MODIS-based mapping of the growing season on Svalbard

By
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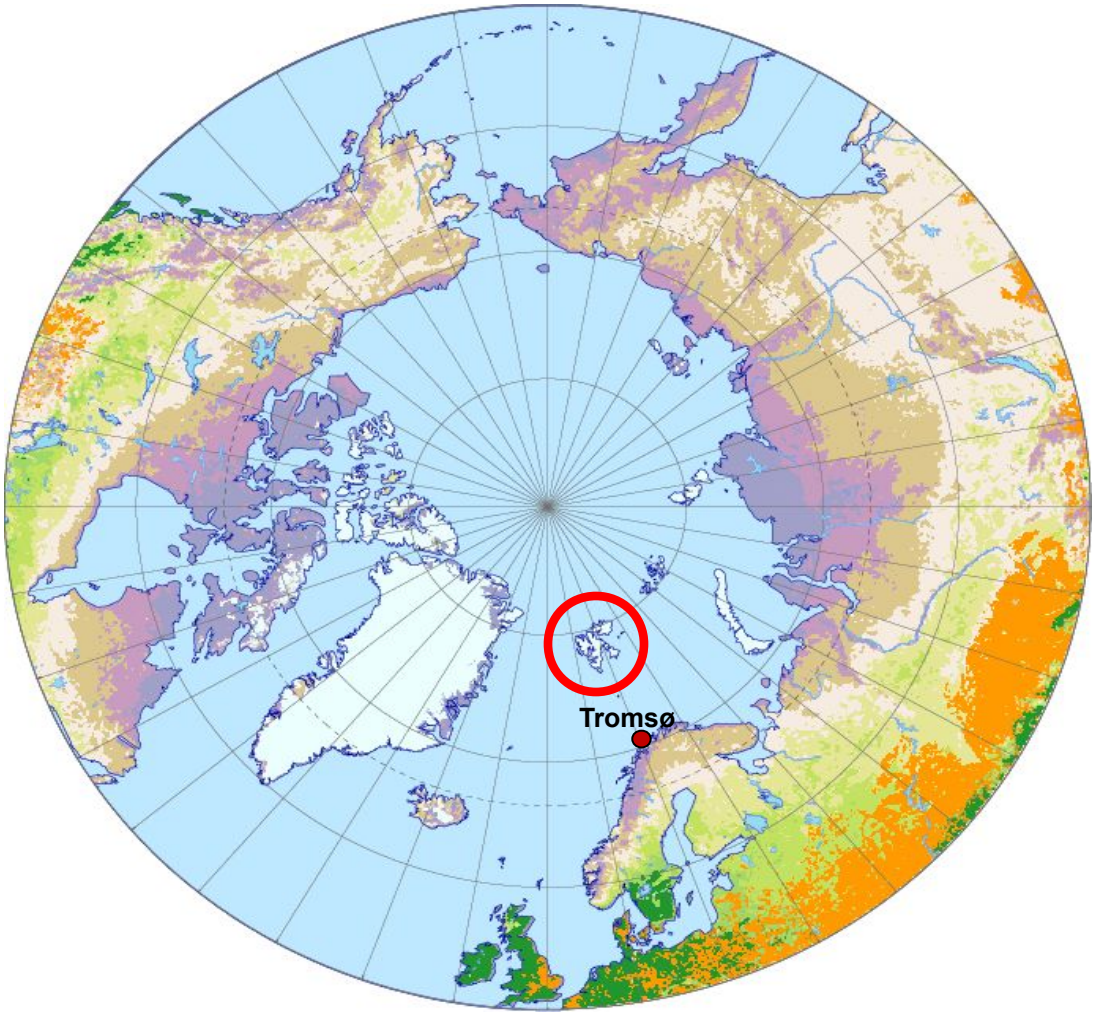

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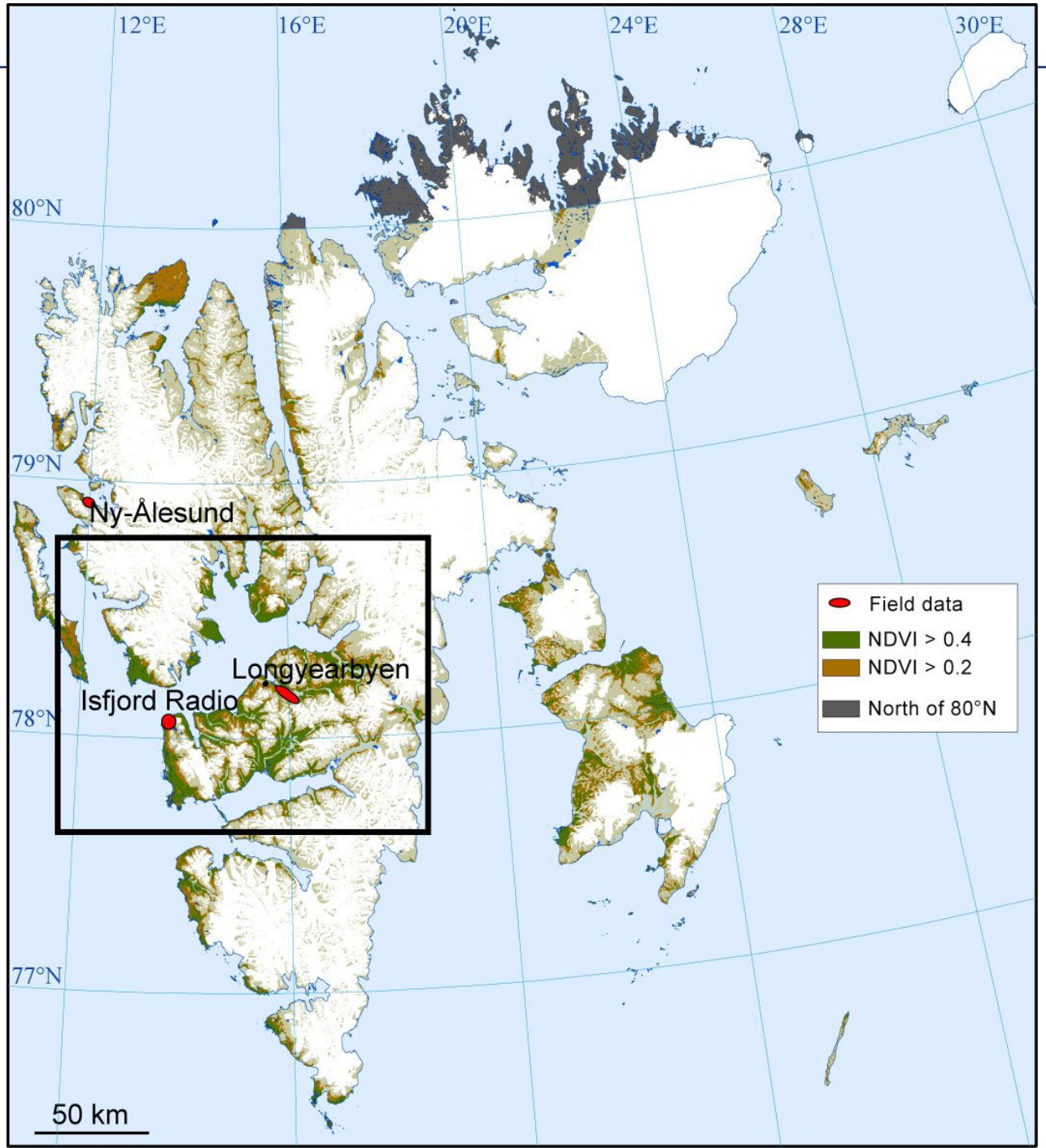
11th International Circumpolar Remote Sensing Symposium
Thursday 23 September, Session 4, 11:00-12:30.

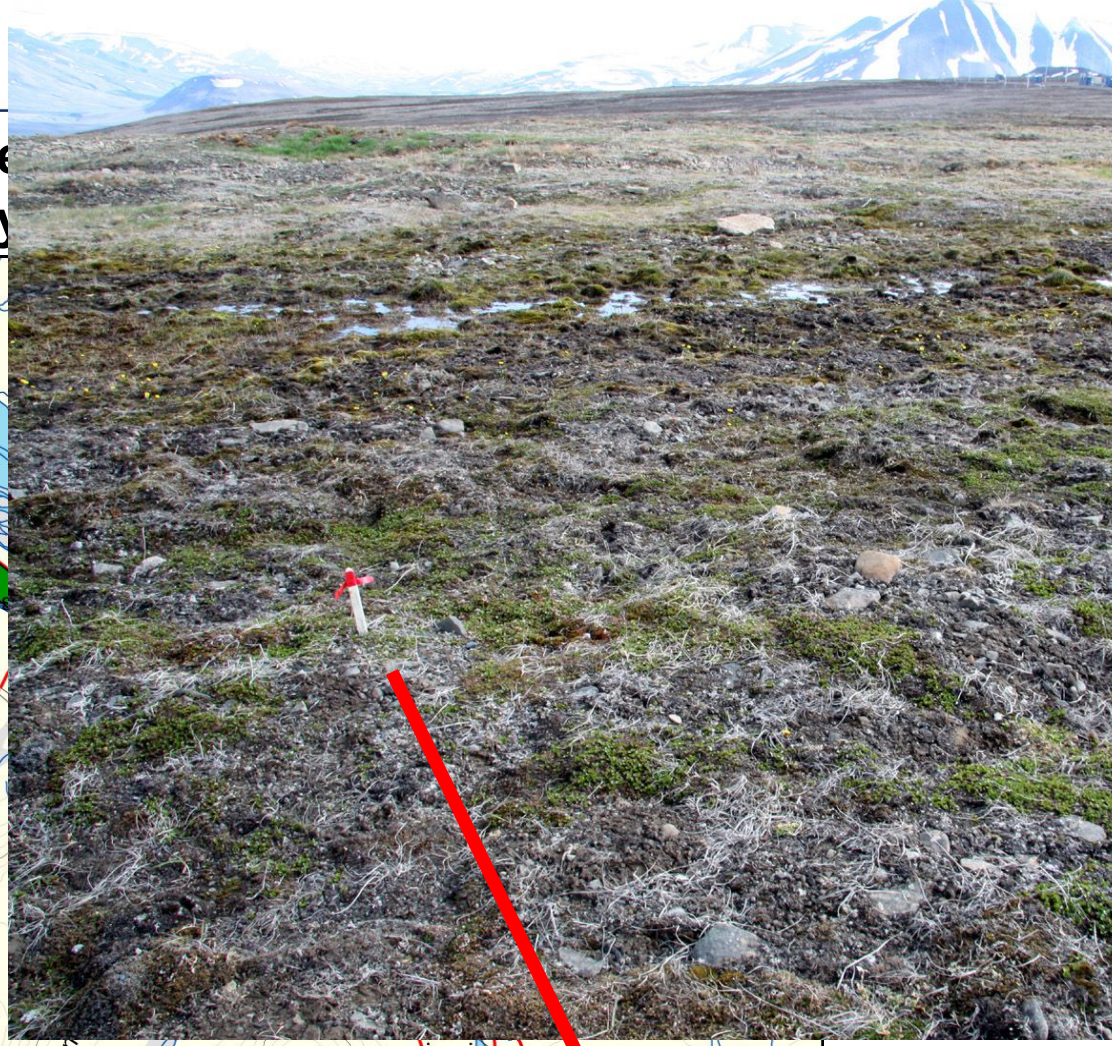
Content

- Field observations of onset and end of the growing season (phenology)
- Methods: Calibration of MODIS data and mapping the growing season
- Results – onset and end of the growing season on Svalbard
- Summary and conclusions
- Next step – mapping the whole north-western most Europe
- Animation

