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Ocean Observations Physics and Climate panel

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KEEPING WATCH OVER OUR CLIMATE

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GOOS
The Global Ocean Observing System

WCRP
World Climate Research Programme

DAY 1: MONDAY 26 JUNE 2023

1. INTRODUCTION

The Ocean Observations Physics and Climate Panel (OOPC) 26 Session was held in Bonn, Germany, kindly hosted at the ECMWF (European Centre for Medium-Range Weather Forecasts) Headquarters with the support of their staff.

The OOPC-26 meeting took place in the week 26-30 June, back-to-back with the 3rd Session of the Global Climate Observing System (GCOS) Joint Panels Meeting (see separate report in GCOS-254). This made it possible that experts from the three GCOS panels to meet and work on several issues of common interest.

For the individual OOPC meeting, the three main areas where progress was sought was:

1. Actions in GCOS Implementation Plan where OOPC input and/or oversight was required.
2. On-going and new actions related to the global Ocean Observing System (GOOS) Strategic Objectives and GOOS Roadmap.
3. Actions in collaboration with CLIVAR (Climate and Ocean Variability, Predictability and Change), one of the World Climate Research Programme (WCRP) core projects.

Furthermore, the meeting provided an opportunity to discuss plans for the next 5 years, that will be reflected in the OOPC 2024-2028 Workplan.

The presentations given at the meeting and extra information can be found on the dedicated website for OOPC-26 here.

Welcome and OOPC meeting planning

Sabrina Speich and Weidong Yu, Co-chairs of OOPC, welcomed the participants and explained how the agenda had been designed, devoting approximately 1 full day to working in issues directly related to GCOS, and GCOS Implementation Plan; 1 full day related to activities that are led by OOPC members, which are also part of GOOS Strategic plan; and one last day where several CLIVAR members would attend as a follow up of a high-level meeting which took place in spring 2023 and allowed to identify several areas of joint work between OOPC and CLIVAR. OOPC-only sessions would be interspersed with GCOS Cross Panel Groups sessions.

1.1 Setting the scene: GOOS Roadmap and Monday.com; How much did we accomplish in 2019-2023?

Sabrina Speich presented OOPC Workplan 2019-2023 and GOOS 2030 Strategy, with three main goals and 11 Strategic Objectives. Strategic Objective SO5 (Authoritative Guidance on Observing System Design) is the one where OOPC is more heavily involved. She described how the different activities running now under OOPC (e.g., Air-Ocean interactions, Boundary Systems, work with EOV/ECVs…) fit in this SO5, and which SO5 activities are dealt with by other panels or transferred to the Observing Co-Design Programme. She also described the main achievements for each of the activities as well as the areas that had not been sufficiently developed yet. The purpose was to put the OOPC work in context and relate it to the strategic objectives of one of its co-sponsor programmes, and also to remind of the progress accomplished by OOPC in the last years as a preparation for the meeting.

Her presentation is available here.

1.2 Setting the scene: GCOS Implementation Plan (GCOS IP) Presentation

Belén Martín Míguez, OOPC officer, presented 2022 GCOS IP and Actions to improve the global observing system for climate contained therein differentiating between three types:

Type 1 – Actions that concern a single panel and will be addressed and/or reported on exclusively by the members of that panel (GCOS and OOPC are generally not implementers of the actions as such, but they need to oversee progress).
Type 2 – Actions that are cross-cutting between panels and require experts from at least two panels working together (some of these actions were selected as topics for the Cross-Panel Groups and OOPC is one of the implementers, together with the other panels).
Type 3 – Actions that are mainly panel-led but need coordination among panels to ensure consistency in the outcome (again, OOPC is implementing the actions in the ocean realm, together with the other panels).

1.3 GCOS IP Actions implemented by OOPC in coordination with GCOS panels (Type 3)

The OOPC officer described Actions A1.1, D1.1 and D2.1, which fall under Type 2 and would be the focus of the last slot of the day.

Action A1.1 Sustainability of in situ networks
Action C1.1 Monitoring Standards and GCOS Climate Monitoring Principles
Action D2.1 Global Climate Data Centres

OOPC experts distributed themselves into three teams and worked on filling in the Tables which had been prepared to gather information on each of the Actions.

There was some discussion on the first Table A1.1, clarifying what the scope was and how the tables should be filled in, including the possibility of sustained funding but with a decline of the number of instruments. The exercise implies an abstraction, as there may be different levels of national funding, contributing to the global endeavor.

For Table A1.1 the column "Meeting ECV spatial requirements" does not apply to OOPC as it does not reflect a relative greater importance of the network.

For Table C1.1, it was discussed that the Ocean Best Practices Repository was the most straightforward source of information. It must be noted that the current version of the Table reflects the tiered nature of many of the atmospheric networks and some columns are not necessary for the ocean variables.

For Table D2.1, OOPC experts raised the issue that ocean climate data may not be as centralized as for other domains. There was a need to differentiate between data archive and data portals, and between remote and in situ data. There were also some concerns on how much further processing data from a specific centre would need. OOPC experts raised the issue of to what extent global climate data centres are needed, or it is just a question of facilitating access to the different datasets, instead of creating something new. David Legler referred to a recent study undertaken by Observations Coordination Group (OCG) (link here) mapping data flows for each ocean network.

The Tables were not completely finalized but good progress was made, and more will be done in remote work after interaction with the other GCOS panels.

N°	Action	Responsibility/Deadline
O0	Finalize Tables A1.1, C1.1 and D2.1	All/October 2023

DAY 2: TUESDAY 27 JUNE 2023 (ONLY AFTERNOON)

2.

2.1 Reporting back from Cross Panel Groups (CPG)

OOPC experts reported on progress achieved in the different CPGs. Interaction with experts from other panels was very fruitful and the general impression was good.

