

Report to CLIVAR SSG-19

Panel or Working Group: Global Synthesis and Observations Panel (GSOP)

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. The issues identified and the insights gained from the evaluation will facilitate the process of improving the ocean synthesis systems. Moreover, the spread of the ensemble of ocean synthesis products also provides an estimate of envelope of uncertainty associated with the current generation of ocean synthesis products. Some multi-synthesis transport estimates have also been investigated. GSOP recognizes that the evaluation needs to be continued in a more coordinated and focused fashion. Under the auspice of GSOP, the KlimaCampus in University of Hamburg is now working towards providing available ocean syntheses in a common format to all interested researchers based on the Ocean Synthesis Directory developed by GSOP. This was especially requested by the modelling community that is looking for easy-to-use products for analysis and coupled model initialization (http://icdc.zmaw.de/easy_init_ocean.html?&L=1). In a sense it is similar to the practice of the Program for Coupled Model Diagnosis and Intercomparison (PCMDI) for IPCC model outputs.

At a joint GODAE_Oceanview_GSOP meeting in California in June 2011 the many activities related to observing system assessment and design were reviewed, which resulted in many encouraging demonstrations of the value of various observing networks (e.g., altimetry, TOGA-TAO, and Argo) in improving ocean synthesis and seasonal climate prediction. At this meeting it was agreed to facilitate further intercomparison of synthesis products, ending as close to real time as possible, through identifying different groups to analyse different variables. These would include some relevant ocean climate change metrics, which could then be presented to the wider community eg. through OOPC state of the ocean. This mechanism is going ahead with the intention now of first results being presented in a GSOP Workshop in November, see below.

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 challenges of measuring surface fluxes, along with the importance of improving them for both ocean and coupled climate modelling purposes, means that they are of great interest to both observation and synthesis communities. We therefore consider that this is an appropriate time to hold a workshop spanning 2 goals (i) to review the consistency and quality of surface fluxes estimates obtained from observational based efforts, atmospheric reanalysis, and ocean synthesis, and (ii) to continue efforts to compare other related aspects of ocean synthesis products. The WOAP Action Plan for WCRP Research Activities on Surface Fluxes published in January 2012 specifically states that "The evaluation of model-based fluxes (NWP, atmospheric and ocean reanalysis) should be seen as an aspect of the evaluation of global surface flux datasets, and handled through the establishment of specific task groups..." A workshop bringing together ocean synthesis and the observational surface flux community will therefore provide an opportunity to exchange ideas and requirements to develop air-sea flux datasets that are consistent with both global and regional constraints.

The need remains to improve the processing 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. It was originally planned to include such as activity in the GSOP workshop planned in 2012 but this has not been practical because of the need to engage with the Air sea flux community. Therefore we are proposing a small workshop for 2013 to engage the subsurface data community, data management programs and the ocean synthesis community. This OS-SCD: Ocean Sub-Surface Climate Data workshop could be held in conjunction with the joint GODAE-GSOP workshop planned for spring 2013 on Observing system evaluation and coupled data assimilation (where resources have already been secured). A proposal for this workshop is therefore attached to this report.

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

Ocean syntheses should provide information for the assessment and attribution of regional sea level rise. Sea level change comparisons will be part of the synthesis evaluation program initiated by GSOP and GODAE-Oceanview

Ocean syntheses can also be used to assess and understand changes in ocean salinity and therefore to provide a perspective on changes in water availability through changes in the regional hydrological cycle and freshwater transports in the oceans over recent decades.

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

Can coupled assimilation approaches lead to more consistent ocean and atmospheric reanalysis products with improved use of near surface data, and better initial conditions for seasonal to decadal climate forecasting?

Can reanalysis or synthesis methodologies be used to quantify, reduce or bias correct for model errors?