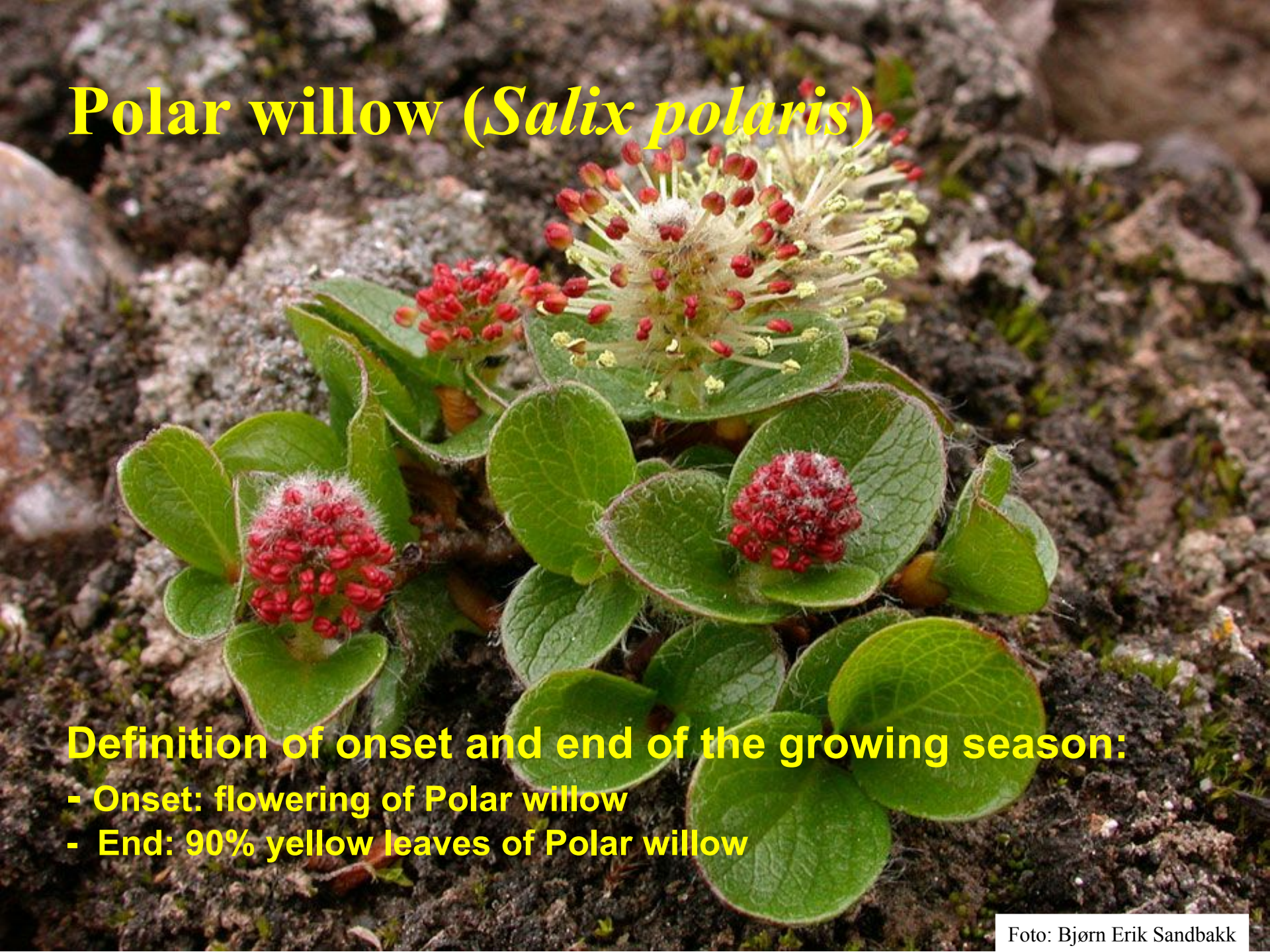
Study area Svalbard



Field observation of onse
(phenology



Polar willow (*Salix polaris*)



Definition of onset and end of the growing season:

- **Onset: flowering of Polar willow**
- **End: 90% yellow leaves of Polar willow**