2.2 EOVs/ECVs New Template and Stewardship

The session started with a general discussion where some OOPC members expressed concerns about the current state of some of the EOV and ECV requirements tables. Especially when compared to the Atmospheric Observations Panel for Climate (AOPC) ones, the tables lack references to support the values proposed, so traceability is more difficult. Furthermore, in the case of surface currents, the choice of ECV products does not seem adequate, and there was agreement that this needed to be fixed.

N°	Action	Responsibility/Deadline
O1 [URGENT]	Review EOV/ECV Surface currents requirements	Rick Lumpkin and Tamaryn Morris/early 2024

The current list of ECV/EOV stewards was updated and completed (2.2 EOV/ECV stewards), as there are several members who have joined OOPC in 2023. There must be at least two stewards per EOV/ECV who will lead the definition of requirements in the next GCOS Status Report/Implementation Plan cycle (2026-2028), and who can amend the current specification/fact sheets, if this is needed. Stewards are supposed to work in consultation with communities of practice, as discussed further on.

While the ECV focuses clearly on climate monitoring and modeling, the current evolution of WMO Rolling Review of Requirements (RRR), and the inclusion of new application areas beyond climate, may imply that OOPC and other communities will be using this framework to propose new requirements.

Another point of discussion was related to what communities of practice need to be engaged in order to ensure transparency and reliability. The example of sea ice was described, which involved a large group of experts who were based on previous ESA CCI projects, including modelers. Communities who could be consulted when producing the specification sheets may include: climate community; climate modeling; ocean predict.

While expert opinion is still a valid source of information, improved traceability could be achieved using peer review literature, but also grey literature (results from workshops, reports, best practices) and results from reanalysis (e.g. CLIVAR intercomparison project, in particular to define uncertainty requirements).

All these reflections should be described in a guideline document, to make sure that requirements are defined consistently for all ECV/EOVs.

N°	Action	Responsibility/Deadline
O2	Draft a one-page guideline document establishing both communities that should be consulted and references that should be provided when producing the specification sheets	ALL/OOPC Officer - 2026

Difficulties experienced when updating the ECV requirements in preparation of 2022 GCOS IP were mentioned and it was stressed that for the next round (2026-2028), this should be planned much more in advance.

However, it was discussed that the modification of the numbers themselves should wait till the next round, possibly following the guidelines developed in O2.

2.3 Work in groups or individually/updating the Specification Sheets (data sources)

OOPC experts were keen on revisiting the current ECV/EOV requirements and, if needed, completing information by adding more references and/or the list of sources for openly accessible data sets with worldwide coverage for which metadata is available (see ECV factsheets https://gcos.wmo.int/en/essential-climate-variables). David Legler provided a document produced by OCG which can be used for the latter (link here, see also Item 1.3). OOPC officer reminded that there is a new EOV/ECV template and that she can assist with transferring the information into the new template.

N°	Action	Responsibility/Deadline
O3	Revise EOV/ECV specification sheets, with a focus on including more references to improve traceability and transparency, and updating the reference data sources	OOPC officer to lead with the new template and All/2026

2.4 GCOS IP Actions implemented by GOOS (OOPC rapporteur and implementer)

OOPC officer presented a document where the GCOS IP Actions are listed, with a short description of the activities. The document also specifies who will be implementing the Actions ("Responsibility" when it is a Type 2 or 3) and who will act as "Rapporteur", i.e, who will oversee and report on progress (mostly Type 1 Actions) in the frame of the upcoming 2027 GCOS Status Report.

The same exercise (assigning "Responsible" and "Rapporteur") was done for most of the Actions, however: (1) not all OOPC experts were attending the meeting, and some names may be missing; (2) responsibilities should be distributed evenly to the extent that this is possible.

N°	Action	Responsibility/Deadline
O4	Complete and consolidate the assignment of OOPC experts to all the GCOS IP Actions	OOPC officer and all/by next OOPC meeting in 2023

Action B6 was paid particular attention ("Expand and build a fully integrated global ocean observing system"). The role played by the Global Ocean Monitoring and Observing programme

(GOMO) (funding 50% of the ocean observing system) was highlighted. OceanOPS and tools developed by Lijing Cheng allow to track changes in the density of the networks.
While Action B7 was put forward initially by the GOOS Biogeochemistry panel, OOPC experts, and in particular Tamaryn Morris (co-chair of SOOP) and Katrin Schroeder (Med-SHIP, member of GO-SHIP SC, vice-chair of MedCLIVAR) can provide input in this action too.

In the case of B10 (earth cycles), several OOPC experts are directly involved in progressing the different components (energy, water, carbon) of this Action.

To complete C1, it is possible to count on experts from the Ocean Best Practices group and from the OASIS Early Career Ocean Professionals (ECOP). A follow-up action will be to encourage communities developing Best Practices to get GOOS endorsement.

E1 drew some attention too. GCOS Secretariat is the leader of this action, organizing regional workshops etc., but there is room also to connect with other regional initiatives (GOOS Regional Alliances GRAs) and report on them in the frame of the GCOS Status Report in 2027.

For F3 ("Improve monitoring of coastal and Exclusive Economic Zones"), the issue of very coarse satellite measurements, without a proper uncertainty estimation, being used to take decisions in coastal zones was highlighted.

The session finished having a look at the draft for OOPC 2024-2028 Workplan, where OOPC activities and responsibilities will be reflected. The structure of the Workplan was explained and the first items were included.

DAY 3 WEDNESDAY 28 JUNE 2022 [GOOS]

3.1 OOPC and the Modelling community/SYNOBS

Peter Oke (OOPC) presented this item whose purpose was to prompt a discussion on how to improve the engagement between OOPC and the modeling community and specifically with CLIVAR/GSOP (Global Synthesis and Observation Panel) and SynOBS. Peter described how GSOP (where he is a co-chair) focuses on defining observational requirements for modeling. GSOP is defining metrics for data assimilation models. **OOPC could help improving those metrics so that they are more insightful and useful.** SynOBS is a UN Decade project, which a shorter timeframe. Both Peter and Hao Zuo are involved in this project, and they are going to run a flagship activity: a series of multi-system (one system = model + data assimilation system) Observing System Experiments and Observing System Simulation Experiments. The teams are going to run equivalent experiments of these two items to quantify the impact of withholding a type of observation, hence to demonstrate the value of assimilating that type of observation. The experiments will finish in December 2023, most of them are global, computational heavy etc. So far, the metrics used had been rather "basic" and very often only semi-quantitative. The problem and the opportunity are to assess when the correlation is really useful and what is a "significant" improvement for a given inclusion of a type of observation/platform.

