Search for landslides of initial slight movement before a disaster using satellite DInSAR

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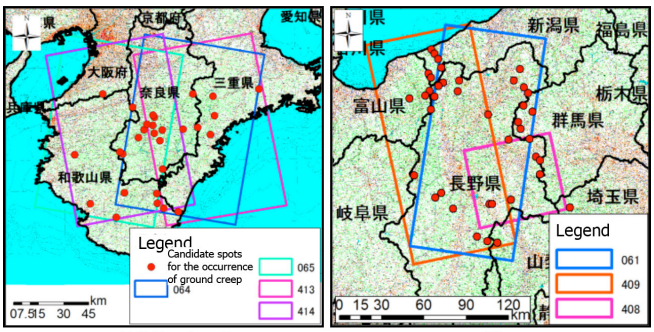
INTRODUCTION

To prevent the damage caused by disasters such as deep layer collapse and landslides, it is useful to detect small variations, which may be signs of a disaster, over a wide area under normal conditions before the disaster occurs. So, we clarified implementation conditions about a method for identifying locations that have moved slightly by using L-band satellite differential Synthetic Aperture Radar interferometry (DInSAR), to detect small variations that could lead to a landslide or deep layer collapse under normal conditions before the disaster happens. Because this study area in Japan is the mountainous district where the vegetation grew thick, there are only few permanent scatterers. In this case the application of PS-InSAR (Permanent Scatterer) is difficult. In contrast, DInSAR can be analyzed, even in case there are few persistent scatterers and as long as there are a few SAR images meeting a condition. Therefore we tried searching for landslides of the initial slight movement of wide areas by using DInSAR.

RESULTS

We acquired analysis images using the L-band differential SAR interferometry (DInSAR) to detect large scale landslides on the Kii Peninsula and the Nagano area in Japan. Regarding the ALOS data used, the differential SAR interferometry was based on images from four paths from the ALOS PALSAR archives for the Kii Peninsula. For the Nagano-ken and surroundings, the differential SAR interferometry involved images from three paths from the ALOS PALSAR archives. For both areas, we tried to obtain good differential SAR interferometry images using pairs formed by the combination of all SAR data for each path. As shown in Fig.1, regarding the extraction of candidate spots for ground creep occurrence using DInSAR of ALOS data, 40 spots in three paths were extracted for the Nagano area. For the Kii Peninsula, 29 spots in four paths were detected. Cf. (Fig. 2)



Kii Peninsula Nagano area

Figure. 1. Candidate spots to ground creep based on DInSAR

CONCLUSIONS

The conclusions regarding the implementation conditions for differential SAR interferometry were that,

- The occurrence of ground creeps should be detected based on the investigation of multiple pairs, the verification of conformity between landslide movement and slope direction, and the combination with other data such as landslide topographic and microtopographic interpretation maps, dangerous spots maps for landslide disasters, among others.
- Coherence improved for smaller distances between orbits. Snowy seasons should be avoided, as the coherence decreases with the accumulation of snow. When the interval of time between image capture of SAR data pairs is long, coherence often decreases. Cf. (Fig. 3)
- In general, the measurement sensitivity is good for slopes along the east direction for eastward irradiation and along the west direction for westward irradiation. SAR interferometry is effective for images taken from both east and west directions.
- The measurement sensitivity of ground surface movement in the south/north direction is low.

