



Assessing the recent climate change effects on Southern Carpathians permafrost

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Most of the rock glaciers from Southern Carpathians (SC) are relict or inactive in the present. A few cases of active or complex (active only across their upper parts) rock glaciers are supposed to exist in Retezat Massif (Vespremeanu-Stroe et al., 2012), but recent growth of vegetation (especially *Pynus mugo*) on their fronts arises the hypothesis of a contemporary inactivation trend.

The present work aims to evaluate how the climate oscillations from the last 70 years impacted SC permafrost. Rock glaciers feedback was assessed using permafrost creep measurements (on two rock glaciers from Retezat Massif) and estimations of the vegetation age installed on the rock glaciers fronts. We assessed the main climatic indices for the alpine area, with a focus on the cold snow free interval (SFI; autumn and early winter) which is the most critical period for permafrost existence as revealed by its correlations with the multiannual variability of the bottom temperature of snow during late winter (BTS) and with the permafrost temperature. We assessed the magnitude of SFI by calculating the freezing index ($^{\circ}\text{Ch}$) at several locations from SC. The oscillation of the freezing index during the last 70 years was possible using air temperature from high meteorological stations by establishing a relation between ground surface temperatures (GST) monitored in numerous sites from SC and air temperature.

The main findings indicate a recent climate warming, since late 1970s, who initiated a gradual rock glaciers inactivation which speeds up in the last decade (2003 – 2012) due to unprecedented low freezing indices. These are supported by the low creep values in the median and terminal parts of monitored rock glaciers comparing with the permafrost rich upper parts and by the young ages of *Pynus mugo* shrubs (few decades) which colonize the rock glaciers fronts.