Depositional processes of surface snow on the Greenland ice sheet

Alexandra M. Zuhr[1,2], Thomas Münch[1], Hans Christian Steen-Larsen[3], Maria Hörhold[4], Thomas Laepple[1,5]

[1] Alfred-Wegener-Institut Helmholtz Zentrum für Polar- und Meeresforschung, Research Unit Potsdam, Telegrafenberg A45, 14473 Potsdam, Germany

[2] University of Potsdam, Institute of Geosciences, Karl-Liebknecht-Str. 24-25, 14476 Potsdam-Golm, Germany

[3] Geophysical Institute, University of Bergen and Bjerknes Centre for Climate Research, Bergen, Norway

[4] Alfred-Wegener-Institut Helmholtz Zentrum für Polar- und Meeresforschung, Research Unit Bremerhaven, 27568 Bremerhaven, Germany

[5] University of Bremen, MARUM - Center for Marine Environmental Sciences and Faculty of Geosciences, 28334 Bremen, Germany

Various kinds of proxy data derived from ice cores are widely used to reconstruct past climatic conditions. To understand the depositional processes that influence the recording of the proxy climate signal in ice cores, we investigate depositional modifications of the snow surface by using a Structure-from-Motion photogrammetry approach to generate near-daily elevation models for an area of 195 m^2 next to the deep drilling site of the East Greenland Ice Core Project in northeast Greenland. Based on the snow height information, we derive snow height changes on a day-to-day basis throughout our observation period from May to August 2018. Specifically, our data shows an increase in the average snow height by ~11 cm throughout this period, while the standard deviation, and with this the surface roughness, decreases from 4 cm to 2 cm. We find good agreement for the general snow height evolution between our snow height data and other snow height estimates from the same location, but our three-dimensional data shows more fine-scale variations. Furthermore, we find irregular snow deposition, erosion and redistribution of snow which induce uneven patterns of snow accumulation resulting in a negative relation between the initial snow height and the amount of accumulated snow. With our method we demonstrate the importance of accumulation intermittency. The presented approach enables a quantitative assessment of the influence of depositional processes on the overall proxy signals formed in polar snow.