ABSTRACT

The Earth is changing. Some of these changes are the result of natural processes but others are caused by human activity. Many of these human activities, chiefly industrial, have a significant physical impact on the environment. For private and government organizations worldwide, it is important to understand and monitor these changes. There is, therefore, today an increasing demand for information detailing changes of the Earth’s surface, such as changes in land cover type, infrastructure and surface elevation.

Satellite-based remote sensing provides the opportunity to monitor changes over very large as well as less accessible areas. Synthetic Aperture Radar (SAR) satellites benefit from all-weather operation and are able to detect both changes of the Earth’s surface and changes in surface elevation. This paper will present results of a research study on the development of methods for monitoring different types of man-made changes using C- and X-band SAR data. The study focuses on changes of new buildings, roads, other industrial infrastructure and surface movements due to human and industrial activities, such as fracking, enhanced oil recovery or mining. With regard to the methodologies, the two major research areas are:

- Investigation into the synergistic use of C- and X-band data for deformation monitoring using interferometric SAR methods. This includes analysis of the different frequencies and their sensitivity to temporal de-correlation of the phase signal due to vegetation in addition to their sensitivity to surface movement. Further, differences between the sensors with respect to ground resolution, revisit time, number of achievable measurement pixels and maximum detectable movement are analysed. Methods including “Temporary Coherent Scatterers (TCS)” are investigated in detail, in order to cope with the issue of temporal de-correlation.
- Amplitude Change Detection (ACD) using C- and X-band: Methods are developed in order to perform amplitude change detection “between” frequencies, e.g. using archived X-band and newly acquired C-band data. Furthermore, the (dis)similarities of the two frequencies’ sensitivity to certain types of surface changes are investigated and longer time series are analysed. Also, correlations between surface changes and surface movements are subject to study.

Two test sites with increased human activity are selected:

- Garzweiler, Germany: open cast Lignite mine with present and future resettlement and infrastructure building measures
- Carmon Creek / Peace River, Northern Alberta, Canada: oil and gas extraction site

For these areas, TerraSAR-X and RADARSAT-2 data over at least one year (Peace River) is available. For Garzweiler, Sentinel-1 data is also used for the InSAR analyses.

This paper will present the intermediate results of the InSAR and Amplitude Change Detection analysis.

The study is conducted in the framework of the CSA-DLR Collaboration on C- and X-band data synergies. It is conducted in a joint project with MacDonald, Dettwiler and Associates Ltd. who focus principally on method development for wide-area change monitoring using Amplitude Change Detection.