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The Sixteenth Session of the Ocean Observations Panel for Climate (OOPC)

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The Ocean Observations Panel for Climate is sponsored by the Global Ocean Observing System the Global Climate Observing System and the World Climate Research Programme. OOPC provides advice and guidance on observations to the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology.



Executive Summary

The Ocean Observations Panel for Climate (OOPC) held its Sixteenth Session in the Offices of the US National Oceanographic and Atmospheric Administration (NOAA) in Washington DC, United States, from 3-5 September 2013. OOPC organized the Session in collaboration with its sponsors the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), the World Climate Research Programme (WCRP), and the Intergovernmental Oceanographic Commission of UNESCO (IOC). The last day of the meeting was organized as a joint day with the Fifth Session of the Observations Coordination Group (OCG) of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) from IOC and the World Meteorological Organization (WMO).

The goals of the Session were: (1) To seek guidance on drivers and priorities from the OOPC sponsors, (2) to initiate the revision of the new OOPC Terms of Reference (ToR), (3) to develop the OOPC Work Plan for the next period of 2013-2018, and 4) to identify initial steps in implementing the Work Plan.

In his opening remarks, Dr David Legler (NOAA) outlined the history of marine observations, and stressed the need for an improved observation of the ocean system that delivers to society the expanded GOOS and Framework for Ocean Observing (FOO), whose efforts represent a step forward to more robust, diverse more integrated observing system, with an emphasis on continued evaluation and assessment. Subsequent presentations and discussions addressed user needs for ocean observations and the status, and needs of ocean observational networks, including their related data management. Discussions placed substantial emphasis on the issue of developing and implementing a new Work Plan for OOPC, and also addressed a number of cross-cutting topics in the domains of atmosphere-ocean and land-ocean observation. During their deliberations, the OOPC co-chairs highlighted the following issues that require the future attention of the ocean observation community in the upcoming years:

- Review existing and consider new ocean Essential Climate Variables (ECVs) and Physics Essential Ocean Variables (EOVs).
- Develop and evaluate the design of ocean observing systems, considering developments in applications and technologies through workshops and evaluation exercises (e.g. the Tropical Pacific Observing System 2020 workshop).
- Identify and address gaps in the sustained observing system such as boundary currents, the deep ocean, and observations in coastal and shelf seas.
- A need to improve the observation coordination at a regional level, and engaging with GOOS Regional Alliances (GRAs) and also the Terrestrial Observation Panel for Climate (TOPC), particularly on issues such as coastal inundation and freshwater fluxes.

At the conclusion of OOPC-16, Dr Katy Hill outlined the next steps in the development of a new Work Plan for the Ocean Observation Panel for Climate. It was agreed that the OOPC/GOOS Secretariat would revise the current draft of the Work Plan and the ToRs, and both documents would then be circulated to participants and sponsors for a final critical review and comment prior to being published. The final version of the documents would then be published on the OOPC as well as the GOOS and GCOS websites.

To aid the development of the projects identified, it was decided that OOPC will provide some templates to be used in the development of OOPC-related Evaluation Projects in the future, for the following:

- Evaluating or proposing a new EOV,
- Observing System Evaluation (e.g. The Tropical Pacific, Upper Ocean Thermal, Boundary Currents),
- Proposing a new observing network to GOOS and GCOS.

Critically, it was recommended that each project has an enthusiastic lead from OOPC and a patron or sponsor who will support the project.

1. Introduction and context.

The Ocean Observations Panel for Climate (OOPC) was established in 1996, and is a scientific expert advisory group charged with making recommendations for a sustained global ocean observing system for climate in support of the goals of its sponsors GCOS, GOOS, and WCRP. The Panel's mandate incorporates providing systems level design and assessment of the observing system, including recommendations for phased implementation, and supports the development of strategies for evaluation and evolution of the system. OOPC also provides advice on scientific requirements to JCOMM. The OOPC Technical Secretariat is hosted by the WMO in Geneva, Switzerland.

In the past, OOPC has mainly focused on physical ocean variables and the open ocean. For the climate-relevant biogeochemical ocean variables, OOPC has been in close collaboration with the International Ocean Carbon Coordination Programme (IOCCP). Due to a restructuring within GOOS following the development of the Framework for Ocean Observing¹ (FOO), and the addition of a new GOOS Expert Panel for biology and ecosystem variables, OOPC's role has now evolved to oversee the ocean component of GCOS and the physical variables for GOOS, while defining sustained ocean observing requirements for WCRP. The Expert Panel also acknowledges the increased need to connect to societal issues in the coastal zone.

As such, discussion is needed on how to move forward with OOPC's new role in global ocean observation and goals of the Session were:

- (1) to seek guidance on drivers and priorities from the OOPC sponsors,
- (2) to initiate the revision of the new OOPC Terms of Reference (ToR),
- (3) to develop the OOPC Work Plan for the next period of 2013-2018, and
- (4) to identify initial steps in implementing the Work Plan.

The meeting overlapped with a meeting of the JCOMM Observations Coordination Group (OCG), which comprises representatives from the major observing networks. OOPC and OCG each met for 2 days, with an additional joint day in the middle to address cross cutting issues. A report on the joint day can be found in Annex V.

All presentations and background documents from the meeting can be found on the OOPC meeting website at www.ioc-goos.org/oopc-16. The details of the OCG meeting can be found at www.ioc-goos.org/ocg-5.

¹ GOOS Framework for Ocean Observing <http://www.oceanobs09.net/foo/>

The focus of the OOPC-16 Session was set on redefining OOPC's role in the global ocean observing system, and developing the new OOPC Work Plan for the coming time period of 2013-2018. Formal presentations were therefore only given by OOPC's three main sponsors GCOS, GOOS, and WCRP. Additionally, IOCCP presented its scope and upcoming activities to OOPC members, as the two panels work directly together to integrate ocean carbon information into the plans of GCOS in support of the United Nations Framework Convention on Climate Change (UNFCCC), the Group on Earth Observations (GEO), and other international and intergovernmental strategies.

Dr Mark Bourassa, the new co-chair of OOPC, welcomed Session participants (see Annex II), and noted that the meeting was a welcoming opportunity to ask for input from the scientific ocean observing community, which is needed to develop the OOPC Work Plan, and the OOPC Terms of Reference to set the future direction and priorities for the Panel.

1.1 The Global Ocean Observation System (GOOS).

Dr Albert Fischer, director of GOOS, and Dr Eric Lindstrom, co-chair of GOOS, reported on the role of GOOS in a global context, on GOOS recent activities in the ocean domain, and outlined the observing systems expectations for OOPC.

Dr Lindstrom presented the Framework for Ocean Observing (FOO), which was called for by the OceanObs09 Conference Statement, adopted by GOOS, and approved by GOOS sponsors. The framework is meant to guide the ocean observing community as a whole to establish an integrated and sustained global observing system. It takes an interdisciplinary approach across ocean physics, biogeochemistry, and marine biology and ocean ecosystems, and advocates for an approach to planning and evolving GOOS through identifying requirements, Essential Ocean Variables (EOVs) to be measured, the readiness of observing technologies and applications in the context of sustained observing, and data and products that will be managed and made widely available to modeling efforts and a wide range of users.

Dr Fischer updated Panel members on the current restructuring of the GOOS structure, which has been expanded to include a Biogeochemistry Panel (based on IOCCP), and a new Biology and Ecosystems Panel. GOOS no longer divides coastal and open-ocean issues, and requirements for observations in the coastal zone and shelf areas/enclosed seas are now part of the mandate of the three expert panels. The move towards the coasts will be a challenging one, and it has to be kept in mind that in open ocean observing, around 20 nations participate in implementing the global observing system. When moving towards the coast, many more countries will need to participate, and many more levels of governance are involved.

The GOOS Regional Alliances (GRAs) have updated their GOOS Regional Policy² in line with the restructuring of the GOOS governance and the updated Framework guidance for GRAs. Historically, GRAs were introduced as a way to integrate national needs into a regional system, and to deliver the benefits of the GOOS strategy, structure, and programmes at a regional and national level. But since then, the GRAs have evolved to meet a wide range of societal challenges related to both coastal and open ocean observations. Dr Douglas Wilson, project coordinator of the GRA IOC/UNESCO sub-commission for the Caribbean and Adjacent Regions (IOCARIBE-GOOS), welcomed a closer collaboration with OOPC in the future (please also see Annex III), especially with regard to capacity development. OOPC will have to think about what is feasible in engaging GRAs and/or coastal observations when providing guidance, encouraging data sharing and the adoption of standards, and increasing capacity development focused on developing information and new services.

² The GOOS Regional Framework 2013 (in EN, ES, FR, RU):

http://www.ioc-unesco.org/index.php?option=com_oe&task=viewDocumentRecord&docID=11235

The most successful component of GOOS over the past decade has been its climate component, which is the global observing system that is required for climate research, monitoring, forecasting and long-term projections of climate variability and change. Since 2009, its overall system has currently stabilized at about 62% of full implementation. Both presenters stressed that the progress has not been going forward the way originally envisaged, and therefore there is a need for the community to strengthen engagement in observing system implementation and ensure delivery of products and information to meet user needs. On a positive note, oceanic satellite observing networks seem to have improved in health and quality in support of ECV monitoring. GOOS defines the role of OOPC as overseeing a collaborative system of sustained observation networks, delivering physical ocean EOVs that builds on requirements (both in-situ and satellite data), oversees the design and evaluation for those EOVs, links to stakeholders in the field of data management, product/information generators, and societal challenges; and closely collaborates with other ocean observing networks, the biogeochemistry and biology and ecosystem GOOS panels that will have the lead on observing the non-physical EOVs, on both a global and regional/local level under the direction of the GOOS Steering Committee.

OOPC will provide input to a proposed GOOS-wide Implementation Plan and GOOS evaluations, which will be based on multiple types of requirements, and organized around the concept of EOVs. The update cycle will be aligned with the GCOS cycle, but flexible enough to accommodate other requirements/cycles, such as the convention on biodiversity. Panels have been encouraged to develop 'GOOS projects' that will focus on the design and assessment of key components of the observing system. Dr Fischer noted that OOPC will be expected to liaise with many stakeholders, which may prove challenging, including;

- Observing networks (e.g. the JCOMM Observations Coordination Group and the Consortium of Earth Observing Satellites, CEOS),
- Data Management (e.g. the JCOMM Data Management Program area, the Intergovernmental Ocean Data Exchange (IODE), and the WMO Information System (WIS)),
- Product and Information Generators (Scientific Community, GODAE OceanView, JCOMM Services, early warning systems),
- GCOS Programme (UNFCCC process, GCOS Panels and Steering Committee), and
- GOOS Programme (GOOS Panels and Steering Committee).

To foster these links, the Panel needs to prioritise activities as the scope is vast, but resources are limited. All channels of communication should be used to foster these connections, not just relying on cross representation at meetings.

In the discussion, questions were raised about how the coastal requirements will be addressed through the global panels in practice. Traditionally, the open ocean and coastal components have been treated separately with only limited success. A first step would be to include representation from the coastal community on the Panel, and begin to look at the requirements for coastal observations in shelf seas. Implications for other groups were also discussed, such as the observing networks, and the CLIVAR panels, as those panels are involved in many process studies. As output, it was suggested that CLIVAR should recommend to OOPC what aspects need to be sustained. With respect to Data Management, there is a need to have a clear picture of where data is submitted and how well this is curated. The issue was further discussed at the joint OOPC/OCG meeting day, and the following OCG-5 Session.

1.1.b International Ocean Carbon Coordination Project (IOCCP).

Dr Maciej Telszewski, director of IOCCP and the GOOS Biogeochemistry Panel Secretariat, introduced Panel members to the overall concept of IOCCP and its crosscuts to OOPC and GOOS.

The programme is co-sponsored by the IOC and the Scientific Committee on Oceanic Research (SCOR) of ICSU, and promotes the development of a global network of ocean carbon observations for research through technical coordination and international agreements on standards and methods. Members of the IOCCP Steering Committee, coming from North America, Europe and Asia, provide a broad range of expertise, and focus on different types of observation – underway pCO₂ observations, surface CO₂ data, ocean interior data, time series networks, instruments and sensors, data management, nutrients, oxygen, and ocean acidification. More information can be found at the IOCCP website – www.ioccp.org.