4. Cooperation with other WCRP projects, outside 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.

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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
5. Past and future changes in water availability (with connections to water security and hydrological cycle)
6. Science underpinning the prediction and attribution of extreme events

5. Workshops/meetings held

- GSOP-5 panel meeting, 11-13 May 2011, Grenoble, France
- Co-hosting with GODAE OceanView Workshop on Observing System Evaluation and Inter-Comparison, 13-17 June 2011, Santa Cruz, CA, USA

6. New activities being planned, including timeline

- 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.
- After the Ocean Synthesis and Air-Sea flux evaluation Workshop GSOP would seek to develop a report to summarize challenges of surface flux estimation and recommends the path towards obtaining globally consistent surface flux products that involves close collaboration between the air-sea flux and synthesis communities. In the synthesis intercomparison component of the workshop we would review the readiness of these products for a white paper on the current applications of synthesis products. These reports would be developed using the framework of Essential Ocean Variables (EOVs) as set out in the Integrated Framework for Sustained Ocean Observations (IFSOO) document following OceanObs09
- 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 April 2013 to sustain the interaction with GODAE OceanView on Observing System Evaluation and Coupled Data Assimilation
- A GSOP workshop on the processing and management of the historical subsurface ocean datasets and their application in climate and ocean synthesis activities is proposed, possibly to be held in conjunction with (before or after) the Oceanview workshop above on Observing system evaluation and coupled data assimilation. Must be held before end June 2013 to access other secured resources.

7. Workshops / meetings planned

- Ocean Synthesis and Air-Sea flux evaluation Workshop, 26th-29th November 2012, Woods Hole, USA
- GSOP-6 panel meeting, 30th November 2012, Woods Hole, USA
- GODAE OceanView/GSOP Workshop on Observing System Evaluation and Coupled Data Assimilation, April 2013, Hobart, Australia
- GSOP workshop on historical subsurface data processing and management for climate, April-June 2013, possibly in Hobart, Australia?

8. Issues for the SSG

GSOP has submitted new Terms of Reference and would seek approval or feedback on those new Terms of Reference

Given strong overlap in remit of GSOP and WCRP Data Council assurance and guidance is sought on interactions with the Council

Annex A

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

1. Panel or Working Group:

Global Synthesis and Observations Panel (GSOP)

2. Title of meeting or workshop:

- GSOP panel and community will **endorse** a meeting organized by GODAE Oceanview in Hobart Australia in April 2013 on Observing System Evaluation and Coupled Data Assimilation. No financial support is requests for this meeting.
- **GSOP workshop proposal OS-SCD: Ocean Sub-Surface Climate Data:** A coordinated effort to develop a high-quality historical ocean subsurface global data set for climate research needs. Case set out below

3. Proposed venue:

Possibly CSIRO, Hobart, Australia (or any other agreed location)

4. Proposed dates:

April 2013 or any date before 30th June 2013

(Possible suggestion: a week before or after the GODAE Oceanview meeting on Observing System Evaluation and Coupled Data Assimilation in April/Hobart, co-sponsored by CLIVAR)

5. Proposed attendees, including likely number:

GSOP panel members

Core group members from major international data centres:

- USA: NODC/NOAA (Boyer et al.)
- UK: MetOffice (Good, Palmer)
- Japan: JAMSTEC (Ishii et al.)
- Germany: KlimaCampus (Stammer, Gouretski)
- Australia: CSIRO/ACE CRC/UNSW (Cowley, Wijffels, Thresher, Domingues, Bindoff, McDougall)

Other potential attendees:

- Eric Lindstrom (NASA)
- Charles Sun (NODC/NOAA)
- Thierry Carval (IFREMER/Coriolis), Loic Petit de la Villion
- Data council representatives

-Other Data Centres, researchers/technical staff with the relevant expertise to contribute to the project (background on data/metadata archaeology; automated and manual quality control systems; data and gridded products delivery)

Total number: 20-30 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:

Justification for one-off workshop:

To facilitate the coordination of an international collaborative project proposal with the objective of maximising the quality and consistency of the historical ocean subsurface temperature data to meet the demanding standards of climate-related applications including Ocean and Coupled model Synthesis.

Rationale, motivation and justification for project proposal:

A core group, with representatives from five major data centres (please see list below), have agreed to participate in a coordinated effort to deliver the most complete and highest quality ocean temperature observations possible, along with metadata and proper error measurements. This new higher quality data will provide the foundation for the development of more accurate instrumental (XBT/MBT) bias corrections; performance metrics to evaluate climate models; key indicators for monitoring global/regional climate variability and change; data assimilation/reanalyses efforts; ocean model initializations; multi-disciplinary (observational and modelling) climate research, including detection and attribution studies. If funding permits, we plan to include/examine salinity observations and provide gridded products tailored to user requirements.

