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Two- and Three-dimensional coseismic rockfall modelling, Christchurch, New Zealand

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New Zealand's Canterbury earthquakes of 2010-2011 highlighted the serious nature of rockfall hazards in the Port Hills region. The Port Hills are a major east-west striking topographic feature bordering the southern edge of Christchurch, the rockfalls produced from these slopes caused several fatalities, with damage being sustained to many residential properties, infrastructure and roads. The rock falls were triggered by high levels of ground acceleration (<2.2g) loosening rocks from the rock mass along weakness planes, exacerbated by the earthquake and aftershock sequence. The extent of the damage was unexpected, with large boulder runouts of up to 900m, carrying a maximum energy ranging between 500 and 3000KJ. To prevent damage of this magnitude reoccurring, it is important to learn as much as possible about the nature of these rockfalls in order to accurately delineate a comprehensive and detailed rockfall hazard zone plan for Christchurch. This will enable land-use planning decisions to be more precise in relation to existing, planned and future developments.

A prediction model can be created based on data collected for each major rockfall-inducing earthquake, such as the amount of rock released and run out distance for each Peak Ground Acceleration (PGA) at the site during the events. Interpolation between these events will allow a prediction of the volume of rockfall to be expected from the Port Hills for any given PGA.
Data collected from Rapaki, a particularly problematic residential area in terms of rockfall, is currently being used to calibrate a site-specific model using three-dimensional simulation software. This site model will be the basis for a hazard zone/risk assessment type plan for Christchurch, which will include zonation based on probabilities and estimated level of risk. Combining results of the site and prediction models, as well as estimated earthquake recurrence intervals, will give a better understanding of rockfall hazards to residential or pre-residential areas, as well as infrastructure, on and around the Port Hills.