Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

STT057-P01 Room:Convention Hall Time:May 24 16:15-18:45

Measurement of land subsidence at Semarang, Indonesia, using InSAR time-series analysis

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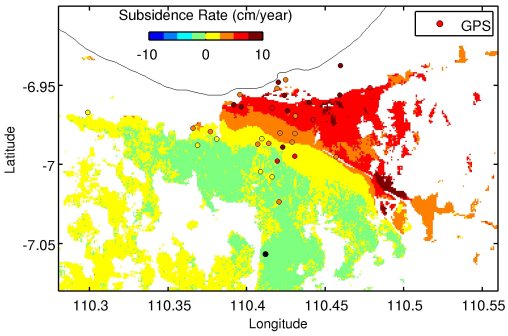
It has been reported that a part of the city of Semarang, Indonesia, suffers from large ground subsidence (Abidin et al., 2010). To investigate the subsidence in detail, we performed an InSAR time-series analysis using ALOS/PALSAR data acquired from both ascending and descending orbits. We used 23 SAR data (14 ascending and 9 descending images, respectively). We produced interferograms for the pairs having a perpendicular baseline of smaller than 1200 m, and further selected the interferograms whose mean coherence was 0.4 or higher, resulting in 68 small-baseline interferograms (49 ascending and 19 descending pairs, respectively). We solved for the temporal evolution of displacements with the time steps defined by the SAR acquisition dates using unwrapped interferograms, and finally converted the mean velocities along the two line-of-sight directions into horizontal and quasi-vertical components. Our results indicate that the northern half (seaside) of Semarang is rapidly subsiding (more than 5 cm/year in most parts), whereas the southern half is stable. The maximum subsidence of 10.4 cm/year is obtained in an east part of the city, which had not been identified by the conventional surveys.



Keywords: Semarang, Land Subsidence, InSAR time series analysis

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Monitoring the subsidence by InSAR and leveling survey

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GSI regularly performs SAR Interferometry (InSAR) analysis with PALSAR data obtained by the Advanced Land Observation Satellite (ALOS), "Daichi". One of the aims of the InSAR analysis is to monitor subsidence. We focused on the Kujyukuri plain, where subsidence occurred, and we compared the results of the InSAR analysis with the results of leveling survey by Chiba prefecture.

Acknowledgement:The Ministry of Economy, Trade and Industry (METI) and the Japan Aerospace Exploration Agency (JAXA) retain ownership of ALOS/PALSAR data.

Keywords: ALOS/PALSAR

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InSAR analysis of the 2010 Fukushima-ken Nakadori Earthquake

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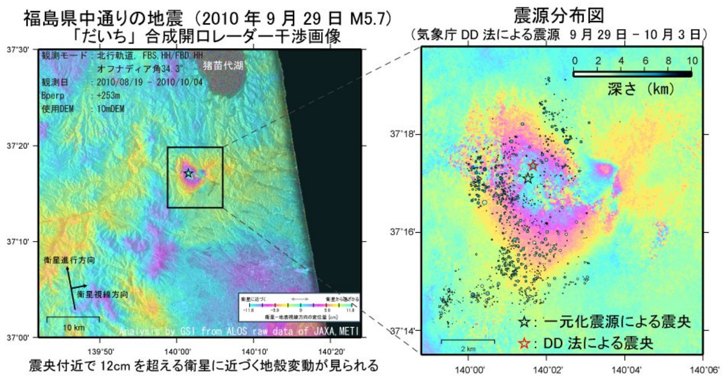
A Mjma 5.7 earthquake occurred in the Nakadori region of Fukushima Prefecture on 29 September 2010. Though the estimated depth of the hypocenter is 8 km (JMA), the quake registered an intensity of 5+ on the Japanese scale at the very localized area in Tenei village. We investigated this local phenomenon with InSAR and GPS data and field study. GEONET (GPS Earth Observation Network System) data indicated that small east-west compression. ALOS PALSAR interferograms of 4 July 2010 ? 4 October 2010 and 19 August 2010 ? 4 October 2010 from Ascending orbits show ?12 cm line-of-sight (LOS) displacements to the satellite. These interferograms include also positive, mainly eastward, LOS displacement signal, which is likely due to landslide induced by the earthquake. We calculated interferogram with an elastic half-space dislocation model by assuming the centre depth of the fault plane is at 2km, 5km, and 8km. The calculated interferogram of the 2 km depth best reproduces the observed interferogram, suggesting that there is a significant discrepancy in the depth between seismic and geodetic approaches. We also report the results of our field study in November 2010.