Dr Telszewski also announced the publication of a new Work Plan within the upcoming months, which will include a stronger focus on societal, scientific and programmatic requirements for marine biogeochemistry parameters within the FOO, and the production of a summary publication of a multidimensional feasibility assessment (including results from a workshop in late 2013) of those marine biogeochemistry parameters that will be presented at a town hall meeting the 2014 Ocean Sciences Meeting of the Association for the Sciences of Limnology and Oceanography (ASLO) in Honolulu, Hawaii. Dr Telszewski stressed that there is a strong need to work in close collaboration with OOPC, as many observational aspects overlap for both communities, and welcomed the idea of hosting a joint town hall meeting of both OOPC and IOCCP at ASLO in early 2014.

Action: Organize joint OOPC/IOCCP Town Hall Meeting at the 2014 Ocean Sciences Meeting of the Association for the Sciences of Limnology and Oceanography (ASLO) in Honolulu, Hawaii (OOPC Secretariat, IOCCP Secretariat).

1.2 The Global Climate Observation System (GCOS).

Dr Carolin Richter, director of GCOS, presented the recent work undertaken within the programme and its three scientific panels for atmospheric, oceanic, and terrestrial observations, and outlined upcoming GCOS-related meetings and activities. GCOS should be seen as a direct link between the science community and policy-makers, as it reports directly to UNFCCC. Furthermore, Dr Richter mentioned that one of the central functions of GCOS is to identify gaps in the observing systems and to review its status of implementation. She outlined the upcoming steps in the GCOS cycle of assessments on the status of observing systems and on progress against the GCOS Implementation Plan. Next steps are the preparation of a 'Third Adequacy and Progress Report' by early 2015, to be followed by a new GCOS Implementation Plan to be published in 2016.

Driven by the development of the Global Framework for Climate Services (GFCS), GCOS is increasing its focus on climate observations for climate change mitigation and adaptation, and observations for climate services. Dr Richter welcomed attendees of the meeting to identify some of the observations that the ocean observation community (especially regarding coastal zones) would like to see included in the process. Additionally, OOPC members welcomed GCOS efforts to connect its three panels for terrestrial, oceanic, and atmospheric observations through cross-cutting issues, and to further its engagement with the climate research community. There is huge potential for OOPC to foster stronger links with the other two GCOS Panels. In regard for the Terrestrial Observation Panel for Climate (TOPC), OOPC's main interests are connected to observations in the coastal zone, as well as in cryospheric regions, as especially hydrological information such as river discharge data is useful for the ocean community. But OOPC members also stressed the lack of near-real time data that is concerning. Interactions with the Atmospheric Observation Panel for Climate (AOPC) should focus on requirements for observations to improve air-sea fluxes, and OOPC stressed that the already existing ECV 'wind speed and direction' is not only of interest for AOPC, but also for OOPC. The Panel suggested that a discussion should be continued with AOPC regarding how to deal with boundary layer measurements between the two panels, particularly as atmospheric boundary layer measurements are extremely important for ocean processes. In addition, there was a suggestion that

GCOS should consider more ECVs such as ocean surface stress, and gravity, and to clearer define the requirements for the ECV 'tracers'.

1.3 World Climate Research Programme (WCRP).

Dr Antonio Busalacchi, chairman of the WCRP Joint Scientific Committee, updated OOPC members on recent and upcoming activities of the programme, stressing the importance of ‘actionable science’, research for practical application, benefit and value to society. WCRP’s future directions will need to ensure that it delivers into the GFCS and ICSU’s Future Earth Initiative, and also the need to be more agile and flexible in responding to requirements and drivers.

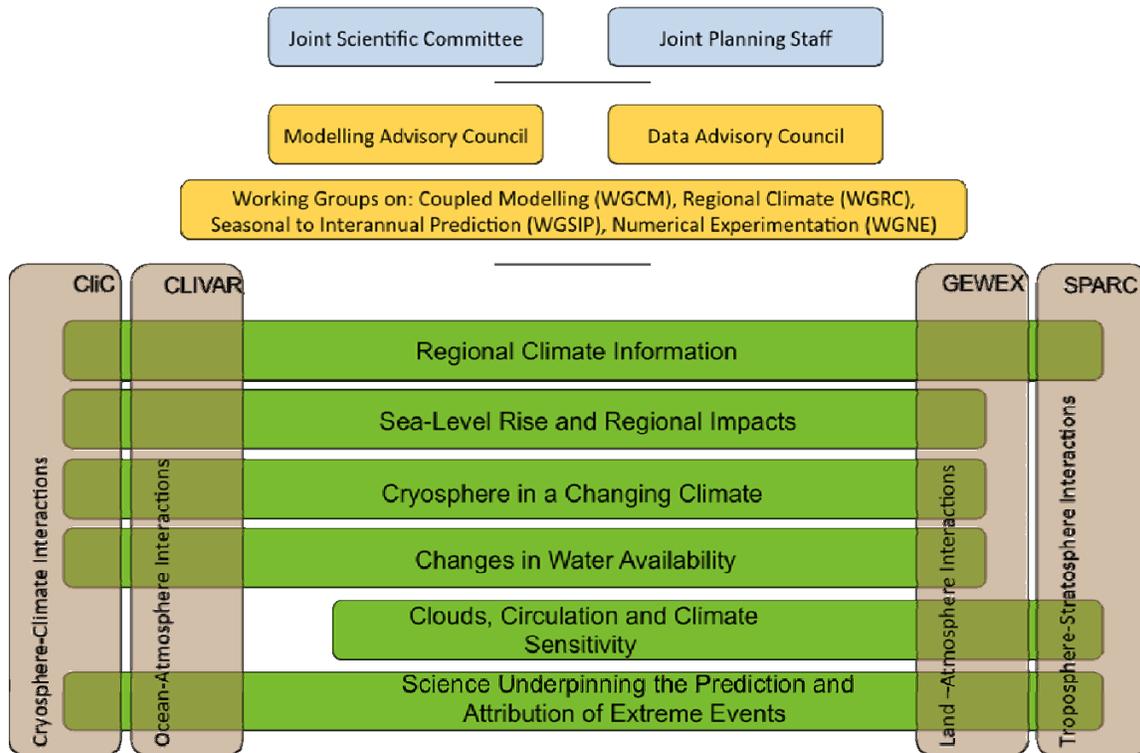


Figure 1: The organization of WCRP as of September 2013.

WCRP has identified six grand challenges (each hosted by one of WCRP’s core projects) – regional climate information, regional sea-level rise, cryosphere in a changing climate, changes in water availability, science underpinning the prediction and attribution of extreme events, and clouds, circulation and climate sensitivity. Those challenges have been identified following the WCRP Open Science Conference in 2011, which commissioned 16-18 whitepapers that were published on the WCRP website and in the book ‘Climate Science for Serving Society’³. Dr Busalacchi also presented the recently revised structure of WCRP (see Figure 1), including a new WCRP Working Group on Regional Climate, which will be the main connection between WCRP, the GFCS, and ICSU’s Future Earth activities. OOPC members were interested to hear that CLIVAR is refocusing its activities on monsoon issues under a single Cross-cutting Panel (in collaboration with Global Energy and Water Exchanges (GEWEX)), and reaching out to coastal zones. At the end of his presentation, Dr Busalacchi underlined the importance of international cooperation, as well a stronger support for education, training and development of the next generation of climate experts and networks.

³ Asrar, G. and Hurrell, J.W. (2013): Climate Science for Serving Society – Research, Modeling and Prediction Priorities; Springer publishing house.

Discussions focused on how OOPC should effectively connect to WCRP activities in the future, and to date, representatives from the CLIVAR Basin Panel and Global Synthesis and Observations Panel have attended OOPC meetings, and this relationship has proved mutually beneficial. OOPC representation is also requested at the WCRP Data Advisory Council under their Terms of Reference, and representatives of the Panel have also been invited to CLIVAR Scientific Steering Group Meetings. The Panel considered this a large number of connections to maintain, and Dr Busalacchi suggested that OOPC should connect in a way that best supported OOPC activities.

Recommendation: *Representation* - One of the OOPC co-chairs to attend the next WCRP Data Advisory Council and the CLIVAR Scientific Steering Group respectively to assess the effectiveness of these connections (OOPC Chairmen).

1.4 The OOPC Terms of Reference.

Dr Toshio Suga, co-chair of OOPC, introduced OOPC members to the new OOPC Terms of Reference (ToR). A draft version had been provided to all participants of the meeting beforehand. An updated and finalized version is attached in Annex III of this report.

During the debate it was noted that the preamble of the ToR draft should be formulated more generally, as it acknowledges the role of OOPC from a more universal approach than focusing solely on climate issues.

During further discussion of the different ToR items, OOPC members stressed the difficulty to clearly define the requirements for ocean observations, and came to the conclusion that there is a strong need to start an evaluation process of those requirements. As this was identified as a complex and important task, OOPC would need to acknowledge this in its finalized ToRs. Additionally, participants of the meeting added that when defining those requirements, OOPC would need to highlight the importance of a close cooperation with the modeling community, especially in regard to gap analyses, observing system experiments and climate model evaluation. Item 4 of the ToR, which deals with the existing/ongoing evaluation of the overall observation system, should be broadened and include additional paragraphs on scientific leadership of integrated observing systems, and cooperating observation networks that will support OOPC's future efforts.

Action: *Terms of Reference* – Update the ToRs based on discussions, and circulate the new draft to OOPC Panel members for comment and editing (OOPC Secretariat, OOPC Chairmen).

Recommendation: Explore potential connections with GODAE OceanView task teams (OOPC Secretariat).

Recommendation: WGOMD/WGCM links should be fostered by OOPC co-chairs (OOPC Chairmen).

2. Developing an OOPC Work Plan.

2.1 Introducing the Work Plan and overarching approach.

Dr Mark Bourassa introduced the new draft OOPC Work Plan for discussion, which sets out potential priorities for the Panel for the next five years. An updated version can be found in Annex IV of this report, which also includes the description of items discussed in greater detail.

OOPC's main roles will include regular reporting to its main sponsors GCOS (with OOPC focusing on the ocean component), GOOS (OOPC to focus on observation of physical ocean variables), and WCRP (OOPC provide support and advice on observations for climate research), as well as to deliver scientific advice and requirements to JCOMM, and strengthen its link to the GODAE OceanView

project⁴. The focus of OOPC will be set on assessing and reviewing existing components of the ocean observation system, and to deliver recommendations on requirements, and systems analyses. Key timeframes/deadlines that OOPC will need to consider include:

- GCOS Assessment and Reporting Cycle (Review and Adequacy Report 2014/15, Update to Implementation Plan, 2016),
- GOOS Reporting cycle (to be determined, potentially in line with OceanObs19), and
- WCRP Open Science Conferences (next conference anticipated in the 3-7 year timeframe).

The Panel will also focus on systems level observing system design and assessment, and is proposing to explore more quantitative approaches to observing system design using both modeling and statistical techniques, whereas these techniques would be informed by the spatial and temporal scales of processes to be measured and accuracy requirements of observations to be set. OOPC is currently developing a discussion paper on the topic, and Dr Bourassa outlined potential approaches that could be taken, which was enthusiastically and robustly discussed by the Panel. Issues that were raised included:

- Taking the approach of going from spatial/temporal scales to platforms is difficult to implement in reality, particularly due to the range of applications that an observing system is expected to deliver against.
- A pragmatic approach of starting with available 'ready' platforms and work backwards was advocated.
- Latency of data delivery needs to be considered, as well as requirements for metadata that are associated with it.
- Lear et al. wrote an OceanObs09 whitepaper on Ocean surface data requirements for Numerical Weather prediction, and labeled the data as 'Threshold, Breakthrough and Gold standard', which will help to inform what kind data should be included.

The input will be taken on board in the development of the discussion paper.

