XVII Session of the International Ocean Carbon Coordination Project Scientific Steering Group & Global Ocean Observing System Biogeochemistry Panel of Experts (IOCCP-SSG-17)

15-16 November 2022

Sopot, Poland & online

REPORT

United Nations Educational, Scientific and Cultural Organization

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Report

Meeting format and participants

The 17th Session of the IOCCP Scientific Steering Group was held on 15-16 November 2022 as a hybrid meeting. There were 9 IOCCP SSG members, two IOCCP Office members and one guest who attended in person at the IOCCP Office Headquarters at the Institute of Oceanology of the Polish Academy of Sciences (IOPAN) in Sopot, Poland. The rest of the IOCCP SSG and guests connected remotely via GoToMeeting during most, if not all sessions. Full list of meeting participants is provided in Appendix A.

After IOCCP Director, Maciej Telszewski, welcomed IOCCP SSG members and guests to IOPAN in Sopot, headquarters of the IOCCP Office since 2012, IOCCP Co-Chair, Kim Currie, opened the meeting by welcoming everyone and expressing gratitude for being able to meet again with all largely present in-person. Kim also acknowledged the contribution of all nations we represent collectively by coming together to form and operate IOCCP, to further science and, equally important, to build a community from local to global scales.

IOCCP Co-Chair Véronique Garçon walked the group through the meeting agenda (Appendix B) inviting all to actively contribute to the discussions and development of new actions to be implemented for the benefit of the marine biogeochemistry community over the next annual cycle.

Overview of activities since IOCCP-SSG-16

The meeting agenda started with an overview of IOCCP's major accomplishments and an update of major activities completed or undertaken over the past months. To view the complete presentation follow this link.

There was a question raised about the limits of expanding IOCCP's portfolio beyond carbon, recognizing that themes such as marine debris go well beyond a traditional view of marine biogeochemistry. It was clarified that IOCCP as GOOS Biogeochemistry Panel has a long-term vision to take up coordination of all biogeochemistry-related Essential Ocean Variables (EOVs) and Essential Climate Variables (ECVs). Currently we don't have the resources to fulfil the entire mandate. The strategy is to launch various coordination activities which can later carry on with a life of their own, as was the case for example with GOA-ON and as we hope for with an Integrated Marine Debris Observing System (IMDOS). Taking up IMDOS as a new type of Human Pressure Variables in GOOS was aided strongly by the fact that this commitment came with dedicated funding for IOCCP Project Officer via the EU H2020 EuroSea project.

IOCCP & the UN Decade of the Ocean for Sustainable Development

Kim clarified that the aim of this session was not to review all of the marine biogeochemistry involved in the UN Decade but to focus on several programs and projects we are most active in, as a Panel, and invited all to share their views on further evolution of these major initiatives. Note that the GOOS Co-Design Programme was covered in a separate session on Operationalizing Carbon Observations.

Global Ocean Oxygen Decade (GOOD)

Véronique started with a presentation on the Global Ocean Oxygen Decade (GOOD) Programme coordinated primarily by IOC-UNESCO WG GO_2NE. The presentation also included the development of the Global Ocean Oxygen Atlas (GO2DAT) as well as other planned actions which are complementary to the current 2021-2023 IOCCP Action Plan. Noteworthy was the GO2DAT Hackaton which took place in May 2022 over 48 hours, bringing together two teams and resulting in a first prototype on a coastal oxygen product in the Pacific ocean area. Plans for the GO2DAT contribution to the next Ocean Hackathon (2-4 December 2022) are already under way in collaboration with OceanOPS among others. Following the GO2DAT Kick-off Meeting in September 2022, a Steering Committee is being assembled. Expanding beyond the scientific community to bring GO2DAT as an IODE Associated Data Unit from its inception means progress is slower but would show dividends in the long-term, learning from the SOCAT experience where that interaction came late. The Liege Colloquium on Oceanography in May 2022 brought together many early career scientists who by now formed a GOOD early career network. Lots of enthusiasm followed the EBUS Conference in Lima, Peru in September 2022. As part of the growing efforts to involve the citizens in observing efforts globally, we contributed to two initiatives: we initiated collaboration with Ponant Science which resulted in successful sampling in June 2022, with plans already made for the next phase in June-July 2023; and are working with The Ocean Race on pilot ocean oxygen measurements. A GOOD Summer School will take place in Chile in November 2023. Complete set of slides on GOOD is available from here (slides 1-34).

Based on the comments from the SSG, the following suggestions were identified:

- For the GOOD Summer School in Chile in 2023, it was suggested that the organisers get in touch with Phillipe Tortel from University of British Columbia who has been running schools and early career training in Chile, and whose postdoc also attended one of the GOOD hackathons.
- For the OceanRace, it was noted that apart from efforts to install biogeochemical sensors there is also Tara Ocean that is putting one IFCB for plankton imagery on one of the boats. There is perhaps room for future coordination across the GOOS Panels when it comes to overseeing what is being collected during OceanRace and what happens with the data.

Ocean Acidification for Sustainability (OARS)

Kim Currie gave an update presentation on the OARS programme. Seven Targeted Outcomes of OARS and corresponding working groups of OARS were designed to aid

delivering impact and benefits for society in line with SDG Target 14.3 on ocean acidification.These include:

1) Equipping the science community to provide OA data and evidence of known quality; led by Kim Currie and Dick Feely
2) Specific data needs; led by Jessie Turner and RIchard Bellerby
3) Co-design of observing systems; led by Véronique Garçon and Martin Hernandez
4) Biological impacts of OA; led by Frank Muller-Karger, Sam Dupont and Gabrielle Canonico
5) Predictions of OA; led by Sam Siedlecki and Richard Bellerby
6) Ocean literacy and public outreach; led by Geraldine Fauville, Abed El Rahman Hassoun
7) Implementation into effective OA policy nationally and regionally; led by Alexis Valauri-Orton and Nick Hartman-Mountford (from the Commonwealth Blue Charter)

IOCCP SSG briefly discussed the development of the OA Data QC Online Package which is being developed under OARS Theme 1. **Since there are plans for a video tutorial on pH to be developed for the IOCCP ICOS OTC 2023 Biogeochemical Sensors Training Course, it was suggested that such an activity be combined with the OARS Data QC Tool**. This would likely pull together resources already available on the web and combine with any new materials recorded during the course in June 2023.