Boyer/Levitus – NODC/NOAA, USA

Ishii et al. - JAMSTEC, Japan

Good/Palmer – MetOffice, UK

Stammer/Gouretski – KlimaCampus, Germany

Wijffels/Thresher/Cowley – CSIRO & Domingues/Bindoff – ACE CRC, Australia

Currently, we all believe there is duplication of efforts, for example, most of the groups largely source the ocean temperature data from the World Ocean Database (NODC-WOD) and then apply their own automated quality control (QC) & data assembling procedures. In addition, all these different efforts are not necessarily producing the best quality/consistent long term records possible. There is a strong consensus among us that, if we are to fully meet climate requirements for the historical ocean subsurface observations in a relatively short period of time, we need to move from the current and independent automated quality control practices to a unified and more effective system based on a semi-automated approach. This new path is only possible if there is a coordinated effort between the major data centres.

Two of the major benefits of a semi-automated approach are:

- (i) A very effective method for eliminating bad data from the historical temperature archive (>95%) and nearly all profiles are unique (e.g., duplicates elimination). This estimate is based on a pilot study in which the semi-automated approach of Wijffels and Gronnell (J. Atm. Oc. Tech., 2008) removed more than 95% of the bad data in the historical archive of the Indian Ocean. In other words, their semi-automated approach removed about 15% of the total 16% of bad historical data found in the Indian Ocean (the 16% benchmark was based on a fully manual QC).
- (ii) It is a one-off process (e.g., no need to QC same profile over and over). So, once the historical archive is quality-controlled, we will only need to QC newly discovered data that will be incorporated into the archive.

Overall plan:

- (1) To get a workshop organised in early 2013 so all people involved from the various data centres can meet and discuss/agree on the scope/details of the project, and thus to facilitate the preparation of a scientific/implementation plan.
- (2) To have a scientific and implementation plan endorsed by CLIVAR.
- (3) To submit our project proposal (endorsed by CLIVAR) to the relevant individual government agencies to get funds and start doing the work.

7. Specific objectives and key agenda items:

Draft workshop agenda items

1.5 day for a comprehensive overview and discussions of the handling/processing of subsurface ocean temperature (salinity) archives by each data centre – from acquisition, quality control methodology, recovery/inclusion of metadata information, measurement error assignments, delivery of data bases and gridded products, to user requirements. (Presentation talks + Q&A sessions)

1.5 day for discussions to define the scope, methodological details and timeline of the project; to coordinate an outline for the science and implementation plan of the project proposal to be submitted for CLIVAR endorsement; to set up the sharing and timeline for the writing and reviewing tasks of the project proposal.

8. Anticipated outcomes (deliverables):

A meeting report summarizing presentations and session discussions held during the workshop.

A science and implementation plan proposal to be submitted for CLIVAR endorsement.

9. Format:

3-day workshop (presentation talks, Q&A sessions, and discussion sessions)

10. Science Organising Committee (if relevant)

Catia Domingues and Matt Palmer (GSOP panel members)

Tim Boyer, Sidney Levitus (NODC, NOAA, USA)

Masayoshi Ishii (JAMSTEC, Japan)

Simon Good (MetOffice, UK)

Susan Wijffels, Ann Thresher and Rebecca Cowley (CSIRO, Australia)

Detlef Stammer and Viktor Gouretski (KlimaCampus, Univ. Hamburg, Germany)

11. Local Organising Committee (if relevant)

Catia Domingues (ACE CRC), Rebecca Cowley (CSIRO)

Nico Caltabiano (ICPO)

Logistical support team (from ACE CRC and/or IMAS-UTAS)

12. Proposed funding sources and anticipated funding requested from WCRP:

- US\$15K from WCRP towards supporting travelling costs for attendees from US, Europe and Asia).
- US\$15K from CSIRO Wealth from Oceans Flagship, conditional to workshop being held before 30th June 2013 (end of Australian financial year). Contact: Dr Susan Wijffels
- The organizing committee has potential source funding from the Australian Research Council Centre of Excellence for Climate System Science (ARC CoE), the Institute for Marine and Antarctic Studies, University of Tasmania (IMAS-UTAS), and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC). ARC CoE and IMAS-UTAS support for a workshop in Hobart, Melbourne or Sydney; exchange visits (via the ARC CoE) for one or two international scientists; ACE CRC participation/travel support for Catia Domingues. Contact: Dr Nathan Bindoff.
- The KlimaCampus, University of Hamburg, will provide travel support for Viktor Gouretski and/or Detlef Stammer. Contact: Dr Detlef Stammer.
- The organizing committee will also look for other sources of funding (e.g., US CLIVAR).