Recommendation: Input from the Panel on observing system design approaches should inform the OOPC Observing System design and assessment discussion paper. OOPC members and guests are invited to engage in the development of the whitepaper (OOPC Secretariat, OOPC Chairmen, OOPC Panel Members).

Potential future priorities of OOPC in the next 2-5 years include (for a more detailed description, please see item 2.4):

- An OOPC-sponsored workshop on 'Sustained Tropical Pacific Observations for Research, Forecasting, and New Science Directions' (TPOS-Workshop), including a follow-up workshop with sponsors and stakeholders.
- Upper ocean thermal review, which will build on the results and actions from the TPOS workshop).
- Support and/or contribution to the newly formed Deep Ocean Observing Strategy (DOOS).
- Evaluation of requirements for and approaches to observing boundary currents and inter-basin flows (including new observing approaches, and potential observation of associated physical, chemical, and biological variables).

⁴ GODAE OceanView website: www.godae-oceanview.org

- Reducing uncertainties in air-sea flux estimates (which ties to several different atmosphere and ocean ECVs, including precipitation, near-surface temperature and humidity, winds, surface pressure, etc.).
- Increased focus on ocean observations in polar seas, especially in regard to observations on key currents, and air-sea fluxes.
- Increased focus on observations in regional and coastal seas, which will include a closer cooperation with the terrestrial and atmospheric observation panels of GCOS (TOPC and AOPC), the GOOS Regional Alliances, and other coastal research networks.

Action: Update the Work Plan based on discussions, and to circulate the new draft to OOPC Panel members for comment and editing (OOPC Secretariat, OOPC Co-Chairs).

2.2 OOPC activities in 2013-2015

Dr Toshio Suga gave meeting participants a more detailed look into the future plans for OOPC in the timeframe of 2013-2015. The following paragraphs focus on the most pressing issues, for further information on these items please see the revised Work Plan in Annex IV.

2.2.1 Evaluation of the Tropical Pacific Observing System.

Driven by the recent deterioration of the data return from the TAO/TRITON array, a NOAA/JAMSTEC co-sponsored Workshop on the 'Future sustained Tropical Pacific Ocean Observing System for Climate Research and Forecasting (TPOS-2020)' will be held at Scripps Institute for Oceanography in the United States from 27-30 January 2014. The workshop will evaluate the requirements for Tropical Pacific observations and will discuss the potential of existing (i.e. TAO/TRITON moorings, Argo profiling floats, satellite observation), and new technologies (i.e. profiling moorings, gliders) of ocean observations in the Tropical Pacific region. OOPC has already provided input on the scope of the meeting. OOPC co-chair Toshio Suga is also the co-chair of the TPOS Scientific Organizing Committee, and the OOPC Secretariat will be providing technical support to the workshop. Since the last OOPC meeting, a Scientific Organising Committee has now been appointed. Any comments or questions on the workshop should be addressed to the Scientific Organising committee via the OOPC Secretariat. The Panel requested clarification on who will be invited/engaged in the workshop and how the outcomes will be taken up and acted on.

OOPC Panel members also stressed the following points:

- The robustness and resilience of the observing system need to be considered,
- Both data management and management of the observing system should explicitly be named in the OOPC ToRs.

Additionally, the potential to bring in new partners to support the array was also discussed, e.g. the French ships operate in the Tropical Pacific area. A follow up 'sponsors' workshop is planned for later in 2014. In the same vein, concern was also raised in the use of observing system evaluation results to inform the observing system design, for the following reasons:

- Many seasonal forecasts assimilate just temperature, and not the simultaneous meteorology and currents data, so in this context, it would be hard to compete with Argo.
- The data is generally used to correct biases, rather than use anomalies to inform variability.

Tony Lee, representing CLIVAR GSOP, is currently contacting groups who carry out OSE type experiments to invite them to provide their results and key metrics for analysis, so that multi-model conclusions can be drawn.

Recommendation: TPOS-2020 invitation list and process be made available as soon as possible, to ensure that OOPC can discuss whether there are key communities or activities which should be engaged (OOPC Secretariat).

2.2.2 Contributing to the development of the Deep Ocean Observing Strategy (DOOS).

DOOS is a cross-GOOS activity, driven at the steering committee level. Potential OOPC contributions to the development of the DOOS were discussed, which will cover physical, chemical and biological observations, and provide a definition of requirements, including scales, accuracies, and the area of focus. A task team is currently developing a whitepaper on deep ocean observing systems, which will outline the future progress of the observing system. A detailed presentation and discussion on future involvements of DOOS were held on the Joint OOPC/OCG meeting day, for further information please see Annex V.

Discussions were largely focused on observation requirements for Decadal Prediction, including accuracy requirements. The Panel proposed that deep ocean observations will be needed to initialize predictions, and boundary current observations would be needed for validation. The Panel recommended that these requirements should be revisited following progress in the DOOS, and a potential focused activity on boundary currents. The Panel also discussed whether modeling should be an explicit component to evaluation projects, and also recommended strengthened links with WCRP's modeling working groups, the Working Group on Ocean Model Development (WGOMD), and the Working Group on Coupled Modelling (WGCM). The Panel also questioned whether the observing system was adequate for describing decadal variability, and noted that ocean reanalysis activities are largely focused on the upper ocean. It was further noted that Deep Ocean expertise is currently lacking on the OOPC Panel, which should be addressed when considering new members in the future.

Recommendation: Engage with the DOOS Task Team regarding whether OOPC can contribute to its further development (OOPC Secretariat).

Recommendation: Evaluate the adequacy of the observing system for describing decadal variability, and observation requirements for decadal prediction, while following progress in the development of the Deep Ocean Observing Strategy and the planned Boundary Current Observing System evaluation (OOPC Panel members, OOPC Secretariat, OOPC Chairmen).

Recommendation: Deep Ocean expertise should be sought for the OOPC Panel (OOPC Secretariat).

2.2.3 Evaluating the Upper Ocean Thermal Observing System.

An evaluation of the Upper Ocean Thermal Observing System has been highlighted as a priority by the AOPC Panel, and is motivated by a range of recent studies that were getting different estimates of upper ocean heat content, while pieces of the issues are currently being addressed by existing activities (e.g. XBT fall Rate Correction, and the GSOP temperature clean up workshop). OOPC will have an opportunity to draw on the outcomes of these activities, and assess whether there is a need for an overarching review.

The Panel additionally suggested that the Upper Ocean Thermal Observing System is an opportunity to connect up the requirements and observing system implementation from open ocean to shelf and coastal zones for one variable. Observations of upper ocean thermal data will also be needed by the Biogeochemistry and Biology panels (e.g. for estimates of mixed layer depth, stratification, etc.), and the Panel questioned whether the mixed layer (from surface to bottom) is being adequately sampled.

Recommendation: Initiate an evaluation of the Upper Ocean Thermal Observing System, including coastal requirements and in support of biogeochemical and biological (e.g. for calculating stratification, mixed layer depth, etc.) aspects (OOPC Secretariat, OOPC Panel members).

2.2.4 Sustained observations of boundary currents and inter-basin flows.

A plan for sustained observations of boundary currents is a potential next horizon for OOPC. The status of existing boundary current observations activities was discussed, including the potential to compare, contrast and benchmark the different boundary current observation approaches around the world. A potential way forward could include a workshop on boundary current observations hosted by OOPC.

OOPC will request updates from both authors of relevant key OceanObs09 whitepapers and representatives of the WCRP/CLIVAR Second International Symposium on Boundary Current Dynamics⁵ that took place in Yun Nam, China, in July 2013. As a next time horizon, there is the potential to include requirements for boundary current observations in the next version of the GCOS Implementation Plan.

Observations of boundary currents will require a mix of technologies, which may differ across different locations – the integration of in-situ data, satellite data and high resolution models will be needed, particularly to constrain eddy fluxes. Some mooring arrays are already placed along Altimeter tracks to extract maximum benefit from the available data and, in some cases, to work towards a potential satellite proxy for boundary current strength (e.g. the Agulhas). There is support from funders for an international process to provide recommendations on boundary current observations, as many are under pressure to fund observing system activities. Gliders are being deployed in many boundary current regions, so an assessment of their utility in this context is timely.

OOPC will assess the science and technology needed to determine whether a workshop on observing system design is timely and a realistic approach, and to identify the next steps that need to be taken towards developing a global measuring system.

Recommendation: Initiate a boundary currents evaluation process to gather information on requirements, status and next steps for sustained observations of boundary currents and inter-basin flows (OOPC Secretariat).

2.3 OOPC activities in 2016-2018

Dr Mark Bourassa presented future potential OOPC activities for the timeline of 2016-2018,

2.3.1 Air Sea Fluxes

Many groups are focusing on improving errors in air sea flux, including the Surface Flux Analysis Project (SURFA), AOPC, CLIVAR and GEWEX. Additionally, the GOOS Biogeochemistry Panel (IOCCP) and SOLAS focus on gas fluxes. OOPC has the role to build a picture of the status of activities collectively, and should provide recommendations on observing system developments for reducing air-sea flux estimate errors, in areas such as:

- Surface waves observations (stress vector, wind vector, transfer of energy),
- Surface current corrections for accurate wind stresses (especially western boundary currents), and
- Encouraging technical developments.

Several observation groups have identified errors in turbulent and radiative surface fluxes as a leading cause of errors in system applications. OOPC has a role in providing recommendations for the standardization of measurements (e.g. heights, corrections, etc), metadata and algorithms for

⁵ For more information on the WCRP/CLIVAR boundary current dynamics workshop, please see: <http://coadc.ouc.edu.cn/isbcd/>

calculating fluxes, and encouraging a technical implementation of those requirements to aid the uptake by users.

Recommendation: Initiate an air sea flux observations evaluation process: connect to groups working in fluxes, and build a picture of the status of activities, with the potential for a coordinated activity focused on observing system requirements for energy and gas fluxes in the 2016 timeframe (OOPC Secretariat, OOPC Panel members).

2.3.2 Polar Seas (the Arctic Ocean and the Southern Ocean)

With regard to observations in polar seas, OOPC has decided to separate their revision efforts for the Arctic and the Southern Ocean, and while some of the observational challenges are similar (e.g. observing under the ice); the organizational and political landscape is still different. In the Arctic, many different groups are coordinating observations in the region at some level, whereas in the Southern Ocean, the community has come together to produce the Southern Ocean Observing System (SOOS). Polar seas are also important in two other priorities, e.g. the Deep Ocean Observing Strategy (deep water formation and fate), and air sea fluxes (in regard to ice-ocean-air), where the largest errors are generally in high latitude regions. From a geopolitical point of view, Polar Seas are a complex region, and different aspects that need to be taken into account:

- The Southern Ocean covers a large High Seas region.
- The area around Antarctica is governed by the Antarctic Treaty.
- The Arctic is surrounded by continents whose extended shelf areas and coastlines are subject to Extended Economic Zones (EEZs) claims.
- Additionally, the rights of indigenous peoples in Arctic Regions are also a factor.

OOPC will set a special focus on air-sea fluxes and air-ice fluxes, as well as ocean-ice interactions, and identified the Arctic Regional Observing System (ROOS, as part of EuroGOOS), the Sustaining Arctic Observing Network (SAON), and the Southern Ocean Observing System (SOOS) as potential partners for future collaboration. OOPC plans to monitor these activities and will connect as needed, particularly to advocate the use of the Framework in developing the observing system.

Recommendation: Monitor the Arctic and Southern Ocean observing coordination activities, and connect as needed, and furthermore promote the use of the Framework process (OOPC Secretariat, OOPC Panel Members).

Recommendation: Follow up on IPY activities with regard to data availability, and recommendations as to what observations need to be sustained (OOPC Secretariat).

Recommendation: Request a report and recommendations from the SOOS-sponsored 'Under Ice Workshop', which could be developed into a webinar (OOPC Secretariat, OOPC Chairmen).

2.3.3 Coastal and shelf seas.

Observations in regional and coastal seas are a great challenge, as an ever-increasing amount of external pressures (i.e. atmospheric pressures – vector winds, heat flux, precipitation; land-based inputs – freshwater, sediments, nutrients, contaminants; fishing, sea-level rise, ocean warming and acidification, coastal flooding, etc.) come into play. In addition, engagement becomes more complex, as more nations, organizations and layers of governance are involved in coastal monitoring.

