Geophysical Research Abstracts
Vol. 18, EGU2016-13341-2, 2016
EGU General Assembly 2016

Rockfall hazard assessment by means of the magnitude-frequency curves in the Montserrat Massif (central Catalonia, Spain): first insights

Marc Janeras, Guillem Domènech, Judit Pons, Elisabet Prat, and Pere Buxó
Institut Cartogràfic i Geològic de Catalunya, Engineering geology, Barcelona, Spain (marc.janeras@icgc.cat)

Montserrat Massif is located about 50 km North-West of Barcelona (Catalonia, North-Eastern Spain). The rock massif is constituted by an intercalation of conglomerate and fine layers of siltstones due to the Montserrat fan-delta sedimentation within the Eocene age. The current relief is consequence of the several depositional episodes and the later tectonic uplift, leading to stepped slopes up to 250 m high, and a total height difference close to 1000 m.
Montserrat Mountain has been a pilgrimage place since the settlement of the monastery, around the year 1025, and a spot of touristic interest, mostly within the last 150 years, when the first rack railway was inaugurated to reach the sanctuary. The amount of 2.4 M visitors in 2014 reveals the potential risk derived from rockfalls. To assess and mitigate this risk, a plan funded by the Catalan government is currently under development.
Three rockfall mechanisms and magnitude ranges have been identified (Janeras et al. 2011): 1) physicochemical weathering causing the detachment of pebbles and aggregates (0.0001 – 0.1 m3); 2) thermic-induced tensions responsible for the generation of slabs and plates (0.1 – 10 m3); and 3) intersection of structural joints within the rock mass resulting in blocks of 10 – 10,000 m3.
In order to quantify the rockfall hazard, a magnitude-frequency analysis has been performed starting from an event-based inventory gathered from field surveillance and historical research. A methodology has been applied to take the maximum profit of only 30 registers with information on volume and date. The massif has been split into several domains with sampling homogeneity. For each one, there have been defined several periods of time during which, all the rockfall events of a given volume have been recorded. Thus, the magnitude-frequency relationship, for each domain, has been calculated.
Results show that the curves are well fitted by a power law with exponents ranging from -0.59 to -0.68 for magnitudes between 1 and 1000 m3. For the Monastery area, one event of a volume equal or higher than 1 m3 is expected within 6 years; for the parking area, a similar return period corresponds to a volume of 10 m3. These spatial differences detected between areas of the Montserrat massif (up to one order of magnitude) must be further explored. Extrapolation of these results to the whole massif leads to 9 events per year equal or larger than 10 m3.
Finally, results have been compared with those obtained by TLS campaigns, in two pilot zones, capable of detecting small-sized rockfalls activity (Janeras et al. 2015), as well as by photointerpretation of noticeable events (Royán & Vilaplana, 2012) obtaining a satisfactory agreement.

References:

Janeras, Jara, López, Marturià, Royán, Vilaplana, Aguasca, Fàbregas, Cabranes, Gili; 2015. Using several monitoring techniques to measure the rock mass deformation in the Montserrat Massif. ISGG2015: Earth and Environmental Science 26 (2015) 012030.

Royán & Vilaplana; 2012. Distribución espacio-temporal de los desprendimientos de rocas en la montaña de Montserrat. Cuaternario y Geomorfología (2012), 26 (1-2), 151-170.