Antarctic Sea-Ice and Bottom Water in High-Resolution Climate Models

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ABSTRACT: The overarching topic of this talk is the problem of an adequate representation of the physical processes around Antarctica in climate models. It starts with the recent observed changes in sea ice, their direct linkage to the stratification of the Southern Ocean, and their immediate connection to the global ocean meridional overturning circulation (MOC) through the rate of Antarctic Bottom Water (AABW) formation. We will readily get to the role of model resolution and variability. As has been shown earlier, high-resolution Antarctic coastal winds are crucial for a realistic representation of coastal polynyas, through which most of AABW is formed. In the absence of tides, eddy-resolving ocean models reveal clear patterns of sea-ice variability due to ocean eddies, weather events, and inertial oscillations, all of which can potentially modify the ice growth rate, and thus convection and AABW formation. The same holds for the effect of higher-resolution and thus steeper bathymetry, which can trigger strong enough Taylor columns to interact with the surface mixed layer, thus leading to the formation of open-ocean polynyas. Variability in AABW formation can be traced as anomalies along the deep western boundaries of the ocean. Coarse-resolution models suggest that they may affect the Atlantic MOC in a relatively short amount of time. It remains to be seen whether this holds for high-resolution models. In such models, AABW anomalies are much more confined along the deep western continental boundaries than in coarse-resolution models, and seem to spread more readily along other bathymetric features such as the mid-ocean ridges.