Acknowledgments

This work was conducted as a collaborative research project between GSI and JAXA. PALSAR data were analyzed by GSI from the ALOS raw data provided by JAXA and METI.



Keywords: interferogram, InSAR, ALOS, Crustal Deformation, landslide

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Application use for RADARSAT satellite

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Currently the spaceborne SAR systems RADARSAT series have now RADARSAT-1 and RADARSAT-2 in space. RADARSAT-1 has been operated for a total of 16 years, RADARSAT-2 for a total of 4 years after the launch, and they are still under the operation without any problems. Furthermore, the RADARSAT constellation mission (RCM), which is the constellation consisting of a fleet of three spaceborne SAR systems and be both complementary and a follow-on to RADARSAT-2, is under the planning.

Conventionally we have mainly sold RADARSAT-1 and RADARSAT -2 image products. Then we have started the service to provide the orthorectified (geometrically corrected) images, the land use classification maps specialized for agriculture by means of polarimetry, and InSAR analysis products since 2009.

Increasing our capability, we advance the development of the valuable SAR products and the improvement of our services furthermore.

Keywords: SAR, Spot-Light Mode

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Estimation of Atmospheric Delay with the JMA-NHM and Its Application to InSAR

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The baseline solutions observed by global positioning system (GPS), electro-optical distance measurement (EDM) or interferometric synthetic aperture radar (InSAR) generally include an error due to atmospheric delay. The methods to correct this error with the grid-point values (GPVs) of various numerical weather models have been researched since Ichikawa *et al*. (1995), Shimada (1999), and recently applied to the volcanological monitoring GPS and EDM data with the mesoscale analysis (MANAL) of the Mesoscale Model (MSM) which is a Non-Hydrostatic Model (JMA-NHM) of the Japan Meteorological Agency (Takagi *et al*., 2010a, 2010b). In this presentation, we report the method to estimate the slant delay in troposphere and lower stratosphere at observation time with the time-interpolated GPVs derived from downscaling the JMA-NHM which is also used to make the MANAL (operational resolution is at 5 km grid size and total of 50 vertical levels). Using GPVs showing potential temperature, pressure and mixing ratios of water vapor, we calculated the refractive indices to transform the atmospheric delays. Then, we applied the method to the InSAR data before unwrapping for the purpose of monitoring the ground deformation in the volcanic area.

Under the estimation of atmospheric delay, the optimization of downscaling JMA-NHM, the direct use of the zenith total delay calculated in MANAL which has operationally assimilated GPS precipitable water vapors since October 2009 (Shoji *et al*., 2009) and others are future works.

Acknowledgements

The PALSAR data used in this report were prepared by 'DAICHI' (ALOS) Domestic Demonstration on Disaster Management Application, in which the Coordinating Committee for Prediction of Volcanic Eruption played a key role. The PALSAR data belong to JAXA/METI. We would like to thank Dr. M. Shimada (JAXA) for the use of his SIGMA-SAR interferometry software.

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Keywords: JMA-NHM, NWP-GPV, refractive index, atmospheric delay, InSAR, ground deformation

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Activities about The Subcommittee for Analysis of Satellite Data

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The Earthquake Research Committee

The Earthquake Research Committee classifies and analyzes research and observation results, as well as study outcomes, in order to evaluate seismic activity comprehensively in monthly meetings and to publish evaluation results.

The Subcommittee for Analysis of Satellite Data

The Subcommittee for Analysis of Satellite Data was established in July 2007 for advances in seismic activity evaluation in the Earthquake Research Committee.

The subcommittee evaluates the seismic activity analyses using SAR data, and examines utilization of the data.

