Geophysical Research Abstracts
Vol. 18, EGU2016-14997, 2016
EGU General Assembly 2016

Seasonal frost conditions in different periglacial landforms in the Eastern Pyrenees from 2003 to 2015

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Glaciers shaped the headwaters and valley floors in the Eastern Pyrenees during the Last Glaciation at elevations above 2100-2200 m. Since the deglaciation of these areas, periglacial processes have generated a wide range of periglacial landforms, such as rock glaciers, patterned ground and debris slopes. The role of soil temperatures is decisive for the degree of activity of periglacial processes: cryoturbation, solifluction, frost weathering, etc. Nowadays, periglacial processes in the Eastern Pyrenees are driven by a seasonal frozen layer extending 5-7 months. In general, at 2100 m the seasonal frost reaches 20 cm depth, while at 2700 m reaches 50 cm depth. However, soil temperatures, and thus, periglacial processes are strongly controlled by the large interannual variability of the snow cover.

With the purpose of understanding the rhythm and intensity of soil freezing/thawing in 2003 we set up several monitoring sites along a vertical transect from the valley floors (1100 m) to the high plateaus (2700 m) across the southern slope of the Puigpedrós massif (2914 m), in the Eastern Pyrenees. The monitoring of soil temperatures has been conducted from 2003 to 2015 in different periglacial landforms using UTL and Hobo loggers. These loggers were installed at depths of 5, 20 and 50 cm at five sites: Calmquerdós (2730 m), Malniu (2230 m), La Feixa (2150 m), Meranges (1600 m) and Das (1097 m). Air temperatures used as reference come from two automatic stations of the Catalan Meteorological Survey in Malniu and Das, and with two loggers installed in La Feixa and Meranges.

No permafrost regime was detected in none of the sites. Data shows evidence of the control of snow cover on the depth of the frozen layer and on the number of freeze-thaw cycles. Air temperatures at 2000-2200 m show a mean of 150 freeze-thaw cycles per year. In La Feixa, with very thin snow cover, only 67 cycles are recorded at 5 cm depth and 5 cycles at 50 cm depth. In Malniu, located at a higher elevation showing a thicker and longer snow cover, only 17 freeze-thaw cycles per year are recorded at 5 cm depth, with no cycles recorded at 50 cm depth. Soils remain unfrozen during years with a very thick snow cover. The snow cover is also largely conditioned by the microtopography and exposure to the dominant winds. These factors condition the distribution, duration and intensity of the frozen ground and, thus, determine the intensity of periglacial processes in these areas.