Action: Develop a video tutorial package on pH as a joint activity of the IOCCP & ICOS OTC Sensors Training Course and the OARS Data QC Online Tool.
Responsible: Kim Currie, Dariia Atamanchuk, Artur Palacz
Timeline: by June 2023
Budget implications: low

Operationalizing Ocean Carbon Observations

The aim of this session was twofold: (i) to discuss progress towards achieving a more operational system of ocean carbon observations and data delivery, and (ii) to clarify how IOCCP should most efficiently interact with the growing number of international initiatives which address the needs of global ocean carbon observations and research. To this end, we briefly reviewed the current achievements and challenges related to the following initiatives and organisations:

- IOCCP & G7/FSOI partnership (overview presentation)
- IOC-UNESCO WG IOCR
- SOCONET & SOCAT with focus on the role of US NOAA and ICOS OTC
- WMO Greenhouse Gas Monitoring
- NACO and the OSNAP array extension
- UN Ocean Decade ObsCoDe Program & the Carbon Exemplar
- JPI Oceans and ICOS OTC
- Relevant European research projects
- Biogeochemical Argo

It was noted that the growing ocean carbon landscape formed by the above listed and other initiatives and organisations is a positive development in the direction of collectively addressing the entire value chain from observations to research, modelling and synthesis

product delivery to end users. However, it is clear that these efforts remain loosely, if at all, coordinated. Moreover, it is not easy to identify which element of the value chain the given effort focuses on, and to what extent. Such recognition and correct landscape mapping is needed for IOCCP to make informed decisions on where and with whom to engage efficiently in the future. **It was agreed that coordinating this entire space is beyond the mandate and capacity of the IOCCP.**

In particular the SSG discussed to what extent IOCCP should or should not be engaged with partners who deal with the research component of the ocean carbon value chain, and how such interactions would aid the development of a strategy and implementation plan for ocean carbon observations. The group recognized the following:

- The ocean carbon sustained monitoring efforts form a very broad base layer of the ocean carbon value chain which is best visualised with a pyramid structure.
- This base layer is difficult to fund as it competes with funding requests which promise and often deliver more impactful results in the short term, like discovery or process studies.
- The base layer is very vulnerable and requires that we urgently and significantly boost the level of funding and create dedicated long-term funding structures for ocean carbon sustained monitoring.
- Ideally, there should be a seamless transition from observations to research, modelling and application delivery, with IOCCP operating at the interface.
- Unlike in the atmospheric community, there are no separate organisations and people conducting ocean carbon sustained monitoring and shorter term discovery and/or process studies (research). This means that in practice, at a community/funding level the two are intertwined and difficult, if not impossible, to separate.
- Efficiently addressing any new research gaps, such as the future role of biology on the ocean carbon cycle, requires development of an integrated approach where the ocean carbon sustained monitoring effort would be co-designed with shorter term discovery and/or process studies in mind.
- There is a disconnect between the two needs with regards to the inorganic as well as organic component of the ocean carbon cycle.
- The ocean carbon community still has to come to an agreement on what an optimal ocean carbon monitoring system should look like. Some information about such requirements should be found across the relevant EOV Specification Sheets (Inorganic Carbon, Particulate Matter, Dissolved Organic Carbon) but the information is not complete and was neither cross-checked across the variables nor formally consulted with the relevant observing networks.
- Although the community is already delivering products (SOCAT, GLODAP), they too require more investment, e.g. into automation and quality control, which are closely linked to the data collection activities.
- Requesting funding for operationalizing the observing system would be strongly aided by setting incremental observing targets, akin to the 1000 BGC Argo floats figure. The community could be encouraged to set such initial targets while developing a stronger scientific basis for making these more rigorous.

It was agreed that IOCCP's role in this landscape is to ensure that these observations remain as a solid foundation for the other elements of the value chain. To this end,

IOCCP will support the global community in **gradually transforming ocean carbon observations from research-based to "operational" where by operational we mean operational resource mobilisation**. Within that remit, IOCCP's coordination services may include clustering together initiatives which explicitly tackle improving ocean carbon observations. IOCCP should continue to **lead the drafting of a detailed document which contains a transition plan from research-based to product-oriented ocean carbon observing system, starting from surface observations.**

Based on these decisions, the group agreed on the following actions:

Action: Draft a 2-page document describing what it takes to sustain the existing elements of the ocean carbon observing system. The document is meant to be a thinned-down version of the originally conceived strategy for surface CO_2 monitoring requested by the G7/FSOI. As such it will avoid discussing the optimal multi-platform network design on which the community struggles to agree. A costing element is required for SOCONET (double the NOAA budget estimate for the US component) and SOCAT. The document is hoped to be first presented at the WMO GHG Symposium in January 2023 in Geneva, Switzerland, and subsequently socialised with the relevant community via G7/FSOI, UN Ocean Decade and otherwise.
Timeline: January 2023
Responsible: Sanders, Sutton, Telszewski
Budget implications: none

Action: Organise an international community workshop towards creating an implementation plan for an optimised surface ocean carbon observing system. The workshop would in fact be a second kick-off of SOCONET and deal with such issues as described below under IOCCP interactions with US NOAA.
Timeline: 2023
Responsible: Sutton, Telszewski
Budget implications: low

Below is a summary of key comments on IOCCP's current and planned involvement with the individual initiatives related to ocean carbon.

G7/FSOI

While the ocean carbon community has been debating how to design the surface CO_2 monitoring strategy, the focus of G7/FSOI has evolved and the process aimed at eventually creating a resource group for the ocean carbon theme was put on hold. The process has led to the recognition that there is tension between what the G7 ministers expect (i.e. a quick synthesis of gaps) and what the scientific community can provide (i.e. rigorous and time consuming scientific analysis of what observations are needed). The importance of filtering the right message for the G7 audience was noted and the SSG was encouraged to further pursue with the community to develop a short document describing priorities and needs to support such an observing system. Following the successful example of obtaining dedicated national funding for elements of the Biogeochemical Argo, it was suggested that initial targets for the observing system should be set and that costing estimates for all elements including data management be included as well.

More information about the next steps and future prospects for funding via the G7/FSOI will be made known as a result of the G7 meeting at the end of November 2022, where a 90 minute session on ocean carbon had been scheduled.

US NOAA

There is strong willingness and now ability at US NOAA to fund a large component of SOCONET (along with its link to SOCAT) over the coming years, supported by newly developed funding mechanisms through the US federal government. This means that there is a real prospect of turning our existing surface CO_2 observing capacity into a sustained operation.

A detailed document with a transition plan from being research-focused to being product-oriented is required. While such a product exists (SOCAT), it needs to be acknowledged and funded. Moreover, we need information on how to standardise quality assurance on sensors between labs in Miami and Seattle, and how to harmonise ship-based measurements with those from buoys and USVs. Such an exercise is in fact needed to be performed globally. Thus, organising an international community workshop on SOCONET appears a priority for the coming year. Continued close communication between IOCCP and US NOAA labs about reinvigorating SOCONET would ensure that the developments in the US generate the desired impact on the international level.

