

SEN3APP: Stakeholder WORKSHOP

**Ice Velocity from Sentinel-1 data,
glacier velocity service by
GAMMA Remote Sensing AG**

Andreas Wiesmann, Tazio Strozzi  **GAMMA REMOTE SENSING**

wiesmann@gamma-rs.ch <http://www.gamma-rs.ch>

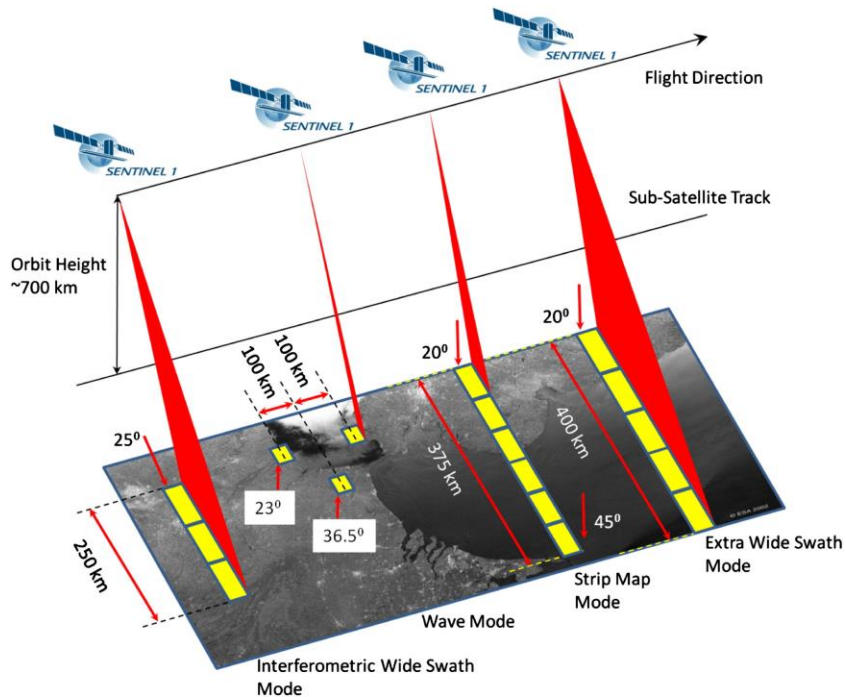


Outline

- **Sentinel-1 Data**
- **Production**
- **Products and Services – Examples (Svalbard, Canadian Arctic, Kyagar Glacier)**
- **Other related Products within SEN3APP**

Sentinel-1 Data

- 12 day revisit, soon constellation
- Day/night capability and independent of weather
- Free access on Sentinel data (no direct data costs)

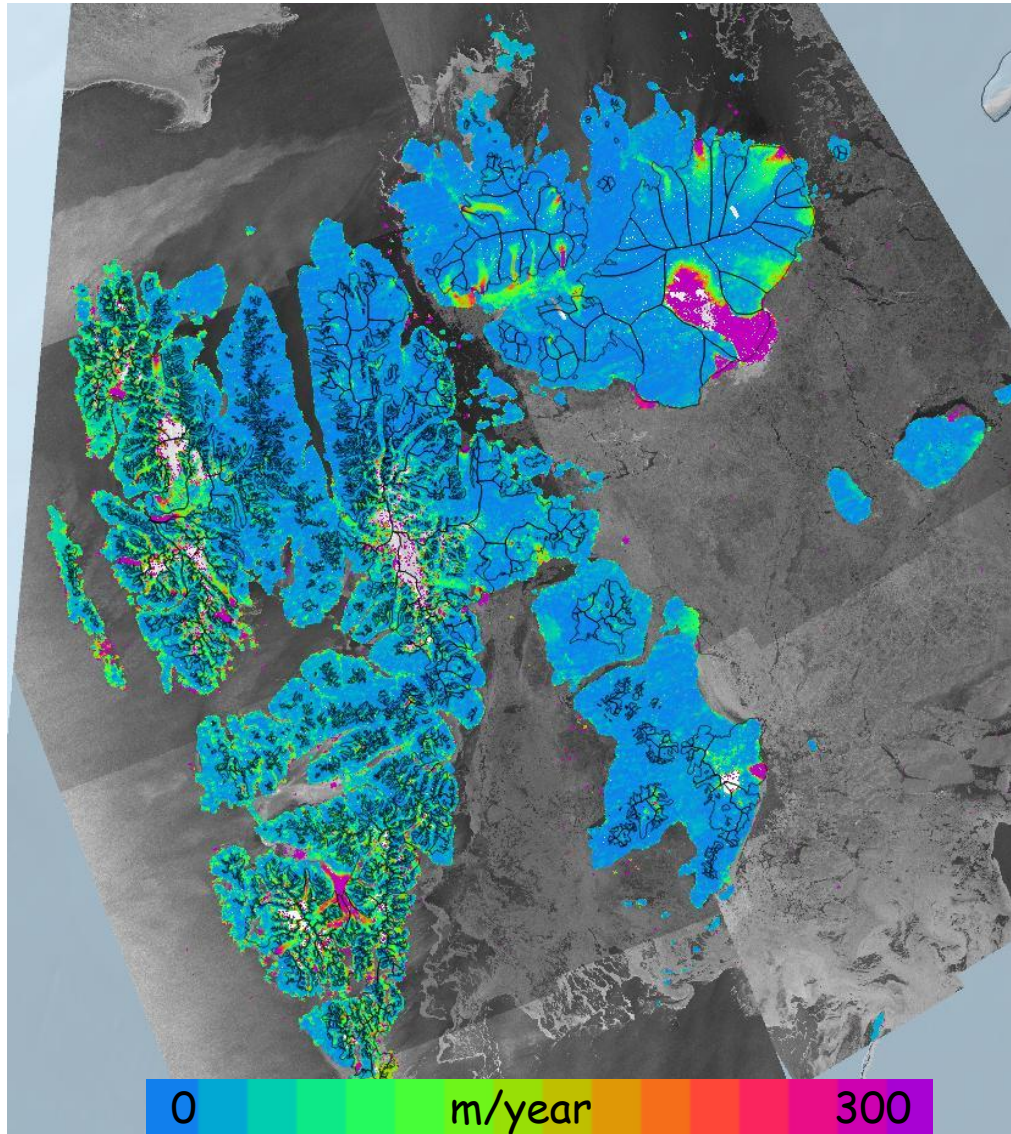


Ice Velocity Map Production

- **Based on advanced feature tracking algorithm**
- **Possible with high and medium resolution data, SLC and GRD**
- **Data selected from SEN3APP (FMI) or ESA Science Hub**
- **Product Generation**
 - **Velocity Map**
 - **Velocity 2D Vector**
 - **Time Series of selected points**
 - **Quality Information**
- **Limitations**
 - **Spatial Resolution → min. size of glacier**
 - **Contrast in image needed**
 - **Wet/dry snow, changing backscatter conditions**

