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Timing and pattern of slope failure events at the source area of earth slides: evidence from continuous monitoring of a case study in the northern Apennines

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Ancient slow-moving landslides such as earth slides-earth flows are frequent in mountain areas where weak and complex geological formation outcrop. Their reactivation, after periods of dormant or suspended movements, is a relevant risk for socio-economic activities. Often reactivation start from the upper slope portions, generally acknowledged as the source area of most of the landslide debris presently distributed over the slope. How slope failure occurs in the source area at the onset of reactivation event has been often described only in general and qualitative terms. More rare are researches in which monitoring data have been provided in order to address issues such as the timing and the patterns of movements in such a crucial slope sector. This research deals with the analysis of a large amount of continuous field monitoring data obtained during 2007 and 2008 at the source area of the Valoria landslide with systems such as wire extensometers, in-place inclinometers, groundwater pressure transducers. The landslide is a more than 3 km long earth slide – earth flow that resumed activity in 2001 and that, ever since, has alternated suspension phases to reactivation events. In particular, monitoring data bracket the onset of the reactivation event started in October 2007, during which these monitoring systems have been able to detect and compute the timing and pattern of roto-traslational movements occurring in the crown and in the head zone of the landslide. Monitoring data have been analysed similarly to what other authors have done for large-scale rock slides, in order to highlight the functions linking displacement, pore-pressure, velocity and time of failure. The results

prove that the failure of large portions of the main scarp exhibits a direct control over the stability of the head zone, in which failure occurs rather suddenly after that portions of the crown fail rapidly. On that respect, data also show that cracks opening in the crown zone leading to these failures display repeated acceleration and deceleration phases during the same event, as a direct and rapid response to changing rainfall rates and temperature. This complicates the prediction of the time of failure of single crown portions, making the implementation of early-warning systems based on movement or rainfall thresholds rather problematic.