Seismic activity and SAR

The characteristic crustal movements caused by the strain accumulation process, the earthquake rupture process, and the post-seismic process are basic data for an understanding of seismic activity.

It is important to advance technologies for dense observations of crustal movement, like SAR, and the analysis method.

Recently, many satellites equipped with SAR were launched. Using the regularly observed SAR data, technology to observe crustal movements caused by seismic activity have progressed rapidly. Especially, Japanese Advanced Land Observing Satellite launched in January, 2006 have caught the clear crustal movements on many parts of the world just after the operation, which showed big possibilities of SAR data in advancement of the understanding of the seismic activity.

The report

The outcomes of the subcommittee listed below will be published as a report. In the lecture, they are introduced in detail.

1.The standard method of analysis and the standard expression for the Earthquake Research Committee

The analysis technique for SAR interference analysis and pixel offset were standardized. For the SAR interference analysis, not only analysis of data observed in the normal strip-map mode but analysis of data observed by ScanSAR was challenged, and then the crustal movement was successfully detected. The expression of the analysis result has varied between organizations, which confused about the interpretation of figures in the Earthquake Research Committee. Therefore a standard expression for the Committee was decided.

2.Estimation of the cause of the observation error.

In SAR interference analyses, errors of the orbit estimates, refractions of the radio wave by vapor, and refractions of the radio wave by the ionosphere cause the estimate error. The features of these errors and reduction measures were introduced.

3.The development of the detection method for regular crustal movement in the wide area.

Because the postseismic deformation and crustal movement caused by a strain accumulation process are very small compared with coseismic displacement, it has been difficult to detect the crustal movement using the SAR. However, the subcommittee have reduced an error using a lot of interference images and successfully extracted only minute crustal movements. A trial and problems for the detection of the strain accumulation for the prospect of subduction-zone earthquakes along the Nankai trough were introduced.

4.Evaluated reliability.

Examples of SAR interference analysis results evaluated in the Earthquake Research Committee were introduced.

Keywords: SAR, Earthquake, crustal movement, Headquarters for Earthquake Research Promotion

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The Active volcanoes in Japan as viewed from the ALOS/PALSAR Interferometry (4)

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ALOS has an L-band SAR (PALSAR), which is not affected by vegetation, and the interference is good even in mountainous areas. So these methods are effective for the crustal deformation observation of volcanic areas.

In previous studies, we have reported the analysis results about all domestic active volcanic areas, using InSAR of ALOS 'Daichi' since 2007. However, these pairs were limited to the special data because the observation period since ALOS launching was not that long. And then we are not able to use snowy season data even if there was enough SAR image data. Because InSAR method is affected by snow. Fortunately, ALOS 'Daichi' has continued operating smoothly since and data for about four years has been accumulated. Therefore we tried interference analysis with pairs of around two years without using the data from the snowy season. The interference processing in long term pairs of more than one year had good correlation and was effective for detecting ground deformations. As a result of volcanic activity in Mt. Azuma and Mt. Kirishima (sinmoe), we were able to detect the local ground deformation. Also, we were able to obtain the superficial ground deformation about non active volcanic areas.

In this report, we are mainly going to talk about the ground deformation around an active volcano using the SAR interference method.

Some of PALSAR DATA used in this report were prepared by ALOS 'Daichi' Domestic Demonstration on Disaster Management Application that CCPVE. Also, some of PALSAR DATA were prepared by PIXEL (PALSAR Interferometry Consortium to Study our Evolving Land surface). PALSAR DATA belongs to METI/JAXA (Ministry of Economy Trade and Industry/Japan Aerospace Exploration agency). We would like to thank Dr. Shimada (JAXA) for the use of his SIGMA-SAR software. In the process of the InSAR, we used 'the digital elevation map 50m mesh' provided by GSI (Geological Survey Institute) and some figures were made using GMT (P.Wessel and W.H.F.Smith, 1999). We are also grateful to Dr. Okuyama (HVO) and Dr. Miyagi (JAXA) for the advice of drawing method by GMT.

Keywords: SAR, Interferometry, ground deformation, ALOS/PALSAR, active volcano