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Properties of induced seismicity at the geothermal reservoir Insheim, Germany

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Within the framework of the German MAGS2 Project the processing of induced events at the geothermal power plant Insheim, Germany, has been reassessed and evaluated. The power plant is located close to the western rim of the Upper Rhine Graben in a region with a strongly heterogeneous subsurface. Therefore, the location of seismic events particularly the depth estimation is challenging. The seismic network consisting of up to 50 stations has an aperture of approximately 15 km around the power plant. Consequently, the manual processing is time consuming. Using a waveform similarity detection algorithm, the existing dataset from 2012 to 2016 has been reprocessed to complete the catalog of induced seismic events. Based on the waveform similarity clusters of similar events have been detected. Automated P- and S-arrival time determination using an improved multi-component autoregressive prediction algorithm yields approximately 14.000 P- and S-arrivals for 758 events. Applying a dataset of manual picks as reference the automated picking algorithm has been optimized resulting in a standard deviation of the residuals between automated and manual picks of about 0.02s. The automated locations show uncertainties comparable to locations of the manual reference dataset. 90 % of the automated relocations fall within the error ellipsoid of the manual locations. The remaining locations are either badly resolved due to low numbers of picks or so well resolved that the automatic location is outside the error ellipsoid although located close to the manual location. The developed automated processing scheme proved to be a useful tool to supplement real-time monitoring.
The event clusters are located at small patches of faults known from reflection seismic studies. The clusters are observed close to both the injection as well as the production wells.