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Quantitative time-lapse 3D seismic data interpretation from the pilot site of Ketzin (CO_2 Storage): the level of noise

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The first European onshore pilot scale project for geological storage of carbon dioxide (CO_2) was initiated in 2004 near Berlin (Germany). This project is multidisciplinary including 3D seismic time-lapse surveys as an essential tool for reservoir characterization at a depth of 650 m. A 3D pre-injection baseline seismic survey was acquired in 2005. CO_2 injection into a sandstone saline aquifer started in 2008 and stopped in 2013 after 67 kilotons of CO_2 had been injected. The 1st and 2nd 3D seismic repeat surveys were acquired after 22 and 61 kilotons of CO_2 had been injected respectively. Time-lapse seismic processing, petrophysical data and geophysical logging of CO_2 saturation levels have allowed for an estimate of the total amount of CO_2 visible in the seismic data to be made. The close agreement (over 85%) between the injected and observed amount is encouraging for quantitative monitoring of a CO_2 storage site using seismic methods. However this estimate contains a number of uncertainties. For example the most of the time delay values in the both 3D seismic repeat surveys within the amplitude anomaly are near the noise level of 1–2 ms, however a change of 1 ms in the time delay affects significantly the mass estimate, thus the choice of the time-delay cutoff is crucial. In this study we put bounds into the noise in seismic data from Ketzin using results of 3D flow simulations.