Report to CLIVAR SSG-20

Panel or Working Group: WGOMD

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

Coordinated Ocean-ice Reference Experiments (COREs) were proposed by WGOMD as a venue for comparing global ocean – sea-ice models run under a common prescribed atmospheric state, with boundary fluxes computed via the same bulk formulae. The second phase of COREs, CORE-II, uses inter-annually varying atmospheric forcing over the 60-year period from 1948 to 2007. In the oceanographic community, the CORE-II simulations are usually referred to as hindcast experiments. These hindcasts provide a framework to evaluate ocean and sea-ice model performance and study mechanisms of time-dependent ocean phenomena and their variability from seasonal to decadal time scales for the recent past. Specifically, we believe that the CORE-II hindcast experiments directly contribute to: i) evaluation, understanding, and improvement of the ocean components of earth system models; ii) investigation of mechanisms for seasonal, inter-annual, and decadal variability; iii) attribution of ocean-climate events to trends and forced and natural variability; iv) evaluation of robustness of mechanisms across models; and v) bridge observations and modeling, by complementing ocean reanalysis from data assimilation approaches. Finally, the CORE-II hindcast simulations can provide consistent ocean and sea-ice initial conditions for decadal prediction experiments. We are extremely pleased to have participation from eighteen modeling groups in this CORE-II effort. The CORE-II website (www.clivar.org/wgomd/core/core-2) has been developed to serve the community with information on how to participate in analysis of these CORE-II experiments. A special issue of Ocean Modelling will be produced in late 2014, and the CORE-II website is being advertised as part of the special issue announcement.

The following multi-model analyses are currently underway:

- North Atlantic Simulations with a focus on the Atlantic meridional overturning circulation, Part I: Mean States; Part II: Variability,
- Global and Regional Sea Level,
- Arctic Ocean and sea-ice,
- The Antarctic Circumpolar Current and Southern Ocean Overturning Circulation with a focus on eddy compensation,
- The Evolution of Southern Ocean Water Masses and ventilation,

Two additional planned studies will focus on the South Atlantic states and representation of ocean circulation in temperature and salinity space, respectively. We plan to actively promote the use and analysis of the CORE-II solutions. Other coordinated analysis efforts are encouraged from the CLIVAR community, particularly with a focus on the Pacific and Indian Ocean basins. The data (and potentially plotting / diagnostics tools) are freely available. NCAR has agreed to host and curate the dataset on its ESGF node and is currently testing the service with the NCAR datasets. Information will be available soon on how to access the centralized dataset via the CORE-II website. In the meantime, people can contact the individual modeling groups to obtain the data.

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 meeting[1]

- Provision of skillful future climate information on regional scales (includes decadal and polar predictability)
- Regional sea-level rise
- Cryosphere response to climate change (including ice sheets, water resources, permafrost and carbon)
- Science underpinning the prediction and attribution of extreme events.

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

CORE-II hypothesis that solutions of models forced with the same atmospheric forcing data will be the same has been shown not to hold as evidenced by the differences in model solutions among the models. These differences do not suggest an obvious grouping of the models based on their ocean model lineage, their vertical coordinate representations, or surface salinity restoring strengths. Thus, the solution differences among the models are attributed primarily to use of different subgrid scale parameterizations and parameter choices as well as to differences in horizontal and vertical grid resolutions in the ocean models. Use of a wide variety of sea-ice models with diverse snow and sea-ice albedo treatments also contributes to these differences. These CORE simulations have already served the ocean modeling community well, helping various modeling groups in evaluations of their models. They are also being used in mechanism analysis, for example regarding AMOC 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)

- Continue to address model biases and improve model physics, also considering biogeochemistry and ecosystems
- High resolution modeling and regional / coastal modeling
- Sea level and interactions with ice sheets
- Atlantic meridional overturning circulation and role of ocean in decadal variability
- Operational oceanography and data assimilation

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

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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

WGOMD interacts with the following activities:

- U.S. CLIVAR AMOC Program
- Arctic Ocean Model Intercomparison Project (AOMIP)
- WCRP Global Modeling (WGCM, WGSIP, WGNE, Climate Model Metrics Panel)
- CLIVAR Atlantic Implementation Panel (AIP)

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

The WGOMD and SOP jointly organized the WGOMD / SOP workshop on Sea-Level Rise, Ocean / Ice-Shelf Interaction, and Ice Sheets. The workshop was held on 18-20 February 2013, Hobart, Australia. 15 early career scientists (ECSs) were awarded funding to attend the meeting based on merit of their contributions (poster and oral presentations). The meeting oral agenda was carefully prepared balancing plenary, overview talks with shorter talks by ECSs on key state of the art findings (11 talks out of the total 23 were given by ECSs).

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

We expect that the WGOMD will be quite busy analyzing the present CORE-II solutions untill early next year. In the meantime, we are planning some new activities. A specific example is forcing ocean models with a partial coupling approach where an interactive atmosphere model is employed – thus allowing feedback – with some forcing components overwritten or controlled. Another example is high-resolution (eddy-permitting / eddy-resolving) ocean modeling as many groups are considering such high-resolution simulations as the computational resources become more available. There are many associated issues such as how to design scale-aware parameterizations.

