Vegetation and ecosystem transformation on Finnmarksvidda, Northern Norway, due to reindeer grazing pressure

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Background

- Reindeer herding in northern Scandinavia is associated with the Saami people
- Rapid increase in the reindeer population during the 1970´s and throughout the 1980´s
- Decrease in lichen cover
- Decreases in body-weights and reproduction rates for the reindeer
- Increased mortality rates for the reindeer
- Problems for the herders communities

Reports and publications

Mapping and monitoring the winter ranges on Finnmarksvidda

- NINA: Collection of field data (local approach)
- Norut Tromsø: Summarizing the situation based on satellite images (regional approach)
- Funded by: The Reindeer Administration Authorities
- Initiated: 1998
- Updated: 2005/2006; 2009/2010 (all areas)
- 2013: The winter ranges in the inner, continental parts

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How to preserve the tundra in a warming climate

Mountain avens *Dryas octopetala* (Photo: Katrine Hoset)

NCoE Tundra is a new Nordic Centre of Excellence, funded by NordForsk, in the scheme of Top-level Research Initiative (TRI). Our scope is to study the interaction between the ecological phenomenon of top down impacts in food webs and climate vegetation interactions and to integrate this perspective with the man-managed reindeer husbandry and the Sámi culture dependent on it.

The Centre is a joint co-operation between nine research parties in three Nordic countries (Finland, Norway and Sweden). The project consists of eight Work Packages, each of them dealing with their own specific issues. More information can be found through the navigation panel on the top.

This research has been kindly funded by Norden, top-level research initiative.

Events

In Stockholm at the meeting (Photo: Inger Elin Utsi/HIF)

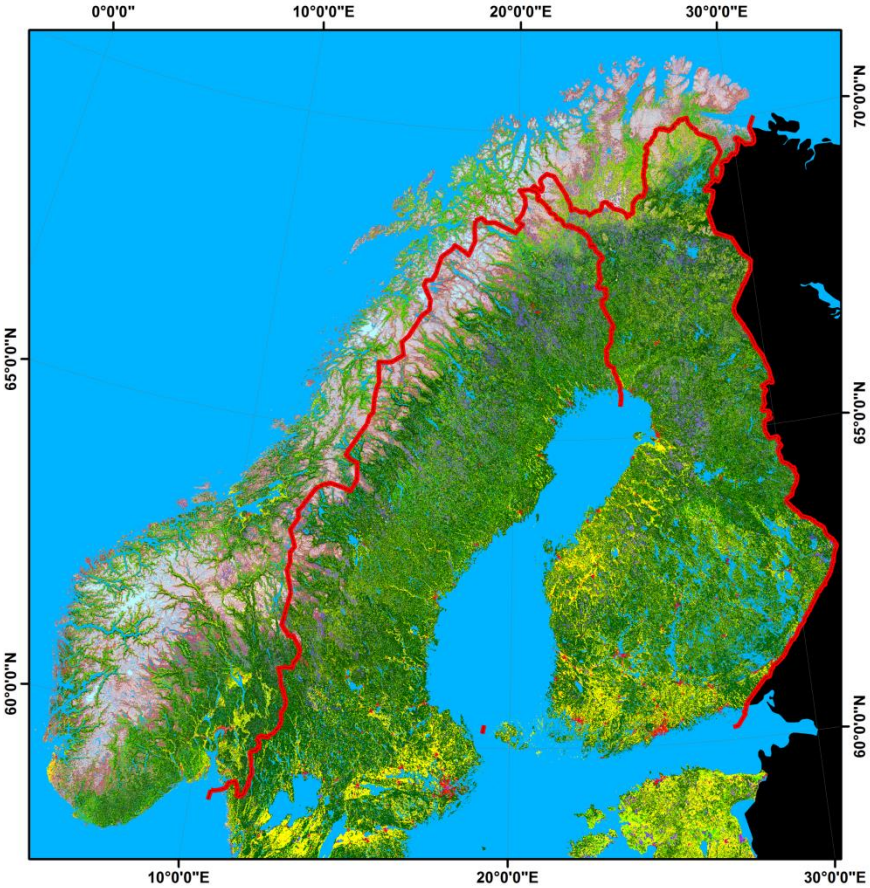
NordForsk gathered about 40 researchers and research managers for a kick-off seminar in Stockholm 24 February, aimed at the three new Nordic Centres of Excellence within the TRI sub-programme Effect studies and adaptation to climate change.

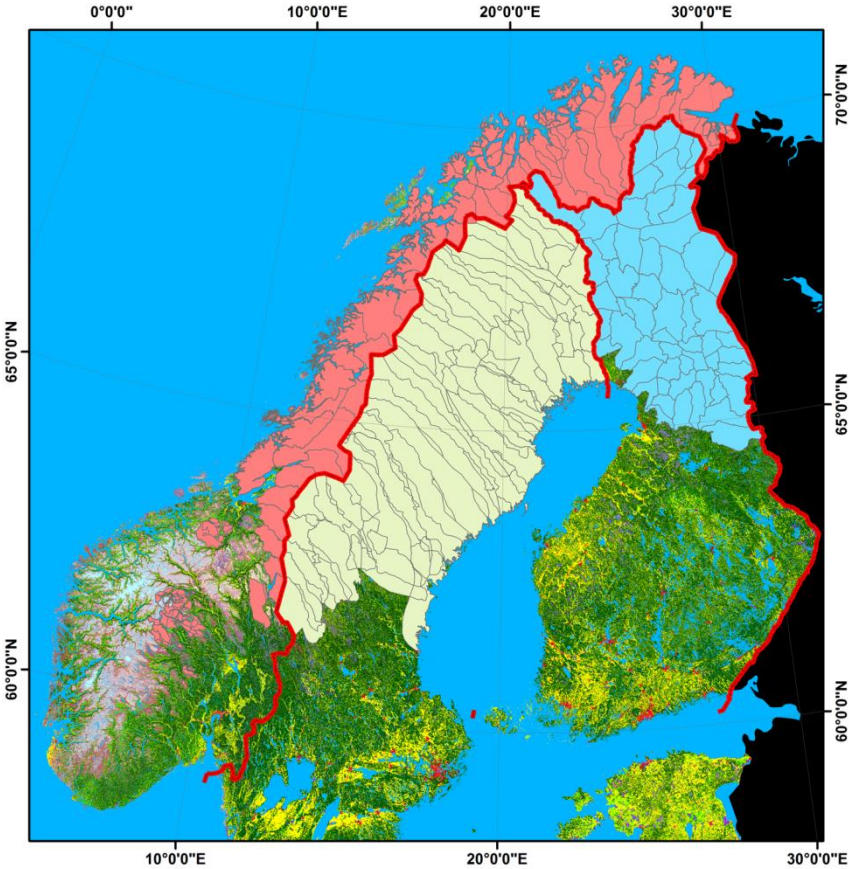
For more information see here (English) or here (Norwegian)

Objectives

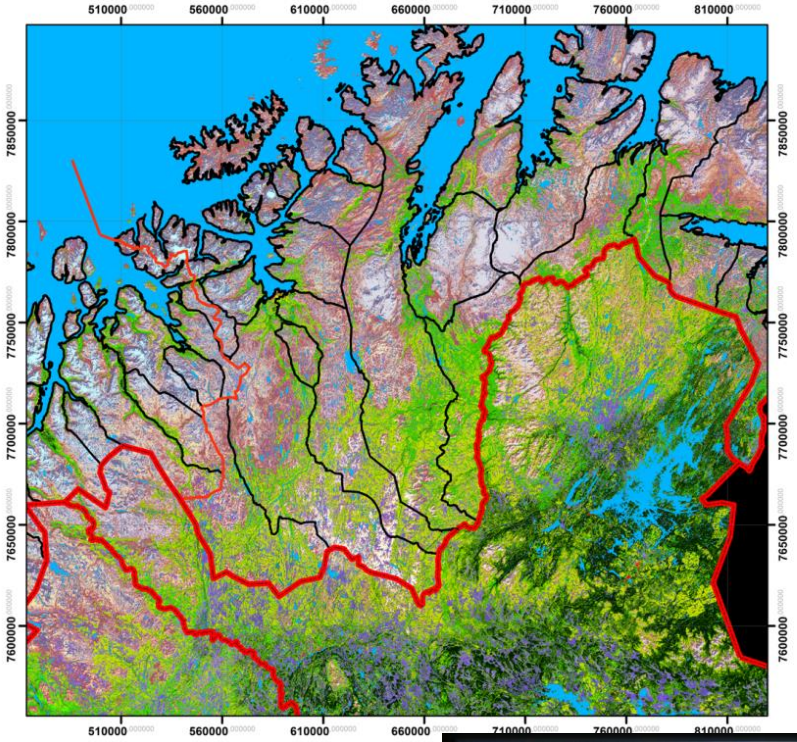
- The overall aim of the performed mapping and monitoring has been to “have an eye on” the processes going on
- Describe the processes, local/regional development, geographical pattern of the processes, changes by time
- Develop satellite based methods for detecting lichen vegetation and evaluate differences in grazing pressure (low/moderat/overgrazed)
- Develop methods for creating large-area vegetation maps based on Landsat TM/ETM+ images
- Perform accuracy assessments of the created map products through ground based measurements
- Search for improvements of the lichen maps by integrating new and improved satellite data resources

