Surge Type Glacier Identification on Northeast Spitsbergen, Svalbard from Landsat Imagery 1984-2018

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Photography encouraged

This presentation participates in OSPP — EGU Outstanding Student Poster & PICO Contest

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EGU2019-135

Introduction

Svalbard archipelago is known as the “surge hot spot” for its high occurrence of glacial surge. This study utilizes all the available **Landsat images (1984-2018)** of 40 major maritime and valley glaciers on NE Spitsbergen, Svalbard to **reconstruct the glacier surface velocity** and identify **historical surge events**.

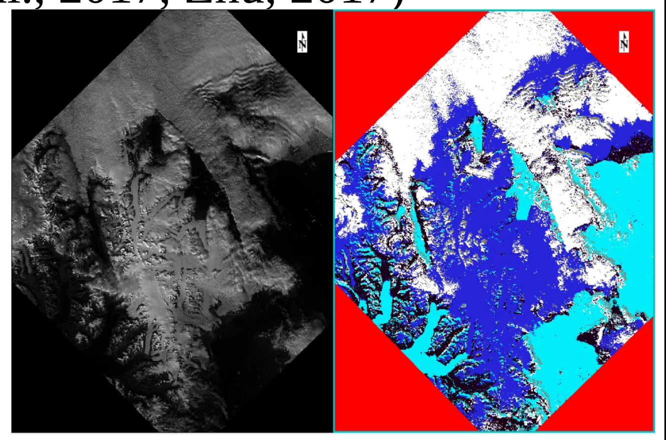
Procedure

1

➢ **Cloud mask**

MFmask/Fmask (Qiu et al., 2017; Zhu, 2017)

Fig.1 Fmask results: (cloud is marked as white)



2

➢ **Re-grid and PCA**

➢(Fahnestock et al., 2016; Scambos et al., 1992)

Table 1. Comparison of Selected Bands of Landsat 4, 5 TM, Landsat 7 ETM+ and Landsat 8 OLI imagery

Landsat 4-5		Landsat 7 Landsat 8	
Bands	Wavelength (µm)	Bands	Wavelength (µm)
Band 2-Green Band 3-Red Band 4-Near Infrared (NIR)	0.52-0.60 0.63-0.69 0.76-0.90	Band 8 - Panchromatic	0.52-0.90 0.503-0.676
Resolution (m)	30	Resolution (m)	15

Band: Green, Red, NIR → Principal Component Analysis → Re-grid → Improved Landsat 4-5 images

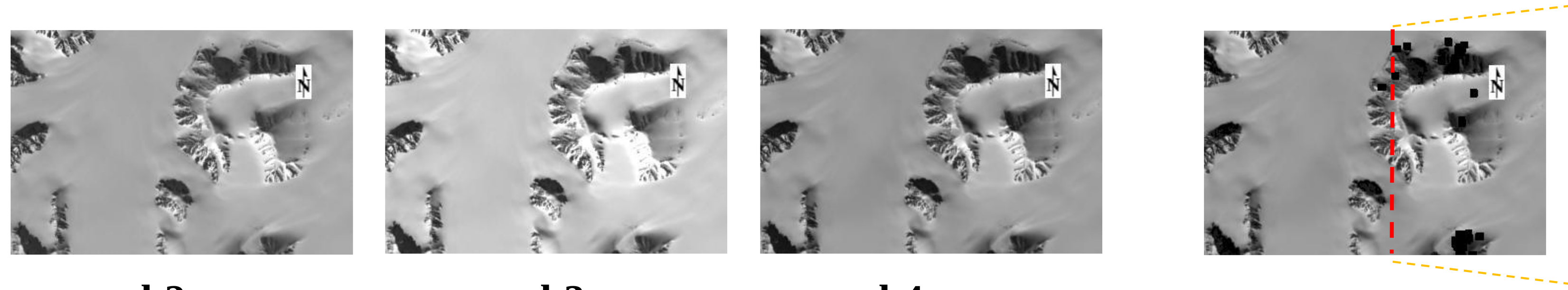


Fig. 2 Visible bands and first component of PCA (15 m noise reduced images with enhanced ice topography and improved surface feature)

