



SEN3APP: Workshop on Remote Sensing Products of the Cryosphere using Sentinels

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

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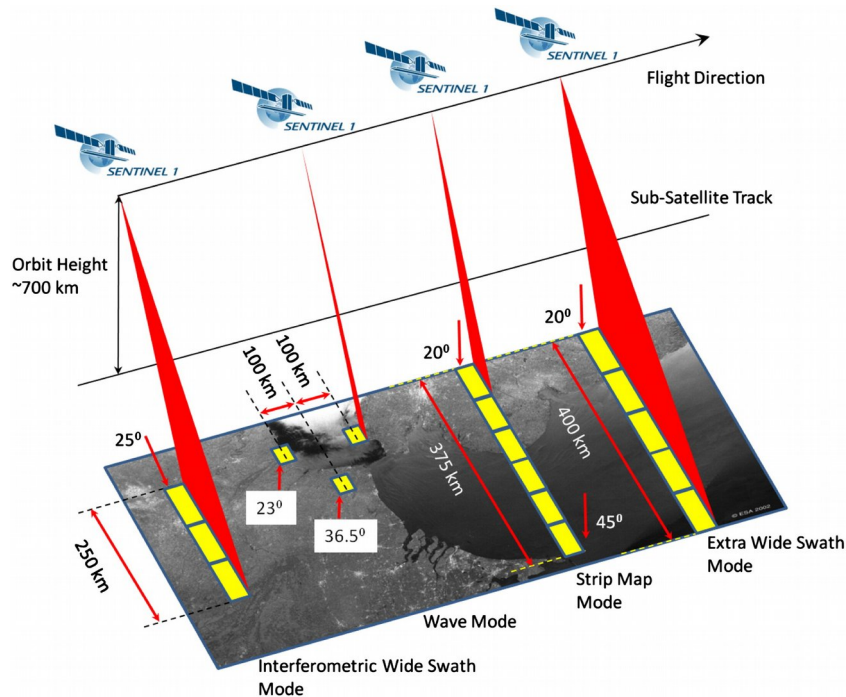
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Outline

- **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)

