VARIABILITY IN SYNTHETIC EARTHQUAKE GROUND MOTIONS CAUSED BY SOURCE VARIABILITY AND ERRORS IN WAVE PROPAGATION MODELS

Paul SPUDICH [1], ***Antonella CIRELLA*** [2], ***Laura SCOGNAMIGLIO*** [2], ***Elisa TINTI*** [2]

[1] U.S.Geological Survey, Earthquake Science Center, Menlo Park, USA
[2] Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy

Numerical simulations of earthquake ground motions are used both to anticipate the effects of hypothetical earthquakes by forward simulation and to infer the behavior of the real earthquake source ruptures by inversion of recorded ground motions. In either application it is necessary to assume some Earth structure that is necessarily inaccurate and to use a computational method that is also inaccurate for simulating the wave field Green's functions. We refer to these two sources of error as "propagation inaccuracies," which might be considered to be epistemic. We show that the variance of the Fourier spectrum of the synthetic earthquake seismograms caused by propagation inaccuracies is related to the spatial covariance on the rupture surface of errors in the computed Green's functions, which we estimate for the case of the 2009 L'Aquila, Italy, earthquake by comparing erroneous computed Green's functions with observed L'Aquila aftershock seismograms (empirical Green's functions). We further show that the variance of the synthetic seismograms caused by rupture variability (aleatory uncertainty) is related to the spatial covariance on the rupture surface of aleatory variations in the rupture model, and we investigate the effect of correlated variations in Green's function errors and variations in rupture models. Thus, we completely characterize the variability of synthetic earthquake seismograms induced by errors in propagation and variability in rupture behavior. The results of this work might be useful in seismic hazard estimation because the variability of the computed ground motion, caused both by propagation inaccuracies and variations in the rupture model, can be computed directly, not requiring laborious consideration of multiple Earth structures.