REFERENCES

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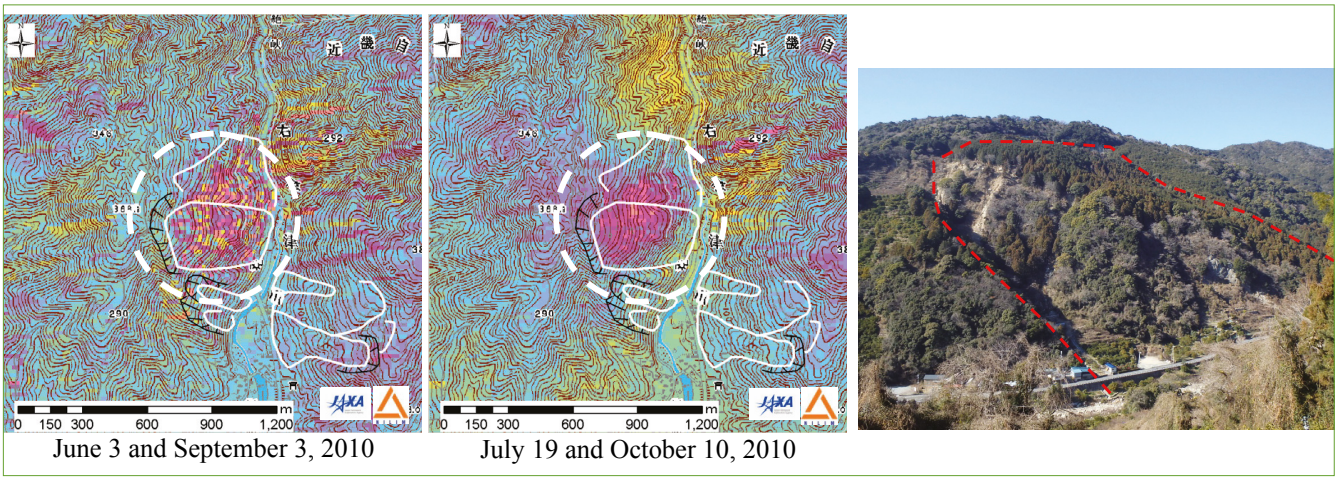

Figure 2. Examples of deformation spot extraction using DInSAR, Tanabe-shi, Kamiakitu

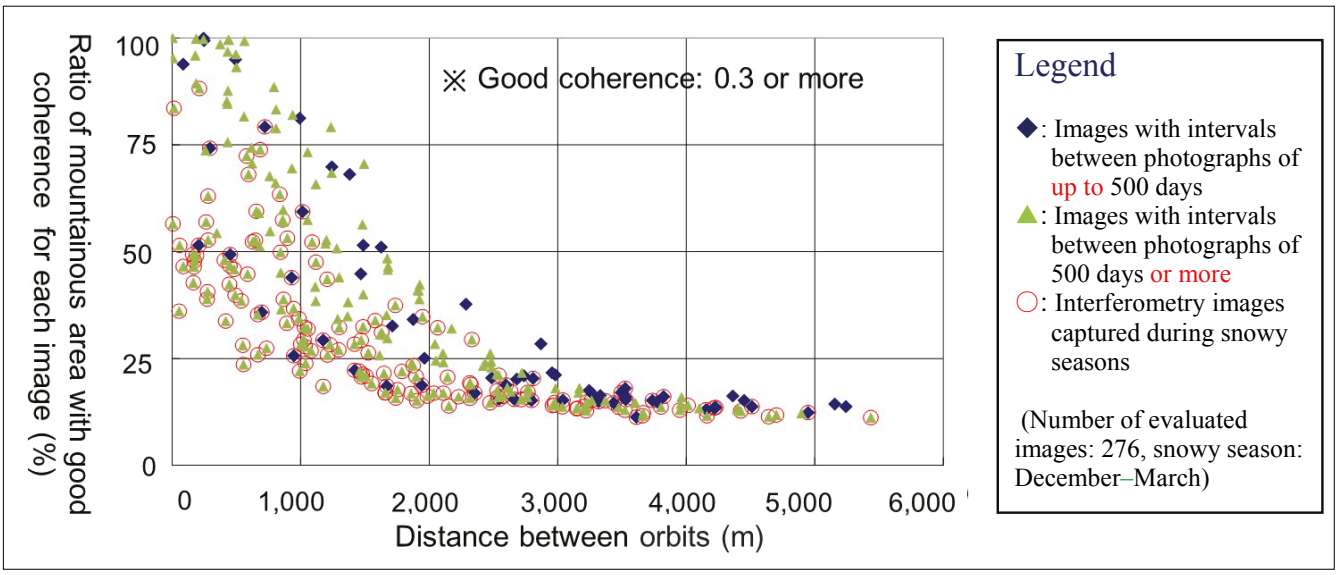

Figure 3. Relationship between distance between orbits and interference (path number 409)

KEYWORDS

Landslide; SAR; satellite; ALOS; Search

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