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Upper and lower bounds of ground-motion variabilities: implication for source properties

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One of the key challenges of seismology is to be able to analyse the physical factors that control earthquakes and ground-motion variabilities. Such analysis is particularly important to calibrate physics-based simulations and seismic hazard estimations at high frequencies.

Within the framework of the development of ground-motion prediction equation (GMPE) developments, ground-motions residuals (differences between recorded ground motions and the values predicted by a GMPE) are computed. The exponential growth of seismological near-source records and modern GMPE analysis technics allow to partition these residuals into between- and a within-event components. In particular, the between-event term quantifies all those repeatable source effects (e.g. related to stress-drop or kappa-source variability) which have not been accounted by the magnitude-dependent term of the model.

In this presentation, we first discuss the between-event variabilities computed both in the Fourier and Response Spectra domains, using recent high-quality global accelerometric datasets (e.g. NGA-west2, Resorce, Kiknet). These analysis lead to the assessment of upper bounds for the ground-motion variability. Then, we compare these upper bounds with lower bounds estimated by analysing seismic sequences which occurred on specific fault systems (e.g., located in Central Italy or in Japan). We show that the lower bounds of between-event variabilities are surprisingly large which indicates a large variability of earthquake dynamic properties even within the same fault system. Finally, these upper and lower bounds of ground-shaking variability are discussed in term of variability of earthquake physical properties (e.g., stress-drop and kappa_source).