Scandinavia and the reindeer herding areas



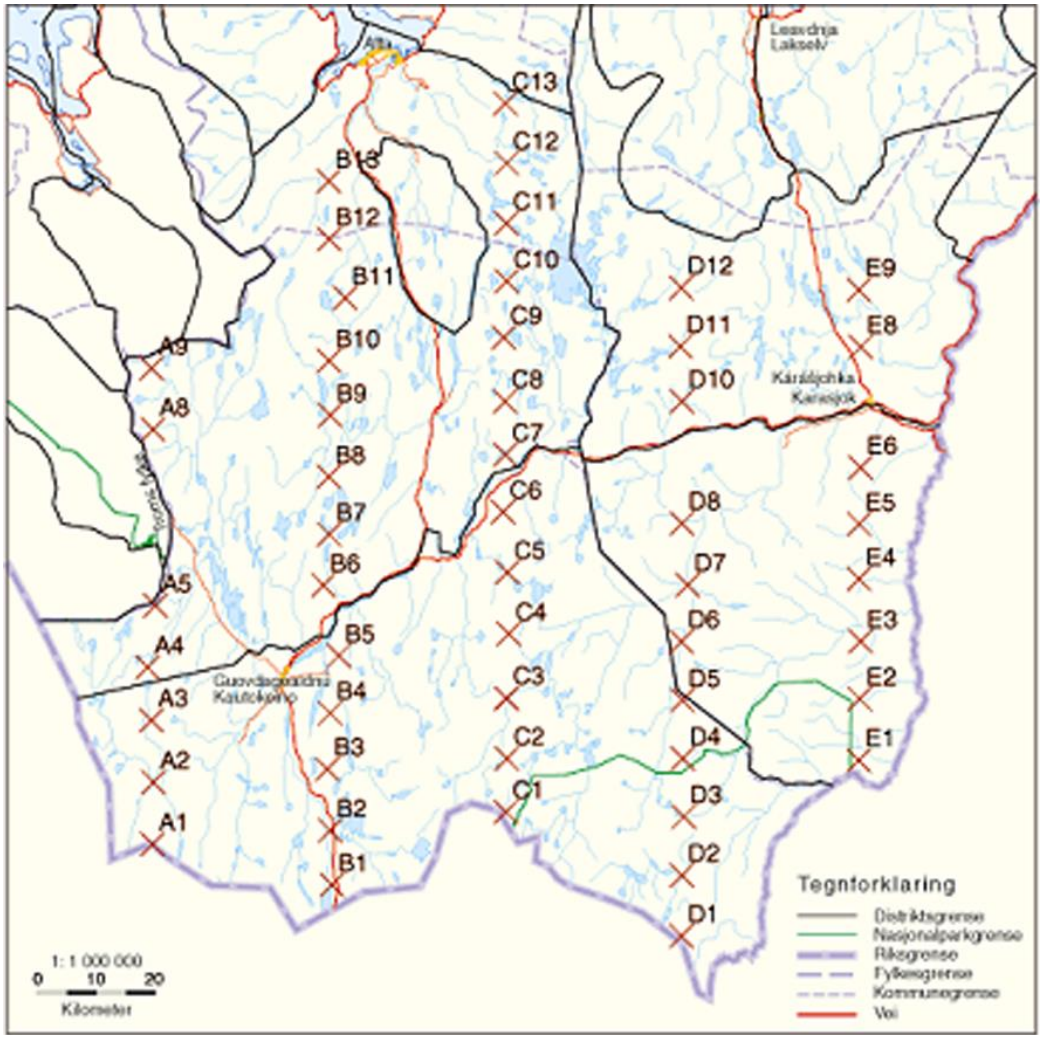


Finnmarksvidda – reindeer ranges and the grazing system

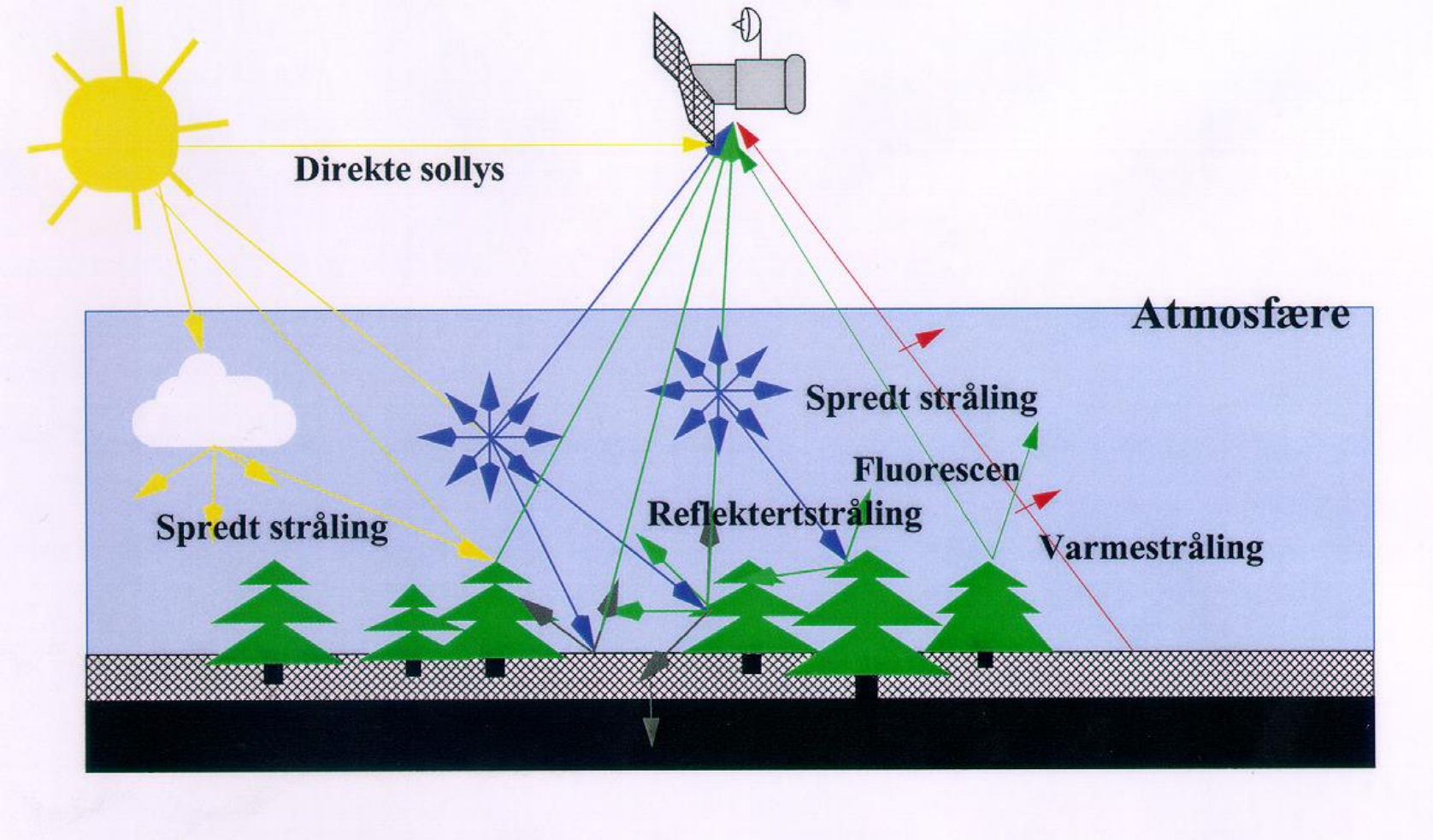


Field studies

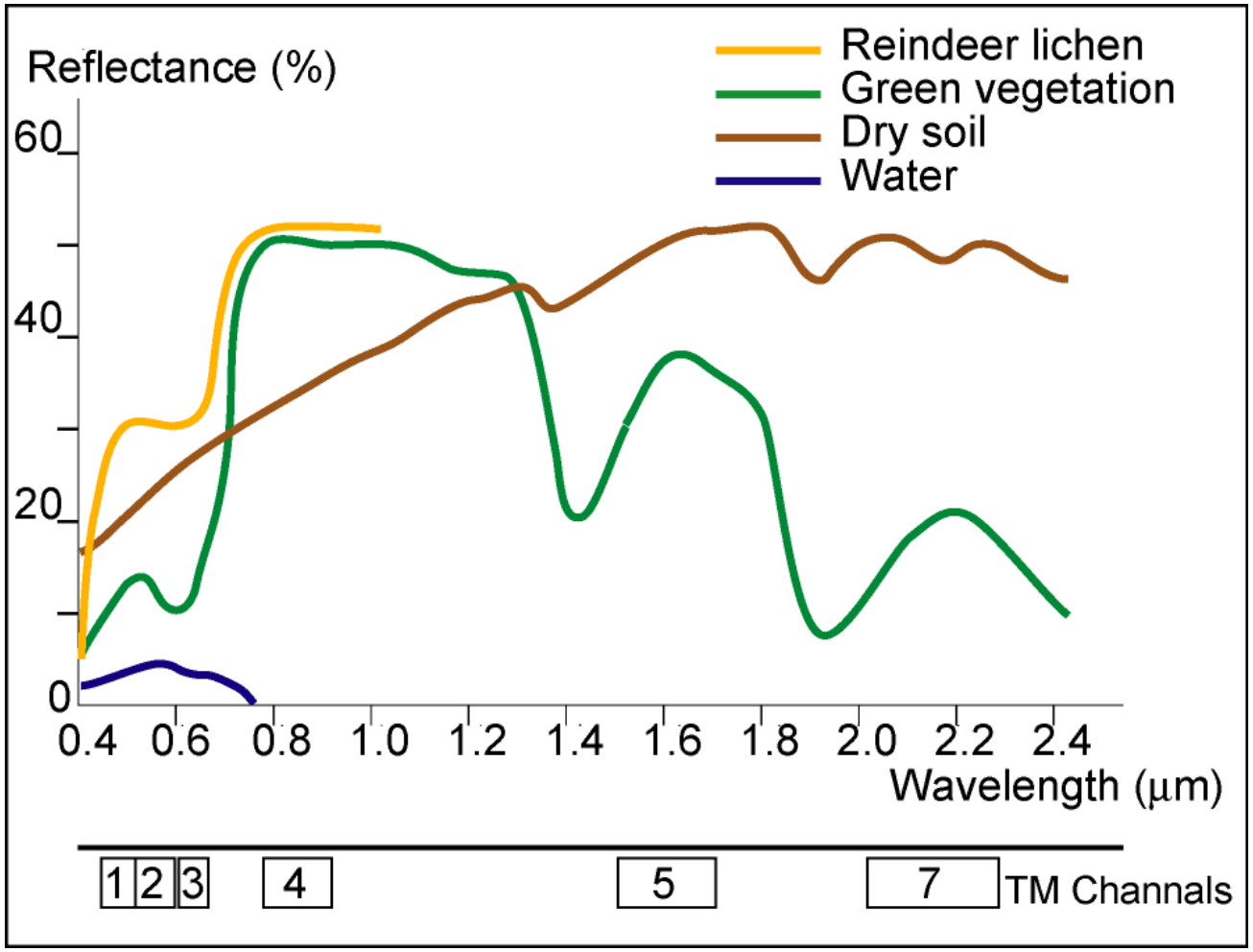
Field investigation performed by Eldar Gaare and Hans Tømmervik, NINA. (BJ-1999).



Remote sensing fundamentals

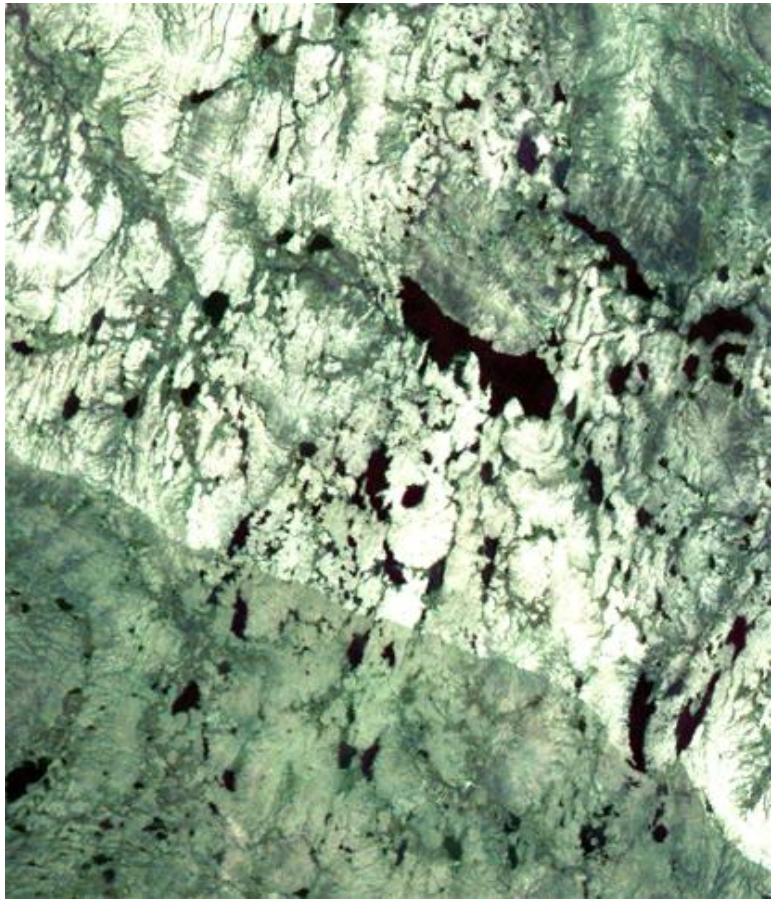


