Utilization of Interferometric Synthetic Aperture Radar Time Series Analysis Technology for Disaster Prevention

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In this research, we investigate the possibility of extraction and monitoring of the ground changes before and after disasters such as landslides using interference synthetic aperture radar (InSAR) time series analysis. An analysis was conducted using the satellite image data obtained before and after the occurrence of the disaster from the location with a past disaster occurrence. The obtained results may be effective in predicting to some extent the occurrence timing of the sediment-related disasters in hazardous areas caused due to frequent earthquakes, volcanic eruptions, and local heavy rains in recent years. Several regions affected due to these sediment-related disasters were considered and a ground deformation analysis was performed on a model area using the InSAR analysis technology.
The Miyazaki prefecture Mimikawa upper basin, southwestern part of the Hiroshima prefecture, Kyushu Northwest and a few other regions were considered for analysis. These are the areas with landslide risks and past occurrences of sediment-related disasters. The image data of a 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 used for the analysis.
Interference SAR time series analysis enables the detection of minute fluctuations using smoothing restraint inversion method for integrally analyzing the interference images of multiple orbits. We also performed a 2.5 dimensional analysis using two orbits of descending and ascending nodes. During the analysis, strong displacements were observed not only in the collapse track, but also at other points in the upper stream of the Mimi River. Those points that demonstrated a high possibility of collapse were then extracted. Such a phenomenon was also observed in some instances of other analyses. From the 2.5 dimensional analysis of the area around the affected area in the southwestern part of Hiroshima Prefecture, actual sediment-related disasters were extracted, almost pinpoint, from the variation diagram of the eastern component. In the area, the faults in the northeast and the southwest directions were dominant and the continuous slope of the mountain extended in the same directions. The characteristic topography of these areas possibly affected the direction of the ground surface fluctuation. In the northwestern part of Kyushu, several points with earlier occurrences of landslides were detected in addition to the actual landslide site by employing the median filter plus histogram extraction processing and Laplacian filter processing together. As a result, it was determined that various measures were necessary for the interference SAR time series analysis to extract the fine ground fluctuation immediately before the disaster, as these fluctuations are unlike the relatively large fluctuations that occur during the disaster.
To actually implement monitoring using the InSAR analysis, it is important to sufficiently consider the geology of the target area and its topographical features and accumulate and maintain the base information on the target area in times of peace. In case of emergencies, the latest observation data can be obtained immediately by retrieving from the archives to perform the required analysis.

Keywords: Interferometric Synthetic Aperture Radar Time Series Analysis, disaster prevention, ground deformation analysis

