Ocean Model Development Panel (OMDP)

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OMDP overview

We are happy to report that we completed two of our primary efforts. The first concerns the documentation and benchmarking of solutions from forced global ocean – sea-ice hindcast simulations from over 20 groups participating in the Coordinated Ocean-ice Reference Experiments phase II (CORE-II) project. This effort produced 9 manuscripts published in a Virtual Special Issue of Ocean Modelling devoted to CORE-II which can be found at

http://www.sciencedirect.com/science/journal/14635003/vsi/10PSR6J3BV4

We note that the CORE-II effort is the most successful coordinated global ocean – sea-ice project ever, and is widely recognized as the community standard for such simulations. It has become a rite-of-passage as the modeling groups compare their solutions to those provided as benchmarks in the Special Issue.

The second completed effort involves defining and formalizing the Ocean Model Intercomparison Project (OMIP) – an endorsed project of the Coupled Model Intercomparison Project phase 6 (CMIP6). OMIP aims to provide a framework for evaluating, understanding, and improving the ocean and sea-ice components of global climate and earth system models contributing to the CMIP6, building upon the CORE-II foundations. OMIP addresses these aims in two complementary manners: i) by providing an experimental protocol for global ocean – sea-ice models run with a prescribed atmospheric forcing, and ii) by providing a protocol for ocean diagnostics to be saved as part of CMIP6. The physical component of OMIP is described in Griffies et al. (2016). A companion paper by Orr et al. (2017) covers the details for the simulations with inert chemistry and interactive biogeochemistry which are now included within OMIP.

As indicated in our 2016 Annual Report, OMDP has undertaken substantial work to replace the existing CORE-II datasets, by creating a new and improved version of the atmospheric forcing datasets based on the JRA-55 (Japanese Re-Analysis) reanalysis product from the Japanese Meteorological Agency (JMA). This heroic effort has been led by Hiroyuki Tsujino from the JMA Meteorological Research Institute, involving many OMDP members and colleagues. The JRA-55 product meets a set of desired features such as high spatial (55 km) and temporal (3 hourly) resolution of the data and, in particular, commitment of the JMA to provide continuous updates. We are very pleased to announce that what we believe is the final version (1.3) of the dataset for use by the broader community has just been produced. This dataset will be referred to as JRA55-do (driving ocean) and will be made available to the community by the end of 2017 after some preliminary evaluation by OMDP. We note that the data production method of JRA55-do essentially follows that of the CORE-II dataset. Specifically, the surface fields taken from JRA-55 are adjusted relative to reference datasets. To improve the adjustment method, high-quality products derived from satellites

and from several other atmospheric reanalysis projects are used, and feedback on the CORE-II dataset from the ocean-modelling community are also considered. Presently the dataset extends from 1958 to 2016, with updates expected monthly. The details of the adjustments to the original reanalysis product, the scientific rationale for these adjustments, and an evaluation of JRA55-do are provided in Tsujino et al. (2018).

Achievements for 2016-17

- The 4th Session of OMDP, 09-12 October 2017, UK Met Office, Exeter, UK. This meeting was in conjunction with the Pan-WCRP Modeling Meeting.
- Expansion of ocean modelling community engagement with the JRA55-do product
- Completion of the *Ocean Modelling CORE-II Virtual Special Issue* with 9 publications available at www.sciencedirect.com/science/journal/14635003/vsi/10PSR6J3BV4
- Completion of the ocean model protocols for CMIP6 OMIP led by Steve Griffies.

Plans for 2018 and beyond

We anticipate that the new forcing datasets will be available to the modeling community by the end of 2017. As the solutions from the OMIP simulations become available during 2018 and beyond, the OMDP will actively guide / help with / advocate as wide use of the ocean model output fields as possible. We also plan to coordinate eddy-resolving / -permitting resolution forced ocean – sea-ice hindcast simulations and their analysis akin to our CORE-II effort as many modeling groups adventure into high-resolution regimes. As in the past, the OMDP will continue to coordinate, lead, and/or help with various activities related to addressing persistent model biases and numerical and physical model developments and communicate with the CLIVAR panels and Research Foci teams regarding their ocean modeling activities and needs.

Articles published in 2016/17 as part of panel activities (if any)

Griffies, S. M., G. Danabasoglu, P. J. Durack, A. J. Adcroft, V. Balaji, C. W. Böning, E. P. Chassignet, E. Curchitser, J. Deshayes, H. Drange, B. Fox-Kemper, P. J. Gleckler, J. M. Gregory, H. Haak, R. W. Hallberg, P. Heimbach, H. T. Hewitt, D. M. Holland, T. Ilyina, J. H. Junglaus, Y. Komuro, J. P. Krasting, W. G. Large, S. J. Marsland, S. Masina, T. J. McDougall, A. J. G. Nurser, J. C. Orr, A. Pirani, F. Qiao, R. J. Stouffer, K. E. Taylor, A. M. Treguier, H. Tsujino, P. Uotila, M. Valdivieso, Q. Wang, M. Winton, and S. G. Yeager, 2016: OMIP contribution to CMIP6: experimental and diagnostic protocol for the physical component of the Ocean Model Intercomparison Project. *Geosci. Model Dev.*, **9**, 3231-3296, doi: 10.5194/gmd-9-3231-2016.