Vegetation classes – spectral characteristics

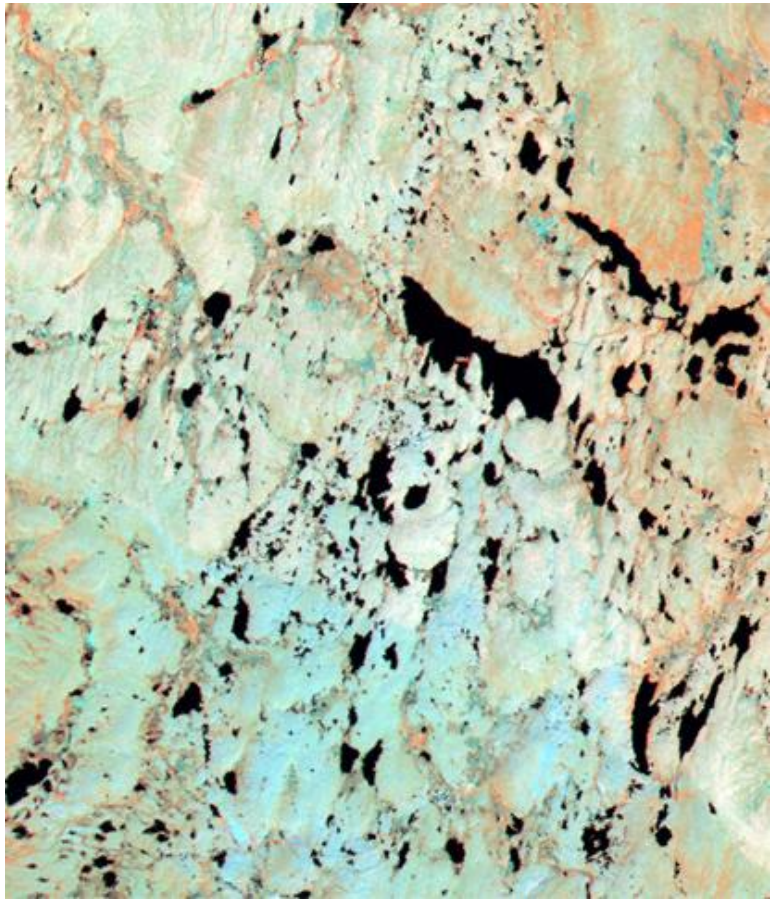


Border areas – Norway-Finland

Border areas - spectral differences



Landsat TM 1987, ch 321



Landsat TM 1987, ch 457

Available data layers

Satellite data – time series:

•Landsat MSS data: 1973 and 1980

•Landsat 5/7 - TM/ETM+ data: 1987, 1996, 2000, 2006, 2009

•Landsat 8 OLI (Operational Land Imager): 2013

Ancillary data sources:

•Digital elevation models

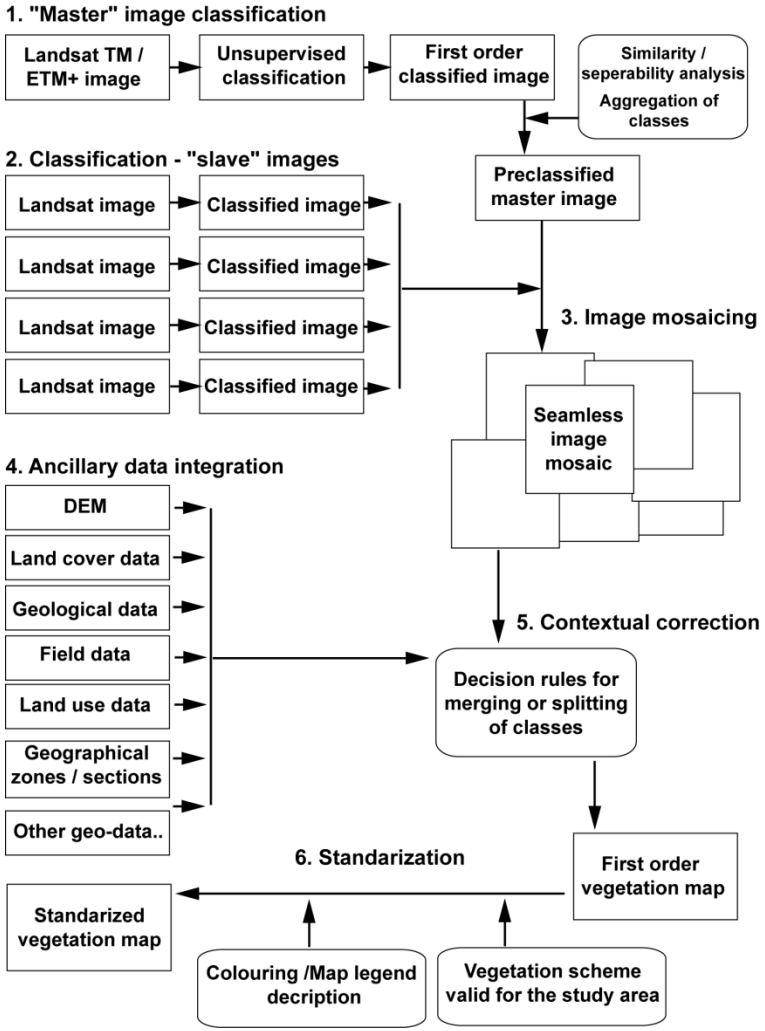
•Digital topographic maps; containing separate cover layers of forests, mires, agricultural areas, water, and open areas

Field recordings:

•In-situ recordings from 52 (6 plots on each site) field sites on Finnmarksvidda (1998). 12 new sites in 2013.

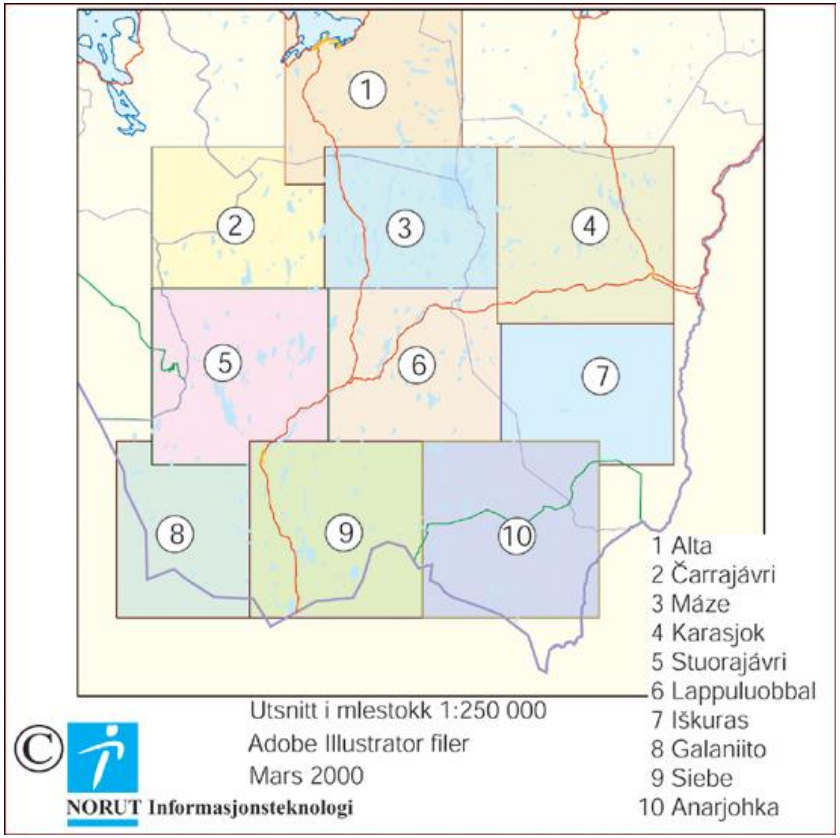
•Field data from the years 2005, 2010, 2013