On a different note, it was commented that NOAA is being frequently approached with requests related to marine CDR and that the industry cannot currently obtain the information they need. This new application provides additional rationale and urgency for installing an adequate observing system for ocean carbon measurements.

WMO Greenhouse Gas Monitoring Initiative

IOCCP is also engaging with WMO on their new initiative on Greenhouse Gas Monitoring. IOCCP promoted the call for abstracts for the WMO GHG Symposium which is due to take place on 30 January - 1 February 2023. The response from the marine BGC community was very limited, perhaps reflecting lack of history in any close collaboration with WMO, perhaps with the exception of the interaction with the Global Atmospheric Watch (GAW). It was noted that GHG monitoring is consistently mentioned as one of the four main priorities for investing resources at WMO, meaning there is a very real prospect of acquiring significant additional resources for operational ocean carbon and other GHG monitoring. Lars Peter Riishøjgaard will be the person responsible for this initiative at WMO, after Albert Fisher takes over his current role as the Director of the Integrated Observing System (WIGOS) Branch of the WMO Infrastructure Department.

The SSG agreed with the urgency and importance of further promoting an active dialogue between the ocean carbon community and WMO on this initiative, conscious of the risk of WMO going ahead with their own implementation pending lack of interest and engagement from the IOCCP side. It was also mentioned that GHG monitoring received significant attention at the recent COP27 meeting in Egypt, revealing that this is a sensitive and thus a noteworthy issue for the member states.

The SSG agreed that the upcoming WMO GHG Symposium is a very good opportunity to harness energy from the community to make further progress on the strategy for surface ocean CO_2 monitoring.

IOC-UNESCO WG IOCR

The goals of the IOCR remain to (i) gather the ocean carbon community to appraise everyone of new and existing ocean carbon projects, programmes and initiatives within and outside of the Ocean Decade Framework, and to (ii) provide a platform to discuss knowledge gaps and emerging ocean carbon questions. IOCCP had been instrumental in the process of forming IOCR until the publication of the first report in 2021. Since then, Kim Currie has been representing IOCCP on the steering group of IOCR. Currently, the group is considering applying to become a Community of Practice under the UN Decade. It is not clear what the impact of that is on the functioning of the IOCR.

Based on the discussions among the SSG, it was decided that IOCCP will engage with the group primarily in the context of implementing the IOCR recommendations relevant to sustained ocean carbon observations. IOCCP Executive will have also attended the IOCR virtual meeting in early December and will contribute to the in-person workshop in Paris planned for April 2023.

JPI Oceans, ICOS OTC and relevant European research projects

Along with an update on the status of ICOS OTC activities, Richard Sanders introduced a number of newly funded EU and UK projects with relevance to ocean carbon observing and research. These include the EU GO-SHIP Project, Horizon Europe Ocean ICU (with dedicated support equal to 12 months at 1 FTE level, for IOCCP Project Officer to develop the surface CO_2 monitoring strategy), 3 million EU project GEORGE devoted to sensor development (with potential to address the Argo pH sensor issue, contact Sokratis Loucaides) and the large UK BioCarbon Programme (led by Adrian Martin from NOC).

A major opportunity to address critical gaps in the European ocean carbon observing landscape was identified through JPI Oceans Ocean Carbon Capacities, the meeting of which took place shortly after the SSG meeting, on 1 December. Maribel García-Ibáñez volunteered to join the virtual JPI Oceans meeting along with Richard Sanders, and she agreed to present the global issues and community suggested solution for a reliable and distributed production and supply of seawater reference materials for carbonate system measurements (see also here). Among other developments, it was mentioned that the North Sea - Atlantic Exchange (NoSE) project, which focuses on better measuring the carbon budget of the Baltic and North Sea, could potentially contribute to the production of reference materials under the umbrella of MINKE and ICOS.

As far as the organic component of the carbon cycle is concerned, the H2020 ECOTIP project was briefly presented. Among other things, ECOTIP delivers new understanding and model capacity to better constrain the mechanisms contributing to the biological carbon pump and the likely direction of its change in the future, with a special focus on the

sub-Arctic and Arctic Oceans. It should be noted that ECOTIP has been partially supporting the IOCCP Project Officer from 2020 and will continue to do so until the first quarter of 2024.

Emmanuel Boss presented the exciting new observing campaign TREC (TRaversing European Coastlines) organised by the European Molecular Biology Laboratory (EMBL) in collaboration with TARA Oceans, which among other things will conduct in situ biological measurements with parallel ocean colour remote sensing validation, and carbonate chemistry measurements in estuarine waters all along the European coastlines with 10 super sites identified. Details of the project can be found in the presentation.

The SSG noted the importance of new carbonate chemistry measurements in these ecosystems considering the challenges of carbon system calculations in low salinity environments. The SSG recommended identifying who the lead PI responsible for carbonate chemistry measurements in the TREC project is.

UN Decade Ocean Observing Co-Design Programme

The Ocean Observing Co-Design, a flagship Programme for GOOS and the UN Ocean Decade, currently focuses on building a Supporters Forum which would engage people and organisations beyond the conventional groups the observing community communicates with. The SSG agreed that IOCCP should continue engaging with the Co-Design Programme's Carbon Exemplar as a vehicle to communicate to a broad audience about the general importance of ocean carbon observations. The SSG speculated whether the Programme could help provide a well supported forum for all carbon initiatives to come together, identify redundancies and long term ambitions.

While it remains to be seen what the Carbon Exemplar can actually provide, IOCCP will monitor its potential to contribute to the development of the overall carbon observing system capable of monitoring the response of the ocean to various pressures ranging from climate change to ocean engineering through mCDR and the related Monitoring, Reporting & Verification (MRV).

NACO and the expansion of the OSNAP array

Plans for the development of the North Atlantic Carbon Observatory (NACO) are described here as per a proposal submitted to Canada First Research Excellence Fund. From the scientific point of view, the North Atlantic is well observed but critical to observe because of deep water formation, alongside with the Southern Ocean. At the same time, it was noted that NACO plays a vital role in attracting political attention to this important issue. The three pillars of NACO are:

1) reducing uncertainty - investigating the interplay between ocean, earth and atmosphere
2) mitigating carbon - enhancing the ocean ability to thwart climate change
3) adapting equitably - empowering a new generation to take environmental action

Current proposal is for 150 million Canadian dollars of funding for ca. 7 years for 72 scientists from 4 institutions in Canada. Realising the grand idea of NACO will require obtaining matching support from EU and other countries. The SSG noted the need to better

connect NACO with the G7/FSOI initiative to avoid approaching G7 governments about ocean carbon observing in an uncoordinated manner.