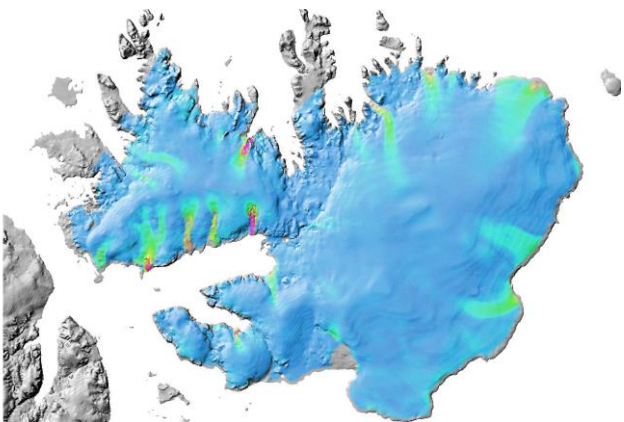
Example Svalbard Sentinel-1

- 21/22 January 2015 - 02/03 February 2015

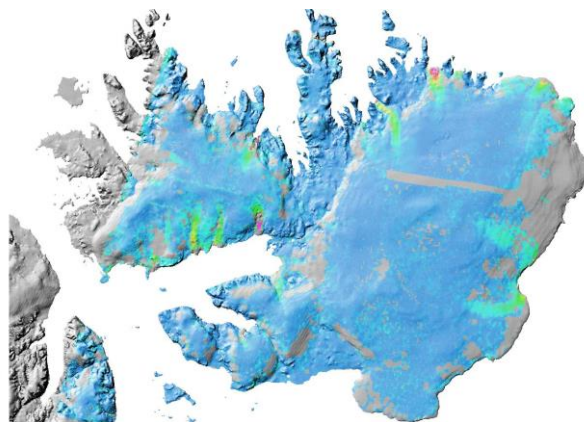


Nordausland (Svalbard) – Historical evolution from 1995 to 2015

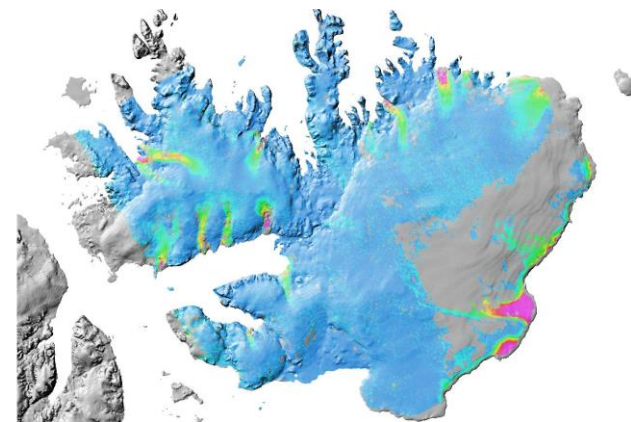
ERS-1/2 1995/1996
InSAR & offset-tracking