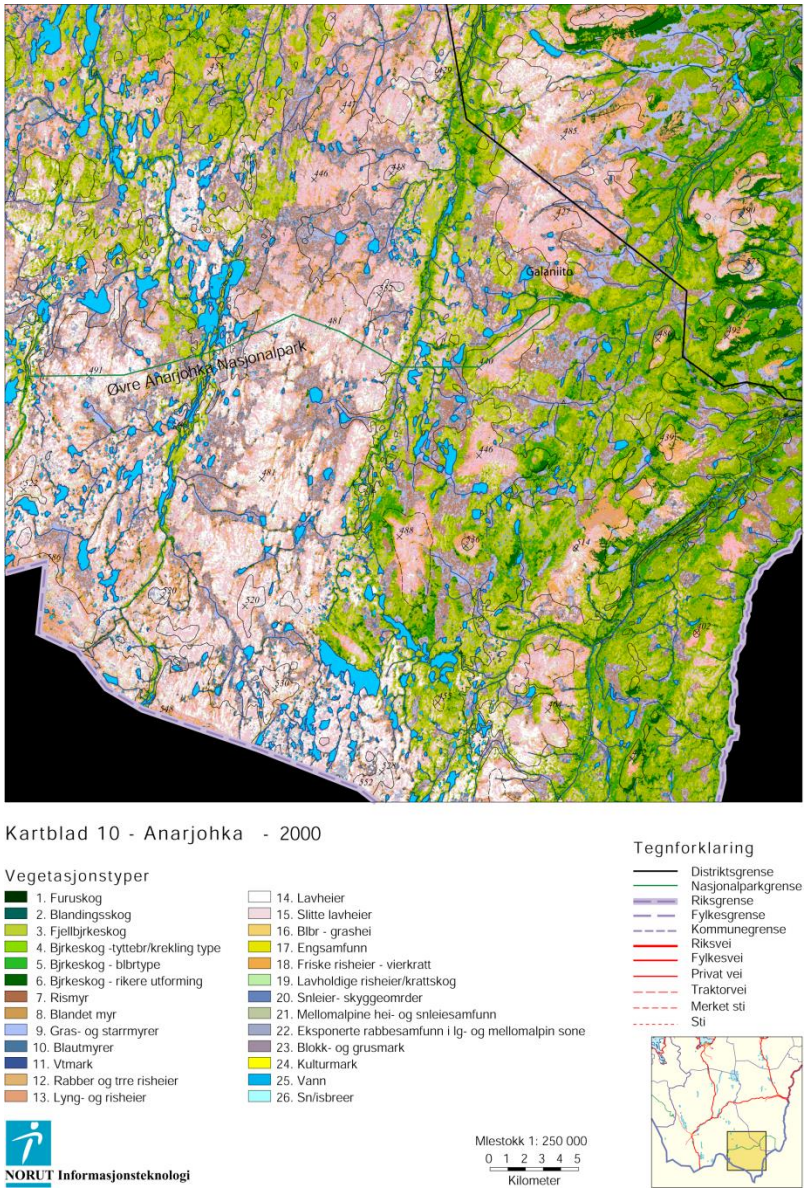
Classification processing scheme



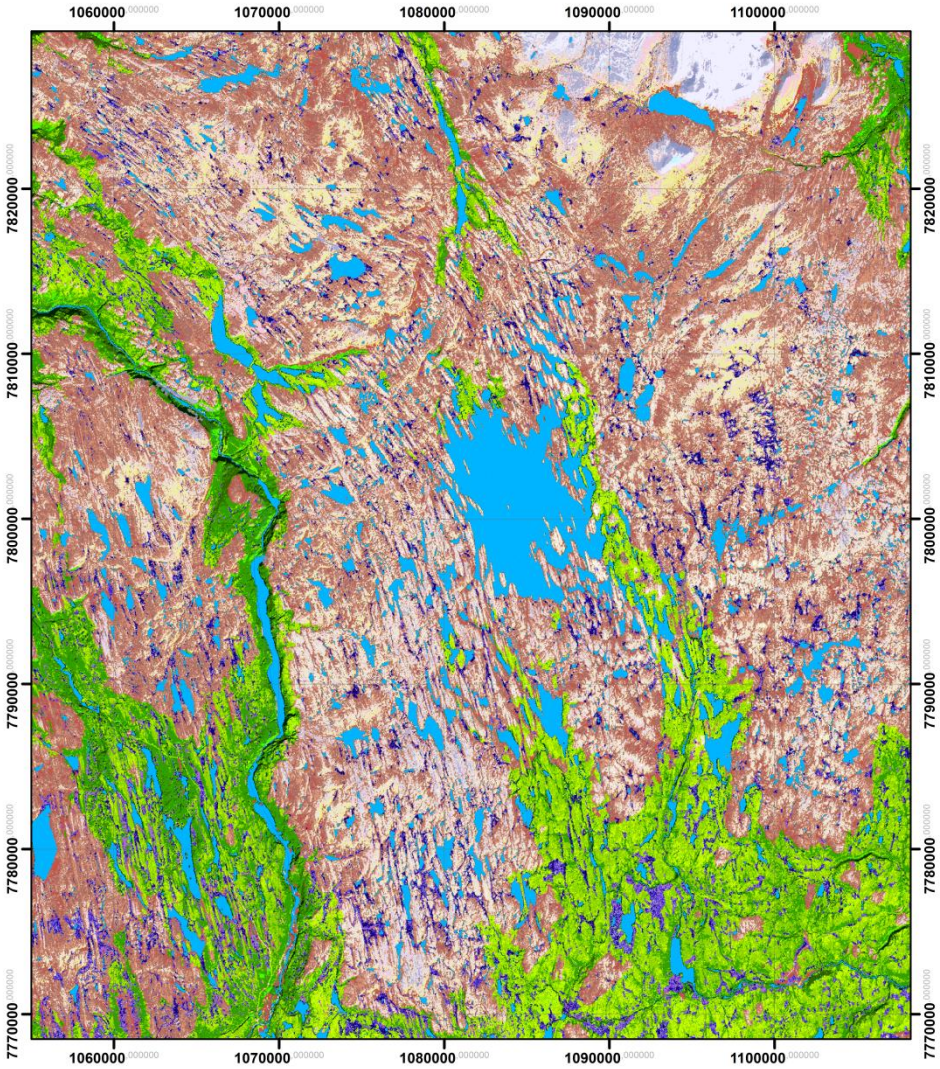
- Pre-classification: Image classification, spectral analysis, separability analysis, description of spectral classes
- Post-classification: Integration of ancillary data (DEM, land cover data, field inventory data)
- Standardization. Relate the map units to a classification system valid for the area

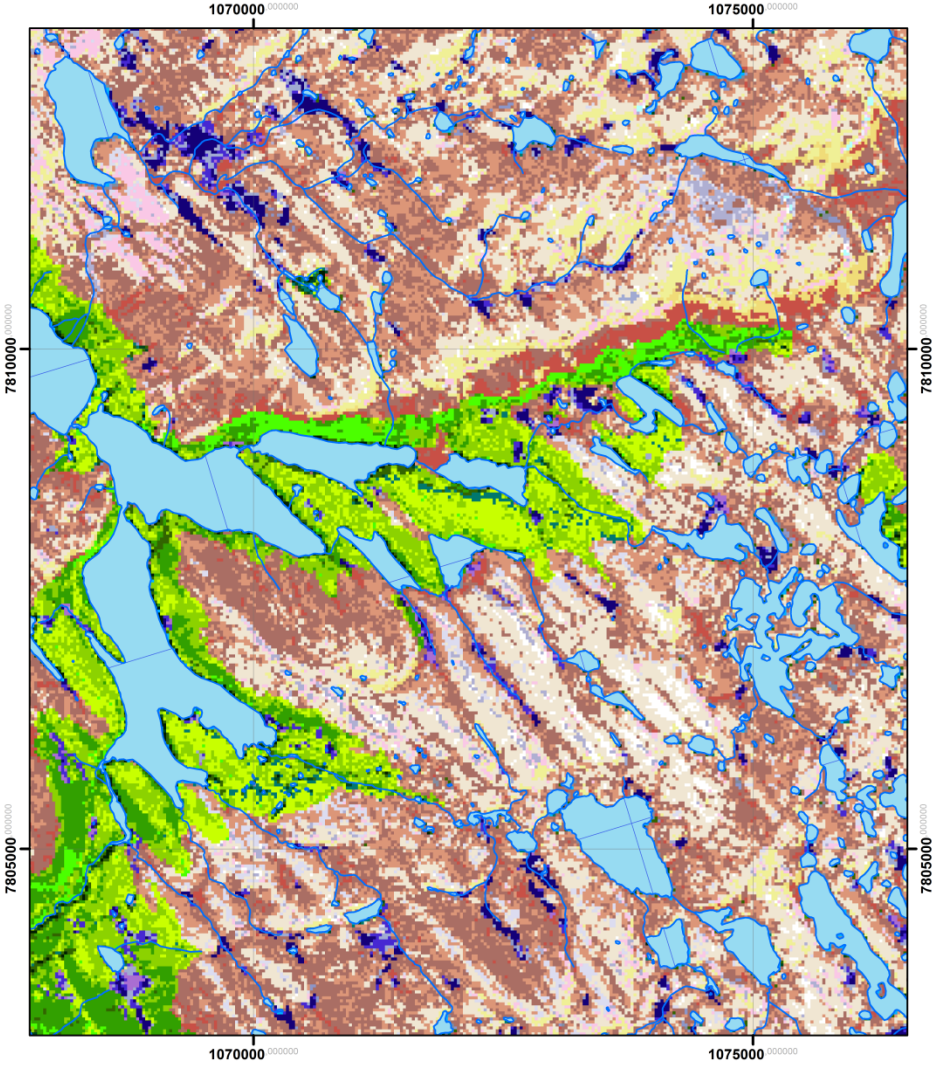
Finnmarksvidda – vegetation maps





Joatka area - vegetation map (2000)





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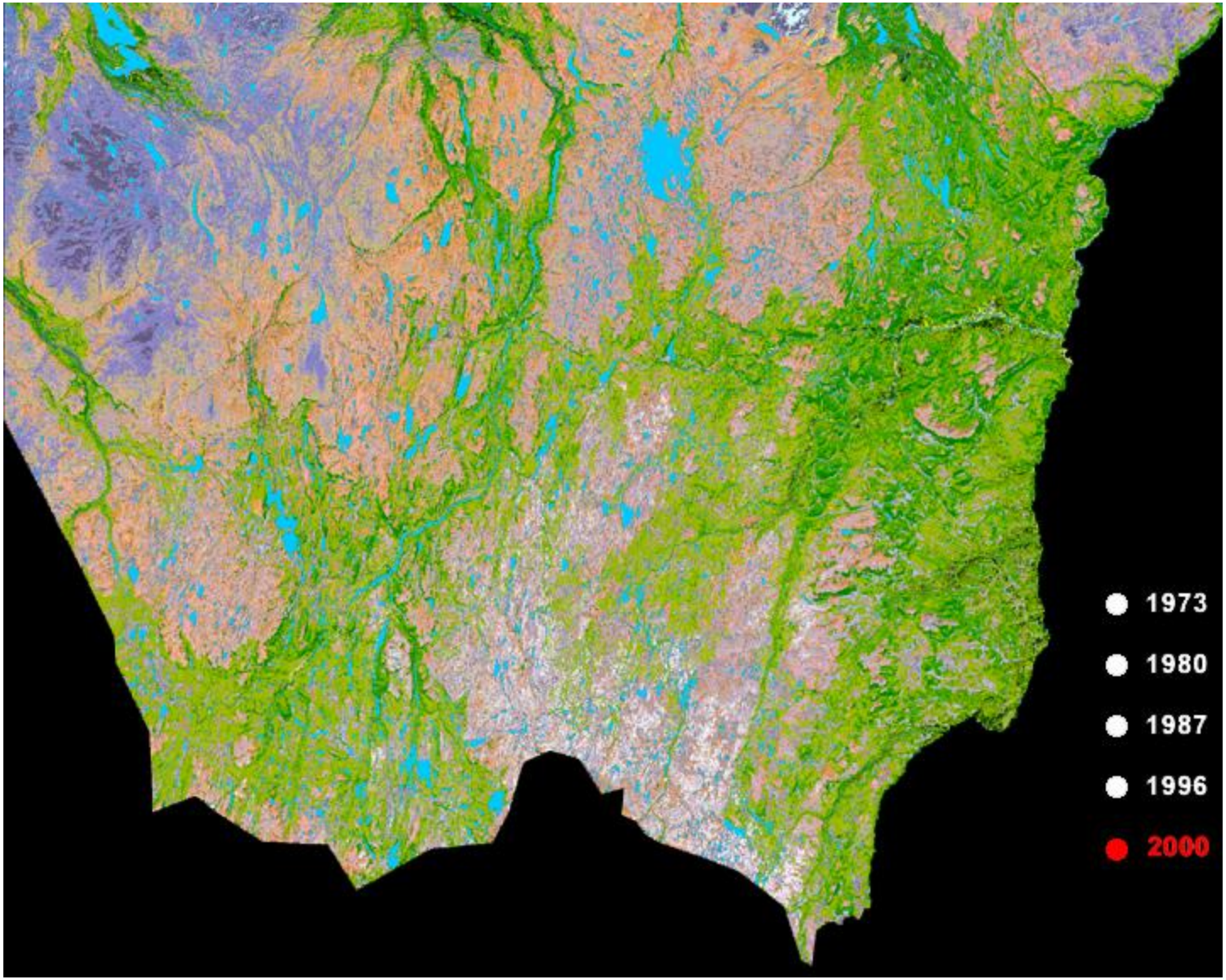

