Regional East Antarctica simulation with optimized ocean, sea ice, and thermodynamic ice shelf model parameters

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Antarctic bottom water (AABW) formation and Antarctic ice loss caused by enhanced ice shelf melting are crucial processes for the Southern Ocean hydrography. However, existing global models have difficulties in simulating these processes at the same time. For example, some models successfully simulate AABW formation in the Weddell and Ross Seas, but their mCDW intrusions towards West Antarctic ice shelves are weaker than observations. Here, we develop a regional ocean model for East Antarctica, which includes the rapidly melting Totten ice shelf (TIS) and AABW formation off the Adelie Land. We use the regional Massachusetts Institute of Technology general circulation model (MITgcm) configuration includes dynamic/thermodynamic sea ice and static thermodynamic ice shelf representation. Our regional model simulates modified Circumpolar Deep Water (mCDW) intrusions successfully, but (1) simulated intrusions towards the TIS are thicker by 200m compared to observations, and (2) salinity of AABW formed in the Mertz polynya is fresher by 0.3. In this study, we aim to simulate AABW formation off the Adelie Land and mCDW intrusions towards the Totten glacier consistent with observations. We conduct a series of sensitivity experiments by perturbing a small number of the ocean, sea ice, ice shelf model parameters, and lateral boundary conditions to achieve better model-data agreement, especially for Antarctic continental shelf regions. We further optimize our simulation by employing Green's function approach.

Keywords: Antarctica, Southern Ocean, Ice Shelf, Circumpolar Deep Water, Antarctic bottom water, Winter Water

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