDAC was well received.

ACTION ITEM 39

Publish a news piece on the state of transition from CDIAAC Oceans to OCADS including instructions on how to submit data at this moment. (Responsible: Pfeil, IOCCP Office. Timeframe: Immediate. Financial Implications: None).

International collaboration

Several collaborations were maintained or established. Within Europe, strong working

collaborations exist with H2020 SeaDataNet/Cloud, EMODnet Chemistry, RI ICOS, H2020 RINGO and H2020 AtlantOS – in most of the above we agreed on sharing and reformatting the Inorganic Carbon EOVS data – for an initial step the SOCAT data inventory.

Within GOA-ON, metadata was structured and harmonized, while standardized vocabulary was implemented for the new GOA-ON data portal. In addition, standardized vocabulary was identified and registered (both CF and NERC/BODC) for all IOCCP-related data products (GLODAP and SOCAT).

Benjamin attended the IODE GOSUD (Global Ocean Surface Underway Data) workshop and the SOCAT community agreed to be responsible for all underway carbonate system data within GOSUD – this will provide data flow of IOCCP's data products to IODE. In addition, the following new collaborations were established for the benefit of biogeochemical data management relevant to IOCCP:

- SeaDataCloud – Benjamin is a member of the scientific council, started to make SOCAT visible
- RI ICOS Ocean Thematic Centre funded in 2016 (2 staff hired) support for SOCAT and for other tasks
- RINGO (Readiness of ICOS for Necessities of integrated Global Observations), programmer was hired for 2 years to:
 - assist with automation for handling bottle data and for secondary and online QC in GLODAP, and to
 - bridge GLODAP and SOCAT data flows, which will in turn enable homogenization of bottle data handling and development of an initial Time Series and/or OA data synthesis product.

ACTION ITEM 40

Continue to support and contribute to the development of activities aimed at implementing strategies described in the IOCCP Data Management Position Statement. (*Responsible: Pfeil, SSG, IOCCP Office. Timeframe: Ongoing. Financial Implications: Low to Medium*).

ACTION ITEM 41

Update the relevant data and information access page on the IOCCP website including careful scrutiny of existing and missing content as well as connections to resources available elsewhere. (*Responsible: Pfeil, Palacz*) *Timeframe: Before next SSG meeting. Financial Implications: None*).

11. Reports from partner projects and organizations

GEO Carbon and GHG Flagship Initiative

This subject was presented by Kim Currie and Siv Lauvset, who are IOCCP SSG designated contacts for the Group on Earth Observations (GEO) Carbon and GHG Initiative (<https://www.earthobservations.org/activity.php?id=113>).

The Initiative tries to coordinate the coordinators involved in “the long-term vision of a data-driven system to provide comprehensive knowledge on changes in the global

carbon cycle and GHG emissions as a result of human activities and global change, and to support decision makers with timely policy-relevant information.” As such, the Initiative should naturally seek collaboration with IOCCP. Unfortunately, that was not the case since the inception of this activity. Therefore, the Initiative seems somewhat disconnected from the coordination efforts ongoing around the marine carbon and biogeochemistry community. To aid that, IOCCP has acted as an informal observer and ad-hoc contributor through selected SSG members. In 2016, both designated IOCCP representatives were, at least marginally, involved in writing the GEO Carbon and GHG Initiative work program (approved last year). Kim’s major focus has been on ensuring a balanced representation of the ocean domain in these documents. Unless it becomes apparent that IOCCP’s services have a chance to be utilized, and that relevant funding can be provided for the work, IOCCP will remain involved in the group in form of subscribing to the e-mail list and responding to adequate calls for actions, without proactive engagement. One task which seems highly relevant is deliverable 3.1 (see below), where our expertise seems to be unique.

Deliverable 3.1 Essential Carbon Variables: a global assessment, including inputs from carbon cycle researchers and information users, of which variables must be observed, where, how, how accurately and how frequently, and how the observation system (including its various parts, and the processing chain all the way to end user) can be configured [Report and published paper].

Siv pointed out the potential confusion related to the fact that the GEO Carbon Flagship has established its own Essential Carbon Variables. The ECV abbreviation is very unfortunate because it is the same as that used for a long time now by GCOS in reference to Essential Climate Variables. The discussion on this topic was deferred to the session on the progress of Biogeochemistry EOVS Specification Sheets.

