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Ground deformation monitoring using RADARSAT-2 DInSAR-MSBAS at the Aquistore CO₂ storage site in Saskatchewan (Canada)

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Abstract. The research objectives of the Aquistore CO₂ storage project are to design, adapt, and test non-seismic monitoring methods for measurement, and verification of CO₂ storage, and to integrate data to determine subsurface fluid distributions, pressure changes and associated surface deformation. Aquistore site is located near Estevan in Southern Saskatchewan on the South flank of the Souris River and west of the Boundary Dam Power Station and the historical part of Estevan coal mine in southeastern Saskatchewan, Canada. Several monitoring techniques were employed in the study area including advanced satellite Differential Interferometric Synthetic Aperture Radar (DInSAR) technique, GPS, tiltmeters and piezometers. The targeted CO₂ injection zones are within the Winnipeg and Deadwood formations located at > 3000 m depth. An array of monitoring techniques was employed in the study area including advanced satellite Differential Interferometric Synthetic Aperture Radar (DInSAR) with established corner reflectors, GPS, tiltmeters and piezometers stations. We used airborne LIDAR data for topographic phase estimation, and DInSAR product geocoding. Ground deformation maps have been calculated using Multidimensional Small Baseline Subset (MSBAS) methodology from 134 RADARSAT-2 images, from five different beams, acquired during 20120612– 20140706. We computed and interpreted nine time series for selected places. MSBAS results indicate slow ground deformation up to 1 cm/year not related to CO₂ injection but caused by various natural and anthropogenic causes.

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