Geophysical Research Abstracts
Vol. 14, EGU2012-11412, 2012
EGU General Assembly 2012

Probabilistic Rockfall Hazard Analysis in the area affect by the Christchurch Earthquakes, New Zealand

P. Frattini (1), S. Lari (1), F. Agliardi (1), G.B. Crosta (1), and H. Salzmann (2)

(1) Universita' degli Studi di Milano - Bicocca, Dep. Scienze Geologiche e Geotecnologie, Milano, Italy (paolo.frattini@unimib.it), (2) Geobrugg AG, Switzerland

To limit damages to human lives and property in case of natural disasters, land planning and zonation, as well as the design of countermeasures, are fundamental tools, requiring however a rigorous quantitative risk analysis.
As a consequence of the 3rd September 2010 (Mw 7.1) Darfield Earthquake, and the 22nd February (Mw 6.2), the 16th April 2011 (Mw 5.3) and the 13th June, 2011 (Mw 6.2) aftershock events, about 6000 rockfalls were triggered in the Port Hills of Christchurch, New Zealand. Five people were killed by falling rocks in the area, and several hundred homes were damaged or evacuated.
In this work, we present a probabilistic rockfall hazard analysis for a small area located in the south-eastern slope of Richmond Hill (0.6 km2, Sumner, Christchurch, NZ). For the analysis, we adopted a new methodology (Probabilistic Rockfall Hazard Analysis, PRHA), which allows to quantify the exceedance probability for a given slope location of being affected by a rockfall event with a specific level of kinetic energy, integrating the contribution of different rockfall magnitude (volume) scenarios. The methodology requires the calculation of onset annual frequency, rockfall runout, and spatially-varying kinetic energy. Onset annual frequencies for different magnitude scenarios were derived from frequency-magnitude relationship adapted from the literature. The probability distribution of kinetic energy for a given slope location and volume scenario was obtained by rockfall runout modeling of non-interacting blocks through the 3D Hy-Stone simulation code. The reference simulation was calibrated by back-analysis of rockfall events occurred during the earthquake. For each rockfall magnitude scenario, 20 rockfall trajectories have been simulated for each source cell using stochastically variable values of restitution parameters. Finally, probabilistic analysis integrating over six rockfall magnitude scenarios (ranging from 0.001 m3 to 1000 m3) was carried out to produce rockfall hazard curves. These curves provide an estimate of the probability of exceeding values of kinetic energy, at each site, within a reference time interval, under the common assumption that rock-falls follow a Poisson process. Finally, by selecting reference values of annual probability of exceedance, we produced rockfall hazard maps, which are valuable tools for land planning and zonation.