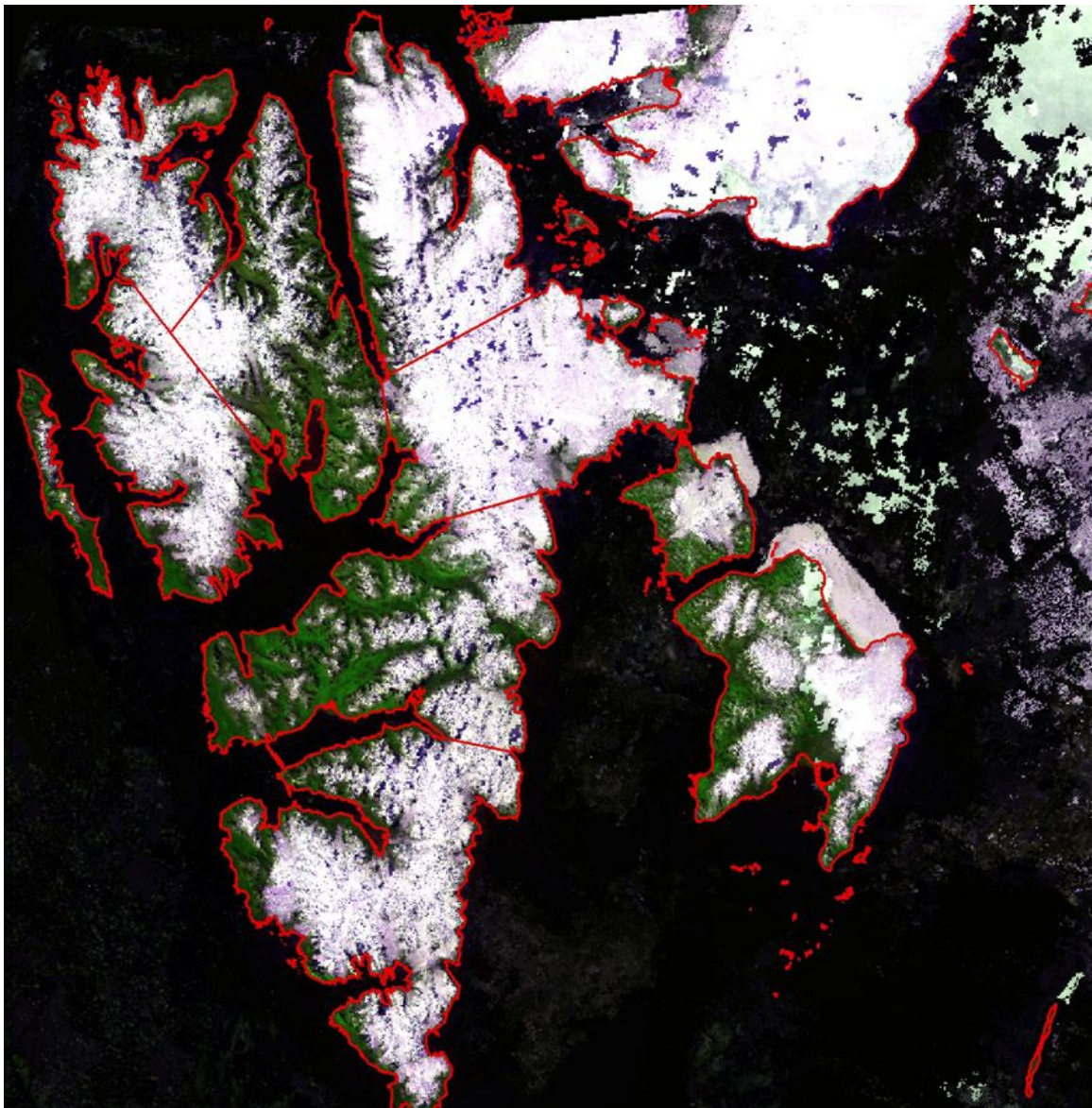
Foto: Bjørn Erik Sandbakk

MODIS data for the 2000-2009 period

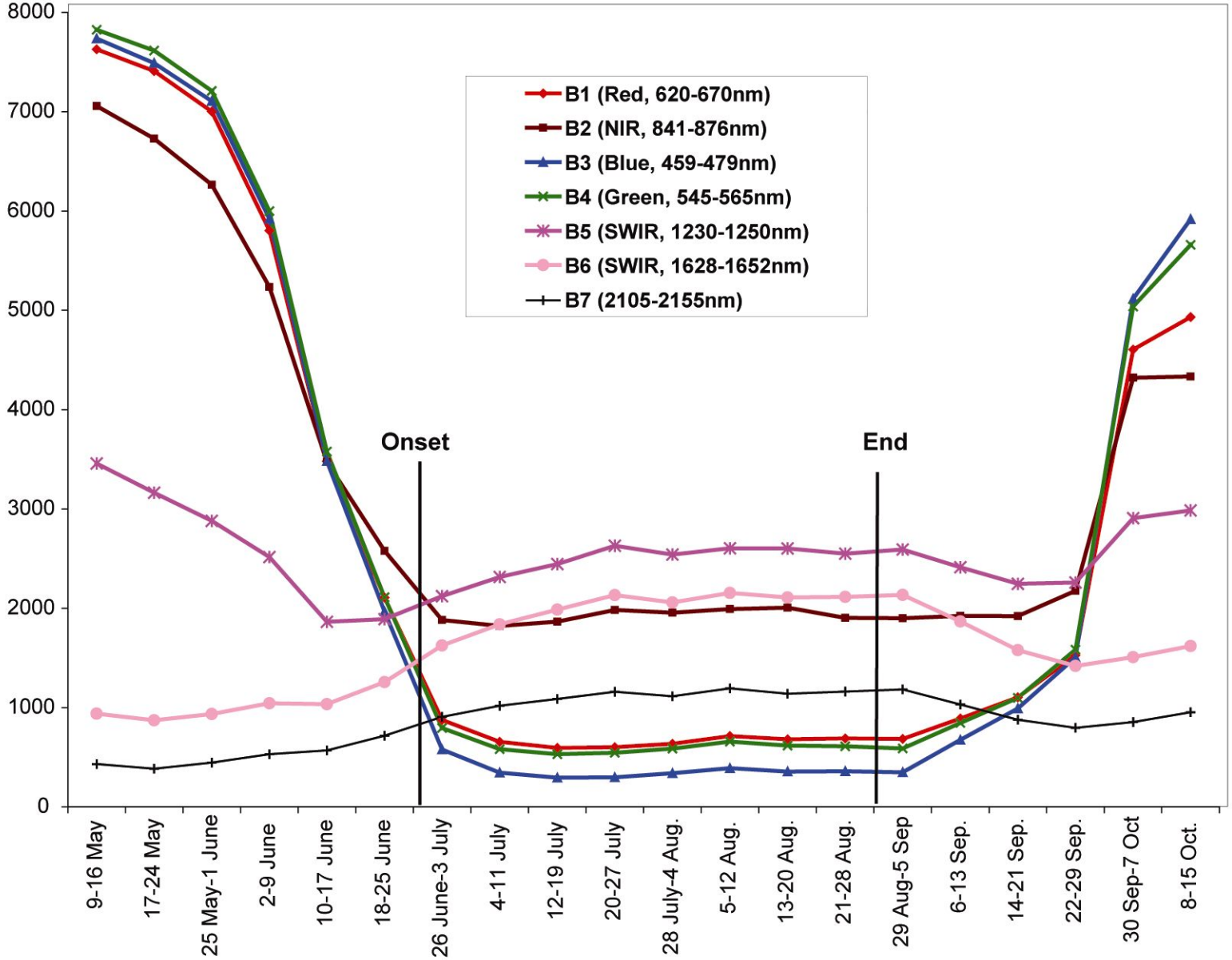
Surface Reflectance, 8-days composite

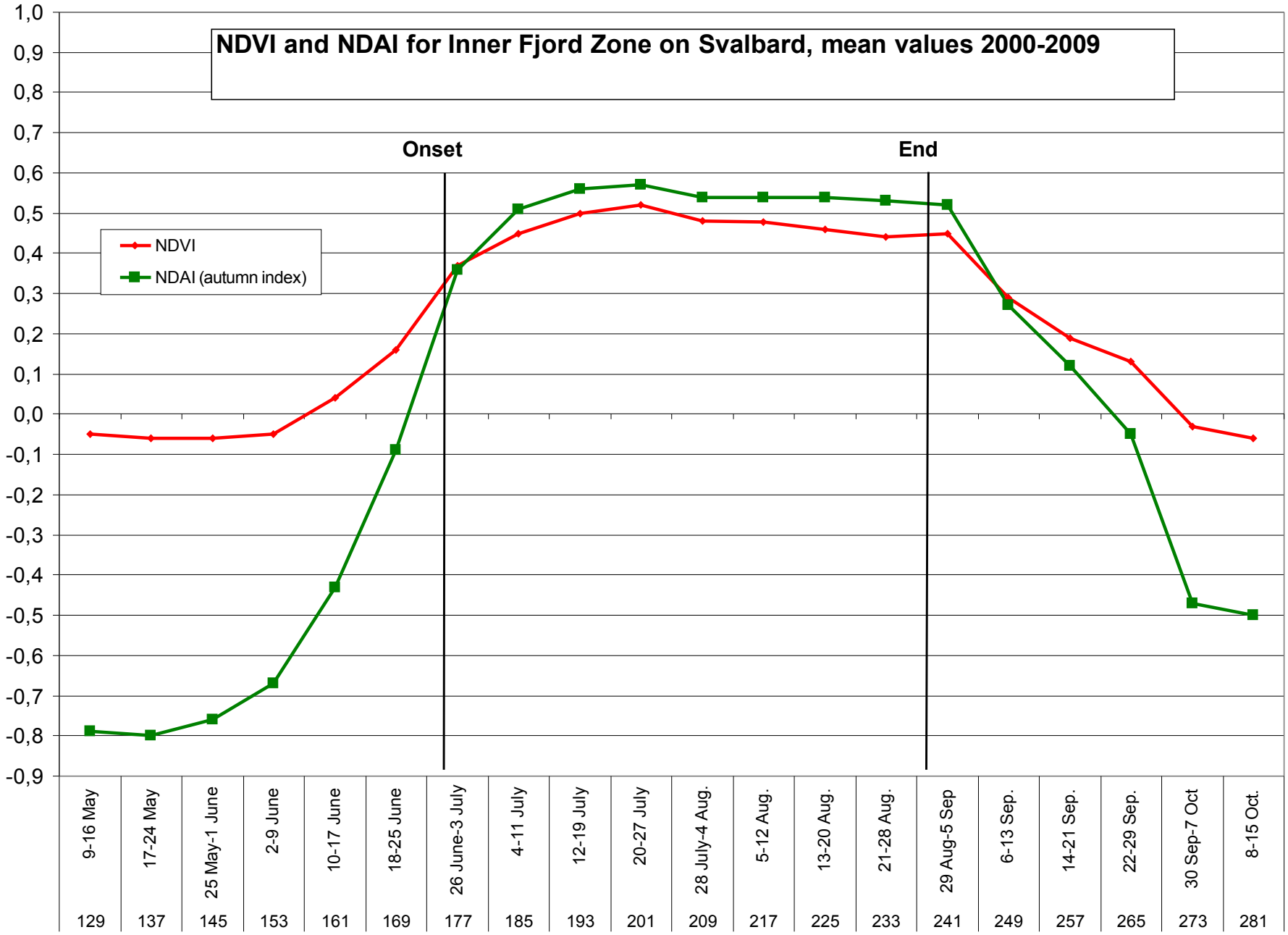
a) MOD09A1 product: 7 band, 500m pixel

b) MOD09Q1 product: Red and NIR, 250m pixel

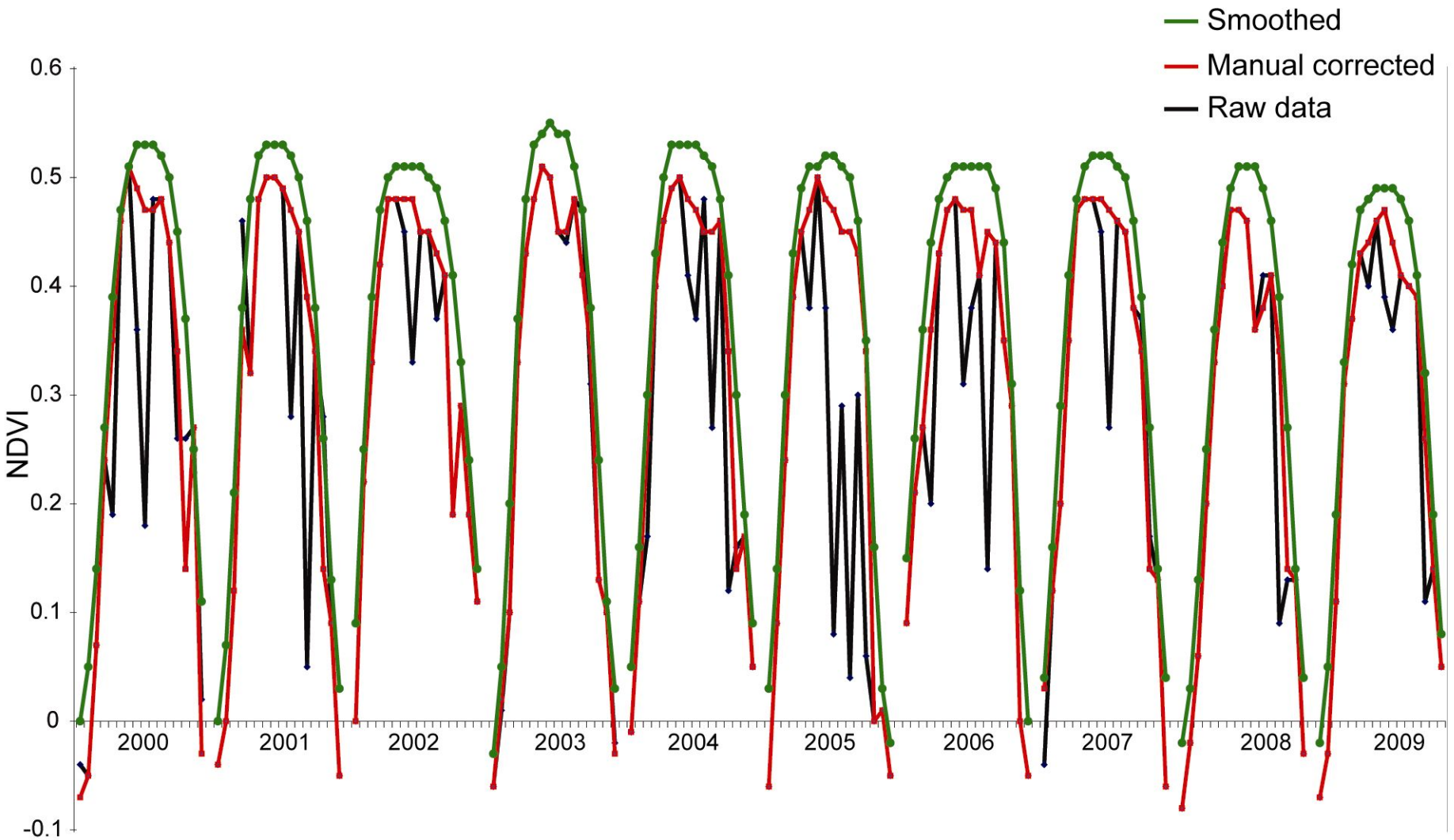


Analyzing reflectance of MODIS bands, - Longyearbyen area



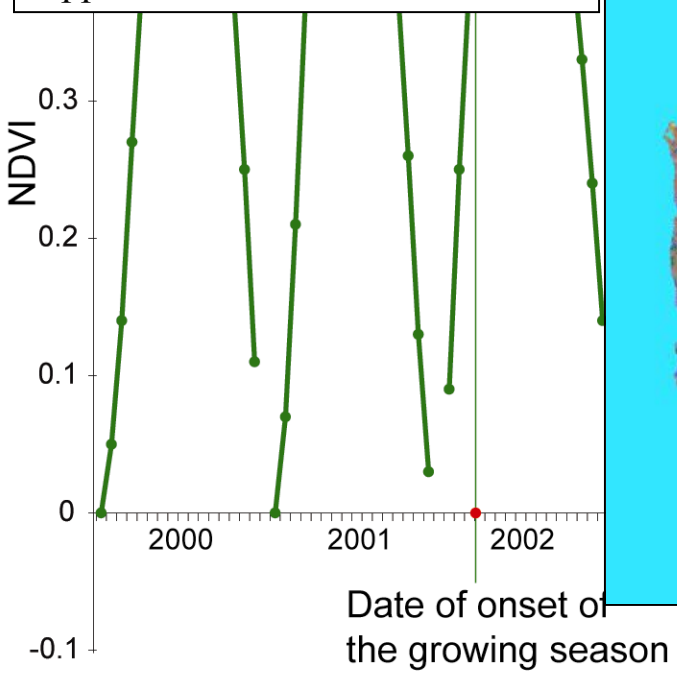

NDVI and NDAI for Inner Fjord Zone on Svalbard, mean values 2000-2009
Onset
End
NDVI
NDAI (autumn index)
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
-0,1
-0,2
-0,3
-0,4
-0,5
-0,6
-0,7
-0,8
-0,9
9-16 May
17-24 May
25 May-1 June
2-9 June
10-17 June
18-25 June
26 June-3 July
4-11 July
12-19 July
20-27 July
28 July-4 Aug.
5-12 Aug.
13-20 Aug.
21-28 Aug.
29 Aug-5 Sep
6-13 Sep.
14-21 Sep.
22-29 Sep.
30 Sep-7 Oct
8-15 Oct.
129
137
145
153
161
169
177
185
193
201
209
217
225
233
241
249
257
265
273
281

