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The effect of forced ventilation through snow on the stable water isotope content of the vapor and the snow – an experiment

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The stable water isotope signal throughout an ice core is a well known and often used proxy for past temperature reconstructions and is important in our understanding of the climate system. The knowledge about the post depositional processes influencing the isotope signal within the snowpack is therefore important. As wind blow across the snow surface micro high and low pressure areas arise because of sastrugies. These pressure differences create forced ventilation through the snowpack which then affect the interstitial mass exchange between water vapor and snow crystals and therefore the climatic signal stored in the snow.

In order of understanding the physics behind this ongoing exchange, a combination of modeling and a controlled experiment has been set up. The process of forced ventilation -as it is believed to occur on Greenland and Antarctica- has then been simulated. The snow within this experiment is collected in Greenland during the new deep drilling project in NW Greenland (NEEM).

Within this experiment, air with a known amount of moisture is pulled through a snow sample of different thicknesses. This sample has a known isotopic content and is kept at different sub-zero temperatures. The flow rate of the air has been controlled between 0,01 and 0,5 cm/s. After the interaction between the water vapor and the ice crystals the changes in both humidity and isotope signal are been studied. New in this research are the measurements of the isotope content with a Picarro WS-CRDS analyzer of the water vapour before and after the snow sample.

Eventually, to estimate the magnitude of the effect of ventilation through snow on the stable isotope content of the water vapor, the results of the experiment are compared with the output from the computer model.

This research will quantify the effect of forced ventilation on the mean isotope signal in the snow and its implications for the derived temperature signal from the water isotope ratio of the ice core as well as study the interstitial mass exchange between the air and the snow crystals.