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# Sea-ice production in Weddell Sea polynyas by numerical simulations and remote sensing methods

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The Weddell Sea in the Atlantic sector of the Southern Ocean is one of the most dynamic air/ice/ocean interaction areas. Coastal polynyas occur frequently during winter, which leads to strong sea ice production, brine release and the formation of High-Salinity Shelf Water (HSSW). This dense water mass contributes to the formation of Weddell Sea Deep and Bottom Water, but also is considered to be one of the main drivers of the circulation in the large sub-ice shelf cavities beneath the Filchner-Ronne Ice Shelf (FRIS). Thus the quantification of quantification of sea ice production in Weddell Sea polynyas is of vital interest for the understanding the ocean circulation in this region.

A multi-method approach is used to quantify sea ice production polynyas in the southern Weddell Sea for the period 2002-2015. We use 1) a regional climate model (CCLM) with 5km and 15 km resolution (C05/15), 2) retrievals from MODIS data at a high resolution of 1-2km and 3) simulations of a sea ice-ocean Model (FESOM) with a resolution down to 3 km. Methods 2) and 3) need atmospheric forcing, which is taken from different reanalyses (ERA-I, CSFR, JRA55, NCEP2) as well as from CCLM data. Estimates of sea ice production and comparisons of the different methods are presented for polynya areas of the Weddell Sea. We study the following polynyas: Antarctic Peninsula (AP), Ronne Ice Shelf (RO), Iceberg A23a (IB), Filchner Ice Shelf (FI), Coats Land (CL) and Brunt Ice Shelf (BR). In all methods, the largest ice production (IP) is found for RO and for BR. However, significant differences between different methods and forcing data sets are found for polynya area (POLA) and IP. In particular, relatively too low temperatures in JRA and C05 lead to higher IP compared to ERA in the MODIS retrievals. Estimations based on CCLM simulations agree generally well with MODIS/ERA-I, but tend to be smaller due to the coarser resolution of the microwave sea ice data used in CCLM. In contrast, FESOM yields a generally larger ice production and shows also a pronounced sensitivity to the atmospheric forcing, but the effect on POLA and IP depends on the region. The main difference between CCLM and the much coarser reanalyses is the missing representation or insufficient representation of polynyas and their interaction with the atmospheric boundary layer.