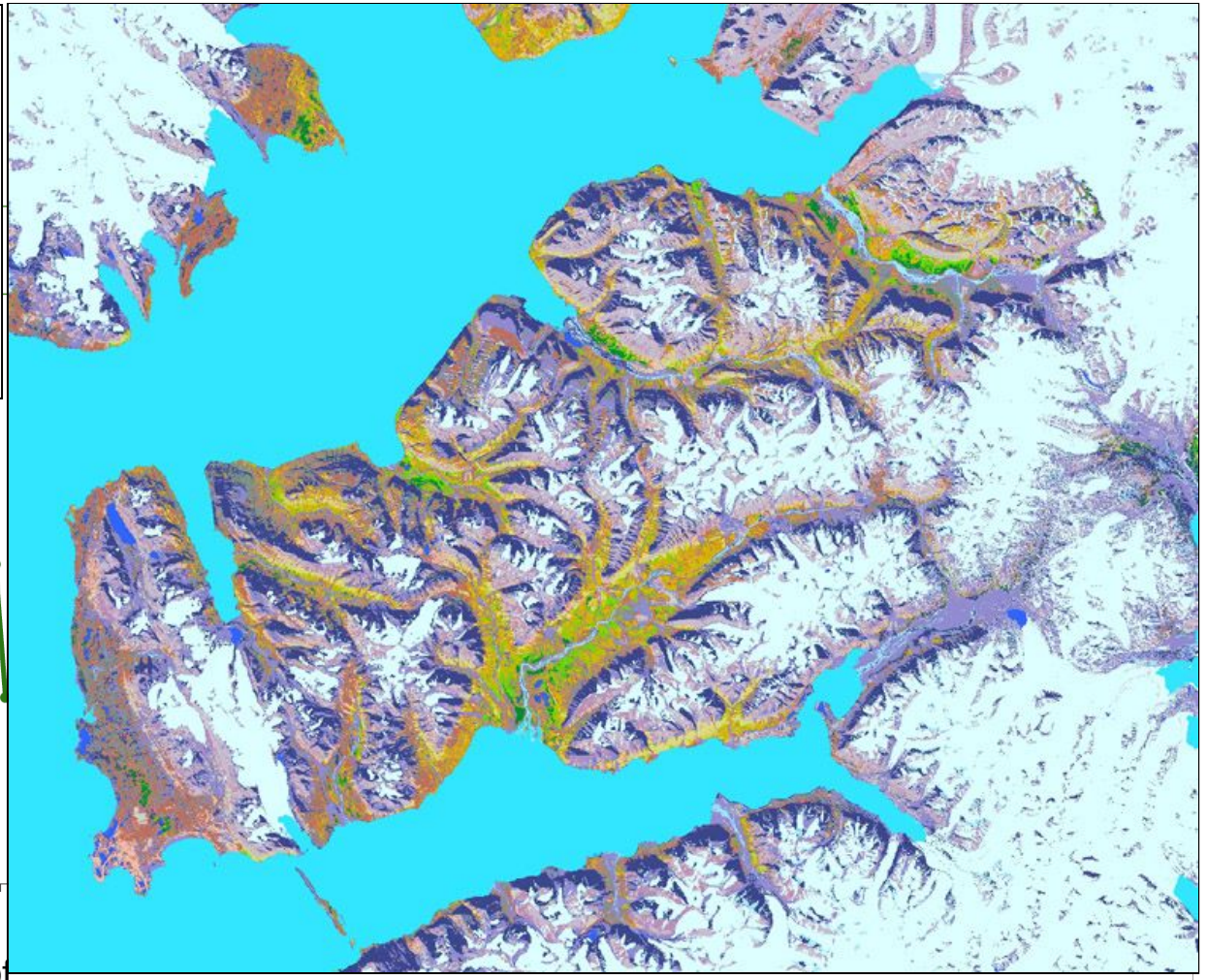
Calibration

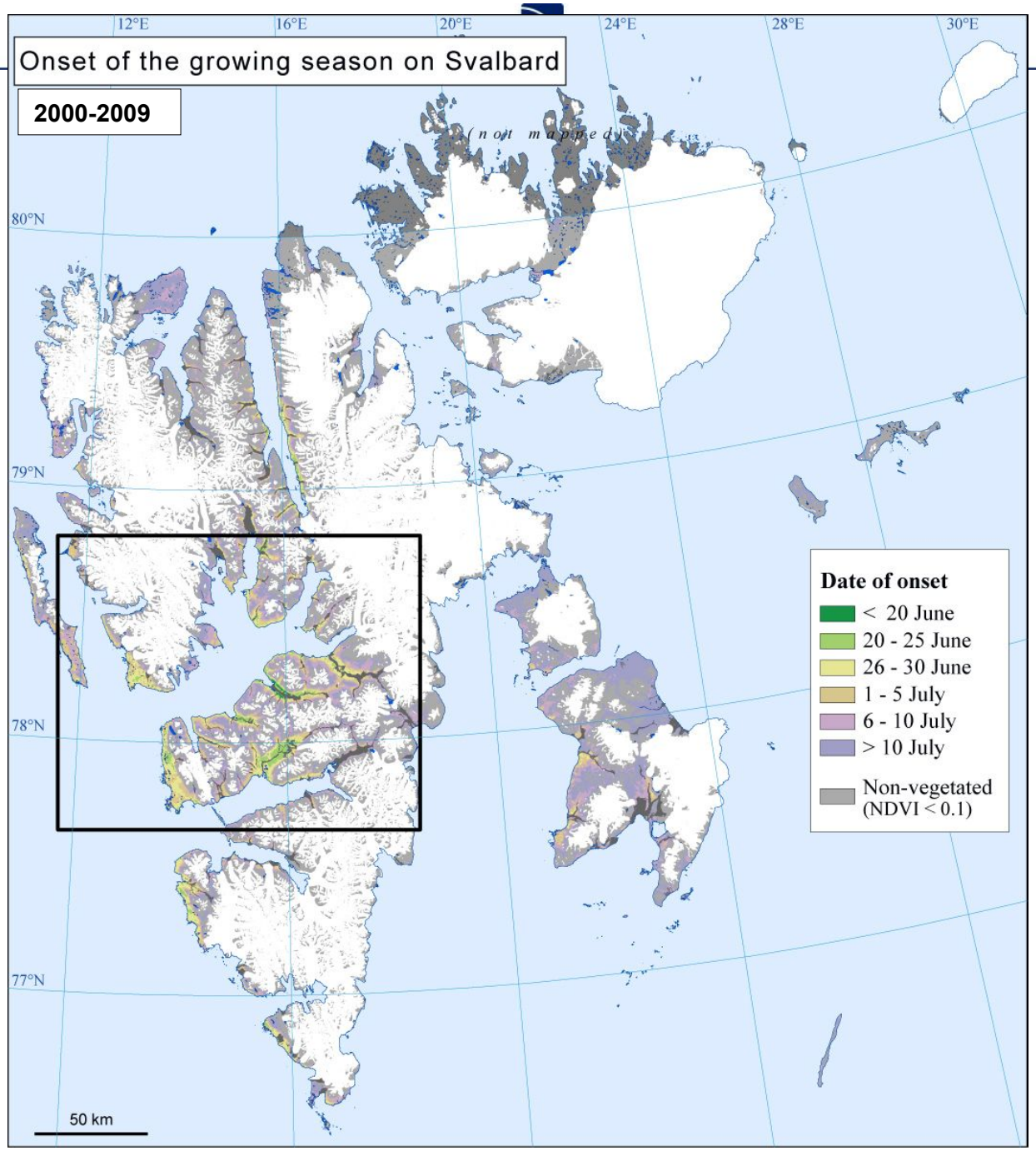


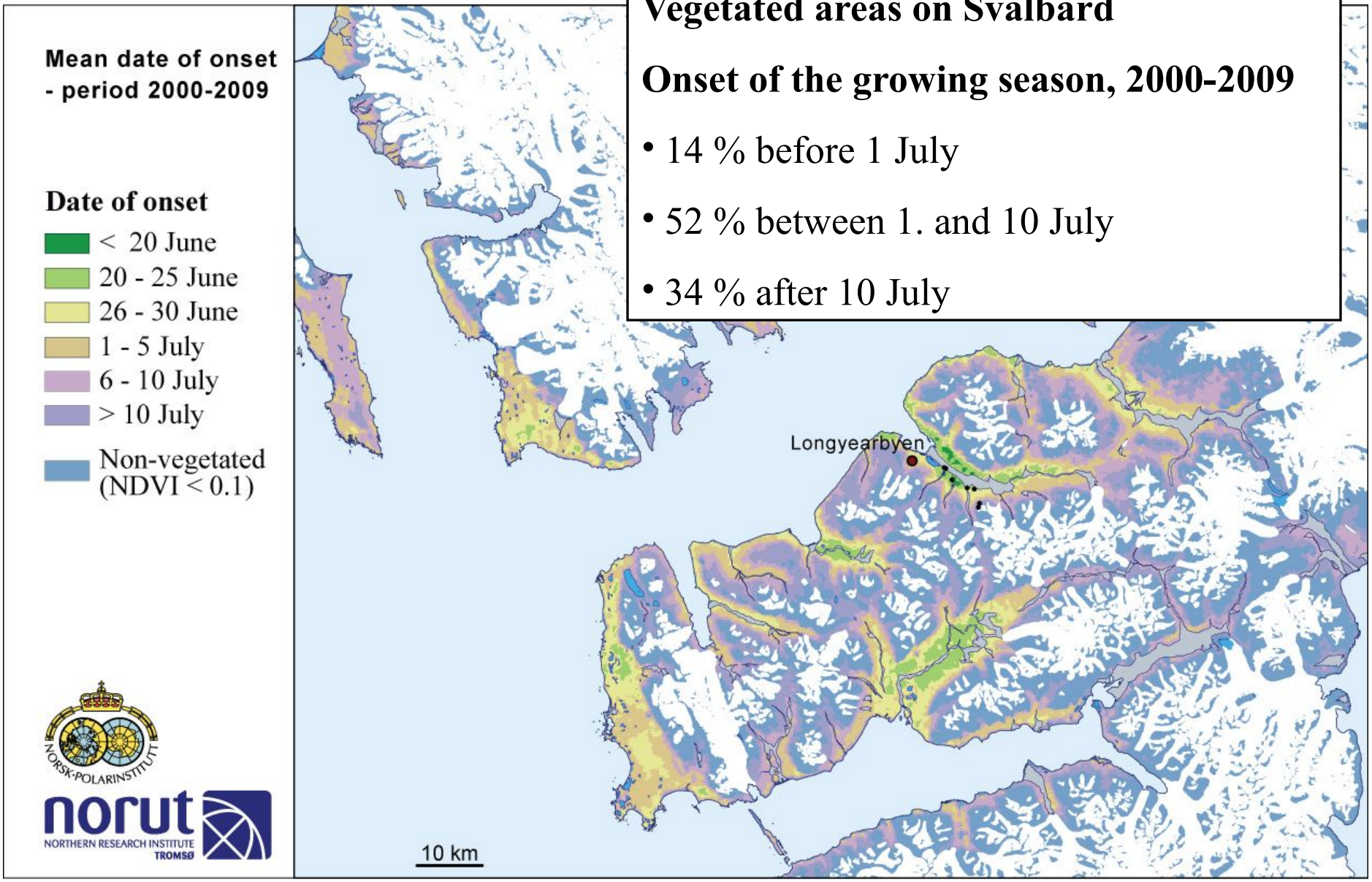
Method to map the onset of the growing season

- We also include additional geo-data (vegetation map, DEM) and knowledge-based rules in the mapping.
- For description of the method see: Karlsen et al. 2008. Int. J. Appl. Earth Observ. Geoinform.