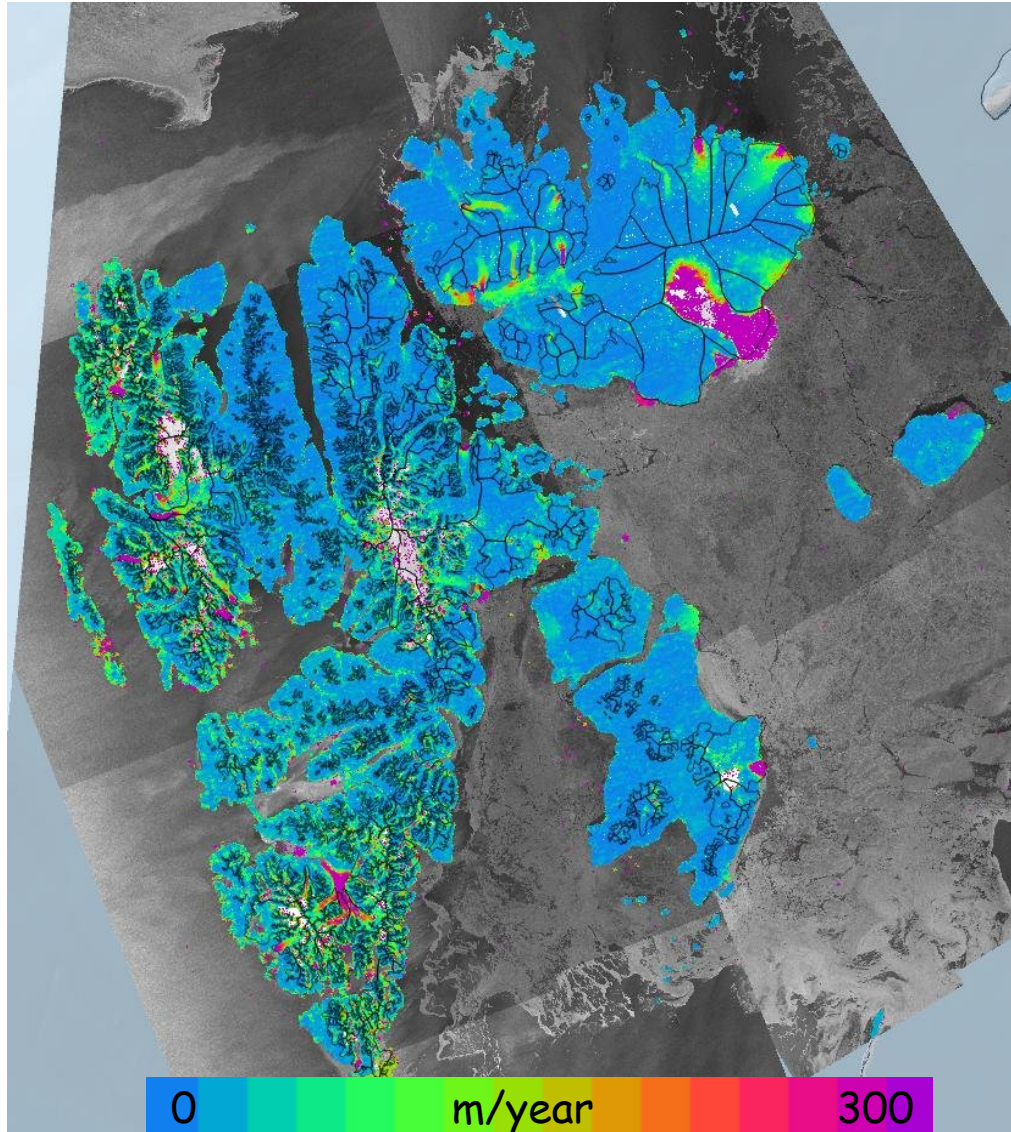


Ice Velocity Map Production

- **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**

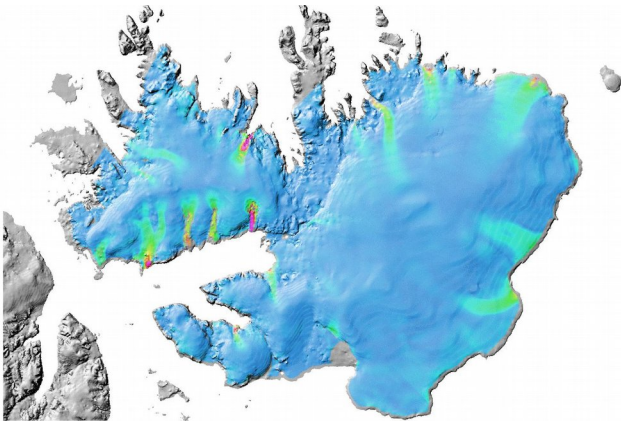
Example Svalbard Sentinel-1

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

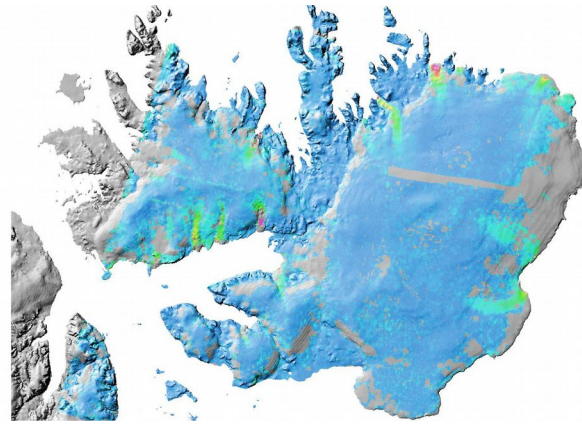


Nordautland (Svalbard) – Historical evolution from 1995 to 2015

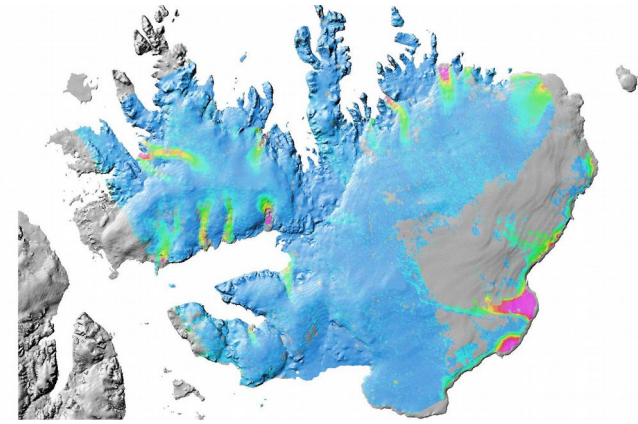
ERS-1/2 1995/1996
InSAR & offset-tracking



