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Mesoscale modeling in the Weddell Sea using a regional NWP model and a global sea ice-ocean model

Lars Ebner (1), Günther Heinemann (1), Verena Haid (2), and Ralph Timmermann (2)

(1) University of Trier, Environmental Meteorology, Germany (ebner@uni-trier.de), (2) Alfred Wegener Institute, Ocean Dynamics, Bremerhaven, Germany

Coastal polynyas are frequent in many polar areas even in winter and play an important role for the coupling between the components of the sea ice-ocean-atmosphere system. Locally enhanced surface exchange processes in areas of open water have important consequences for the atmosphere and ocean processes, as well as for ice formation and the associated brine release.

The non-hydrostatic, mesoscale model COSMO from the German Weather Service (DWD) has been applied for the Weddell Sea Region and therefore, adjustments of the COSMO model have been made to allow for the distinctive polar conditions. Besides a new parameterization of the roughness length, we have changed the soil/ice parameterization of the Antarctic continent in the model. For a better representation of the ice shelf elevations, we incorporated the ETOPO1 ice surface dataset. Furthermore, we use a thermodynamic sea ice model, which allows for a realistic treatment of the sea ice-atmosphere interactions. Remote sensing data from the passive microwave sounder AMSR-E was used to derive a high resolution, daily sea ice coverage for the model simulations. Results for several case studies show the improvements by the model adaptions. Whereas the model simulations show very good agreement with measurements in topographically homogeneous regions, larger differences occur with measurements in topographically heterogeneous regions.

With these model adaptions and a 2 step nesting, we have produced a high-resolution COSMO dataset (15 km and 5 km) for one winter season (6 months), to provide forcing data for the high resolution sea ice-ocean model FESOM. The benefit of high-resolution forcing data for the sea ice-ocean model FESOM is investigated. Due to the higher spatial and temporal resolution, a more realistic simulation of polynya dynamics is expected, compared to the common forcing with global reanalyzes, like NCEP or GME.