Onset of the growing season on Svalbard
2000-2009
(not mapped)
12°E
16°E
20°E
24°E
28°E
30°E
80°N
79°N
78°N
77°N
Date of onset
< 20 June
20 - 25 June
26 - 30 June
1 - 5 July
6 - 10 July
> 10 July
Non-vegetated
(NDVI < 0.1)
50 km

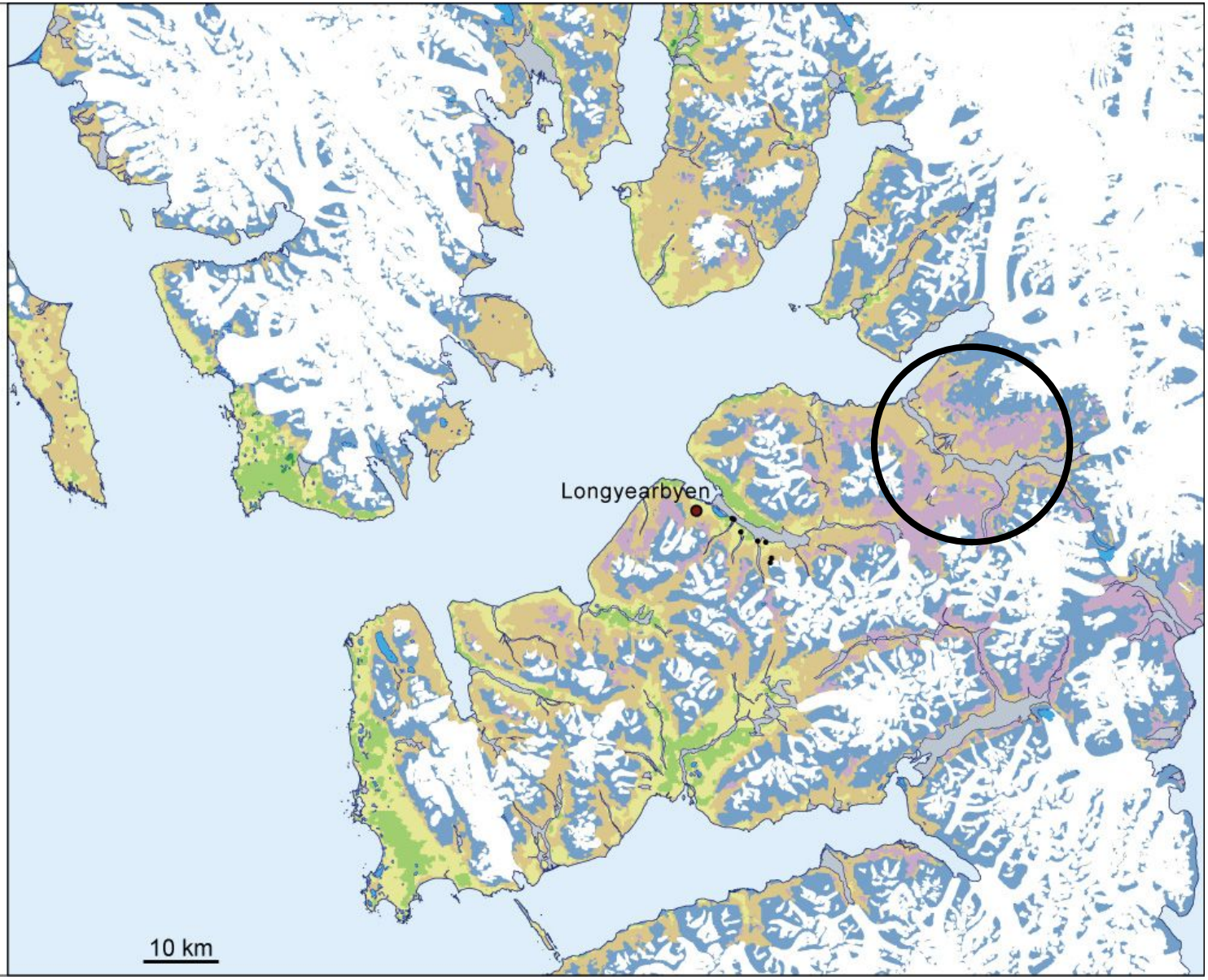


Vegetated areas on Svalbard

Onset of the growing season, 2000-2009

- 14 % before 1 July
- 52 % between 1. and 10 July
- 34 % after 10 July

2000



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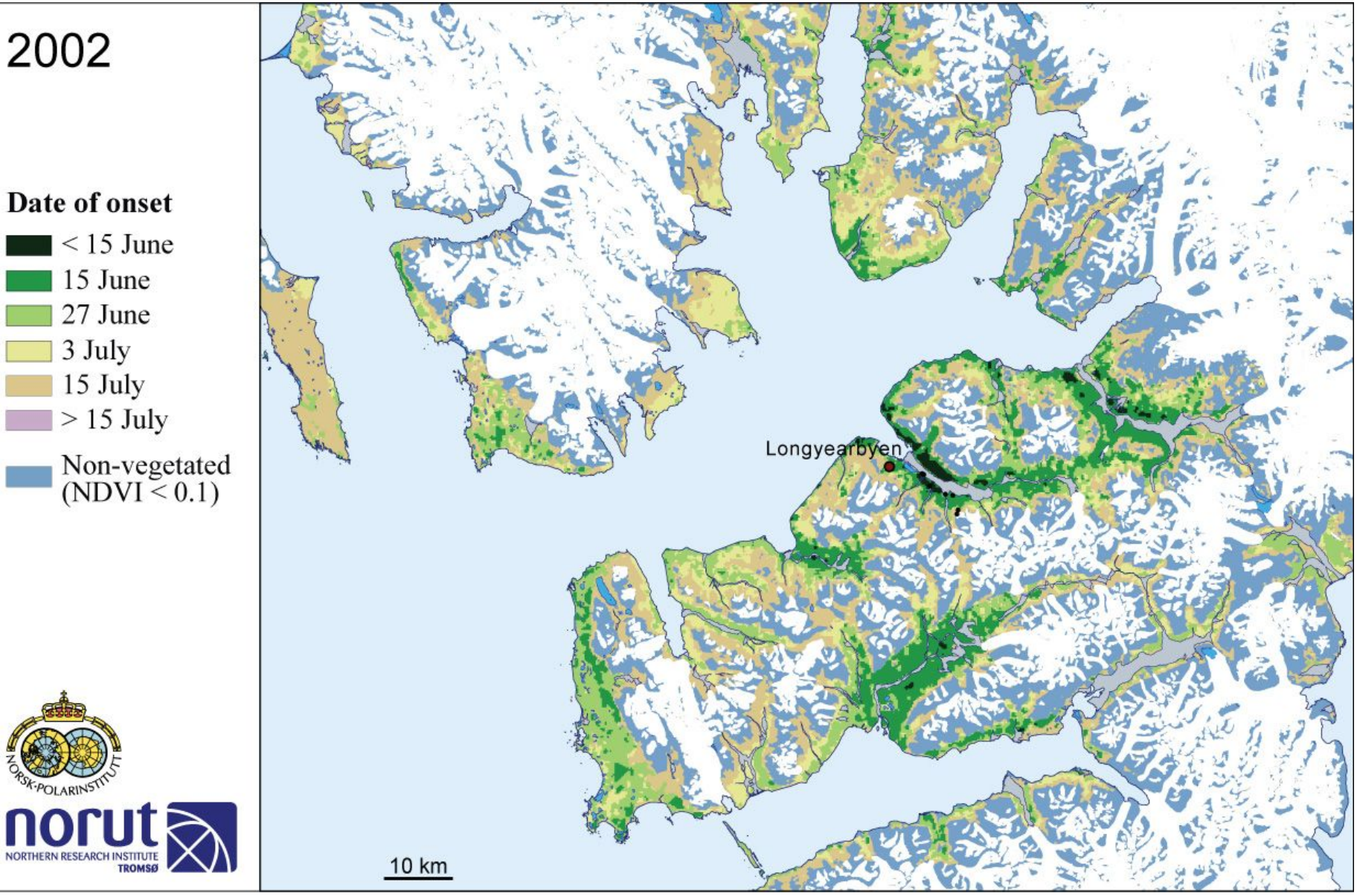
2002



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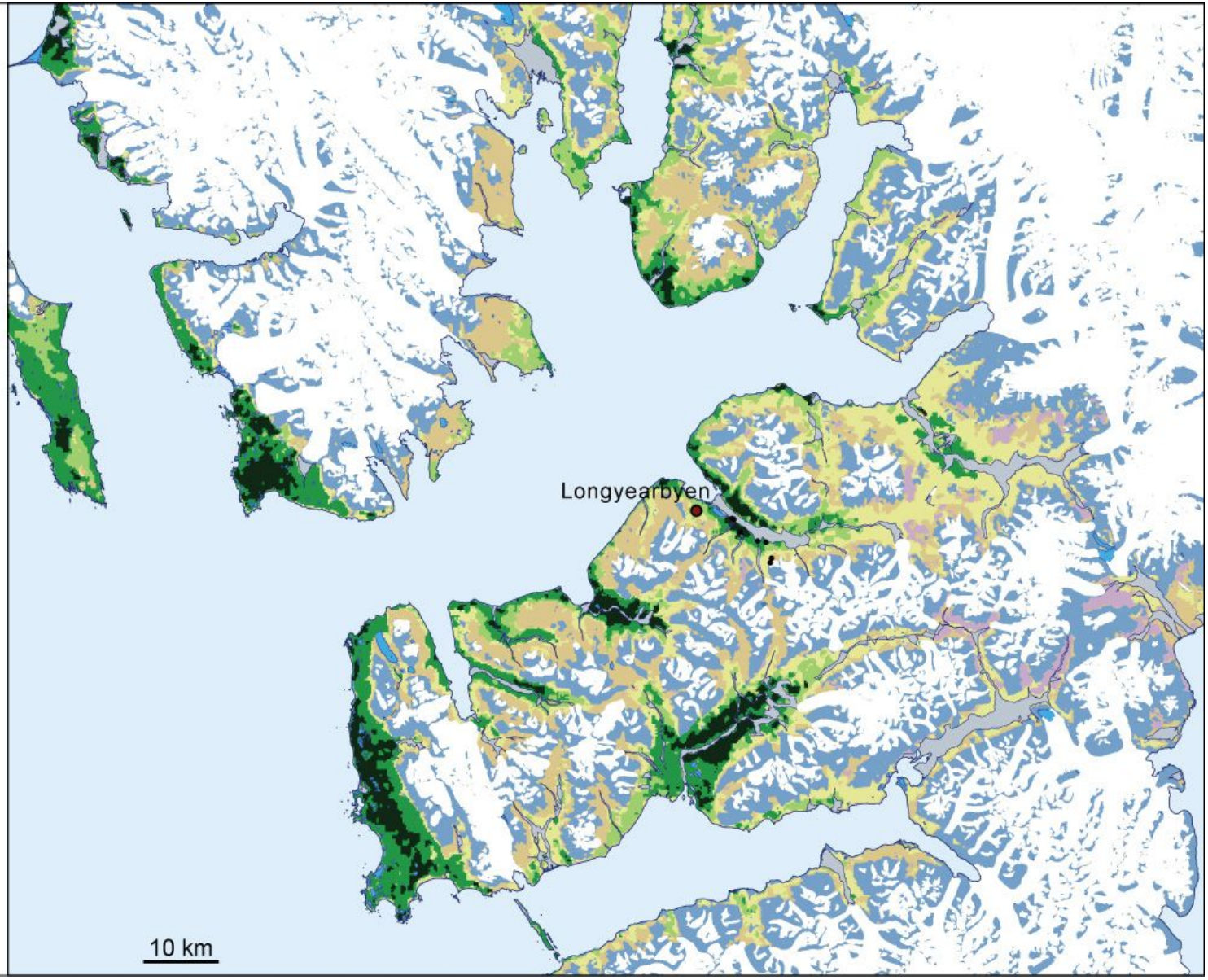
2006



