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Slope morphodynamics in periglacial environments: data from physical modelling

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Physical modelling helps to constrain the impact of climate changes on landscape evolution, in periglacial environments. Data from experiments attest that changes in thermal and moisture regime influence both erosion rate and slope morphodynamics.

- When rainfall is moderate erosion processes involve (i) cryoexpulsion of the coarse blocks, (ii) frost creep and gelifluction that induce slow down slope displacements of the active layer, (iii) gravity slides leading to slow and short mass movements. Changes in slope morphology are characterised by (i) the initiation of drainage network, (ii) the development of a crest line which shows a progressive upward migration. A high erosion rate is measured at the beginning of the experiment as a consequences of gravity slides. A strong decrease in erosion rate is then observed during the period of topographic smoothing.

- When heavy rainfall is applied to the model, slope processes are reactivated leading to the more marked slope degradation. Gravity driven erosion processes become prominent. They give rise to gravity flows that initiate on the steeper slope. Flows are accompanied by marked scars. Triggering of debris flows is controlled by the topography and by the occurrence of a permafrost at deep which minimizes water infiltration and plays the role of a slip surface. The highest erosion rates are related to heavy rainfall. The rates of regressive erosion increase of about 100% when water supply evolves as expected during climate warming.

These experiments bring new data showing that slopes with permafrost are particu-

larly sensitive to changes in thermal and moisture regime. They should improve the knowledge of landscape evolution in periglacial environments, when climate warming increases both the thaw of the permafrost and the abundance of water during spring thawing.