Hao Zuo clarified that the SynOBS experiments are focusing on certain cases (sea level, marine heatwaves…) while there is no guidance on what kind of variance matrix they should use. He also mentioned that there are also plans to run experiments to initialize seasonal forecasts, and OOPC could help here too. It is also important to note that this is ocean-only experiments for their main part.

Sabrina Speich stressed that this activity can be very impactful and added that OOPC could also look into the impact of using different data assimilation systems.

They highlighted in particular the relevant of subsurface observations for predicting marine heatwaves. The importance of fit-for-purpose (vs. generic) metrics was commented and the example of XBT was suggested (what's their impact and how to evaluate it using variables that are integrative like heat content or transport). To suggest different experiments (so far, XBT is not one of the experiments) it would be better to wait for a potential follow-up.

The suggestion is to set up a joint task team, with members from OOPC, GSOP and SynOBS as soon as possible as the teams have already started. And not only modelers (like Peter/Hao who are at the interface) but also hard-core observationalists.

N°	Action	Responsibility/Deadline
O5	Set up a joint task team across OOPC/GSOP and SynOBS, to develop metrics to evaluate SynObs syntheses and define/understand ocean observation requirements for the modeling community	Peter Oke/Hao Zuo leading / Oct 2023

3.2 OASIS

Meghan Cronin presented the latest development in the Observing System Interaction Strategy (OASIS), which is an Ocean Decade Programme as well as a SCOR group. She explained the three "Grand Ideas" where community recommendations are being harmonized: (1) a globally distributed in-situ network to measure air-sea fluxes; (2) satellites optimized for air-sea fluxes; (3) improved models and understanding of air-sea fluxes. She highlighted the connection of OceanSITES with land-based Reference Networks through shared best practices, as well as the potential of meteorological moorings that can be used to measure fluxes. There was some discussion on the difficulty of assimilating this kind of data, as it is not easy to understand what part of the error is due to the algorithm or the measurement of the state variable itself. The discussion drifted towards the need to make progress in using fully ocean-atmosphere coupled the models, which right now are not operational.

Meghan's presentation can be found here.

3.3 Ocean Indicators

Karina von Schuckmann is leading this cross-GOOS panels Task Team that intends to develop an international global ocean indicator framework. There is a multidisciplinary task team, interviews have been done to their members to better scope the activity, considering all current initiatives in this space as well as working upon a definition and the criteria that indicators should fulfill. Most of the efforts are restricted to the environmental indicators, similar work must be done for the other areas (social and economic etc.).

Some progress has been made in defining the first ocean indicators both in the physical (ocean warming; sea level change; sea ice extent) and the biogeochemistry realm (ocean acidification; ocean deoxygenation; net community production). Regionalization will be a follow up activity to test how Indicators can be used. OOPC discussed that sea ice change would be more appropriate, and sea ice volume would be more informative (but to get longer enough time series observation-based estimates would be necessary). The audience for Ocean Indicators could differ slightly from GCOS indicators audience (it could be interpreted that GOOS is closer to the general public, but it is arguable).

Karina von Schuckmann also informed about the G7 FSOI activity on "Global ocean monitoring indicator framework", which leverages the efforts done by the GOOS Task Team, and will organize a think-tank workshop "Ocean Indicators for a Sustainable Future", engaging with experts from social and economic sciences and provide the foundations for a larger international conference.

The regionalization that is being done right now with products derived from satellite measurements that are extended towards the coast is very problematic. Many artifacts happen and the products in the EEZ are often useless and misleading as product limitations are not provided (e.g., limitation of sea level close to the coast), indicators derived from different data products provide inconsistent messages (e.g., extremes and records in sea surface temperature products; trend estimates from global and regional chl-a products), and uncertainty evaluations are still lacking (e.g., error bars for area-averaged time series; natural vs. long-term variability). Other in-situ-based indicators suffer from data gaps in some regions, which is particularly the case when approaching national waters and coastal zones. Moreover, more observations are also needed to allow for improved model skills for regional applications and indicator developments as well as to increase validation capacities, and to develop reliable forecasts and projections for regional applications.

N°	Action	Responsibility/Deadline
O6	OOPC agrees on the three initial Ocean Indicators for the environmental pillar and a paper will be written.	Karina von Schuckmann

Karina's presentation can be found here.

3.4 OOPC Energy and Water cycles global to regional

Lijing Cheng explained the proposal of a new activity on Ocean observational priorities for the energy and water cycles, from global to regional scales. The ocean is seen at the center of the Earth System view and three key aspects need to be dilucidated: storage, transport, and fluxes at interfaces.

Lijing presented the objectives and expected outcomes for the very ambitious activity, with strong links to the activity on GCOS Earth-Cycles activity (Action B10 GCOS IP). Several aspects where knowledge is still limited were highlighted like the different time scales at which exchanges occur, the feedback between the different cycles (heat/water), differences between regions, estimation of uncertainties etc.

Lijing finished by stressing that this initiative implies interacting with many existing initiatives and building a community dialogue. He also stressed that OOPC role should be shedding light on priorities for observations, to improve knowledge on all those aspects. Meghan added that OASIS should be able to contribute to this endeavor too, by improving the estimation of Air-Sea Fluxes.

Lijing's presentation can be found here.

