Estimation the thickness changes of mountain glacier with InSAR observation

Jianmin Zhou, Zhen Li

Key Laboratory of Digital Earth, Institute of Remote sensing and Digital Earth, Chinese Academy of Science, Beijing, China

zhoujm@radi.ac.cn

The ice loss of glacier has been the dominant mass contributor to sea level changes during twentieth century [1]. It is important to monitor thickness changes of mountain glaciers for their contributions to calculate ice volume loss and mass balance [2]. Although traditional ground-based techniques exist for measuring glacier thickness changes directly and inter-annually, they tend to be labor-intensive, expensive and provide very limited spatial coverage. So the remote sensing data are an attractive source of information to complement in situ measurements [3]. Differencing multi temporal digital elevation models (DEMs) generated from space-borne or air-borne observations becomes one of the effective methods to monitor the spatial patterns of glacier thickness and volume changes [4]. These methods include generation of DEMs from radar interferometry, for example, the Shuttle Radar Topography Mission (SRTM) DEM acquired in Feb, 2000 [5], or from spaceborne or airborne photogrammetry [6], or from laser altimetry [7]. However, the accuracy of the results derived from these methods depends mainly on the DEMs’ accuracy. Because of the low precision of these DEMs, the estimation of glacier thickness change is difficult to satisfy the evaluation of ice loss with precision. Over the past decades, the spaceborne synthetic radar aperture interferometry (InSAR) technique has proved to be an effective remote sensing tool to map ground deformations [8]. Using the DInSAR method, pairs of SAR images can be processed to obtain the high spatial resolution maps of surface deformation with large spatial coverage and the precision achieved on the order of centimeters [9]. Because the current SAR satellite systems have relatively short revisit period, DInSAR has the capacity to resolve time-dependent deformation. During the recent years, studies based on DInSAR have so far mostly concentrated on obtaining the glacier movement, and little has been done on deriving the glacier thickness changes using the one component of surface deformation along the line of sight (LOS).

The goal of this study is therefore to use the differential phase derived by DInSAR algorithm to obtain the mountain glacier thickness change and analysis the spatial variations of the Dongkemadi glacier thickness changes. Using this method the glacier thickness changes can be monitored in cm-level accuracy. The results shows the glacier thickness changes of KG are divided by the central axis into the left thickening side and the right thinning side from 3500 m to 3700 m. The accumulation zone of Dongkemadi glacier shows continue to thicken. Net loss occurred mainly at the north-eastern glacier.


Key words: Mountain glacier, Thickness change, Differential interferometric synthetic aperture radar (DInSAR).