Automatic Detection, and P- and S-wave Picking Algorithm: an application to the 2009 L'Aquila (Central Italy) earthquake sequence.

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In order to process as quickly as possible the enormous amount of digital waveforms continuously recorded at permanent and temporary seismic stations in Italy, we implemented a semi-automatic procedure in order to identify local earthquakes and to provide consistently-weighted P- and S-wave arrival times.

Local earthquake detection is obtained by a STA/LTA ratio-based algorithm applied to 3-component seismograms from individual stations. A minimum of 4 triggered stations are required to declare a seismic event. This setting proves to be extremely effective to detect a large number of very-low magnitude earthquakes (ML>1.5) with a small number of false alarms.

The automatic picking system Mannekenpix (Aldersons, 2004), originally working on vertical component data, has been expanded to tackle 3-component data. In order to increase the reliability of P-wave and S-wave picking, the system is now virtually capable of discriminating among noise samples, P-wave samples and S-wave samples. This Identification is performed by a C5 decision tree (Quinlan, 1993) derived from training data. Five groups of predicting variables are included: Energy, Polarization, Spectral Power, Skewness and Kurtosis. In addition, the SEDSL algorithm (Magotra et al., 1989) is also used as a predictor.

The picking procedure requires a preliminary calibration derived from a reference subset of high-quality manual picks. After calibration, the picking system is statistically able to mimic the picking by a human analyst and to provide consistent uncertainty estimates translated into picking weights.

We illustrate very satisfying results of the automatic procedure showing P- and S-phase automatic readings for the L'Aquila sequence. The readings are fully comparable to those of a good human analyst, allowing high-quality earthquake locations of low-magnitude events in an extremely short amount of time. For a full day of continuous recording, we obtain around 2600 triggers, from which 75% lead to high-quality located events (mean RMS 0.1s) with at least 25 phase readings.

References

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