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Timing and regional patterns of snowmelt on Antarctic sea ice from passive microwave satellite observations

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The better understanding of temporal variability and regional distribution of surface melt on Antarctic sea ice is crucial for the understanding of atmosphere-ocean interactions and the determination of mass and energy budgets of sea ice. Since large regions of Antarctic sea ice are covered with snow during most of the year, observed inter-annual and regional variations of surface melt mainly represents melt processes in the snow. It is therefore important to understand the mechanisms that drive snowmelt, both at different times of the year and in different regions around Antarctica.

In this study we combine two approaches for observing both surface and volume snowmelt by means of passive microwave satellite data. The former is achieved by measuring diurnal differences of the brightness temperature TB at 37 GHz, the latter by analyzing the ratio TB(19GHz)/TB(37GHz). Moreover, we use both melt onset proxies to divide the Antarctic sea ice cover into characteristic surface melt patterns from 1988/89 to 2014/15.
Our results indicate four characteristic melt types. On average, 43% of the ice-covered ocean shows diurnal freeze-thaw cycles in the surface snow layer, resulting in temporary melt (Type A), less than 1% shows continuous snowmelt throughout the snowpack, resulting in strong melt over a period of several days (Type B), 19% shows Type A and B taking place consecutively (Type C), and for 37% no melt is observed at all (Type D). Continuous melt is primarily observed in the outflow of the Weddell Gyre and in the northern Ross Sea, usually 20 days after the onset of temporary melt.
Considering the entire data set, snowmelt processes and onset do not show significant temporal trends. Instead, areas of increasing (decreasing) sea-ice extent have longer (shorter) periods of continuous snowmelt.