Geophysical Research Abstracts
Vol. 21, EGU2019-10671, 2019
EGU General Assembly 2019

Development of a harmonized parametric catalog for ground shaking studies in Europe using EIDA, and analysis of regional attenuation features

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With the recent development of the European Integrated Data Archive (EIDA, http://www.orfeus-eu.org/data/eida/), an open-access infrastructure where data from different networks operating in Europe are archived and disseminated following common standards, we have the opportunity to compile harmonized ground-motion data sets for seismic hazard assessment studies. Here, we present a new and harmonized parametric catalogue for ground shaking studies in Europe obtained using stream2segment, a highly customizable Python package helping the user in the whole workflow of downloading, inspecting and processing event-based seismic data by means of a relational database management system as archiving storage. We used stream2segment to extract segments from EIDA containing recordings of earthquakes with magnitude above 2.5 in continental Europe and above 3 in the Mediterranean area. Through stream2segment, a customized processing pipeline is applied to discard noisy data and to extract parametric information for compiling a parametric table (aka flat file). The flat file (12500 earthquakes, 2200 stations and 205000 records) includes peak parameters (e.g., peak ground velocity and acceleration), spectral acceleration, and Fourier amplitude spectra. As first application of the flat file, here we present the calibration of a harmonized local magnitude scale for Europe. We first calibrate simultaneously a set of non-parametric attenuation functions regionalized over six different regions covering Europe, and anchoring the models to the Richter's scale at 17 km. Uncertainties on the attenuation coefficients, station corrections and magnitude values are evaluated through bootstrap analysis. A second calibration step is performed to derive a parametric attenuation model considering a piece-wise linear function to describe the attenuation with the logarithm of distance, and introducing two hinge-distances at 10 and 60 km. For distances above 10km, we also consider the anelastic attenuation term. We apply a mixed effect regression with network-dependent random effects on the anelastic coefficients. The obtained non-parametric attenuation functions show significant differences among the regions, up to 0.4 m.u. at 400 km, being the attenuation stronger for regions in the Mediterranean area. The non-parametric analysis also highlights the region-dependent changes in the rate of attenuation with distance due to the effects of later arrivals generated by crustal heterogeneity. The parametric analysis confirms the stronger attenuation for networks operating in the Mediterranean area, such as the Italian and Greek networks, with respect to networks located in continental Europe. The network-dependent random effects allow to quantify the between-network variability for different networks operating in the same region or country. The observed between-network variability is within ± 0.2 m.u., smaller than the variability among the six regions.