9. Workshops / meetings planned

With the recent increases in computational power, more and more modeling groups are conducting high-resolution ocean-only and / or coupled simulations. Most of these activities appear to be quite independent despite the fact that groups are encountering very similar challenges and trying to come up with similar solutions. To foster collaboration between these groups and expedite progress, the WGOMD is planning to hold a small-scale workshop on high-resolution ocean modeling, bringing interested scientist together. We plan to have our 12th session panel meeting in conjunction with this workshop.

10. Issues for the SSG

<u>Membership</u>

The following is the status of the current WGOMD membership.

G. Danabasoglu (co-chair) (2014)	NCAR, USA
H. Drange (co-chair) (2014)	University of Bergen, Norway
E. Curchitser (2013)	Rutgers University, USA
M. Winton (2014)	GFDL/NOAA, USA
S. Marsland (2014)	CSIRO-ACCESS, Australia
H. Tsujino (2014)	MRI, Japan
D. Holland (2013)	Courant Institute, USA
K. Fennel (2013)	Dalhousie University, Canada
G. Nurser (2013)	National Oceanography Center, UK
H. Johnson (2014)	University of Oxford, UK

K. Fennel – due to rotate off. Suggested replacement is Galen McKinley (U. Wisconsin-Madison, USA).

H. Tsujino – due to rotate off. Suggested replacement is Yoshiki Komuro, JAMSTEC, Japan.

Open position: NEMO representative. We have been quite actively searching for a qualified person to represent the NEMO modelling efforts for more than a year to replace G. Madec. At our panel meeting, Julien Le Sommer (MEOM / LGGE) was suggested as a possibility.

Open position: Operational / data assimilation modelling community representative. It has proven difficult to find a candidate for this position. However, at our panel meeting, Simona Masina from CMCC, Italy, was suggested as a possibility.

WGOMD seeks one additional new member to represent ocean model development activities in China in light of the recent progress in ocean modelling in the country.

We have not contacted any of the suggested names yet.

Concern about the new CLIVAR structure

There was unanimous concern with the implications of the proposed new CLIVAR structure. Specifically, the WGOMD members strongly thought that it is essential for our working group to meet on a regular and frequent basis (every 12-14 months) to accomplish our work plan. It was pointed out that the successful CORE efforts would not be possible under the new CLIVAR structure. Having the WGOMD panel meetings every 2.5 – 3 years or so was seen as a major obstacle for close collaboration and synergy between the working group members, which are essential for success. To be clear and to re-stress, the initiative-driven meetings can still go on, but the WGOMD is strongly in favor of meeting on a frequent basis. One suggestion is to make a distinction between panels and working groups in the new CLIVAR structure, reflecting more of an advisory role of the panels.

Communication of modeling activities and issues both within and outside of CLIVAR

The WGOMD co-chairs or designated members have been and will be attending the WGCM and WGSIP panel meetings as well as the WCRP Modelling Advisory Council

(WMAC) meetings to the extent possible. In these meetings, in addition to the WGOMD activities, we are expected to present the broader CLIVAR modeling community and related activities and issues. Regardless of the CLIVAR structure, it is important that the WGOMD is kept abreast of modeling activities and issues – that need broader attention or input – of the CLIVAR community either coming from the panels or associated with grand challenge activities. To improve this particular communication branch and to provide a forum for CLIVAR to follow modeling related issues both within and outside CLIVAR, we suggest that a web page or a bulletin board should be established. This venue can also be used to post or link the WGCM, WGSIP, and WMAC meeting reports to provide a one-stop shop for CLIVAR to ensure information flow occurs efficiently from these external groups to any interested groups or people within CLIVAR. Similarly, outside groups can follow such web pages as well.

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:

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1. **Panel or Working Group:** WGOMD
2. **Title of meeting or workshop:** High Resolution Ocean Modeling Workshop and 12th Session of the WGOMD panel
3. **Proposed venue:** Princeton or somewhere in Europe (easy access)
4. **Proposed dates:** Spring 2013
5. **Proposed attendees, including likely number:** Key high resolution ocean modelling communities. The idea is to keep the meeting relatively small for useful information exchange. About 50 participants.
6. **Rationale, motivation and justification, including: relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:**

With the recent increases in computational power, more and more modeling groups are conducting high-resolution ocean-only and / or coupled simulations. Most of these activities appear to be quite independent despite the fact that groups are encountering very similar challenges and trying to come up with similar solutions. It is important to foster collaboration between these groups to expedite progress. High resolution modeling is needed for many scientific and societal applications, including regional climate information regarding sea level and extremes as well as decadal prediction efforts.

7. **Specific objectives and key agenda items:** Improved high resolution ocean modeling; expedited progress; improved communication; addressing common problems; progress towards scale-aware parameterizations
8. **Anticipated outcomes (deliverables):** as in item #7.
9. **Format:** Less talk, more work. We envision a truly workshop oriented format keeping the participation to a small number.
10. **Science Organising Committee (if relevant)** WGOMD
11. **Local Organising Committee (if relevant)**
12. **Proposed funding sources and anticipated funding requested from WCRP:** We plan to seek funding from multiple sources.