HYBRID BROADBAND GROUND-MOTION SIMULATIONS FOR THE 2016 AMATRICE EARTHQUAKE, CENTRAL ITALY, AND SENSITIVITY OF GROUND-MOTION TO EARTHQUAKE SOURCE PARAMETERS

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Abstract

On 24th August 2016 at 8:15 UTC, a M6.2 earthquake struck several villages in central Italy, including Cumiana, Accumoli, and Amatrice. It caused 299 fatalities, major destruction, and extensive damage in the surrounding area (up to 11 intensity degree). The earthquake was followed by 5.68 (M) aftershocks occurring in the National Earthquake Network (RAN) of the Tuscany Region of Civil Protection, to the National Earthquake Network (Regione Lazio Module, RSN) of the Institute of Geophysics and Volcanology (INGV), and in other local networks. This earthquake represents a unique field event, allowing to the high levels of observed ground motion and damage, and to this context, several hypotheses were used to check the hybrid model approach based on a dynamic code analysis.

Conclusions

- We integrated the dynamically simulated earthquake scenarios of the paper into the ATCC model, based on a frontal view of available data from the 2011 and 2016 earthquakes (Tinti et al., 2011) and Herrero et al. (1994). To test the KF model, we used the simulation results (Herrero et al., 2017a) and combined it with the hybrid approach (Herrero et al., 2017b). The results show that the hybrid approach better agrees with observed values for most of the stations.

Results

- Synthetic hybrid recordings and Fourier amplitudes are generally comparable with observed ones.
- Acoustic analysis (AAV and NOA) shows good agreement with the simulated values.
- At all distances, ground-motion parameters agree better with EADAT and C80E50 than with the GMPEs.
- While the near-field effects are governed by the source effects, far-field effects are dominated by the path effects, ground motion being comparable at similar distances.

Method

- Low-frequency subevents were obtained by Tinti et al. (2016) by correcting the recordings of the 3D input component simulations of the RAN and RSN networks closest to the epicenter (Fig. 12). The hypocenter, used in the hybrid approach, is the result of Chiarabba et al. (2016), as implemented by Herman et al. (2017). The input subevents were combined with the hybrid approach and the fault distribution for each event. The results show that the hybrid approach better agrees with observed values for most of the stations.

1. Simulated signals

2. Comparison with GMPEs

3. Residuals

4. Spatial distribution of ground motion parameters

5. Directivity and site effects

6. Conclusions

In the near field, we have found that, rather than the use of GMPEs, hybrid simulations have a smaller capability to detect near-source effects and to reproduce the source complexity as the site effect. However, this effect is observed at sites with high seismicity and high-frequency content. In this case, hybrid simulations improve ground motion predictions.

Finally, the use of site-specific amplification factors derived from the observed data is recommended to improve ground motion predictions.