

Ocean Model Development Panel

Baylor Fox Kemper, baylor@brown.edu
Julien Le Sommer, julien.lesommer@univ-grenoble-alpes.fr

Panel overview

1-2 paragraphs background with a summary of panel current main mission and 2019-2020 activities and obstacles, if any.

The key roles for the Ocean Model Development Panel in CLIVAR and WCRP are to: (i) Collaborate with and to advise other CLIVAR panels and Research Foci Teams on issues related to ocean modelling; (ii) Coordinate activities aimed at addressing modelling needs (e.g., experimental protocols and analysis methods), especially to identify and address model biases (e.g., eastern boundary upwelling), improve ocean process representation and parameterizations, and (iii) address other issues impeding progress of CLIVAR core activities, research foci, and WCRP Grand Challenges.

OMDP has been pushing forward the development of ocean circulation model through identifying the challenges and prospects in ocean circulation models (Fox-Kemper et al. 2019; Griffies et al. 2010), organizing the Co-ordinated Ocean-Ice Reference Experiments (CORE-I and CORE-II) and the newest variants, the Ocean Model Intercomparison Projects (OMIP-1 and OMIP-2). The panel was involved in the coordinated development of forcing datasets: CORE-I (Large & Yeager, 2004), CORE-II (Large & Yeager, 2009), and now JRA55-do (Tsujiro et al. 2018). Since last year, OMDP has built protocols for comparing ocean-sea ice models at high-resolution and low resolution (Chassignet et al., 2020), and protocols for comparing ocean model parameterizations, (Li et al., 2019). Based on these protocols and previous successes, OMDP will continue leading the ocean model community to engage in intercomparison of model resolution and parameterizations, and other aspects of ocean models.

Membership Update

Two members rotated off: Todd Ringler (LANL, USA), Ivonne Montes (Instituto Geofísico del Perú, Peru).

Five members were invited to be the Emeritus/Emerita: Simon Marsland (CSIRO, Australia), Enrique Curchitser (Rutgers University, USA), Mats Bentsen (University of Bergen, Norway), Fangli Qiao (FIO, China), Helene Hewitt (Met Office, UK).

Eight new members: Adele Morrison (ANU, Australia), Luke Van Roekel (LANL, USA), Qiang Wang (AWI, Germany), Zhao Jing (OUC, China), Arne Biastoch (GEOMAR, Germany), Laure Zanna (NYU, USA), Julie Deshayes (CNRS, France), Doroteaciro Iovino (CMCC, Italy)

Achievements for 2019-2020

- Workshops

Future Directions in High-resolution Ocean Modelling, Kiel, Germany, postponed to 2021 because of COVID-19.

- Scientific results from activities
 - i) Protocol of OMIP-1 (CORE) – OMIP-2 (JRA55-do) comparison, and the comparison results (Hiroyuki et al., 2020)
 - ii) Protocol of OMIP-2 high-resolution vs. low-resolution model comparison, and the comparison results (Chassignet et al. 2020)
 - iii) Assessment of 1D modeling using the GOTM/CVMix framework.
 - iv) Discussion of SWOT Adopt-a-Crossover
- Scientific capacity building and career support

The co-chairs have aggressively pursued nominations for consideration by the SSG. The emphasis on early-career, gender and geographic representation, and disciplinary scope has been much higher than in the recent few years during the co-chair transitions. In 2020 OMDP recruits 8 new members. Four out of them are female and most are young scientists.
- Knowledge exchange
 - i) CLIVAR Exchanges/US CLIVAR Variations : A joint special edition on Sources and Sinks of Ocean Mesoscale Eddy Energy, Doi: 10.5065/g8w0-fy32
 - ii) Plan to communicate more with the CLIVAR regional panels and will contribute its expertise to WCRP Lighthouse Activities and other WCRP new core projects.

Plans for 2021 and beyond

- i) Workshop on Future Directions in High-resolution Ocean Modelling, 29.9.-1.10.2021, Kiel, Germany,
- ii) OMDP-6, 28. 9, Kiel, Germany
- iii) Scientific plan (each of these has a panelist team leader and a slack channel, many map directly onto lighthouse activities as mentioned in our lighthouse activity survey):
 - a) Ongoing:
 - 1) JRA55-do vs. CORE II, 1D mixing comparison and ocean & climate model impact
 - 2) A hires OMIP study on ML in forced vs coupled
 - 3) A group to discuss comparison of hires OMIP-2 runs from a eddy statistics perspective: cf SWOT AdAC, eddy-statistics, energy fluxes
 - 4) A study on the Arctic in highres OMIP-2
 - 5) A lores+hires OMIP-2 study on North Atlantic Current biases versus model formulation
 - 6) Ocean-only future climate forcing for lores & hires
 - b) Exploration Stage, Planned for Followup at May Meeting:
 - 7) A hires OMIP study on T&S characteristics in the subpolar North Atlantic
 - 8) Automated extension of JRA55-do
 - 9) Spin up time of a variety of models

We are exploring collaborations on some of these topics with WGNE and COMMODORE.

Articles published in 2019/20 as part of panel activities (if any)

Tsujino H, Urakawa L S, Griffies S M, et al. Evaluation of global ocean–sea-ice model simulations based on the experimental protocols of the Ocean Model Intercomparison Project phase 2 (OMIP-2)[J]. *Geoscientific Model Development*, 2020, 13(8): 3643-3708.

Li Q, Reichl B G, Fox-Kemper B, et al. Comparing ocean surface boundary vertical mixing schemes including Langmuir turbulence[J]. *Journal of Advances in Modeling Earth Systems*, 2019, 11(11): 3545-3592.

