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Inluence of snow cover on MAGST over complex morphologies

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Snow cover affects ground temperatures by increasing albedo, consuming melt energy and insulating the ground surface from cold atmospheric conditions. However such insulating effect is a non-linear function of the snow depth. Several studies show that thin snow covers promote cooling effect until a critical thickness above which a warming effect occur. In high-mountain regions, snow cover distribution and thickness are strongly variable within few tens of meters. While low slope angles promote thick snow cover, the snow depth in steep bedrock is usually shallower but also spatially more variable and intermittent. Consequently, it is hypothesized that the cooling effect is largest in medium-steep terrain and it diminishes towards both vertical rock walls, because of the absence of snow cover and more gentle terrain, which promotes thick snow cover.

In this work these hypotheses are verified performing a series of idealized 1D experiments using the hydrological model GEOtop. The experimental design is based on the comparison between the MAGST of one *dry* simulation without snow and the MAGST of many *wet* simulations, describing different scenarios of snow accumulation. The topographic complexity of high-mountain regions is summarized by a list of simulation points covering diverse aspects (0-360°N), slope angles (0-90°) and elevations (2000-4000 m). Two enforced correction of the snow depth are used for creating the many different conditions of snow amount over each simulation point. Such corrections are based on (i) the limitation of the maximum snow water equivalent admitted over the point and (ii) a reduction of the snow depth in function of the slope angle.

The experimental design developed has proved successful. The initial hypothesis have been confirmed and the variability of cooling/warming effect of snow on MAGST described. The mean annual snow depth (MASD) admitted before the warming of MAGST takes place, is spatially variable due to changes in snow density and related thermal conduction properties. Such amount of snow is higher on gentle morphologies (below 30-40°) and southern aspects, while strongly decreases towards steep slopes and shaded quadrants. Regardless the topography all the conditions which promotes the onset of a thin MASD promotes the cooling of MAGST. Consequently the cooling can potentially occur everywhere. On the other hand the warming effect can occur only on gentle terrain, which promotes thick snow cover. At higher elevation the intensity of both cooling (with thin snow) and warming (with thick snow) is enhanced as a consequence of the higher temperature difference between MAGST and mean annual air temperature (MAAT). In the experimental conditions adopted, the maximum intensity of cooling and warming due to snow ranges within 2-3 [°C]. The methods, assumption and limits of the work will be discussed.