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Modelling Longwave Radiative Fluxes in Complex Alpine Topography: Investigating Parameter Sensitivity and Measures of Uncertainty

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The energy balance at the Earth's surface is the dominant force driving snowmelt, glacial runoff, and permafrost active layer dynamics amongst other physical processes in alpine regions. Sub-grid topographical effects in mountain regions, such as aspect, slope, sky view factor and surface properties, significantly modify the surface energy budget. Therefore, in recent years there has been increased interest in spatially distributed estimates of the surface energy balance at increasing spatial and temporal resolutions. This has been promoted by availability of DEMs and increased computational power.

This paper provides a comparison of several longwave downward radiative flux parameterisations and assesses suitability for application to energy balance modelling in alpine environments through a series of sensitivity studies with Monte Carlo methods. Influence of surrounding topography and both clear sky and cloudy conditions are considered.

First, several high alpine locations with available longwave radiation measurements (Meteo Swiss) in the Swiss Alps are chosen to estimate behavioural parameters for each candidate parameterisation and identify best parameterisations with which to model distributed energy balance and its associated uncertainty.

In a second step, these parameterisations are used to spatially and temporally model incoming longwave radiation in an alpine region. Monte Carlo methods are used to associate uncertainty to the distributed model outputs.