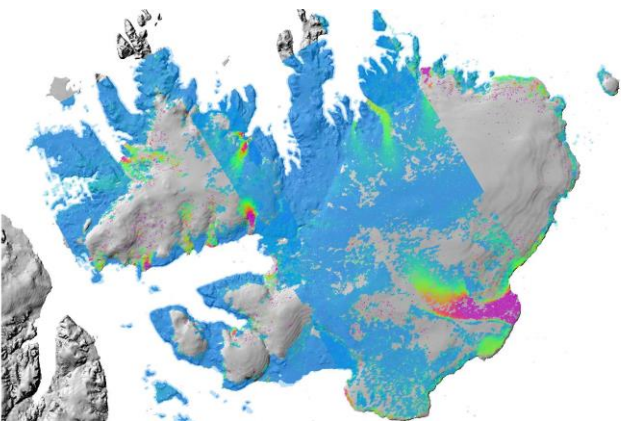
JERS-1 1997
offset-tracking



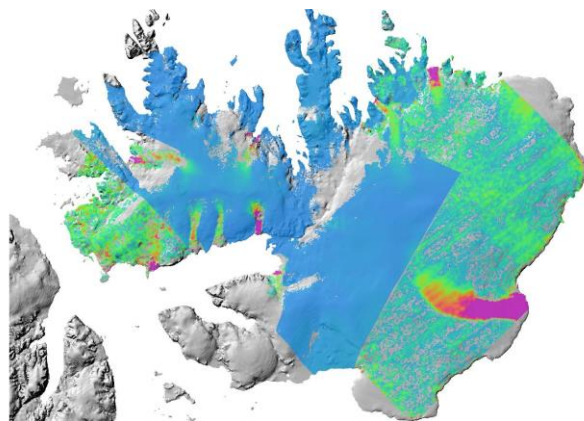
ALOS PALSAR 2008
offset-tracking



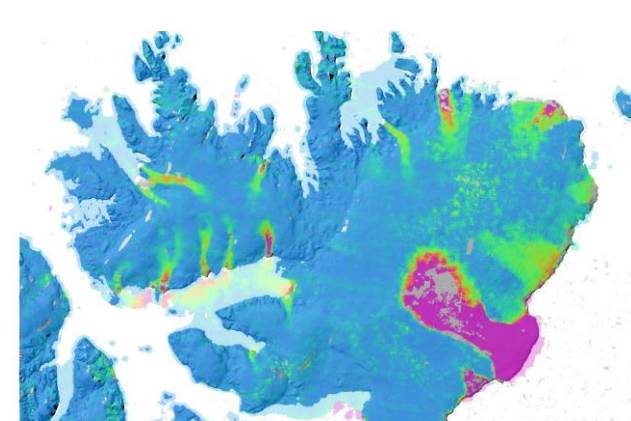
ALOS PALSAR 2010
offset-tracking



ERS-2 2011
InSAR & offset-tracking

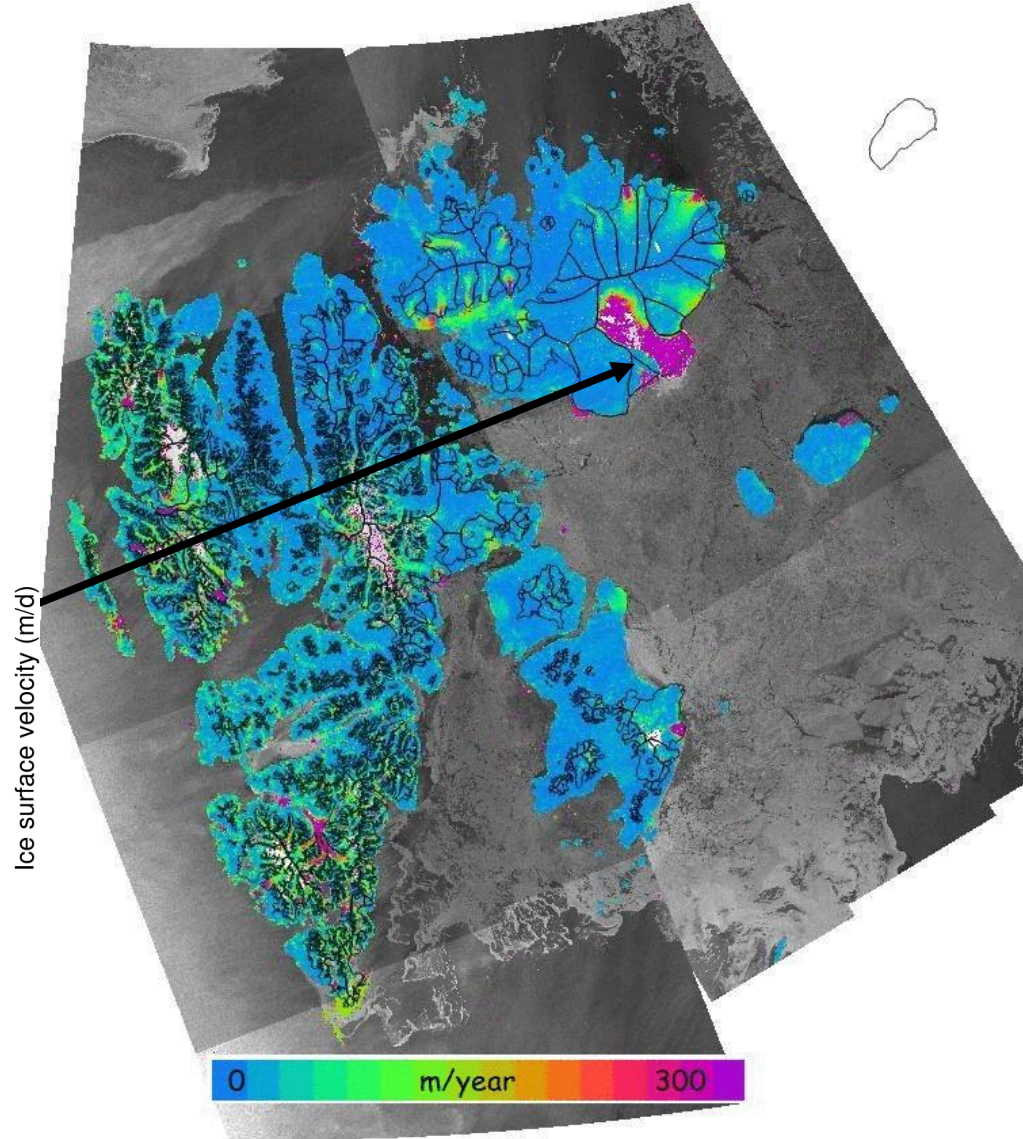
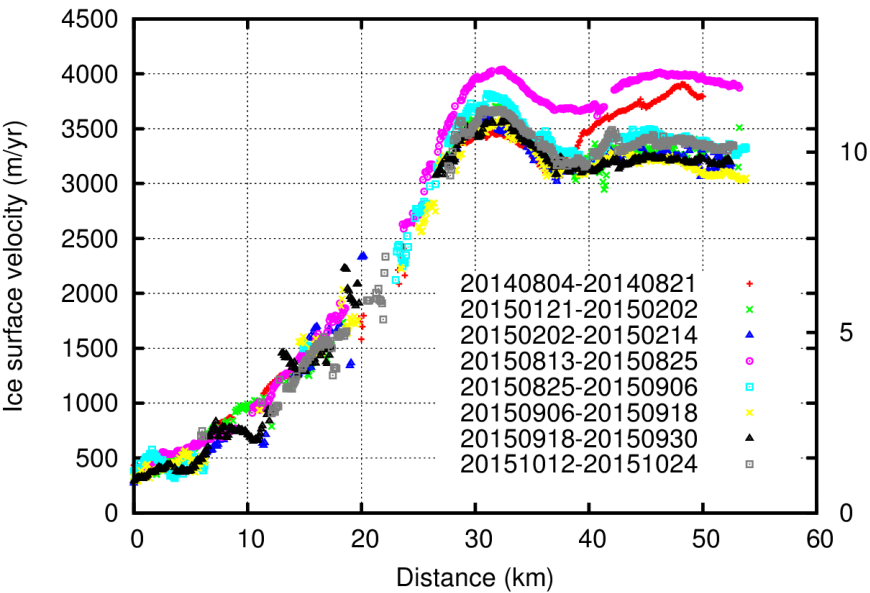


