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Palermo 2010 - Underwater seismic monitoring of the epicenter area of the 6 September 2002 Palermo Earthquake

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The northern Sicily offshore is one of the most seismically active areas of the Italian territory, but because of its position with respect to the national seismic network of the INGV, the minimum magnitude of completeness in its central-western sector is about ML= 2.
On the 6th September 2002, at 01:21 UTC, a strong earthquake (Mw 5.9) occurred in this area. The seismic event was recorded by the INGV network and located at about 50 km in NNE direction, from the Palermo city. In the following months, more than a thousand of aftershocks were located in the same epicentral area, describing a narrow sub-vertical seismogenic volume (large about 20 km and long more than 80 km) within the crustal thickness (Giunta et al., 2004).
In the last years the Centro Nazionale Terremoti of the INGV invested in developing its own OBS/H. In December 2009, about seven years after the Palermo seismic crisis, the OBSLab of Gibilmanna installed an OBS/H near the epicentral area of the mainshock, at a depth of about 1500 m. The OBS/H was equipped with a Guralp CMG40T-OBS 3C seismometer, an HTI-04-PCA/ULF hydrophone and a Tinytag ACS-0001-PK temperature logger and it was recovered in July, after about 8 months of operation.
During the seismic monitoring campaign, the OBS/H recorded several teleseismic and regional earthquakes and about 250 local micro-events not located by the INGV on-land network.
Their local magnitude is included in the -0.5/2.5 range, and the TS-TP time difference is included in the 0.2/5 s range. A visual analysis of the seismograms revealed some similarity. Many authors observed that earthquakes with very similar waveforms (multiplets) are typical of earthquake swarms and probably linked to repeated slip on the same fault plane (Maurer and Deichmann, 1995; Poupinet et al., 1984). To better characterize the recorded microseismicity we applied a clustering technique to group similar events.
We measured the similarity between the waveforms of different events by the cross-covariance function. The distance matrix, based on the maximum of the normalized cross-covariance function between couples of events, was used to construct the dendrogram for 124 microevents. For its construction, an agglomerative hierarchical clustering algorithm, based on nearest neighbor, was used.
We found 9 distinct clusters and some doublets and triplets with very high similarity level. The earthquakes were located with a 3C single station location technique, based on the polarization analysis of the signals (Frohlich and Pulliam, 1999). The spatial distribution of the hypocenters is in agreement with the waveforms clustering and shows different but also superimposed hypocenters clouds, almost all close to the Palermo 2002 cluster (Giunta et al., 2004). However, the microevents magnitude-time distribution shows that some events, clustered in the waveform and hypocentral domains, are not clustered in the time domain. Different source models and mechanical behaviors have been invoked to explain the diversity of these seismogenic processes.

References

Frohlich, C., and J. Pulliam (1999). Single-station location of seismic events: A review, and a plea for more research, Phys. Earth Planet. Int., 113, 277-291.
Giunta, G., Luzio, D., Tondi, E., De Luca, L., Giorgiani, A., D'Anna, G., Renda, P., Cello, G., Nigro, F., e Vitale, M., (2004). The Palermo (Siciliy) seismic cluster of Septermber 2002, in the seismotectonic framework of the Tyrrhenian Sea-Sicily border area, Ann. of Geoph., 47, 6, 1755-1770.
Maurer, H., and N. Deichmann (1995). Microearthquake cluster detection based on waveform similarities with an application to the western Swiss Alps, Geophys. J. Int. 123, 588-600.
Poupinet, G., W. L. Ellsworth, and J. Frèchet (1984). Monitoring velocity variations in the crust using earthquake doublets: an application to the Calaveras fault, California, J. Geophys. Res. 89, 5719-5731.