Geophysical Research Abstracts
Vol. 18, EGU2016-12319, 2016
EGU General Assembly 2016

Evaluation of induced seismicity forecast models in the Induced Seismicity Test Bench

Eszter Király (1), Valentin Gischig (2), Jeremy Zechar (1), Joseph Doetsch (2), Dimitrios Karvounis (1), and Stefan Wiemer (1)

(1) ETH Zürich, Institute of Geophysics, Schweizerischer Erdbebendienst (SED), Zürich, Switzerland (eszter.kiraly@sed.ethz.ch), (2) Swiss Competence Center on Energy Research – Supply of Electricity, ETH Zürich, Switzerland

Induced earthquakes often accompany fluid injection, and the seismic hazard they pose threatens various underground engineering projects. Models to monitor and control induced seismic hazard with traffic light systems should be probabilistic, forward-looking, and updated as new data arrive. Here, we propose an Induced Seismicity Test Bench to test and rank such models. We apply the test bench to data from the Basel 2006 and Soultz-sous-Forêts 2004 geothermal stimulation projects, and we assess forecasts from two models that incorporate a different mix of physical understanding and stochastic representation of the induced sequences: Shapiro in Space (SiS) and Hydraulics and Seismics (HySei). SiS is based on three pillars: the seismicity rate is computed with help of the seismogenic index and a simple exponential decay of the seismicity; the magnitude distribution follows the Gutenberg-Richter relation; and seismicity is distributed in space based on smoothing seismicity during the learning period with 3D Gaussian kernels. The HySei model describes seismicity triggered by pressure diffusion with irreversible permeability enhancement. Our results show that neither model is fully superior to the other. HySei forecasts the seismicity rate well, but is only mediocre at forecasting the spatial distribution. On the other hand, SiS forecasts the spatial distribution well but not the seismicity rate. The shut-in phase is a difficult moment for both models in both reservoirs: the models tend to underpredict the seismicity rate around, and shortly after, shut-in. Ensemble models that combine HySei's rate forecast with SiS's spatial forecast outperform each individual model.