Sentinel-1 2015
offset-tracking

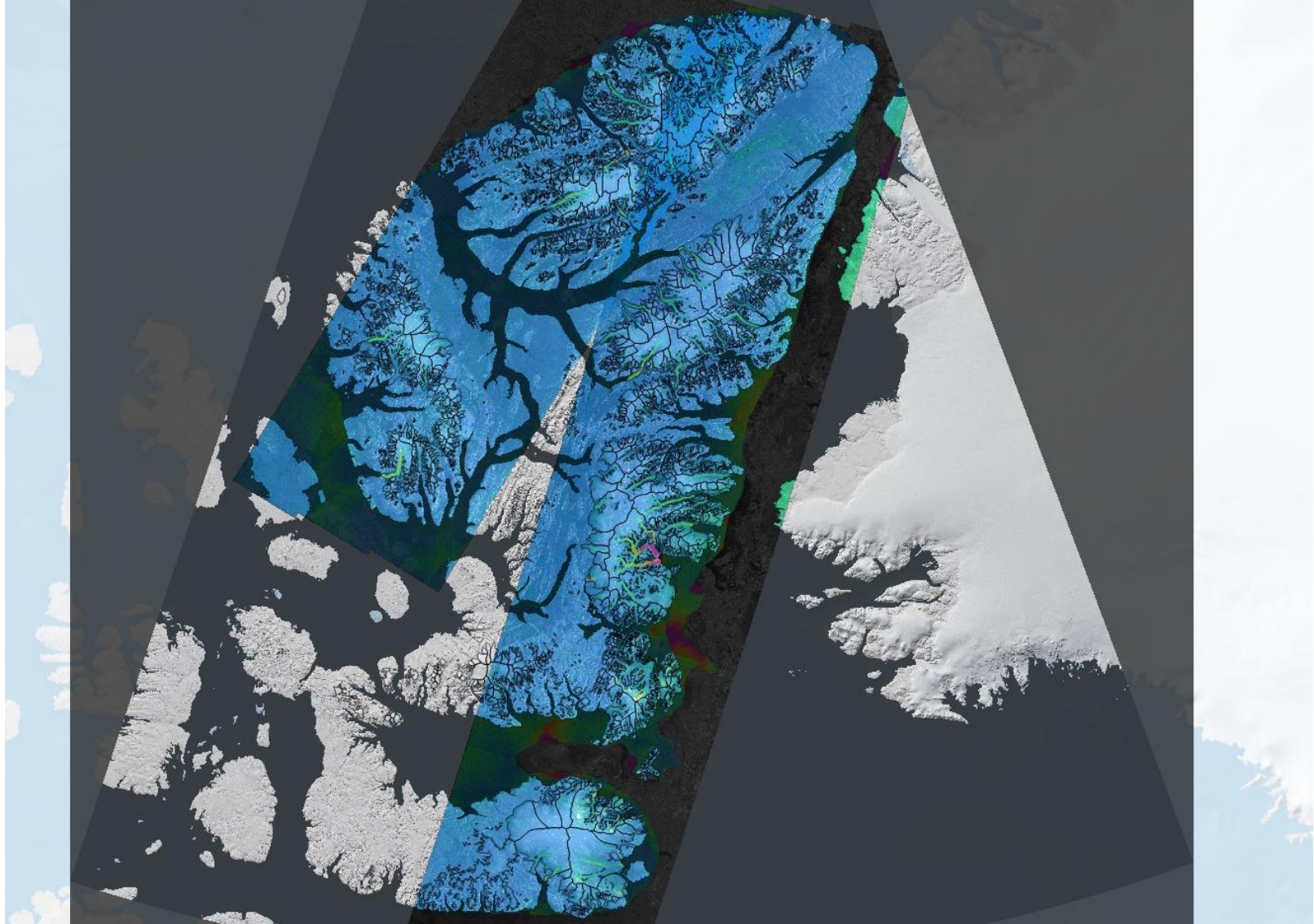


Svalbard – Recent Evolution from Sentinel-1

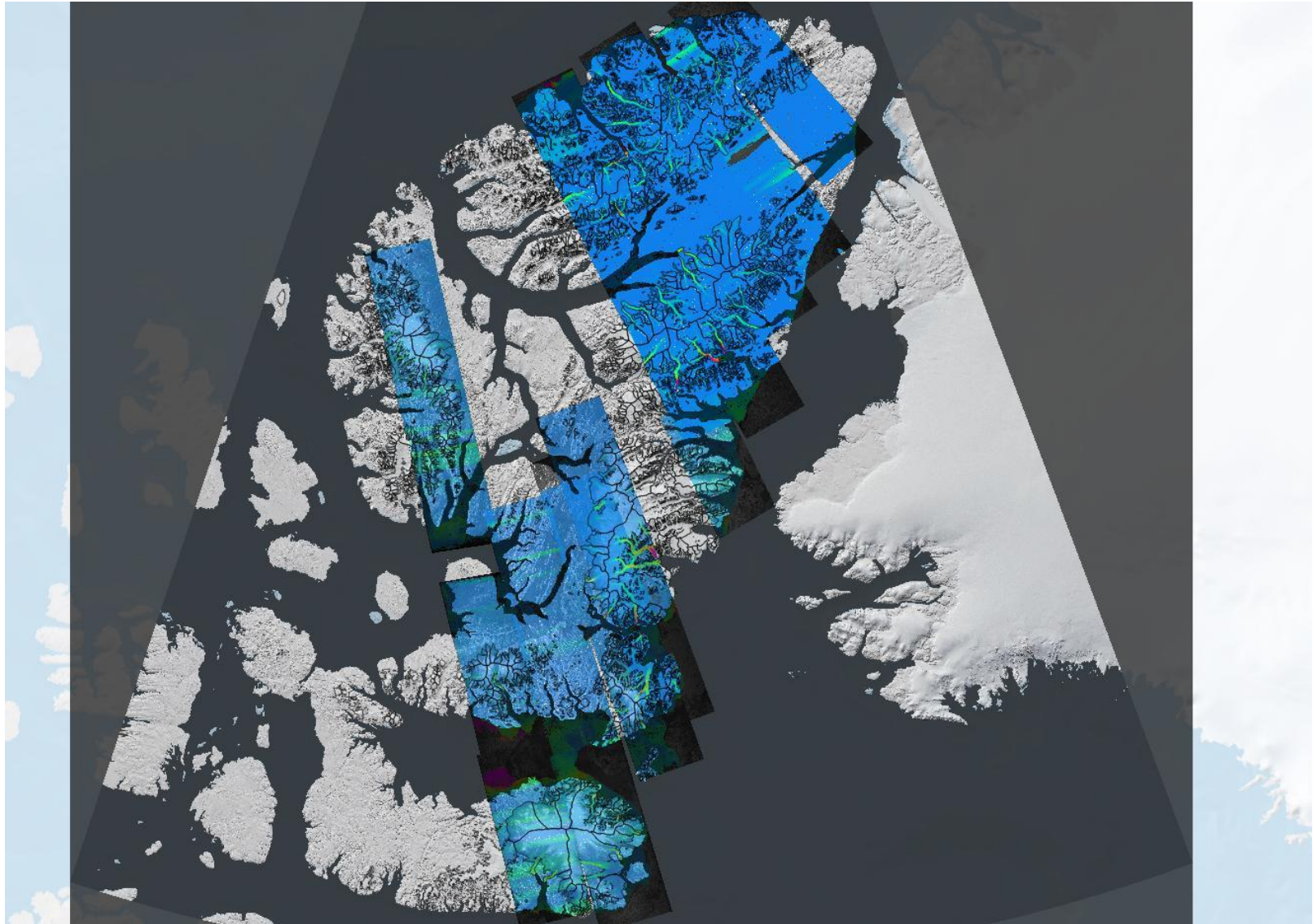
Sentinel-1 21/22-01-02/03-02-2015



