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Permafrost and global warming: data from physical modelling in cold rooms

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Global climate warming, actually measured, is particularly efficient in periglacial environments where it amplifies significantly the abundance of water during spring thawing. Physical modelling experiments carried out in cold rooms have investigated (i) the efficiency of slope processes, (ii) the morphological evolution of experimental slopes and (iii) the quantification and the rate of slope erosion that follows thawing of the permafrost.

2 m square full-scale portion of natural slopes have been used to analyse the behaviour of the frozen soil during climate warming. Soil lithology has been chosen in order to give similitude between natural and experimental slope deposits.

Various sensors were integrated into the experimental soil in order to monitor temperature and to measure frost heave and down slope displacements. To simulate natural conditions, the slopes have been frozen and thawed from the surface and a permafrost is created at depth. In the experiments the water supply (melts and rains) induces an increase of water content of the active layer and consequently an increase of pore water pressure of the material. A shear strength decrease allows the initiation of gravity slides and flows.

Climate warming influences also the depth of the thawing front and has a direct impact on the flow characteristics. It controls the thickness of the thawed layer and consequently it influences the size and the composition of the flows.