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Automated Master Event Full Waveform Location, An Application to NW Bohemia

Sergio Gammaldi (1,2), Francesco Grigoli (3), Simone Cesca (2,3), Gilberto Saccorrotti (4), and Josef Horálek (5)

(1) University of Pisa, Italy (s.gammaldi@live.it), (2) GFZ German Research Centre for Geosciences, Potsdam, Germany, (3) Institute of Earth and Environmental Sciences, University of Potsdam, Germany, (4) Istituto Nazionale di Geofisica e Vulcanologia, Pisa, Italy, (5) Geophysical Institute, Academy of Science Czech Republic, Prague, Czech

Automated seismic event location is an important task in seismic and microseismic monitoring operations, where one deals with large datasets of generally weak seismic events characterized by low signal-to-noise ratios. In such applications, manual location procedures are time consuming or in some cases not applicable. In the last years, several automated location method based on waveform stacking have been developed and successfully applied to different datasets recorded at local and regional distances. These methods are noise robust and do not require manual phase picking and identification. On the other hand, they require a good knowledge of the seismic velocity model. We focus here on the location approach developed by Grigoli et al. (2013, 2014) based on the stacking of short time average to long time average ratios (STA/LTA) traces of characteristic functions, using both P and S phases. For the P phase, we use the STA/LTA traces of the vertical energy function. For the S phase, the method performance was improved using a second characteristic function, based on the principal component analysis technique. Here, we further extend this method using a master event approach. Characteristic functions are stacked using travel time tables, which are derived from theoretical travel time differences with respect to a reference location, and observed arrival times for a reference event. Our new relative location method presents several benefits, which improve the location accuracy. First, it accounts for phase delays, due to local site effects, e.g. surface topography or variable sediment thickness. Second, theoretical velocity model are only used to estimate travel time within the source volume, and not along the entire source-sensor path. After testing the method with synthetic data, we applied it to real data related to earthquakes in NW Bohemia. This work has been funded by the German BMBF “Geotechnologien” project MINE (BMBF03G0737A).