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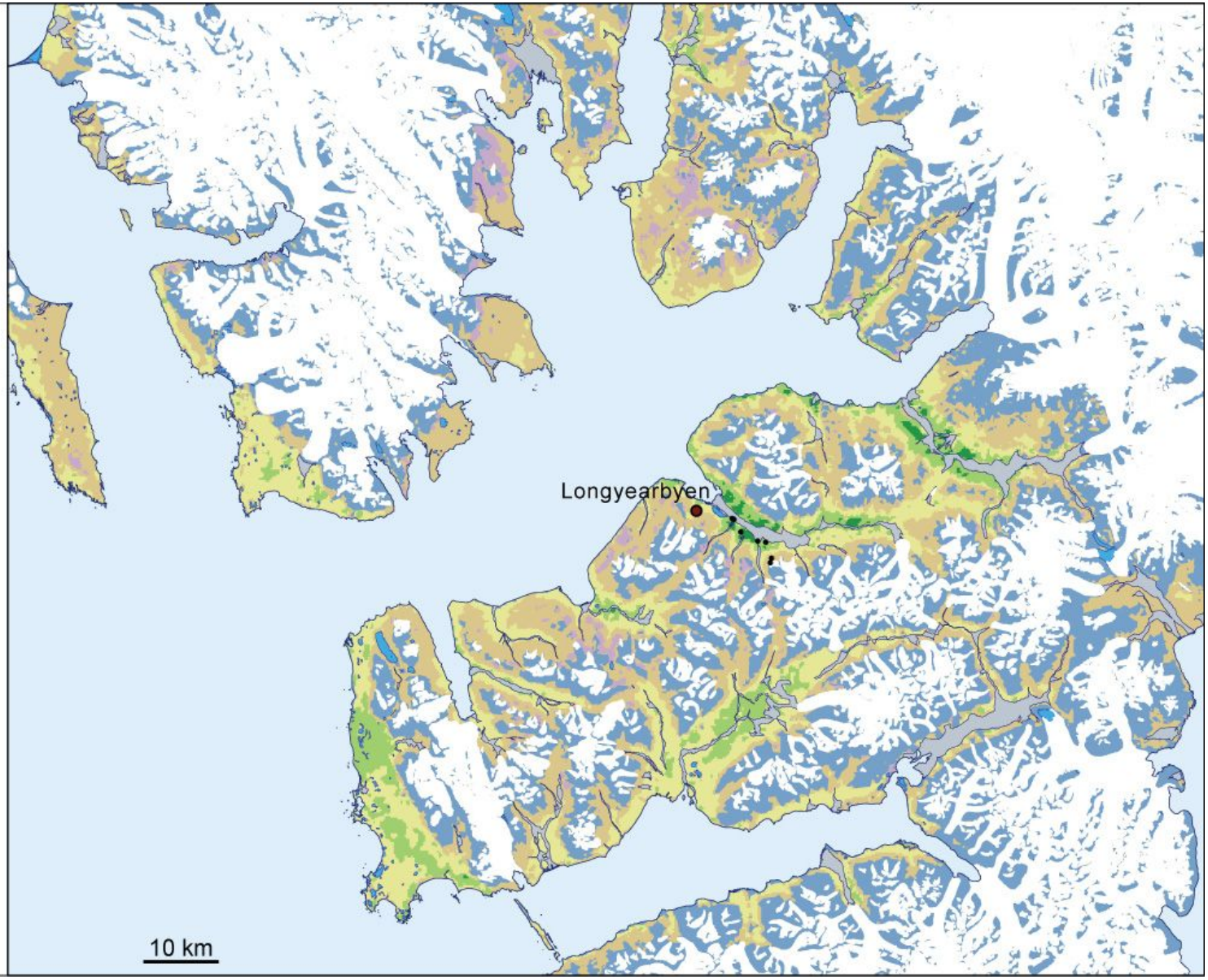
2009



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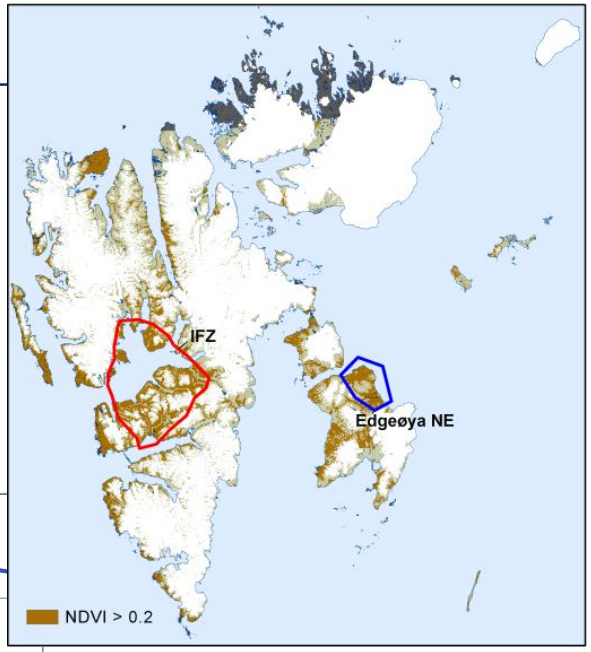
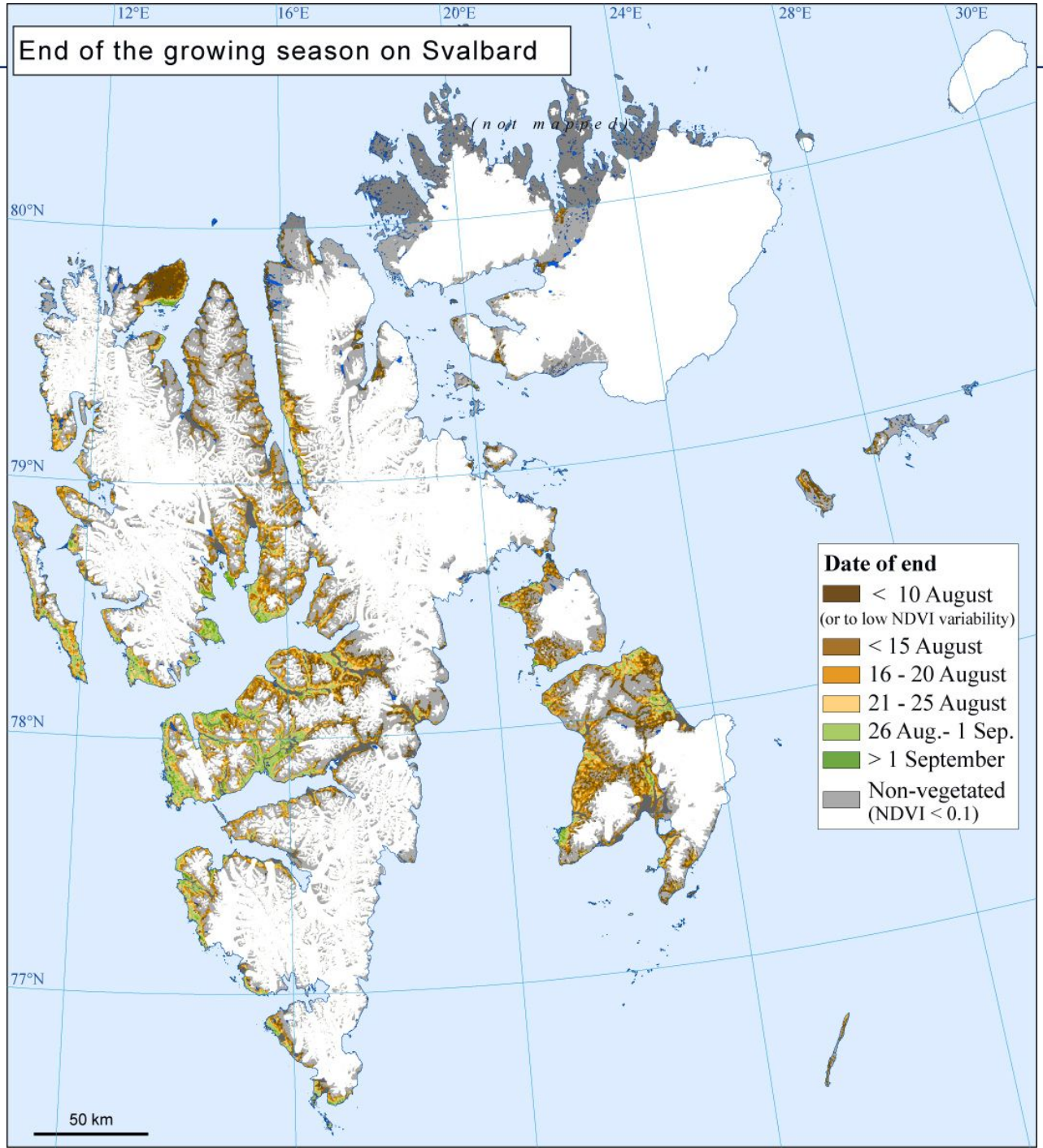
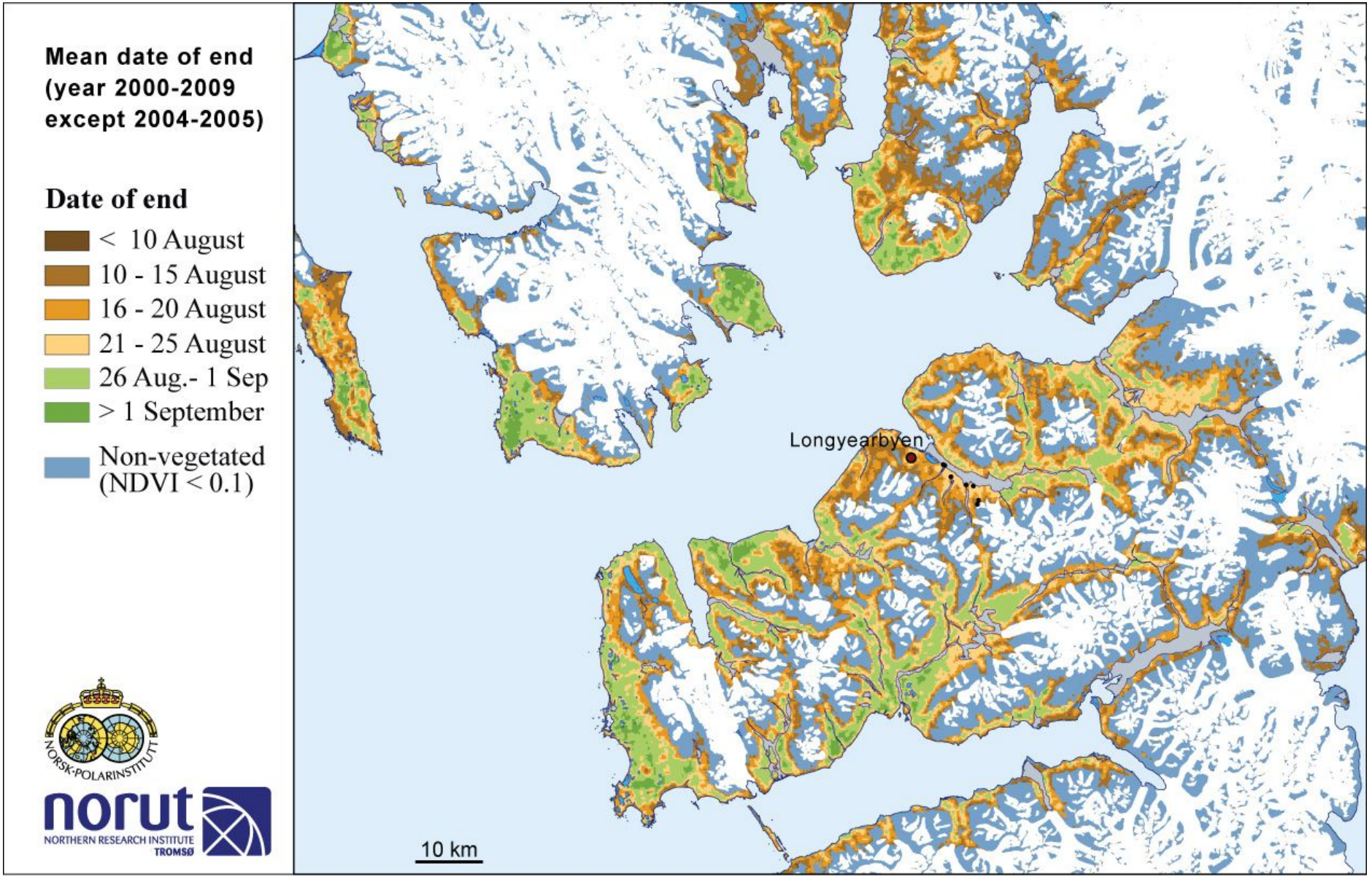
Trends and regional variation