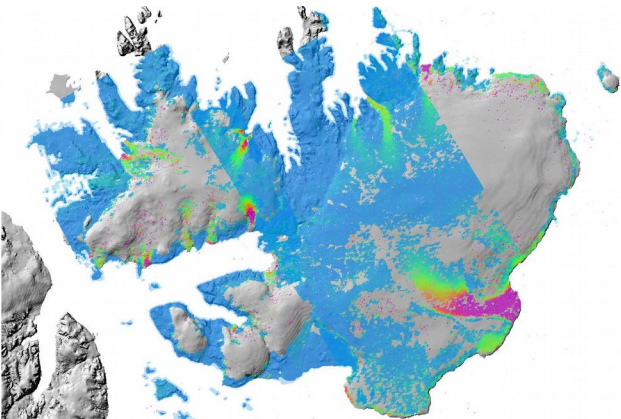
JERS-1 1997
offset-tracking



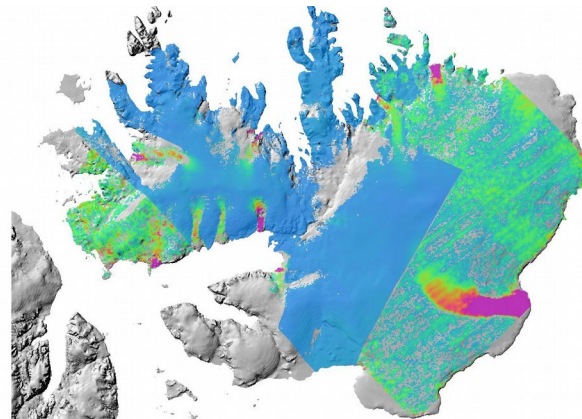
ALOS PALSAR 2008
offset-tracking



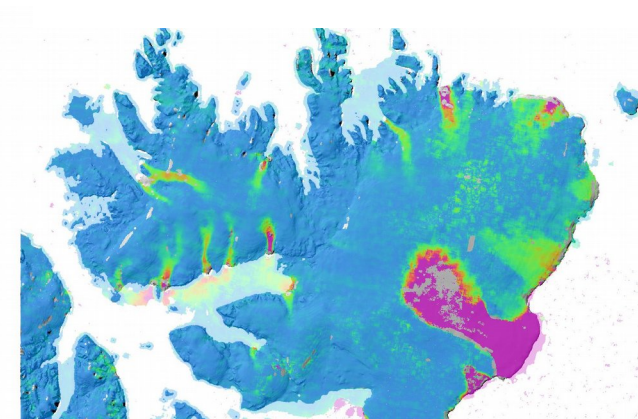
ALOS PALSAR 2010
offset-tracking



ERS-2 2011
InSAR & offset-tracking

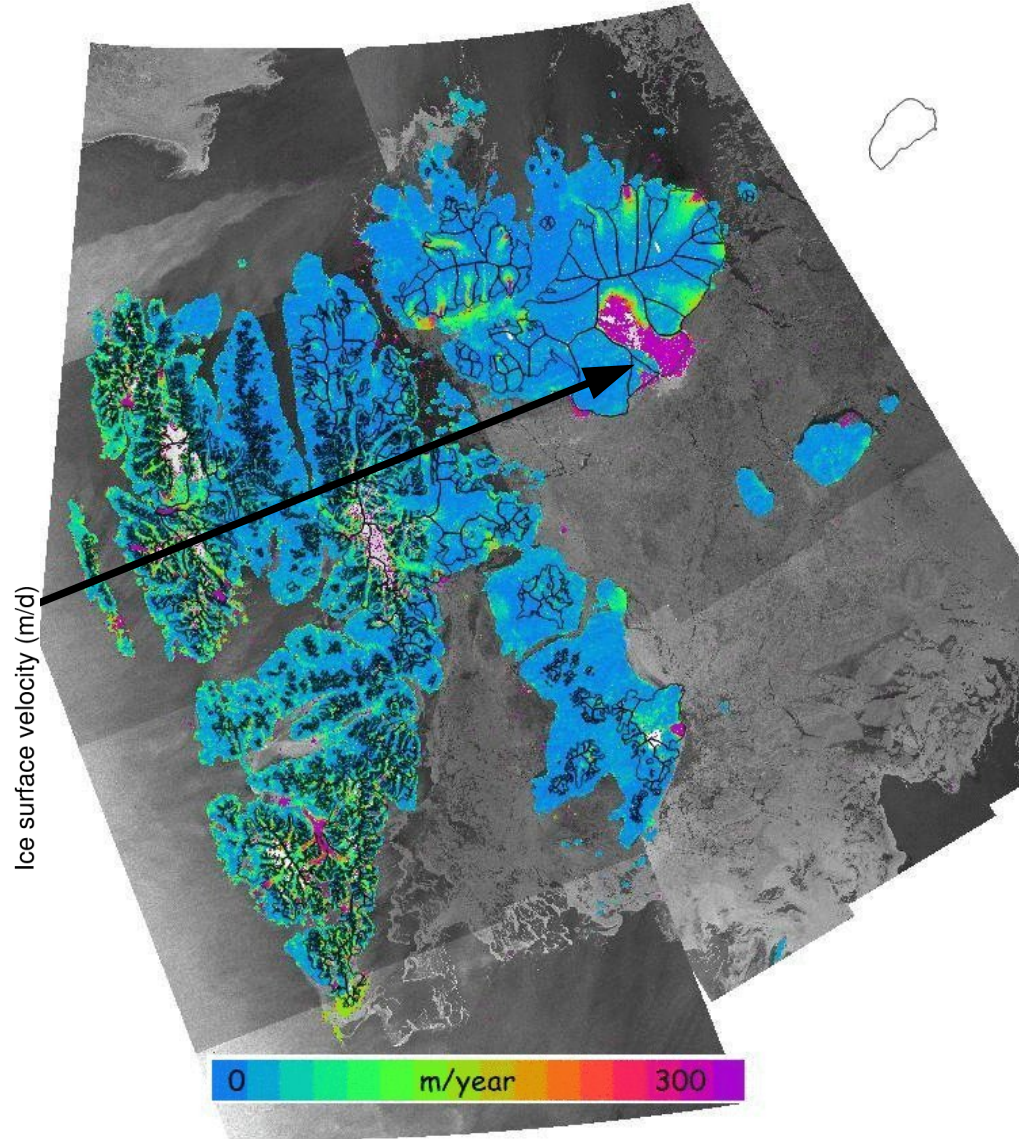
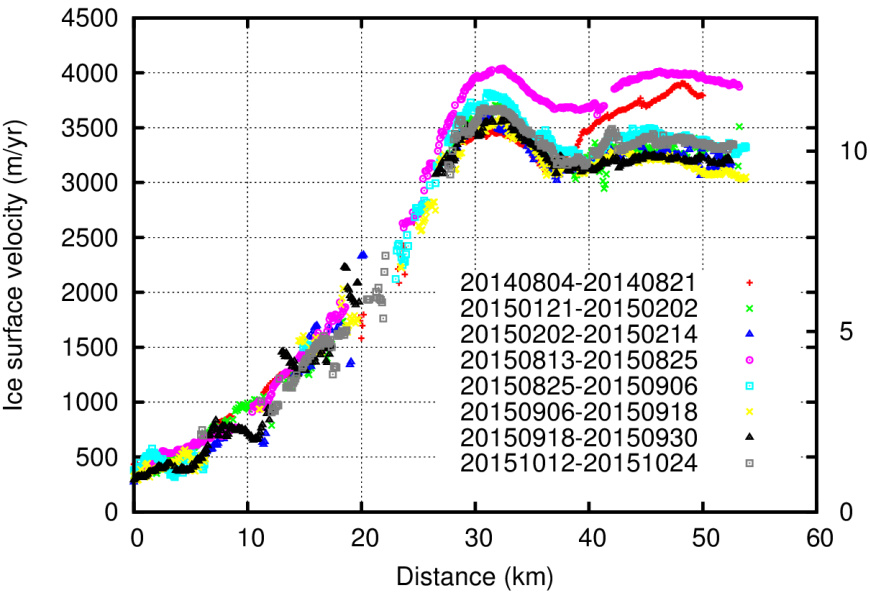


