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Characterization of large mass movements occurred in the Italian Alps using seismic monitoring networks

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Passive seismic monitoring techniques have been profusely adopted to detect seismic sources induced by slope deformation and landslide propagation. Seismic signal processing can provide relevant information on the dynamics of unstable slopes, and may allow the identification of collapse precursors. Otherwise, seismic sensors have been used to characterize the volume and propagation velocity of rock-slides and debris-flows. For these purposes, geophone arrays are usually installed in specific monitoring sites.

However, also a broadband seismic network can be used to identify signals originated by the detachment and movements of large masses. One advantage of using these networks would be the ability to detect remote events that might otherwise go unnoticed for weeks or months. Furthermore, even if often recorded at a distance, the spectral analysis of the low frequency content of the recorded signal may allow a preliminary characterization of the phenomenon.

We selected five well known large mass movements occurred in the Italian Alps with volumes between 300.000 cubic meter (Monte Rosa rock avalanche, 2007) and 34.000.000 cubic meter (Val Pola rock avalanche, 1987). On average, seismic stations located up to 40 km far from these events were able to detect them, except for the Val Pola rock avalanche which was recorded at a distance greater than 100 km. As already observed by other authors, for these phenomena common signal characteristics include emergent onsets on all channels, slowly decaying tails and a triangular spectrogram shape. For this study we used different ground velocity sensors and considering the event magnitude, the distance source-receiver and to ensure a flat frequency response we focused on the 1-40 Hz frequency band. In this work these five large slope instabilities are described and the associated seismograms are presented and analyzed together with a first discussion of their spectral characteristics.