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Uncertainty in modelling the energy balance of snow and ice surfaces due to unresolved topography

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Large-scale climate models almost invariably regard land surfaces as flat on subgrid scales for the purpose of calculating radiative fluxes. Solar radiation at the surface, however, is strongly influenced by variations in slope and aspect, and these can be highly variable over a wide range of length scales in mountainous regions. On widely differing time scales, the spatial distributions of both seasonal snow patches and glaciers are sensitive to surface energy fluxes. In this presentation, a high-resolution model for solar radiation distributions over complex topography is used to assess the uncertainty in the surface energy balance arising when the topography is not resolved. Parametrizations for the areal mean and standard deviation of solar radiation within a gridbox are derived. These are applied to the problem of unresolved variations in snowmelt.