CESM Ocean Model Working Group (OMWG) Winter Meeting Summary
15 May 2014

The CESM OMWG Winter Meeting was held at NCAR on January 16-17, 2014. The meeting was well-attended, with good talks and fruitful follow-up discussions. To continue our collaborations with the CESM Biogeochemistry Working Group (BGCWG) in addressing ocean model biases, we again had representation and presentations from the ocean-focused members of the BGCWG.

The presentations covered a wide range of topics that included updates on various model simulations (fully-coupled, forced ocean, etc.) and model development and data assimilation efforts, spin-up issues with CAM5, fast spin-up of tracers, and ocean acidification. Some of these talks again highlighted deficiencies of our ocean model (POP; Parallel Ocean Program) as well as of resulting simulations. Examples include persistent shallow mixed layer depth biases in the Southern Ocean, resulting in biases in oceanic tracer uptake, and problems with the representation of oxygen minimum zones. Addressing the underlying causes of such biases remains our working group's highest priority.

Following the requests from the CESM Scientific Steering Committee (SSC), the majority of our discussions focused on re-assessing the OMWG near-term priorities and creating a draft timeline for our desired model developments for inclusion in CESM2. Because the Model for Prediction Across Scales – Ocean (MPAS-O) will not be available for CESM2, POP will remain as the CESM ocean component for at least the next three years. Thus, all of our planned development efforts will use POP. With overarching themes of addressing persistent model biases and advancing our modeling capabilities to explore emerging science questions, we identified five focus areas. In addition, several volunteers were identified from among the OMWG members with a designated lead for each group to facilitate and coordinate efforts. These focus areas and their participants are – as also outlined in the attached schematic:

- *Algorithmic Developments [Participants: Bryan (lead), Danabasoglu, Hecht, Lindsay, Maltrud, Tseng, Yeager]*: The planned and ongoing POP2 algorithmic developments are i) elimination of virtual salt fluxes in favor of true freshwater surface fluxes; ii) implementation of a new vertical coordinate system, z*; iii) introduction of a conservative Robert time filter to replace the time-averaging time step; iv) making partial bottom cell treatment fully operational; and v) considering both slightly finer horizontal resolution than currently used and increased vertical resolution. While the first and second developments are designed to better address sea level rise, coastal sources of fresh water, and land-ice – ocean interaction science questions, the third development allows efficient high-frequency coupling of the ocean model to resolve the diurnal cycle and inertial periods explicitly. The fourth development provides a better representation of the bottom topography, but it requires somewhat extensive modifications particularly in the mesoscale and submesoscale parameterization subroutines along with extensive testing. The last development item primarily targets

higher vertical resolution in the upper ocean to better represent the sharp gradients in the thermocline.

- *Diabatic Processes [Jayne (lead), Bryan, Danabasoglu, Fox-Kemper, Gent, Jochum, Large, Levy, Long]*: The planned and ongoing developments include i) new and modified tidal mixing and near-inertial wave mixing parameterizations; ii) Langmuir mixing parameterization; ii) development and incorporation of the CVMix (Community ocean Vertical Mixing) modules into POP2; iii) revisiting and modifying some parts of the K-Profile Parameterization (KPP); and iv) considering incorporation of additional (and new) parameterizations emerging from the Climate Process Team (CPT) activities on internal mixing or from the general OMWG community, e.g., Internal Wave Dissipation, Energy, and Mixing (IDEMIX).

- *Adiabatic Processes [Gent (lead), Danabasoglu, Fox-Kemper, Long, Moore]*: The developments involve i) changes in the prescriptions for both the isopycnal and thickness diffusivity coefficients used in the Gent and McWilliams mesoscale mixing parameterization and ii) implementation of an anisotropic version of this parameterization.

- *Coupling and Boundary Conditions [Large (lead), Bailey, Bryan, Tseng]*: The developments involve evaluation and use of a newly developed coupler scheme for diurnal cycling of the near-surface ocean temperature and incorporation of an estuary parameterization.

- *Metrics and Diagnostics [Danabasoglu (lead), Levy]*: In response to an earlier request from the CESM SSC, the OMWG had prepared and submitted (to the SSC) a short document summarizing our current practice of model evaluation along with a list of desired redesign and improvements of the OMWG metrics and diagnostics. The goal here is to start making some progress.

The attached schematic shows our intended timeline for these developments, many of which have already started. It is our intention to include BGC-related metrics and diagnostics in our evaluation process throughout these development efforts. At certain sub-completion stages, we plan to pass intermediate versions of POP2 to the BCGWG for more thorough evaluations. Finally, we note that the OMWG will continue working with an eddy-permitting resolution version. We plan to use this high-resolution version for scientific exploration, rather than for long climate-scale simulations for CMIP and IPCC.