Contribution of deformation to sea-ice mass balance: a case study from an N-ICE2015 storm

The fastest and most efficient process of gaining sea ice volume is through the mechanical redistribution of mass as a consequence of deformation events. During the ice growth season divergent motion produces leads where new ice grows thermodynamically, while convergent motion fractures the ice and either piles the resultant ice blocks into ridges or rafts one floe under the other. Here we present an exceptionally detailed airborne dataset from a 9km² area of first and second year ice in the Transpolar Drift north of Svalbard that allowed us to estimate the redistribution of mass from an observed deformation event. To achieve this level of detail we analyzed changes in sea ice freeboard acquired from two airborne laser scanner surveys just before and right after a deformation event brought on by a passing low pressure system. A linear regression model based on divergence during this storm can explain 64% of freeboard variability. Over the survey region we estimated that about 1.3% of level sea ice volume was pressed together into deformed ice and the new ice formed in leads a week after the deformation event would increase the sea ice volume by 0.5%. As the region is impacted by about 15 storms each winter a simple linear extrapolation would result in about 7% volume increase and 20% deformed ice fraction at the end of the season.

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