THE GLACIER MOVEMENT ESTIMATION AND ANALYSIS WITH INSAR IN THE QINHAI-TIBETAN PLATEAU

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1. INTRODUCTION

The glacier is important factor in climatologica and hydrological investigations, especially in the western China. Also, glacier also play important interactive role in the regional climates through its effect of increasing surface albedo, and Glacier changes are among the clearest signals of on-going warming trends existing in nature. The remote sensing plays an important role for glacier inventorying and monitoring work. Most remote sensing data used to mountain glaciers study mainly are optical data, which is hard to acquire in more cloud region. SAR systems have an important ability to observe the earth's surface, independent of cloud conditions. Particularly, the SAR interferometry provides a useful tool for monitoring the velocity of glacier movement [1, 2].

For accurate measurement of glacier movement with InSAR data, the suitable method of retrieving velocity of glacier motion need be considered for the different type of glaciers in case of the difference of the characteristics of surface and movement velocity. Although the main potential of InSAR for glacier movement estimation has been shown in several case studies, its successful application is often limited by decorrelation, especially for maritime glacier which has high relatively motion velocity. The decorrelation in glacier area is serious duo to the huge change of the glacier surface. In this paper, we analyze the characteristics of different glaciers type, such as continental glacier, sub-continental glacier and maritime glacier, and demonstrate the method and result for the glacier motion in Qinghai-Tibetan plateau.

2. STUDY SITE AND DATASETS

Total four glacier sites with different characteristics are chosen for methodic experiment of extracting glacier movement with InSAR, which are the Dongkemadi glacier, Muztag Ata glacier, Hailuogou glacie, and Keqicar Baxi glacier. The Dongkemadi glaciers (33.08N,92.09E) is continental glacier, which is located in the head region of the Buq river, on the northern slope of the Tanggula Mountain in the central part of the Qinghai-Tibetan Plateau. The Muztag Ata glacier (38. 33N, 74. 17E) is also continental glacier in north-west of the plateau. The Hailuogou glacier (29. 58N, 101. 91E) belong maritime glacier in the east of the plateau near the Indian ocean monsoon channel. The Keqicar Baxi glacier (41. 81N, 80. 10E) is a sub-continental glacier in the Tianshang Mountain. We use different SAR data such as C-band ERS-1/2 with 1 day interval and L-band ALOS/PALSAR with 46 days interval to estimate and analysis the motion's characteristics of these four glaciers with three types. The ERS-1/2 data pair with C band is acquired from descending orbits at Apr. 22 and Apr. 23, 1996 in the Dongkemadi glacier area. The PalSAR data pairs with L band in ascending mode are selected at Dec.10, 2006 and Jan.25, 2007 in the Dongkemadi glacier area, at Feb. 27 and Apr. 13, 2008 in the Muztag Ata glacier area, at Jan. 12 and Apr. 13, 2008 in the Hailuogou glacier area, at Jun. 12 and Jul. 28, 2006 in the Keqicar Baxi glacier area.

3. METHOD AND RESULTS

In the current study, we utilized the repeat two-pass D-InSAR approach, with an external DEM, to extract the motion of the glacier surface. This method employs two component SAR images, producing one interferogram. And the deformation of the

surface, such as glacier flow, in the time interval can be detected. For derivation of surface deformation or displacement, another interferogram has to be synthesized. The synthesized interferogram is generated from an existing DEM. It is then subtracted from the original interferogram, thereby removing all fringes that relate to ground elevation, leaving only fringes that represent glacier surface motion [3].