Sentinel-1 2015
offset-tracking

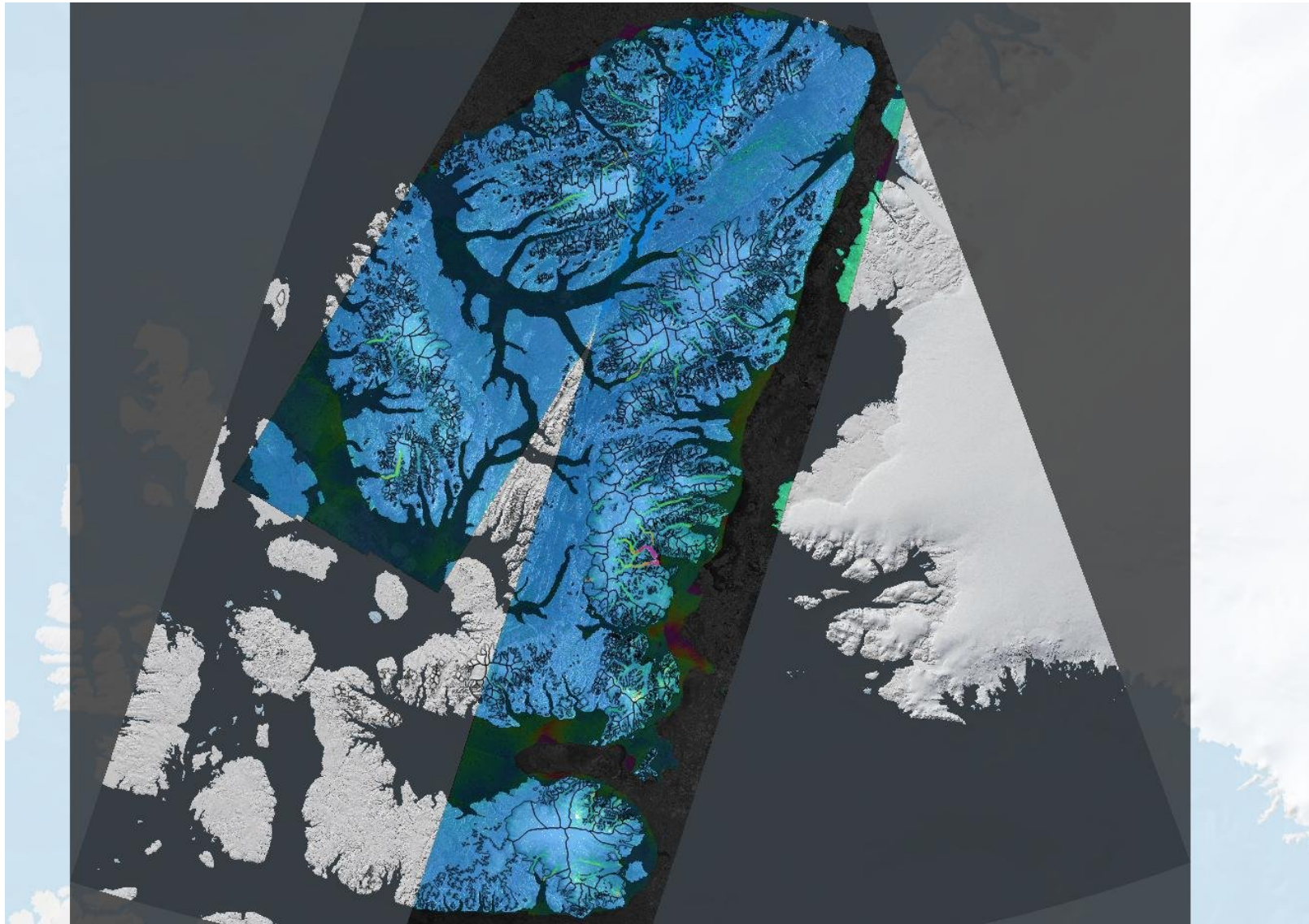


Svalbard – Recent Evolution from Sentinel-1

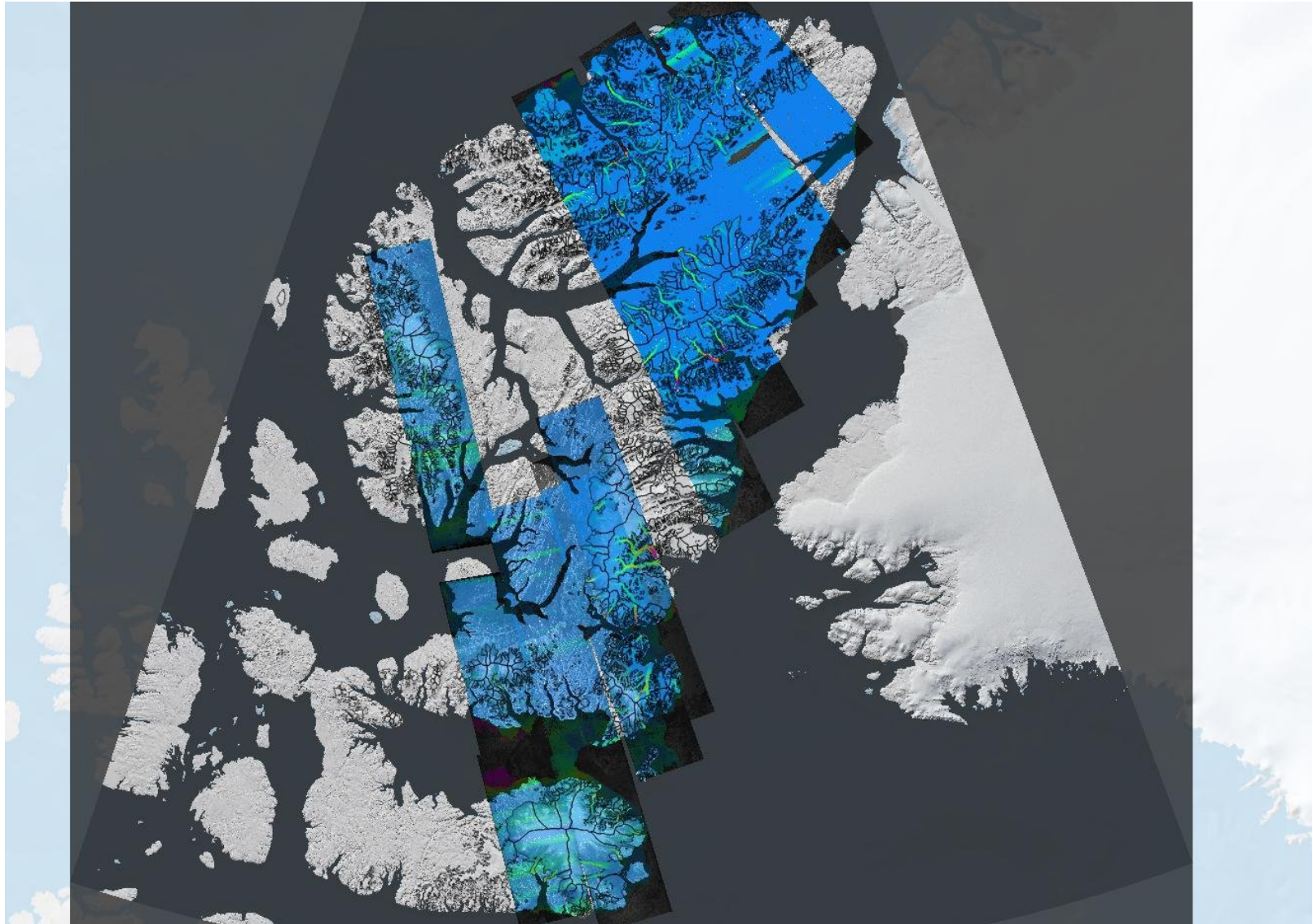
Sentinel-1 21/22-01-02/03-02-2015