Related to that, there was a request from Oksana Tarasova (WMO, Global Atmosphere Watch, I3GIS) for IOCCP or members of the larger community to engage in the workshop that sets standards and best practices for greenhouse gas measurement techniques. The SSG agreed that the IOCCP should continue to stay involved by ensuring proper ocean carbon visibility in the works of GEO Carbon and GHG Initiative. When input from IOCCP is requested, we should provide PDFs of slides presenting the current status of SOCAT and GLODAP, properly acknowledging both projects, as well as IOCCP. A member of the SSG will also attend the upcoming GGMT-2017 meeting in Switzerland (see Action Item 7 above).

ACTION ITEM 42

Ensure proper ocean carbon visibility in the GEO Carbon and GHG Initiative. (Responsible: Currie, Lauvset. Timeframe: ongoing. Financial Implications: None).

Biogeochemical Argo and IOCCP

Hervé Claustre, a co-chair of Biogeochemical Argo Program, presented the update remotely. Below are key points from Hervé’s presentation.

On Biogeochemical Argo in general:

- In the past, several acronyms and names for this program were used (for example Bio-Argo). Finally, following long negotiations within the community the only name to be used is Biogeochemical (BGC) Argo.

- Variables measured on BGC-Argo floats: oxygen, nitrate, pH, Chl_a, suspended particles, downwelling irradiance.
- Target array is around 1000 floats on a global scale which requires approximately 250 deployments annually. The estimated running cost of such an array including floats equipped with all the above sensors, data transmission, data processing and quality control is about \$27M annually.
- ERIC Euro-Argo agreement was signed in 2014 which will result in 60-70 deployments per year through national and EU funding.
- There is a new US OCB Subcommittee on BGC-Argo led by Ken Johnson (MBARI, USA) and Emmanuel Boss (UMaine, USA), to develop synergies with the Ocean Time Series sub-committee.
- Metrics for BGC-Argo in form of maps of global distributions per variable are being developed. For example, pH is measured almost exclusively in the Southern Ocean.
- Development and implementation of the in-air calibration of optode oxygen has made the oxygen measurements on floats stable. This is a great success of the community. See *Williams et al. 2016, GRL*.
- BGC-Argo data is used for calibration and validation for satellite measurements. As soon as such cal/val will be possible in most ocean basins, several data products for models and projections will become available.

On BGC Argo links with IOCCP:

- Synergies with post-WOCE and post-JGOFS communities will soon be very fruitful.
- GO-SHIP is an ideal deployment platform for floats due to highest available data quality measured on deployment. It would be very useful to advocate for POC and CHL_a measurements on deployment cruises.
- GLODAP as a target synthesis product also for BGC Argo.
- BGC-Argo could be the cross road between ocean colour, GO-SHIP, and Argo.

Hervé's presentation was followed by a Q&A on few technical issues:

- With respect to sensor drift, the strategy for pH is to use reference databases, ship-borne measurements from depth. For Chl_a and backscatter, cross-comparison with remote sensing will be exercised. Several issues related to bio-fouling will have to be addressed.
- In the long term, discussions are needed as to how the presence of BGC Argo will impact the design and observing targets for other observing networks. This will vary regionally and seasonally.

GOOS Biology and Ecosystem Panel

Samantha Simmons, a co-Chair of the GOOS BioEco Panel updated the IOCCP on GOOS BioEco activities since February 2016, such as:

- results of the survey that lead to proposed EOVs
- status of proposed EOVs and specification sheets

- communication and engagement with other organizations
- Panel's contribution to GCOS IP 2016
- Panel's structure and governance

Her presentation sparked a hot debate focused mainly around issues related to the choice of specific EOVs. For example, a lack of biological rate measurements on the EOV level was noted and criticized. Sam explained that rates are considered under the 'derived products' category in the specification sheet. Nonetheless, IOCCP SSG pointed at the critical role the rate measurements play in interpretation of biogeochemical measurements and expressed concern at their negligence in the list of EOVs. While impressed with the thought-process behind identifying EOVs, the outcomes seemed surprising to the SSG and apparently disconnected from the other two disciplines.

