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Landslides under microscope: understanding slow-moving landslides through passive microseismic monitoring

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This research project aims to develop better knowledge on the mechanisms controlling slow-moving landslides in clays through passive microseismic monitoring. Recent studies have shown that seismic monitoring is able to give interesting information on landslide mechanics and in some case to provide precursory patterns useful for failure forecasting.

Most of the seismic signals produced by mass movements have an average duration from 2 to 20s with a frequency content ranging from 10 to 150 Hz. These signals can be categorised in specific event types of elementary processes (e.g. rockfall, friction along slip surfaces, scratching and fissure opening). However, due to the sparse distribution or the relatively low density of the array of sensors located on landslides, or due to the attenuating characteristics of the landslide soil masses, most of the monitoring experiments carried out so far do not determine the real localisation and dynamic mode of the events.

The objective of this work is to present the results of field experiments carried out in autumn 2009 at two landslides developed in marls: the Super-Sauze landslide (South French Alps) and the Valoria landslide (North Italian Apennines). Both experiments consisted on the temporally installation of two arrays composed of one three-component sensor in the centre of an equilateral triangle of aperture 25-30 m, and three vertical geophones located at each angle of the triangle. At Super-Sauze, the monitoring was completed by a three-component accelerometer station in order to monitor landslide deformation in soft material and a third array with six vertical geophones was permanently installed, in order to get a long-time monitoring of the area, in correlation to the seasonal variations and the regional seismic activity. During the acquisition at the Valoria landslide, a collapse occurred in the upper part. This unpredictable phenomenon provided a high quantity of seismic events, which led to some hypothesis about how the failure process was initiated and how it developed and propagated.

The results presented here are obtained from the use of “nanoseismic monitoring”, described by Joswig (2008), which enables to resolve events in poorer Signal-to-Noise Ratios than microseismic networks, for continuous recording, and where each individual event can be isolated; with the perspective to determine better at what depth and along which material interface the source process exactly takes place.