A first step would be to encourage data availability in coastal regions. The potential to benefit from global high-resolution ocean hindcasts and forecasts is a good driver for nations who do not have

their own ocean forecasting activity. For instance, the BlueLINK project (Australia) has held an Indian Ocean Rim workshop to discuss how countries in the region could contribute to and benefit from Australian modeling programmes.

In the future, OOPC will need to interact with the GOOS Regional Alliances, with the Biogeochemistry and Biology panels on issues around water quality, and find common ground with both AOPC and TOPC. OOPC participants also suggested the potential for space agencies to be more strongly involved in coastal requirements as they cannot only provide data on a regional level, but also offer financial support in priority areas for in-situ validation and/or calibration. As a first step towards the coast, it was suggested that the requirements for climate observations in the coastal zone could be assessed ahead of the next version of the GCOS implementation plan by looking at requirements for existing ECVs in coastal and shelf seas. Sea level was identified as a key variable, which would integrate across open ocean to coastal issues, and the Panel discussed the international tide gauge network, which has been designed for global applications. More tide gauges are implemented locally for port tide charting, but focus is needed on requirements for tracking regional sea level rise. The GEO Coastal Zone Community of Practice (CZCP) has apparently run an activity on coastal inundation, so a first priority could be to gather information on existing activities in this area.

Recommendation: Coastal and Shelf Seas should be an ongoing priority; targeted or low level activities will be progressed on an ongoing basis (OOPC Secretariat, OOPC Panel members).

Recommendation: Assess existing and recent activities in the science and observation requirements for sea level rise impacts and coastal inundation (OOPC Secretariat, OOPC Panel members).

Action: Enquire with NODC on their holdings of coastal and shelf observations (OOPC Secretariat).

2.3.4 Upwellings

Upwellings were identified as a potential future focus, which would integrate both physics and biology issues, and across open ocean to coastal regions. One of the new CLIVAR 'Research Opportunities' focuses on the dynamics of upwelling systems, and is a joint activity with the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) program. In addition, the US Global Change Research Program has proposed a set of indices for upwelling.

Recommendation: Maintain the communication with CLIVAR and IMBER upwelling activities, particularly in relation to observation requirements for determining the drivers, rates and scales of upwelling.

2.4 Connecting to Essential Ocean Variable (EOV) requirements.

The assessment of requirements for different aspects of the ocean that have been discussed above will need to be translated into requirements for EOVs/ECVs. The Essential Climate Variable (ECV) concept has been a highly successful one, particularly in engaging the space agencies. OOPC will need to consider both the GCOS (Implementation Plan and Adequacy reporting) and GOOS (Framework for Ocean Observing and future development of a GOOS Implementation Plan) processes, as well as foster interactions with the other expert panels of GOOS and GCOS.

Societal needs are driven by the level of granularity required when determining ECVs/EOVs, as opposed to details of what measurements are actually taken, and existing ECVs often comprise a group of variables measured (i.e. ocean acidity). The need for absolute calibration of an observation was discussed (e.g. for bio-optics), and clarity is needed on what is actually being measured. IOCCP

is concerned that the experts will be inundated by requests for new EOVs, so some guidance on what constitutes an EOv would be welcomed by the community.

The development of a template proposing new EOVs provides an opportunity to connect the GOOS and GCOS assessment processes. OOPC is in a good position to develop the template, due to its experience in the development of the Ocean ECVs. As a first step, it was recommended that such a template should be exercised with existing ECVs, and extending them towards variables in coastal areas. Potential new EOVs discussed at the meeting included Ocean Surface Stress and Gravity.

Action: OOPC to design a template for proposing new EOVs, and circulate the template for discussion (OOPC Secretariat, OOPC Panel members, OOPC Expert community).

Action: Develop strawmen drafts of the status of already existing ocean ECVs, using the template, and circulate them to the scientist teams in their respective area of expertise (OOPC Secretariat, OOPC Panel members/Expert community to volunteer for each ECV).

Recommendation: Foster the connections to the satellite community, and explore new connections (OOPC Secretariat).

3. Implementing the OOPC Work plan.

Dr Mark Bourassa presented a short overview timeline for future OOPC activities that have been discussed during the first day of the meeting, and explained to participants of what will be the main interest for the Panel.

- 2013 - 2014: - TPOS-workshop
 - Deep Ocean Observing System
- 2014 - 2015: - Review of the Upper Ocean Thermal Observing System
 - Boundary Currents Observing System (including a potential workshop)
 - GCOS Third Adequacy Report and new Implementation Plan
- 2015 - 2016: - Reducing Errors in Air-Sea Fluxes
 - Revision of GCOS Implementation Plan
- 2016 - 2018: - Regional and Coastal Seas
 - Polar Regions
 - Preparations for OceanObs19

The Panel members were concerned that the timeline did not reflect hard deadlines, ongoing projects, etc., and requested that the OOPC Secretariat prepares a timeline diagram, reflecting these subtleties.

Action: Develop a timeline for all current/future OOPC activities to reflect hard deadlines, ongoing projects, and future possibilities (OOPC Secretariat).

Planned OOPC projects, such as TPOS-workshop, the Upper Ocean Thermal Observing System, the Boundary Currents Observing System, reducing errors in air-sea fluxes, and observations in both the regional and coastal seas and in polar regions could potentially driven as a two-year revision process guided by OOPC. Each project would need an expert assigned by OOPC, and a Patron (i.e. funder). The OOPC Secretariat will develop an OOPC observing system revision template, which will be open for discussion with the other GOOS panels and ocean observing community. Such a template would include the motivation, justification, objectives (or Terms of Reference) and expected outputs,

communications and metric for future performance monitoring. The Panel suggested that an assessment of whether to take the issue further should be built into the process.

The Panel also discussed the potential for more integrative approaches to observing system evaluations. For instance, an evaluation of the North Atlantic Observing System could be done. The Tropical Pacific Observing System Evaluation could be considered a first step in this direction.

Action: OOPC to design a template for developing OOPC observing system evaluation projects (OOPC Secretariat, OOPC Panel members).

Session participants also stressed the fact that preparations for OceanObs19 will be very time consuming, and therefore OOPC needs to define early on the nature of its involvement with OceanObs19 conference planning. With regard to Panel representation and meeting attendance, the OOPC secretariat keeps a prioritized list of meetings of relevance to OOPC, assessed based on:

- (1) First priority – Reporting to sponsors, and engagement with key organizations connected to OOPC.
- (2) Second Priority – Science meetings and workshops of relevance to OOPC Work Plan priorities.
- (3) Third Priority – Development of Ocean ECVs/Physics EOVs and key multidisciplinary issues, attending meetings of other groups related to ocean observing.

Action: OOPC Members to inform the Secretariat of meeting attendance of relevance to OOPC, to be included in the Panel meeting plan (OOPC Panel members, OOPC Secretariat).

As OOPC is currently undergoing a restructuring of future activities through the development of the Work Plan, potential new members for the OOPC Panel with a broad interest in ocean observation science are needed in the Work Plan priority areas discussed. Participants were welcomed to submit names of potential new members to the Secretariat. It was stressed that working for the OOPC Panel is a voluntary contribution parallel to the everyday work life of most people involved, and organizations, research networks, and universities the members work for need to sign off on the additional workload. Considering the fact that most current involved experts are coming from the United States or Europe, both participants of the meeting and the OOPC Secretariat agreed that there should be more visible diversity on the Panel in nationalities, age and gender, and OOPC should ask for advice from regional observing systems on how to best include experts from different regions that have different observation requirements. The Panel stressed that there is a need to develop Terms of Reference for Panel members, which will clarify the expectations for new experts joining.

Action: Members to suggest names of potential experts to engage in the OOPC Work Plan, and as potential candidates for OOPC (OOPC Panel members, OOPC Secretariat).

4. Next steps

The discussions and actions identified at this meeting will further the updating of the OOPC Terms of Reference, as well as the development and prioritization of the OOPC Work Plan. Discussions also shed light on the future expectations of potential new OOPC members and their area of expertise to progress the Work Plan. A summary of actions and recommendations can be found below.

1. Introduction and context

1.1.b The International Ocean Carbon Coordination Project.

Action: Organize joint OOPC/IOCCP Town Hall Meeting at the 2014 Ocean Sciences Meeting of the Association for the Sciences of Limnology and Oceanography (ASLO) in Honolulu, Hawaii (OOPC Secretariat, IOCCP Secretariat).

1.3 The World Climate Research Programme.

Recommendation: *Representation* - One of the OOPC co-chairs to attend the next WCRP Data Advisory Council and the CLIVAR Scientific Steering Group respectively to assess the effectiveness of these connections (OOPC Chairmen).

1.4 The OOPC Terms of Reference.

Action: *Terms of Reference* – Update the ToRs based on discussions, and circulate the new draft to OOPC Panel members for comment and editing (OOPC Secretariat, OOPC Chairmen).

Recommendation: Explore potential connections with GODAE OceanView task teams (OOPC Secretariat).

Recommendation: WGOMD/WGCM links should be fostered by OOPC co-chairs (OOPC Chairmen).

2. Developing an OOPC Work Plan.

2.1 Introducing the Work Plan and overarching approach.

Recommendation: Input from the Panel on observing system design approaches should inform the OOPC Observing System design and assessment discussion paper. OOPC members and guests are invited to engage in the development of the whitepaper (OOPC Secretariat, OOPC Chairmen, OOPC Panel Members).

Action: Update the Work Plan based on discussions, and to circulate the new draft to OOPC Panel members for comment and editing (OOPC Secretariat, OOPC Co-Chairs).

2.2 OOPC activities in 2013-2015.

Evaluation of TPOS **Recommendation:** TPOS-2020 invitation list and process be made available as soon as possible, to ensure that OOPC can discuss whether there are key communities or activities which should be engaged (OOPC Secretariat).

DOOS **Recommendation:** Engage with the DOOS Task Team regarding whether OOPC can contribute to its further development (OOPC Secretariat).

Recommendation: Evaluate the adequacy of the observing system for describing decadal variability, and observation requirements for decadal prediction, while following progress in the development of the Deep Ocean Observing Strategy and the planned Boundary Current Observing System evaluation (OOPC Panel members, OOPC Secretariat, OOPC Chairmen).

Recommendation: Deep Ocean expertise should be sought for the OOPC Panel (OOPC Secretariat).

Thermal Observing **Recommendation:** Initiate an evaluation of the Upper Ocean Thermal Observing System, including coastal requirements and in support of biogeochemical and biological (e.g. for calculating stratification, mixed layer depth, etc.) aspects (OOPC Secretariat, OOPC Panel members).

Boundary currents **Recommendation:** Initiate a boundary currents evaluation process to gather information on requirements, status and next steps for sustained observations of boundary currents and inter-basin flows (OOPC Secretariat).

2.3 OOPC activities in 2016-2018.

Air-sea fluxes **Recommendation:** Initiate an air sea flux observations evaluation process: connect to groups working in fluxes, and build a picture of the status of activities, with the potential for a coordinated activity focused on observing system

requirements for energy and gas fluxes in the 2016 timeframe (OOPC Secretariat, OOPC Panel members).

Polar seas

Recommendation: Monitor the Arctic and Southern Ocean observing coordination activities, and connect as needed, and furthermore promote the use of the Framework process (OOPC Secretariat, OOPC Panel Members).

Recommendation: Follow up on IPY activities with regard to data availability, and recommendations as to what observations need to be sustained (OOPC Secretariat).

Recommendation: Request a report and recommendations from the SOOS-sponsored 'Under Ice Workshop', which could be developed into a webinar (OOPC Secretariat, OOPC Chairmen).

Coastal & shelf seas

Recommendation: Coastal and Shelf Seas should be an ongoing priority; and targeted or low level activities will be progressed on an ongoing basis (OOPC Secretariat, OOPC Panel members).

Recommendation: Assess existing and recent activities in the science and observation requirements for sea level rise impacts and coastal inundation (OOPC Secretariat, OOPC Panel members).

