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Glacier Surface Velocity Fields and Spatiotemporal Variation in West Kunlun Shan, China, Detected by ALOS/PALSAR

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The Third Pole Environment (TPE) is centered on the Tibetan Plateau. Average elevation surpass 4000m and a number of Mountain glaciers developed in the Third Pole region. For the people living in arid areas around TPE, these glaciers is crucial for the water source so directly influence on social, agricultural and economic development. It is said that mountain glaciers outside of polar region was affected by global environment changes, especially small glaciers and ice cap in low latitude, and melt water raised sea-level. As index of future water supply, global climate changes and sea-level prediction, spatial and temporal observation for the Third Pole region is important. However, glacier measurement data have been limited because of political and technical issues. Observed area in our study is West Kunlun Shan (WKS) which located north-west of TPE, in China. Previous works are very few in WKS. Ice-core record at Guliya ice cap (Thompson et al. 1995) and snow covered area changes using optical satellite data (Shangguan et al. 2007) was investigated. But the spatial and temporal changes in the surface velocity fields in WKS have not been reported. Recently, remote sensing techniques using Synthetic Aperture Radar (SAR) on board satellite have been drawing attention as an important tool for determining glacier flow (Joughin et al. 1998, 2001, Pritchard et al. 2005).

We detected surface velocity fields of a number of valley glaciers in West Kunlun Shan, using pixel-offset technique based on the ALOS/PALSAR data. The temporal coverage is from 2007 to Jan. 2010 with a nominal time interval of 46 days and the spatial is ˜15000 square kilometers, over 4000m above sea level. In this study, we assumed that glaciers flow parallel to surface topography and glacier flow constantly during period of each observation. Based on these assumptions, we converted the results to daily surface velocity field.

We paid particularly attention to the lower reaches of Duofeng glacier, north side of WKS, from which glacier signals were detected both paths in all seasons. We estimated seasonal variation model using least squares method. In our estimated model, two local maximum existed in summer and winter season. Surface velocity during summer was up to 120-130% above winter background values. Relationship surface melt water and fluctuation of flow speed of glacier and ice-sheet was reported (Bartholomew, I. et al. 2010, Sundal, A.V. et al., 2011). We compared surface temperature (NCEP Operational Data) and seasonal variation. Both maximum peaks moderately corresponded. Despite of seasonal variation, mean surface velocity was slightly and regularly decelerated.

Also, in order to investigate detailed variation, we manually partition the lower reaches of Duofeng glacier to several sections and similarly estimated variation model for each sections. In summer, surface velocity rapidly increased in middle section (5100-5600m a.s.l.) and degreased in terminus section (˜5000m a.s.l.). In winter, on the other hand, surface velocity was maximum in the upper section (over 5700m a.s.l.) and gradually degreased toward terminus.

Keywords: ALOS, PALSAR, feature tracking, mountain glacier, west Kunlun Shan, seasonal variation