Modeling Directivity Effects of the October 31, 2002 (MW=5.8), Molise, Southern Italy, Earthquake.

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SUMMARY

1. On October 31 (10:32 UTC) and November 1, 2002, two moderate earthquakes (MW=5.8 and MW=5.7, respectively) struck the Molise (Southern Italy) region, causing damage in an area comprising 29 municipalities.

2. Acceleration data recorded by the Italian Strong Motion Network (RAN) show a strong anisotropy in PGA distribution associated with the October 31 mainshock. The closest stations, located approximately at the same epicentral distances but to the east and west from the source, exhibit strong differences in the ground shaking level with PGA ratios up to 10.

3. Mainshocks sources were located at about 20 km depth, on a seismogenic structure underlying the Apulia Platform. At corresponding depths more than 1900 aftershocks were detected by a temporary seismic network, installed soon after the main event. Two different couples of seismogenic sources were proposed for the mainshocks: VDL31/01 (Valle and Di Luccio, 2003) and BV31/01 (Basil and Vannoli, 2005).

4. Since only BV31 model allows for effective horizontal unilateral rupture propagation, we test the proposed seismogenic sources by comparing synthetic and recorded acceleration data at nearby stations. Synthetic accelerations of the October 31, Mw 5.8 event, were obtained at a high frequency technique (DSM, Pacor et al., 2005), and compared with data that was performed in term of peak values and frequency content. Although acceleration data recorded at some stations exhibit relevant spectral amplifications, probably due to site effects, especially for eastward sites, BV31 model produces a better fit with recorded data than VDL31 model. Also, comparison between synthetic and recorded PGAs favours BV31 model, suggesting an eastward unilateral propagation for the October 31 event.

5. Both DSM and the Hybrid Integral Composite (HIC) method of Gallovic and Brovko (2006) were employed to simulate the ground motion up to 150 km epicentral distance. Synthetic peaks obtained by both methods follow the same general trend of recorded PGAs. As regard to HIC synthetics, the observations have lower difference between NS and EW peak accelerations. This could be perhaps addressed to vanishing radiation pattern at high frequencies.

4. Verification test on rupture directivity

- BV31 model
- VDL31 model

5. Far field simulations

- Horizontal Peak Ground Accelerations
- DSM: ground shaking maps
- HI: spectral accelerations and time series at nearby sites

Simulation details

- 3D slip distribution
- Sub-sources database
- Hybrid approach
- Cross-over

October 31, 2002: closest eastward stations. Forward directivity?

October 31, 2002: closest westward stations. Backward directivity?

References

- Gallovic, F. and Brokesova, J. (2006), Hybrid k-squared method, as described in the “Simulation details” box.

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