Complementary to NACO are plans to elongate the OSNAP array which currently monitors physical EOVs in the subpolar North Atlantic. In order to attract funding, OSNAP will augment its platforms with new biogeochemical measurements, in particular oxygen and nutrients EOVs. It would be relevant to engage the OSNAP leads in the process of drafting recommendations for refined biogeochemical and biological requirements for sustained ocean measurements in the Arctic, in particular to better constrain carbon sequestration as pursued by the H2020 ECOTIP project.

Biogeochemical Argo

While the development of the Biogeochemical Argo is proceeding tremendously, an unexpected problem arose lately which might benefit from IOCCP attention. Namely, HoneyWell's SeaFET/DuraFET pH sensors which were used on BGC Argo were deemed too expensive and too labour intensive to make, and as result, ceased to be produced. There are ongoing efforts to convince the company either not to discontinue production or to release the IP. At the same time Dariia Atamanchuk and Ken Johnson are talking to other companies (e.g. PyroScience) to test the deployment of their pH sensors on the floats. The SSG noted that the same sensor is being used on gliders and for coastal observations as part of GOA-ON. So this is a wide issue.

On a positive note, it was mentioned that there are first floats being equipped with UVP-6 sensors and hyperspectral downwelling irradiance measurements which could put new and better constraints on the carbon budget in the upper and interior ocean.

Global solution to the crisis in CRM production and distribution

Maribel García-Ibáñez led the discussion about IOCCP's role in leading the multinational effort on the search for a global solution for seawater reference material availability for measurements of the i carbonate system. In her presentation, Maribel reviewed the outcomes of the CRM workshop which took place in March 2022 and which were presented to the broader scientific community during the recent BIPM Metrology for Climate Action 2022 workshop. The SSG discussed the proposed new models of RM production, distribution and certification which would require unprecedented involvement of the National Metrology Institutes (NMIs) on a global level. The following concerns and suggestions were put forward by the SSG:

- It is necessary to design a plan on how to engage NMIs in the process in a coordinated manner. While NMIs perform certification of RMs in a more expensive way than research institutes, they can certify multiple parameters.
- Global coordination of NMIs is not trivial. It is a task for BIPM. However, there is a precedence in EURAMET which is a European consortium of NMIs which has already begun working on pH through the SapHTies project (Metrology for standardised seawater pH_T measurements in support of international and European climate strategies).
- There are differences in methodologies to certify RMs used by Scripps and the US National Institute of Standards and Technology (NIST) which is meant to replace the

Dickson Lab eventually as the global certifier. In EURAMET this is a purposeful approach to use different methods but obtain equal traceability. Comparison of methodologies is required.

- There is currently no dialogue between the users of the RMs and what the metrology labs can provide in terms of capacities, limitations, timelines, etc. IOCCP could provide a platform where such dialogue takes place which would significantly speed up the process of developing RMs (e.g. DIC, TA) which will otherwise take more than 5 years (according to discussions from the BIPM Metrology for Climate Action 2022 workshop).
- There is an urgent need to develop a conceptual model of financing the regional nodes for RM production (and certification). JPI Oceans, in particular the German government, expressed interest in supporting such a development in Europe on a scale similar to the Dickson's Lab in the US.
- Protocols for in-house or working RM production are being produced separately in the US (Andrew Dickson) and in the EU (Tobias Steinhoff - EuroGOSHIP Programme) with suboptimal coordination between the two efforts.

Based on the above, the IOCCP SSG identified the following 4 priorities for actions within the ongoing action around coordinating the global response to the vulnerability of production and supply of seawater RMs for the carbonate system.

Action: Coordinate the global response to the vulnerability of production and supply of seawater RMs for the carbonate system through:

- Producing the position paper on the proposed global solution for RM production, supply and certification following on the recommendations from the community workshop in March.
- Estimating a budget for establishing a European regional production hub based on the available Dickson Lab budget cross-checked with European realities.
- Establishing coordination between the scientific community and the NMIs.
- Coordinating the development of best practices for in-house or working RM production globally.

Responsible: Maribel García-Ibáñez, Kim Currie, Artur Palacz
Timeline: 2023 and beyond
Budget implications: none

Observations-Modelling Interface

This session aimed at fostering the dialogue between IOCCP and two international modelling groups which promote biogeochemical modelling capacity regionally and globally, namely OceanPredict and ETOOFS. Pierre Bahurel (MOI, France) was invited to give an overview presentation in which he also shared ideas for where active collaboration could be established. In particular, Pierre pointed at the need to organise a dialogue between experts on biogeochemical data and models to identify the work which is necessary to make data synthesis products comparable and exploitable by the modelling community. The session was complemented with a presentation from Fei Chai, IOCCP's SSG member responsible for the Observations-Modelling Interface Theme, in which he shed more light on the needs and current capacities of biogeochemical modelling linked to integrated coastal observatories. Talking about the land-ocean continuum in the coastal ocean, Fei stressed

the need to predict human impacts on the ocean, quoting some recent publications which include biogeochemistry on top of physics when addressing issues of connecting estuarine with the open ocean in forecasting models.

The SSG discussed concrete steps towards organising a workshop in 2023 as a first step to establish a regular dialogue between the marine biogeochemistry observationalists, data product developers and the modellers. The workshop was agreed to be jointly organised by IOCCP and OceanPredict. The outcomes would complement ongoing efforts to incorporate more user insight into the desired functionality of existing products such as SOCAT. The event should engage modelling centres which not only perform state-of-the-art biogeochemistry data assimilation on a global scale, but also those which develop applications on local to regional scales.

ACTION: Organise a Joint workshop between IOCCP, GO-SHIP, Argo and the OceanPredict Task Team on Marine Ecosystem Analysis and Prediction
Responsible: Véronique Garçon, Fei Chai, the Office for IOCCP; Pierre Bahurel, Stefano Ciavatta, Marjorie Friedrichs for OceanPredict
Timeline: 2023.
Budget implications: low

Developing the workshop agenda will benefit from the following discussion points which emerged during the session:

- The need to develop standards, uncertainty estimates and overall best practices for using multiple-source data in forecasting models.
- Recognition that standards for using coastal data might be different and more complex than in the open ocean domain.
- Inclusion of remote sensing products in the standardisation work, with strong involvement of the IOCCG.
- Priorities for standardisation of EOV data products should include oxygen, pH, and nutrient measurements.
- The need for reference products which would, for instance, reconcile the differences between surface ocean observations from ships, moorings, USVs and profiling floats.
- The need to better constrain initial and boundary conditions in the models with biogeochemical data prior to being able to achieve multiple model ensemble runs as in case of physical forecasting.
- The use of available systematic metrics for systematic model comparison and evaluation, such as the ESMValTool (https://www.esmvaltool.org/).

