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Snowdrift modeling with the Weather Research and Forecasting model

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Snow transport is the process of snowparticles being lifted in the air and transported horizontally when a wind speed exceeds a certain threshold value. In the mass budget of glaciers, this transport is an important process since it strongly contributes to the redistribution of snow. While a lot of research has been done in describing the physical process of snowdrift and applying this theory to various regions, snow transport this is typically neglected in models of atmosphere-glacier interaction. This shortcoming causes substantial uncertainties in mass balance determinations.

To improve quantifications of mass balance and our understanding of boundary-layer processes in cold regions in future, the goal of our project is to implement the process of snowdrift in the Weather Research and Forecasting (WRF) model. To do so, we provide a new snowdrift package that calls three separate modules. The first module calculates the erosion of snowparticles over a snow-covered surface. The eroded particles are carried further by the chem-tracer that has already been established in WRF-Chem. This allows the estimation of the snow concentration in each grid cell at every time step. The second module describes the gravitational settling process of the air-borne snowparticles, which occurs when the wind speed lowers. The third module computes the loss of snowparticles in the air due to sublimation of the drifting particles. This also changes the temperature and humidity profiles of the air layer.

A first case study will concern a unique measurement campaign in January 2019 on the Hintereisferner – a glacier in the Austrian Alps. We will focus on a single storm event and collect both routine and special data (e.g., snow depth, mass flux of snow particles, wind speed, radar precipitation) for comparison against the WRF model run for the same time period. Our preliminary model setup foresees high resolution in the glacier area by four nested domains, driven at lateral boundaries by ERA Interim Data. The smallest domain covers the Hintereisferner with a resolution of 240 m. Here we report the first results and experiences with the model-measurement comparison. This will help to estimate the quality of the implemented snow drift scheme and gives the opportunity for further improvements of the model.