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3D geomechanical modelling of induced seismicity: simulated finite-source to moment tensor inversion

Jingming Ruan, La Ode Marzujriban Masfara, Ranajit Ghose, and Wim Mulder
Delft University of Technology, Delft, Netherlands (j.ruan@tudelft.nl)

Geomechanical modelling is widely used to simulate the triggering of induced earthquakes in a gas-producing region, such as in the Groningen gas field. Dynamic simulation can provide information on the process of dynamic rupture during earthquake nucleation and on the generated seismic wavefield. Through geomechanical modelling, one can 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 resulting seismic wavefield from such a finite source should be more realistic than that from a point source. Previous studies on the inversion of induced-earthquake data in the Groningen area usually assumed a point source. In the present research, we implement the full moment tensor inversion of the synthetic waveforms caused by the dynamic rupture of a geomechanically simulated finite fault. We then link this moment tensor to the moment tensor obtained from the inversion of field-seismic data for an earlier earthquake, using the same inversion approach in both cases. The inverted moment tensor from the field seismic observation serves as a constraint to our geomechanical simulation. This enables us to perform a more realistic simulation of an induced earthquake.