Land deformation monitoring and its application using InSAR and time series analysis

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InSAR, which is an application technique of synthetic aperture radar (SAR), is becoming established as the method for land deformation measurement that can observe subtle ground surface displacement over a wide area at high resolution. Especially after the launch of PALSAR onboard Advanced Land Observing Satellite 'Daichi (ALOS)' in January 2006, with the greatest benefit of high coherence realized by utilizing the L-band microwave, it has consistently made significant achievements in the analysis of surface deformation caused by earthquakes and volcanic activities, monitoring of ground subsidence, and detection of landslide which had occurred all over the world. When the Noto Peninsula Earthquake and the Niigata Chuetsu-oki Earthquake attacked Japan in 2007, rapid analysis using PALSAR images taken by urgent observation played a major role in elucidating mechanism using the fault model and determining the afflicted area. Meanwhile, in Europe, new analysis technologies such as PS (Permanent Scatterer, Persistent Scatterer) and SBAS (Small BAseline Subset) that allow observation of long-term ground deformation with millimeter-order accuracy were introduced, utilizing the large amount of C-band SAR data accumulated for 17 years from ERS-1/2 and ENVISAT.

In this study, the author developed another method to measure the long-term land deformation by combining the conventional InSAR processing and time series analysis, where one of the concepts of SBAS approach to analyze only multiple data combinations which have small baseline was applied and smoothness-constrained inversion technique by ABIC minimization method was used for time series analysis. As an example of the application of this method, the author presents the results of a study that monitored the ground subsidence in the Zonguldak coalfield area, north Turkey, using the Canadian RADARSAT C-band SAR sensor.