Action: Enquire with NODC on their holdings of coastal and shelf observations (OOPC Secretariat).

Upwellings

Recommendation: Maintain the communication with CLIVAR and IMBER upwelling activities, particularly in relation to observation requirements for determining the drivers, rates and scales of upwelling.

2.4 Connecting to Essential Ocean Variable (EOV) requirements.

Action: OOPC to design a template for proposing new EOVs, and circulate the template for discussion (OOPC Secretariat, OOPC Panel members, OOPC Expert community).

Action: Develop strawmen drafts of the status of already existing ocean ECVs, using the template, and circulate them to the scientist teams in their respective area of expertise (OOPC Secretariat, OOPC Panel members/Expert community to volunteer for each ECV).

Recommendation: Foster the connections to the satellite community, and explore new connections (OOPC Secretariat).

3. Implementing the Work Plan

Action: Develop a timeline for all current/future OOPC activities to reflect hard deadlines, ongoing projects, and future possibilities (OOPC Secretariat).

Action: OOPC to design a template for developing OOPC observing system evaluation projects (OOPC Secretariat, OOPC Panel members).

Action: OOPC Members to inform the Secretariat of meeting attendance of relevance to OOPC, to be included in the Panel meeting plan (OOPC Panel members, OOPC Secretariat).

Action: Members to suggest names of potential experts to engage in the OOPC Work Plan, and as potential candidates for OOPC (OOPC Panel members, OOPC Secretariat).

The OOPC Secretariat would like to thank all participants of the workshop for fruitful discussions, and in particular, for the wisdom and guidance of long standing OOPC members. The OOPC would also like to thank the NOAA Climate Program Office for generously hosting the meeting.

Annex I – Agenda

Tuesday 3 rd September: Introduction and context				
09.00 (30 min)		Welcome from host, Introduction from the co-chairs.	Mark Bourassa, Toshio Suga	
09.30 1 hour (30+30)	1.1.	GOOS - Framework for Ocean Observations and New GOOS Structure, - expectations of OOPC	Presentation by Eric Lindstrom and/or Albert Fischer + Discussion	<u>Framework for Ocean Observations</u>
30 Min		Coffee		
11.00 50 mins (30+20)	1.2.	GCOS - Broader drivers (UNFCCC, GFCS, WIGOS) - Implementation Plan, process for review/adequacy reporting. - Expectations of OOPC	Presentation by Carolin Richter + Discussion	<u>GCOS Implementation Plan</u>
11.50 25 mins (15+10)	*	Introduction to the International Ocean Carbon Coordination Project (IOCCP)	Presentation by Maciej Telszewski	
12.15 45 mins (30+15)	1.3.	OOPC Terms of Reference, including discussion on defining OOPC role and Key connections.	Presentation by Toshio Suga + Discussion	Draft OOPC Terms of Reference
1hr 15		Lunch offsite		
14.15 45 mins (30+15)	1.4.	WCRP, CLIVAR - Developments (grand challenges, research opportunities) - Connection to, expectations of OOPC.	Presentation by Tony Busalacchi + Discussion	
15.00 1 hr	2.1.	Developing an OOPC Work Plan: Introduction - Key connections, deadlines and reporting requirements. - Overarching approach: Variables, Scales and Accuracies - Engaging with other GOOS/GCOS Panels, WCRP/CLIVAR.	Presentation by Mark Bourassa + Discussion	Draft OOPC Work Plan
30 mins		Coffee		
16.30 1.5 hrs	2.2.	DISCUSSION: Developing the Work Plan, key activities to progress in next 2 years 2013-14: Tropical Pacific Review, Deep Ocean Observing System, GCOS IP Review and Adequacy Report	Discussion lead: Toshio Suga	

		2014-15: Upper Ocean Thermal, Boundary Currents, Deep Ocean Observing System		
17.30-18.00	2.3.	Recap and wrap up for the Day	Mark Bourassa and Toshio Suga, Katy Hill	
18.00		Meeting close		

Wednesday 4th September: OOPC Work Plan tasks and priorities				
9.00 1.5 hrs	2.4.	DISCUSSION: Developing a Work Plan continued: Timing, activities to pursue, connections to make. 2015-18: Air Sea Fluxes, Polar Seas, Regional and Coastal Seas.	Discussion lead: Mark Bourassa	
30 mins		Coffee Break		
11.00 1.5 hrs	2.5	DISCUSSION: Work Plan continued: connecting to EOVS requirements. - Reviewing existing Ocean ECVs - Requirements for new EOVS/Ocean ECVs	Discussion lead: Toshio Suga	
1 hr 30 mins		Lunch offsite		
14.00 1.5 hrs	3.1.	DISCUSSION: Implementation of Work Plan: - Projects/activities to progress, champions, - OOPC Future membership, invited experts to engage, etc.	Discussion lead: Mark Bourassa	
30 mins		Coffee Break		
16.00 1.5 hrs		DISCUSSION: Implementation of Work Plan continued: - Funding requirements, Sources of potential funding. - OOPC Secretariat activities and priorities (representation, organizing workshops, website, etc)	Discussion lead: Toshio Suga	
17.30 30 mins		Summary, review actions and recommendations	Toshio Suga, Mark Bourassa, Katy Hill	
18.00		Meeting close		

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Annex III – Revised Terms of Reference (as presented to the OOPC Sponsors)

Recognizing the need for ocean observations beyond those for climate, and the increased need to connect to societal issues in the coastal zone, OOPC's role has evolved to oversee the Ocean component of the Global Climate Observing System (GCOS) and the physical variables for the Global Ocean Observing System (GOOS), while defining sustained ocean observing requirements for the World Climate Research Program (WCRP) and supporting assessments (i.e. IPCC), monitoring, projections and research. In this context, OOPC provides advice on scientific requirements to the Joint WMO-IOC Technical Commission on Oceanography and Marine Meteorology (JCOMM), which is responsible for the coordination of implementation of platform-based observing system components. It is recognized that there are potentially a large number of groups that OOPC needs to interact with. These connections will be fostered in the context of progressing the OOPC Work Plan, which details OOPC activities and foci with a 3-5 year time horizon.

In light of these relationships, the OOPC will operate with the following terms of reference.

1. **Assess, review and prioritise requirements** for sustained ocean observations of physical Essential Ocean Variables (EOVs), and ocean Essential Climate Variables (ECVs) in support of GOOS, GCOS and WCRP by;
 - 1.1. engaging the broad stakeholder community (primary scientific) to assess, review and update requirements for EOVs and ECVs,
 - 1.2. assessing the readiness of observing technologies, identifying those that have high feasibility and high potential impact in delivering required information,
 - 1.3. assessing the adequacy of present global EOV/ECV observations to make recommendations for phased implementation, contributing to the GCOS Implementation Plan and GOOS Work Plan, and
 - 1.4. providing an authoritative source of guidance on the development of national coastal and ocean observing requirements and observing system implementation plans.
2. Work with the JCOMM Observations Coordination Group and other relevant regional bodies to **coordinate observing networks** that contribute to ocean ECVs and physics EOVs by;
 - 2.1. encouraging GOOS Regional Alliances (GRAs) and national commitments to regional and global observing networks
 - 2.2. promoting common best practices and observing standards for global and national observations
 - 2.3. encouraging readiness of emerging networks, particularly those that fill observing gaps or lower costs per observation
 - 2.4. promoting data sharing for global and national observations [and adherence to IOC data policy, GCOS Monitoring Principles]
 - 2.5. identifying opportunities for synergistic cooperation and/or common technical support, and
 - 2.6. developing metrics for implementation.
3. Work with the International Ocean Data Exchange (IODE), JCOMM, WMO Information System (WIS), GRAs and other partner organizations (e.g. Group for Earth Observing (GEO), WCRP) to **review the status of and requirements for data and information management**, availability, and resultant products encouraging interoperability and stringent evaluation of fitness for purpose.
4. Help develop a **process for ongoing evaluation** of the observing system in liaison with users of the data, based on the optimum suite of platforms for required variables, spatial and temporal scales and accuracy through
 - 4.1. Delivering scientific Leadership in evaluating requirements for ECVs and EOVs

- 4.2. Engaging with Modelling community on use of and requirements for observations for ocean model development, state estimates, ocean and climate prediction and observing system evaluation to feed back into the observing system.
- 4.3. Providing guidance to networks on requirements for implementation.
5. Support global ocean observing activities by involved parties (national/regional activities including GRA's and global programs) through **liaison and advocacy for agreed plans**.
6. **Report to** the GOOS Steering Committee, GCOS Steering Committee and WCRP Data Advisory Council on the progress in implementing the ocean component of the GCOS Implementation Plan and the physics component of the GOOS Framework for Ocean Observations.
 - 6.1. Liaise with other GCOS and GOOS Panels, WCRP Steering Groups and other relevant entities such as WMO and IOC commissions on observing system issues.

The Chair(s) of the Panel will be selected by the OOPC Panel, and approved by the steering committees of the 3 sponsors (GOOS, GCOS and WCRP). Members will be approved by the Chairs of the 3 sponsors and other partner organizations, and serve (repeatable) two year terms.

Annex IV: OOPC/OCG Joint Day, 5th September 2013.

Members of the Ocean Observation Panel for Climate (OOPC) and Observations Coordination Group (OCG) of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), as well as invited experts representing major ocean observing networks, met for a joint day session on the 5 September 2013 in Washington DC, United States. As OOPC-16 was held back-to-back with OCG-5, this was the perfect opportunity to talk about requirements for the Framework for Ocean Observing (FOO), and to further discuss about an evaluation of the observing system. All presentations and background documents from the joint day meeting can be found on both the OOPC meeting website at www.ioc-goos.org/oopc-16 and OCG meeting website at www.ioc-goos.org/ocg-5.

Dr Wayne Higgins, director of the NOAA Climate Programme Office, welcomed participants to the session and shared his future vision for ocean observations. He stressed that NOAA's efforts are strongly dependent on international coordination, and therefore strongly appreciated the efforts made by OOPC and OCG to further discussions on ocean observations together.

J1. Framework for Ocean Observing/Requirements.

The purpose of the first session was to identify activities for reviewing ocean observation requirements, led by OOPC and others, where the role of OCG as an observing network is required in negotiations of feasibility, impact, etc. Therefore, GOOS and OOPC updated participants on recent activities and newly agreed plans following OOPC-16, and OCG provided updates on observing system missions including those of GCOS, GOOS, and WMO (Rolling Review of Requirements).

J1.1 The Global Ocean Observing System (GOOS)

Dr Albert Fischer, director of GOOS, and Dr Eric Lindstrom, co-chair of GOOS, updated OCG Members and invited experts that had not attended OOPC-16 on the role of GOOS in a global context, the restructuring of GOOS, and outlined the observing systems expectations for OOPC in the future. A detailed description of the main aspects of their talk can be found in Paragraph 1.1 of the OOPC-16 report.

Additionally to the presentation of the Framework for Ocean Observing (FOO) and an update on the current restructuring of the GOOS structure, Dr Fischer introduced OCG participants to the GOOS Regional Alliances (GRAs) that have updated their GOOS Regional Policy⁶ in line with the restructuring of the GOOS governance and the updated Framework guidance for GRAs. Historically, GRAs were introduced as a way to integrate national needs into a regional system, and to deliver the benefits of the GOOS strategy, structure, and programmes at a regional and national level. Since then, the GRAs have evolved to meet a wide range of societal challenges related to both coastal and open ocean observations, and the updated Regional Policy that not only recognizes the importance of GRAs to the GOOS goals, but also sets guidelines for recognition by the IOC governing bodies and Terms of Reference for the self-governed GOOS Regional Council, to be comprised of all GRA chairs. A close collaboration between GOOS/OOPC and OCG will further support for implementation on a regional scale.