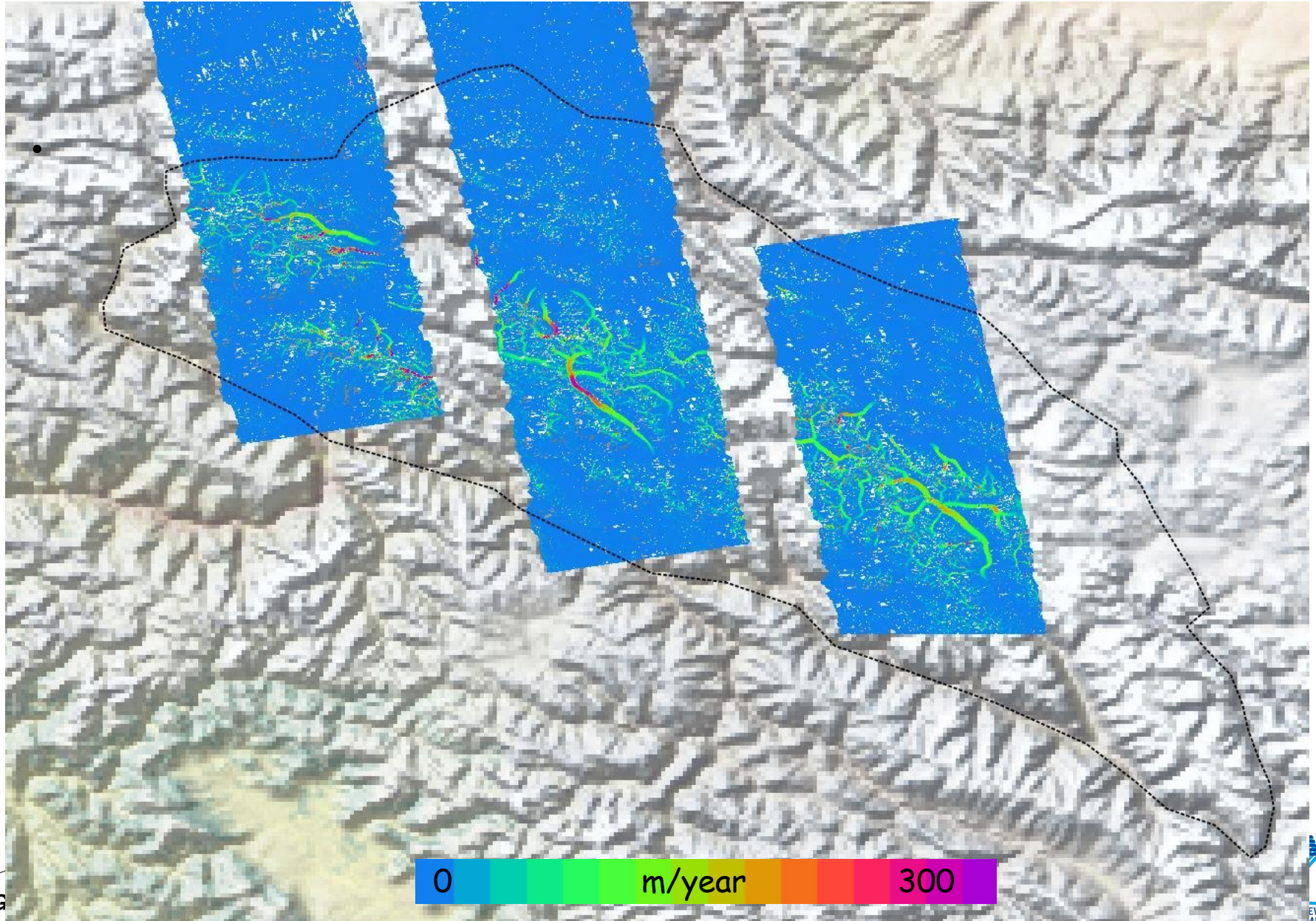
Example Canadian Arctic – Sentinel-1 Winter 2015



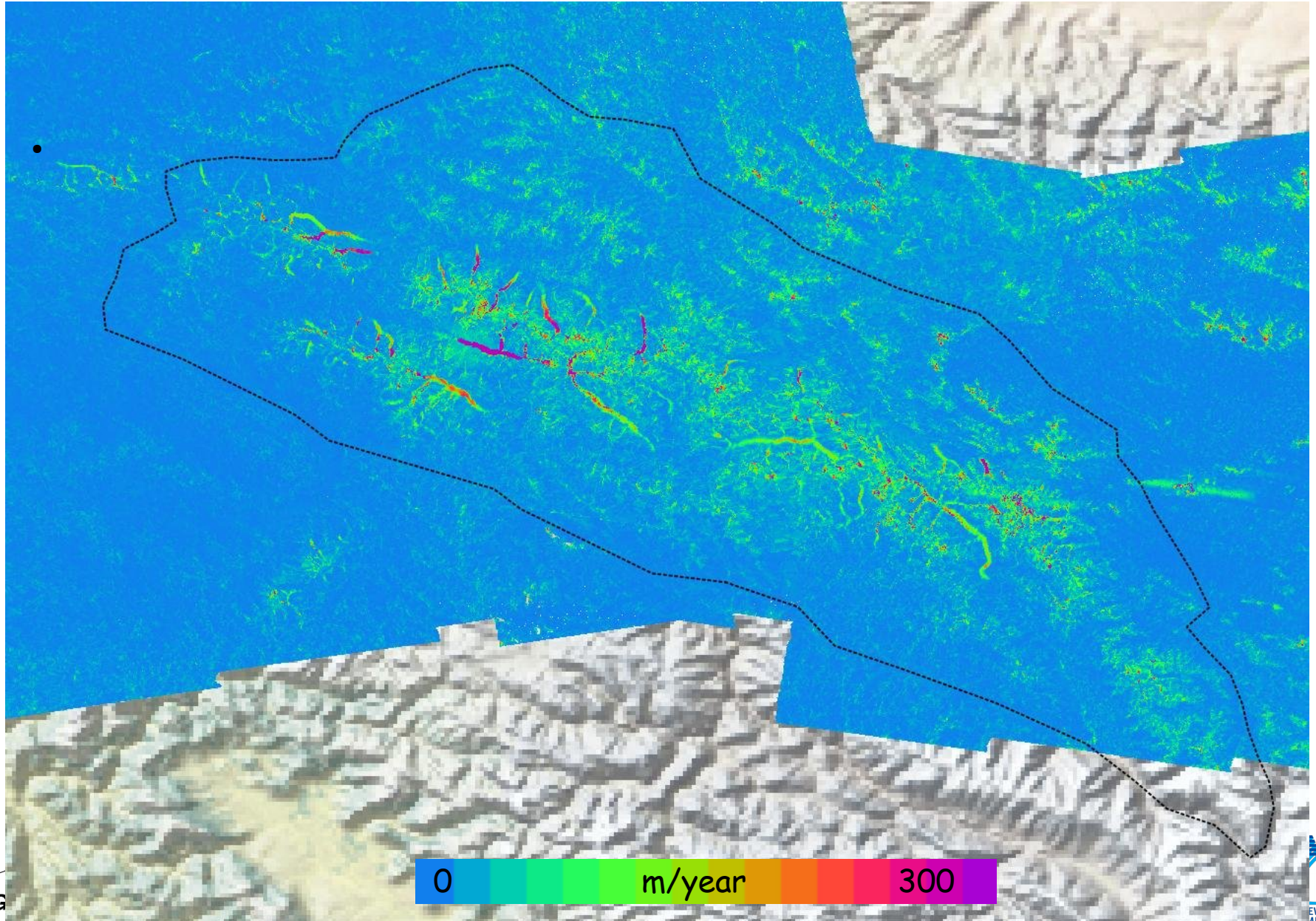
Example Canadian Arctic – ALOS PALSAR Winter 2007-2011



