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Simulation of Laptev Sea polynya dynamics using the FESOM model with different atmospheric forcings

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The Laptev Sea polynyas play a key role for the shelf areas of the Siberian Arctic due to their impact on ice production. Changes in polynya dynamics result in modified fluxes of energy, momentum and matter in the atmosphere-ocean-sea ice system. An improved understanding and quantification of polynya effects in the Laptev Sea can be achieved by high-resolution sea ice-ocean models. Here we use the well-established Finite Element Sea Ice-Ocean Model FESOM (5 km x 5 km) (AWI Bremerhaven). It consists of a hydrostatic primitive-equation ocean model and a dynamic-thermodynamic sea ice model. In our study the model is forced by 6-hourly GME analyses (0.5° x 0.5°), daily and 6-hourly NCEP/NCAR reanalyses (2.5° x 2.5°) and hourly COSMO data (5 km x 5 km) to investigate a polynya event during the TRANSDRIFT winter experiment 2008. The input data consists of 10 m-wind, 2 m-temperature and specific humidity, total cloudiness and precipitation rate. In order to test the quality of the forcing data, comparisons with in-situ have been performed. They show shortcomings of the atmospheric analyses model data with respect to the daily course of the temperature, but very good agreement for the wind. The opening process of a main polynya event on 29 April 2008 is represented with all atmospheric forcing fields (except the daily NCEP data) in a similarly good way. However, there are differences in direction and velocity of the icedrift and in the location and development of the polynyas. Small-scale structures are best represented by applying the high-resolution COSMO data. The maximum sensible heat flux is 220 W/m2, the maximum latent heat flux is 120 W/m2, the maximum advective ice thickness reduction is 5 cm/h and the maximum thermal ice thickness production is 5 mm/h.