There was also a brief mention of organic films and their role in carbon cycling. This aspect was deemed suitable for research but not for sustainable observation requirement setting.

Sam noted the individual issues and will respond to IOCCP's comments upon consultation with the wider BioEco Panel.

12. IOCCP's activities in leading GOOS Biogeochemistry Panel

Overview of GOOS structures and roles for GOOS BGC Panel

This session started with a presentation from a GOOS Director, Albert Fischer. Albert's presentation focused on the latest developments in GOOS and the role of IOCCP as GOOS BGC Expert Panel. To find out more about the current status and planned activities please consult the report from the Fifth Session of the GOOS Steering Committee, which took place in Sopot, Poland in June 2016 (report available from http://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=18311)

At the global level GOOS Biogeochemistry Panel (led by IOCCP) delivers strategic oversight, coordination, and evaluation of the sustained ocean observing system for the three GOOS themes: climate, services, and ocean health. The services theme is perhaps the least developed, and until recently, the least required from the biogeochemistry community. However, with an increased awareness of ocean acidification impacts on coastal industries, the services theme will be an increasingly important aspect of GOOS BGC focus.

Albert then explained the roles of various elements of the GOOS structure: GOOS Application areas, the three Expert Panels, GOOS Regional Alliances (GRAs) and their various levels of development and engagement as well as a value chain where GOOS, and therefore GOOS BGC Panel, works with partners to deliver innovation, observations, data management, forecasts, science and assessments and societal benefit (Figure 4).

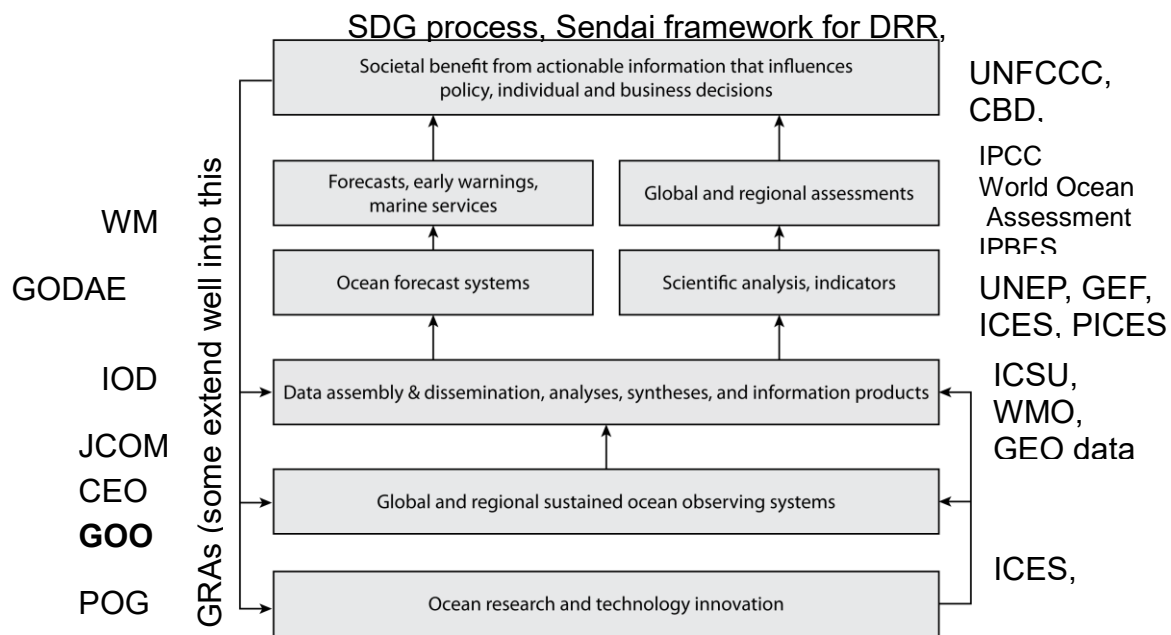


Figure 4. GOOS value chain

Albert finished by listing several activities where GOOS BGC Panel might want to engage or engage stronger.