3.5 Ocean Decade and the role of OOPC including Boundary Systems/Boundary currents exemplar

Sabrina Speich introduced the topic and the Ocean Decade framework where three GOOS led Ocean Decade programmes are developing. Tamaryn Morris continued providing some more information of the Observing Co-Design programme, delving into the Boundary Currents exemplar. They have had several meetings and are focusing on the Agulhas Current as a pilot region. She explained that there is a strong connection with the SynOBS project to assist with the design. There will be a review paper, and a steering committee is being set up, connecting with certain sectors such as fisheries.

OOPC experts provided some feedback on some of the recommendations which may simply not happen (such as daily cycles for Argo floats). They warned against certain design ideas for which no funding will be difficult to source.

There was also some discussion on how the Boundary System Task Team (BSTT) should continue and relate to the Boundary Currents exemplar. The task of completing the BSTT paper which focuses on reviewing the six boundary current systems which were presented, is the priority of the BSTT currently. It was suggested that the activity may be developed outside OOPC, as it involves many experts that are not part of OOPC.

N°	Action	Responsibility/Deadline
O7	Clarify situation of Boundary System Task Team vs Boundary Currents	OOPC Officer/ (once the paper is finished)

Some projects related to Boundary Currents were mentioned as potential partners, like the K2 group (Kuroshio Decade project). Importantly, there is a Decade Coordination Office where all projects related to ocean observations so, potentially of interest for OOPC, are associated.

3.6 Presentation from Ocean Sound

Peter Tyack, from the BioEco panel (University of St Andrews in Scotland) connected remotely to the OOPC meeting and introduced the Ocean Sound Essential Ocean Variable. The origin was understanding the impact of ocean noise on marine mammals. He ran through the type of measurements involved, the platforms and systems used, main applications, and touched upon the societal drivers and pressures from a GOOS perspective. Peter explained that EOV involves passive acoustics, not only from living organisms but also from physical phenomena and human activities. He stressed that because sound propagates so well in low frequency, a very low number of passive sound sensors can provide a lot of information. Peter Tyack explained that there is an Ocean Sound EOV Implementation Plan and that there is an under explored capacity to get long time, high-quality records. They have been successful in protecting some endangered species by warning industry (e.g., fisheries) of their presence.

N°	Action	Responsibility/Deadline
O8	Follow up with Peter Tyack/BioEco co-chairs on the need to continue with the co-stewardship of this variable	OOPC Officer and Co-chairs/September 2023

Peter's presentation can be found here.

3.7 Presentation from Co-sponsors: GOOS

Emma Heslop, Acting Director of GOOS, addressed OOPC. She first presented the GOOS Workplan 2023-2025, referring to the main goals including System Integration and Delivery; Deepening Engagement and Impact and Building for the Future. She also noted the work within the GOOS Regional Alliances (GRAs), and a discussion followed around what structure could become the regional alliance for the Arctic. She mentioned the Observing Co-Design programme under the Ocean Decade and there was some discussion as whether the "El Niño"/ENSO should receive or not attention in the framework of Co-Design, as a well-known phenomenon. TPOS is currently a GOOS project and is now evolving and looking for the right umbrella. She also summarized the main outcomes from the last GOOS Steering Committee in 2023, including the discussion on increasing visibility of GOOS and improving the communication internally and externally. Emma posed some questions to finish: how does OOPC see its link with the Ocean Observing Co-Design programme, is there a need for a more formal oversight? How do we see the link between OOPC and the operational forecasting community both in weather and ocean? What are the priorities that can stem from GCOS IP and be transmitted to GOOS SC? And finally, are there thoughts on having a more efficient interaction with the other panels?

N°	Action	Responsibility/Deadline
O9	Write an answer to GOOS Director's questions	OOPC Officer and OOPC Co-chairs

A short discussion followed Emma's talk around the GRAs and the very different capacity depending on the regions and the functional connections (or lack of functional connections) with the WMO Regions. The GRAs could be a powerful way of linking with many stakeholders.

3.8 New EOVs

Turbulent Mixing

OOPC office reminded the panel about the background for this proposal, which has been further developed with a paper being recently submitted to Frontiers. OOPC experts agreed that the science case is clear in terms of impact and relevance; however, there are serious questions about its implementation in terms of the degree of expertise required to operate the instruments and understand the results. Another issue is also the representativeness could be an issue (patchiness).

GOOS SC may also have view on the issue about feasibility and cost-effectiveness, relative to other variables, especially if the solution proposed is Argo mix. Finally, while the case for climate and ocean health is clear, the importance in terms of operational services is much weaker.

There are some tests planned to demonstrate the representativeness of punctual measurements for greater scales. Besides, the user community is getting broader, so there is potential. Another remark is that there is a logical continuation between Air-Sea Fluxes and Turbulent Fluxes. The general impression is that this variable is worth supporting, but the variable should be considered a pilot EOV and does not qualify as mature yet.

Bathymetry and the submission process (EOV paper)

This item was related to a communication from GEBCO/IHO to GOOS Director, by which they explored the possibility of including Bathymetry in the list of EOVs.

The main argument against it is that Bathymetry, while being crucial for many applications mostly as a boundary condition, is not a variable that changes with time globally and significantly for the type of applications GOOS is concerned with.

OOPC Officer shared with the panel the current description of the process to submit new variables to be included in the EOV list.

It was discussed that some variables can be considered strategic and GOOS SC may still need to support those but enlarging the EOV list may not be the right place.

N°	Action	Responsibility/Deadline
O10	Write a formal response to the proponents of Turbulent Fluxes	Ben Rabe and Tony Lee/August 2023

3.9 OOPC and the WMO Rolling Review of Requirements Process

Stefan Kern explained how he had been involved in the Statement of Guidance related to Sea Ice and the definition of Variables as well as the requirements. They concluded that they needed to tackle both the climate monitoring and operations (navigation etc.). They are approaching this as a review of the existing corpus of literature, both peer-reviewed and grey. They are also proposing to amend the description of variables currently included in the OSCAR database towards a better fit-for-purpose or to even completely deprecate variables and replace them with more precisely defined variables.

It was stressed that the importance of this process is that it provides a gate to WMO Member States in terms of guidance on observing system development.

