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# A consistent and uniform research earthquake catalog for the AlpArray region

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A homogeneous earthquake catalog –in terms of location and magnitude– is a prerequisite to improve our understanding of the seismotectonics and the seismic hazard in the greater Alpine Region. The AlpArray initiative (www.alparray.ethz.ch), with its AlpArray Seismic Network (AASN) operational since 2016, provides unprecedentedly uniform station coverage for the region with more than 650 broadband seismic stations, 300 of which are temporary.

We take advantage of this large dataset to: i) provide consistent and precise hypocenter locations and ii) provide preliminary but uniform magnitude calculations across the region. For these purposes, we collected the first two years of data (2016-2017) from more than 1000 stations (> 20TB of data), systematically checking the data and metadata quality. Our workflow is based on two steps: 1) Initial detection from continuous data in SC3 framework including STA/LTA trigger, Baer-post picker for P, postlocator Nonlinloc, ML, etc. 2) Refinement of the associated picks by sophisticated P+S post pickers including automated quality assessment of timing and phase identification. First, we detect events in the region during 2016 and 2017 using the STA/LTA based detector of the SeisComP3 monitoring system in off-line mode. Triggers are improved by the application of a post-picker using the Baer-Kradolfer algorithm. To minimize the impact of erroneous automatic picks on the location, the initial automatic hypocenters are derived by the Equal-Differential Time (EDT) algorithm implemented in the NonLinLoc location software. In addition, a quality-score is determined for each automatic origin and the one with the highest score is the preferred solution for the event.

Among the detected events, we select 20 geographically homogeneously distributed events with magnitudes $\geq 2.5$ representative for the entire catalog. We manually pick the selected events to establish a consistent phases reference data set (P-, S- and secondary phases), including arrival-time time uncertainties. The reference data, are used to adjust the secondary, high-quality automatic post-picker. We use a Python-based framework that combines well established picker algorithms, a multiple picking evaluation and Python libraries for Machine Learning classification algorithms to automatically assess phase-recognition and timing uncertainties (see abstract of Bagagli et al., 2019).

Subsequently, the high-quality automatic picks of all well-locatable earthquakes are used to calculate a minimum 1D P-wave velocity model for the region with appropriate stations corrections. Finally, all the events are relocated with the NonLinLoc algorithm in combination with the updated 1D model. We compare our locations with existing earthquake catalogs (ISC, EMSC, national catalogs). The proposed procedure represents an important step towards the uniform earthquake catalog for the entire greater Alpine region using the AASN.