Achievements of ground deformation monitoring using ALOS satellite series at GSI and the way forward

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1. Geospatial Information Authority of Japan

1. Introduction

The Geospatial Information Authority of Japan (GSI) has a project for detection of ground displacement by SAR, and has been conducting nationwide ground deformation monitoring by InSAR analysis since ALOS satellite. At present, the main missions of the project are a regular nationwide monitoring of ground deformation due to volcanic activity and land subsidence, and an emergency analysis for earthquakes and other disasters. The results are provided through GSI Maps, and are also provided to specialized conferences such as the Coordinating Committee for *Prediction* of Volcanic Eruption for use in evaluation of seismic/volcanic activity. With this background, this presentation will review the effectiveness of ALOS-2 in detecting and monitoring changes in the earth's surface, and introduce the GSI's efforts in preparation for ALOS-4.

2. Effects of ALOS-2 on national land monitoring

One of the most important improvements from ALOS to ALOS-2 in terms of land monitoring is the improvement of spatial resolution. The 2015 phreatic eruption at Owakudani volcano is a symbolic event, as it was a kind of breakthrough observation that enables us to detect the details of the spatial distribution of local ground deformation of about 200 m in size before the eruption. This kind of information on local deformations has greatly contributed to evaluation of volcanic activity at other volcanoes. For earthquake observations, the contribution to inland earthquakes is particularly crucial, and the 2016 Kumamoto earthquake was an important recent observation. We succeeded in comprehensively and in detail capturing the location, the spatial extent, and the displacements of major source faults and their secondary-produced faults. Further the high resolution has promoted practical use of the amplitude images. For the Nishinoshima eruption, we successfully monitored formation and growth of the newly-created island. ALOS-2 has contributed to prompt monitoring of the expansion of the national land. For the ALOS-2-based monitoring, it is also important that the observation results are used for official evaluation of seismic/volcanic activities such as the 2015 Sakurajima magma intrusion event. With the advent of ALOS-2, SAR is becoming one of the social infrastructures that support the safety of our society.

3. Future national land monitoring by ALOS-4

The most significant feature of ALOS-4 is to realize high-frequency observation. This will make it possible to provide information on temporal variation of ground deformation by InSAR time series analysis (TSA) at a practical level. The TSA will be a core product in future our projects.

The GSI has introduced the TSA to the routine monitoring of volcanoes since 2021, and the results of 38 active volcanoes in Japan (as of February 2022) are available to the public on the GSI map. The effectiveness of ALOS-2 has been demonstrated by the detection of local deformations in summit areas for some volcanoes. It is expected that ALOS-4 will be used to monitor volcanoes with high temporal resolution and in combination with ALOS-2 to monitor long-term changes. The GSI will continue to increase the number of target volcanoes and publish the results through GSI maps.

We plan to strengthen an attempt to utilize the results of TSA for the management of national positioning information. Since Japan is subjected to complex crustal movements, it is necessary to have a system to

accurately correct the deviations caused by crustal movements. The GSI has been providing GNSS-estimated corrections, and is attempting to incorporate the results of TSA to improve the spatial resolution of the corrections.

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