SOURCE MODELLING OF THE 1998 LAURIA EARTHQUAKE (MW 5.4) IN SOUTHERN ITALY BY SIMULATION OF THE GROUND ACCELERATION TIME HISTORY

Simulations of the acceleration time-history using the stochastic modelling method proposed by Beresnev and Atkinson (1997) have been performed in order to characterize the seismogenic source of the September 9, 1998 Lauria earthquake (Mw = 5.4). This earthquake occurred in the Pollino area, a really complex zone from the geological point of view marking the transition between the highly seismogenic tectonic domains of Southern Apennines and the Calabrian Arc. Different strain orientations coexist and interact in this transitional area, such as the NE-SW and E-W oriented extensional regimes of the southern Apennines and northern Calabria, respectively. Seismic catalogs based on historical information do not include seismic events with reported intensities greater than VIII (MKS) in the Pollino area. However, paleoseismological investigations (Michetti et al., 2000) have recently revealed that events exceeding this threshold may have occurred in the specific zone and are to be taken into account for hazard evaluations.

The inversion of teleseismic waveforms for the 1998 mainshock as shown in Fig. 2 yielded a normal faulting mechanism along NW-SE trending nodal planes. The source depth was found equal to 16 km and the source time function has a trapezoidal shape with rise time of 0.8 s and a total duration of ~5 s. From the two nodal planes and the distribution of aftershocks as shown in Fig. 1 it was difficult to identify the fault plane. Thus we used the information from the strong motion data to confine the fault plane.

Fig. 1 - Surface projection of the fault plane and epicentre locations of the aftershocks of the sequence (squares). Triangles indicate the locations of the seismic stations used for simulations. The ABCD and EFG segments indicate the nearest geological faults recognised on the map, and the IH dashed line indicates the intersection of the rupture area with the surface.
Fig. 2 - Focal mechanism of the Lauria 1998 mainshock determined from teleseismic waveform modelling.

We performed hundreds of simulations by varying the source model parameters and found the best agreement with the observed data for the NW-SE trending plane dipping 50° to NE, and a rupture area of 8 x 7 km² with upper and lower edges located at 5 km and 12 km, respectively. This solution is in agreement both to a mapped fault located a few kilometres southeast of Lauria and to the Southern Apennine regional strain field. The surface projection of the fault plane as shown in Fig. 1 together with the epicenter locations of the aftershocks of the sequence, indicates a quite good correspondence between the source location and the aftershock distribution.

The reliability of the source model is further supported by the low values (30%) of residuals estimated for the S-wave duration and pga parameters when comparing simulated and observed waveforms. Moreover, the observed spectrum amplitudes are well reconstructed by the simulation at all stations, especially for frequencies greater than 4 Hz (Fig. 3).

Fig. 3 - Comparison among the observed signal horizontal component spectrum (grey dashed lines) and the simulated spectrum (solid black line) at all three stations

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