2021 ICOS OTC pCO_2 Intercomparison Exercise

Dariia Atamanchuk presented the current status of publishing the outcomes of the 2021 ICOS OTC pCO_2 Intercomparison Exercise (IC). The SSG asked about the lessons learnt from this round of intercomparison which were summarised in preliminary format on Dasha's slides, courtesy of Tobias Steinhoff. It was noted that having a small group in charge of the operations on-site made it possible to document absolutely everything that was going on with the sensors in the laboratory. This was seen as critical to the success of the exercise and a key lesson learnt for the future. The SSG made an additional recommendation to

organise these exercises more frequently than once per decade, in particular recognising the potential of the mCDR industry to advance carbon sensor development rapidly.

Noting the importance of using QuinCe for standard data processing during the exercise, the group discussed some issues related to its use during the IC and in SOCAT:

- QuinCe was not used to correct sensor data but rather to ensure uniform data interpolation methods which would otherwise be different across the sensor groups.
- It was recommended that Jupyter Notebooks from the IC be published in order to foster best practices for data processing from these instruments and sensors.
- There is a need for QuinCe to incorporate auxiliary sensor data on pH and oxygen to further aid the automatic quality control of pCO_2 data. Currently, only raw data is being handled.
- If QC'ed, both pH and oxygen could be submitted as part of the SOCAT metadata.

When asked about a similar intercomparison for pH measurements, the SSG noted the following:

- One of the WP of the EU MINKE project, coordinated by CSIC (Spain) with partners across the EU, is focused on pH measurements providing access to training and sensors for OA research.
- pH intercomparisons should be done at sea not to deal with pressure effects in a lab tank.
- In the past, the XPrize competition was utilised to progress pH sensor development and related intercomparisons and this kind of approach should continue to motivate sensor developers into the future.

Action: Connect the ICOS OTC pCO_2 Intercomparison Exercise Team with the EU MINKE project to coordinate future efforts for efficiency and wider relevance.
Responsible: Dariia Atamanchuk, Maribel García-Ibáñez
Timeline: 2023
Budget implications: none

IOCCP & ICOS OTC 2023 Biogeochemical Sensors Training Course

Dariia Atamanchuk presented the current status of preparations for the upcoming IOCCP & ICOS OTC Biogeochemical Sensors Training Course which will take place on June 5-18 in Kristineberg, Sweden. Dariia informed the SSG about the outcomes of the meeting of the Scientific Advisory Committee, revised scope of the course compared to the last edition in 2019, and outlined the timeline for the next weeks and months. The SSG gave positive feedback on the proposed scope and offered suggestions for additional course instructors where relevant. Pending the release of the open call for applications, the SSG was asked to promote the announcement widely in their networks, in particular in the Asia-Pacific region from where we had received zero applications back in 2019 (not counting Australia). In connection with the training course, the EU project KADI (**K**nowledge and climate services from an **A**frican observation and **D**ata research **I**nfrastructure) was mentioned as a specific conduit for disseminating information to qualified candidates in the Africa region.

Action: Promote the course announcement through relevant communication channels.
Responsible: Office, all SSG
Timeline: December 2022-January 2023
Budget implications: none

Coordination of the Nutrients EOV

Véronique Garçon gave a short introduction (slides 37-43) to the issue with lack of coordination of the Nutrients EOV, in particular in the face of unexpected passing of Michio Aoyama, past IOCCP SSG member, who had served as the driver for a series of interlaboratory comparisons of nutrient measurements in seawater. Ensuring Michio's legacy became a catalyst for discussion about taking up broader coordination in the nutrient measurement space. The decision was in addition motivated by the following:

- There is no active community of practice associated specifically with nutrient measurements in seawater which could play a coordinating role, especially after the termination of SCOR WG COMPONUT.
- Measurements of nutrients in seawater are no longer limited to ship-based sampling but are increasingly done autonomously e.g. on profiling floats in the open ocean or via a variety of sensors in coastal waters.
- Use of nutrient CRMs is a standard practice in the community although stronger advocacy for that is still needed when it comes to climate quality measurements.
- There is a gap in nutrient expertise in the GLODAP group. Up to now, QC on nutrients from repeat hydrography surveys was done by carbon and transient tracer expertise. In particular, issues were identified with significant and consistent offset in silicate measurements in the Pacific ocean as compared between US and Japanese measurements. GLODAP has no resources to set up a dedicated nutrients working group to resolve such a critical issue.
- Work on the time series data synthesis product by Nico Lange also revealed gaps in nutrients metadata being reported, including in data submitted to SOCAT.
- A number of sensor development groups focused on nutrients now exist in Europe and likely beyond.
- The new Euro GO-SHIP project includes a dedicated task on Nutrients EOV, focusing on comparison of various approaches to sample preservation as well as on developing a blueprint for CRM production in Europe. IOCCP SSG would be interested in working with the task leadership to enhance their work.
- IOCCP might consider facilitating application for a new SCOR WG with the end goal of reconciling the ship-based and sensor nutrient measurements to enhance the capacity to forecast nutrients variability through operational models.

Action: Organise an online scoping meeting with experts in nutrient measurements across a variety of platforms and domains to identify the needs of the community, to identify a potential champion to liaise with IOCCP, and to delineate the requirements for coordination and communication support from IOCCP.
Responsible: Maciej Telszewski, Maribel García-Ibáñez
Timeline: first quarter of 2023. Possible new SCOR WG application by April 2023
Budget implications: none

OOPC & IOCCP Interactions

Following the IOCCP Director's visit to the OOPC Annual Meeting in Darmstadt, Germany in October 2022, the IOCCP and OOPC continued a dialogue around priority joint actions during a dedicated session during IOCCP-SSG-17. To this end, OOPC Officer, Belén Martín Míguez, attended the meeting in-person. In her presentation, Belén briefly introduced the OOPC as GOOS Physics & Climate Panel as it stands now, and re-capped the discussion about joint interactions initiated during the OOPC meeting.

It should be noted that there is excellent and frequent communication between the OOPC and IOCCP Secretariats which is seen as critical to the currently successful and any future planned joint activities.

The following joint activities were discussed during the meeting, with the first two covered in more detail elsewhere in this report:

- Cross-GOOS Working Group on Ocean Indicators
- WMO's new initiative on Global Greenhouse Gas Monitoring System
- IOCCP's contribution to OASIS
    - It was agreed that with several IOCCP SSG members being part of the OASIS Programme, our interaction on that level is probably adequate. One IOCCP SSG member expressed interest in joining OASIS as well, which would in particular responds to the need for stronger regional implementation of OASIS.
- Initiating the implementation of the GOOS initiative on VOICE
    - With VOICE implementation currently relying on the success of the Chilean demonstration planned within the CLAP project, there is limited collaboration to be performed on the global level. OOPC is nevertheless waiting for concrete requests on how they can assist.
- How can the current observing systems quantify the water, heat and carbon cycles at a regional level?
    - A concept note is being prepared by OOPC and IOCCP suggesting to benefit from the RECCAP-2 process when it comes to carbon.
- Review and update of GOOS EOV Specification Sheets according to the new jointly agreed template.
    - This is currently proceeding on the Secretariat level with members of both Panels to be involved soon.
- Input into the next GCOS cycle starting expected in 2027-2028.
    - The group was assured that there were no problems with having one dedicated person from the SSG join the official writing team of the next GCOS IP cycle.

