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# Assessment of coastal landslide hazard: the Villerville-Cricqueboeuf landslides (Normandy coast, France).

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In Normandy, along the Calvados coast, the 12 km long Pays d'Auge section is periodically affected by rotational and translational landslide since several centuries. These landslides occurred in in marly formations covered by chalks and quaternary deposits. In January 1982, major landslides have caused several damages (roads, destroyed houses) and a recession of the hillslopes. The affected slopes are the Cirque des Graves at the West of the city of Villervile and the Fosses du Macre at the East of the city of Cricqueboeuf.

To assess the magnitude and the probability of occurrence of landslides, quantitative analyses have been carried out at detailed scale (1:2,000), including morphological and geotechnical investigations, implementation of a monitoring network (surficial and deep displacements, climatic and piezometric data, etc.) and 2D slope stability calculation (limit-equilibrium methods and numerical deformation methods).

The analysis of the relationships between effective rainfall, groundwater table variations and velocity of the landslide indicate clearly that the landslide mechanisms are controlled by the hydrology. Rainfall plays a decisive part in the temporal variability of the observed movements. Analyses at different time scales (daily to yearly) have outlined hydrological thresholds triggering crises of the landslides. These thresholds are associated to the annual or pluriannual rise of the ground water table in relation to rainfall. The response time between the rain (total and/or effective) and the groundwater is generally short but vary with the season.

Indeed, for the future, on the basis of the thresholds observed during the major crises of 1988, 1995 and 2001, the modelling of the temporal variation of the GWT allowed

to propose a probability of occurrence of landslide crises.Slope stability calculations and deformation analyses allow to (1) calculate the influence of each triggering factors (pore water pressures variations, and discharge of the foot by sea erosion) and to (2) define the principle of mitigation action (drainage, foot wall defence, etc.) to reduce the level of hazard.