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Thin ice thickness distribution and ice production in the North Water and Laptev Sea polynya regions using MODIS thermal infrared imagery

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We present investigations of Arctic polynya dynamics for the period 2002/2003 to 2011/2012. Thin ice thicknesses were calculated from MODIS ice surface temperatures, combined with ECMWF ERA-Interim reanalysis atmospheric data in an energy balance model. Regions of interest include the North Water Polynya, located between Ellesmere Island (Canada) and Greenland, and the Laptev Sea flaw polynyas. Based on calculated thin ice thicknesses, associated quantities like polynya area and total ice production were derived for all regarded regions and compared to recent studies using passive microwave remote sensing data. Calculated ice production reaches mean values of 223 km^3 for the North Water Polynya and 79 km^3 for the Laptev Sea. They underline the importance of the two coastal polynya systems in the context of the Arctic sea ice budget, although their individual contribution seems to be overestimated in other satellite-based studies. For both regions, obtained polynya areas and ice production clearly exceeded the corresponding values from passive microwave studies, despite a good agreement in the overall seasonal development. Possible reasons include a hidden effect of undetected clouds and the applied parametrizations in the polynya area retrieval. The application of a simple cloud coverage-correction scheme yielded reasonable adjustments for the polynya area and accumulated ice production, while open questions originating from inherent cloud effects have to be addressed in future studies. Noticeably, the sea ice cover in both regarded polynya regions shows signs of a delayed fall freeze-up over the 10 year-period.