Example Karakoram – ALOS PALSAR Winter 2008

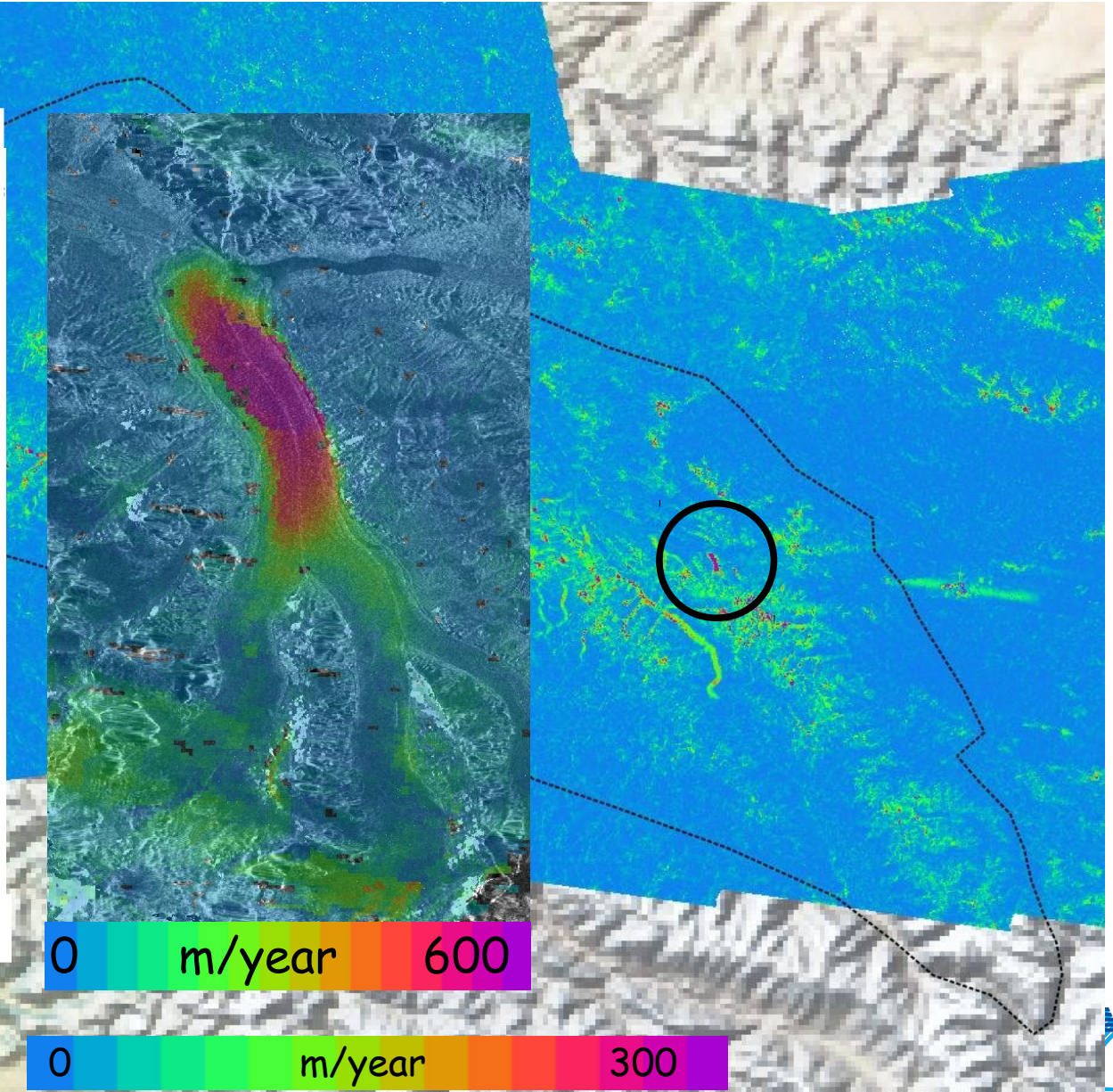
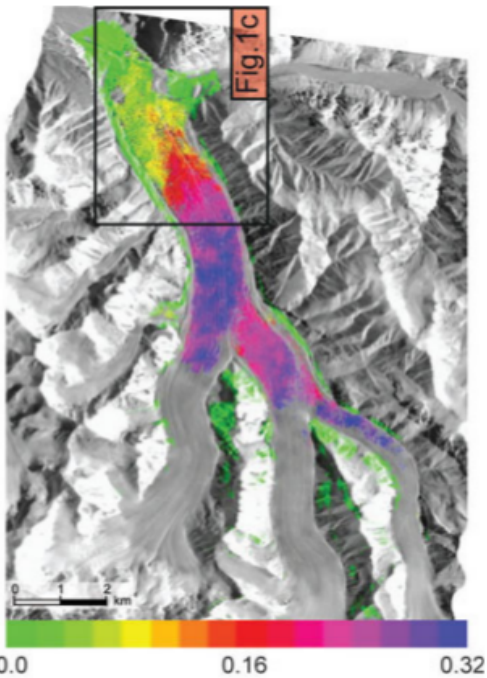


