ABSTRACT

Monitoring of small scale surface deformation is very important thing to prevent disaster of surrounding of housing area. However, number of ground observation stations for subsidence/landslides are less than seismic/crustal deformation monitor. Application of DInSAR technology has prospects to improve and interpolate this situation. In this paper, capabilities of DInSAR for small scale surface deformation detection have been focused on. Three case studies were discussed to understand it. In the case of "the Niigata Chuetsu-oki Earthquake in 2007", small scale surface deformation due to liquefaction and landslide was detected with the crustal deformation. And, in case of analysis of surrounding of coal mine site, subsidence due to overuse of ground water was detected and source of deformation was estimated by numerical analysis. Moreover, reactivated landslide was detected through the monitor of active landslide.

2. CASE STUDIES OF SMALL SCALE SURFACE DEFORMATION DETECTION

2.1. Small surface deformation at the Niigata Chuetsu-oki Earthquake in 2007

In 16 July 2007, M6.8 earthquake struck to Chuetsu district of Niigata prefecture, Japan. JAXA observed the area of epicenter by ALOS PALSAR in 19 July 2007. Crustal deformation due to this earthquake was analyzed by PALSAR DInSAR using observation data of 19 July 2007 and 19 January 2007. In order to analyze DInSAR, SIGMA-SAR processor was used. Fig. 1 shows the detected crustal deformation that LOS shortening in northern part of fringe area and LOS lengthen at southern part of fringe area was obtained. Based on the report of ground survey, many small scale surface deformations of surrounding of housing area were confirmed over the seaboard region. Fig. 2 shows the enlarged view of damage area of seaboard region. A landslide occurred in mountain side and very complicated fringe pattern in flatland was confirmed. This fringe pattern was caused by liquefaction with ground flow. In case of ground liquefaction, surface condition shows several patterns as subsidence, upheaval, flow, and so on. This result shows these deformations.

2.2. Small surface deformation of surrounding of coal mine site

Due to the overuse of ground water, subsidence occurred in surrounding of coal mine site. Especially, subsidence at housing site is current problem at the northern part of China. ALOS PALSAR DInSAR was applied to detect subsidence of surrounding of two of coal mine sites in the northern China, and subsidence at housing area were detected as Fig. 3. In order to estimate sources of subsidence, numerical model was applied to site-2, Fig. 3(b).
From the result of numerical analysis, subsidence occurred by three sources can be estimated. And also, these sources distributed in different depth can be estimated as Fig. 4. The approach of combination use of numerical analysis and DInSAR has a possibility of factor estimation of subsidence, and also it is effective as a means of supplementing the result of DInSAR.

2.3. Landslide monitoring of Shikoku district, Japan

Since 2003, authors have been monitoring the one of the landslides in Shikoku district, Japan, named Zentoku landslide using JERS-1 SAR and ALOS PALSAR DInSAR (e.g. [2], [3], [4]). Through this monitoring activity, reactivated landslide was detected near the Zentoku landslide in 2007. Fig. 5 shows the results of ALOS PALSAR DInSAR using observation data of 14 January 2007 and 17 January 2008. From the result, two
active landslide blocks was confirmed. And these landslide blocks was corresponding to landslide terrain map provided by National Research Institute of Earth Science and Disaster Prevention (NIED), Japan [7]. From the landslide terrain map, it can be considered that each landslide blocks were link together. From both DInSAR result and landslide terrain map, it can be considered that the upper block was behaved together with lower block. In this case, it can be considered that lower block was moved to the direction of bottom of slope and also upper block was deformed with subsidence and flow.

Figure 5. Detected reactivated landslide by ALOS PALSAR DInSAR (with landslide terrain map (©NIED))

3. CONCLUSIONS

ALOS PALSAR brings excellent results of detection of small scale surface deformation as well as large scale surface deformation through the case studies. Especially, it is effective to detect very slow landslide movement at high vegetation area. Detection of reactivated landslide is the most prospects to DInSAR analysis. In order to detect reactivated landslides, continuous monitoring is necessary. And, it was confirmed that combination use of DInSAR and numerical model is effectively to understand mechanism of small scale surface deformation. An approach of combination use of DInSAR and numerical model has a possibility to advanced small surface deformation detection analysis by DInSAR.

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5. REFERENCES