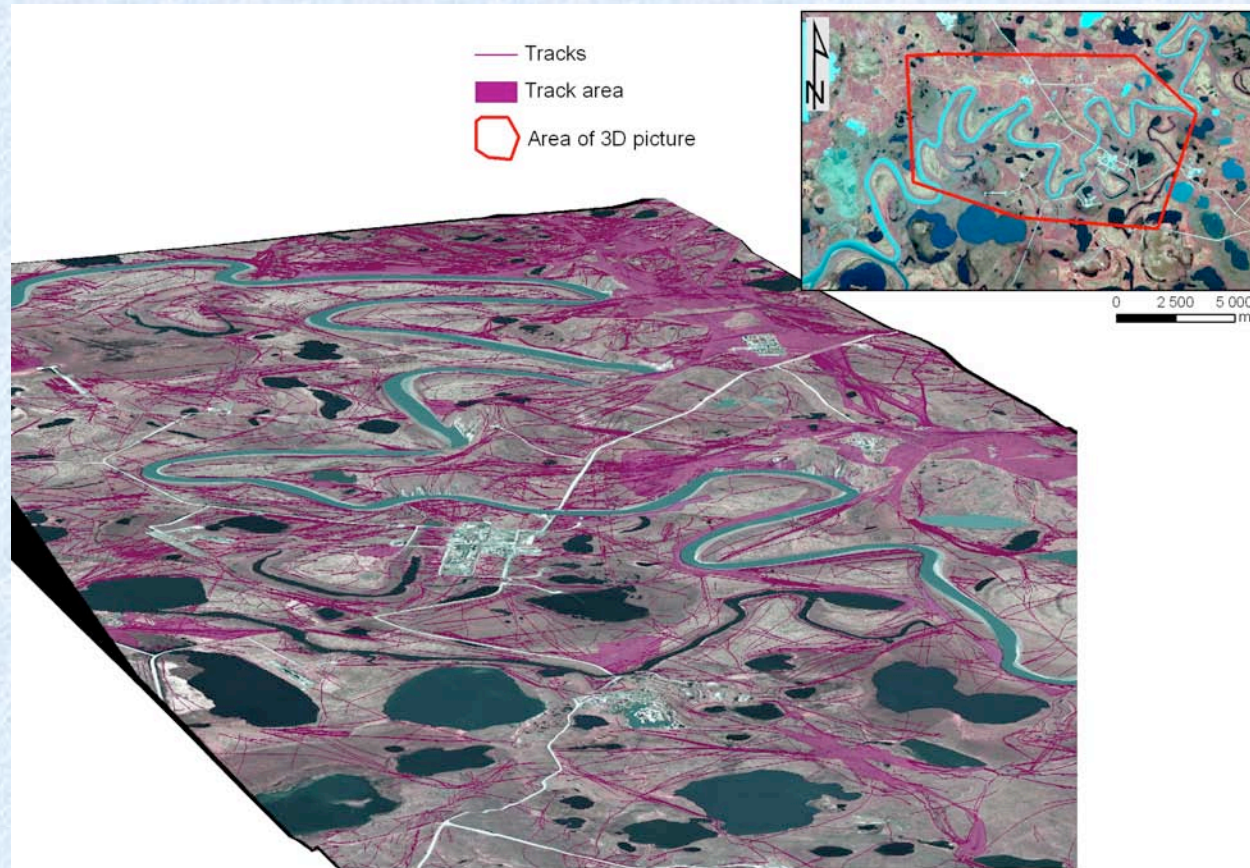


Land-use and land-cover changes in Yamal peninsula



**Workshop:
2 nd Yamal Land-Cover Land-Use Change Workshop
Rovaniemi, 8-11 March 2010**

Timo Kumpula* & Bruce C. Forbes & Florian Stammer****

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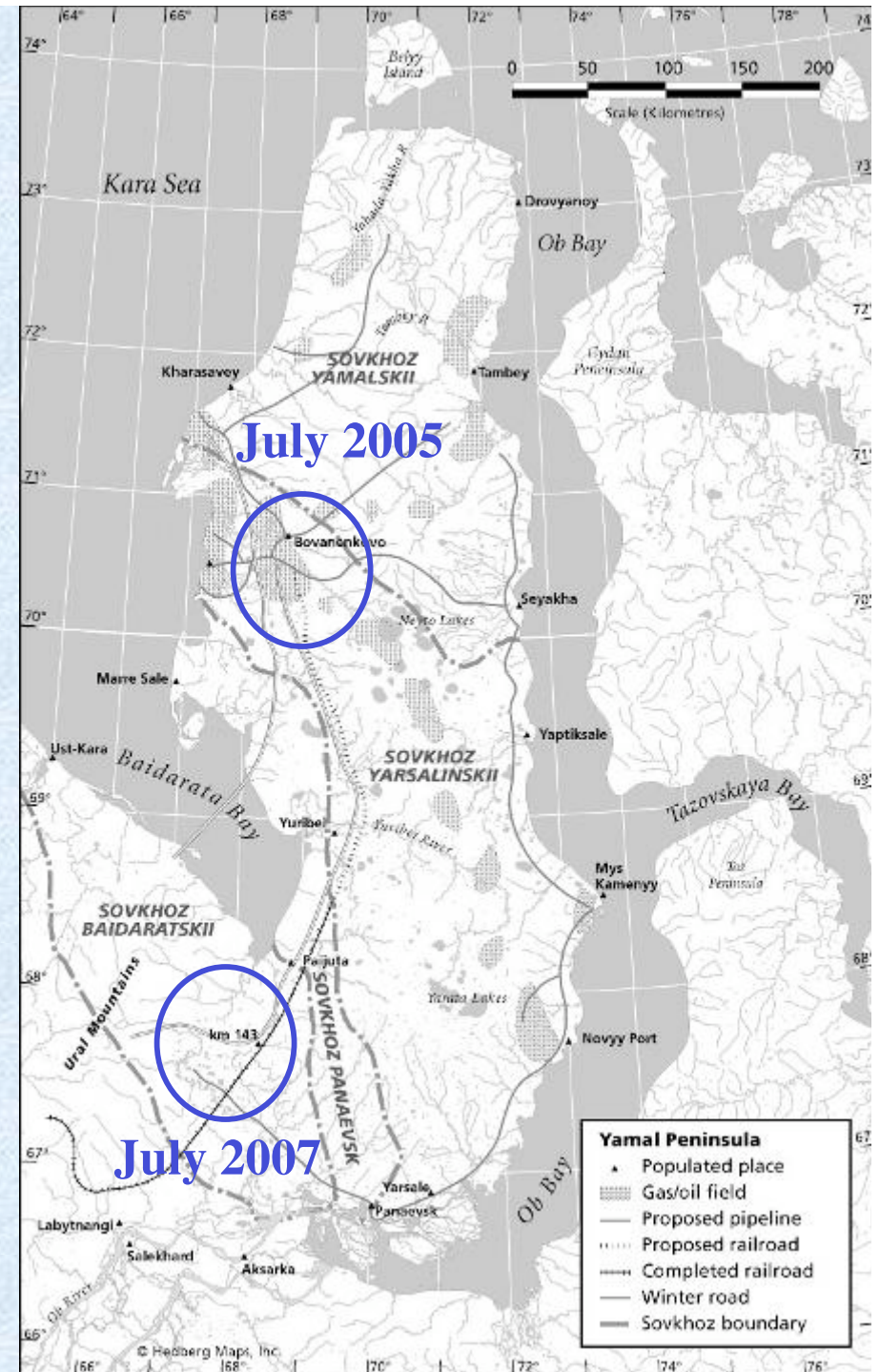
Bruce Forbes, Arctic centre Rovaniemi
Florian Stammler, Arctic centre Rovaniemi
Timo Kumpula, University of Eastern Finland
Nina Meschtyb, Moscow University
Anu Pajunen Arctic centre
Elina Kaarlejärvi, Arctic centre

ENvironmental and Social Impacts of Industrialization in Northern Russia (ENSINOR)

- Case study approach
 - Changes in social-ecological systems, including herding
 - Local and scientific knowledge (geography, anthropology, botany)
- Finnish Academy
project 2004-2007**



Research areas



GIS database collection

Interpretation of impacts:

- Landsat TM ETM, SPOT, ASTER, Quickbird-2
- Road network
- Pipeline network
- Off road vehicle track network
- Infrastructure
- Quarries



