FEASIBILITY OF SEISMIC MONITORING OF CCS IN PERTH BASIN

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This work studies seismic response of injection of super-critical CO_2 in Perth Basin, WA for the purpose of CO_2 sequestration. We aim to propose the most suitable way of monitoring and verification of such storage. To this end, we generated synthetic seismic datasets based on static geological models reflecting various hypothesis about the subsurface properties and fluid flow simulations for different injection scenarios. We investigated in detail two cases:

1. Reference case – the injected CO_2 remains confined in the injection interval, which we aim to characterise quantitatively;
2. Relatively small leakage (~10 kt) into the shaley overburden through a major fault, which we merely aim to detect.

Existing theories of fluid substitution predict small seismic contrasts caused by the injection. Effectively, we cannot rely on the time-lapse changes of the reflection strength, which makes conventional surface-based time-lapse seismic inefficient. However, the fluid flow simulations predict that the buoyancy-driven plumes have significant thickness to allow for the robust detection of the time shifts, which makes seismic pull-down effect more efficient for the time-lapse seismic monitoring of the injection. Furthermore, this feasibility study proves high efficiency of a surface-to-borehole monitoring systems. In particular, results of the full-waveform inversion of the synthetic borehole seismic datasets shows that such a system will allow for the quantitative characterisation of the injected plume.