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Use of a black box model (TEMPO) to predict changes in landslide rate induced by rainfalls

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Predicting landslides is a challenge for scientists, as it may help save lives and protect individual properties or collective resources. One of the main challenges in active landslide monitoring concerns the prediction of slope's movements in the near future. This study focuses on an innovative method to predict landslide occurrences, by using statistical analyses of various data acquired in situ. Most of instrumentation systems designed for monitoring landslides induced by rainfalls are basically based on water pressure, displacement and precipitation measurements.
In this study, a black box tool is used to predict the evolution of the displacements of the movement according to the evolution of the rainfall. More specifically, the TEMPO software (Pinault and Schomburgk, 2006) allows predicting the changes in the landslide rate by computing the transfer function between the input signal (the rainfalls in this case) and the output signal (the displacements). This function is based on impulse response functions.
This method has been applied at two sites: the first one concerns the Super-Sauze landslide, which takes place in the Southern French Alps, mountainous region. This site is controlled by the active movement within black marls, with velocities ranging between 0.005 and 0.3 m per day. The second site is in the Reunion Island, where the extreme climatic conditions (cyclonic activity) produce large deformations within the active landslide, resulting in displacements large as 3 cm per 12 hours. Finally, predicting slope's movements in relation with rainfalls appears to be possible when the correlation between the two signals is sufficiently clear, as for the Reunion Island. For more complex situations the model needs to be developed, in particular for implementing some correcting aspects. These results are discussed and show the advantages as well as the limitations of TEMPO mainly related to climatic conditions.

Pinault, J.L. and S. Schomburgk (2006), Inverse modeling for characterizing surface water/groundwater exchanges, Water Resour. Res., 42, W08414,doi:10.1029/2005WR004587