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CRYOSUB: a concept for continental modelling of cryospheric processes at sub-grid scales in high mountain regions

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This paper introduces a concept and initial results of a sub-grid scheme that will allow for continental scale modelling of cryospheric processes, especially in high mountain regions under present and simulated future climate. This is achieved by parameterising the effect of mountain topography on these processes at the sub-grid scale within a 1D lumped model that can be driven by gridded climate datasets. It is envisaged that this scheme will allow for high resolution mapping of target variables at continental scales as well as the incorporation of the most important aspects of land surface heterogeneity in mountain regions into coarse models due to reduction of computational effort by several orders of magnitude.

Primary features of the scheme are as follows: (1) Topography exerts the greatest control on surface/ sub-surface processes and boundary layer fluxes in mountain regions and therefore is the primary axis around which we discretise our model domain into a set of lumped samples using a topographic pre-processor. (2) Driving gridded climate datasets are scaled to samples based on a topographic parameterisation scheme. (3) Model simulations are performed for each sample using a 1D land surface model. (4) Model output of target variable is spatialised to model domain resolution (DEM resolution) according to sample membership.

The importance of this work is twofold, to allow for simulation output to be mapped at high resolutions in mountain regions with greatly reduced computational effort and, to allow for high mountain specific process to be represented in climate models, allowing for simulations of future climate impacts in high mountain regions.