Example Karakoram – Sentinel-1 Winter 2015

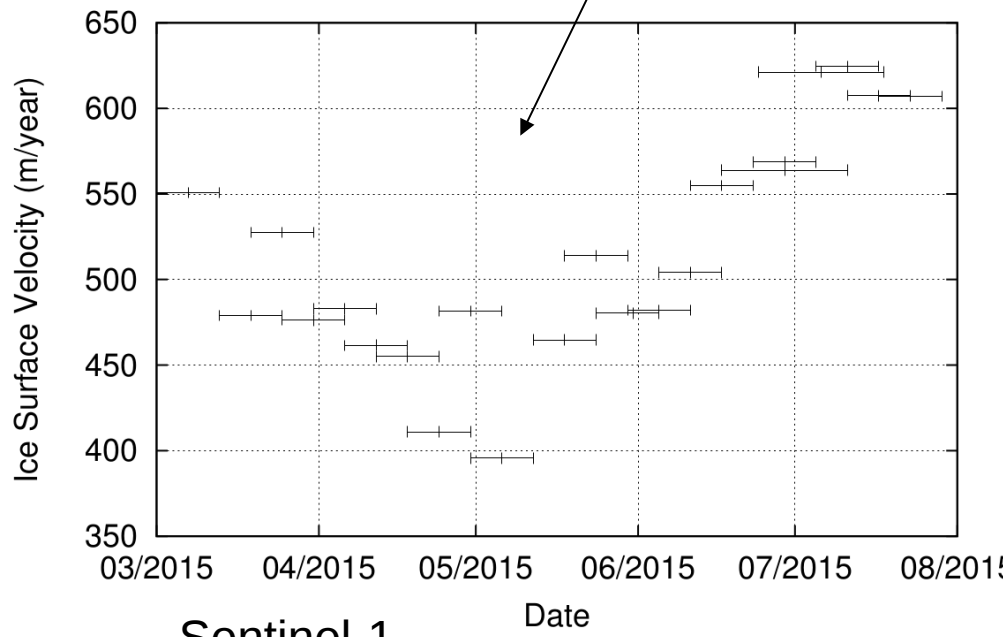
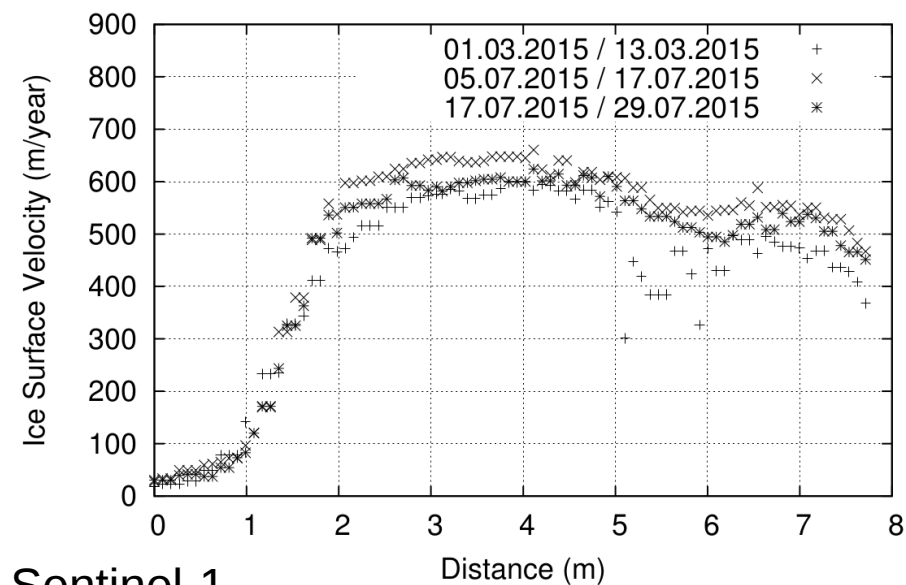
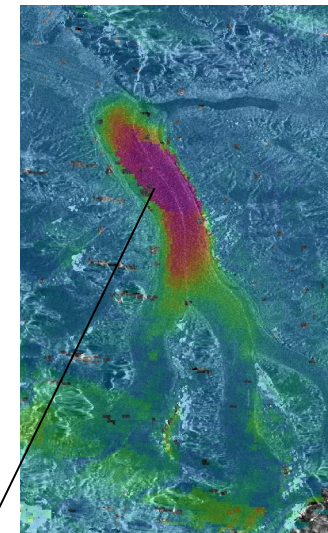
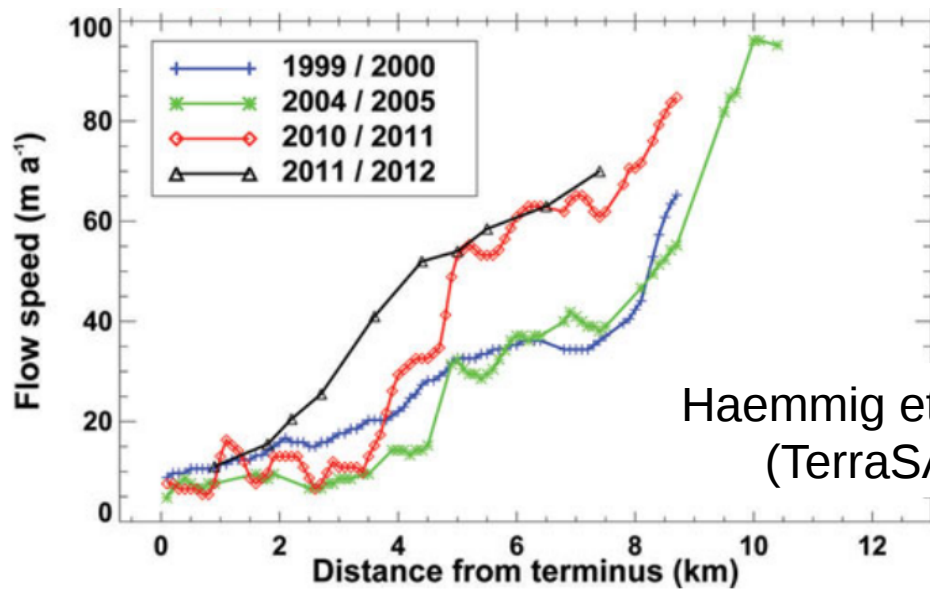