1973
1980
1987
1996
2000

Changes in lichen cover

- percent of the total area

	1973	1980	1987	1996	2000	Total km2
D17 (s/f)	15,0	15,0	5,7	0,1	0,1	2589,3
D30 (s/f)	30,3	20,1	6,1	0,4	0,2	5331,2
D41 (s/f)	27,1	15,2	4,6	0,0	0,0	399,7
D18 (w)	15,9	14,9	6,9	1,5	0,8	2717,6
D31 (w)	37,7	36,6	25,2	11,9	6,9	5463,9

Paper - Phytocoenologia

Phytocoenologia	35 (4)	969–984	Berlin–Stuttgart, December 13, 2005

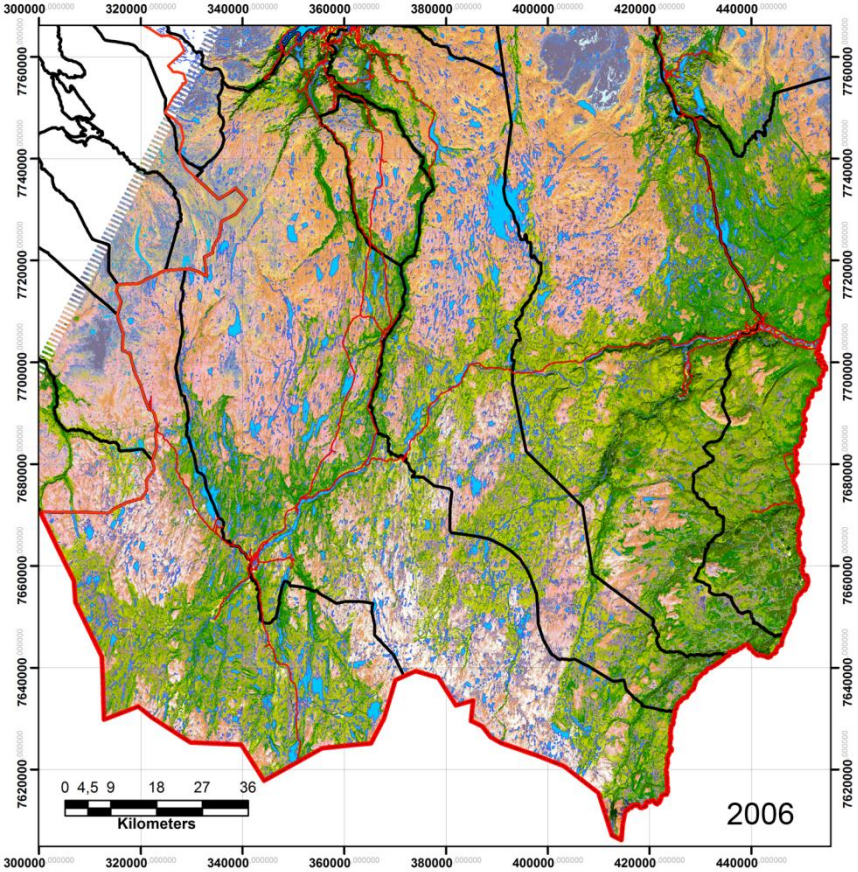
Monitoring vegetation changes on Finnmarksvidda, Northern Norway, using Landsat MSS and Landsat TM/ETM+ satellite images

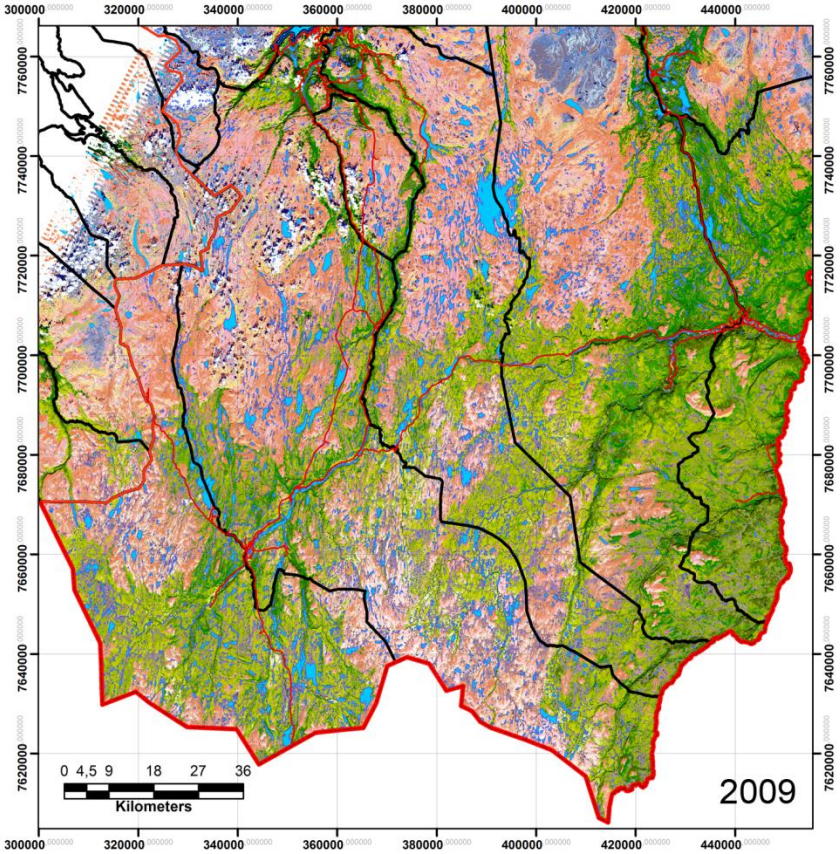
by Bernt JOHANSEN and Stein Rune KARLSEN, Tromsø, Norway

with 9 figures and 1 table

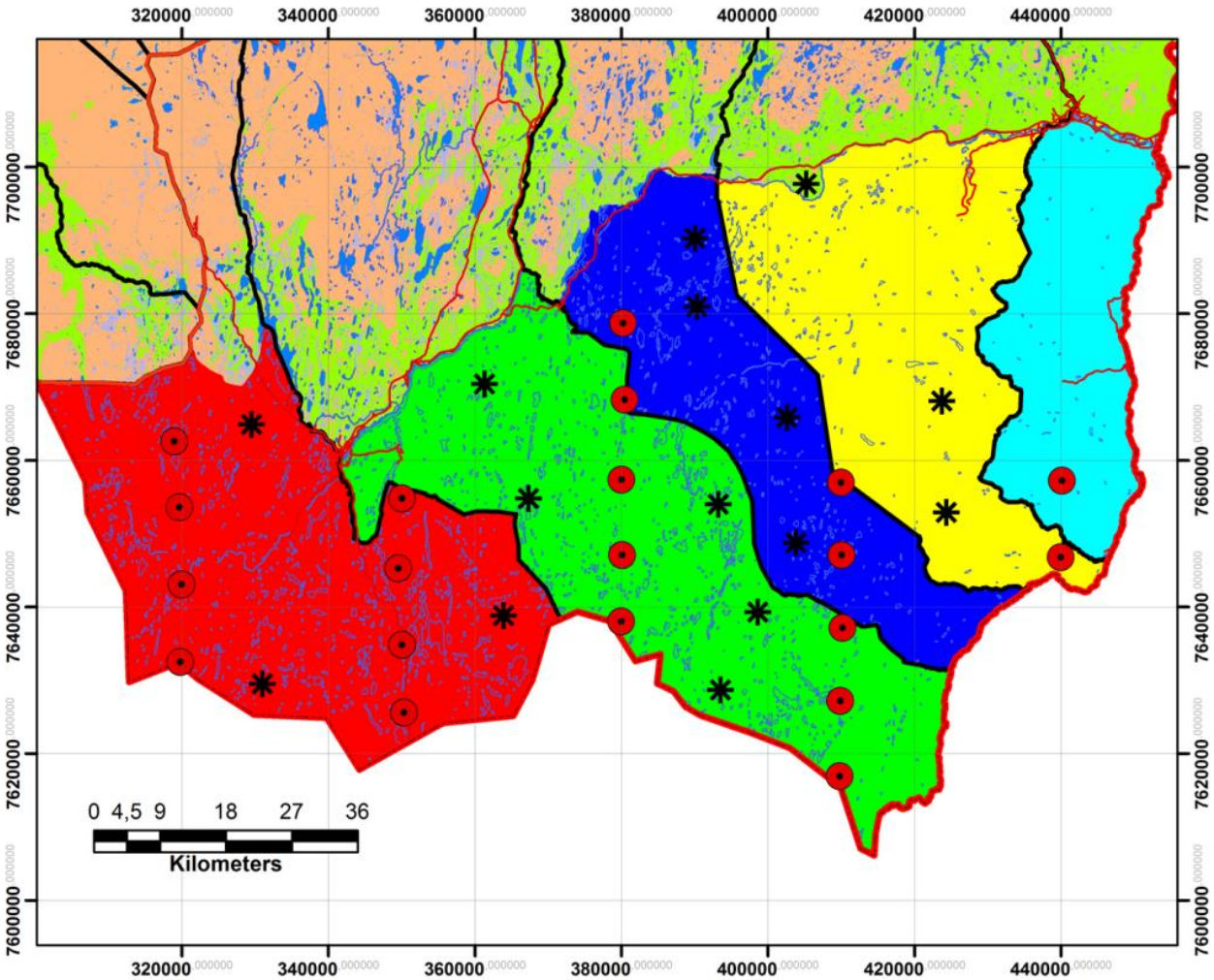
Abstract. During the 1980s the reindeer population in Finnmark expanded from about 100,000 animals to more than 200,000. The result was a considerable decline in lichen cover, a significant decrease in reindeer body-weights, increased mortality rates, especially during winters, and low calving capacity for several siidas/districts. The decline in lichen cover on Finnmarksvidda was monitored using Landsat MSS images from 1973 and 1980 and Landsat TM/ETM+ data for the years 1987, 1996 and 2000. The decline in lichen