Orr, J. C., R. G. Najjar, O. Aumont, L. Bopp, J. L. Bullister, G. Danabasoglu, S. C. Doney, J. P. Dunne, J.-C. Dutay, H. Graven, S. M. Griffies, J. G. John, F. Joos, I. Levin, K. Lindsay, R. J. Matear, G. A. McKinley, A. Mouchet, A. Oschlies, A. Romanou, R. Schlitzer, A. Tagliabue, T. Tanhua, and A. Yool, 2017: Biogeochemical protocols and diagnostics for the CMIP6 Ocean Model Intercomparison Project (OMIP). *Geosci. Model Dev.,* **10**, 2169-2199, doi: 10.5194/gmd-10-2169-2017.

Tsujino, H., S. Urakawa, H. Nakano, R. J. Small, W. M. Kim, S. G. Yeager, G. Danabasoglu, W. G. Large, S. A. Josey, T. Suzuki, Y. Komuro, D. Yamazaki, S. M. Griffies, H. Tomita, M. Valdivieso, S. J. Marsland, and F. B. Dias, 2018: JRA-55 based surface dataset for driving ocean – sea-ice models (JRA55-do). *Ocean Modelling* (in preparation).

Budget and other needs for 2018

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.

Annex A

Proforma for CLIVAR Panel requests for SSG approval for meetings

1. **Panel or Working Group:** Ocean Model Development Panel (OMDP)
2. **Title of meeting or workshop:** Workshop on Sources and Sinks of Ocean Mesoscale Eddy Energy / The Fifth Session of the OMDP
3. **Proposed venue:** Tallahassee, Florida, USA
4. **Proposed dates:** March - April 2019
5. **Proposed attendees, including likely number:** Ocean and climate modeling scientists interested in eddy-resolving / -permitting ocean modeling, air-sea interactions at these scales, and related mechanisms. Order 100 participants.
6. **Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Grand Challenges, and any cross-panel/research foci links and interactions involved:** The purpose of the workshop is to review the current understanding of mesoscale eddy-mediated exchanges of kinetic energy in the global ocean in order to guide their representation in future mesoscale eddy permitting ocean model components of earth system models. Ocean mesoscale eddies are the main oceanic reservoir of mechanical energy as well as an important energy reservoir in the climate system. However, because the earth climate system is a forced dissipative system, the ability of earth system models to estimate the long-term evolution of climate is constrained by how mechanical energy is dissipated in earth system models. Realistic representations of eddy-mediated energy exchanges in ocean circulation models are very important to obtain reliable estimates of future climate projections. Over recent years, observations and theory have documented several new eddy-mediated energy exchanges mechanisms. These include interactions with submesoscales, internal waves, boundary processes, surface winds, and surface waves. However, these processes are not yet fully represented in ocean circulation models so that eddy-mediated energy exchanges are still inadequately accounted for in these models. Arguably, the representation of eddy-mediated energy exchanges could be a key source of uncertainty in future earth system models. Due to these science aspects, we believe that this workshop is highly relevant to CLIVAR and WCRP science, including various basin panels, RFs, and GCs.
7. **Specific objectives and key agenda items:** The specific objectives of the workshop include i) to review recent theoretical and observational advances on the understanding of eddy-mediated mechanical energy exchanges; ii) to identify future observations that could contribute to better constrain our estimation of these exchanges; and iii) to guide the representation of these exchanges in ocean circulation models through physical parameterizations. Anticipated key agenda items include interaction of balanced mesoscale eddies with submesoscale flows in the surface ocean; status of sub-grid-scale closures for eddying models; interaction between

balance mesoscales and the internal wave field; mesoscale eddy dissipation along boundaries (bottom and lateral); and key future sources of observations.

8. **Anticipated outcomes (deliverables):** Information exchange among participants; CLIVAR Exchanges Special Issue to broadly and quickly disseminate the current state of science.
9. **Format:** Workshop format will be determined by its Scientific Organizing Committee. Workshop is anticipated to be for 2-2.5 days, followed by a 2-day OMDP session.
10. **Science Organising Committee (if relevant)** OMDP members
11. **Local Organising Committee (if relevant)** Eric Chassignet, Florida State University
12. **Proposed funding sources and anticipated funding requested from WCRP:** US CLIVAR Inter-Agency Group (IAG); CLIVAR