In the requirements domain:

- Publish/maintain EOVS specifications
- Targets for global observation of variables, by phenomena
- Consider working with some specific more advanced GRAs to extend specifications into the coastal ocean - as source information for other GRAs

In building and increasing readiness:

- Technology roadmaps to increase feasibility of EOVS observations

In development of standards and best practices for observations:

- use IOC (through GOOS and JCOMM) to raise the visibility of norm-setting work in observing networks
- Develop standard operating procedures simplified for use more universally (very relevant for SDG14 implementation)
- Sensor Summer School in 2015 was an excellent example of building capacity, can we use Ocean Teacher Global Academy to capture and share material, replicate the experience in other regions?

In data management

- engagement with IODE/JCOMM on the Biogeochemistry GDAC could raise visibility and use by IOC Member States who are not yet participating. This could present intergovernmental possibilities to put pressure on data sharing.

In information products development

- Very soon there will be a strong demand for national-scale information products on Ocean Acidification, to feed into reporting for SDG 14 indicator. Can the BGC Panel imagine coordinating product development at such scale?
- What are other intermediate users to target to improve connection from observations to end users?

Albert's presentation was followed by a discussion. The SSG had several questions about the presented value chain and GOOS's role in it. In particular, a seemingly poor visibility of the co-design based on users' feedback was noted, as was a potentially limited relevance of data products for assessments to meet the societal requirements.

With respect to embracing observing networks by GRAs, it was noted that it is often misleading to state the direct linkages between certain observing networks and regional observing systems simply based on the fact that they operate in the region. Regional coordination, data quality and sharing protocols as well as adherence to globally approved standards and best practices needs to be confirmed before a certain GRA can be seen as operating an observing network.

Finally, a short discussion developed around IOCCP's past interactions with the GRAs. Most Panel members were of the opinion that their interaction with any form of a coordinated GRA is minimal and rather collaborations with individual scientists flourish. Albert suggested that the best way to engage with GRAs in a bit more formal way would be to invite them to review manuals and guides for best practices. It was agreed that IOCCP will maintain or increase its communication with EuroGOOS and other GRAs in order to evaluate the usefulness of such manuals and guides to the mainly coastal communities.

ACTION ITEM 43

Engage in collaboration with GRAs to increase the use and usefulness of developed standards and best practices, through attendance at the GRA Forum and annual meeting(s) of individual GRAs. Decisions on which meetings to attend will be made on a case-by-case basis. (Responsible: *IOCCP Office, SSG*. Timeframe: *ongoing*. Financial Implications: *Low*).

Update on the status of biogeochemical EOVs

Albert's presentation was followed by a short update on the current status of biogeochemical EOVs presented by Artur Palacz.

The format of EOV Specification Sheet was significantly updated over the past year and the new version will be published before GOOS SC-6 meeting in September. GOOS Panels made significant effort to homogenize concepts and definitions used around the EOVS. Concepts like: supporting variable, sub-variable, phenomenon, observing target and other used in the specification sheet were discussed across panels, and final definitions were agreed upon.

IOCCP was also strongly involved in the development of two new EOVs: Ocean Color and Marine Contaminants/Pollutants. The former will soon be ready for community verification as relevant experts were approached and provided significant input allowing the Panel to construct the initial version of the specification sheet. The latter is in much less developed stage and as it encompasses several types of pollution (plastic, heavy metals, hydrocarbons, PCBs, POPs and perhaps more). There is a need for a wide initial dialogue with relevant organizations like UNEP, GESAMP and similar. The aspect of pollution due to underwater noise will be handled separately by the Physics and BioEco Panels, as explained by Sam Simmons.

During discussion, the overall recommendation was made that a draft specification sheet should be developed which should help us understand the existing observing

capacity and specific requirements for observations for each pollutant separately.

The Panel also discussed at length the need to change some of the EOV names. Toste provided extensive background justification stemming from the naming convention of the GCOS ECVs which is aimed at upper level communication with end users rather than scientists. The Panel agreed on changing the names of Carbonate System to Inorganic Carbon, Dissolved Oxygen to Oxygen, Inorganic Macronutrients to Nutrients.

With respect to any potential confusion with other non-GOOS EOVs published and put forward, there was a suggestion to communicate to respective groups an idea to refer to those as Core Variables (of a certain region, biome or regime), leaving the EOV name for exclusive use by GOOS.

