Review of GMD-2018-129
"Interactive ocean bathymetry and coastlines for simulating the last deglaciation with the Max Planck Institute Earth System Model (MPI-ESM-v1.2) by V. L. Meccia and U. Mikolajewicz for Geosci. Model Dev. Discuss. Doi.org/10.5194/gmd-2018-129

Overall Comments:

This paper presents a complicated multi-step algorithm for automatically and successively modifying the MPI ocean model (MPIOM) bathymetry and land/ocean mask and restart input fields in a transient simulation under evolving boundary conditions such as for ice sheet growth and melt on long time scales. The set of time-stepped ICE6-G_C boundary conditions through the deglacial period are used here to demonstrate the utility and feasibility of the method. However, the ultimate goal is to be able to incorporate active solid earth and ice sheet models to drive ocean bathymetry, volume and coastline changes due to isostatic adjustments and added ice sheet meltwater fluxes that are important for simulating climate change over a glacial-interglacial cycle. This paper documents a new procedure for approaching an extremely challenging technical problem. Up to now, when ocean bathymetry or coastlines need to be changed over the course of a long transient simulation, it necessitates much human intervention and hands-on methods that may have been designed to be used once, and thus is usually done infrequently or not attempted at all. The authors have demonstrated the success and feasibility of this new procedure that can automatically be applied at run-time and updated every 10 years for the long durations needed, though it is designed to be highly specific to MPIOM's particular model grid and architecture. I recommend acceptance after some minor revisions that could help clarify the details of the procedure.

Specific comments:

1) It should be mentioned in the procedural description that an important feature of the MPIOM is the employment of partial depth bottom cells, which makes their procedure possible. Models without partial bottom cells would be constrained to discrete values of bottom depth relative to the global mean sea surface (i.e., not including the sea surface height).

2) Lines 107-112: This procedure omits any lakes that form other than those connected to the Caspian and Black seas. The existence of large mid-continental post-glacial lakes formed following the melt and retreat at the southern boundary of the massive Laurentide ice sheet may be important for accurately reproducing the deglacial climate state. Drainage from Lake Agassiz, for example, and the routing of this significant source of meltwater to the ocean, is often hypothesized as causing changes in the meridional overturning circulation during the deglacial period. Excluding such lakes may be necessary in this first implementation of the tool, however, I suggest including a short explanation for why this step is required in this first implementation, the potential ramification, and plans for including them in the future.

3) As discussed again below, I found section 2.4, which describes the method for redistributing mass and tracers vertically and horizontally in the process of adjusting the restart files, difficult to follow. For example, what is meant by “vertical re-location” in line 259. A schematic diagram depicting the procedure following changes in depth would help to clarify this procedure.

4) There is no mention of what is done to adjust velocity components and other related fields that restart the flow fields following changes in land/ocean mask and bathymetry.

5) Section 3 describes how freshwater fluxes are added to the ocean from the melt of grounded ice sheets by the river discharge model, effectively increasing ocean volume. Section 2 describes the procedure for changing bathymetry and ocean volume using the ICE6-G_C data, implicitly changing volume due to melting ice sheets. Figure 8 shows the procedure works out as the volume change from these two processes match, but it reads like the ocean volume is being changed twice here. Is it because the bathymetry changes are made as a result of the meltwater added slowly over previous interval of time (10 years) since last bathymetric changes? Thus, new volume, added through bathymetry changes, lags or catches up to the volume change due to freshwater added through meltwater over the preceding interval? A schematic showing all of these complicated steps would help clarify.

Minor comments by line:
63: “In the frame of the project…” -- awkward phrase to start the sentence.

150: OK--omitting Arctic and Southern Oceans in this list because they are contiguous with the other major ocean basins?

171:”Specific regions are examined in detail and modified if necessary.” Also, “…look at the HR land-sea mask…” Suggests human oversight here, but I suspect this is not the case. This step must use some rather specialized coding because many specific regions in the HR mask are checked against the new GR30 mask. What methods are used to make this more automatic? Are multiple solutions possible to obtain using the fraction ocean in the new GR30 to identify pathways that connect new regions?

Section 2.3 and section 3, lines 300-308: Globally adjusting ocean depth to keep global mean SSH constant, and volume changes through adding freshwater from melting ice sheets. Are the steps employed in Section 2.3, done every timestep after freshwater from melting grounded ice sheets is added, thus increasing global ocean volume through increases in SSH?

248: Do the final changes made to depth as described in step 2.3(d) require iterations back to (3)?

259: Section 2.4(a) What is meant by “vertical re-location”? I find this section difficult to understand the actual details of the method even after looking at Figure 5. A schematic

illustrating the method would be helpful, especially for locations that are already “wet” points that become deeper. How are tracers at mid-depth changed? Also does the process of vertical re-location” result in lateral gradients at depth in the ocean, even after horizontal smoothing?
263: “new layer’s thickness”?

300: The “instantaneous time derivative of the gridded ice thickness” is computed for the meltwater fluxes added by the hydrological discharge model. Does this gridded ice sheet thickness come from the ICE6-G_C data interpolated in time to every 10 years? Does “instantaneously” mean the meltwater flux calculation is done every time step, or for every 10-year interval?

366: “…called with a maximum of three input files.” The description of the tool software and scripts is short. A bit more information about how it is used in practice and integrated into the model run-time would be helpful. For example, how does it interface with the model during run-time? Which input files are needed? Is the tool launched in the main run script, at the start of a restart submission using files from the previous submission? Because restart files are generated, does this mean that the 10 year time interval between bathymetry changes fixes the maximum number of years between resubmission?