Finnmarksvidda - map product – 2006/2009

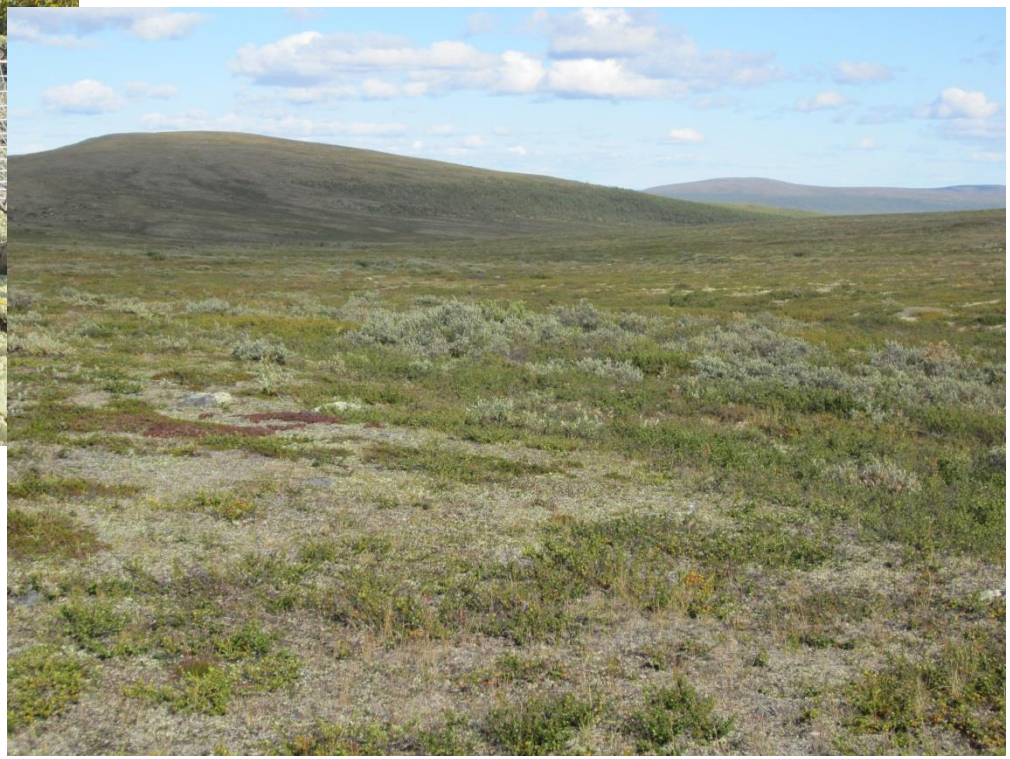




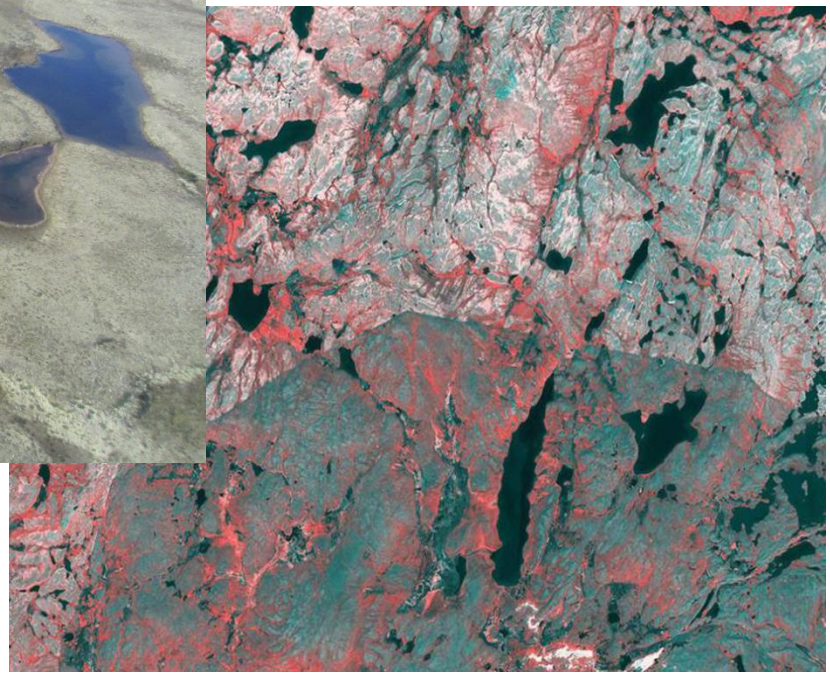
New recordings – winter ranges 2013



Field recordings 2013



Border areas Norway/Finland 2013



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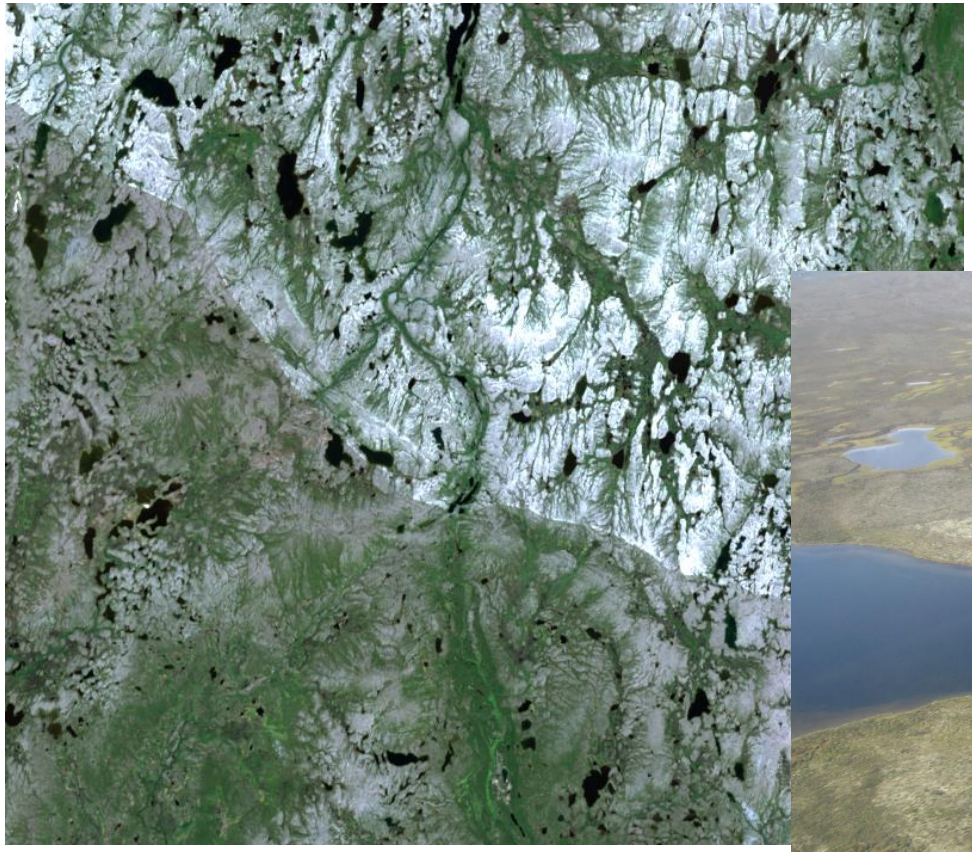
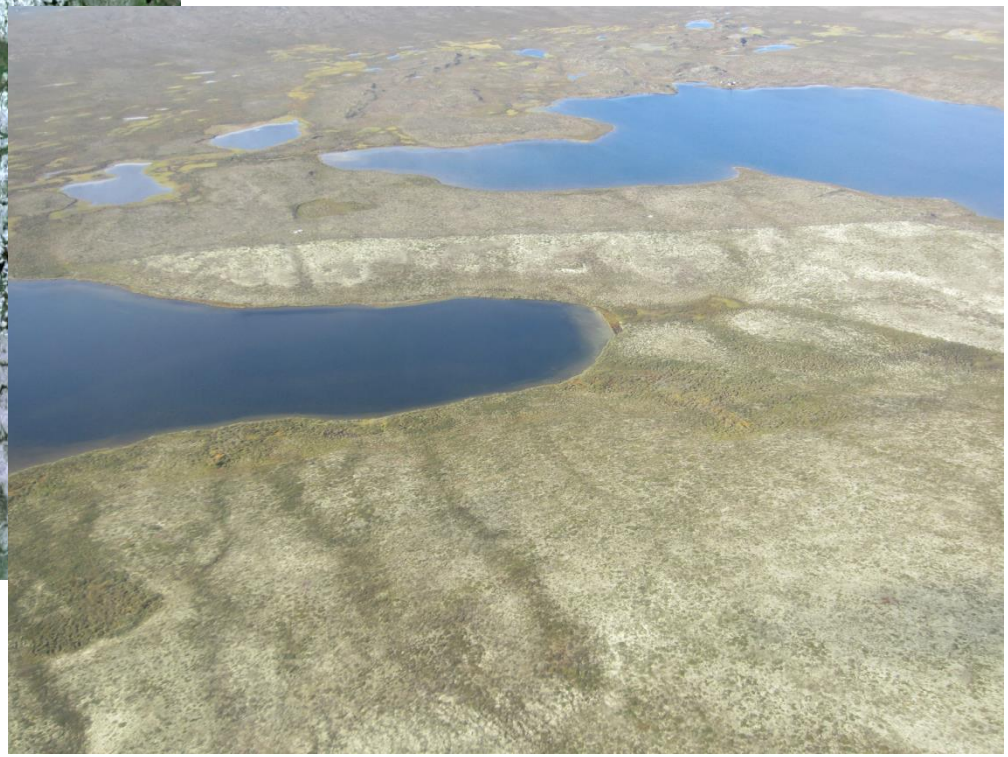
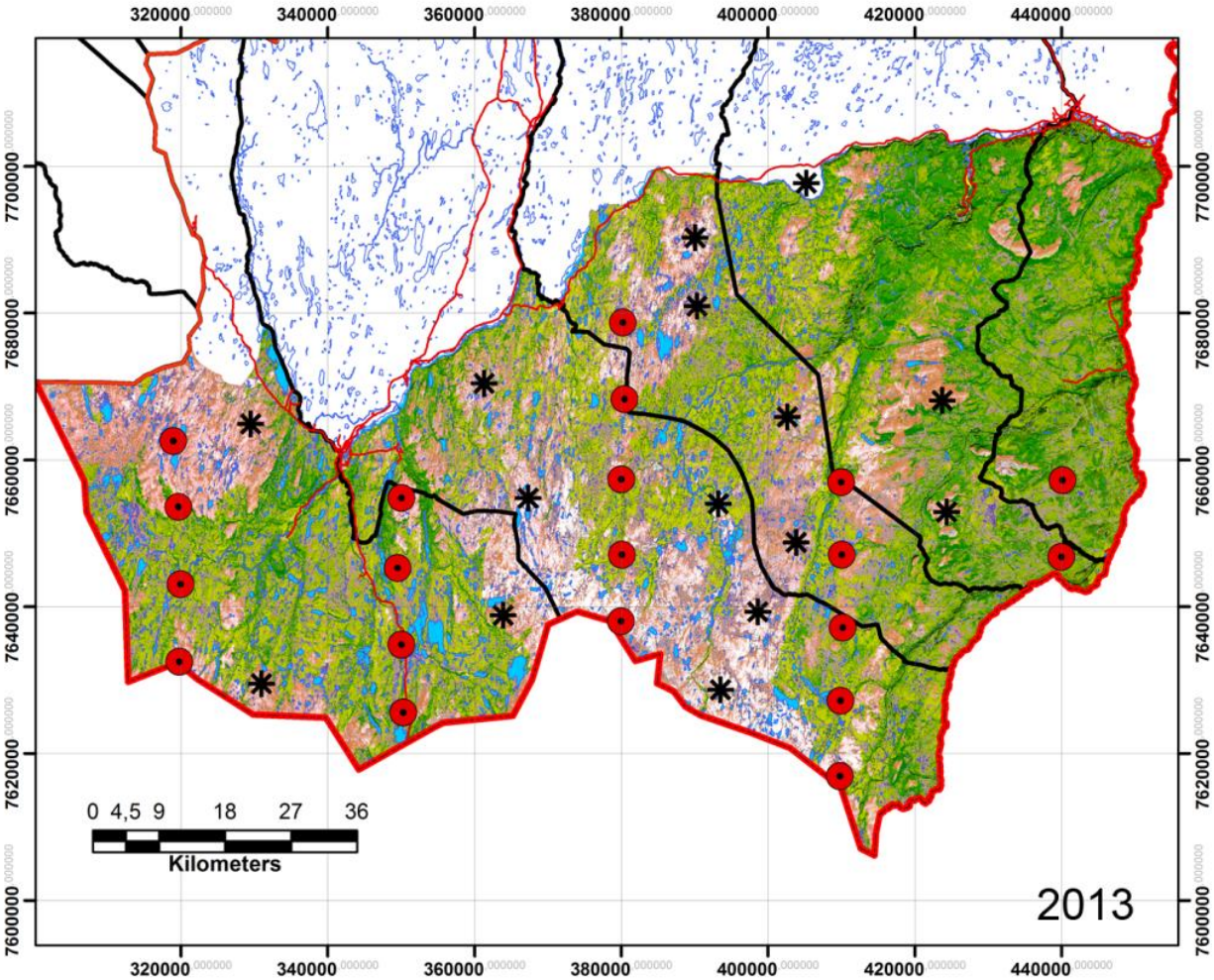




Most recent recordings - 2013



Changes on vegetation types

Nr	Vegetasjonstyper	1987	1996	2000	2006	2009	2013
0	Unclassified	0,0	0,0	0,0	0,1	0,6	0,0
1	Pine and mixed forests	2,0	2,0	1,8	8,4	8,9	4,2
2	Decideous forest	27,8	32,9	36,9	31,5	28,3	36,4
3	Mountain birch forest	15,0	13,9	10,2	13,1	15,0	12,6
4	Bogs and mires	7,4	9,7	7,8	5,1	4,1	7,8
5	Grass and sedge mires	9,6	7,1	9,4	11,7	13,1	10,1
6	Heather, dwarf shrubs	13,2	11,0	10,2	11,4	11,7	14,1
7	Lichen heaths	19,0	8,4	5,6	6,7	6,1	4,0
8	Depleten lichen heaths	0,9	10,0	12,3	7,3	8,0	5,7
9	Meadows, agriculture	0,0	0,1	0,2	0,4	0,5	0,2
10	Ridges, boulder fields	0,6	0,5	1,1	0,3	0,1	0,6
11	Snow-bed vegetation	0,6	0,5	0,6	0,4	0,1	0,3
12	Water	3,9	3,8	3,8	3,5	3,6	3,9
		100,0	100,0	100,0	100,0	100,0	100,0

Conclusions

- In the project the occurrence and distribution of lichen vegetation on Finnmarksvidda has been be expressed through vegetation maps and area statistics
- Lichen amounts has been recorded for the period 1998 – 2013 through detailed measurements (The monitoring program of Finnmarksvidda)
- By comparing the maps (satellite based) and the field data a dramatic decrease in the lichen cover can be described for a period of 40 years
- Further the speed and trends in the lichen decrease process can be described
- The reindeer management authorities has found the results highly valuable
- The results are today incorporated in the management of the reindeer range on Finnmarksvidda