Landsat Data

↓

① Cloud, Cloud Shadow mask

↓

Landsat 4-5 | Landsat 7-8

↓

② Re-grid and Principal Component Analysis (Landsat 4-5)

↓

③ Georeferencing (subpixel image registration)

↓

④ Reconstruct Surface Velocity (COSI-Corr) (Leprince et al., 2007)

↓

Surge Identification

3

➢ **Subpixel Image Registration**

(Guizar-Sicairos et al. 2008)

Low pass filter
- Winter: Oct - May
- Summer: June - Sept

Georeferencing
- Low-pass filtered cloud free referencing object

High pass filter
- co-registered images
- Gaussian filtered image

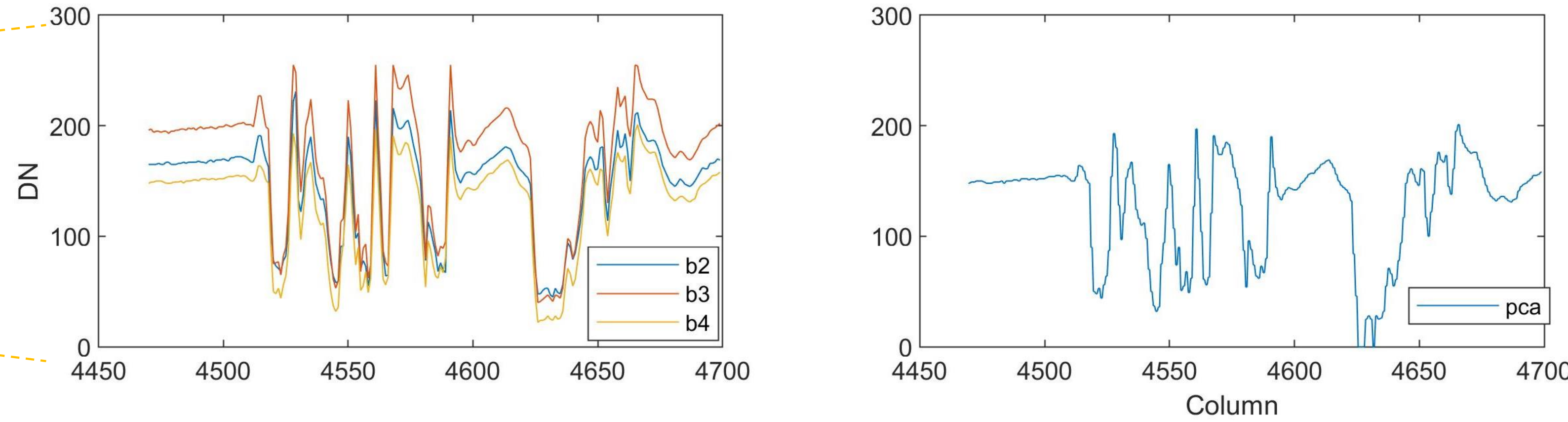


Fig. 3 Pixel Value of b2, b3, b4 and 1st PCA component along the red dotted line in Fig. 2 (LT05_L1GS_216003_20060621_20161121_01_T2)