Finally the discussion lead by Rik touched on the proposal to explicitly name “air-sea CO₂ flux” and “surface pCO₂” as separate EOVs. In his argumentation Rik compared the air-sea CO₂ flux to heat flux (which is an EOV) and he argued that this is a totally different category than Inorganic Carbon. As it is now, this important measurement does not stand out which potentially endangers the existence of relevant observing networks. This proposal requires more consideration than it could be given at the time the decision is to keep status quo in the list of BGC EOVs with regard to Inorganic Carbon.

ACTION ITEM 44

Work with GESAMP on developing a scope and an initial specification sheet for Marine Contaminants/Pollutants EOV and to develop a comprehensive understanding of the existing observing capacity and related requirements. (Responsible: IOCCP Office, SSG. Timeframe: *ongoing*. Financial Implications: *None*).

ACTION ITEM 45

Update the names of the three EOVs: Nutrients, Oxygen and Inorganic Carbon. (Responsible: IOCCP Office. Timeframe: *immediate*. Financial Implications: *None*).

Introduction of Oxygen theme to IOCCP portfolio

As IOCCP continues to take on more tasks in its role of GOOS Biogeochemistry Panel, our coordination efforts gradually expand to Biogeochemistry EOVs. Three years earlier we introduced Nutrients and welcomed Michio Aoyama as a responsible expert. In January 2018 we will start providing coordination services to the community focused on sustained Oxygen observations. Our first responsible expert for Oxygen will be Veronique Garçon and she agreed to join the 12th session and give us an informal overview of a myriad of activities which we might want to contribute to.

Relevant key points and issues highlighted by Veronique during her presentation included:

- Eastern Boundary Upwelling Ecosystems (EBUEs) are a strong focus of the community and GOOS BGC might find several roles to play there
- Current generation of models face the issue of not being able to reproduce very low oxygen levels in the ocean. In model runs performing future projections of change in volume in OMZs not even signs agree between the models. Perhaps this is not a direct area of activity for IOCCP but promoting observing capacity for extremely low oxygen levels would help the models significantly

- GOOS BGC should interact with the newly established Global Ocean Oxygen Network (GO2NE) – approved in June 2016 as an IOC Working Group. Maciej Telszewski and Veronique are a part of GO2NE and will make sure that both groups interact wherever needed.
- Two SCOR WG proposals related to oxygen were submitted to last year: Neither was successful and they will be resubmitted as one proposal in 2017.
- An International Conference on Ocean Deoxygenation will be held on 3-7 September 2018 in Kiel, Germany. This event will be combined with GO2NE meeting.
- SCOR Working Group 144 Microbial Community Responses to Ocean Deoxygenation submitted a letter to Nature Communications.
- IOCCP and GO2NE should not duplicate efforts. The focus for GO2NE is on policy and raising awareness, whereas IOCCP will focus on relevant measurements, observing standards, protocols, data management and similar aspects. Both effort seem very complimentary.

Veronique finished her overview by stating the the first activity which she plans to engage in in her role as IOCCP SSG expert will most probably be the implementation of Oxygen Minimum Zone-related outcomes stemming from the IMSOO workshop organized by GOOS directly after the IOCCP Session.

13. Changes in IOCCP Structure and Terms of Reference

New Chairmanship structure

Following the discussions held over the past year, and to meet the demands of the expanding scope of IOCCP's activities, the IOCCP SSG has decided to introduce a co-chairmanship system starting in January 2017. The first co-chair of IOCCP will be Dr. Masao Ishii (JMA-MRI, Tsukuba, Japan) who kindly agreed to join Toste Tanhua (GEOMAR, Kiel, Germany) in taking responsibility as an IOCCP co-Chair. Up until the end of 2016 Masao served as the SSG member responsible for Interior Ocean Observations, and he will also remain in that role over the coming year. For a more detailed introduction of our new co-Chair please read the IOCCP Conveyor Issue 37 at <http://www.ioccp.org/index.php/ioccp-conveyor>.

