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# Synthetic Earthquake Catalogs by 3-D HM Modelling of Gas Production

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## Abstract

Induced seismicity due to oil and gas production is a generally observed phenomenon. It has been agreed that slip on pre-existing faults is induced by poroelastic stress changes in the reservoir / surrounding rocks (Segall and Fitzgerald, 1998) and differential reservoir compaction due to the extraction (Roest and Kuilman, 1994).

Synthetic earthquake catalogs by 3D HM Modeling using a generic model of the gas field from Northern Germany are aiming to investigate the hazard from induced seismicity. In this modeling approach, the mechanical behavior of the rock formation is based on poroelastic theory and Mohr-Coulomb failure criterion. The main features of our algorithm for earthquake catalogs are applying Irwin's fracture criterion to determine whether the faulting process has stopped and Clustering algorithm DBSCAN to discover multiple seismic events in one time step. Numerical results compare fairly well to measured reservoir pressures and observed subsidence data.

Synthetic earthquake catalogs have shown plausible features in time, space and magnitude distribution, but there are some magnitude gaps between relative big and small events. This also can be found in Gutenberg- Richter relation. The onset of seismic activity postdates the commencement of production by approximately 9 years. The induced earthquakes are weak with magnitudes (Mw) up to 2.0+. The Gutenberg–Richter b-value is about 1.4.