EGU22-2683
https://doi.org/10.5194/egusphere-egu22-2683
EGU General Assembly 2022

Increasing complexity of NEMO for climate applications by explicitly simulating the large sub-ice shelf seas

Katherine Hutchinson[1], Julie Deshayes[1], Christian Éthé[1], Clement Rousset[1], Martin Vancoppenolle[1], Nicolas Jourdain[2], and Pierre Mathiot[2]
[1]Sorbonne Université CNRSIRDMNHN, LOCEAN Laboratory, Paris, France
[2]Université Grenoble Alpes CNRS/IRD/G-INP, IGE, Grenoble, France

None of the coupled climate models contributing to the DECK experiments of CMIP6 directly simulate ocean circulation under the ice-shelves of Antarctica, thereby omitting a potentially critical piece of the climate puzzle. Ocean-ice shelf interactions are vital to the production of Ice Shelf Water (ISW), a parent water mass of the globally important Antarctic Bottom Water (AABW). In NEMO these interactions can be explicitly represented or parameterised. For the parameterization, the cavities are left closed and the observed melt is injected along the depth interval between the ice shelf base and the bathymetry at the position of the ice shelf front. While this accounts for an input of freshwater along the Antarctic coastline, it does not allow for a change in melt rate in response to ocean conditions, nor does it adequately represent dense water production on the continental shelf.

To address this, we explicitly simulate ocean circulation beneath three large Antarctic ice shelves thought to be responsible for the majority of dense water production feeding AABW, namely: Filchner-Ronne Ice Shelf (FRIS), Ross Ice Shelf and Larsen C Ice Shelf. All smaller cavities are provisionally left parameterized. We present a new NEMO configuration with ocean circulation under the large Antarctic ice shelves and explicit ISW formation. Results show that the grid resolution of the NEMO global 1° configuration, is sufficient to set-up sub-ice shelf circulation patterns that are in line with observations and produce melt rate patterns that agree well with both high resolution models and satellite measurements. The net melt of FRIS after 2 cycles of CORE forcing corresponding to the period 2005-2009 is 95 Gt/yr which is slightly lower than observed, while the net melt of Ross is overestimated at 125 Gt/yr (Rignot et al., 2013: FRIS = 155 Gt/yr, Ross = 48 Gt/yr). Work is in progress to address these opposing tendencies in melt rates of the two major Antarctic ice shelves, by including the effect of tides within the cavities. We propose that the next step in climate modelling be to open the ice shelf cavities where the global model grid resolution is sufficient to do so, and employ a parameterization for the small ice shelves and for the inlets of large cavities that are too small to be resolved.