New IOCCP Terms of Reference

The IOCCP was established as a standing project of SCOR and IOC-UNESCO in 2005 when the coordination capabilities of a small advisory panel shared between the two organizations, no longer met the needs of the community. The complexity of the marine carbon cycle and its numerous connections to carbon's atmospheric and terrestrial pathways meant that a wide range of types of observations had to be made in order to establish it's qualitative and quantitative role in the global climate system. The initial Terms of Reference for IOCCP provided guidance for the SSG on how to coordinate this myriad of activities focused on carbon observations and related data management.

Over the past decade the IOCCP was recognized as a successful model, however our ever-increasing understanding of the inter-correlation of marine carbon cycle with carbon-related biogeochemical parameters demands a coordinated, comprehensive biogeochemistry observing system that serves the current needs for information related to issues like ocean acidification, ocean deoxygenation, eutrophication and

more. Our coordination activities have naturally expanded to incorporate these issues and we decided that it's time for us to re-define the projects ToRs to reflect the current coordination needs of the marine carbon and biogeochemistry community as defined by their requests for action from IOCCP. The updated ToRs as listed below were approved by our sponsors and we hope that they will have a direct positive impact on coordination efforts for most of the observing networks. The full text of the IOCCP ToRs:

The International Ocean Carbon and biogeochemistry Coordination Project (IOCCP) promotes the development of a global network of ocean carbon and biogeochemistry observations, coordinates the development of globally acceptable strategies and provides technical coordination developing operating methodologies, practices and standards, homogenizing efforts of the research community and scientific advisory groups. IOCCP also provides communication services for marine biogeochemistry community as well as advocacy and links to a multidisciplinary sustained global observing system.

Here we consider the term biogeochemistry to include the Global Ocean Observing System (GOOS) Essential Ocean Variables (EOVs) for Biogeochemistry. These EOVs enable the understanding and quantification of the following phenomena: ocean acidification, ocean deoxygenation, eutrophication, exchanges between the atmosphere, surface ocean and deep ocean, and carbon and nutrient remineralization and sequestration.

- 1. Identify priority measurements for implementation of GOOS observations of ocean carbon and biogeochemistry, and promote development and adoption of necessary measurements and measurement technology.*
- 2. Develop activities to implement the goals and recommendations set by international and intergovernmental bodies relevant to the work of IOCCP.*
- 3. Develop and maintain a set of specifications, implementation goals, and progress metrics for EOVs for ocean carbon and biogeochemistry parameters for GOOS and corresponding Essential Climate Variables for the Global Climate Observing System (GCOS).*
- 4. Promote international agreements on measurement methodologies and best practices, primary and secondary data quality control and quality assurance procedures, data and metadata formats, and development and use of certified reference materials.*
- 5. Coordinate activities of individual networks and programs to streamline ocean carbon and biogeochemistry measurements.*
- 6. Facilitate a dialogue with stakeholders to implement a scientifically and economically effective, fit-for-purpose observing system for ocean carbon and biogeochemistry.*
- 7. Develop and support training activities for users of observing technologies (instruments, sensors and platforms) for ocean carbon and biogeochemistry.*
- 8. Promote and develop interoperable data management activities and policies to ensure open access to, and preservation of, fully documented ocean carbon and biogeochemistry data.*
- 9. Promote the integration of ocean carbon and biogeochemistry information into research and assessments including the use of relevant data synthesis products (e.g., SOCAT, GLODAP).*
- 10. Serve as an international communication centre on ocean carbon and biogeochemistry observing activities.*
- 11. Report to sponsors and the global ocean carbon and biogeochemistry observing community on the state of planning and accomplishments of IOCCP.*
- 12. Raise funds to implement IOCCP activities.*

14. Project Office and general administration

Rotations of SSG members

The following members rotated off at the end of 2016:

1. Are Olsen (Ocean Interior Synthesis Activities)
Rotated off after 6 years of service on the Panel.

IOCCP Website

Artur Palacz presented this aspect. There were several activities related to website maintenance and information dissemination in 2016. The IOCCP Office have completed the following tasks related to the IOCCP website:

