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The Role of Sublimation on the Surface Mass Balance of the Interior Greenland Ice Sheet

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Precipitation along with sublimation and deposition are the main contributors to the surface mass balance (SMB) in the accumulation area of the Greenland Ice Sheet (GrIS). However, precipitation events are rare and intermittent. In between precipitation events the surface snow continuously undergoes sublimation and deposition. Recent studies imply that these surface exchange processes influence the isotopic composition of the surface snow which is later archived as a climate record in ice cores. In order to understand the possible implications on the recorded climate signal, sublimation needs to be quantified on a local scale.

Here we present simulated SMB components for eight ice core drilling sites on the GrIS using the regional climate model MAR (Modèle Atmosphérique Régional). We validated MAR against in-situ flux observations at the East Greenland Ice Core Project site and found a high sensitivity of sublimation to the downward long wave flux and to the parameterization of the surface roughness length. We propose a surface roughness length optimized for the interior of the GrIS which is supported by our observations.

Our results show that in the GrIS accumulation area the mass turnover via sublimation and deposition can reach the same order of magnitude as precipitation. This highlights the importance of a better understanding of how the climate signal is imprinted in the surface snow isotopic composition.