

Monitoring slow-moving landslides with seismic sensors: Preliminary insights from an instrumental deployment on a km-scale landslide in Nepal

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Abstract:

Satellite methods offer unrivalled spatial coverage of surface displacements on a weekly scale. However, they do not directly provide details of deformation at depth, nor do they offer sufficient temporal resolution to elucidate the continuity or intermittent nature of the landslide deformation during phases of heavy rainfall, strong rise in the water table or during intermediate seismic shaking. To address these issues in the context of the ANR/FNR project "Slide", we have recently deployed in late October 2025 a geophysical network (seismic sensors + GNSS receivers) at the level of one active landslide in Nepal ("Bolde landslide") previously identified by satellite methods. Two stations have been installed in May 2025 and one additional monitoring station has been deployed in a neighbouring landslide ("Tapgaon"), which moved significantly following the Gorka earthquake in April 2015 but has remained quite stable since then.

In this presentation, we show the very first data and preliminary analyses from the deployment of 13 short-period 3-components (3-C) seismic nodes (SmartSolo) and 3 broadband 3-C seismometers (Nanometrics Trillium Compact) inside and outside the Bolde landslide to form a network (+1 broadband seismometer in Tapgaon). One aspect of this so-called passive seismic survey relies on the analysis of the seismic ambient noise continuously recorded by 3-C sensor(s) to infer changes in the landslide's properties (i.e., weakening, reconsolidation) with time, e.g. following rainfalls or large earthquakes. If multiple sensors are used, spatial changes can be studied. Additionally, the same network of seismic sensors in Bolde allows to locate microseismicity in the area associated to creeping events along the failure planes (i.e., low magnitude seismicity not felt by humans). In complement to the measurements of ground deformation provided by the co-located GNSS stations, the seismic signals (e.g., slope quakes, tremor) provide information on how the deformation propagates at depth, whether it affects the entire slip plane simultaneously or more restricted areas, leading to a better understanding of the rupture dynamics and the construction of a model that can potentially predict the evolution of the slip along the failure plane.