Geophysical Research Abstracts
Vol. 20, EGU2018-1294-1, 2018
EGU General Assembly 2018

Permafrost distribution modeling in the marginal periglacial environment of Southern Carpathians, Romania

Razvan Popescu (1,2), Marina Virghileanu (2), Alfred Vespremeanu-Stroe (1,2), Ionut Savulescu (2), Mirela Vasile (1), Nicolae Cruceru (3,4), Bogdan Mihai (2), and Alexandru Nedelea (2)

(1) GEODAR Research Center for Geomorphology, Geoarchaeology and Paleo-Environments, University of Bucharest (rzv_popescu@yahoo.com), (2) Faculty of Geography, University of Bucharest, (3) Department of Informatics – Geography, „Spiru Haret" University, (4) Institute of Speleology „Emil Racoviță" Bucharest, the Romanian Academy

This study presents the buildup of a high-resolution permafrost distribution model in an attempt to estimate the probable permafrost surfaces in the highest massifs of Southern Carpathians, i.e. Făgăraș, Parâng and Retezat. Our approach uses accurate land cover maps obtained by NDVI calculation on Sentinel-2 MSI (10 m resolution) and Landsat 8 OLI (pansharpened at 15 m resolution) satellite imagery. Three classes of land cover represented by forest and subalpine shrubs (1), alpine meadows (2) and screes (3) were well delimited. A fourth class (mountain rockwalls) was extracted from the digital elevation model as slopes with declivity above 45°. The field methods applied in the Southern Carpathians in the last decade indicate that permafrost can only possibly occur in rock glaciers, talus slopes and rockwalls and thus we focused on spatially defining these landforms. Debris covered slopes and talus slopes were considered to be scree areas with slope angles between 17° and 45°; they were fairly differentiated using the mean value of surface curvature of each polygon. The former are usually linear or slightly convex in terms of general curvature (-0.03...+0.3) while the latter are more or less concave (<-0.03). It was important to delimit these two landforms because talus slopes present a high permafrost probability due to great thickness and debris sorting (which foster overcooling by chimney circulation and air stratification) while debris covered slopes are permafrost free in Carpathians mainly because of their reduced thickness. We also set the limits for the lower third of the talus slopes which usually contain permafrost by using the 30° slope threshold. The scree areas with slope angles below 17° were considered rock glaciers. The polygons of the three classes (rock glaciers, talus slope base and rock walls) were split upon altitude, aspect and lithology and were assigned to different permafrost probability classes (10-90%) according to the in situ measurements (thermal and geophysical) obtained by our team or from the literature. The results indicate 2D surfaces where permafrost is more or less possible of 5.9 km2 in Retezat, 4.7 km2 in Parâng and 2.5 km2 in Făgăraș. If we convert the probability classes into a spatial component we can assert that permafrost is more probable on 2.7 km2 in Retezat, 0.9 km2 in Parâng and 0.6 km2 in Făgăraș. The larger probable permafrost surfaces of Retezat and Parâng are attributed to lithology, i.e. the larger occurrence of hard rocks (granodiorites, granites and amphibolites) in comparison to Făgăraș where softer rocks prevail (micaschists and paragneisses, chlorite-sericite schists and crystalline limestones). The largest area of permafrost is found in talus slopes (44-74%) while rock glaciers have a smaller share (20-38%). Probable rockwall permafrost areas are very small in the granitic massif (<2.3%) while it increases to 35 % in the crystalline massif of Făgăraș. This approach indicated much smaller permafrost areas in comparison to previous studies and we consider it could be applied successfully in other marginal periglacial areas around the world if locally calibrated.