

Fault source characterisation in New Zealand: Magnitude-frequency distributions and aperiodicity

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We provide a precis of collaborative studies being carried out by the University of Otago and GNS Science to better characterise active fault sources for seismic hazard modelling in New Zealand. First, we are seeking to understand the strong aperiodicity of large earthquakes on many faults in low seismicity regions. For example, the Akatore Fault (eastern Otago) shows evidence of two large late Holocene ground-rupturing earthquakes, which appears to be well in excess of the long-term rate of activity of the fault. In contrast the Dunstan, Pisa, and Hawkdun range-front faults show long elapsed times since their last major ground-rupturing earthquakes (the order of 10^4 years for Dunstan, and 10^5 years or more for Pisa and Hawkdun). Ongoing work is focused on understanding the mechanical drivers of this aperiodicity, and accommodating this behaviour into seismic hazard models.

Second, we are revisiting the question of whether the magnitude-frequency distributions for fault sources are best modelled according to the Gutenberg-Richter (GR) relationship or Characteristic Earthquake (CE) model. The last three versions of the national seismic hazard model utilised the CE model. We evaluate the alternative applicability of the GR relationship by constructing GR magnitude-frequency distributions for four major fault sources (Alpine, Hope, Wellington and Ohariu). Slip rate and fault plane dimensions are used to develop seismic moment rate-balanced GR magnitude-frequency distributions, and the resulting distributions are evaluated against paleoseismic and historical seismicity data. We find that the GR relationship is compatible with these data for the four fault sources when uncertainties in the GR-predicted earthquake rates, and the expected productivity of aftershocks at time periods outside of the historical record, are considered. We are presently investigating the extent to which these findings are applicable to other faults in New Zealand.