The most successful component of GOOS over the past decade has been its climate component, which is the global observing system that is required for climate research, monitoring, forecasting and long-term projections of climate variability and change. Since 2009, its overall system has currently stabilized at about 62% of full implementation. Both presenters stressed that the progress has not

⁶ The GOOS Regional Framework 2013 (in EN, ES, FR, RU):
http://www.ioc-unesco.org/index.php?option=com_oe&task=viewDocumentRecord&docID=11235

been going forward the way originally envisaged, and therefore there is a need for the community to strengthen engagement in observing system implementation and ensure delivery of products and information to meet user needs. This also includes the cost effectiveness element, as maintaining such a global observing network is strongly resource demanding. Participants of the meeting expressed their concerns that the impact of the global economy is mitigating this statement of feasibility, and GOOS needs to define a strategy of how to communicate the status of ocean observations to potential funders. This will include OOPC/OCG efforts to develop new and expanded observing system metrics to communicate the need for ongoing effort to sustain the observing system, and also report implementation against requirements for variables in addition to the existing platform reporting.

Additionally, experts mentioned that the development of ocean forecasting systems on a global and regional level, as well as in coastal regions presents an opportunity to strengthen the relationship between observations and modeling to deliver to societal applications and also inform observing system design; and that the observing system 'fitness-for-purpose' status should be assessed in regard to this key data application area. Dr Fischer then informed participants that OOPC is currently trying to increase its connection with GODAE OceanView, which is an international coordination activity that provides coordination and leadership in consolidating and improving global and regional ocean analysis and forecasting systems on an international level.

J1.2 The Ocean Observations Panel for Climate (OOPC)

Dr Toshio Suga and Dr Mark Bourassa, the two new co-chairs of the Ocean Observations Panel for Climate (OOPC), filled OCG Members in on the decisions that had been made at the OOPC-16 meeting. Dr Suga introduced the new OOPC work plan and updated participants on OOPC's future plans and priorities. A detailed description of the discussion concerning the new OOPC work plan can be found in the OOPC-16 report, which includes a section on how to (1) develop and (2) implement the work plan. Future activities and priorities are further explained in item 1.5 of the joint day report.

Main focus of OOPC efforts will be set on a regular reporting to its main sponsors GCOS, GOOS, and WCRP, as well as to deliver advice on scientific requirements to JCOMM, and to strengthen its link to the GODAE OceanView project. This will include the evaluation of existing components of the ocean observation system, and the delivering of recommendations on requirements, and systems analyses. OCG Members stressed that OOPC needs to expand its mandate into the forecasting and services area, and should further ensure a stronger contribution of the ocean observing network to surface atmospheric variables.

Dr Suga also presented decisions made at OOPC-16, which include recommendations and actions for OOPC regarding its new Terms of Reference, the new work plan, new and current memberships, fostering links with other observation networks and communities (e.g. satellite community, GODAE OceanView, CLIVAR Working Groups, etc.), OOPC representation at meetings, and potential contributions to GOOS projects. The full list of actions from the OOPC-16 meeting is provided in Chapter 4 of the OOPC-16 report. Regarding the latest draft of the OOPC Terms of Reference, representatives of JCOMM requested that OOPC should include the connection to the JCOMM Management Committee and JCOMM's Data Management programme area. Additionally, JCOMM stressed that OOPC needs to stronger focus on atmospheric observations, and should pay attention to both observations of sea state and waves. An up to date draft of the Terms of Reference which is currently being considered by the OOPC sponsors can be found in Appendix III

Dr Mark Bourassa presented OOPC's future plans for the quantitative assessment of observing system design based on spatial, temporal and accuracy requirements for variables using statistical and modeling techniques, and assessments of the contribution of various observing platforms. Both observing system requirements and contributing observing networks will be assessed on their

'readiness', in line with the FOO. The requirements are based on scientific and operational objectives, and will be evaluated on their feasibility. OOPC and OCG need to work together to develop clear guidelines for contributing networks to articulate their role in the observing system. OOPC will develop a set of templates to evaluate the requirements for and implementation of the observing system by variable, and the contribution/readiness of component observing elements/networks. Additionally, OOPC is currently in the process of writing a whitepaper on 'Quantitative approaches to observing system design and assessment', which provides a rationale for the need of a quantitative systems based assessment with a focus on variables and scales.

1. OOPC is developing a whitepaper on quantitative observing system design and assessment, and is seeking engagement from OCG:

1.1 Action: OOPC to work with OCG to develop a template for capturing characteristics of observations for Observing System Assessment by variable, including capturing nuances of observation methods, e.g. line observations (OOPC Members, OCG Members).

1.2 Recommendation: OOPC to include GSOP in the development of an Evaluation of Observing System template, and initialize projects (e.g. engaging GSOP experts) (OOPC Members, OOPC Secretariat, OCG Members).

1.3 Recommendation: Gliders to work with both OOPC and GRAs, and continue to demonstrate and evaluate the capabilities of gliders for the evaluations (GROOM, OOPC Members).

J1.3 OCG-4 summary to JCOMM

Ms Candyce Clark, chair of the OCG, updated participants on the current OCG priorities, underlined the important value that the coordination group is adding to JCOMM, and highlighted collective charges for OCG and OOPC. OCG is part of JCOMM's Observations Programme Area (OPA), which aims at implementing and maintaining a fully integrated ocean observing system across the entire marine meteorology and oceanographic community, and works to develop, plan and coordinate the acquisition, exchange and management of observations. The OCG seeks scientific advice on requirements from the OOPC, and also responds to the observational requirements of the other JCOMM Programme areas, such as Services and Forecasting Systems, as well as the broader Global Framework for Climate Services (GFCS).

OCG links global in-situ implementation programmes. Formal members are the Data Buoy Cooperation Panel – DBCP, the Global Sea Level Observing System – GLOSS and the Ship Observations Team – SOT; while ad hoc members include the International Argo Programme, the OceanSITES Reference Stations, the Global Ocean Shipboard Hydrographic Investigations Programme - GO-SHIP and the International Ocean Carbon Coordination Project – IOCCP through JCOMM coordination. A technical coordination of the formal OGC networks is provided by JCOMMOPS. The OCG's current priorities are to identify key drivers for existing observing system requirements, work with OOPC on system based design and observing system metrics by network and variable, and to identify new potential new elements of the sustained observing system in response to requirements and technology readiness, such as ocean gliders. The ocean glider community was represented at the meeting by Pierre Testore from the European GROOM project, to discuss future engagement in the OCG and the development of a global sustained ocean glider observation network.

J1.4 The World Meteorological Organization

Mr Etienne Charpentier, representative of the WMO Marine Meteorology and Oceanography Programme (MMOP), updated OCG Members and invited experts on the current status of the Global

Framework for Climate Services (GFCS), and the WMO Rolling Review of Requirements (RRR) database.

Global Framework for Climate Services (GFCS)

Mr Charpentier gave a short update on WMO key priority areas, which include the GFCS, aviation meteorological services, capacity building for the developing and least developed countries, the implementation of the WMO Integrated Global Observing System (WIGOS) and the WMO Information System (WIS), and disaster risk reduction.

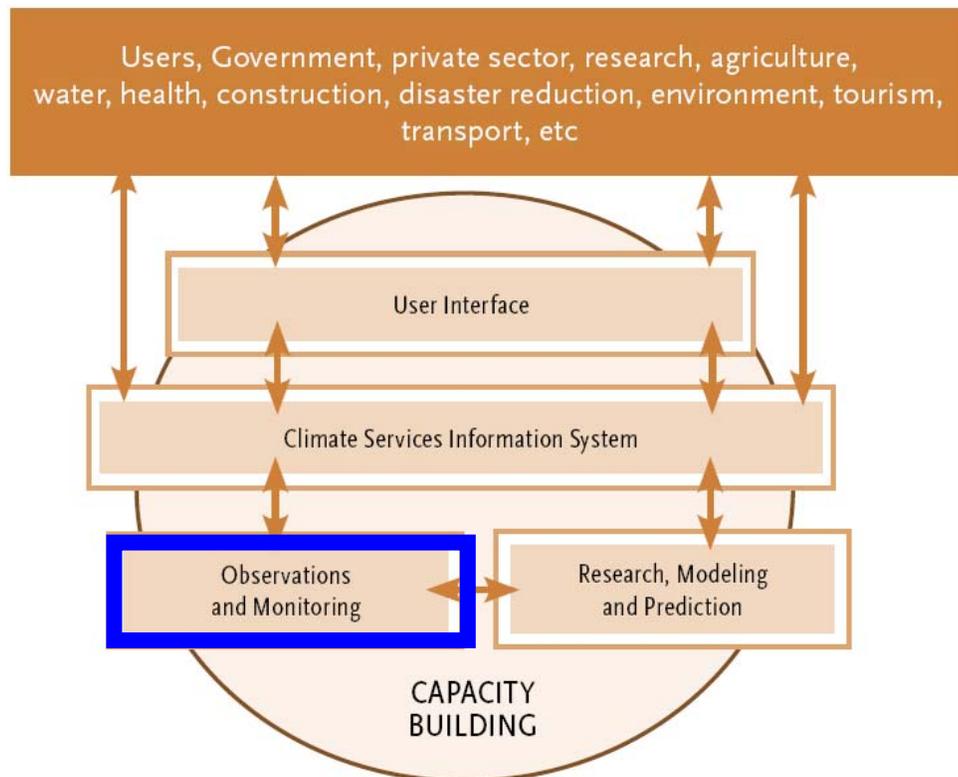


Figure 1: The main pillars of the Global Framework for Climate Services.

GFCS was developed to enable a better management of the risks of climate variability and change, and adaptation to climate change at all levels – through development and incorporation of science-based climate information and prediction into planning, policy and practice. The need for such a framework arose as the present capabilities for providing climate services do not exploit all that we know about the climate, and fall short of meeting the current and future needs and do not deliver their full benefits, especially in developing countries, as many countries currently lack the infrastructural, technical, human and institutional capacities to provide high-quality climate services. GFCS will build on existing capacities and leverage these through coordination to address these shortcomings. Mr Charpentier also explained the vision of the GFCS, which is expected to provide ways for climate services users and providers to interact and improve the effectiveness of the framework and its climate services; to generate, protect and distribute climate data and information according to the needs of users and to agree on standards; and to collect data to meet service provision needs, and develop agreements and standards for generating the necessary climate data. The ocean observation community will mainly provide expertise to the latter aspect of GFCS (see Figure 1).

Current JCOMM activities that directly contribute to the development and enhancement of climate services for the marine and coastal community include ocean climate observations and the support for research, long-term maintenance of an integrated global metocean data management (both for in-situ and remote sensing components), and polar metocean information services. JCOMM's core mandate in GFCS should focus on services in support of the safety of life and property at sea and in coastal areas, the management for ocean-based economic, commercial and industrial activities, prevention and control of marine pollution, sustainable development of the marine environment, provision of data information, products and services required to support climate research and the prediction of climate variability.

Future GFCS-projects proposed by JCOMM include:

- Ocean Extremes Monitoring System, Marine Climate Data System – MCDS,
- Integration of in-situ and satellite-based data for ocean observations,
- Integrated marine meteorological and oceanographic data and services in the framework of WIGOS and WIS, Global ocean observations in support of climate services),
- Marine and ocean climate information and assessment tools focusing on the impacts of weather and climate change on fisheries resources - in collaboration with the Commission for Agricultural Meteorology, Seasonal Ocean Climate Forecast System,
- Wave and Surge Climate Services,
- Coastal Inundation Forecasting Demonstration Project – CIFDP, in collaboration with the Commission for Hydrology,
- Enhanced Arctic Ocean Maritime Safety Information for Global Maritime Distress and Safety System – GMDSS, Adoption of an ISO 9001 Framework for the Delivery of Marine Weather and Ocean Services,
- Development and Adoption of a Generic Set of Competencies for Marine Weather Forecasters).

During the follow-up discussion, OCG Members and invited experts stressed about the fact that most of those proposed projects were decided on a tight timeframe, and without opportunity for consultation with the OOPC or OCG. Therefore, JCOMM and OCG experts need to further discuss on how to provide coordinated input to the GFCS projects in the future.

2. Recommendation: Strengthen the connection to the Global Framework for Climate Services (GFCS).

4.1 Recommendation: JCOMM OPA Implementation Goals should be better reflected in the GFCS compendium of related projects (OCG Chair, JCOMM Co-Presidents).