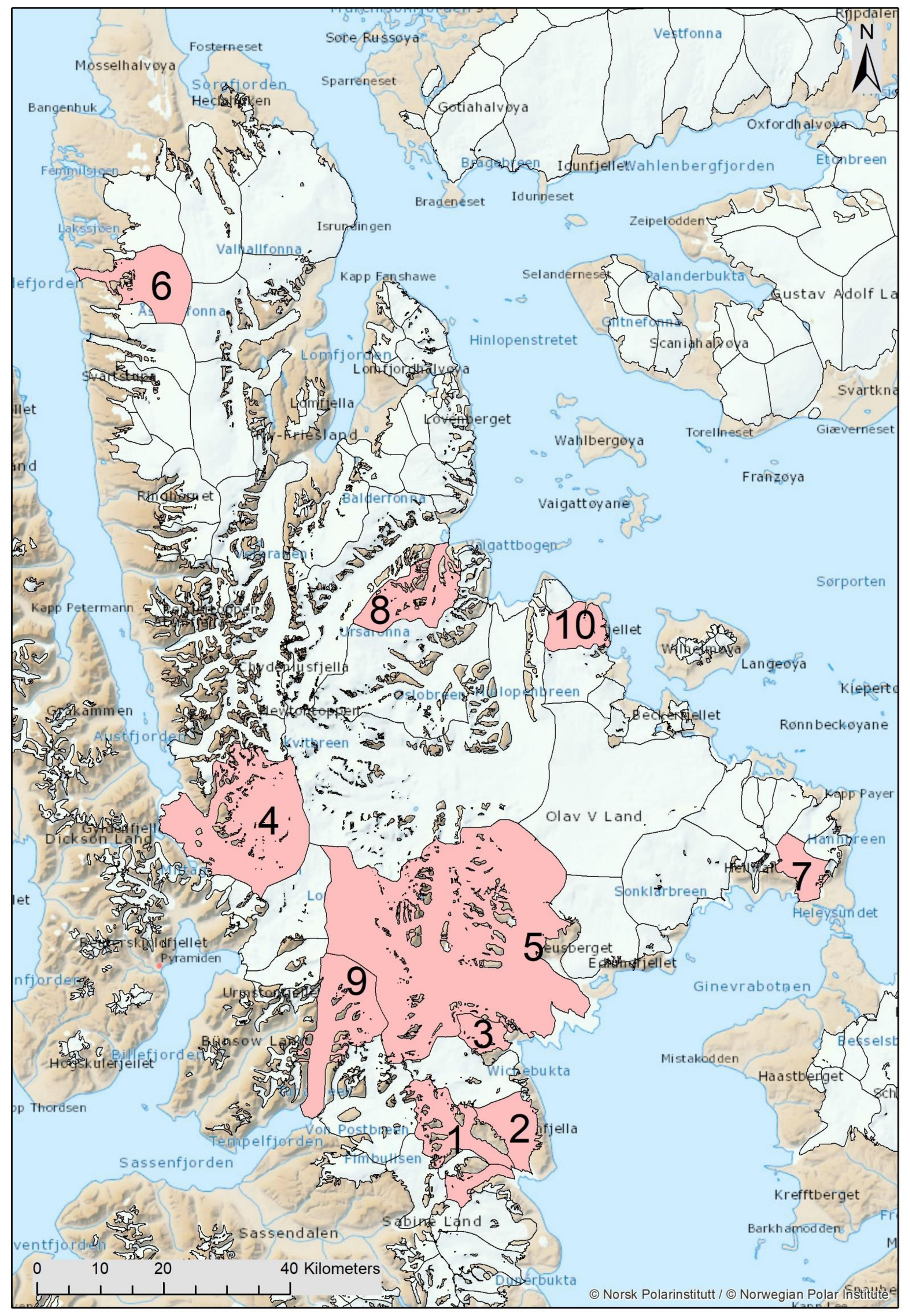
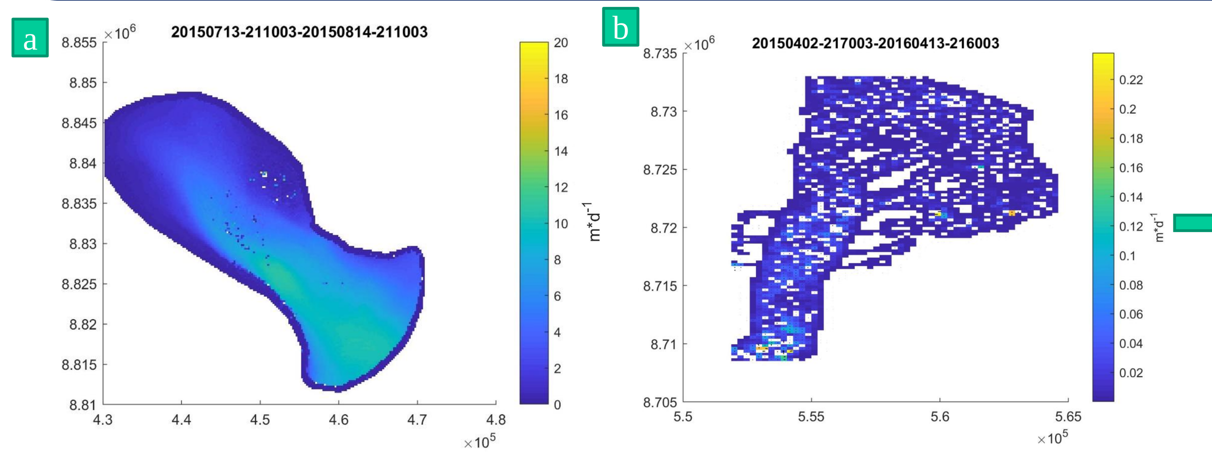