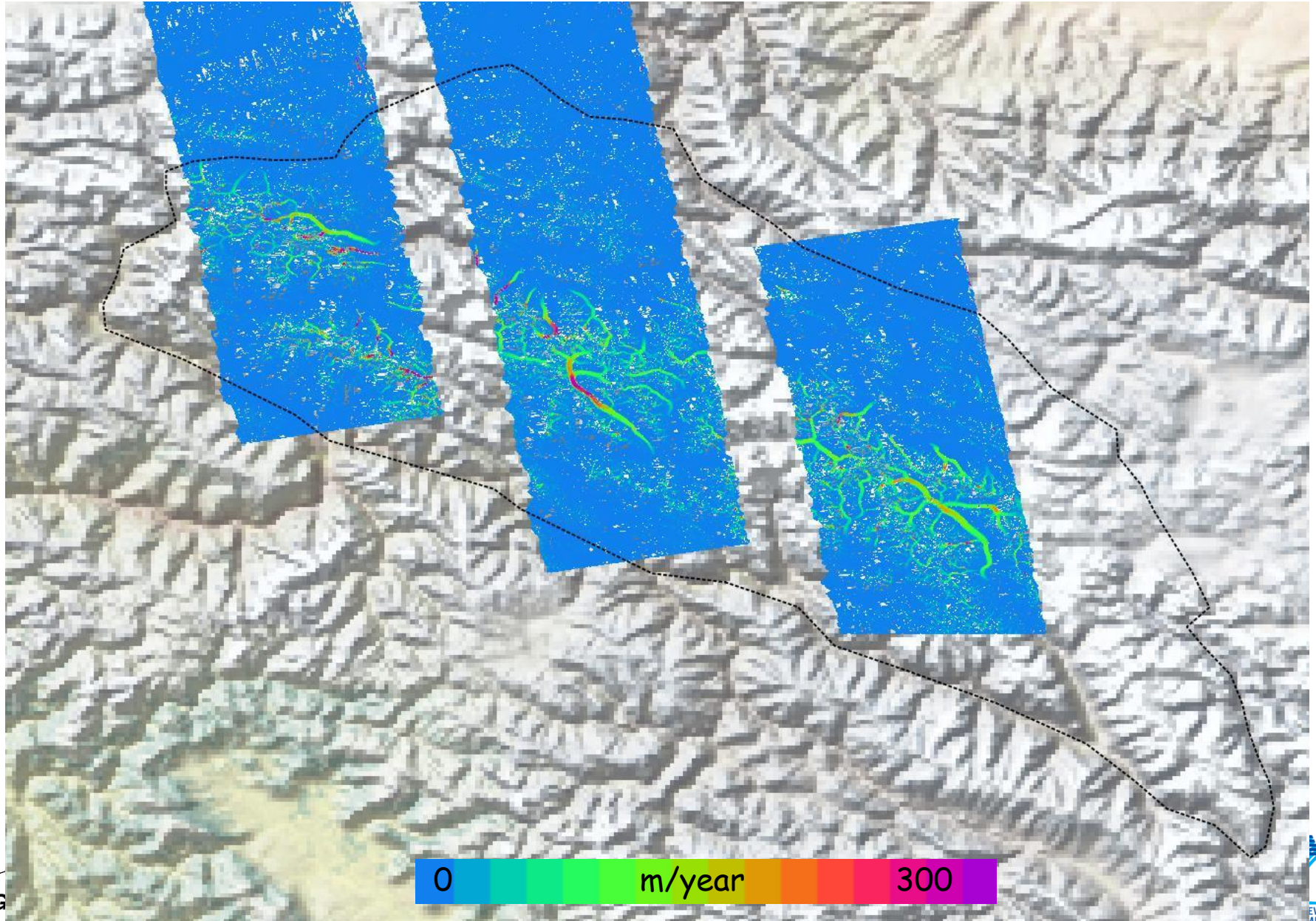
Example Canadian Arctic – Sentinel-1 Winter 2015



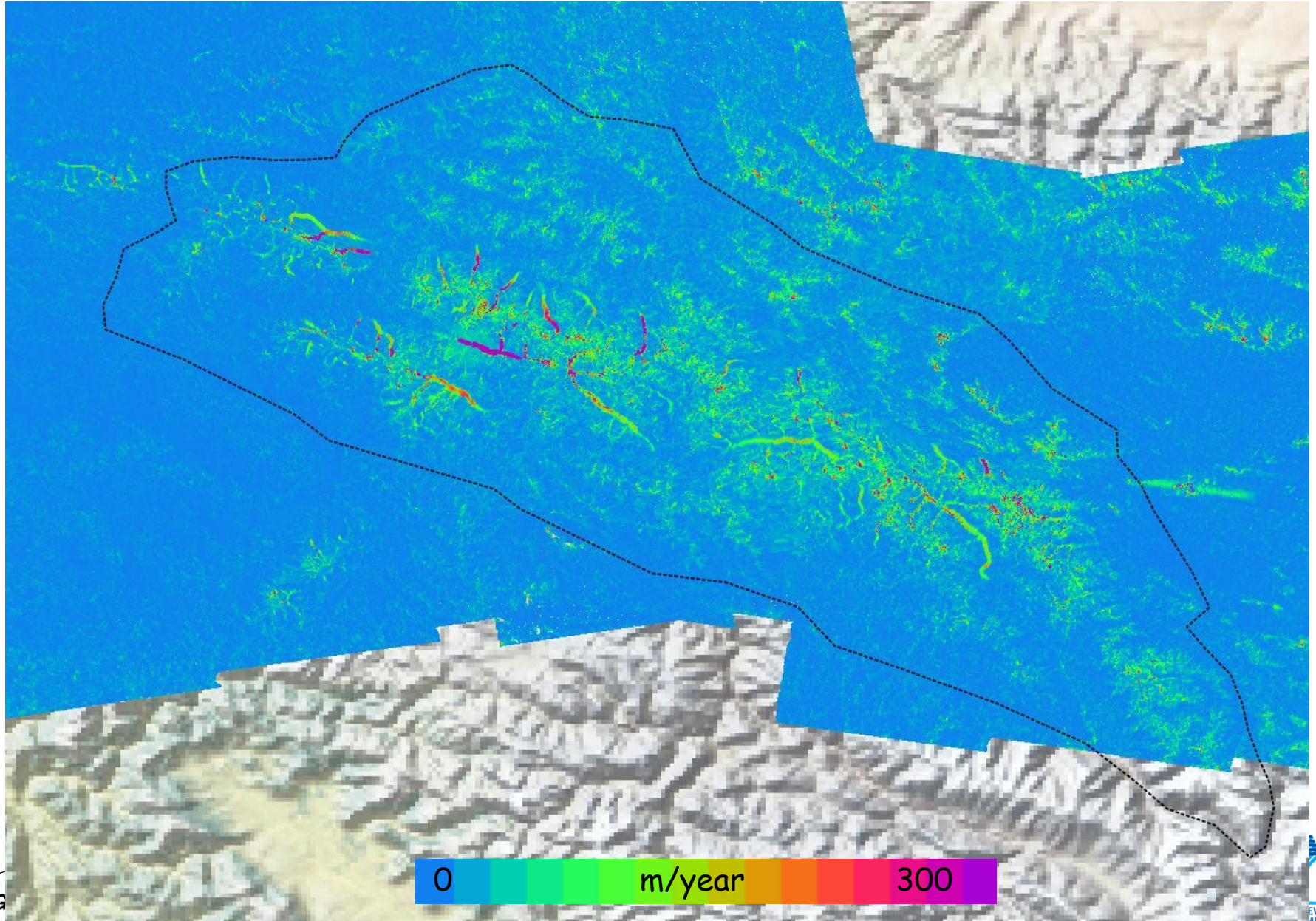
Example Canadian Arctic – ALOS PALSAR Winter 2007-2011