Ocean Indicators

Karina von Schuckmann (Mercator Ocean International, France) joined the meeting remotely to give a presentation about the GOOS Task Team on Ocean Indicators. In response to the presentation, the group discussed with Karina to clarify:

- the classification of domains, in particular the Ocean & Biosphere with a suggestion to change it to "Ocean Biosphere,"

- the meaning of indicator champions as key indicators to be suggested,
- the difference between an EOV and an ocean indicator, pointing for example at the resemblance of indicators and derived products or phenomena included in the EOV Specification Sheets,
- the overall mapping of existing ocean indicator frameworks already being developed,
- the number of indicators to be suggested at the proof of concept stage (max 2 per environment area).

The SSG responded positively to Karina's request for input which resulted in identifying two actions:

Action: Provide suggestions for revision of the indicator criteria. Collective response submitted by email to Karina.
Responsible: IOCCP SSG
Timeline: January 2023
Budget implications: none

Action: Propose a limited number of ocean indicators as a proof of concept. IOCCP Office to initiate an email discussion with the Panel. Collective response submitted by email to Karina.
Responsible: IOCCP SSG
Timeline: March 2023
Budget implications: none

Time Series Efforts

A number of initiatives were reviewed in this session, with Kim Currie presenting the first two items, and Keyhong Park presenting the third one. Comments and suggestions from the SSG are listed below accordingly.

I. The ship-based time series data synthesis product led by Nico Lange (GEOMAR, Germany) as part of the H20202 EuroSea project

The SSG were surprised and concerned with the Bermuda Atlantic Time Series (BATS) backing out from the effort, due to issues related to the secondary quality control (QC) protocols for the submitted data. This was seen as potentially decreasing the value and legitimacy of the final product. Additional efforts to negotiate with BATS were recommended, especially considering that no such issues were reported in the past with BATS contributing to SOCAT where secondary QC protocols are very similar.

II. The Marine Ecological Time Series (METS) Research Coordination Network (RCN) which is coordinated by Heather Benway at the US Ocean Carbon & Biogeochemistry (OCB)

METS RCN is an effort aimed to establish FAIR data solutions to support a global observing system of marine ecological time series. The SSG briefly discussed a potential METS RCN's response to the call for new emerging networks issued by the GOOS Observations Coordination Group (OCG). It was noted that METS RCN likely needed to gain maturity and

better identify how it hoped to benefit from being recognized as an OCG network prior to making a formal application.

III. The regional time series efforts coordinated by Korea in the North Pacific and the Southern Ocean

Keyhong provided a comprehensive insight into the status of time series measurements and data management operated by Korea. The SSG acknowledged Keyhong's successful bid to engage with the Southern Ocean Observing System (SOOS) following the recommendation from IOCCP-SSG-16. Currently, Keyhong is awaiting approval from SOOS and GOA-ON to start as Co-Chair along with Julie Schram (Uni. Alaska Southeast, USA) of the new Southern Ocean Regional Hub for Ocean Acidification.

The SSG discussed at length an issue of the lack of access to data collected by the Korean research community operating a wealth of time series sites, as well as the projected decrease in biogeochemical monitoring due to lack of interest of the younger generation of researchers to engage in sustained observations (monitoring).

The SSG noted that issues with data sharing are not such a distant past even when it comes to such mature products as SOCAT. It takes time to build trust among the community and to convey the message about benefits of international collaboration on data management and synthesis product development. Top-down enforcement of research data dissemination in South Korea is likely necessary in the long-term as was the case with the US and the EU prior to the successful FAIR data campaign. Nevertheless the SSG made several specific recommendations which could help tackle the issue of data sharing in the East Asia region in general:

- Consult the GEOTRACES programme on the lessons learnt around data sharing from their successful Intermediate Data Product.
- Organise webinars promoting open data concepts in local languages (Korean, Chinese, Japanese and other) potentially in consultation with the IOC.
- Promote sharing metadata as a first instance in order to gain a more accurate overview of the current observing capacity.
- Engage the IOC and the national focal points to engage in dialogue on open data requirements.

SSG composition and budget

Changes in IOCCP SSG composition

The group reviewed the current SSG composition and expected timeline of rotations. Two major changes are anticipated for the near future. IOCCP-SSG-17 was the last meeting for Siv Lauvset as an IOCCP SSG member. The SSG thanked Siv heartily for her tremendous and longstanding commitment to IOCCP and the service for the entire marine biogeochemistry community. Each panel member was encouraged to express their thanks to Siv in their own language in addition to English, which in an important way emphasised and gratified the community building service that Siv as well as all other IOCCP SSG members are asked to provide across cultures globally.

Siv has been responsible for the Synthesis Activities Theme at the IOCCP SSG for the past 6 years. The SSG discussed at length the need to evolve the theme in response to changing community needs, and in particular the growing number of biogeochemistry data synthesis activities relevant to different platforms and EOVs. An open call for the vacant SSG position will be released in early 2023.

Action: Draft the Terms of Reference for the new position at IOCCP SSG and announce an open call.
Responsible: Office + SSG
Timeline: first quarter of 2023
Budget implications: none

The SSG also acknowledged that a new Co-Chair will need to be appointed at the start of 2024. Kim Currie's final term as IOCCP SSG member ends in 2023. The process of identifying potential and interested candidates is led by the IOCCP Director.

Update of the IOCCP SSG skills, roles & responsibilities matrix

The SSG were asked to review and update the IOCCP SSG skills, roles & responsibilities matrix - an internal tool which informs the selection of new SSG members and helps keep track of the group's strengths and weaknesses in relation to the Terms of Reference.

The following shortcomings were noted during the discussion, also considering current and near future rotations:

- A new column should be added to represent the level of engagement with relevant UN Decade Programmes and/or Projects
- SSG's expertise in Inorganic Carbon EOV will be substantially reduced with the departure of Siv and Kim from the Panel.
- SOCAT and GLODAP can no longer be considered mature and well supported due to the collapse of the Bergen data management team, and thus explicit support from IOCCP is needed for these as well as other data synthesis efforts.
- Establishing a permanent liaison function between IOCCP and IOCCG was recommended to aid the joint curation of the Ocean Colour EOV/ECV. Such interaction has increased in frequency and efficiency since Emmanuel Boss joined IOCCP, benefiting GOOS and GCOS alike.
- Allocating specific roles for Early Career Ocean Professionals while acknowledging that effective service for IOCCP requires that one already has a strong network developed around them.

