Utilization of Interferometric Synthetic Aperture Radar Technology for Disaster Prevention

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The purpose of this research is to investigate the possibility of extraction and monitoring of ground deformation before and after disasters such as landslides using interference synthetic aperture radar (InSAR) analysis. In flood area extractions, we will introduce analysis results using Sentinel-1A /1B VH cross-polarized images and ALOS-2/PALSAR-2 images. The analysis area was defined as a place where a disaster occurred in the past; satellite image data used for the analysis were obtained before and after the disaster. Based on the results, it may be possible to obtain useful information for responding to a disaster or to predict the timing of a disaster to some extent. Several disaster-affected regions were considered and an analysis was performed on a model area using InSAR analysis technology. The study region covers a wide area such as the northern part of the Hokkaido Iburi region, Miyagi, the northern Kanto region, Nagano, the southwestern part of Hiroshima, southern Okayama, as well as the Ehime and Saga prefectures. In recent years, these areas have been hit by floods caused by typhoons, heavy rain, and sediment-related disasters caused by earthquakes and heavy rainfall. The image data of an HH polarized wave with an incident angle of 34.3˚, acquired during the satellite operation period, was retrieved from the archive data of ALOS/PALSAR and analyzed. In addition, ALOS-2/PALSAR-2 (level 1.1, polarization: HH, incident angle: 34.3 ˚) and Sentinel-1A/1B (VV: horizontal polarization and VH: cross polarization) were used. Interference SAR time series analysis enables the detection of minute fluctuations using a smoothing restraint inversion method to integrally analyze the interference images of multiple orbits. During these analyses, strong displacements were observed not only at the collapsed points but also at the uncollapsed ones. These uncollapsed displacement points suggest a high possibility of subsequent collapse points. The flood distribution area was accurately extracted from the VH cross-polarized images of Sentinel-1A/1B, showing adequate agreement with the hazard map. This resulting image is an intensity image generated at the initial stage of image analysis, does not require complicated analysis, and can be created from a single original image. Therefore, if an image taken at a good timing can be obtained, it is likely to be useful in quickly grasping the current situation of the target area. To implement monitoring using InSAR analysis, it is important to sufficiently consider the geology of the target area and its topographical features as well as accumulate and maintain the base information on a regular basis. In case of emergencies, the latest observation data can be obtained immediately by performing independent analyses or additional analyses together with archived data.

Keywords: InSAR, disaster prevention, heavy rain, sediment-related disaster

