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How does your ice sheet melt? On the importance of retention in snow and firn models (RETMIP)

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Mass loss from Greenland ice sheet surface melt is buffered by percolation and refreezing into the underlying snowpack. These microscale processes are dependent on a number of factors such as snow grain size, density and temperature that are often not well known and are heavily parameterized in firn model. However, processes such as melt and snowfall are also important in determining retention rates and these may vary according to atmospheric forcing. In the retention model intercomparison project (RetMIP) we compare 7 different 1D models and 4 different 2D models with each other and with detailed observational data from 4 key field sites covering a range of firn types to gain insight into how different parameterisations as well as atmospheric forcing affect snowpack processes. We use a common atmospheric forcing output from the HIRHAM5 regional climate model to drive the particpating RetMIP models which allows us to exclude the effects of different forcing and examine the influence of internal parameterisations.
We show that initialisation of snowpack models is key but that evolution of retention through time is strongly determined by melt rates as well as by specific values used in micro-scale parameterisations. Differences in surface mass balance estimates derived from models, particularly on a regional scale can be strongly affected by retention and as the ice sheet surface evolves in the future these are likely to become more important but also more variable both in time and space.