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A 'benchmarking' exercise on the performance of kinematic ground motion simulation codes

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It is well known and documented that the time- and frequency-domain characteristics of earthquake ground motion vary significantly. This variation can occur as a consequence of source properties, wave propagation through different earth strata, soil media and topographic features. The quantification of this uncertainty is important and now an integral part of research and application projects alike. In most of these projects the simulations are carried out using a single numerical code. Although many of the codes that are being used for ground motion simulation purposes rely on the same theoretical basis, variations in numerical implementation may result in simulated waveforms that differ from each other even if similar input parameters are used in the definition of the source, path and local soils.

To address this problem a simulation layout was designed with 50 simulation points, a one-dimensional crustal model and a vertical fault plane with a strike-slip mechanism. The codes by Madariaga, Bouchon, Spudich, Wang and Irikura were included in the exercise. The simulation parameters were varied to test their influence on the resulting ground motion for each simulation code. The simulation points are positioned at 1, 5, 15, 30 and 50 km distance to the fault with 10 observation points in each line. Our simulation area effectively covers 150 km x 50 km. The varied source parameters were slip, rise time, subfault size, and rupture velocity. The results were compared in the time domain (wave forms, peak ground displacements, velocities and accelerations, durations) and in the frequency domain (fourier amplitudes, response spectra)