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Merging a Terrain-Based Parameter with Drifting Snow Fluxes for Assessing Snow Redistribution in Mountainous Areas

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Wind and the associated snow transport are dominating factors determining the snow distribution and accumulation in alpine areas. These factors result in a high spatial variability of snow heights that is difficult to evaluate and quantify. We merge a terrain-based parameter Sxm, which characterizes the degree of shelter or exposure of a grid point provided by the upwind terrain, with snow particle counter (SPC) data. SPC estimate the snow flux, the mass of drifting snow particles per time and area. From the SPCs' point measurements of horizontal snow flux, a quantity of transported snow is derived, which is distributed over the terrain in dependency of Sxm. Estimated changes in snow heights due to wind redistribution are compared with measured changes, obtained with terrestrial laser scanning (TLS). Data and results are from the Col du Lac Blanc research site in the French Alps. We use a high raster resolution of 1 m, which is required when assessing the snow-redistribution situation in highly structured terrain or in the starting zones of small and medium-sized avalanches.
Results show that the model works in principle. It could reproduce patterns of snow redistribution and estimate changes in snow heights reasonably well, as shown by good regression quality (r^2 values of 0.60 to 0.76).
The derivation of Sxm and the amount of transport have shown to be not generally applicable, however, but rather are formulations that must be calibrated when applied in studies with other terrain and weather characteristics.