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Characterization of the groundwater dynamics in landslides in varved clays

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Around a hundred landslides have occurred in the last century within the Trièves Plateau in the French Alps. The Plateau is characterized by the outcrop of varved clays and buried under a colluvium layer. The varved clays are sediments with alternating laminae of silt and clay with a thickness of 1-20 mm. The landslides are rotational or translational slides with slip surfaces at depths ranging from relatively shallow (4 to 8m) to deeper (20 to 40m). Most of these landslides are more or less continuously moving. The displacement velocities range from several millimeters to several centimeters per year.

The most important triggering mechanism for the landslides in varved clays is groundwater dynamics. The groundwater dynamics is driven by infiltration of precipitation into the colluvium layer and water flow in deep fissures, which enhances infiltration of water into the varved clays. Knowledge of the hydrological mechanisms within these types of landslides is limited and the dynamics are difficult to quantify. A better understanding is needed for the prediction of future displacements of the landslides.

The aim of this research is to characterize the groundwater dynamics in landslides in varved clays. A model is being developed to simulate the infiltration of water from the fissures into the varved clays, controlled by the water level in the colluvium. In this model the colluvium and varved clays are seen as two hydrological subsystems, which are connected by the fissures. In the upper subsystem the colluvium is modeled as an unconfined aquifer and the lower subsystem consists of the varved clays. Water is conceptualized to infiltrate horizontally into the silt layers, which are modeled as thin confined aquifers. The water level in the fissures is calculated by means of a water balance and acts as a connecting boundary condition between both subsystems. The model is used to analyze the influence of the high anisotropy and fissures on the groundwater dynamics in landslides in varved clays. Model simulations and provisional conclusions will be presented.