End of the growing season on Svalbard
12°E
16°E
20°E
24°E
28°E
30°E
80°N
79°N
78°N
77°N
(not mapped)
Date of end
< 10 August
(or to low NDVI variability)
< 15 August
16 - 20 August
21 - 25 August
26 Aug.- 1 Sep.
> 1 September
Non-vegetated
(NDVI < 0.1)
50 km

Mean date of end (year 2000-2009 except 2004-2005)



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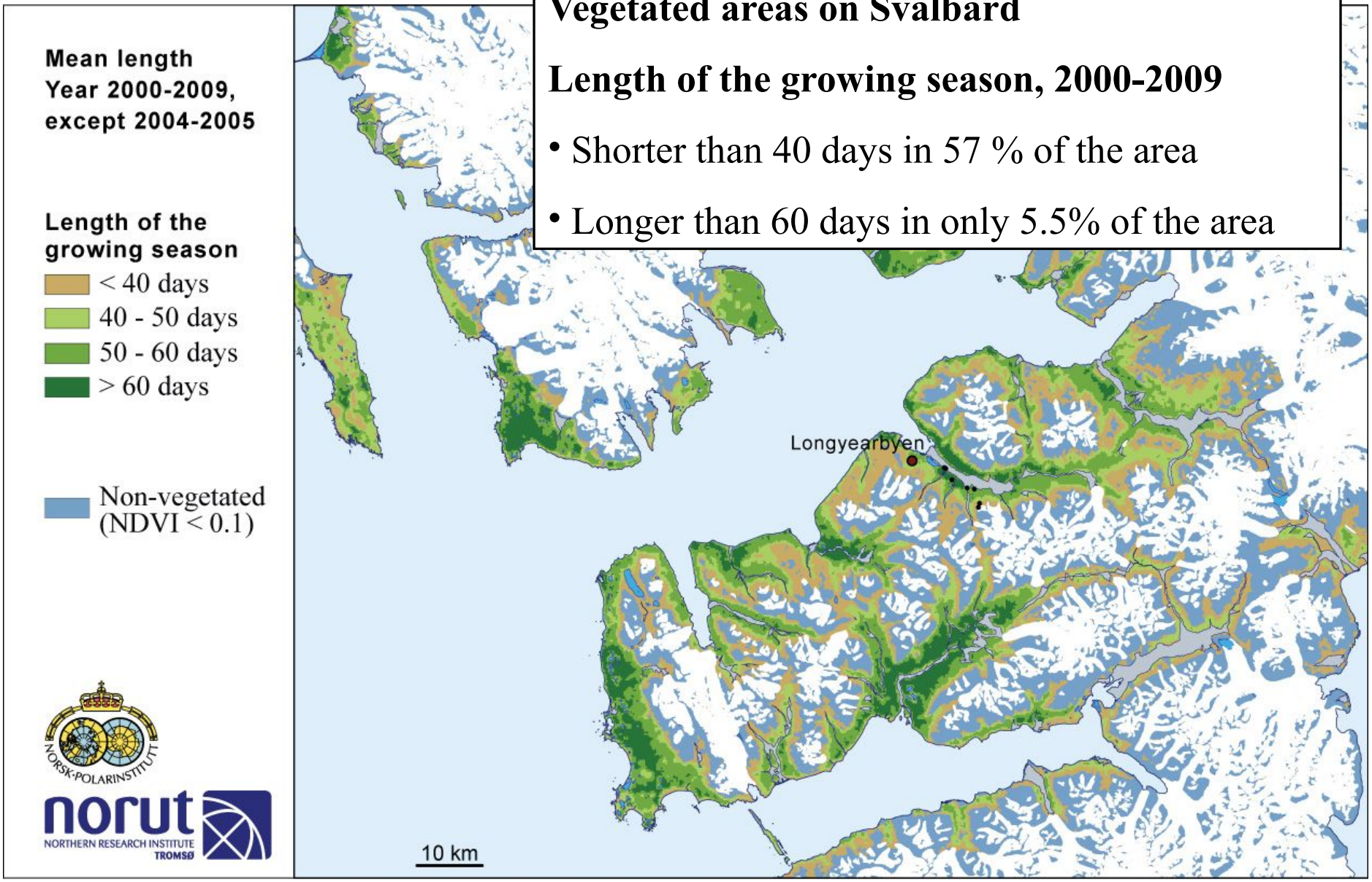
Vegetated areas on Svalbard

Length of the growing season, 2000-2009

- Shorter than 40 days in 57 % of the area
- Longer than 60 days in only 5.5% of the area



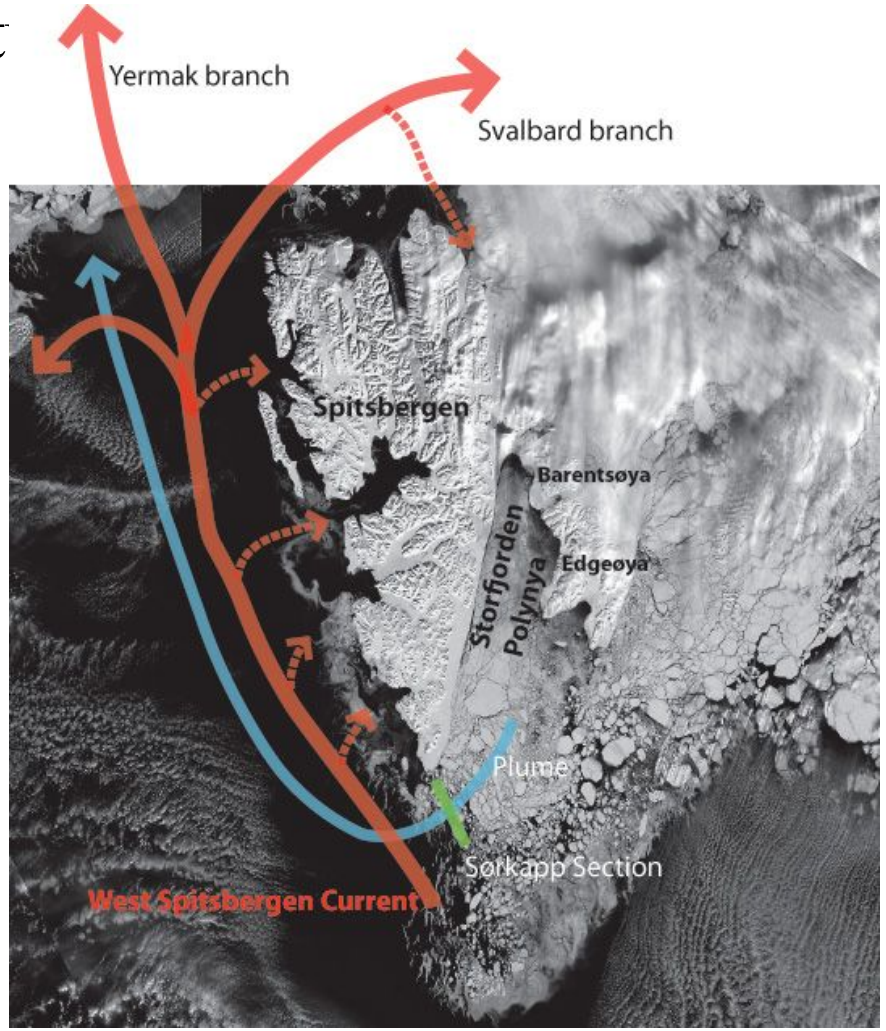
Summary and conclusions

- First time the growing season has been mapped so fare north
- Challenging due to frequent cloud cover, short growing season, and scattered vegetation cover
- We need to observe phenology in field on a scale that can be compared with MODIS data
- End of the growing season: MODIS data is not well correlated with field observations and more research is needed. So far the use of combining the SWIR and the red band in an autumn index show best results.

