COOLING EFFECT OF THE COARSE, BLOCKY TOP LAYER AT TWO DIFFERENTLY ORIENTED RELICT ROCK GLACIERS, AUSTRIAN ALPS

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rock glacier, temperature, blocky layer, aspect, convection

The thermal effects of coarse blocky top layers in alpine environments are investigated at two relict rock glaciers (Niedere Tauern Range, Austria). The mean annual ground temperature of blocky layers can be up to several degrees lower than the mean annual air temperature because dense cold air can easily infiltrate the debris during cold periods, whereas warm air is preferentially escaping. Furthermore, thermal convection of air within the debris can occur, especially during winter when the surface is snow covered. Therefore, landforms like rock glaciers enable permafrost to exist at lower elevations than expected based on air temperature. The two rock glaciers investigated in this study (SRG, DRG) are located in two adjacent alpine cirques and are comparable in size and geology although their genesis is different. A further difference between them is their orientation: SRG faces towards N-NE, DRG towards S-SW. Air- (AT), ground surface- (GST) and ground temperature (GT, at 1m depth) have been recorded over a continuous period of four years at several locations on both rock glaciers. The data show that for comparable elevations the mean annual AT is higher at DRG, but GT and GST are lower compared to SRG. One of the locations of DRG even shows a mean annual GT <0°C, indicating the possibility of permafrost patches at this rock glacier. Estimates of the Rayleigh number indicate that thermal convection of air during winter time is common at both rock glaciers but more distinct at SRG. Moreover, the analysis of wind data from an automatic weather station situated on SRG suggests that wind-forced convection occurs if the wind speed exceeds a threshold of 3m/s. Numerical simulations show that convection of air in the pore space of the debris is an important process of heat transfer, whereas conduction within the rocks is negligible. The colder temperatures within the DRG are likely to be explainable by the aspect of the rock glacier, which might influence the GT as sun-exposed sites show in general a later appearance and earlier melting of continuous snow cover and therefore enable cold air to infiltrate for longer periods of time.