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Kim Partington, Ronald Lindsay, Jinro Ukita

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9.7 Representation of Antarctic Coastal Polynyas in Ocean Climate Models: A Justification for Assimilation of Ice Concentration?

Achim Stoessel

Department of Oceanography
Texas A&M University, College Station

Thorsten Markus

NASA Goddard Space Flight Center
Greenbelt, Maryland

Abstract

The representation of Antarctic coastal polynyas in global ocean general circulation models (OGCMs) have a profound impact on long-term deep-ocean properties. Compared to maximum ranges in magnitude of ambient conditions such as wind velocity and air temperature, the extent of coastal polynyas play the most decisive role in determining the rate of Antarctic Bottom Water formation, through the process of sea-ice formation, brine release, and formation of High Salinity Shelf Water. This study investigates the local, regional and high-frequency behaviour of the model representation of coastal polynyas with the aid of daily ice concentration derived from satellite passive microwave data using the "NASA Team 2" algorithm. Large regional and temporal discrepancies arise that are primarily related to the type of convection parameterization used in the model. Arguing that the empirical "thermodynamic lead closing" parameter is the weakest part in the sea-ice component of the OGCM, ice is being redistributed within a model grid cell by assimilating NT2 ice concentration. This measure yields potentially more reliable estimates on the impact of critical high-latitude processes on long-term deep-ocean properties. On the other hand, there are still various issues to be solved, e.g. whether the presented assimilation strategy is useful for the entire ice pack, how to properly deal with coastline mismatch between data and model, and how much assimilation of daily data interferes with daily winds that drive the sea-ice model. Besides the assimilation, this paper has revealed major short-time scale discrepancies between modelled and satellite-derived ice concentration, suggesting that much work is still needed to improve subgrid-scale high-latitude processes in global OGCMs.