Geophysical Research Abstracts
Vol. 13, EGU2011-6927, 2011
EGU General Assembly 2011

Automated P- and S-phase arrival time estimation at local and regional distances

Ludger Kueperkoch (1), Thomas Meier (2), Andrea Bruestle (1), Jimin Lee (1), Wolfgang Friederich (1), and The Egelados Working Group (3)

(1) Ruhr-Universität Bochum, Institut für Geologie, Mineralogie und Geophysik, Germany (ludger.kueperkoch@rub.de), (2) Christian-Albrechts-Universität zu Kiel, Institut für Geophysik, (3) University of Hamburg (Germany), Aristotle University of Thessaloniki (Greece), Istanbul Technical University (Turkey), National Oberservatory of Athens (Greece), GeoForschungsZentrum Potsdam (Germany), Technical University of Crete (Greece)

The increasing amount of seismological data derived from permanent and temporary networks requires more and more the application of automatic procedures for phase arrival time estimation and event location. Furthermore, automated algorithms are the basis for any earthquake early warning system, where precise event location is expected within near-real time. Here we present automatic procedures for fast and robust P- and S-onset time estimation.
For P-onset time estimation, a characteristic function (CF) is calculated from the time series based on higher order statistics. A preliminary arrival time is estimated based on the Akaike Information Criterion (AIC) determined from the CF. Based on this approximative onset time the CF is recalculated from the time series in the vicinity of the preliminary P-onset taking into account a broader frequency range. A sophisticated picking algorithm is then applied to the recalculated CF to estimate the P-arrival time at high precision.
For S-onset time estimation, autoregressive (AR) prediction of the waveform is applied to both horizontal components. We show that the prediction error detects instantaneous changes in amplitude, frequency, phase, and polarization when using one AR model for predicting both single horizontal component waveforms. The rms-prediction error serves as a CF to which the same picking procedure is applied as for P-onset time estimation. Furthermore, we show that for S-onset time estimation the application of AR orders of 2 or 4 are sufficient.
An automated quality assessment is implemented using signal-to-noise ratios of both the filtered seismogram and the corresponding CF, and two slopes of the CF after the estimated onset time. One slope is calculated within a very small time window to take into account the very local behaviour of the CF after the pick and a second slope is calculated within a longer time window to recognize the more global behaviour of the CF after the onset time.
The algorithms are tested on a large data set derived from recordings of a regional, temporary network in the aegean, which covered the entire Hellenic subduction zone and continuously monitored the seismicity for 18 months. We show that automated onset time estimation and location is feasable even for data sets with very heterogeneous signal-to-noise ratios. Furthermore, the proposed algorithms are well suited for the implementation in an earthquake early warning system.