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Magnitude-frequency of earthquake-induced rockfall events in carbonate rocks

Giovanni B. Crosta (1), Federico Agliardi (1), Paolo Frattini (1), Samuel Cucchiaro (1), Francesca Colucci (1), Andrea Crema (1), Andrea Valagussa (1), Kranitz Fabrizio (2), Sara Bensi (2), and Paolo Manca (2)

(1) Universita' degli Studi di Milano - Bicocca, Dep. Scienze Geologiche e Geotecnologie, Milano, Italy (giovannibattista.crosta@unimib.it, +39 02 6448 2029), (2) Servizio Geologico, Regione Friuli-Venezia Giulia, Via Giulia, 75/1 – I-34126, Trieste, Italy (fabrizio.kranitz@regione.fvg.it, +39 040 3774457)

Defining sound magnitude-frequency relationships for rockfall events is of great importance both to model the pattern and rate of cliff retreat, and to set up Quantitative Risk Analyses aimed at both landplanning or protective measure design. Nevertheless, magnitude-frequency relationships are based on rockfall inventories that are generally incomplete or biased. Moreover, the role played by geomechanical factors and rockfall triggering processes (e.g. earthquakes) in controlling magnitude-frequency relationships is still poorly understood. In the framework of the Interreg MASSMOVE project, we collected a large dataset of rockfall volumes related to the 1976 catastrophic Friuli earthquake sequence. The dataset includes several thousands of blocks related to both co-seismic and inter-seismic rockfall events affecting steep carbonate rock slopes in areas located at different distance from the earthquake epicentre: Venzone-Carnia (close to the epicentre), Villa Santina (about 15 km from the epicentre), and Timau (about 30 km from the epicentre, substantially unaffected by the earthquake). In order to build the dataset, we integrated historical data, field data collected immediately after the earthquake, and new geomorphological data obtained both in the field and through a multi-temporal analysis of aerial photos. Different magnitude frequency relationships were derived for the entire dataset and for specific subsets of rockfall blocks or events. The obtained results allow to discuss several issues relating to the influence of epicentral distance, the related geological and geomechanical controls, and the effects of fragmentation processes in single events on earthquake-related M-F relationships.