

Report to CLIVAR SSG-20

Panel or Working Group:

1. **Contributions to developing CLIVAR science and fit, where appropriate, to the CLIVAR imperatives**

One of the main contributions from GSOP to CLIVAR science is to evaluate the current generation of ocean synthesis/reanalysis products and to promote their application to study ocean circulation and its relation to climate. The evaluation has led to improved understanding about the consistency and fidelity of many aspects of ocean synthesis products (e.g., heat content, meridional overturning and related heat transport, major ocean current transports, etc.). Several papers have been published related to the evaluation and a program of further activity is underway. GSOP has now started a new initiative which aims to spin up a community effort on exploitation of ocean reanalyses, evaluation, and multi-ensemble products for ocean monitoring. Initial results have been analysed and discussed at the CLIVAR GSOP WHOI Workshop on Ocean Syntheses and Surface Flux Evaluation, which facilitated further intercomparison of synthesis products, ending as close to real time as possible, through identifying different groups to analyse different variables.

Another key activity being developed by GSOP concerns ocean-atmosphere surface fluxes. These were identified as an important cross-cutting area within WCRP, linking CLIVAR and GEWEX interests, and they can also form a useful basis for synthesis intercomparisons while engaging with a new community. The CLIVAR GSOP WHOI Workshop on Ocean Syntheses and Surface Flux Evaluation has prepared a series of recommendations that aim to improve the measurement and understanding of ocean-atmosphere surface fluxes.

GSOP has been tasked to lead the discussion on ocean climate indices. One key issue from the perspective of the global ocean observing community is the need to create a broader awareness of oceanic variability and its impact on society. There could be substantial scientific benefit to increased awareness/understanding of linkages between oceanic anomalies and existing climate indices. There has been much emphasis on 'world ocean' averages for IPCC, but regional signals are larger and merit further study. Also, low frequency signals as well as interannual and multi-annual variability can be identified in most familiar climate index time series.

There is an important need to improve the international coordination of quality-control process and management of the historical subsurface ocean datasets in order to allow climate applications such as ocean synthesis to make informed choices in how to make more effective use of these data. The CLIVAR-GSOP Coordinated Quality-Control of Global Subsurface Ocean Climate Observations Workshop, which will be hosted by CSIRO in Hobart,

2. **Briefly list any specific areas of your panel's activities that you think would contribute to the WCRP Grand Challenges as identified by the JSC at its most recent meeting¹**

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1. Provision of skillful future climate information on regional scales (includes decadal and polar predictability)
2. Regional sea-level rise
3. Cryosphere response to climate change (including ice sheets, water resources, permafrost and carbon)
4. Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity

Ocean syntheses should provide information for the assessment and attribution of regional sea level rise and its nature (e.g., the relative contributions by thermal expansion and freshwater input). Sea level change comparisons will be part of the synthesis evaluation program initiated by GSOP and GODAE-Oceanview

Ocean salinity is a key indicator of the Earth water cycle. Ocean syntheses can also be used to assess and understand changes in ocean salinity, its relation to freshwater transport and the water cycle.

Ocean synthesis products have a great potential to estimate decadal changes in the past few decades and to improve the initialization of decadal prediction.

Ocean synthesis products provide the observationally constrained estimates of the physical state of the ocean that can be used to drive ecosystem models to study, e.g., biophysical interaction in upwelling regions.

3. Key new science findings in the context of the new ocean-atmosphere CLIVAR (1-3 suggestions)

- Observation-based high-resolution products of air-sea fluxes.
- Upper-ocean heat content estimates in relation to climate variability and change.
- Satellite observations of sea surface salinity bring new understanding to coupled ocean-atmosphere variability.

4. Key science questions that you anticipate your community would want to tackle in the next 5-10 years within the context of the new ocean-atmosphere CLIVAR (1-3 suggestions)

- Decadal variability from observations and synthesis products.
- Improving initialization of decadal prediction.
- Nature of regional sea level variability and change.

5. Cooperation with other WCRP projects, other global change bodies (e.g. IGBP) and links to applications

GSOP began working with the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER), a project endorsed by IGBP, through a collaboration with the Marine Ecosystem Task Team of the Global Ocean Data Assimilation Experiment (GODAE) OceanView program. Tong Lee, GSOP co-chair, is a member of that task team working closely with marine ecosystem scientists from the IMBER community to ensure that ocean synthesis products meet the need of biogeochemistry modeling.

GSOP has also begun communicating with the CliC community on Arctic synthesis products.

GSOP has also engaged with the GEWEX community through a workshop on surface fluxes and ocean synthesis in 2012.

6. Activities in the context of scientific capacity building and career support?

Co-chair Tong Lee is working with the CLIVAR Indonesia throughflow Task Force to plan a

Capability Building Workshop in early 2014 to train students and early career researchers of Indonesia to find the right types of observations and ocean synthesis products to study the Indonesian Sea region.

