Snowmelt processes on Antarctic sea ice observed by satellite scatterometers

Introduction

Snowmelt processes on sea ice are the key drivers determining the seasonal sea-ice energy and mass budgets. While there is strong surface melt on Arctic sea ice, snowmelt on Antarctic sea ice is weak with most snow surviving the summer. Here, we compile time series of snowmelt onset dates on perennial Antarctic sea ice from 1992 to 2014 using active microwave observations from European Remote Sensing Satellite (ERS-1/2), Quick Scatterometer (QSCAT) and Advanced Scatterometer (ASCAT) radar scatterometers. Describing snow melt processes, we define two transition stages: A weak backscatter rise indicating the initial warming and metamorphosis of the snowpack (pre-melt), followed by a rapid rise indicating the onset of thaw-freeze cycles (snowmelt).

Hypothesis: The conceptional model

- Different sensors respond to snowmelt processes in different depths within the snow cover

Method

- Analysis of the seasonal cycle of radar backscatter (Ku-band at 13 GHz, C-band at 5.6 GHz)

Snowmelt patterns from passive microwave observations

Spatial variability of snowmelt onset dates

- Latitudinal gradient in snowmelt onset dates

Snowmelt onset retrieval from different sensors

- Snowmelt onset dates from scatterometers are earlier by 13 and 5 days than those from passive microwave observations

Compilation of snowmelt onset time series

- Ku-band (QSCAT scatterometer) derived pre-melt and snowmelt onset dates are earlier by 25 and 11 days than those derived from C-band (ERS/ASCAT scatterometers)

Key points

- Correcting for sensor differences between Ku- and C-band scatterometers allows to compile a backscatter time series
- Snowmelt onset dates show no significant trend
- Using satellite remote sensing sensors with different signal frequencies might allow to describe snowmelt processes in different snow layers


Stefanie Arndt, Christian Haas