# Annual Variation on Ice Flow by Using Satellite Images in Shirase Glacier, Antarctica

Tomoaki KITAYAMA[1], Kazuki NAKAMURA[2] and Fumihiko NISHIO[3]
[1,3] Center for Environmental Remote Sensing, Chiba University
Advanced Industrial Science and Technology
E-mail: tomotomo@graduate.chiba-u.jp

**Abstract**

In 1998, shiase glacier floating ice tongue broke (Fig.1). same time, Sea Ice discharged from Lutow-Holm Bay in Antarctica (Ushio, 2006). But we have not understood it changes, because observations are very difficult in this area. For the understanding of Shirase Glacier detailed changes, especially Velocity of Floating ice tongue using satellite images from 1990 to 2006. Using satellite is acquired by MOS-1, MOS-1b, JERS-1, ERS-2, and Terra.

The result from that, the velocity of floating ice tongue had not constant and had changed for the past 17 years. Particularly, after the floating ice tongue broken in 1998, it was clarified that the velocity of the glacier had increased greatly when it was compared with the average year value.

## 1. Introduction

In the present climate condition, the melt in the cryosphere is remarkable. Result it is thought that the sea level rises. The 90% ice on the earth exists in the Antarctica. When thinking about the sea level change related to the climate changes, it is very important to think about the mass balance on the Antarctic ice sheet. In this area, the amount of consumption is decided by the glacier. So study of glacier is very important

In this study, using satellite images that velocity of shirase glacier floating ice tongue calculated. Annual variation on Ice flow velocity was presumed of 17years from 1990 until 2006.

## 2. Study Area

Shirase glacier located about 100km southwest of syowa station at east Antarctica (Fig.2). It flows to the Lutow-Holm Bay. Front of this glacier is floating ice tongue.

## 3. DATA

For the long term observation, using some satellite images. MOS-1 (sensor name is MESSR), MOS-1b (MESSR), JERS-1 (SAR), ERS-2 (AMI) and Terra (ASTER).

For the Geometric correction, Used RAMP (Raderasat Antarctic Mapping Project Digital Elevation Model Version2) Data Set by NSIDC (National Snow and Ice Data Center).

## 4. Method

All satellite images have difference information about Longitude, Latitude, resolution and others. There information should be made same. So I did Geometric Correction. Second, Reading coordinates of corresponding point between images with different time. And glacier velocity is requested by using coordinates value by using the following expression.

$$V_{year} = \frac{365}{\Delta T}\sqrt{(x_2 - x_1)^2 + (y_1 - y_2)^2}$$

Flow velocity is calculated like this.

## 5. Result

It understand that the average velocity (1990~2006, 17years) is 2750m/a in left bank and 2350m/a in right bank (Fig.3). There is 400m difference in left and right velocity. It is thought that the thickness of Ice in left and right is cause in it (Nakamura et al., 2007). It understands that velocity is not constant and has variation every year. Especially, velocity in 1990 and 1998 was faster than Average. At the same time, shirase glacier floating ice tongue broken (Fig.1 and Fig.4). I think that it relate these events. When Floating ice tongue shorter Velocity of shirase glacier faster.

## 6. Summary and Discussion

It understand that velocity of shirase glacier floating ice tongue (1990~2006, 17years Average) are 2750m/a in left bank and 2350m/a in right bank. There is 400m/a difference in left and right velocity. And the velocity is not constant and has variation every year. Especially, velocity in 1990 and 1998 was faster than Average. At the same time, shirase glacier floating ice tongue broken (Fig.1 and Fig.4). When it broken that sea ice decreased in Lutow-Holm bay at the same time.

I think that velocity is not constant because there are possibility of influencing sea ice extend in lutow-holm bay, temperature, wind and melt water under the bed lock. But I don' t understand it. And I think that it relate velocity increase to floating ice tongue broken. When floating ice tongue is long that it velocity is decreasing. Because floating ice tongue velocity depends on the shirase glacier movement. So floating ice tongue controls glacier movements. When floating ice tongue broken that velocity is increase because there is no bar.

