Local scale depositional processes of surface snow on the Greenland ice sheet

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Abstract:

Ice cores from polar ice sheets and glaciers are an important climate archives. Snow layers, consecutively deposited and buried,contain climatic information of the time of their formation. However, particularly low-accumulation areas are characterised by temporally intermittent and spatially variable precipitation, which can be further re-distributed after initial deposition.Therefore, the local conditions of accumulation at an ice core site influence the quantity and quality of the recorded climate5signal in proxy records. Local surface features at different spatial scales further affect the signal imprint. This study therefore aims to characterise the local accumulation patterns and the evolution of the snow height to describe the contribution of snow(re-)deposition to noise in climate records from ice cores. By using a photogrammetry Structure-from-Motion approach, we generated near-daily elevation models of the snow surface for a 195 m2area in the vicinity of the deep drilling site of the East Greenland Ice Core Project in northeast Greenland. Based on the snow height information we derived snow height changes on a10day-to-day basis throughout our observation period from May to August 2018. Specifically, the average snow height increased by∼11 cm. The spatial and temporal data set allowed an investigation of snow deposition versus depositional modifications.We observed irregular snow deposition, erosion, and the re-distribution of snow, which caused uneven snow accumulation patterns, a removal of more than 60 % of the deposited snow, and a negative relationship between the initial snow height and the amount of accumulated snow. Furthermore, the surface roughness decreased from 4 to 2 cm throughout the spring15and summer season at our study site. Finally, our study further shows that our method has several advantages over previous approaches, making it possible to demonstrate the importance of accumulation intermittency, and the potential influences of depositional processes on proxy signals in snow and ice