Project: **1102**

Project title: **SFB-Transregio (TRR181)**

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In the attached request form, we discuss the following new developments in ICON-O which we are working on during this phase of DKRZ:

1a) implementation of tides into ICON-O
1b) tuning the model with respect to the tidal forcing
2a) implementation of the "zstar" vertical coordinate approach which is necessary to achieve the high vertical resolution we are aiming for
2b) testing the zstar coordinate and thin upper layers in numerous configurations
3a) implementation of "partial bottom cells" (PBCs) which allow the very last vertical grid cell which is filled with water to have a varying thickness. This assures that the total water depth is much closer to the actual bathymetry and not so much dependent on the vertical resolution in the deep ocean which is usually coarse.

While the steps 1a, 2a, and 3a were successfully completed during the last half year, we are currently at the end of the testing and tuning phase of the tidal forcing and the zstar and PBC coordinates (1b, 2b, and 3b). This testing phase took up most of the computational resources we used so far.

Test configurations e.g. include
- Various simulations with tidal forcing in the R2B8 (10km resolution) and R2B6 (40km resolution) ICON-O grid configuration for a period of three years for each experiment to assure an equilibration of the tides. Parameters which were tuned include the biharmonic horizontal viscosity, the drag coefficient for bottom friction, and the model time step.
- One simulation including tidal forcing with a lower resolution of the telescoping grid (ranging from 8km to 80km) to check whether the grid refinement might cause problems for the propagating tidal waves (which was not the case).
- Various simulations with the zstar and partial-cell coordinates in R2B4 (160km) and R2B6 (40km) for at least 100 simulated years in each experiment. In this set of experiments, we tested different vertical resolutions, different realizations of surface fluxes, different versions of the sea-ice limiter, and different partial-cell parameters.

The current status of our preparatory work is
1) We are mostly satisfied with the performance of the model under tidal forcing and therefore think that the tides are ready to be used in the final configuration.
2) and 3) We still need some further tests to solve some issues with respect to the sea-ice limiter but we are confident that we can finalize this work during the next three weeks.

Finally, we are optimistic that we can start with the first experiment using the SMT-WAVE grid at the end of November and we have reserved most of our remaining computational resources for this first simulation.