7. Activities in the context of knowledge exchange with societal actors?

8. New activities being planned, including timeline, request for endorsements, potential for new funding opportunities

- After the Ocean Synthesis and Air-Sea flux evaluation Workshop GSOP will establish a working group to develop the strategy for regional heat/salt budget analysis and regional flux assessment and address the challenges of surface flux estimation. GSOP also identifies coupled assimilation that includes other components of the Earth's climate system as an important future direction and intends to foster related coupled assimilation activities, beginning with that listed below.
- A follow-on workshop is being planned for July 2013 to sustain the intercomparison activity that is underway.

9. Workshops / meetings planned

- CLIVAR-GSOP Coordinated Quality-Control of Global Subsurface Ocean Climate Observations Workshop, on 12-14 June 2013 in Hobart, Australia
- GSOP-GODAE-Oceanview Ocean Synthesis intercomparison workshop. ECMWF July 1-3 2013.
- Synthesis evaluation and coupled assimilation meeting, March 2014.
- GSOP meeting, May to June 2014, location TBD.

10. Issues for the SSG

GSOP is concerned that the five grand challenge questions do not currently accommodate a particular area that where research has become extremely active research in the past 3-4 years: ENSO diversity and its teleconnections and impacts?

CLIVAR will focus on the coupled ocean-atmosphere system in the next decade. ENSO is the strongest mode of coupled ocean-atmosphere climate variability on interannual time scales. Although ENSO per se has been an "old" problem, the diversity of ENSO and the related teleconnections and impacts are new problems that have urgent scientific questions and important societal relevance. US CLIVAR has a very active working group on this. A similar working group/task force under WCRP or International CLIVAR is also being proposed (focusing more on coupled models and mechanisms). GSOP believes that International CLIVAR should help foster these ongoing grassroots activities by incorporating ENSO diversity and its teleconnections and impacts into one of the five grand challenges questions/themes.

We agree that the grand challenges themes do not have to include everything. However, currently there no mention of interannual variability at all except for the Monsoons. This gap has also been highlighted from operational centres where seasonal forecasting is still a fundamental activity and interest, motivating some of their interactions with CLIVAR. GSOP believes that including the challenge of understanding ENSO diversity and the related impacts into grand challenge themes of CLIVAR is necessary.

Annex A

Proforma for CLIVAR Panel and Working Group requests for SSG approval for meetings

Requests should be made through D/ICPO (rogbar@noc.ac.uk), against the following headings:

1. **Panel or Working Group:** Global Synthesis and Observations Panel (GSOP)
2. **Title of meeting or workshop:** 7th GSOP meeting + Ocean Synthesis Intercomparison Workshop
3. **Proposed venue:** TBD, possibly ESRIN depending on success of European project funding requests
4. **Proposed dates:** Summer 2014
5. **Proposed attendees, including likely number:** GSOP Members, Ocean synthesis leaders and other relevant experts, including GODAE-Oceanview reps. 15-20 people.
6. **Rationale, motivation and justification, including: relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:**

Panel Aims:

- Review and consider responses to degradation of components of the global ocean observing systems (e.g., TOGA-TAO) and consider challenges of re-design (e.g., through OSSE experiments).
- As the observing systems become more integrated across disciplines, the need for coupled synthesis become more urgent. Need to look at whether GSOP needs to stimulate coordination of further coupled synthesis work.
- Improve and define joint activities with OOPC, GODAE OceanView and NASA, ESA
- Review progress on recommended actions from GSOP WHOI workshop on Surface fluxes

Intercomparison Workshop Aims:

- Review consistency of ocean synthesis products
- Review results from OSSE experiments included
- New Focus for synthesis comparisons (Surface fluxes was 1st focus), possibly aiming at regional sea level comparisons (fits with CLIVAR challenges) or regional heat budgets (consistent with new ESA CLIVAR STSE program under planning)
- Review benefits from Coupled Synthesis products

7. **Specific objectives and key agenda items:**

- Observing systems assessment
- Synthesis product evaluation and applications
- Coupled synthesis

- Renew advocacy for observing systems (e.g., in-situ system facing pressure of reduction; new satellite observing systems such as sea surface salinity from SMOS and Aquarius).
 - Improved understanding of the uncertainty in ocean synthesis products. Aim is still a white paper recommending which syntheses can be used for different purposes.
 - Strategy for encouraging development of coupled syntheses.
 - Progress on recommendations from GSOP surface flux workshop.
9. **Format:** 1.5 days for panel meeting and 2 days for synthesis intercomparison workshop
10. **Science Organising Committee (if relevant):** GSOP co-chairs and GODAE-Oceanview representatives
11. **Local Organising Committee (if relevant):** TBD
12. **Proposed funding sources and anticipated funding requested from WCRP:**
Funding for European partners at intercomparison workshop may be available through ESF COST proposal (outcome known 15th May 2013). Also possible support from ESA under STSE CLIVAR project currently under discussion. The anticipated funding requested from WCRP is USD20K, which is mainly for the travel support of panel members and ex officio members.