

HAZARD & RISK SCIENCE DOWN UNDER

In a new occasional series, we will be publishing articles relating to hazard and risk science research from the antipodes. In this issue, Christina Magill, Benfield Research Fellow in Volcanic Hazards at Risk Frontiers (Macquarie University, Sydney) writes about a new volcanic loss model developed for the Auckland Volcanic Field.

AUCKLAND VOLCANIC RISK SIZED UP

Auckland, New Zealand's most populous region, is home to over 1.2 million people and a high proportion of the nation's commerce and industry. It is also centred on the Auckland Volcanic Field (AVF), which currently hosts 49 small-volume basaltic volcanoes. VolcaNZ is a probabilistic volcanic loss model for the Auckland region developed by Risk Frontiers at Macquarie University, Sydney. The model simulates tephra (ash) fall hazards from the AVF as well as from the more distant Tuhua, Okataina, Taupo, Tongariro and Egmont volcanic centres. Losses resulting from structural and non-structural damage to residential buildings and associated clean-up costs are then calculated using Monte Carlo simulation methods.

In contrast to models that simulate perils such as earthquake, hurricane, hail and flood, a volcanic loss model must consider complex events that may extend over long periods of time and include multiple hazards at various magnitude and spatial scales. VolcaNZ provides a first step towards solving these problems and work will continue to improve the model capabilities in these areas.

Because of the long return periods between volcanic events and changes in eruption characteristics with time, VolcaNZ considers only losses associated with the next volcanic event to impact Auckland. First, the model probabilistically selects the source volcano for each simulation and determines event magnitude using geological evidence. The AVF is monogenetic, meaning that the next event will occur at a new location within Auckland. More complex calculations are therefore carried out for the AVF, with eruption positions determined and then combined with underlying geology to establish likely eruption style.

The aerial extent and thickness of tephra deposits are simulated using the Ashfall model developed by New Zealand's Institute of Geological and Nuclear Sciences. Input parameters were determined by calibration with tephra deposits preserved at Auckland and simulations take into account expected meteorological conditions. Tephra thickness is calculated at grid points and then converted to a surface so that the hazard magnitude is known for every building location within the region for each simulation.

Structural building damage may occur when more than 100mm of tephra is deposited directly on roofs or when tephra drifts against walls, foundations or chimneys. Considering previous damaging volcanic events, VolcaNZ assigns a minimum and maximum damage value to each building for every simulation dependent on the overlying tephra thickness. A central damage value, representing loss as a percentage of the total replacement cost, is then randomly selected between these limits.

Although large thickness falls are possible within the Auckland region, small thickness (1 - 10 mm) falls are expected to be far more frequent. Resulting non-structural damage arises from the corrosive and abrasive properties of tephra and is

therefore assumed to be independent of thickness. The model calculates expected losses associated with non-structural damage to roof and wall coatings, air-conditioning units, aerials and satellite dishes.

Costs associated with cleanup activities are expected to comprise a high proportion of the total loss from the next volcanic event to impact Auckland. The costs of tephra removal from buildings, cleaning of building exteriors and tephra transport and disposal are also calculated within VolcaNZ, assuming much of the cleanup process will be undertaken by homeowners.

Within VolcaNZ, loss results from all simulations are ranked and assigned average recurrence intervals to produce loss curves. Surprisingly, the smallest calculated losses arise from AVF eruptions, due to the more-limited area affected. Within Auckland, losses as high as \$20 billion NZ dollars are calculated for large volume Taupo and Okataina eruptions (central North Island). Because the model considers only damage to, and cleaning of, residential buildings, losses calculated by this first version of VolcaNZ greatly underestimate the true impact of the next eruption. Even at this early stage, however, we can already see that loss from the next volcanic event to impact Auckland will be significant.