4.2 Recommendation: Global Alliance for CPR Surveys (GACS) should be connected to GFCS on food security issues (OCG Secretariat, GACS Representatives, JCOMM Management Committee).

Rolling Review of Requirements (RRR)

Mr Charpentier also presented an update on the process of the Rolling Review of Requirements (RRR), which defines user requirements for observations that are compared with the capabilities of present and planned observing systems. Currently, the RRR has 12 application areas: Global Numerical Weather Prediction, High Resolution Numerical Weather Prediction, Synoptic Meteorology, Nowcasting and Very Short Range Forecasting, Seasonal to Inter-annual Forecasts, Aeronautical Meteorology, Atmospheric Chemistry, Ocean Applications, Agricultural Meteorology, Hydrology, Climate Monitoring (GCOS), and Climate Applications (Other aspects, addressed by the Commission for Climatology). For each of the application areas considered, the Statement of Guidance (SOG) provides an assessment of the adequacy of observations to fulfill requirements and suggests areas of progress towards improved use of space-based and surface-based observing systems. Only the most significant variables in the given application areas have been analyzed in the SOGs, which can be found on the WMO website: <http://www.wmo.int/pages/prog/www/OSY/GOS-RRR.html>).

Mr Charpentier then presented JCOMM's main future contributions to the RRR, which includes an evaluation of the quality of wave observations, the development of cost-effective wave observations from drifters, a completion of the RAMA array, the promotion of an integrated approach between in-situ and remote-sensed measurements when considering requirements, and to further address ocean-related actions in the Implementation Plan for the Evolution of the Global Observing System (EGOS-IP), which are focusing on a transition to operational observations and include the following (C – cross-cutting, S – space-based, G – ground level, in-situ):

- C5** Sustained funding for the key marine/ocean observing systems (e.g. TIP, Argo, surface drifters with barometers, altimeter, scatterometer, SST from microwave radiometry, sea ice measurements from research satellite missions)
- C8** Continued adherence to WMO data sharing principles irrespective of origin of data, including data provided by commercial entities
- C13** Establish capacity building strategies for observing systems in developing countries
- G1** Traceability of meteorological observations and measurements to SI or WMO standards
- G2** Global exchange of hourly data which are used in global applications
- G3** Global exchange of sub-hourly data in support of relevant application areas
- G4** Exchange of observations according to the WIGOS standards
- G49** Maintain and optimize ASAP network over North Atlantic, & develop similar programmes for the N. Pacific & Indian Ocean
- G50** Use state-of-art technologies to improve accuracy for all measurements made at sea stations. Develop visibility measurement capabilities over the ocean.
- G51** Improve the quality of ship observations.
- G52** Support DBCP in its mission (1250 drifters, 400 MB) for SST, surface velocity, air T & wind
- G53** Install barometer on all newly deployed drifting buoys
- G54** Extend RAMA to similar coverage as TAO & PIRATA
- G55** Increase ice buoy data coverage on the northern polar cap
- G56** Global availability of in-situ sea level data (e.g. tide gauges, Tsunameters).

- G57** For ocean and weather forecasting purposes, transition the Argo profiling float network from research to operational status, & ensure timely delivery & distribution of high vertical resolution data for sub-surface temperature and salinity
- G58** For ocean and weather forecasting purposes, improve timely delivery & distribute high vertical resolution data for sub-surface temperature from Ships/XBT

Additionally, Mr Charpentier explained to participants that the RRR database will not include all of the requirements for the observing and monitoring mechanisms involved within the GFCS.

J1.5 Observing System Evaluations and Workshops

Dr Toshio Suga gave meeting participants a more detailed look into the future review and evaluation plans for OOPC in the timeframe of 2013-2015. For a detailed description of the most pressing issues, please see item 2.2 of the OOPC-16 meeting report.

Main focus in early 2014 is set on the evaluation of the Tropical Pacific Observing System (TPOS). Driven by the recent deterioration of the data return from the TAO/TRITON array, a NOAA/JAMSTEC co-sponsored Workshop on the 'Future sustained Tropical Pacific Ocean Observing System for Climate Research and Forecasting (TPOS-2020)' will be held at Scripps Institute for Oceanography in the United States from 27-30 January 2014. The workshop will evaluate the requirements for Tropical Pacific observations and will discuss the potential of existing (i.e. TAO/TRITON moorings, Argo profiling floats, satellite observation), and new technologies (i.e. profiling moorings, gliders) of ocean observations in the Tropical Pacific region. OOPC has already provided input on the scope of the meeting. OOPC co-chair Toshio Suga is also the co-chair of the TPOS Scientific Organizing Committee, and the OOPC Secretariat will be providing technical support to the workshop. The workshop will be based on a whitepaper process, and the recommendations will be published in the meeting report the first half of 2014. For more information, see www.ioc-goos.org/tpos2020.

Dr Eric Lindstrom introduced OCG participants to the concept of the Deep Ocean Observing Strategy (DOOS). The DOOS is a cross-GOOS activity, and therefore tries to integrate all three GOOS focus disciplines – physics, carbon/biogeochemistry, and biology/ecosystems. There is a need to communicate the relevance of the deep ocean to governments and science-funding agencies, and clarify the need for a global strategy for Deep Ocean observing (starting at approximately 2 km water depth) that will incorporate new observation technologies and networks in the existing observing system. The DOOS is a GOOS activity structured in line with the Framework for Ocean Observing, which includes the use of readiness levels to assess the fitness-for-purpose (related to EOVs and associated observations and data products), as well as communication with oversight panels, expert teams, and implementation communities to organize discussions related to system requirements and observations. Dr Lindstrom presented a timeline of planning and moving towards implementing such a deep ocean observing system up to OceanObs'19, which will include the establishment of a development programme, conducting design studies based on models, existing observation systems, evaluation framework, and the implementation of a pilot programme.

Furthermore, Dr Lindstrom informed participants paper on the Deep Ocean Observing Strategy will be available within a few months. He also welcomed participants to provide input for a future strategy, and to identify potential future needs and actions.

3. Recommendation: OOPC and OCG to work together to strengthen the connection between observing system requirements and network data delivery.

3.1 Action: OCG Members to work with the OOPC Secretariat to identify where existing drivers/requirements come from for each network. The OOPC Secretariat will draw on OCG talks for a first draft, and send out to OCG Members for comment (OOPC Secretariat, OCG Members).

3.2 Recommendation: Information on how individual EOVs are distributed amongst the observing networks to be collated in EOV document templates (OOPC Secretariat, OOPC Members).

3.3 Action: OOPC draft template for assessing status/proposing new observing networks/elements to be circulated to OCG for discussion (OOPC Secretariat, OOPC Members).

3.4 Recommendation: Stronger connections to be developed between OOPC and the JCOMM Services and Forecasting Systems program area for developing requirements for ocean applications (marine services, ocean forecasting, etc.) to feed eventually into the OCG implementation goals (OOPC Secretariat).

3.5 Action: Organize teleconferences on a quarterly basis between Secretariats of the GOV, GSOP, OCG, and OOPC to discuss cross panel activities and links (Katy Hill – OOPC, Albert Fischer – OCG, Kirsten Wilmer-Becker – GODAE, Nico Caltabiano – GSOP, Long Jiang – ETOOFS).

J2. Framework for Ocean Observing/Evaluation of the Observing System.

The second session of the day dealt with current observing system metrics and their potential improvement, as well as how OOPC and OCG can work together in the evaluation of the observation system. Discussions also included potential steps on how to successfully evaluate the overall observation system, both satellite-based and in-situ, in regard to the ECV/EOV concept.

J2.1 Platform-based Metrics

Ms Candyce Clark summed up the sorts of information that needed to be captured by an expanded set of observing system metrics:

- Identification of the individual network implementation goals and automated programme metrics.
- The intensity of effort required to sustain the different networks;
- EOV/ECV based implementation, against requirements for those variables.
- Data flow – metrics of flow of real-time and delayed-mode data (including quality standards); and
- Products – delivery of value added products (derived or gridded).
- Uptake and Use - Is the data being used? By whom and what is the main reason? What kind (and level) of impact do they have?

Ms Clark asked for input and comments from OOPC and OCG Members and invited experts, and pressed that there needs to be further discussion among each – How do they define and implement metrics? Do they have real-time and/or delayed-mode data delivery? What is the networks' data uptake and use? What is the networks' performance? OCG will need to evaluate the performance of the existing networks in the observing system, and work with OOPC to evaluate the implementation by Variable.

4. Recommendation: The current metrics for the observing system implementation need to be revised to include an EOV/ECV focus, reflect ongoing effort required for deployment/implementation, real time/delay mode data delivery and data uptake and use.

2.1 Action: The current 62% of the observing system completion did not necessarily reflect the drops noted in the last two years with regard to the drifter array, and the TAO array data availability (OSMC/JCOMMOPS to update based on data availability).

2.2 Action: JCOMMOPS/OSMC to work with networks to refine the implementation metrics so that they are able to show the actual evolution of the observing systems, and ongoing effort required to sustain those (JCOMMOPS, OSMC).

2.3 Action: Roles of OSMC and JCOMMOPS need to be defined with regard to delivering Observing System information (Candyce Clark, JCOMMOPS, OSMC).

2.4 Action: JCOMMOPS to compile information about the evolution of the observing networks in order to visualize with new graphical products the trends of gaps of the array. Such tools will in particular be useful to the OOPC for making its recommendations to JCOMM in the future (JCOMMOPS, OOPC Members).

2.5 Action: OCG to develop an inventory and summary of usage of data. TIP and Argo already actively develop bibliographies, which can form a starting point (OCG Members, OCG Secretariat).

2.5.1 Action: Request TIP and Argo to provide information on status of bibliography, how data is collected and managed (e.g. database), and what resources are required for this activity.

J2.2 Evaluation of the overall Ocean Observing System

Mr Bob Keeley introduced meeting participants to a review report he is currently writing on an ECV-based evaluation of the whole in-situ ocean observing system, as the JCOMM Management Committee has voiced the need for an assessment on the state of in-situ data systems with respect to interoperability, consistency of treatment, metadata collection, etc. The report is composed as follows: (1) a description of the work, (2) evaluation of each of the following observing systems – SOOP, TSG, VOS, Drifters, TIP, OceanSITES, GLOSS, Argo, GO-SHIP, and IOCCP, (3) evaluation based on individual ocean ECVs, and (4) concluding remarks. Part (2) will focus on data providers, data assembly, processing and archiving processes, data dissemination, difference between data sets, user communities, monitoring and performance metrics, GCOS-IP performance indicators, and future recommendations for each evaluated network. Part (3), focusing on an ECV-based approach, provides information about the review of instruments, instrument characteristics, data providers, FOO system readiness descriptions, ECV requirements (from WMO OSCAR), composite view, and future recommendations. Mr Keeley reminded the attending experts that the approach had to be ECV-based, as there is no current existing list of Essential Ocean Variables available yet.

Mr Keeley also expressed his concerns, and furthermore explained some of the problems and difficulties he faced during his writing progress, especially in regard to the structure of the OSCAR database, differences in real-time and delayed-mode data reporting, and duplication across different data sets. He welcomed OCG and OOPC experts to think about the following aspects:

- How to provide sensible targets for marine observing systems that are not sampled in the x-y-z boxes of OSCAR? Is there a possibility to recast the OSCAR requirements?
- How to assess success for measuring an ECV across many different observing systems?
- What role do OOPC and/or OCG want to have in the review of the draft report?
- Are observing targets different for real-time and delayed-mode data? And if so, what are those differences?
- Is it possible for OOPC/OCG to provide a general future direction on how to avoid duplication of data sets in archives?
- What are OOPC's plans for regular reporting on the performance of observing data systems to deliver the data?

- In the process of defining EOVs, OOPC should indicate the type of metadata that will be crucial to capture. Should there be encouragement of data providers to indicate their uncertainty estimates?

After finalizing the draft version, the report will be circulated to individual experts from both the OOPC and OCG community for review. The report itself will then be published some time in early 2014.