Example Kyagar Glacier – Sentinel-1 Winter 2015

Haemmig et al., 2014
(TerraSAR-X)



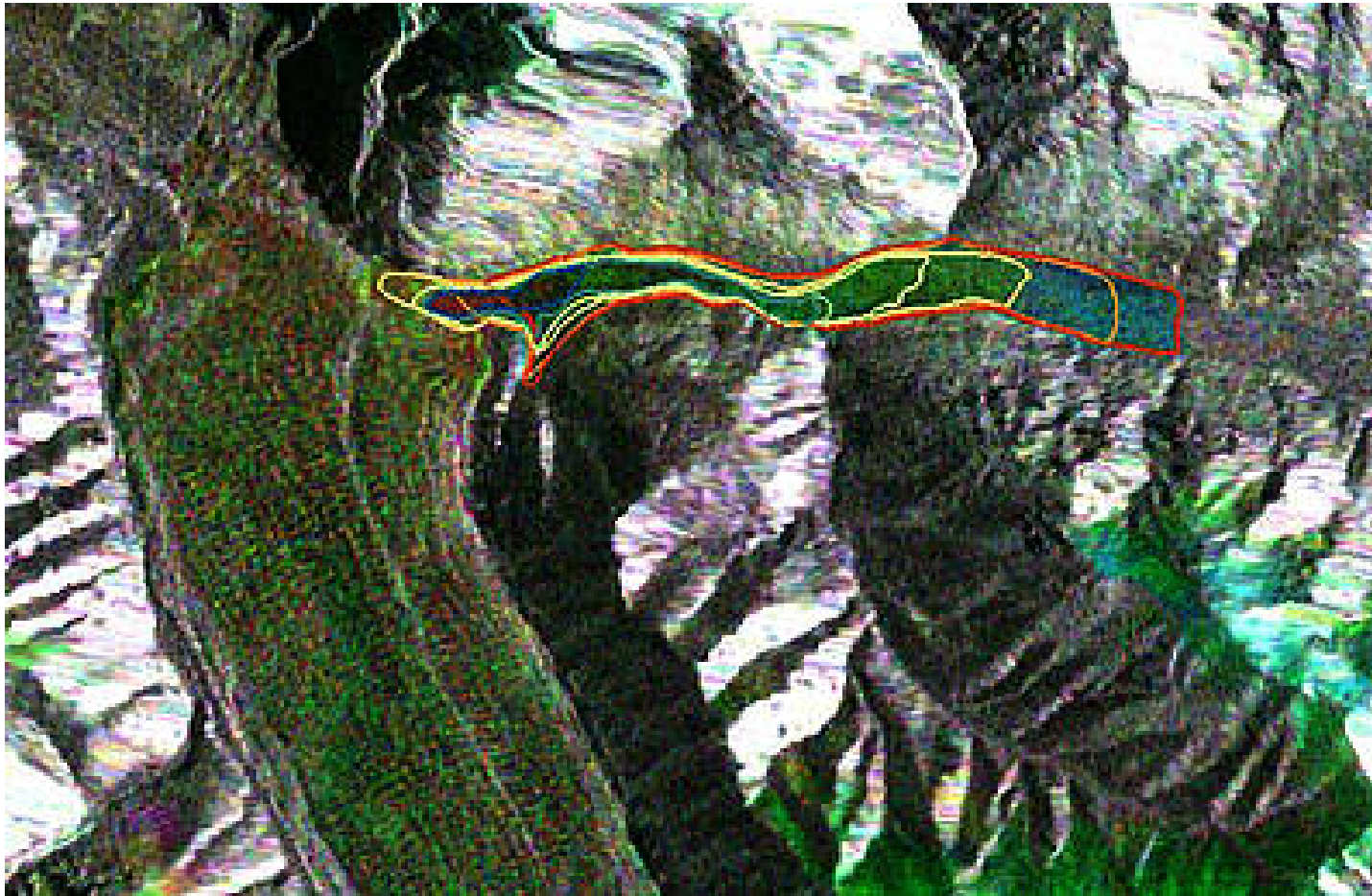
Example Kyagar Glacier – Sentinel-1 2015



Sentinel-1

Sentinel-1

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)

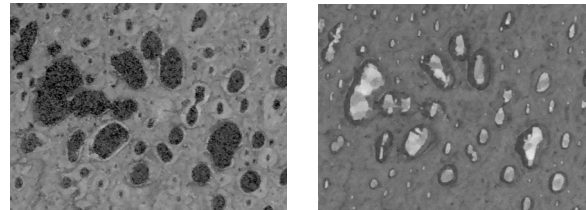
Conclusion GAMMA Sentinel-1 Ice Velocity Map

- **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)**

GAMMA SEN3APP services based on Sentinel-1 (research)

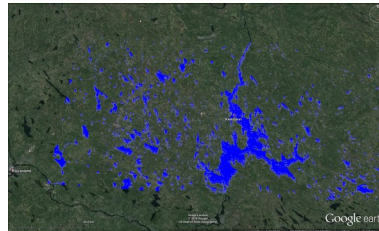
- **Lake Ice state**

- Binary map of lake ice state (open water, floating ice, grounded and potentially frazil ice)
- Seasonal product



- **Water Bodies**

- Binary map of water and land classification. The water class refers to open and permanent inland water bodies (rivers, lakes, impoundments)
- Seasonal product



- **Freeze/Thaw**

- Time series of backscatter/coherence values indicating freeze/thaw for selected points
- Annual product

