Measurement of landslide surface deformation along Kali Gandaki River, Nepal using time-series Sentinel-1 InSAR images

*Hiroshi, P. Sato[1], Masahiro Chigira[2], Ching-Ying Tsou[3]

1. College of Humanities and Sciences, Nihon University, 2. Disaster Prevention Research Institute, Kyoto University, 3. Faculty of Agriculture and Life Science, Hirosaki University

This study aims to detect landslide surface deformation along Kali Gandaki River, Nepal. Surface landslides was causatively related with a large deep-seated gravitational slope deformation (DGSD) in a hilly region of the southwestern Alps (Tibaldi et al. 2004). Tibaldi et al. (2004) also mentioned that post-glacial and active surface landslides developed on the convex lower part of the slope, suggesting that they resulted from instability due to the new profile assumed by the slopes during the deep-seated deformation. Sato (2019) has already interpreted images of synthetic aperture radar interferometry (InSAR) and pointed out occurrence of the deformation in the study area where Kali Gandaki River incises the mountains between Tal Bagar and Lete, Nepal. To detect landslide deformation, we used time-series Sentinel-1 InSAR and unwrapped InSAR images and measured the velocity of the deformation along line of sight (LoS) using the tool of LiCSBAS. This tools was developed and provided by an open-source InSAR time series analysis package that integrates with the automated Sentinel-1 InSAR processor (LiCSAR) (Morishita et al. 2020). We downloaded 81 products of the data observed from 11 Sep 2016 to 04 May 2018 in the Frame ID of 158A_06249_131313 which covers the study area. An SBAS (Small Baseline Subset algorithm) analysis of the products gave us the resulting velocity of the deformation for about two years (Fig.1), overlain on the landslide landform classification map (Chigira et al. 2019). In Fig.1, red and orange point indicates the location of the knick point of the river around Tal Bagar and Lete, respectively. We set two measurement lines (Fig.1) on the slope near Tal Bagar and Lete. As shown in Fig.2, the line 1 (near Lete) showed −10mm/yr to −30mm/yr (downward and/or easting) deformation along LoS, and this remarkable deformation is illustrated between 600m and 1200m in distance; where is interpreted as the depression and the scar of the old landslide in the landslide landform classification map (Chigira et al., 2019). As shown in Fig.3, the line 2 (near Tal Bagar) showed −15mm/yr to 0mm/yr (downward and/or easting) deformation along LoS, and the deformation recorded at a velocity greater on and near the ridge than on the convex lower part of the slope, where is interpreted as DGSD (Chigira et al. 2019). The velocity shown in Figs 2 and 3 may include some noise and more calculation is needed. Its signal is estimated as more or less than ±15mm/yr; however, the measured velocity shown in the figures was found to be harmonized with the interpreted landslide landform classification map. This study was supported by KAKEN 17H02973; Principal Researcher, Prof. Masahiro Chigira, DPRI, Kyoto Univ.

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