In addition to the planned evaluation on in-situ observing systems, Dr Mark Bourassa presented a talk on the importance of an evaluation of satellite systems, and furthermore the combination of future recommendations for both the in-situ and satellite-based observing community. Combining satellite and in-situ systems would benefit the ocean community, as satellite systems rarely have an absolute calibration, but usually have stable calibrations, which is of huge importance for climate applications such as decadal changes. Examples for such a successful combination include ocean observations for sea level change, and change in Tropical Pacific winds. Dr Bourassa underlined the importance of a stable calibration, and stressed that currently only a relatively small number of high-quality observations can be used to test those calibrations. Therefore, other sensors are needed to provide a better space/time coverage.

A combined in-situ and satellite-based system is needed to maintain a global network for surface observations. OOPC will need the information to further assess the fitness-for-purpose of the observing system for climate and operations.

5. JCOMM Report on data flow by Bob Keeley will be available in late 2013. OCG Members to review.

5.1 Action: OOPC to review sections by EOv, to be collated by OOPC Secretariat (OOPC Secretariat to define process with OCG Chair and coordination with OOPC Members).

5.2 Action: OCG networks to review sections by network, engaging data teams and JCOMMOPS technical coordinators, to be collated by OCG Secretariat (OCG Chair/Secretariat to coordinate with OCG Members).

5.3 Action: JCOMM Data Management Programme Area need to be engaged (OCG Secretariat, JCOMM Members).

5.4 Action: OCG will hold a teleconference on this topic in January 2014 (OCG Secretariat to facilitate) in order to:

5.4.1 Action: Review the Terms of Reference of the proposed JCOMM cross-cutting task team on Integrated Data Flows in Oceanographic Services for WIGOS and WIS and make adjustments, and propose new members, noting that its scope also includes integration of products data flow (OCG Secretariat, OCG Members).

5.4.2 Action: Decide if OCG should have a separate task team to address some of the issues raised in the report that cannot be taken up by the larger JCOMM task team due to its scope (OCG Members).

5.4.3 Action: Ensure European initiatives (e.g. MyOcean, SeaDataNet, Eurofleets, Jerico, EMODnet, ODIP) are engaged in the ongoing work (OCG Secretariat).

J2.3 Connections to Synthesis and Product Development

Dr Eric Dombrowsky, co-chair of GODAE OceanView (GOV), gave a presentation on the connections to synthesis and product development, whereas Dr Tony Lee and Dr Eric Lindstrom underlined the importance of a well-working collaboration between the modeling and the observation communities to not only improve the quality of future climate models, but also to identify the current observation gaps.

It was suggested that OOPC should further its links to the Global Synthesis and Observations Panel (GSOP) of CLIVAR, as both have similar Terms of Reference and therefore need to avoid repetition. Areas such as working with the observations community to improve data quality (such as the recent Ocean temperature clean up work shop), is an area ripe for collaboration between these two groups. Rather than focusing on cross representation at meetings, it suggested that secretariats of the panels and projects connect up for a teleconference on a semi-regular basis to swap information, discuss activities and identify areas of mutual interest. Additional benefits for such collaboration will improve information provided for observational impact assessments (e.g. the deterioration of the TAO/TRITON network), and improve observation quality (control, error estimates, etc.). Furthermore, GSOP should be asked for input on the development of a template to evaluate observing systems that OOPC had already decided on during OOPC-16.

Dr Dombrowsky mentioned that the production of reanalysis implies the need for high-quality observation data sets (in delayed mode), and introduced the concepts of CORA (IFREMER), AVISO, and sea ice data products. All those products are available on GOV's MyOcean servers (<http://www.myocean.eu>). He also informed participants that different approaches are currently used for data forcing, whereas most European groups use ECMWF's ERA reanalysis products. Several of GOV's partners use their real-time systems to produce reanalysis, which is further explored on the website of the 4th WCRP international conference on reanalysis that took place in May 2012 (<http://icr4.org>). In Europe, there is a concerted effort to provide several global 1/4° reanalysis products that are served through the MyOcean portal.

J3. Next Steps.

The actions identified at the meeting will further the links between OOPC, OCG, and JCOMM in the future. A summary of actions and recommendations can be found below.

1. OOPC is developing a whitepaper on quantitative observing system design and assessment, and is seeking engagement from OCG:

1.1 Action: OOPC to work with OCG to develop a template for capturing characteristics of observations for Observing System Assessment by variable, including capturing nuances of observation methods, e.g. line observations (OOPC Members, OCG Members).

1.2 Recommendation: OOPC to include GSOP in the development of an Evaluation of Observing System template, and initialize projects (e.g. engaging GSOP experts) (OOPC Members, OOPC Secretariat, OCG Members).

1.3 Recommendation: Gliders to work with both OOPC and GRAs, and continue to demonstrate and evaluate the capabilities of gliders for the evaluations (GROOM, OOPC Members).

2. Recommendation: Strengthen the connection to the Global Framework for Climate Services (GFCS).

4.1 Recommendation: JCOMM OPA Implementation Goals should be better reflected in the GFCS compendium of related projects (OCG Chair, JCOMM Co-Presidents).

4.2 Recommendation: Global Alliance for CPR Surveys (GACS) should be connected to GFCS on food security issues (OCG Secretariat, GACS Representatives, JCOMM Management Committee).

3. Recommendation: OOPC and OCG to work together to strengthen the connection between observing system requirements and network data delivery.

3.1 Action: OCG Members to work with the OOPC Secretariat to identify where existing drivers/requirements come from for each network. The OOPC Secretariat will draw on OCG talks for a first draft, and send out to OCG Members for comment (OOPC Secretariat, OCG Members).

3.2 Recommendation: Information on how individual EOVs are distributed amongst the observing networks to be collated in EOV document templates (OOPC Secretariat, OOPC Members).

3.3 Action: OOPC draft template for assessing status/proposing new observing networks/elements to be circulated to OCG for discussion (OOPC Secretariat, OOPC Members).

3.4 Recommendation: Stronger connections to be developed between OOPC and the JCOMM Services and Forecasting Systems program area for developing requirements for ocean applications (marine services, ocean forecasting, etc.) to feed eventually into the OCG implementation goals (OOPC Secretariat).

3.5 Action: Organize teleconferences on a quarterly basis between Secretariats of the GOV, GSOP, OCG, and OOPC to discuss cross panel activities and links (Katy Hill – OOPC, Albert Fischer – OCG, Kirsten Wilmer-Becker – GODAE, Nico Caltabiano – GSOP, Long Jiang – ETOOFS).

4. Recommendation: The current metrics for the observing system implementation need to be revised to include an EOV/ECV focus, reflect ongoing effort required for deployment/implementation, real time/delay mode data delivery and data uptake and use.

2.1 Action: The current 62% of the observing system completion did not necessarily reflect the drops noted in the last two years with regard to the drifter array, and the TAO array data availability (OSMC/JCOMMOPS to update based on data availability).

2.2 Action: JCOMMOPS/OSMC to work with networks to refine the implementation metrics so that they are able to show the actual evolution of the observing systems, and ongoing effort required to sustain those (JCOMMOPS, OSMC).

2.3 Action: Roles of OSMC and JCOMMOPS need to be defined with regard to delivering Observing System information (Candyce Clark, JCOMMOPS, OSMC).

2.4 Action: JCOMMOPS to compile information about the evolution of the observing networks in order to visualize with new graphical products the trends of gaps of the array. Such tools will in particular be useful to the OOPC for making its recommendations to JCOMM in the future (JCOMMOPS, OOPC Members).

2.5 Action: OCG to develop an inventory and summary of usage of data. TIP and Argo already actively develop bibliographies, which can form a starting point (OCG Members, OCG Secretariat).

2.5.1 Action: Request TIP and Argo to provide information on status of bibliography, how data is collected and managed (e.g. database), and what resources are required for this activity.

5. JCOMM Report on data flow by Bob Keeley will be available in late 2013. OCG Members to review.

5.1 Action: OOPC to review sections by EOY, to be collated by OOPC Secretariat (OOPC Secretariat to define process with OCG Chair and coordination with OOPC Members).

5.2 Action: OCG networks to review sections by network, engaging data teams and JCOMMOPS technical coordinators, to be collated by OCG Secretariat (OCG Chair/Secretariat to coordinate with OCG Members).

5.3 Action: JCOMM Data Management Programme Area need to be engaged (OCG Secretariat, JCOMM Members).

5.4 Action: OCG will hold a teleconference on this topic in January 2014 (OCG Secretariat to facilitate) in order to:

5.4.1 Action: Review the Terms of Reference of the proposed JCOMM cross-cutting task team on Integrated Data Flows in Oceanographic Services for WIGOS and WIS and make adjustments, and propose new members, noting that its scope also includes integration of products data flow (OCG Secretariat, OCG Members).

5.4.2 Action: Decide if OCG should have a separate task team to address some of the issues raised in the report that cannot be taken up by the larger JCOMM task team due to its scope (OCG Members).

5.4.3 Action: Ensure European initiatives (e.g. MyOcean, SeaDataNet, Eurofleets, Jerico, EMODnet, ODIP) are engaged in the ongoing work (OCG Secretariat).

The Secretariats of OOPC and OCG would like to thank all Members, invited experts, JCOMM and JCOMMOPS for the great discussions from which the good work relation between OOPC and OCG will benefit from in the future. The OOPC and OCG would also like to thank the NOAA Climate Program Office for generously organizing the meeting at the Hilton Doubletree Hotel.

Agenda of the Joint OOPC-16/OCG-5 Meeting

Thursday 5 th September: Joint OOPC/JCOMM OCG Day				
8.30 am (10 mins)		Open, introductions and welcome	Chairs OOPC and OCG	
J1. Framework for Ocean Observing/Requirements (chair: Clark) Purpose: identify activities for reviewing requirements (led by OOPC and others) where OCG role as observing community/network voice is required in negotiations of feasibility vs. impact.				
8.40 40 mins (20+20)	J1.1	Update on GOOS including idea of GOOS Projects	Albert Fischer	Document
9.20 1 hr 20 (40+40)	J1.2.	Report on OOPC Plans and approaches <ul style="list-style-type: none"> - Including information on GCOS Review, IP review and adequacy reporting, and updating of implementation plans - Quantitative approaches to setting observing system requirements, design and assessment: EOVs, ECVs, scales and accuracies, linking to platform based requirements. 	Toshio Suga, Mark Bourassa, Katy Hill	OOPC Draft Work Plan + update Paper on Observing System Design and Assessment
10.40 30 mins		Coffee		
11.10 1 hr	J2.3.	Connections to synthesis and product development (GODAE Oceanview, CLIVAR GSOP, JCOMM ETOOFS, JCOMM SFSPA, JCOMM TT SAT, GHRSSST)	Eric Lindstrom, Eric Dombrowsky	
12.10 20 mins	J1.3	Reminder JCOMM-4 charge to OCG; Observing system missions: GCOS, GOOS, WMO/RRR	Candyce Clark	
12.30 30 mins (15+15)	J1.4	WMO RRR/GFCS	Etienne Charpentier	Document
13.00 1hr		Lunch onsite		
14.00 1 hour (15+15+30)	J1.5	Review workshops and activities: <ul style="list-style-type: none"> - Tropical Pacific Observing System Review and Assessment - Deep Ocean Observing System - Discussion on OOPC/OCG Roles and Contributions 	Toshio Suga Eric Lindstrom	Document

J2. Framework for Ocean Observing/Evaluation of the observing System (Chair: Bourassa/Suga)				
Purpose: improve JCOMM metrics and for involving synthesis/product community in OBS system evaluation.				
15.00 1 hour (30+30)	J2.1	Platform based metrics/implementation progress - Overview of successes and major blockages - Discussion	Candyce Clark	Report from OSMC Reports from Networks.
30 mins		Coffee		
16.30 1 hour (30+30)	J2.2	Towards an EOVs/ECVs based evaluation of the overall system, satellite and in situ	Bob Keeley (presentation), Mark Bourassa/Toshio Suga (Discussion)	Document
17.30 30 mins		Joint Day wrap up	Mark Bourassa/Toshio Suga/Candyce Clark	
18.00		Meeting close.		

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