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# On the dependency of the decay of ground motion peak values with distance for small and large earthquakes

Alain Dujardin (1), Françoise Courboulex (1), Matthieu Causse (2), Paola Traversa (3), and Tony Monfret (1)

(1) Géoazur, Université de Nice Sophia Antipolis, CNRS-OCA, VALBONNE, France (dujardin@geoazur.unice.fr), (2) ISTerre / IFSTTAR, Université Grenoble I, CNRS, GRENOBLE, France, (3) EDF, AIX EN PROVENCE, France

Ground motion decay with distance presents a clear magnitude dependence, PGA values of small events decreasing faster than those of larger events. This observation is now widely accepted and often taken into account in recent ground motion prediction equations (Anderson 2005, Akkar & Bommer 2010).
The aim of this study is to investigate the origin of this dependence, which has not been clearly identified yet. Two main hypotheses are considered. On one hand the difference of ground motion decay is related to an attenuation effect, on the other hand the difference is related to an effect of extended fault (Anderson 2000).
To study the role of attenuation, we realized synthetic tests using the stochastic simulation program SMSIM from Boore (2005). We build a set of simulations from several magnitudes and epicentral distances, and observe that the decay in PGA values is strongly dependent on the spectral shape of the Fourier spectra, which in turn strongly depends on the attenuation factor (Q(f) or kappa). We found that, for a point source approximation and an infinite value of Q (no attenuation) there is no difference between small and large events and that this difference increases when Q decreases.
Theses results show that the influence of attenuation on spectral shape is different for earthquakes of different magnitude. In fact the influence of attenuation, which is more important at higher frequency, is larger for small earthquakes, whose Fourier acceleration spectrum has predominantly higher frequencies.
We then study the effect of extended source using complete waveform simulations in a 1D model. We find that when the duration of the source time function increases, there is a larger probability to obtain large PGA values at equivalent distances. This effect could also play an important role in the PGA decay with magnitude and distance.
Finally we compare these results with real datasets from the Japanese accelerometric network KIK-net.