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Ice production of polynyas in the Laptev Sea calculated from mesoscale NWP model simulations for the winters 2007/08 and 2008/09

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The Laptev Sea area of the Siberian Arctic is known as being a highly productive area for the formation of new ice throughout the winter season. This area is characterized by flaw polynyas which occur at the edge of the fast ice surrounding the coastal zones during wintertime. Due to large turbulent atmospheric heat fluxes, polynyas are strong sea ice producers. However, estimates of sea ice production in the Laptev Sea polynyas are arguable since high resolution and high quality atmospheric data is not available for that area. Previous estimations of ice production rely on global reanalyses as atmospheric forcing, such as NCEP with about 280km horizontal resolution, which is too coarse to take polynyas into account.

In our study, we use the limited area model COSMO with a prescribed sea ice coverage by daily AMSR-E satellite data. Runs with 15 and 5 km horizontal resolution (nested in global GME model data) are performed for the two winter periods (Nov-May) 2007/08 and 2008/09. The net energy loss of the polynya surface is used to determine ice production. COSMO is run in a forecast mode for overlapping daily 30h runs. We use a thermodynamic sea ice module for COSMO and varied the ice thickness in the polynya area from 0 to 10 cm. This allows for a new approach for estimating the ice production in the Laptev Sea polynyas.

The total polynya ice production is calculated as 51.25 km^3 in 2007/08 and 126.87 km^3 in 2008/09 for the assumption of ice free polynyas. A coverage with 10 cm of thin ice reduces the ice production by about 30 %. An AMSR-E- and NCEP-based study gives a value of 46.37 km^3 for 2007/08 and an average of 55.2 km^3 for 1979-2008 with a maximum of 73.3 km^3 in 2003/04 and a minimum 35.7 km^3. Hence, interannual variability between the two COSMO-simulated years outnumbers the long-term mean interannual variability of satellite-based study with NCEP forcing. Our study leads to the conclusion that interannual variability is underestimated by previous studies, which are not able to take into account the interaction between the polynya and the overlying atmospheric boundary layer. In future, we will use ERA-Interim data as forcing data for COSMO to extend the modeled time range to 10 years.