A novel method to estimate and analysis the movement of the different types of glaciers is developed in this study. The glacier's pattern is analyzed firstly according to the magnitude of the coherence of the InSAR pairs. The coherence of the maritime glacier is smaller than the continental glacier, as the maritime glacier's move faster than the continental glacier. Then, the motion of the glaciers estimated in two ways. One is that the movement of the whole glacier is derived; the whole glacier movement will cause the deformation of the terrain surface around the glacier. So we use the motion result extracted by InSAR of the terrain surface near the terminus of glacier to deduce the movement of the whole glacier. And the other one is that the motion of the glacier's surface is monitored. From the result extracted by InSAR of the glacier's surface, we estimate and analysis the spatial variations of the glacier's surface. (Fig.1, Fig.2)

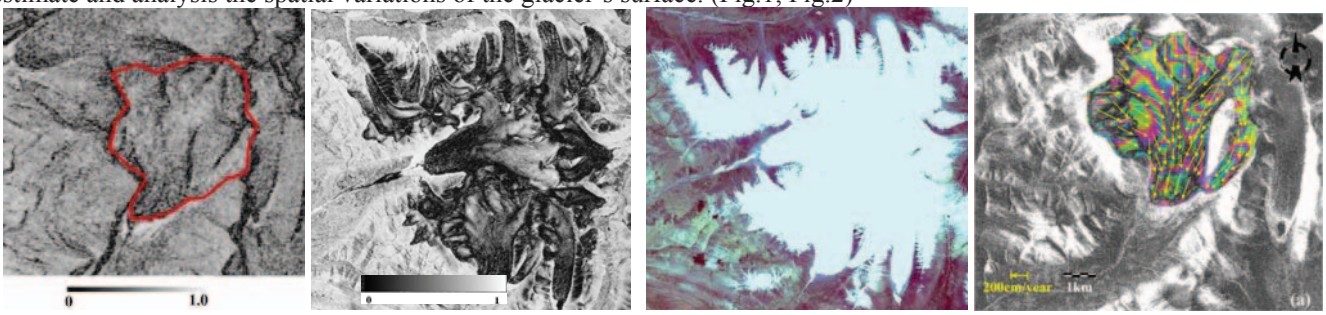

Figure1. The coherence coefficients image at the Dongkemadi glaciers area for ERS-1/2 Tandem between Apr. 22 and Apr.23, 1996, ALOS/PalSAR pair between Dec. 10, 2007 and Jan.25, 2008 (middle-left), Landsat/TM image (middle-right), and glacier motion velocity extracted from PalSAR interferogram.

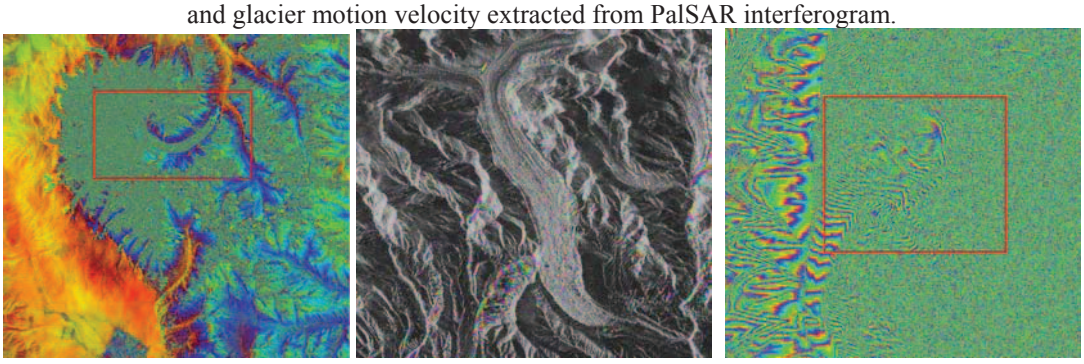

Figure2. The interferogram image at the Keqicar Baxi glacier area for ALOS/PalSAR pair between Jun. 12 and Jul. 28, 2006 (left and middle), and interferogram image at the Hailuogou glacier area between Jan. 12 and Apr. 13, 2008(right).

4. CONCLUSION AND DISCUSSION

The datasets of five pairs C-band ERS-1/2 and L-band ALOS/PALSAR SAR images in descending and ascending mode for these four glaciers with different characteristics in Qinhai-Tibetan Plateau are used to analyze. The results show that the velocity of these glaciers has a great difference mainly caused by environment situation and glacier morphology. The method developed in this study can be used to extract glaciers movement velocity for different type of glaciers.

5. REFERENCES

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