OOPC officer explained how the Rolling Review of Requirements has experienced a transformation and included a number of ocean-related application areas under an Oceanic Earth System Category and stressed that this is leveraging on the work already done with the EOV/ECV.

Hao Zuo is going to take responsibility for a new Application Area: Mesoscale Forecasting and Real-Time Monitoring.

Sabrina Speich highlighted that OOPC is bound to enlarge the area of "influence" beyond climate monitoring to extremes, operational services, predictions etc.

Updating the requirements is very important, but it was stressed that the final objective is really to do the gap analysis and get input into the Statement of Guidance.

The last part of the meeting consisted on reflecting the results of the discussions of the day and translating them into activities for the 2024-2028 OOPC Workplan.

DAY 4: THURSDAY 29 JUNE 2023 (ONLY AFTERNOON)

4.1 Reporting back from CPG (this item was skipped)

4.2 OOPC and CLIVAR; setting the scene and potential activities in common, with a focus on the pan-tropical observing system

Weidong Yu introduced the item and the long joint history between OOPC and CLIVAR and he showed the results of a first high-level meeting that was held between OOPC leadership and CLIVAR leadership (panel chairs, and CLIVAR chairs) as well as CLIVAR Secretariat. CLIVAR Secretariat developed a mind map depicting the CLIVAR-OOPC areas from cooperation as a result of the discussion. The mind map is here.

Mike McPhaden was representing CLIVAR in this meeting, together with Benjamin Rabe (CLIVAR/NORP). Mike is heavily involved in several initiatives under CLIVAR umbrella and has a particular interest in the Indian Ocean. He mentioned how research shows that there are very notable teleconnections between the different ocean basins and explained some examples focusing on ENSO. Many groups and papers have already been published and there is certainly room for developing a pan-tropical ocean observing system.

A discussion followed where OOPC members highlighted areas where Mike's talk intersected with other topics of interest such as: ENSO; Fluxes and budgets/earth cycles; Marine heatwaves; Boundary currents. OOPC experts deliberated that ENSO is a coupled system, it is way broader than the marine heatwaves that are currently being considered by Observing Co-design and would require a huge group (including atmospheric experts, WMO) working on that. Boundary currents were discussed at length, and it was recognized that many experts work both in CLIVAR and OOPC and that synergies could be better exploited.

The discussion shifted then to how we could move forward the pan-tropical ocean observing system idea.

The first idea could be to go back to the three reports and do a summary paper emphasizing the cross-panel components and how an integrated system could be built. The intention is NOT to do IndOOS II, TPOS II… the reviews of the three basins were done independently and without guidelines and this would be an opportunity to find the commonalities but elevate that to propose new recommendations with a pan-tropical approach. Experts also discussed the sustainability of the system, which is very fragile, with huge impacts in the networks density (especially in the Indian Ocean). It was agreed that OOPC expertise in defining observational requirements would be very important to support CLIVAR, in particular the Tropical Basin Interactions Research Foci (TBI) WG3 (Observations). It was agreed that implementation, funding, sponsorship is regionally dependent.

Given that the TBI RF WG3 already exists (chaired by Gregory Foltz), it could be more efficient just to plug into the recently formed observations one, while being connected with the other WG1 and WG2. However, the TBI is time-limited, so creating a joint Working Group may be more appropriate.

Harmonizing the different levels of recommendations which can be found in the three tropical basins reviews was again something underlined as a desirable output from this activity.

TBI WG3 is finishing by the end of 2024 and Mike offered to consult with TBI WG3 and then with CLIVAR SSG the idea of a joint OOPC/CLIVAR group around this topic. If green light was

obtained, the ToR of this new joint group could be discussed, including the possibility of including non-physical variables and engaging other groups (e.g. carbon, chlorophyll…).

N°	Action	Responsibility/Deadline
O11	Once Mike McPhaden has consulted with TBI WG3 and CLIVAR SSG, draft the ToR of the joint OOPC/CLIVAR group.	OOPC/CLIVAR/September 2023

Jing Li (CLIVAR Secretariat) provided a few extra updates on upcoming events organized by CLIVAR which may be of interest for OOPC: workshop on AMOC online, Summer school on Marine Heatwaves (Trieste).

Weidong Yu introduced the Decade Collaborative Center (DCC) on the Ocean-Climate Nexus which has been set up in Qingdao (China), which is closely connected with the Decade Coordination Office led by GOOS/Emma Heslop. The DCC has capacity to support concrete activities that are running under the umbrella of the Ocean Decade, in particular the Observing Co-Design and OASIS.

A meeting is being organized on the 27-28 September in Qingdao and OOPC members are invited to participate.

DAY 5: FRIDAY 30 JUNE 2023

5.

5.1 Presentation from Co-Sponsors: WCRP

Mike Sparrow, Head of WCRP Secretariat presented WCRP Structure, including the Core Projects and Research Communities (stable), the WCRP Lighthouse Activities (LHA) (5-10y focus areas). The main connections are between OOPC and CLIVAR, but other Core Projects such as ESMO and RifS can also be of interest for OOPC. Mike explained the main scope for each of the 5 Lighthouse Activities. Within the LHA *My Climate Risk*, which is growing around hubs, many of those ocean-oriented joint with CLIVAR. He provided some further insights on how WCRP Activities are supported by the Secretariat in Geneva. He also encouraged OOPC members to engage with the WCRP Science Conference in Kigali (Rwanda) in October 2023.
Hindumathi Kulaiappan, WCRP Secretariat, joined the meeting and suggested that OOPC connects with ESMO and Digital Earth, while keeping CLIVAR informed. GPEX was also discussed (with a high focus on land-based precipitation, and not ocean precipitation) and it was informed that there will be a call for membership.

