



Data pre-processing for time-lapse full waveform inversion: an example from the Ketzin CO₂ geological storage site

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Full waveform inversion is an effective tool for velocity model building. Recently it has been introduced as a complementary method for interpreting time-lapse seismic data as it can be used to detect velocity changes in reservoirs. There are already some successful applications in the fields of oil/gas production and CO₂ injection monitoring. We present a case study of data pre-processing of time-lapse data from the Ketzin CO₂ geological storage site. Ketzin is a well-known onshore CO₂ geological storage pilot site. Due to the restriction of the acquisition geometry, the time-lapse seismic data sets here have limited maximum offset which makes direct inversion for reservoir velocity difficult. As shown by experiences from other case studies, the double difference full waveform inversion method is the best choice here. The success of double difference time-lapse full waveform inversion is highly dependent upon data pre-processing. This is because it only inverts the difference between the baseline and repeat shot gathers. In order to get the correct velocity change in the reservoir, it is important to apply some pre-processing steps to remove the time-lapse noise above the reservoir. In this study we apply cross equalization and time-lapse difference static corrections to remove the time-lapse noise in the shot gathers. We test our methods by using synthetic data sets. The results show that these methods can effectively remove the time-lapse noise in the shot gathers. We also apply these methods to the real time-lapse shot gathers from the Ketzin site. The time-lapse differences above the reservoir time sections are significantly reduced after pre-processing.