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# Surface temperature and radiation budget of snow-covered complex terrains

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The temporal evolution of the snowpack is controlled by the surface temperature, which plays a key role in physical processes such as snowmelt. It shows large spatial variations in mountainous areas, where the illumination conditions are variable and depend on the topography. The surface energy budget is affected by the particular processes that occur in these areas, such as the modulation of the illumination by local slope and the re-illumination of the surface from surrounding slopes. These topography effects are often neglected in models, considering the surface as flat and smooth. Here we aim at estimating the surface temperature and the radiation budget of snow-covered complex terrains, in order to evaluate the role of the different processes that control their spatial variations. For this, a modelling chain is implemented to derive surface temperature from in-situ measurements. The main component is the Rough Surface Ray-Tracing (RSRT) model, based on a photon transport algorithm to quantify the impact of surface roughness in snow-covered areas. It is coupled to a surface scheme in order to estimate the radiation budget. To validate the model, we use in-situ measurements and satellite thermal observations (TIRS sensor aboard Landsat-8) in the Col du Lautaret area, in the French Alps. The satellite images are corrected from atmospheric effects with a single-channel algorithm. The results of the simulations show (i) an agreement between the simulated and observed surface temperature for a diurnal cycle in winter; (ii) the spatial variations of surface temperature are on the order of 5 to 10°C between opposed slope orientations; (iii) the agreement with satellite observations is improved when considering topography effects. It is therefore necessary to account for these effects to estimate the spatial variations of the radiation budget and surface temperature over snow-covered complex terrain.