



## **Relict permafrost features in Mediterranean environments: the Majella Massif**

S. Cocco (1), M. Basili (1), C. Cioci (1), D. Di Peco (1), G. Brecciaroli (1), A. Agnelli (2), and G. Corti (1)

(1) Dipartimento di Scienze Ambientali e Produzioni Vegetali, Università Politecnica delle Marche, Ancona, Italy(s.cocco@univpm.it), (2) Dipartimento di Scienze Agrarie ed Ambientali, Università degli studi di Perugia, Italy

The Earth's climate has warmed by about 0.74 °C over the past century and a further warming is predicted for the next decades. Climatic changes propagate downward into the ground and modify soil thermal regime inducing many transformations. It is expected that climate warming will cause increased permafrost melting in high latitude environments and even to total permafrost degradation in regions of lower latitude. In fact, direct observations in the tundra region have shown recent increases in surface and soil temperatures and permafrost melting while in many European mountains recent micro-climatologic studies have identified only small alpine enclaves of screes with permafrost. However, in the literature no reports exist on relict permafrost in the Apennines, except for few observations about the presence of periglacial features such as rock glaciers. Some authors indicated in the past the presence of favourable conditions for preserving sporadic mountain permafrost in the Majella Massif (Central Apennines, Italy), especially in the upper Cannella Valley, where sun irradiation is particularly reduced and winds blow very energetically during the cold period. In the same valley, we monitored soil temperatures at different depths since 2006, in order to study the effects of climate change on pedogenesis and to evaluate the resilience of soils to change.

The temperature data referred to the 2006-2007 and those of 2007-2008 showed different trends. The temperatures of the first year were relatively mild and soil freezing was progressively induced from top to down soil. In contrast, during the winter of the second year the temperatures assumed the lowest values (minus 2-3°C) atop the soil, increased down soil (plus 0.5-1.5°C) till the depth of 30-40 cm and decrease to minus 1-2°C more in depth (60 cm); in addition, in depth, the temperature below 0°C were reached before than at surface. This behaviour was evidently due to a deep cold source and interpreted as a clue of the presence of relict permafrost in the ground. The presence of an even deep permafrost would explain the observations made during a previous survey in August 2004, when in a soil pit dug till the depth of 2.6 m we measured temperatures that from 22.6°C at surface progressively decreased till 2.1°C at depth. The area under study is close to the Mount Amaro where there is an active rock-glacier that some authors considered the last relict permafrost feature of Late Pleistocene glacial events that interested the Apennines.