## References

K. Nakamura, K. Doi, K. Shibuya, 2007.Why is Shirase Glacier turning its flow direction eastward? Polar Sci. (accepted)

S. Ushio., et al 2006. Sea ice variation in Lutow-Holmbukta, Antarctica, during the last fifty years. J. Japanese Soc. Snow and Ice 68, 4, 299-305

**Fig.1 Collapse of shirase glacier floating ice tongue**

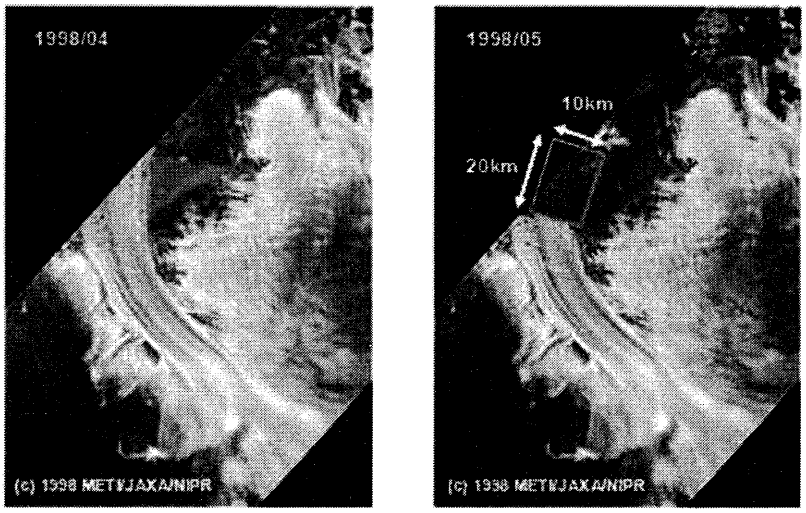


**Fig.2 Shirase glacier and Antarctica**

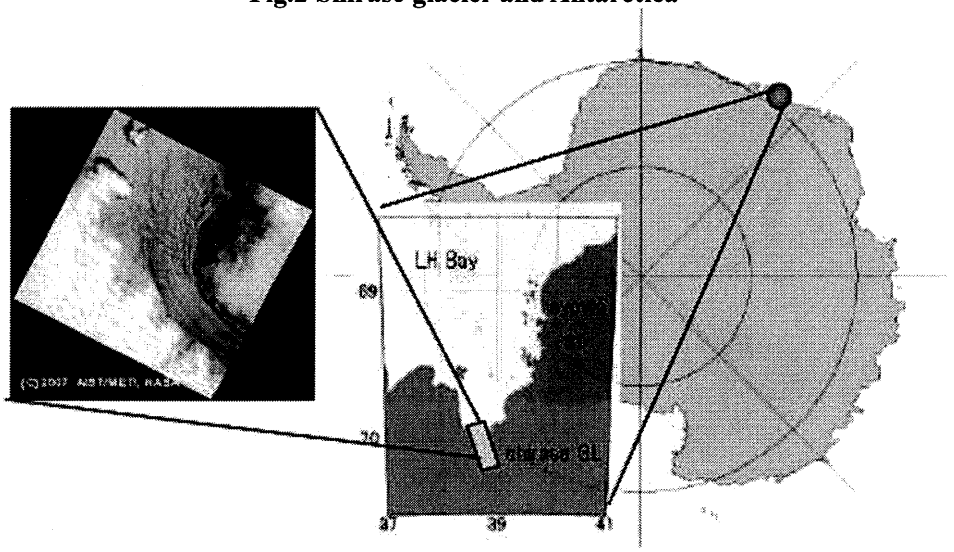

Fig.3 Velocity of shirase glacier left and right bank

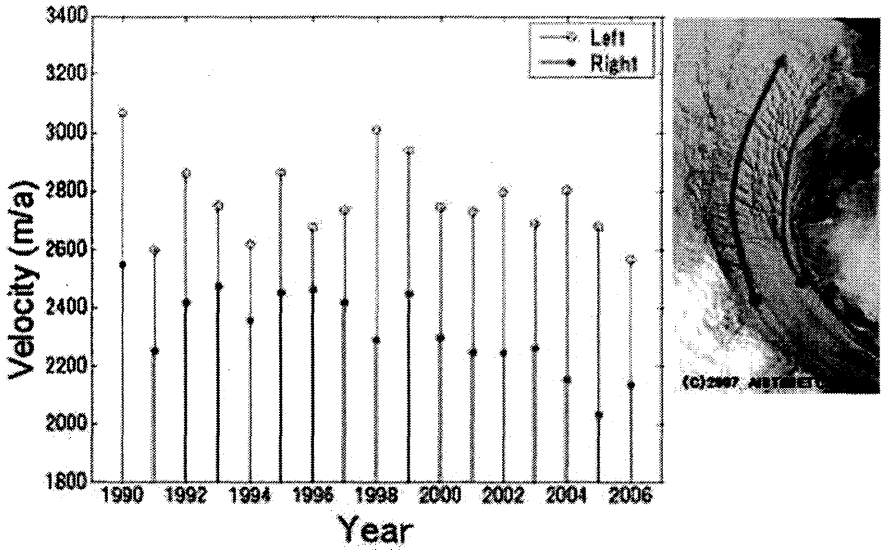


Fig.4 Distance for floating ice tongue from reference line