Moreover, the group identified the need to:

- Better integrate the IOCCP Action Plan with the GOOS IP through Monday.com
- Address specific IOCCP Actions through regular Virtual Quarterly meetings which were scheduled in advance for the whole of 2023 shortly after the in-person SSG meeting.

IOCCP Budget for 2023-2024

The IOCCP Director briefed the SSG about the current budget situation, noting that significant funds were secured for key IOCCP activities planned for 2023, in particular the organisation of the IOCCP & ICOS OTC 2023 Biogeochemical Sensors Training Course. Further funds are available for IOCCP to spend on activities until mid 2024. Considering multiple community workshops requested to be organised by IOCCP in 2023, co-funding from partners will be needed to organise the events, as has been customary at IOCCP over the past years. Among additional initiatives which could be supported by the budget the SSG explicitly mentioned:

- Reserving seed money for the Nutrients EOV community to come together
- Paying publication charges for review papers written by IOCCP
- Supporting GLODAPv3 product development and release

Future of Data Synthesis Activities

In light of the recent decision of the University of Bergen (UiB), Norway, to discontinue funding for the international data management efforts, and the effective disbandment of the SOCAT Data Management group at UiB, the SSG discussed the implications of that for global marine biogeochemistry data handling and what the appropriate response from IOCCP should be.

The following situation with respect to SOCAT was reported:

- After Benjamin Pfeil had left UiB earlier in 2022, Rocío Castaño Primo and Camilla Stegen Landa will move to IMR (Norway) as of January 1, 2023. This effectively means that a new home needs to be found for SOCAT, and it needs to be outside of UiB.
- The loss of two dedicated staff members working up to now on SOCAT (RocÍo and Camilla) is effectively destroying the operation of SOCAT as we know it now.
- Immediate consequence is that SOCATv2023 will not be as big as before.
- SOCAT is now 24 person months short from operating as it is.
- Without an additional at least 3-4 person months, it will cease to exist.

The SSG discussed the following ideas on how to respond to the crisis:

<u>In the short term</u>

- Include the requirements for SOCAT in the planned 2-pager on operationalizing surface CO_2 observations to be presented at the WMO Symposium and beyond.
- There is potential for a short-term solution for SOCAT support at IMR especially considering they host the Norwegian National Oceanographic Data Centre (NODC). This requires negotiations with IMR leadership, perhaps aided by the IODE as the global coordinator of NODCs. Contacting Peter Pissiersens (IODE) was suggested.
- There is potential for acquiring funds at JPI Oceans to cover the 4 PM requirement for SOCAT minimal maintenance, to be transferred to the Norwegian NODC at IMR.
- The transition period for finding a long term solution will last approximately 2 years and negotiating this sort of timeframe with IMR (or any other relevant entity) is needed.

In the long term:

- A new European hub for SOCAT is needed to complement the US-based group based at NOAA PMEL (Seattle) and led by Kevin O'Brien.
- One challenge is that there are very few organisations where the necessary expertise in marine carbon science and scientific data synthesis co-exist as it was the case at UiB. Such co-location of expertise benefited the development of SOCAT and GLODAP tremendously. On the other hand, IMR has the expertise in overall biogeochemistry as it is running a biogeochemistry component of Copernicus.
- Collaboration with WMO seems necessary in order to ensure sustainability of SOCAT operations in the long-term. Presenting the current situation at the WMO Symposium is critical. However, it must be recognized that it will take a few years before such a permanent solution with SOCAT at WMO could be completed. Once at WMO, we expect the countries to be more willing if not obliged to invest in SOCAT on a national level.
- At the same time, discuss with IODE the potential of them providing long-term support for SOCAT based on coordinated dataflows via NODCs. IODE coordinates the global network of NODCs offering a truly global solution, as for example with SDG 14.3 reporting on pH for ocean acidification. This has potential to create hubs outside of Europe and North America.
- While EMODnet Chemistry also seems capable of providing long-term support for SOCAT (technically and with reliable funding from the European Commission), there would be a need for added competence in terms of carbon and scientific data synthesis.
- Consider the very successful Argo model when proposing a long-term solution for SOCAT.
- It should be noted that it is the PIs who own SOCAT because of the 2nd QC process involved. We are not talking about storing or managing data per se.

In the end, the **SSG decided that IOCCP will focus on incorporating SOCAT into the existing global structures of WMO and IODE, and in parallel open up to potential data centres who are able and willing to fund the SOCAT effort.**

Action: Negotiate with IMR leadership the possibility of running SOCAT operations by dedicating a total of 4 PMs annually of its staff during a 2-3 year transition period, based on external funds to be requested from JPI Oceans among other potential sources. Seek the support of IODE in the negotiations.
Responsible: Richard Sanders, Kim Currie, Maciej Telszewski
Timeline: first quarter of 2023
Budget implications: none

Action: Present the vulnerability of SOCAT to WMO and IODE, including through the 2-page document on operationalizing surface ocean CO_2 observations.
Responsible: Richard Sanders, Adrienne Sutton, Kim Currie, Maciej Telszewski
Timeline: first quarter of 2023
Budget implications: none

Appendix A: List of meeting participants

Table A1. 2022 SSG member composition and annual meeting attendance

Name (Gender)	Home institution	Country of residence	Expertize (Role)	Attendance
Kim Currie (F)	NIWA	New Zealand	Ocean acidification **(Co-Chair)**	In person
Véronique Garçon (F)	CNRS-LEGOS	France	Oxygen **(Co-Chair)**	In person
Siv Lauvset (F)	NORCE	Norway	Synthesis activities	In person
Adrienne Sutton (F)	NOAA PMEL	USA	Time-Series Efforts: Global	In person
Sana Ben Ismail (F)	INSTM	Tunisia	Regional Implementation	remotely
Keyhong Park (M)	KOPRI	South Korea	Time-Series Efforts: Regional	In person
Maribel García-Ibáñez (F)	UEA / CSIC	UK / Spain	Interior Ocean Observations	remotely
Dariia Atamanchuk (F)	Dalhousie Univ.	Canada	Instruments & Sensors	In person
Steve Jones (M)	NORCE	Norway	Data & Information Access Services	In person
Richard Sanders (M)	NORCE	Norway	Surface Ocean Observations	In person
Fei Chai (M)	SIO/Univ. Maine	China/USA	Observations - Modelling Interface	remotely
Emmanuel Boss (M)	Univ. Maine	USA	Particulate Matter	In person

