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Assessment the activity of deep-seated landslide by using TCP-InSAR interferometry from ALOS/PALSAR images

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Taiwan is located at an active mountain belt and subtropical climate environment; severe catastrophic landslides that commonly transform from deep-seated landslides (Deep Seated Gravitational Slope Deformation, DSGSD) have caused considerable damages in mountainous areas. After the 2009 Hsiaolin landslide that caused 450 casualties during the Typhoon Morakot, over 3000 DSGSD have been identified by using 1m resolution LiDAR derived DEM. Within these DSGSD, how to evaluate their activity and to determine which require further detail investigation becomes an important task for landslide hazard mitigation of the island.

The Permanent scatters InSAR technique (PS-InSAR) has recently been demonstrated to be a valuable and useful approach to detect surface displacements with millimetre precision for monitoring slow moving landslide phenomena over a large area. However, temporal decorrelation from vegetation and orbit errors still severely limit the possible observations of ground deformation in PS-InSAR. Temporarily coherent point InSAR (TCP-InSAR) is a modified PS-InSAR approach. The unique characteristics of TCP-InSAR technique on dense observations and robustness of multi-temporal errors make it becoming an efficient tool to detect the activity of DSGSD in heavy vegetation area. In this study, TCP-InSAR interferometry from 20 ALOS/PALSAR satellite images is used to evaluate the activity of deep-seated landslides in dense forest, mountainous area of Taiwan. PALSAR L-band interferograms provides better performance and more homogeneous PS distribution coverage than C-band and X-band for the mountainous areas due to its greater penetration capacity in vegetated environments.

Four deep-seated landslides with an area over 10 ha in Chingin area of central Taiwan are selected as study examples. Cingjing village located at Centre Taiwan is well known as one of the three high altitude agriculture area in the island. The Central Geological Survey of Taiwan as potential failure area has recently announced 60% of the Cingjing area. In this study, surface deformations obtained from TCP-InSAR show significant down moving displacement. The landslide activity index that is defined as the average of vertical down moving displacement rate is used to evaluate the activity of deep-seated landslides. The calculated landslide activity index of selected four deep-seated landslides is in the range of 7.17 mm/yr to 15.14 mm/yr which is consistent with nearby GPS recording data.

Besides the selected four deep-seated landslides, several imperceptible deep-seated landslides with an area less than 10 ha which have also been confirmed by field investigation are recognized in TCP-InSAR analysis. Therefore, the deformation obtained from TCP-InSAR not only using for the assessment of the activity of deep-seated landslide but also helping the recognition of the location of deep-seated landslide.