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Textile protection of snow and ice: Measured and simulated effects on the energy- and mass balance

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Measurements and simulations of the energy fluxes and mass changes of an artificially covered snow and ice surface (geotextile material) and a reference plot within an Austrian glacier ski resort are presented and compared. A modified version of the snow cover model SNOWPACK is used to successfully reproduce the artificially compacted and the additionally covered snow cover in a physically based way. Supplementary measurements of crucial material properties of the 0.0045 m thin geotextile serve as model input as well. Results indicate that the shortwave reflectivity of the covers is responsible for half the performance (47%). Thermal insulation of the material (14%) and a negative latent heat flux due to evaporation of precipitation from the cover surface (10%) have almost the same contribution. An assumed layer of air between the cover and
the snow and ice surface (thickness 0.075 m to 0.12 m) adds the rest, which is at the upper limit of observations and may therefore also compensate for model errors. This generally explains the
high performance of the method in glacier skiing resorts and, most importantly, an altitude dependant application limit of the method: the method becomes less effective at lower altitudes, where sensible heat fluxes become more important compared to short wave radiation.