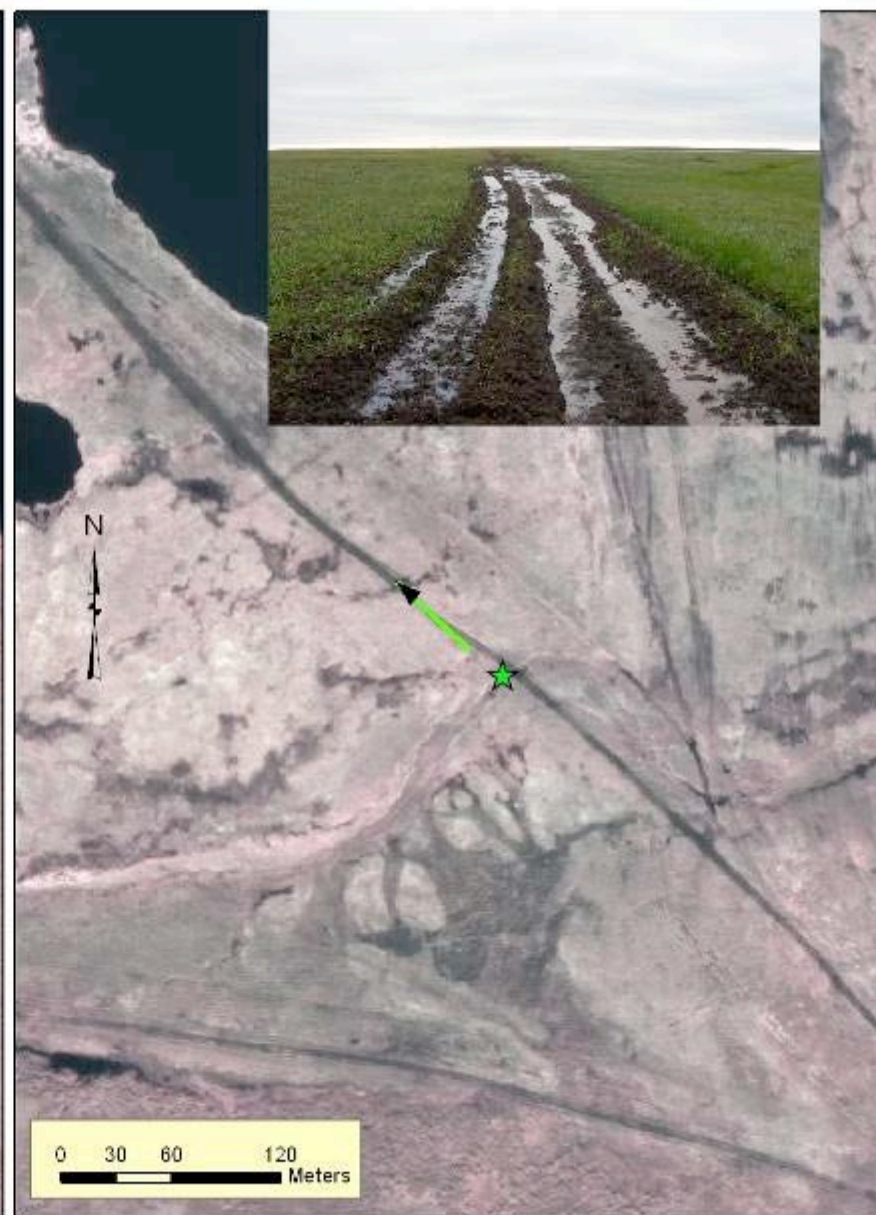
Table 2. Capacity to detect different impacts of hydrocarbon exploration in Bovanenkovo. *Data on soil contamination are from Varandei oil field in

Impact	Socio-cultural survey	Ground truthing	Quickbird-2 Panchromatic	Quickbird-2 Multispectral	ASTER TERRA VNIR	Spot Panch.	Spot Multispec.	Landsat ETM7	Landsat TM
Small scale < 0,09 ha									
Soil contamination*	XX	XX	-	-	-	-	-	-	-
Removal of top soil and vegetation	XXX	XXX	XXX	XX	X	X	X	-	-
Industrial waste:									
- metal	XX	XX	X	-	-	-	-	-	-
- glass	XX	X	-	-	-	-	-	-	-
- concrete	XXX	XXX	XX	X	-	-	-	-	-
- wood	XXX	XXX	X	-	-	-	-	-	-
Single off-road vehicle track	XX	XX	XXX	XX	X	X	X	-	-
Vegetation changes:									
- shrubs to graminoids	X	XX	X	XX	X	-	-	-	-
- peatland to graminoids	X	XXX	X	XX	X	-	-	-	-
- revegetated barren ground	X	XXX	X	XX	X	-	-	-	-
Pipelines	XXX	XXX	XXX	XX	X	-	-	-	-
Powerlines	XXX	XXX	XX	X	-	-	-	-	-
Drilling towers	XXX	XXX	XXX	XX	X	X	-	-	-
Trucks/Vehicles	XXX	XXX	XX	X	-	-	-	-	-
Medium scale > 0.1 ha - < 1 ha									
Roads	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XX	XX
Multiple off-road tracks	XX	XX	XXX	XX	XX	XX	XX	X	X
Concrete paved yards and roads	XXX	XXX	XXX	XX	XX	XX	XX	X	X
Vegetation changes:									
- shrubs to graminoids	XX	XX	X	XX	X	-	X	X	X
- peatland to graminoids	XX	XXX	X	XX	X	-	X	X	X
- revegetated barren ground	XX	XXX	X	XX	X	-	X	X	X
Barren ground on industrial sites	XXX	XXX	XXX	XXX	XX	XX	XX	X	X
Revegetated areas	X	XX	X	XX	X	X	X	X	X
Barracks & built up areas	XXX	XXX	XXX	XX	XX	XX	XX	X	X
Winter roads	XXX	XX	XXX	XXX	XX	XX	X	X	X
Large scale > 1 ha									
Removal of top soil and vegetation	XXX	XXX	XXX	XXX	XX	XX	XX	XX	XX
Vegetation changes:									
- shrubs to graminoids	XXX	XXX	X	XXX	XX	XX	XX	XX	XX
- peatland to graminoids	XXX	XXX	X	XX	XX	XX	XX	XX	XX
- revegetated barren ground	XXX	XXX	X	XXX	XX	XX	XX	XX	XX
Production and worker settlements	XXX	XXX	XXX	XXX	XX	XX	XX	X	X
Quarries	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XX	XX
Impoundment water bodies	XXX	XX	XXX	XXX	XXX	XXX	XXX	XX	XX

