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Seismic data for the characterization of a rockslide and an artificially triggered rockfall

Mar Tapia (1,2), Marta Guinau (1), Marta Torné (1), Cristina Pérez-Guillén (1,3), Manuel Jesús Royán (1), Pere Roig (1), Emma Suriñach (1,2), Anna Echeverria (1), Giorgi Khazaradze (1), and Xabier Blanch (1)

(1) Grup RISKNAT, Institut Geomodels, Universitat de Barcelona, Faculty of Earth Sciences, Department of Earth and Ocean Dynamics, Barcelona, Spain (mtapia@iec.cat), (2) Laboratori d'Estudis Geofísics Eduard Fontserè, Institut d'Estudis Catalans (LEGEF-IEC), Barcelona, Spain, (3) Graduate School of Environmental Studies, Nagoya University, Nagoya, Japan

On May 5th, 2013 a planar rockslide (∼450 m3) occurred in the village of La Riba (NE Spain), which forced the closure of the road C-240z during 6 months. This slide left suspended in the slope a block of material barefoot (∼130 m3), that forced to perform a controlled blasting, followed by rock slope stabilization works.

Information on the natural rockslide was obtained from data of two permanent broadband seismic stations located 10 km from the site. We were able to confirm the existence of the rockslide and estimate its volume and its occurrence time. A single seismic station analysis using P-waves allows us to locate the event. Aerial and terrestrial LiDAR data, corresponding to the pre and post rockslide stages, respectively, were used to calculate the volume of the natural rockslide. After comparison with the seismic data we conclude that the recorded event corresponds to the fall of the largest part of the natural rockslide. It was accompanied by a set of rock blocks of smaller sizes whose seismic signal was not recorded.

Two temporary seismic stations were deployed close to the site to record the controlled blasting. Other remote sensing techniques were also used: LiDAR, photogrammetry and HD video recordings. Photogrammetry and LiDAR data allows us to estimate volumes of the fallen blocks and compare it with the values extracted from seismic data. Trajectories and propagation details of the blasted rock blocks, involving material of different size, were reconstructed from the seismic and video recordings. The high frequency content of the signals allows us to interpret qualitatively the complexity of the rockfall evolution with a detailed description not obtained in previous studies. It should be noted that the volumes involved in this work are smaller than those usually treated with similar techniques.

The results from the natural rockslide with far seismic data and the blasting with near seismic data confirm that only a small part of the energy released is transmitted into the ground as seismic energy.

Although the LiDAR and photogrammetric data have allowed the characterization of the detachments, they do not provide information on the behaviour of the materials during the displacement. Seismic signals, on the other hand, are often the only data recorded during rock detachments that considerably improve our knowledge on the propagation of the mobilized mass. The results of this work can be very useful for the characterization of rockfalls and rockslides with only seismic signal records.

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