Example Karakoram – ALOS PALSAR Winter 2008

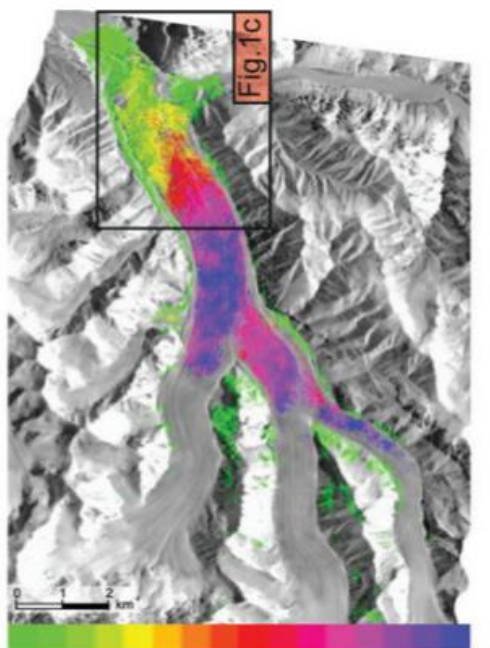


Example Karakoram – Sentinel-1 Winter 2015



Example Kyagar Glacier – Sentinel-1 Winter 2015

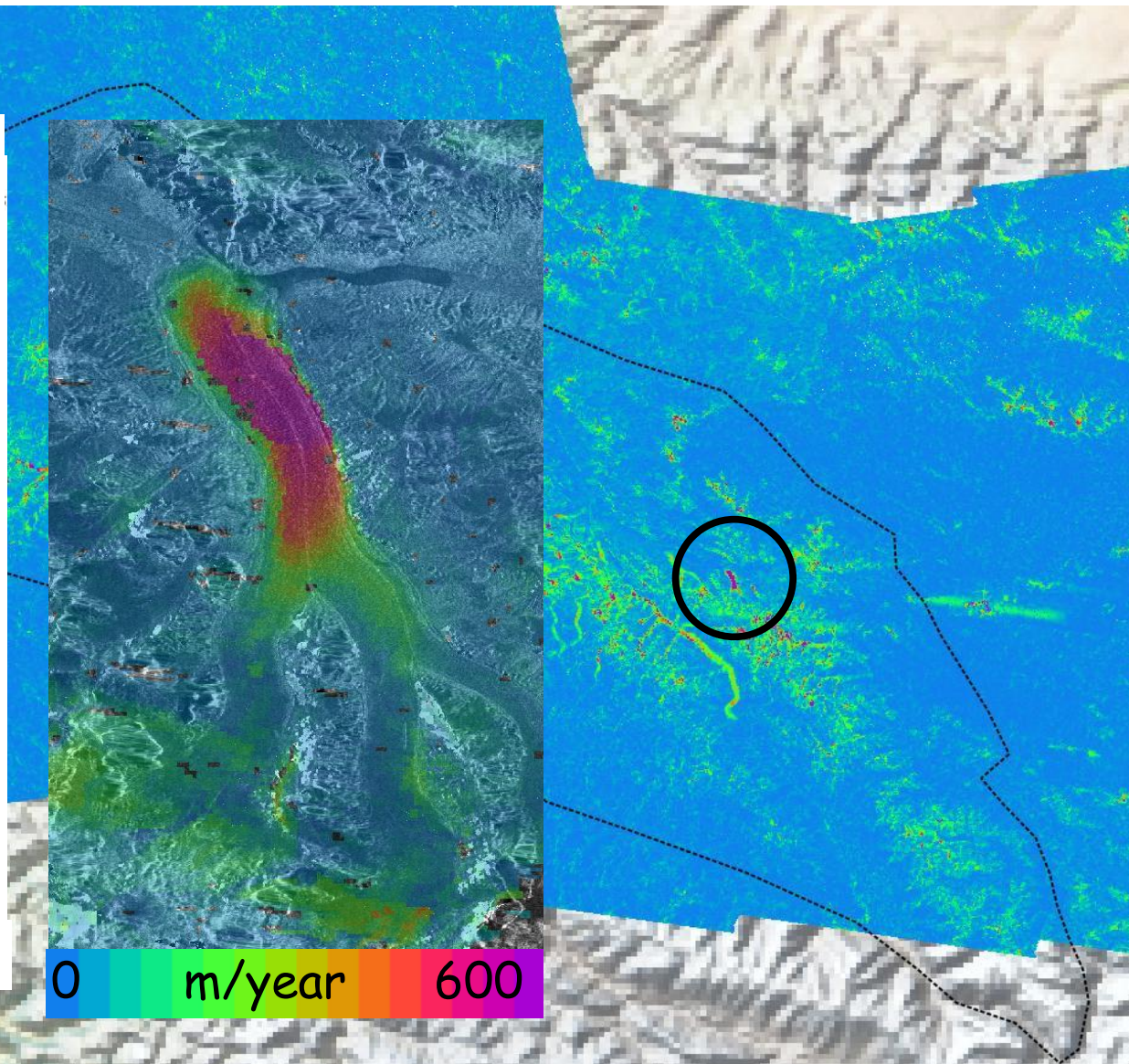
Haemmig et al., 2014
(TerraSAR-X)