Sabrina Speich informed about the outcomes from the Earth Cycles Cross Panel Group and the WCRP-GCOS Earth Cycles workshop which had taken place the previous week in Paris. The agreement is to set up a joint project focusing on closing the 3 cycles taken into account their interactions, quantification of uncertainties, providing a common framework for analysis and submitting data, as well as increasing process understanding. GCOS would be focusing in the quantification of fluxes and storage changes, split into the three cycles, with a task team of 2 to 3 members per panel. WCRP will also launch a call.

Weidong Yu reported on the close interaction between CLIVAR and GOOS/OOPC (workshop in Trieste in August 2022; high level meeting with CLIVAR chairs and dedicated session during the present OOPC-26 meeting). This connected to the Marine Heatwaves exemplar within Observing Co-Design as well as GATT (GCOS Adaptation Task Team), which goes in parallel with the Marine Heatwaves Foci. For the time being, all the activities are in relatively early stages with a different

focus. It is important to keep informed and to seek a convergence, once there are enough resources.

Mike McPhaden mentioned that the underlying premise for the idea around building a pan-tropical observing system is that dynamically the three tropical basins are interacting through the atmosphere, the ocean circulation and other oceanic connections as well as feedbacks between river runoff and precipitation over land. There is a large body of literature and this motivates working on an integrated pan-tropical system to get more efficiency, coherency and better take into account these interactions.

5.2 The Role of OOPC in a changing landscape including:

OOPC-Decade linkage

The strong linkages between the GOOS Observing Co-Design Programme (under the Ocean Decade) and OOPC was underlined several times during the OOPC meeting.

OOPC members were asked to indicate their connections with the UN Ocean Decade (programmes, projects, coordination mechanisms…) in the following folder.

OceanObs2025 midway conference

Tamaryn Morris introduced the idea for this conference, which started after OO'19, so as to ensure that the recommendations that had been proposed were taken, and most importantly not to leave anyone behind (e.g. SIDS, Least Developed Countries, countries under-represented in GOOS), so that the vision of a truly global ocean observing system may be accomplished. Since there are many other big conferences, instead of a big event, there will be smaller coordinated workshops around certain aspects in preparation of OO'29.
She also highlighted some of the key initiatives currently being fostered in Africa. There is an Ocean Decade Africa Roadmap, but those initiatives are not necessarily well aligned. Fortunately, WMO Regional Alliance RA I (Africa) does overlap well with GOOS Africa, but communications internal to each country are faulty and the representatives to one initiative do not necessarily inform other representatives or understand who is involved in certain activities. Other connections were mentioned: POGO; AfriGEO…

It was mentioned that OceanObs'29 may seem far away, but it isn't. Nowadays technology will allow to explore different means to develop community white papers (CWPs) which for OO'19 was a tremendous effort and maybe not the most cost-effective. While the CWP were a very valuable source of information and inspiration, perhaps there could have been fewer of them, and more coordinated and making sure they have greater visibility.

OO'25 midway can be instrumental for the preparation of OO'29, to engage with donors and stakeholders.

Connection to G7 FSOI (Future of the Seas and Oceans Initiative)

The G7 are seeking guidance on priorities for investment within national systems, so they can align investment in areas of agreed priority.

The connect with experts representing G7 nations, and they are on "watch", to report on developments in certain areas. In the case of Ben Rabe, he has been asked to report on progress on the development of an observing system evaluation framework. Ben sought from feedback from the rest of the panel.

Other OOPC experts are involved in G7 FSOI. G7 FSOI are willing to support certain activities, but they have to be clearly defined etc. Expert groups are being formed around other priority

topics such as the Indicators. A discussion followed around how OOPC can really engage and influence the G7 FSOI work.

Meghan suggested that G7 FSOI may consider providing support to take OceanSites to the next step so that they could become a reference station.

More ideas were discussed, as something that Ben could bring to G7. For that purpose, it could be useful to seek advice from David Legler who had coordinated input from the ocean observing community to G7. One-pager or infographics may be more useful to ask for funds/support.

N°	Action	Responsibility
O12	Ben to clarify with Katy Hill (G7 FSOI UK) what kind of input is needed for the G7 meeting.	Ben, Karina, Tony, Meghan /ALL- July 2023

5.3 Items that could not be finished

Related to Item 2.8 and at the request of some OOPC members, Mike McPhaden explained that measuring turbulent fluxes is feasible technically in many different platforms, but sending data in real time would be much more difficult.

5.4 Consolidation of OOPC Workplan

OOPC Officer went back to the Agenda and the draft Workplan to go through all the items that had been discussed and: (1) make sure that nothing had been overlooked; (2) get a first impression on what things could be more or less urgent.

The Session allowed to populate the 2024-2028 OOPC Workplan and discuss some of the details. The Workplan will have to be finished by January 2024, even though it will remain a live document.

N°	Action	Responsibility
O13	Complete 2024-2028 OOPC Workplan	OOPC Officer /ALL – Dec 2023

5.5 Next meeting

The next OOPC in person meeting (OOPC-27) will most likely take place in 18 months, as agreed by GCOS, as a compromise between the need and to keep the carbon footprint small.

Other opportunities, back-to-back with other meetings (e.g., Ocean Conference in Barcelona) could be exploited.

ANNEX 1: AGENDA

Day 1: Monday 26th June 2023 - AFTERNOON -OOPC/GCOS					
Time (CEST)	**Item**	**N.**	**Presenter**	**Notes/outcome**	**Docs/PPT**
14:00-14:15	Welcome and OOPC meeting planning	1.0	OOPC Co-chairs		
14:15-14:30	Setting the scene: GOOS Roadmap and Monday.com How much did we accomplish in 2019-2023?	1.1	OOPC Co-chairs		2019-2023 Workplan OOPC and GOOS Strategic Objective 5
14:30-14:45	**GCOS IP Presentation:** • Actions for GCOS/OOPC, Actions for GOOS/OOPC, Actions led by others.	1.2	OOPC Co-chairs		
14:45-17:30	**GCOS IP Actions implemented by GCOS.** **The GCOS 2022 Implementation Plan is available here** • A1 Sustainability of Networks • C1: Monitoring Standards and GCOS Climate Monitoring Principles • D2: Global Climate Data Centres	1.3	OOPC Secretariat	Break out in groups Consider the approach presented in the Tables and first attempt to fill them in.	Table A1.1 Table C1.1 Table D2.1 1.3 OCG mapping datasets
17:30-18:00	Roundtable: preparation of Cross-panel Sessions	1.4	All		
18:00-19:00	Cocktail ECMWF				

