EGU2020-5242, updated on 20 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-5242
EGU General Assembly 2020

Occurrence of earthquake doublets in the light of the ETAS model

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While Probabilistic Seismic Hazard Assessment is commonly based on earthquake catalogues in a declustered form, ongoing seismicity in aftershock sequences is known to be able to add significant hazard, which can also increase the damage potential to already affected structures in risk assessment. Especially so-called earthquake doublets (multiplets), i.e. a cluster mainshock being followed or preceded by one (or more) events with a similarly strong magnitude occurring within pre-defined temporal and spatial limits, can cause loss multiplication effects to the insurance industry, which therefore has a pronounced interest in investigating the frequency of earthquake doublets to happen worldwide. A widely used method to analyse and simulate the triggering process of earthquake sequences is the Epidemic Type Aftershock Sequence (ETAS) model. We estimate the ETAS model parameters for some regional areas and produce synthetic catalogues, which are then analysed particularly with respect to the occurrence of earthquake doublets and compared to the observed history. Also, different seismic subduction-type regions in the world are pointed out to have shown differing relative frequencies of earthquake doublets. Regression models are used to study whether certain mainshock and local, geophysical properties such as magnitude, dip and rake angle, depth, distance to subduction plate interface and velocity of converging subduction plates nearby show explanatory power for the probability of a cluster containing an earthquake doublet.