- Re-established frequent communication via email news distribution (news every 5 days on average).
- Re-issued the quarterly newsletter *The IOCCP Conveyor*.
- Cleaned up the list of subscribers, extended onto targeted international program and project PIs.
 - In January 2016 the list of subscribers was significantly outdated, with dozens of inactive email addresses and a large number of newsletters bounced back due to classification as spam. After the clean-up, the number of 'true' subscribers was about 400.
 - Over the course of 2016 that number grew to 500.
 - The IOCCP Office made an analysis of how many relevant project, programs or observing networks steering committee members are subscribed to our communication services and reached out to those who were not. There was a positive response to our requests for subscription and we now have at least one steering committee member from most if not all partner projects/programs receiving information from IOCCP on a regular basis.
- Updated the website (Content Management System - Joomla) to maintain existing and enable new functionalities.
 - Updates to many of the modules, plug-ins and extensions used in the CMS were no longer supported by the former Joomla version. This had to be updated also due to security reasons.
 - The update took longer than expected effectively delaying progress on many planned page updates.
- Transferred website to a dedicated server, increasing security.
 - Despite this transfer, there are still ongoing problems with spam-bot visits and subscriptions. New means have been taken to limit that problem at the beginning of 2017.
- Addressed the individual Action Items from XI IOCCP SSG Report pertaining to updates on IOCCP theme sites. Completed: Action Item 22. Ongoing: Action Items 26, 34 and 36. Overdue (moved over as Action Items for 2017): Action Items 10, 13, 14 and 30.
- Enabled statistics for each IOCCP page (Action Item 43).
 - Statistics software for each page is enabled via Google Analytics software. Functional since March 2016.
 - There is a very large number of bots attacking our site which makes the true TOTAL page visit counts unreliable.

- BUT bots stick to the home page (for subscriptions), and the cryptic pages added by themselves.
- Error due to bots on individual page visit statistics is likely very small or zero.

IOCCP annual cycle including publishing of IOCCP Conveyor

The annual IOCCP cycle will continue to consist of 3 quarterly Virtual Meetings (focused on 1-3 specific tasks) and one in-person annual SSG meeting. The SSG and Project Office will produce material for *IOCCP Conveyors* to be published approximately every 4 months, however this might vary depending on the activities organized by IOCCP.

It was decided that the next in-person meeting will be 3 days long to allow for discussions and planning of activities encompassing the full breath of the expanding scope of the Panel. It was also decided that the in-person meeting will not be held in January or February due to the holiday season in the southern hemisphere, nor it will be held around any major activity organized by IOCCP Office. The SSG also decided that it is more desirable to allocate funds to IOCCP activities than to spend larger sums of money to host the next meeting in the southern hemisphere, e.g. in Dunedin (Kim Currie) or in Santiago (Cristian Vargas).

Annual cycle for 2017-2018

Meetings

VMQ2 – Doodle for 22-31 May
 VMQ3 – Doodle for 28 August-8 September
 VMQ4 – Doodle for 27 Nov. - 1 Dec.
 In-person meeting: March-August 2018

IOCCP Conveyor

Conveyor 37, April 2017
 Conveyor 38, September 2017
 Conveyor 39 December 2017
 Conveyor 40, April 2018

VMQ2 – Virtual Meeting in the second quarter of 2017

Budget and fundraising activities

The IOCCP Project Office support is provided by the US National Science Foundation (NSF) through a grant to SCOR, and by the European Commission through the Horizon 2020 project AtlantOS. The current 3-year grant from NSF will finish on 30 September 2018. AtlantOS funds for a Project Officer will be available until 31 December 2018. Generous in-kind support for the Project Office continues to be provided by the Institute of Oceanology of Polish Academy of Sciences (IO PAN).

In 2016-2017 program support for IOCCP activities comes from three sources:

- NSF through a grant to SCOR
- IOC-UNESCO through GOOS Project Office.
- EU Horizon 2020 AtlantOS Project.

The IOCCP action items are assigned a financial implication level based on “low” (<\$5,000), “medium” (<\$10,000), and “high” (<\$15,000).

Fundraising activities continue to be important for the IOCCP Office and the SSG. The

SSG and Project Director are urged to actively look for potentially suitable calls for proposals and when a relevant one comes up an ad-hoc team should be organized to compose a specific text bringing IOCCP's expertise to a specific call. Also, fund-raising for specific activities (like the IOCCP Sensors Course) proves to be a very efficient way of forwarding program's agenda.