0.0 0.16 0.32

22 July 2012 – 2 August 2012

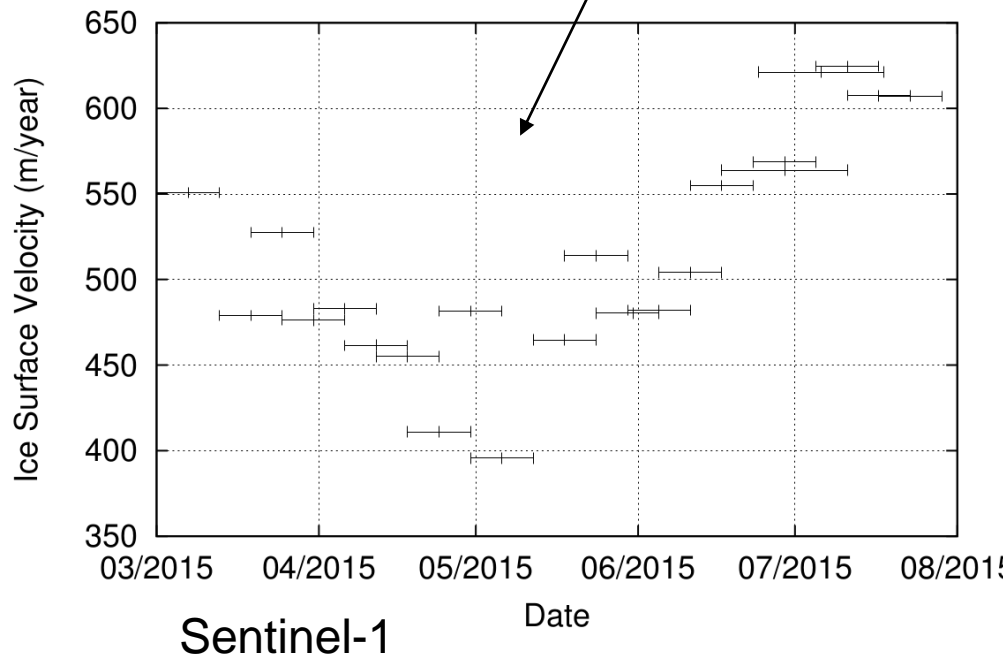
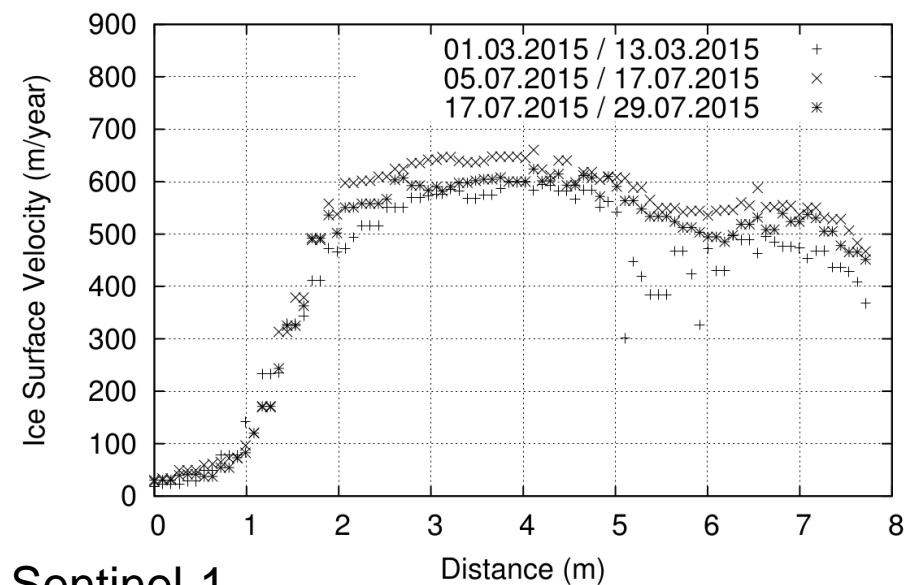
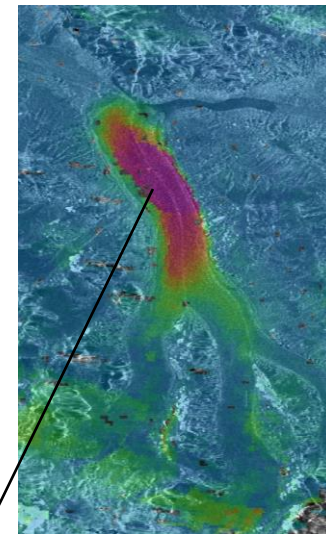
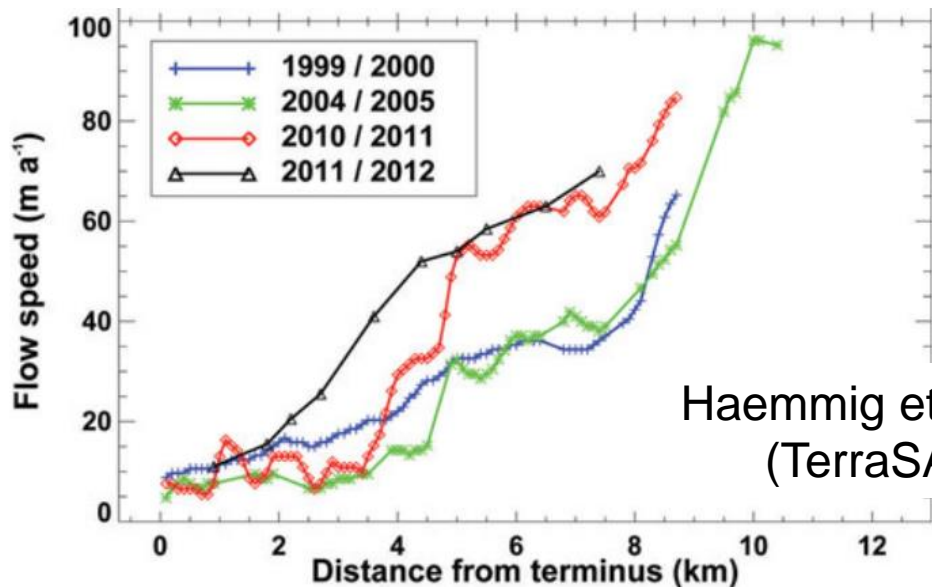
0.32 m/d = 117 m/yr



