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Investigation of the energy balance over snow in steep alpine terrain

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In previous research the applicability of an energy-balance model used as forcing data for a snow-cover model in complex alpine terrain has been investigated. Now as a next step a full coupling of a snow cover model and an energy-balance model has been performed which gives a significant increase in model accuracy. This means that on the one hand surface properties are taken into account to model the albedo properly (radiation) and to get an accurate roughness length (turbulent fluxes) and on the other hand internal processes such as heat conduction through the snow cover and phase changes within the snow cover are modelled precisely.

The aim of this paper is to compare the results using the new model coupling with the results obtained by previous investigators. The detailed snow-cover model SNOWPACK was coupled to a distributed energy-balance model. It uses a so-called view factor approach to take account of properties that vary spatially whereas SNOWPACK is covering processes within the snow cover and surface properties.

The study site is located in the Eastern Swiss Alps around the Weissfluhjoch, close to the village of Davos where the Snow and Avalance Research Center is situated. The three time periods studied are in the winter of 1998/99.

Using a sky view factor approach instead of only dividing between obstructed and unobstructed sky improves the estimation of the incoming direct solar radiation which has been underestimated before. Terrain effects are far better captured and the diffuse short-wave radiaton from the terrain, which was markedly overestimated, gets more realistic values. The incoming long-wave radiation was consistently overestimated which led to overestimated temperatures at the surface. Using the new model approach measured values were possible to obtain by the model formulations.

Current work deals with the implementation of small-scale topographic influences such es forest gaps, small gullys and valleys. In future work effects of multiple scattering of solar radiation and multiple scattering of longwave incoming irradiance from terrain will be dealt with. Modelling these effects should give an clear idea of the importance of these effects for different applications (hydrology, roadweather forecast,...).