Fig. 4 Study Area and Surge/Active glaciers

Results



Take the average velocity near the front for noise filtered results

Fig. 5 Velocity Map of Basin 3 (a) and Tunabreen (b)

Table 2 Identified Surge-type glacier and the Active Phase

No.	Glacier	Surge/Accelerate Period	
1	Hayesbreen S	2004-2006	
	Hayesbreen	2004-2006	
2	Heuglinbreen	2004-2005	
3	Johansenbreen	2004-2006	
4	Mittag-Lefflerbreen	2004-2006	
5	Negribreen	2004-2005	2017
6	Nordbreen	2007-2008	
7	Pedasejenskobreen	2015-2016	
8	Polarisbreen	2011	
9	Tunabreen	2003-2005	2016-2017
10	Vaigattbreen	2015	

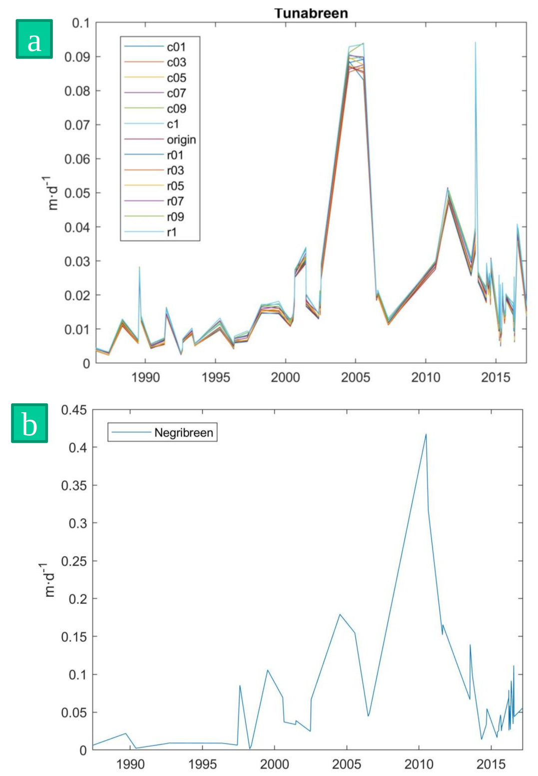


Fig. 5 Average Velocity Near Front (a: Tunabreen; b: Negribreen)

Conclusions

- The method is limited by the spatial resolution of image and the actual. displacement of ice flow at given time window.
- The noised feature track results can still provide sufficient information of the relative change of ice flow speed.
- Further research should focus on improving the data resolution and the use of cloud computing platform.

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