Monitoring the Motion of Yiga Glacier Using GF-3 Images

WANG Qun 1,2, FAN Jinghui 3, YUAN Weilin 3, TONG Liqiang 3, Joaquim João Sousa 4, LIU Guang 5

1 China Highway Engineering Consultants Corporation, Beijing 100097, China; wangq0723@163.com
2 Research and Development Center of Transport Industry of Spatial Information Application and Disaster Prevention and Mitigation Technology, Beijing 100097, China
3 China Aero Geophysical Survey and Remote Sensing Center for Land and Natural Resources, Beijing 100083, China; jh15fan@agrs.cn (J.F.); yuanweilin@mail.cgs.gov.cn (W.Y.); tongliqiang@mail.cgs.gov.cn (L.T.)
4 School of Sciences and Technology, University of Trás-os-Montes e Alto Douro, and INESC TEC (formerly INESC Porto), Vila Real, and INESC TEC (formerly INESC Porto), 5000801 Portugal; jjsousa@utad.pt (J. J. S.)
5 Key Laboratory of Digital Earth Science, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing 100094, China; liuguang@radi.ac.cn (G.L.)

Abstract: Glacier motion represent a significant reference for the hazard assessment of glacier and glacial lakes. GF-3, as the first civil spaceborne synthetic aperture radar satellite in China, has important advantages in monitoring glacier motion due to its characteristics of all-weather, all-time capabilities and high spatial resolution. In this paper, based on five GF-3 images with FSⅡ imaging modes, the surface velocities of the Yiga Glacier, located in Nyenchen Tonglha Mountains, are estimated over five time periods using offset tracking technique during November 2017 to March 2018. The results were compared with the offset tracking results of sentinel-1 images which have a similar time with GF-3 image and based on the assumption that the velocity of the bedrock in the study area should be 0, the velocity residuals of the bedrock in each period are calculated, then the applicability of GF-3 image in monitoring glacier surface motion was evaluated. The results of GF-3 images show that the distribution of Yiga Glacier motion is similar in four periods, and the maximum surface velocities are all distributed in the central part of the glacier where the elevation changes dramatically. Meanwhile, the results are consistent with the results of sentinel-1 based on two images. The RMSEs of velocity residuals in the bedrock area in four periods are 1.4 cm/d, 2.0 cm/d, 1.7 cm/d and 2.3 cm/d, respectively, which validate the reliability of the deformation estimated used GF-3 images in this paper. Based on the above analysis, GF-3 SAR data can be used as one of the conventional data sources for monitoring glacier surface movement. Because of its high spatial resolution and high cost performance, GF-3 can play a unique role in monitoring the motions of glaciers.

Keywords: glacier motion; GF-3; offset tracking; Yiga Glacier