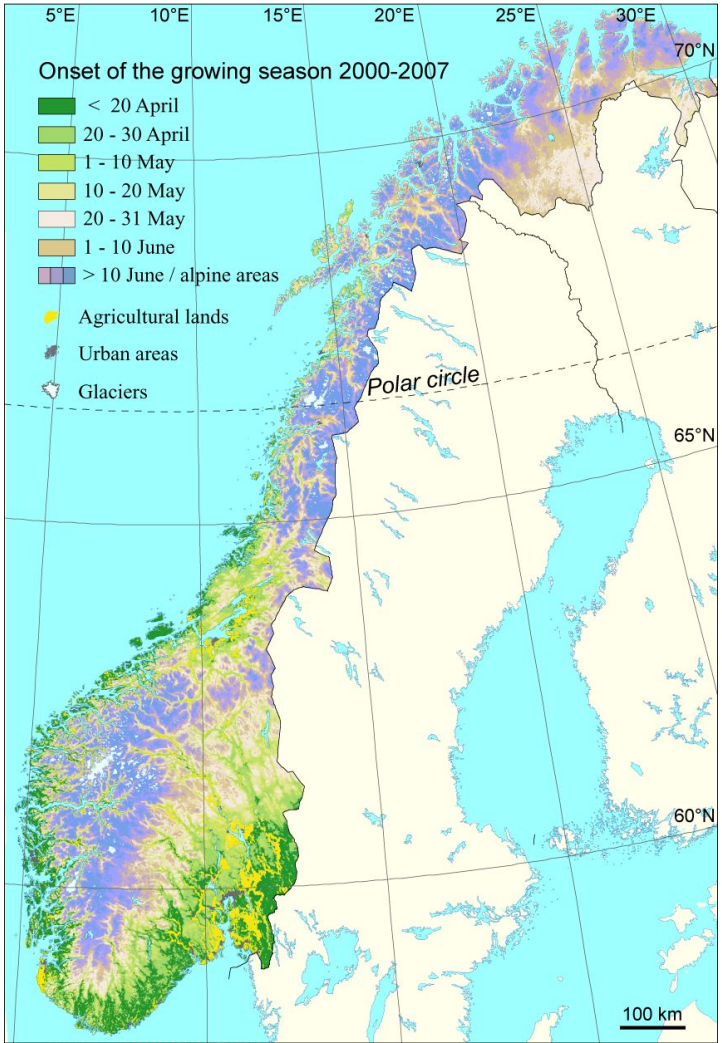
Summary and conclusions

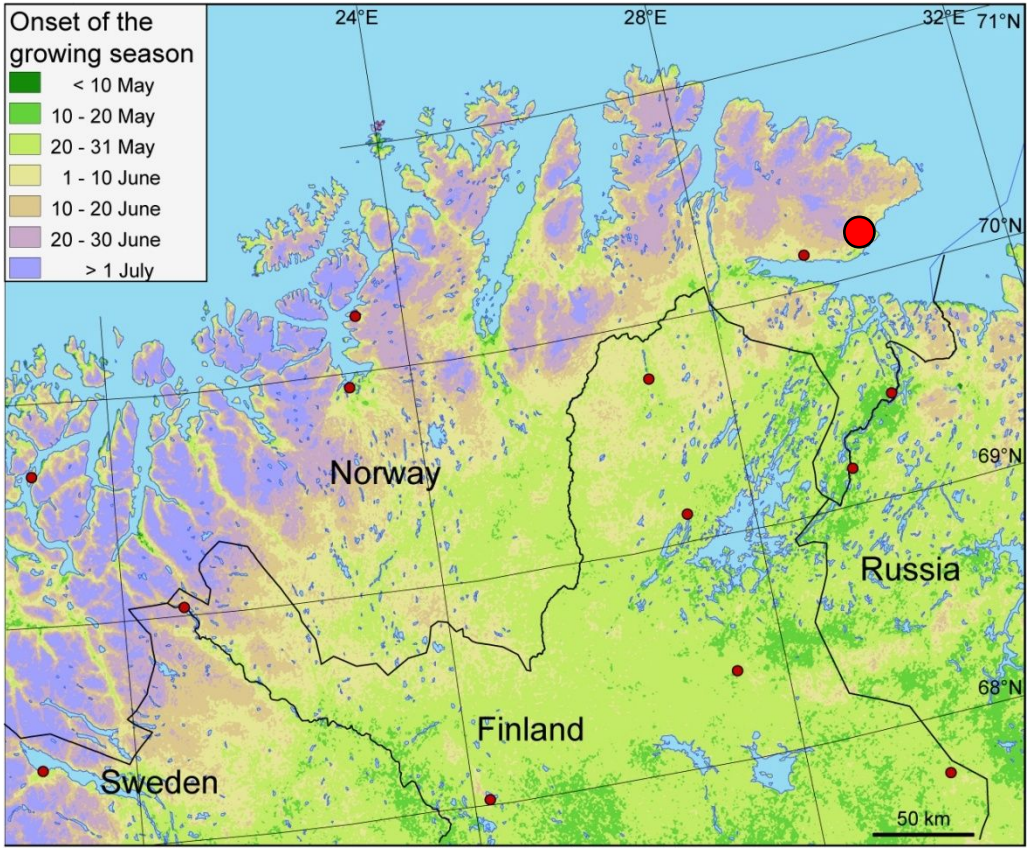
- Onset of the growing season shows large variation from year-to-year
- Onset of the growing season is possible influenced by the timing of melting sea-ice, but more research is needed on this
- Onset of the growing season is well correlated with spring temperatures and, hence, is a good bio-indicator of changing climate
- The length of the growing season is supposed to highly influence the population size of most birds and animals on Svalbard.
- Changes in the length of the growing season is the first step in changing vegetation cover.
- Longer growing season - positive feedback loop to climate

Svalbard – temperat



Next step
Mapping the whole north-western most Europe?





Karlsen et al. 2008. Int. J. Appl. Earth Observ. Geoinform.

Karlsen et al. 2009. Aerobiologia.

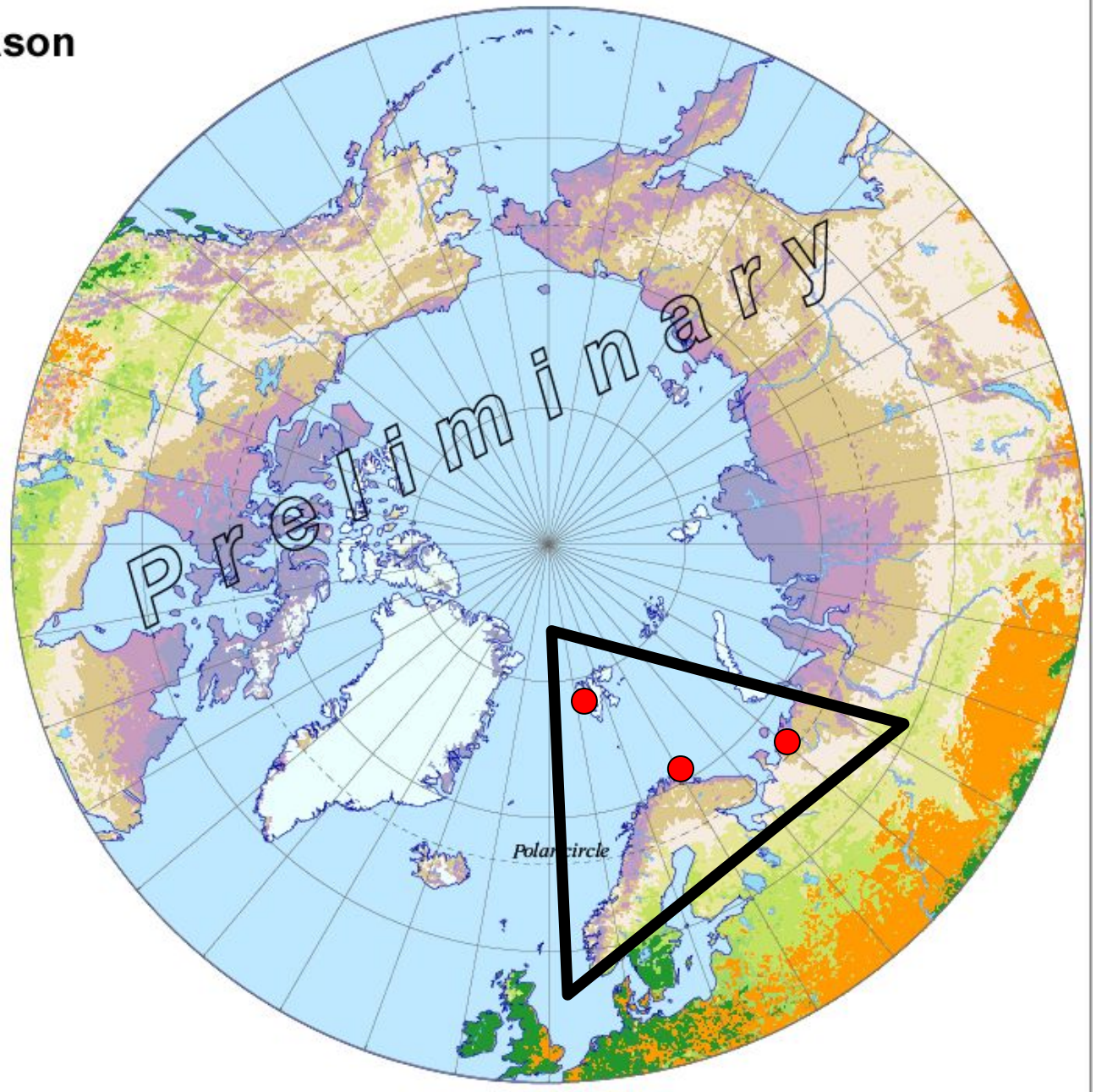
Karlsen et al. 2009. Climate Research.

Onset of the growing season

Mean values for the 1982-2006 period,
based on the GIMMS-NDVI dataset

- < 20 April
- 20 - 30 April
- 1 - 10 May
- 10 - 20 May
- 20 - 31 May
- 1 - 10 June
- 10 - 20 June
- > 20 June

- Glacier / lack of data
- Cropland



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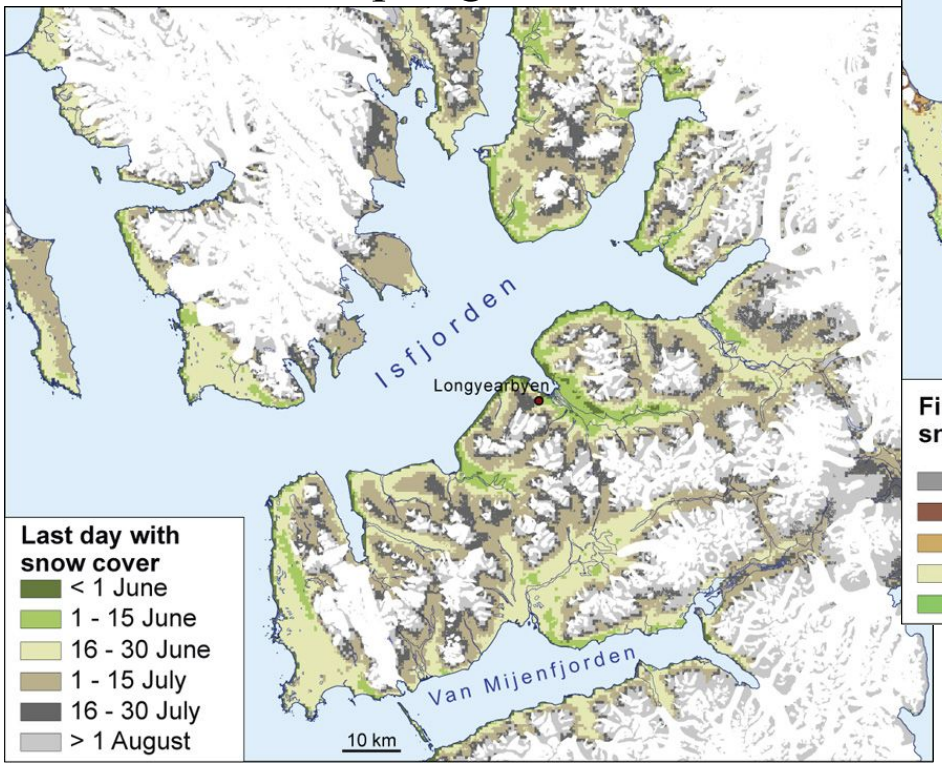
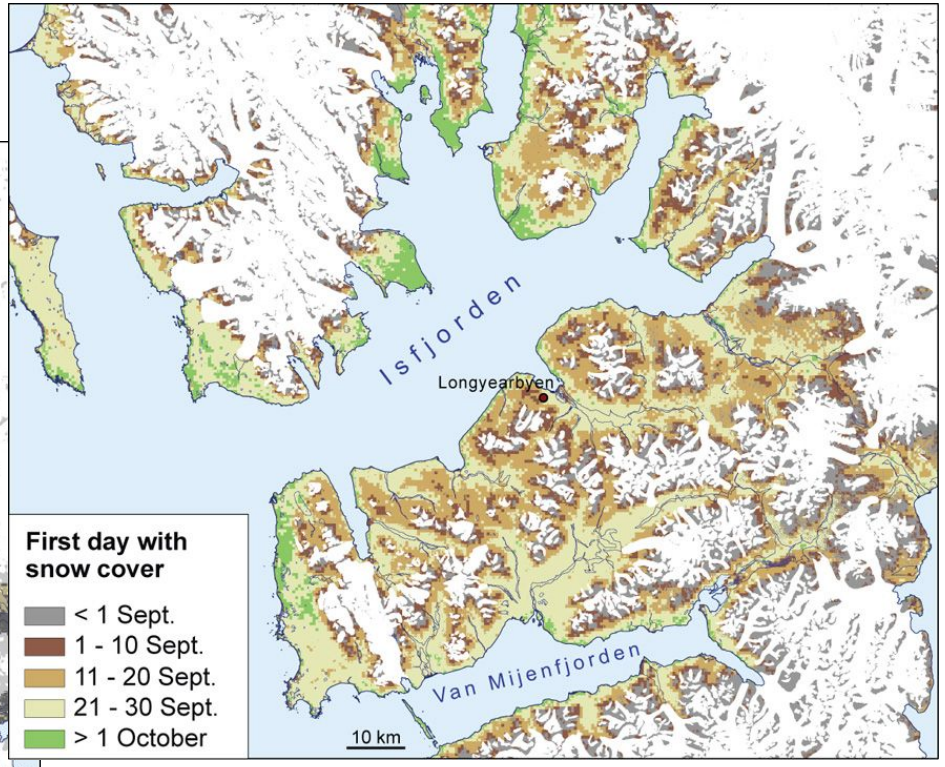
Snow cover maps, mean values for the 2005-2009 period

- based on combined MODIS and microwave (ASAR) data

Spring



Autumn



Animation

- Combined snow cover and growing season maps

Acknowledgement

This project is a part of an ongoing “Environmental monitoring system for Svalbard and Jan Mayen (MOSJ)”

Lead by the Norwegian Polar Institute