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Seismic modeling based on reservoir simulation for quantitative interpretation of 3D time-lapse seismic measurements at the Ketzin pilot site

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3D seismic data were acquired for baseline pre-injection characterization in Autumn 2005 and for CO_2 monitoring in Autumn 2009. Occurrence of free gas in porous medium changes the medium's elastic properties. Appropriate values for the compressional wave velocity (Vp), the shear wave velocity (Vs) and the free gas saturation before injection and at the monitoring time were determined using geological and petrophysical qualities of the Ketzin reservoir and 3D reservoir simulation. This allows us to predict new 3D velocity models, to compute the 3D synthetic time-lapse response (4D) and to compare these with the field 3D time-lapse response (4D). The "tuning effect" is visible in both the synthetic and real datasets with the maximum values of the normalized time-lapse amplitude at the top of the reservoir close to the injection location. These amplitudes decrease with increasing distance from the injection location and reach the noise level a few hundred meters from the injection point. The maximum push-down time-delay in the synthetic data is up to 4 ms and comparable with that observed in the real data.