ACTION ITEM 46

Prepare tentative budgets for several venue options for the next IOCCP SSG Annual meeting, including Dunedin (NZ), Concepcion (CHL), Bangkok (THA), Cape Verde (CBV), and Paris (FRA). Set-up a doddle poll to collect meeting time preferences of SSG members. (*Responsible: IOCCP Office. Timeframe: June 2017. Financial Implications: None*)

ACTION ITEM 47

Continue active participation in proposal writing and fundraising for specific activities. (*Responsible: Telszewski, Palacz, Tanhua, Ishii, SSG. Timeframe: Ongoing. Financial Implications: None to Low*)

Meeting Agenda

MONDAY, 6 February 2017

8.15-9.00:

Arrival

- | | |
|-------------|---|
| 9.00-9.15 | Opening and Welcome (Toste and Masao) |
| 9.15-9.20 | Local Logistics (Maciej) |
| 9.20-9.30 | Introductions (All) |
| 9.30-10.00 | Underway CO ₂ Observations (Rik) |
| 10.00-10.30 | Synthesis Activities: Surface Ocean (Kim) |
| 10.30-11.00 | Ocean Interior Observations (Masao) |

11.00-11.30

Coffee Break

- | | |
|-------------|--|
| 11.30-12.00 | Synthesis Activities: Ocean Interior (Siv) |
| 12.00-13.00 | Data and Information Management (Benjamin with input from Rik on the CDIAC/NCEI) |

13.00-14.00

Lunch Break

- | | |
|--------------|----------------------------|
| 14.00-15.30: | GOOS Biogeochemistry Panel |
|--------------|----------------------------|
- The role of GOOS in a bigger picture (GRA'a for example) of ocean observing and BGC Panel's role in the bigger picture and cross-reference with GOOS Implementation Plan (Albert, 20 mins)
 - Current status of biogeochemical EOVs and specific update on Ocean Colour and Pollution EOV (Artur, 20 mins)
 - Development of goals and metrics for BGC EOVs (Artur, 15 mins)

- GCOS IP – what is the exact role (and tasks?) for GOOS BGC – tracking, coordination, implementation, other (Toste, 15 mins)
- Consistency between ECV and EOVS approach. For example, naming of EOVS: Oxygen, Tracers, Inorganic Carbon (Toste, 10 mins)
- Confusion stemming from numerous efforts to establish EVs (GOOS, SOOS, DOOS, other?) (all, 10 mins)

15.30-16.00: Coffee Break

16.00-17.30: IOCCP Structure

- ToRs (All, 30 mins) – intro Maciej
- Co-chairmanship and rotations into the future (All, 15 mins) - intro Maciej
- Rotations/merging/addition of themes (All, 45 mins) – intro Maciej

17.30-18.00: Recap and summary of action items

TUESDAY, 7 February 2017

8.15-9.00: Arrival

9.00-9.30: biogeochemicalArgo (Hervé Claustre - remotely)

9.30-10.30: Update and discussions on Project Office activities 2016-2017

- Activities funded and organized since February 2016 (Maciej, 15 mins)
- Current budget and actions for 2017-2018 (Maciej, 15 mins)
- Website (Artur, 15 mins)
- Project Office staff employment situation (Maciej, 5 mins)
- IOCCP Conveyor – content for the next issue and publication strategy (Maciej, 10 mins)

10.30-11.00: Ocean Acidification (Dick and report from Cristian)

11.00-11.30: Coffee Break

11.30-12.00: Nutrients (Michio)

12.00-12.30: Instruments and sensors (Doug)

12.30-13.00: Time Series Efforts (Bjorn)

13.00-14.00: Lunch Break

14.00-14.30: Oxygen (Veronique)

14.30-15.00: GOOS Biology (Sam Simmons), EOVS, cross-cutting issues

15.00-16.00: OceanObs'19 (Toste leads, All, 60 minutes)

16.00-16.30: Coffee Break

16.30-17.30: Updates from programs

- DOOS (Dick or Rik)
- TPOS (Masao)
- G7 and SDG 14 (Masao and Toste)

17.30-18.00: Summary of action items and collected input, initial plan for next IOCCP SSG session, closing remarks (Maciej, Toste and Masao)