

Spatial distribution of permafrost in the northern Tien Shan, Central Asia

YAMAMURA, Akiko^{1*} ; NARAMA, Chiyuki² ; TOMIYAMA, Nobuhiro³ ; TADONO, Takeo⁴

¹Department of Environmental Science ,Niigata University, ²Niigata University, Department of Environmental Science, ³Remote Sensing Technology Center of Japan (RESTEC), ⁴Japan Aerospace Exploration Agency (JAXA)

Tien Shan Mountains in the arid and semi-arid regions of Central Asia, with their water resources in the form of mountain glaciers and permafrost, are known as the water towers of Central Asia. Although it is necessary to investigate the current level of these mountain glaciers and permafrost to estimate the amount of water stored (Sorg et al., 2012), the spatial distribution of permafrost is not well known in the northern Tien Shan. We clarify the current state of mountain permafrost in the Kyrgyz Ala-Too Range using the distribution, classification, and motion of rock glaciers as indicators of mountain permafrost.

We applied DInSAR analysis to rock glaciers which identified by field surveys and interpretation of aerial photographs. We extracted the active and inactive rock glaciers according to the motion of rock glaciers. To validate the detected surface motion on rock glaciers, we conducted GPS measurements on rock glacier in Sokuluk Valley. The average movement was 75cm/yr on the glacier-origin rock glaciers between 2013 and 2014. In addition, ground surface temperature shows that the geothermal conditions were sufficient to maintain mountain permafrost inside rock glaciers at the study site.

The distribution of the active and inactive rock glaciers that confirmed their motion revealed discontinuous permafrost altitudinal zones located above 2900 m a.s.l. in the northern part and above 3400 m in the southern part of the Kyrgyz Ala-Too Range. In addition, we confirmed local subsidence between around 3300-3500 m a.s.l. related to the melting of mountain permafrost inside the rock glaciers during summer by short term DInSAR. Half of the active and inactive rock glaciers are glacier-origin type. We also report the environment conditions of glacier-origin rock glaciers.

Keywords: DInSAR analysis, mountain permafrost, rock glacier, Tien Shan