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The importance of earthquake interactions in forecasting injection induced seismicity: retrospective modelling of the Basel Enhanced Geothermal System

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We explore the role of earthquake interactions during an injection induced seismic sequence. We propose a model, which considers both a transient pressure and the static stress redistribution due to event interactions as triggering mechanisms for induced seismicity. We produce more than one thousand of stochastic seismic catalogues that allow a probabilistic analysis of the problem. By calibrating the model against observations at the Enhanced Geothermal System (EGS) of Basel, Switzerland, we are able to reproduce the time behaviour of the seismicity rate. In particular, we observe that considering earthquake interactions in the modelling can lead to a larger number of expected seismic events (27% more) if compared to a pressure-induced seismicity only. The increase of the rate is true particularly after the end of the injection activity, in accordance with the simultaneous increase of the Coulomb Index (CI, i.e. the percentage of events that occur in locations with positive, cumulative Coulomb static stress changes).
We conclude that implementing a model for estimating the static stress changes due to mutual event interactions increases significantly the understanding of the process. This implicitly allows for an improved methodology to forecast the behaviour of induced seismicity, therefore having a significant implication in hazard assessment.