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Dynamic effects of vegetation on the long-term stability of slopes: components of evaporation

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Vegetation, and especially forest, is widely known to improve slope stability as a result of mechanical and hydrological effects. While the mechanical effect of root reinforcement is well recognized, the influence of hydrological effects is less certain as knowledge of the interaction between vegetation and hydrological process is still limited. Particularly the long-term and seasonal variations in evaporation and transpiration and its stabilizing effects are difficult to isolate from the overall noise in the hydrological signal as it comprises losses over different part of a vegetation stand.

The overall aim of this research is to understand and quantify the long-term stabilizing effect of forest on potentially unstable slopes. In this study we focus on the fluctuations in slope stability that arise as a result of variations in transpiration losses over the life cycle of stands.

Temporal variations in evapotranspiration comprise first of all interception that can account for an important quantity of evaporation from a forest, and it dynamically changes with seasonal and annual changes of the canopy and forest floor. In addition, vegetation requires different amounts of water for transpiration during its various growth stages.

We employed a spatially distributed, physical-based, dynamical model to estimate the hydrological behavior of vegetation on several slopes of the Combeloup catchment in France. Different vegetation scenarios were applied to simulate the hydrological consequences over the vegetation life cycle. To investigate the sole effect of vegetation, climate change and response of vegetation to climate etc., were ignored in this stage of the research.

The preliminary results indicate the influence of evaporation from canopy interception on the overall evaporation is limited for this case study area. Furthermore, the results show that the vegetation species and its growth stage drive the water consumption of the forest. Through the water balance this influences the antecedent soil moisture conditions along the slope and thus changes the response to potential triggering rainfall events..

The outcome should help to understand the long-term impact of vegetation on slope hydrology and define sustainable and reliable management strategies at the scale of forest stands.