ESC2016-390, 2016
35th General Assembly of the European Seismological Commission

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4–10 September 2016 Trieste

Variability of the simulated ground motion from a set of source models of the 2011 Mw5.2 Lorca earthquake

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A seismic event occurred on 11 May 2011 close to the town of Lorca (South-East Spain); despite the moderate magnitude (Mw=5.2), the damages were relevant. The largest PGA value (360 cm/s2) ever recorded so far in Spain was recorded at the accelerometric station located in Lorca (LOR), and it was explained as due to strong directivity effects rather than to strong path/site amplifications. In the last years, multiple source models, retrieved by the inversion of geodetic data, seismological signals or a combination of both, have been published, giving us the great opportunity to investigate the variability of the computed ground motion for a moderate earthquake, as effect of the various source models. To this aim, we estimated the ground shaking adopting the wavenumber integration method (up to 1 Hz) and selecting, from the literature, four different source models. The results show that the computed ground motion can vary considerably, especially in the forward directivity area (SW from Lorca). For instance, the velocity response spectra at 2.0 s period ranges within one order of magnitude, though the uncertainties are well within the standard deviation of the GMPE estimates. Of course the observed variability reflects the uncertainties on the inversion methods, the different algorithms and the parametrization adopted in the different source studies.
In our low-frequency simulation the seismograms recorded at LOR are well reproduced by a source with a single asperity and unilateral rupture toward SW. We used the same model to compute strong motion simulations in the high-frequency up to 10 Hz using the Empirical Green Functions approach. We obtained an excellent fit for the LOR data, while we underestimated the motion recorded at stations located NE from the epicentre probably due to unmodelled backward directivity and/or local soil effects.