Table A2. Project Office staff and additional meeting participants

Name (gender)	Home institution	Country of residence	Role	Attendance
Maciej Telszewski (M)	IOCCP/IO PAN	Poland	Project Director	In person
Artur Palacz (M)	IOCCP/IO PAN	Poland	Project Officer	In person
Belen Martin Miguez (F)	OOPC/WMO	Switzerland	GOOS Physics & Climate Panel Officer	In person
Albert Fischer (M)	IOC UNESCO	France	GOOS Director	remotely
Maria Grigoratou (F)	Mercator International	France	G7 FSOI EU Office	remotely
Karina von Schuckmann (F)	Mercator International	France	GOOS Physics & Climate Panel Member	remotely
Pierre Bahurel (M)	Mercator International	France	ETOOFS Director	remotely
Patricia Miloslavich (F)	SCOR	USA	SCOR Executive Director	remotely

Appendix B: Agenda

Day 1 - Tuesday, 15 November

07:45 - 08:30	*Breakfast at Hotel Haffner (optional)*
09:00 - 09:05	**Welcome & Logistics** (Maciej)
09:05 - 09:15	**Opening of IOCCP-SSG-17 & agenda overview** (Kim, Véro)
09:15 - 09:30	**Overview of IOCCP accomplishments** since IOCCP-SSG-16 (Maciej)
09:30 - 10:30	**IOCCP & the UN Decade** ● GO2NE & GOOD, including GO2DAT (30 min - Véro) ● GOA-ON, OARS, including OA online data QC tool (30 min - Kim, Adrienne) ● Other if relevant…(eg. OASIS - Adrienne?)
10:30 - 11:00	*Coffee Break*
11:00 - 12:30	**Operationalizing ocean carbon observations - Overview of activities** *Summary presentations (ca. 10 min) on status and plans of:* ● Status of surface CO2 strategy developed with G7 FSOI (Maciej, Maria) ● SOCONET revitalization (Adrienne/Maciej) ● WMO GHG Monitoring and the role of IOCCP (Maciej, Belen) ● GOOS Decade Programme ObsCoDe Carbon Exemplar (Richard) ● North Atlantic Carbon Observatory (Richard, Dariia) ● IOC WG Integrated Ocean Carbon Research (Kim) ● Surface carbon observations and BGC Argo (All)
12:30 - 13:30	*Lunch break*
13:30 - 14:30	**Operationalizing ocean carbon observations - Discussion & synergy** *Discussion on IOCCP's exact coordination role and synergies between the initiatives presented above (moderated by Kim, Richard, Adrienne and Maciej)*
14:30 - 15:00	**Operationalizing ocean carbon observations - CRMs (Part 1)** ● IOCCP Position Paper on global supply and distribution of seawater carbonate RMs (Maribel) ● Best Practices on secondary RMs (Maribel) ● pH (Maribel)
15:00 - 15:30	*Coffee Break*
15:30 - 16:30	**GOOS Cross-Panel Collaboration: GOOS Physics Panel** ● Update on Ocean Indicators Framework (Karina von Schuckman, 15+15) ● Interaction with GOOS Physics Panel - OOPC, (Belen 20+5 min) - *cross-panel discussions including OOPC update*
16:30 - 17:00	**Operationalizing ocean carbon observations - CRMs (Part 2)**

- IOCCP Position Paper on global supply and distribution of seawater carbonate RMs (Maribel)
- Best Practices on secondary RMs (Maribel)
- pH (Maribel)

Day 2 - Wednesday, 16 November

07:45 - 08:30 *Breakfast at Hotel Haffner (optional)*

09:00 - 09:45 **Observations-modelling interface** - *moderated by Véro*

- stocktake of what is going on at the obs-modelling interface
- what should/can IOCCP do with that knowledge
- ETOOFS/IOCCP possible cross-cutting activities (15+5 min, Pierre Bahurel, ETOOFS)

09:45 - 10:15 **Coordination of Nutrients EOV** - *moderated by Véro*

- Is explicit global coordination required?
- Ensuring legacy of Michio Aoyama

10:15 - 10:45 *Coffee Break*

10:45 - 11:30 **Changes in the SSG Composition** - *moderated by Exec*

- Current status for each member
- Siv's replacement
- Data management to include carbon data management and synthesis, but also other EOVs, including O2?

11:30 - 12:00 **Update on Time Series Activities** - *moderated by Adrienne & Keyhong*

- Plans of METS-RCN (Kim)
- Update on carbon TS pilot product (Kim with input from Nico Lange)
- SOOS and other time series updates (Keyhong)
- Best practices for assessing Trends of Ocean Acidification Time Series (Adrienne)
- Update of time series directory on IOCCP website (Adrienne)

12:00 - 12:30 **Reports from activities**

- ECOTIP and EuroSea (10+5 min - Artur)
- Status of ICOS IC Exercise final report (Dariia)

12:30 - 13:45 *Lunch break*

13:45 - 14:15 **Reports from activities**

- ECOTIP and EuroSea (10+5 min - Artur)
- Status of ICOS IC Exercise final report (Dariia)

14:15 - 15:15 **Discussion on the future of data management and synthesis activities** - *moderated by Siv Lauvset & Steve Jones*

The data management at University of Bergen, which has supported SOCAT and GLODAP since the beginning, will cease to exist at the end of the year when the two remaining data managers (Rocío

and Camilla) begin positions elsewhere. This loss presents a serious issue especially for SOCAT, but also for GLODAP and European carbon data management in general. It will also affect the operationalization of the observation system.

15:15 - 16:00 **Office Business**

- Budget
- Communications
- Addressing the EU Funding Call “HORIZON-CL6-2023-CLIMATE-01-8: Closing the research gaps on Essential Ocean Variables (EOVs) in support of global assessments” [Topic B - Biogeochemistry EOVs]

16:00 - 16:15 *Coffee Break*

16:15 - 16:35 **2023 Sensors Summer School - update** (15+5 min - Dariia)

16:35 - 16:50 **Emmanuel Boss - update on IOCCP-relevant activities** (15+5 min - Emmanuel)

16:50 - 17:20 **Review of new Action Points** (Artur and All)

17:20 - 18:00 **Breakout Meetings / Bilateral Discussions**

Time for additional conversations around specific activities/topics:

- Regional Workshop in Tunisia - Sana, Maciej, Artur
- OA Data QC - Kim, Adrienne
- Collaboration with WMO & GCOS - Maciej, Artur, Belen
- Update of the time series repository - Keyhong, Artur
- SOCONET workshop planning
- mCDR and IOCCP - ?
- Addressing the EU Funding Call “HORIZON-CL6-2023-CLIMATE-01-8: Closing the research gaps on Essential Ocean Variables (EOVs) in support of global assessments” [Topic B - Biogeochemistry EOVs].