An integrated analysis of surface velocities induced by rainfall in the Séchilienne landslide (Western Alps, France)

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An integrated analysis on the relationship between rainfall and displacement in the most active area of the Séchilienne unstable slope was performed. This study combines several techniques and models to adequately reproduce the landslide movement induced by the rainfall.

The analysis of available time series shows a long term trend and seasonal variations in the displacement, respectively independent and synchronous to precipitations. In particular wavelet analysis highlights that the movement is rather linked to groundwater recharge than to precipitation (rainfall + snowfall), involving then the importance of groundwater process in the area.
A first and simple relationship between the water input and the fluctuations of displacements apart from the general trend is shown using a tank model. Moreover, a seasonal analysis of this relationship was performed, showing that displacement rate follows the behavior of the hydrological cycle.
Two different models were applied to the long temporal series of extensometric and precipitation data: the FLAME model, from BRGM and the FORESEES model, from Univ. Lausanne. These tools are based on a combined statistical-mechanical approach to predict changes in landslide displacement rates from observed changes in precipitation amounts. The forecasting tool FLAME associates 1) a statistical impulse response (IR) model to simulate the changes in landslide rates by computing a transfer function between the rainfall and the displacements, and 2) a 1D mechanical (ME) model (e.g. visco-plastic rheology), in order to take into account changes in pore water pressures.

The performance of different combinations of models was evaluated against observed displacement rates at the selected pilot study area. Our results indicate that both models are able to reproduce, with a high degree of accuracy, the observed displacement pattern in the general kinematic regime. Finally the variability of the results, depending in particular on the input data, is discussed.