Chassignet E P, Yeager S G, Fox-Kemper B, et al. Impact of horizontal resolution on global ocean–sea ice model simulations based on the experimental protocols of the Ocean Model Intercomparison Project phase 2 (OMIP-2)[J]. *Geoscientific Model Development*, 2020, 13(9): 4595-4637.

Budget and other needs for 2021

Please keep in mind that the overall budget of CLIVAR is limited and this needs to be distributed between all activities and the SSG meeting.

Since the Kiel workshop and OMDP-5 were postponed to 2021, we request to carry forward the 2020 funds agreed for OMDP into 2021, which is 5000\$.

Aim for a total length of ~2 pages, more is fine, but not necessary

Annex A

Proforma for CLIVAR Panel requests for SSG approval for meetings

Note: If your group has approved funds in 2020 that were not used because of Covid19, and you propose to use them in 2021, they should be included again in this request, in addition to any new request.

1. **Panel name:** Ocean Model Development Panel
2. **Title of meeting or workshop:** The 6th session of OMDP and the workshop on future directions of high resolution ocean models.
3. **Proposed venue (Or indicate if online):** Kiel Germany (GEOMAR hosting)
4. **Proposed dates: 28 September – 1 October, 2021**
5. **Proposed attendees, including likely number:**

Attendees will be part of the panel members (around 10) and some invited and/or early career speakers. It is expected that 50-100 other participants will join with their own funds for the concurrent workshop.

6. **Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Grand Challenges, and any cross-panel/research foci links and interactions involved:**

Ocean Model development panel will have the 6th panel meeting in 2020, discussing membership issues, the ongoing papers about the OMIP-1 (CORE) – OMIP-2 (JRA55-do) comparison, especially focusing on high-resolution vs. low-resolution issues. This workshop will have direct relevance to

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

The aim of this workshop is to address such questions and to provoke further research and collaborations. The focus will be on the realistic representation of the eddy ocean and its interannual to decadal variability in forced basin and/or global ocean-sea ice models as well as in coupled climate models, with the ocean models utilizing spatial resolutions sufficient to admit a vigorous transient mesoscale eddy field. We particularly invite contributions linking observations and reanalysis products with models. Studies furthering the understanding of ocean physics as a driver of biogeochemical processes are also welcome.

A draft workshop description is attached to this annual report.

8. **Anticipated outcomes (deliverables):**

A meeting report and collaborative papers for peer-reviewed literature are the intended outcomes. Breakout sessions will be included and consensus documents from those sessions will inform these documents.

9. Format: One day panel meeting plus one to three day workshop.

10. Science Organizing Committee (if relevant)

Arne Biastoch and Torge Martin (GEOMAR), Helene Hewitt (UK MetOffice), Anne-Marie Treguier (CNRS), Stephen Griffies (NOAA-GFDL), Gokhan Danabasoglu (NCAR), Baylor Fox-Kemper (Brown University)

11. Local Organizing Committee (if relevant) Arne Biastoch, Markus Scheinert, Torge Martin, Nikole Lorenz

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

~\$5000 to support travel costs for some panel members and attendees.

Annex B Description of the Kiel workshop
Future Directions in Basin and Global Mesoscale-Eddying Ocean Modeling
This workshop has been endorsed by CLIVAR

Ocean models are an integral part of today's ocean and climate research. Over the past decade, there has been increasing use of mesoscale-eddy ocean models for studies of ocean variability on seasonal to decadal timescales, based on the success of forcing products like CORE, DRAKKAR, and JRA55-do. These eddy simulations provide a direct link to observations and serve as a basis for biogeochemical studies. While forced ocean-only models are used for such hindcasts and state estimates, coupled climate models are used to separate internal (natural) variability from external variability and anthropogenic warming trends. To merge the benefits of these different approaches, there is a need for joint evaluation of recent advances in physical processes and numerical methods.

Advances in high-resolution ocean modelling provide opportunities but also challenges for simulating the ocean climate system, particularly with the growing availability of observational measures. A selection of related questions are:

- How robust is the decadal variability among hindcasts as compared to observational measures?
- How do modelling strategies regarding spinup, grid resolution (mesoscale to submesoscale), physical parameterizations, and numerical methods affect model drift and robustness of results?
- Are there additional processes critical to explicitly resolve, such as the submesoscale, internal and surface gravity waves, and tides, along with their feedbacks with the atmosphere and the cryosphere?
- Is it critical to make the step from ocean-only hindcasts to coupled simulations to separate internal variability from external variability and anthropogenic climate warming?

A workshop addressing challenges and future directions in high-resolution ocean modeling will be held in Kiel, Germany, on October 7-9, 2020 hosted by GEOMAR.

The aim of this workshop is to address such questions and to provoke further research and collaborations. The focus will be on the realistic representation of the eddy ocean and its interannual to decadal variability in forced basin and/or global ocean-sea ice models as well as in coupled climate models, with the ocean models utilizing spatial resolutions sufficient to admit a vigorous transient mesoscale eddy field. We particularly invite contributions linking observations and reanalysis products with models. Studies furthering the understanding of ocean physics as a driver of biogeochemical processes are also welcome.

During the workshop, we will celebrate the achievements and contributions of Prof. Claus Böning to ocean science and numerical ocean modelling. Claus will retire in autumn 2020.

Scientific steering committee: Arne Biastoch and Torge Martin (GEOMAR), Helene Hewitt (UK MetOffice), Stephen Griffies (NOAA-GFDL), Gokhan Danabasoglu (NCAR), ?Baylor Fox-Kemper (Brown University), ?Anne-Marie Treguier (IFREMER)

Local organizing committee: Arne Biastoch, Markus Scheinert, Torge Martin, Nikole Lorenz (all GEOMAR),