Day 2: Tuesday 27th June 2023 - AFTERNOON OOPC/GCOS					
Time	**Item**	**N.**	**Presenter**	**Notes/outcome**	**Docs/PPT**
14:00-14:20	Reporting back from CPG	2.1	All		
14:20-15:00	EOVs/ECVs New Template and Stewardship	2.2	OOPC Co-chairs /Secretariat	Revisit our list of ECV stewards	2.2 New template EOV/ECV 2.2 EOV/ECV stewards
15:00-15:30	Work in groups or individually/updating the Specification Sheets (data sources)	2.3	ALL		See Specification Sheets in GCOS website https://gcos.wmo.int/en/essential-climate-variables
15:30-16:00	Coffee Break				
16:00-17:30	**GCOS IP Actions implemented by GOOS (OOPC rapporteur and implementer)** **The GCOS 2022 Implementation Plan is available here** A1. Ensure necessary levels of long-term funding support for in situ networks, from observations to data delivery B2. Development and implementation of the Global Basic Observing Network (GBON) B6. Expand and build a fully integrated global ocean observing system B7. Augmenting ship-based hydrography and fixed-point observations with biological and biogeochemical parameters B8. Coordinate observations and data product development for ocean CO_2 and N_2O B9. Improve estimates of latent and sensible heat fluxes and wind stress C1. Develop monitoring standards, guidance and best practices for each ECV D2. Ensure Global Data Centres exist for all in situ observations of ECVs E1. Foster regional engagement in GCOS	2.4	OOPC Secretariat	This section is meant for the panel to go through the relevant actions, assign rapporteurs or "implementers" amongst the panel and inclusion in OOPC workplan, if appropriate. E.g. A1, C1, D2 – This is dealt with in Day 1 B7 and B8 – Biogeochemistry panel E1 . Connection with GRAs B6/F3 – relation with GOOS Other Actions related to Space Agencies (A2, A3…)	2022 GCOS Implementation Plan 2.4 OOPC and GCOS IP task assignation (ultimately this will be part of OOPC Workplan)

	F3. Improve monitoring of coastal and Exclusive Economic Zones OTHER ACTIONS: A2, A3, topic E… etc. (consider who can support)				
17:30-18:00	**Taking stock:** writing session to fill in the Skeleton of 2024-2027 OOPC Workplan **(GCOS related)**: • Agreeing on structure and sections • Assigning responsible people • Action plan	2.5	ALL	We will have a populated skeleton with the Activities OOPC will be carrying out in the next 5 years including the following sections (as in GCOS IP and GOOS IP)	2.5 2024-2028 OOPC Workplan draft • Activities • Issue/Impact • OOPC expert leading/involved • Other implementers • Means of Assessing Progress • Additional Details

Day 3: Wednesday 28th June 2023 - MORNING OOPC / GOOS					
Time	**Item**	**N.**	**Presenter**	**Notes/outcome**	**Docs/PPT**
09:00-10:00	OOPC and the Modeling community/SYNOBS	3.1	Peter Oke and Hao Zuo	A preparatory meeting will be held by email	3.1 Modeling and Observations
10:10-10:30	OASIS	3.2	Meghan Cronin	How can we best reflect this in OOPC Workplan?	3.2 OceanSites 3.2 Cronin OASIS
10:30-11:00	Coffee Break				
11:00-11:20	Ocean Indicators	3.3	Karina von Schuckmann	How can we best reflect this in the OOPC Workplan/FSOI Priority Topic	
11:20-12:00	OOPC Energy and Water cycles global to regional	3.4	Lijing/Karina /Eitarou	How can we reflect the next years in OOPC Workplan and how it relates to the WCRP/GCOS workshop and the Cross Panel Group	3.4 Proposal for the Activity

12:00-13:00	Ocean Decade and the role of OOPC including Boundary Systems/Boundary currents exemplar	3.5	Tamaryn /Maria Paz/Sabrina	Intersection Ocean Decade - OOPC through its members and whether we can reflect this in OOPC Workplan	3.5 OOPC Boundary currents
13:00-13:15	- Presentation from Ocean Sound	3.6	Peter Tyack (BioEco)	Ocean sound is a shared EOV	3.6 Tyack Ocean Sound EOV
13:15-14:00	Lunch Break				

Day 3: Wednesday 28th June 2023 - AFTERNOON OOPC / GOOS					
Time	**Item**	**N.**	**Presenter**	**Notes/Outcomes**	**Docs/PPT**
14:15-14:30	Presentation from Co-sponsors: GOOS (including OOPC and connections with the other GOOS panels)	3.7	Emma Heslop		
14:30-15:30	New EOVs: Turbulent Mixing Bathymetry and the submission process (EOV paper)	3.8	Ben, Tony Belén/Emma		3.8 Turbulent fluxes paper
15:30-16:00	Coffee Break				
16:00-16:30	OOPC and the WMO Rolling Review of Requirements Process	3.9	Sabrina/ALL/Hao Zuo	Including a definition for the Application Area "Climate Monitoring and Services".	
16:30-17:30	**Taking stock:** writing session to fill in the Skeleton of 2024-2027 OOPC Workplan **(GOOS related)**:		ALL	Same as item 2.5	2.5 2024-2028 OOPC Workplan draft

