The 1979–2005 Greenland ice sheet melt extent from passive microwave data using an improved version of the melt retrieval XPGR algorithm

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Abstract

Analysis of passive microwave satellite observations over the Greenland ice sheet reveals a significant increase in surface melt over the period 1979–2005. An improved version of the cross-polarized ratio (XPGR) algorithm is used to identify the melt and the surface melt acceleration is discussed with results from the regional climate model MAR. From 1979 to 2005, the ablation period increases everywhere over the melt zone except in the regions where the model simulates an heavier summer snowfall. Indeed, more snowfall in summer decreases the liquid water content of the snowpack, raises the albedo and therefore reduces the melt. Finally, the melt acceleration over the Greenland ice sheet is highly correlated with both Greenland and global warming suggesting a continuing surface melt increase in the future.

Perturbations in the derived microwave melt signal

- Therefore, we propose four improvements to the XPGR algorithm to reduce the perturbations in the remote melt signal due to the atmospheric variability (see Fettweis et al. (2006) for more details). The improved XPGR algorithm will be referred hereafter to as ImpXPGR.
- Improvement n°1: We impose the continuity of the melt season to remove gaps shorter than three days between two melt days. The XPGR method aims to detect massive melt and short gaps (due to dense clouds mostly causing liquid precipitation) in the middle of the melt season detected by XPGR are mostly unrealistic.
- Improvement n°2: The XPGR detection algorithm excludes three adjacent grid points where XPGR detects melt are classified as melting grid points.
- Improvement n°3 and n°4: A minimum value of T19H is assumed to detect melting melt with the aim to remove occasional anomalies in the SSM/I-SSMR brightness temperatures field. The 19GHz channel is chosen because it is the least sensitive to the atmospheric variability.

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