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Sea ice production in the southern Weddell Sea: role of atmospheric forcing and fast ice

Lukrecia Stulic (1), Ralph Timmermann (1), Stephan Paul (1), Rolf Zentek (2), and Günther Heinemann (2)
(1) Alfred Wegener Institute, Climate Sciences, Bremerhaven, Germany, (2) University of Trier, Trier, Germany

In the southern Weddell Sea coastal polynyas, enhanced ice production leads to the formation of dense shelf water that drives thermohaline circulation and influences the circulation beneath the Filchner-Ronne Ice Shelf. We use the Finite Element Sea ice-ice shelf-Ocean Model (FESOM) to investigate sea ice production and High Salinity Shelf Water (HSSW) formation in the southern Weddell Sea coastal polynyas for the period 2002-2014. The model forced with ERA-Interim reanalysis data reproduces well the locations and high freezing rates in the major coastal polynyas when compared to MODIS retrievals. The mean annual sea ice production is found to be 134 ± 24 km^3, with the largest contributions from the Ronne and Brunt Ice Shelf polynyas. Using output from the regional atmospheric model COSMO-CLM as a forcing data set reduces polynya ice production (121 ± 19 km^3), mostly over the eastern shelves due to weaker offshore winds. An additional experiment is conducted to represent polynyas formed on the lee side of grounded icebergs. MODIS data is used to obtain reliable information about existence, location, and extent of the fast-ice bridge formed between the Filchner-Ronne Ice Shelf and a chain of grounded icebergs. Position and shape of the fast-ice bridge affect interannual variability of polynya sea ice production, increase sea ice production westward of the ice bridge and suppress it eastward of it, leading to a more realistic polynya representation. It is found that high-resolution atmospheric forcing and treatment of grounded icebergs are crucial to realistically reproduce ice production in the region. Consequences for the ice export out of polynyas and HSSW production will be discussed.