GROUND DEFORMATION IN ALBERTA'S OIL SANDS DUE TO ENHANCED OIL RECOVERY MAPPED BY RADARSAT-2 DINSAR

S. Samsonov [a*], M. Czarnogorska [a]

[a] Canada Centre for Mapping and Earth Observation, Natural Resources Canada, Ottawa, ON, Canada, (sergey.samsonov@nrcan-rncan.gc.ca)

Commission I, WG I/2

KEY WORDS: DInSAR, Ground deformation, Oil sands, Steam Assisted Gravity Drainage, Cyclic Steam Simulation, Alberta, Canada, enhanced oil recovery

ABSTRACT:

Ground deformation in Alberta's oil sands in Canada was observed with RADARSAT-2 Differential Interferometric Synthetic Aperture Radar (DInSAR). Canadian RADARSAT-2 satellite is capable of acquiring SAR data with 24 days repeat cycle with beams of various resolution, coverage and polarization. We employed advanced DInSAR techniques for measuring linear deformation rates and time series of deformation when coherence of individual interferograms was favorable. In case of very fast deformation observed at some site the accurate phase unwrapping for a large number of interferograms was not possible so for these areas we computed individual interferograms only. Alberta's oil sands represent one of the largest deposits of crude oil in the world. About 20% of the recoverable bitumen is close to the surface and is accessed through the open pit mining. Extraction of the remaining 80% of deposits, located at depth greater than 65 meters surface mining, is performed using two enhanced oil recovery methods: the Steam Assisted Gravity Drainage (SAGD) and the Cyclic Steam Simulation (CSS). With DInSAR we observed ground deformation at both SAGD and CSS sites, but the rate and temporal pattern of deformation was significantly different. At SAGD sites the linear deformation rate measured with SBAS DInSAR showed uplift with a maximum rate of ~2 cm/year. At CSS sites the deformation rate was higher, up to 30 cm of displacements over 24 day cycle or 450 cm/year. Presented here results suggest that CSS enhanced oil recovery method produces significantly larger ground deformation than SAGD method. Therefore, associate risk and potential impact on the environment and infrastructure can also significantly differ.