Assessment of INSAR potential in simulating subsurface geological structure

Negin Fouladi Moghaddam[1], Chris Rüdiger[1], Sergey Samsonov[2], Jeffrey P. Walker[1], Mike Hall[1]

[1]Monash Univ. (Australia);
[2]Natural Resources Canada (Canada) and European Ctr. for Geodynamics and Seismology (Luxembourg)

High resolution geophysical surveys, including seismic, gravity, magnetic, etc., provide valuable information about subsurface structuring but they are very costly and time consuming with non-unique and sometimes conflicting interpretations. Several recent studies have examined the application of DInSAR to estimate surface deformation, monitor possible fault reactivation and constrain reservoir dynamic behaviour in geothermal and groundwater fields. The main focus of these studies was to generate an elevation map, which represents the reservoir extraction induced deformation. This research study, however, will focus on developing methods to simulate subsurface structuring and identify hidden faults/hydraulic barriers using DInSAR surface observations, as an innovative and cost-effective reconnaissance exploration tool for planning of seismic acquisition surveys in geothermal and Carbon Capture and Sequestration regions. By direct integration of various DInSAR datasets with overlapping temporal and spatial coverage we produce multi-temporal ground deformation maps with high resolution and precision to evaluate the potential of a new multidimensional MSBAS technique (Samsonov & d'Oreye, 2012). The technique is based on the Small Baseline Subset Algorithm (SBAS) that is modified to account for variation in sensor parameters. It allows integration of data from sensors with different wave-band, azimuth and incidence angles, different spatial and temporal sampling and resolutions. These deformation maps then will be used as an input for inverse modelling to simulate strain history and shallow depth structure. To achieve the main objective of our research, i.e. developing a method for coupled DInSAR and geophysical observations and better understanding of subsurface structuring, we will compare DInSAR inverse modelling results with previously provided static structural model to iteratively modify DInSAR structural framework for better match with in situ observations.