Day 4: Thursday 29th June 2023 - AFTERNOON OOPC / CLIVAR					
Time	**Item**	**N.**	**Presenter**	**Notes/Outcomes**	**Docs**
14:00-14:15	Reporting back from CPG	4.1	All		
14:15-15:30	OOPC and CLIVAR: setting the scene and potential activities in common. • Focus on pan-tropical observing system	4.2	OOPC Co-chairs (Weidong) Mike McPhaden	Other OOPC members who could contribute: Tamaryn, Sabrina, Maria Paz, Lijing, Ben…	4. 2 Mind map connections OOPC-CLIVAR
15:30-16:00	Coffee Break				
16:00-16:30	OOPC and CLIVAR: setting the scene and potential activities in common. Focus on pan-tropical observing system (cont'd)	4.3	OOPC Co-chairs (Weidong) Mike McPhaden		There is no PPT
16:30-17:00	**Taking stock**: writing session to fill in the Skeleton of 2024-2027 OOPC Workplan (**CLIVAR related**):	4.4	ALL	Agreeing on structure and sections and assigning responsible people	Same as 2.5 2.5 2024-2028 OOPC Workplan draft
17:00-20:00	EXCURSION				

Day 5: Friday 30th June 2023 - MORNING OOPC					
Time	**Item**	**N.**	**Presenter**	**Notes/Outcome**	**Docs/PPT**
11:30-12:15	Presentation from Co-sponsors	5.1	WCRP	Expectations from co-sponsors, guidance to OOPC	
12:15-13:00	"Free style" discussion: the role of OOPC in a changing landscape including: 1. OOPC-Decade linkage. 2. OceanObs'2024/25 midway conference 3. Connection to G7 FSOI	5.2	 1. All 2. Weidong & Tamaryn 3. Ben		 1. 5.2 Table: OOPC participation in the Ocean Decade 2.Midway OO'24 3. G7 FSOI Workplan
13:00-14:00	Lunch Break				
Day 5: Friday 30th June 2023 - AFTERNOON OOPC					
Time	**Item**	**N.**	**Presenter**	**Notes/Outcome**	**Docs/PPT**
14:00-14:30	Time for items which could not be finished. (e.g. Renewal of members)	5.3			
14:30-15:30	Consolidation of OOPC Workplan 2024-2027 draft	5.4	OOPC Co-chairs /Secretariat		Same as 2.5 2.5 2024-2028 OOPC Workplan draft
15:30	END OF MEETING				

ANNEX 2: LIST OF ACTIONS

N°	Action	Responsibility/Deadline
O0	Finalize Tables A1.1, C1.1 and D2.1	All/October 2023
O1	Review EOV/ECV Surface currents requirements	Rick Lumpkin and Tamaryn Morris/early 2024
O2	Draft a one-page guideline document establishing both communities that should be consulted and references that should be provided when producing the specification sheets	ALL/OOPC Officer - 2026
O3	Revise EOV/ECV specification sheets, with a focus on including more references to improve traceability and transparency, and updating the reference data sources	OOPC officer to lead with the new template and All/2026
O4	Complete and consolidate the assignment of OOPC experts to all the GCOS IP Actions	OOPC officer and all/by next OOPC meeting in 2023
O5	Set up a joint task team across OOPC/GSOP and SynOBS, to develop metrics to evaluate SynObs syntheses and define/understand ocean observation requirements for the modeling community	Peter Oke/Hao Zuo leading / Oct 2023
O6	OOPC agrees on the three initial Ocean Indicators for the environmental pillar and a paper will be written	Karina von Schuckmann
O7	Clarify situation of Boundary System Task Team vs Boundary Currents	OOPC Officer/(once the paper is finished)
O8	Follow up with Peter Tyack/BioEco co-chairs on the need to continue with the co-stewardship of this variable	OOPC Officer and Co-chairs/September 2023
O9	Write an answer to GOOS Director's questions	OOPC Officer and OOPC Co-chairs
O10	Write a formal response to the proponents of Turbulent Fluxes	Ben Rabe and Tony Lee/August 2023
O11	Once Mike McPhaden has consulted with TBI and WG3 and SSG, draft the ToR of the joint OOPC/CLIVAR group	OOPC/CLIVAR/September 2023
O12	Ben to clarify with Katy Hill (G7 FSOI UK) what kind of input is needed for the G7 meeting	Ben, Karina, Tony, Meghan /ALL- July 2023
O13	Complete 2024-2028 OOPC Workplan	OOPC Officer /ALL – Dec 2023

In addition to the Actions which were discussed at the OOPC-26, there were a number of Actions for OOPC which resulted from the GCOS Cross Panel Group discussions taking place that same week (see GCOS-254).

N°	Action	Responsibility (OOPC members)/Deadline
OOPC/GCOS- 1	Three OOPC members to become part of the ECV Rationalization Task Team	All/September 2023
OOPC/GCOS-2	Ensure alignment between the OOPC Energy and Water cycles global to regional new Activity, and the developments in the joint GCOS/WCRP Task Team on Earth Cycles	ALL/OOPC Officer – on going
OOPC/GCOS-3	Climate Data Store to undergo a self-assessment using the CoreTrustSeal process	Stefan Kern – on going
OOPC/GCOS-4	Connect with AOPC and participate in the writing of a report describing tiered networks for flux-relevant ECVs including the ones with co-located direct flux measurements over both land and ocean	Meghan Cronin/Tony Lee/Eitarou Oka/Weidong Yu
OOPC/GCOS 5	Synthesize the outcomes of the Cross-Panel Group Session into a short report	Karina von Schuckmann/autumn 2023

ANNEX 3: LIST OF PARTICIPANTS

OOPC Members:

Sabrina SPEICH, France (Co-chair)
Weidong YU, China (Co-chair)

Lining CHENG, China
Maria Paz CHIDICHIMO, Argentina
Meghan CRONIN, United States
Antonio HERMOSA, Fidji
Stefan KERN, Germany
Tony LEE, United States
Rick LUMPKIN, United States
Tamaryn MORRIS, South Africa
Eitarou OKA, Japan
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Benjamin RABE, Germany
Karina VON SCHUCKMANN, France
Hao ZUO, United Kindgdom

Experts:

Emma HESLOP, France
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(Names in *italics* indicate remote participation)

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