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## Temperature and slope stability in temperate climate

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Changes in slope stability can arise from hydro-mechanical processes driven by atmosphere-soil interaction, and these processes are affected by the temperature at which they occur. This is well studied in cold climates, but even at temperatures well above freezing, experiments show significant changes in soil parameters upon comparatively small variations in temperature. These effects are typically neglected in geomechanical models, as their formulations do not typically include temperature or, if they do, they relate it to soil hydrology and not soil mechanics. Therefore, by only focusing on extremes in hydrological forcing, we may be underestimating the role of climate change in landsliding in temperate regions. Within ongoing projects, we are exploring the relationship between temperature and slope stability with various approaches and at various scales. In the laboratory, we are conducting temperature-controlled oedometer tests and ring-shear tests on saturated soils, observing patterns of strengthening or weakening in relation to both the mineralogy and shear rate. We also are evaluating correlations between basic and mechanical properties on the basis of the soil's response to heating and cooling. We are using such correlations in the field to obtain insights on slope stability, particularly of rock bodies. Focusing on soils, we are developing thermo-hydro-mechanical model formulations for slope stability under climate change. At the catchment scale, we are using statistical tools to find whether a temperature-related variable (such as the land surface temperature) can inform landslide susceptibility models. Insights from debris flow-yielding steep mountain catchments and gentle clay slopes with slow creep processes suggest the significance of temperature and its fluctuations in influencing/controlling gravitational processes also independently of its influence on vegetation and hydrological forcing.

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