3D geomechanical modelling of induced seismicity: finite source wavefield simulation to moment tensor inversion

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3D geomechanical modelling of induced seismicity: full moment tensor inversion on finite-source wavefields

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Geomechanical modelling is generally used to simulate the nucleation of induced earthquakes in, for instance, the Groningen gas field. We apply quasi-static simulation to investigate the stress changes from gas production. When a fault reaches a critical state, dynamic simulation provides information on the dynamic rupture during earthquake nucleation and the resulting wavefield. With the use of geomechanical modelling, it is possible to investigate the effects of the model parameters, e.g., depletion pattern and friction parameters. In the modelling, the dynamic rupture at a finite fault is simulated both in space and time. The generated seismic wavefield from such a finite source is considered to be more realistic than the resulting wavefield from a point source. The latter is often assumed in previous studies on the inversion of induced-earthquake data in the Groningen area. To link the wavefield generated by a geomechanically simulated finite source to the field-seismic data for an earlier earthquake, we apply the same full moment tensor inversion to the waveform of a finite and of a point source. The inverted moment tensor from the field seismic observation provides a constraint to our geomechanical simulation. This allows us to perform a more realistic simulation of an induced earthquake.