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Application of an existing landslide forecast analytical model to different geographic, climatic, geological and topographic settings

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Small to medium size soil instabilities regularly cause damage to the road and train networks in France. Their triggering, type and evolution are usually linked to climatic factors but the relatively poor knowledge regarding to the coupling between precipitation, water infiltration processes, fluid flow in the landslide body and slope movements hampers an accurate prediction of the time and size of most failures.

In the framework of a new research project (Landslide risk management in urban environment and vulnerable structures) held by the LCPC (Laboratoire Central des Ponts et Chaussées), we will apply the landslide forecast analytical model proposed by Alfonsi (1997) to different geographic, climatic, geological and topographic settings. This model is based on a linear relationship between the cumulated water height and slope velocity. Requiring essentially long time histories of slope velocity, rainfall and snow recordings, it performed very well on two major landslides of the French Alps - La Clapière and Séchilienne – although these sites are characterized by notably different geological and topographic settings.

In this project, we will define whether this model is applicable to different geographic, climatic, geological and topographic settings (for instance the Martinique Island and the NW coast of France) and can therefore be used as the first-level information required to design an efficient early-warning system. Besides, we will evaluate whether incorporating water measurements at depth in addition to rainwater recordings could enhance the predictive model accuracy. To characterize the water infiltration time delays with depth, in particular the space-time distribution of water content in the vadose zone, we will equip the unstable slopes at depth with temperature or TDR sensors and compare the measurements to pluviometer data and displacement recordings. The aim is to define quantitative correlations between the potential triggering factor and slope movements. Finally, devices characterizing incoming sun radiation will be used to assess the evapotranspiration effects that may modify water infiltration process in summer time.