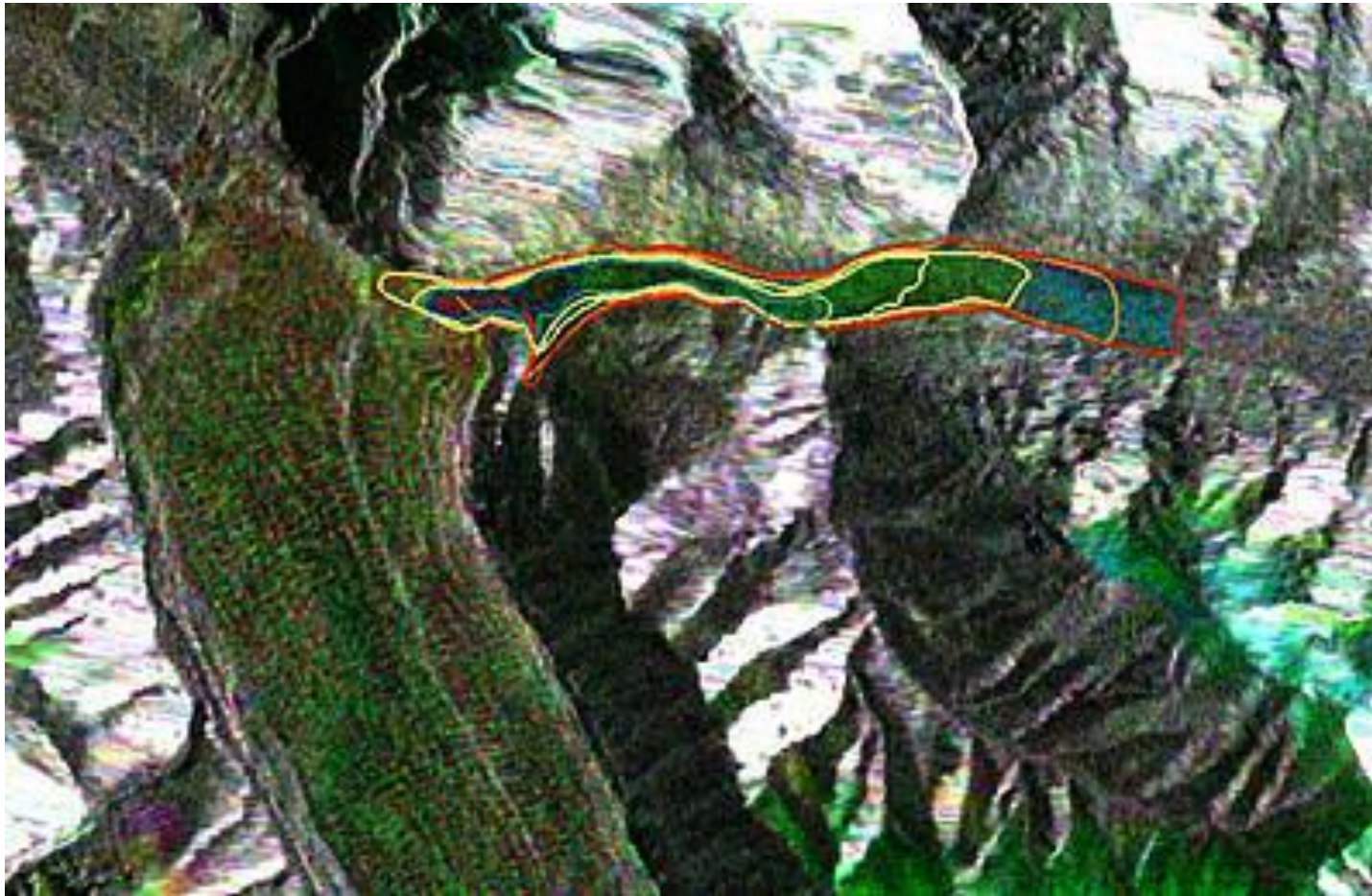
0 m/year 600

0 m/year 300

Example Kyagar Glacier – Sentinel-1 Winter 2015



Example Kyagar Glacier – Sentinel-1 Winter 2015



Sentinel-1 RGB composite of 23 July (red), 11 July (blue), 17 June (green) 2015

Lake outlines 17 June, 23 June, 24 June, 5 July, 11 July, 18 July, 23 July 2015
(max length about 4km)

Conclusion GAMMA Sentinel-1 Ice Velocity Map

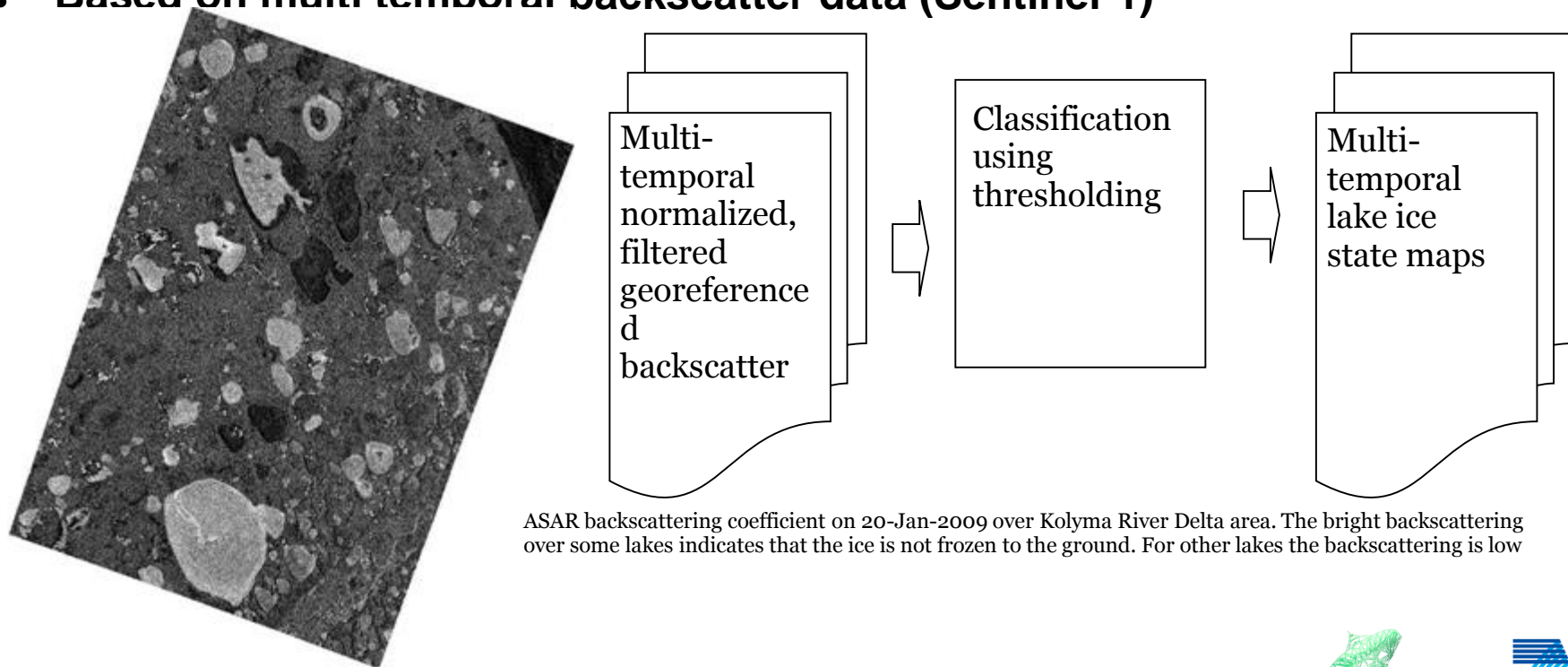
- **Based on Sentinel-1 data that are day/night and weather independent**
- **Data are available usually within a few days after acquisition**
- **High repeat rate of 12 days allows frequent observation if necessary (e.g. surging glaciers)**

Other GAMMA services based on Sentinel-1

- **Lake Ice state**
 - **Binary map of lake ice state (open water, floating ice, grounded and potentially frazil ice)**
 - **Research Product**
- **Water Bodies**
 - **Binary map of water and land classification. The water class refers to open and permanent inland water bodies (rivers, lakes, impoundments)**
 - **Static multi-year product**
- **Freeze/Thaw**
 - **Time series of backscatter values indicating freeze/thaw for selected points**
 - **Annual Product**

Lake ice State

- The lake ice state product distinguished between different possible states of tundra lakes, including at least open water (unfrozen), floating ice, and grounded ice
- Based on multi temporal backscatter data (Sentinel-1)



ASAR backscattering coefficient on 20-Jan-2009 over Kolyma River Delta area. The bright backscattering over some lakes indicates that the ice is not frozen to the ground. For other lakes the backscattering is low