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Numerical investigations of epistemic uncertainty in attenuation relations

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A key input in probabilistic seismic hazard assessment is the ground motion attenuation relation, delineating the peak amplitude of ground-shaking a given distance from an earthquake of a given magnitude. Typically such relations are obtained from seismic records of historical earthquakes. The low rate of seismicity in Australia and the relatively sparse distribution of seismographs precludes, in most instances, the empirical determination of ground motion attenuation relations. This has lead to the less-than-ideal scenario that an empirical attenuation relation obtained using seismic data primarily from one region (the Gippsland Basin), is applied for all of Eastern Australia. The 5-layer velocity model assumed for this attenuation relation is almost certainly not appropriate for all regions. In order to better understand the relationship between ground motion attenuation and the assumed velocity model, we utilise two-dimensional numerical simulations of wave propagation in heterogeneous elastic media. The simulation model is a layer-cake in which the velocities and depths of each layer may be varied. Earthquakes are modelled as point sources with variable seismic moment and depth. For each simulation, we compute a synthetic empirical attenuation relation. We perform an ensemble of numerical simulations varying each of the model parameters and examine the standard deviation of attenuation relation parameters obtained. Our aim is to determine which model parameters contribute most strongly to the epistemic uncertainty in ground motion attenuation relations. We also examine the influence of frequency dependant Q upon the attenuation relation, by introducing complex-valued elastic moduli.