Geophysical Research Abstracts
Vol. 19, EGU2017-1873, 2017
EGU General Assembly 2017

Monitoring performance for hydraulic fracturing using synthetic microseismic catalogue at the Wysin site (Poland)

José Ángel López Comino (1), Simone Cesca (1), Marius Kriegerowski (1,2), Sebastian Heimann (1), Torsten Dahm (1), Janusz Mirek (3), and Stanislaw Lasocky (3)

(1) GFZ German Research Centre for Geosciences, Section 2.1: Physics of Earthquakes and Volcanoes, Potsdam, Germany (jalopez@gfz-potsdam.de), (2) University of Potsdam, Institute of Earth and Environmental Sciences, Potsdam-Golm, Germany, (3) Institute of Geophysics, Polish Academy of Sciences, Krakow, Poland.

Previous analysis to assess the monitoring performance of a dedicated seismic network are always useful to determine its capability of detecting, locating and characterizing target seismicity. This work focuses on a hydrofracking experiment in Poland, which is monitored in the framework of the SHEER (SHale gas Exploration and Exploitation induced Risks) EU project. The seismic installation is located near Wysin (Poland), in the central-western part of the Peribaltic synclise at Pomerania. The network setup includes a distributed network of six broadband stations, three shallow borehole stations and three small-scale arrays. We assess the monitoring performance prior operations, using synthetic seismograms. Realistic full waveform are generated and combined with real noise before fracking operations, to produce either event based or continuous synthetic waveforms. Background seismicity is modelled by double couple (DC) focal mechanisms. Non-DC sources resemble induced tensile fractures opening in the direction of the minimal compressive stress and closing in the same direction after the injection. Microseismic sources are combined with a realistic crustal model, distribution of hypocenters, magnitudes and source durations. The network detection performance is then assessed in terms of Magnitude of Completeness (Mc) through two different techniques: i) using an amplitude threshold approach, taking into account a station dependent noise level and different values of signal-to-noise ratio (SNR) and ii) through the application of an automatic detection algorithm to the continuous synthetic dataset. In the first case, we compare the maximal amplitude of noise free synthetic waveforms with the different noise levels. Imposing the simultaneous detection at e.g. 4 stations for a robust detection, the Mc is assessed and can be adjusted by empirical relationships for different SNR values. We find that different source mechanisms have different detection threshold. The background seismicity (DC sources) is better detectable than induced earthquakes (tensile cracks mechanisms). Assuming a SNR of 2, we estimate a Mc ~ 0.55 around the fracking wells, with an increase of 0.05 during day hours. The value of Mc can be decreased to ~ 0.45 around the fracking region, taking advantage by the array installations. The second approach applies a full waveform detection and location algorithm based on the stacking of smooth characteristic function and the identification of high coherence in the signals recorded at different stations. In this case the detection can be increased at the cost of increasing also false detections, with an acceptable compromise found for Mc ~ 0.1.