



## **Reconstruction of the 1979-2005 Greenland ice sheet surface mass balance using the regional climate model MAR**

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In order to improve our knowledge on the current state and variability of the Greenland ice sheet surface mass balance (SMB), a 27-year simulation (1979-2005) has been performed with the coupled atmosphere-snow regional model MAR. This simulation reveals an increase in the main factors of the SMB which are, on the one hand, the snowfall (+ 1.0 +/- 1.5 km<sup>3</sup> yr<sup>-2</sup>, not significant) in winter and on the other hand, the run-off of the melt water (+ 5.3 +/- 3.0 km<sup>3</sup> yr<sup>-2</sup>, significant) in summer. The net effect of these two competing factors leads to a SMB loss rate of - 4.1 +/- 4.1 km<sup>3</sup> yr<sup>-2</sup>, which has a significance of 95%. The melt extent derived from the passive microwave satellite data since 1979 also shows the acceleration of the surface melt. The contribution of changes in the net water vapour fluxes to the SMB variability is negligible. The melt water supply has increased because the Greenland ice sheet has been warming up by + 0.08 +/- 0.04 °C yr<sup>-1</sup> since 1979. Latent heat flux, sensible heat flux and net solar radiation have not varied significantly over the last three decades. However, the simulated summer downward infra-red flux has increased by 7.1 W m<sup>-2</sup> since 1979. The natural climate variability (e.g. the North Atlantic Oscillation) does not fully explain these changes on the Greenland ice sheet. These changes result very likely from the global warming induced by human activities. The increase of +137 km<sup>3</sup> in the melt water run-off in the period 1979-2005 suggests that the overall ice sheet mass balance has been increasingly negative, given the observed melt-induced outlet glacier acceleration.