

Nationwide crustal deformation monitoring by SAR satellite

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Spatiotemporally comprehensive geodetic observations can be often powerful tools for crustal deformation monitoring. Synthetic aperture radar (SAR) is one of promising techniques for the purpose. The Geospatial Information Authority of Japan (GSI) has been regularly conducting nationwide ground deformation monitoring by an interferometric SAR (InSAR) since the advent of ALOS-2 satellite. One of our main missions is an emergency analysis for large earthquakes. The GSI has an ALOS-2-related contract with Japan Aerospace Exploration Agency (JAXA), under which the GSI requests an emergency observation once a large earthquake occurs, and the JAXA conducts the observation in response to the request. The JAXA provides the GSI with the SAR data acquired by the emergency observation within one hour, and the GSI analyzes the data by applying InSAR method and/or other techniques to obtain the crustal deformation (Fig. 1). The analysis results are provided to specialized conferences such as the Earthquake Research Committee, the Headquarters for Earthquake Research Promotion for use in evaluation of seismic. In particular, SAR has contributed to evaluation of inland earthquakes. SAR has mapped crustal deformation with high spatial resolution, which has led to unveil detailed location and types of fault motions such as the 2016 Kumamoto earthquake and the 2024 Noto Peninsula earthquake.

Another mission is a routine nationwide monitoring of ground deformation. InSAR time series analysis is an effective technique to improve the detectability of slow-progressing deformation by statistically processing a large number of InSAR images. The GSI has conducted the analysis routinely since 2021, and provided the results on GSI's online map (Fig. 2). Our deformation map successfully detects various types of land deformations such as post-seismic deformation, inflation/deflation of volcanoes, ground subsidence, and landslides in which the ground have slowly deformed with a few mm per year. In 2024, a Japanese new SAR satellite, called ALOS-4, has launched successfully. The most significant feature of ALOS-4 is to realize high-frequency observation with 20 times per year. This will make it possible to provide information on temporal variation of ground deformation by InSAR time series analysis at a practical level. The time series analysis will be a core product in future our projects, which will definitely contribute to observation for seismic activity. In this presentation, I will show the analysis results and the effectivity of InSAR-based nationwide land monitoring.

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