Kumpula, et al (2010). (In press to Arctic)

Table 3. Capacity to detect phenomena associated with Nenets reindeer herding. Rankings include – not visible, x visible with effort, xx

Phenomenon	Socio-cultural survey	Ground truthing	Quickbird-2 Panchromatic	Quickbird-2 Multispectral	SPOT-5-ASTER-LANDSAT-5
Small scale ≤ 2 sqm					
Reindeer	xxx	xxx	–	–	–
Nenets sledge	xxx	xxx	x	x	–
Meso scale > 2 sqm $\rightarrow > 15$ sqm					
Nenets tent (chum)	xxx	xxx	x	x	–
Migration routes & trails close to camps	xxx	x	x	x	–
Local scale > 15 sqm $\rightarrow > 0,09$ ha					
Nenets camp (group of tents and sledges)	xxx	xxx	xx	x	–
Sacred sites, graveyards	xx	x	–	–	–
1 year or less old camp site	xxx	xx	–	–	–
Older Nenets campsite	xx	x	x	x	–
Reindeer herd > 100 animals clustered	xxx	xxx	xx	x	–



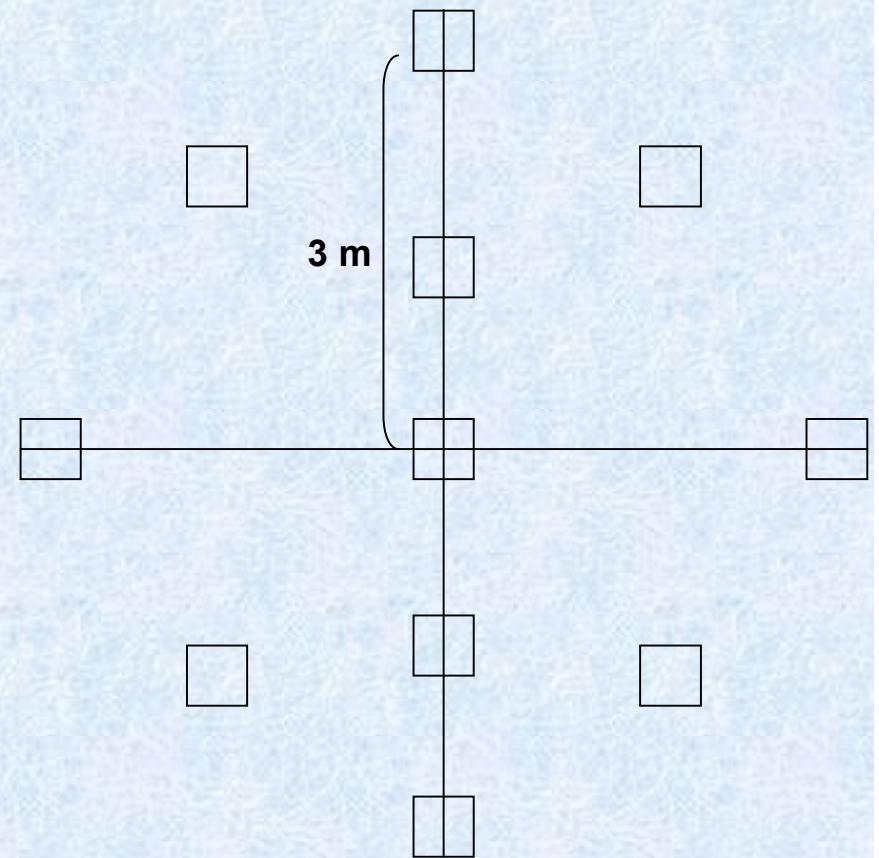


Satellite data:
Quickbird-2 image 28.7.2004
(2.4 m and 0.64 m resolution
image combination)
Copyright: Digital Globe & Eurimage

0 0.125 0.25
Km

-Spectrometer measurements

- ASD field spectrometer 350- 10745 nm
- Measured reflectance:
 - main vegetation types
 - main bare ground types
 - main species

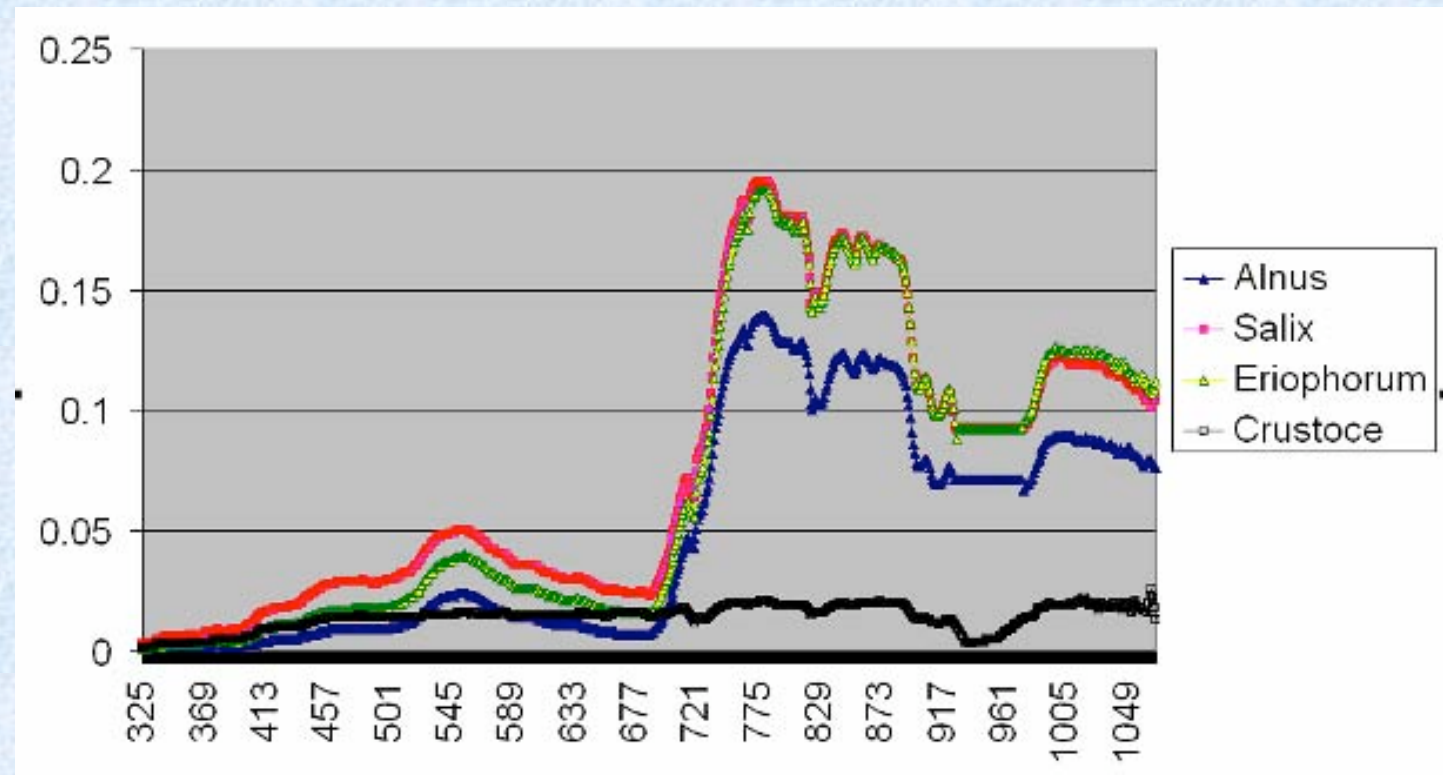


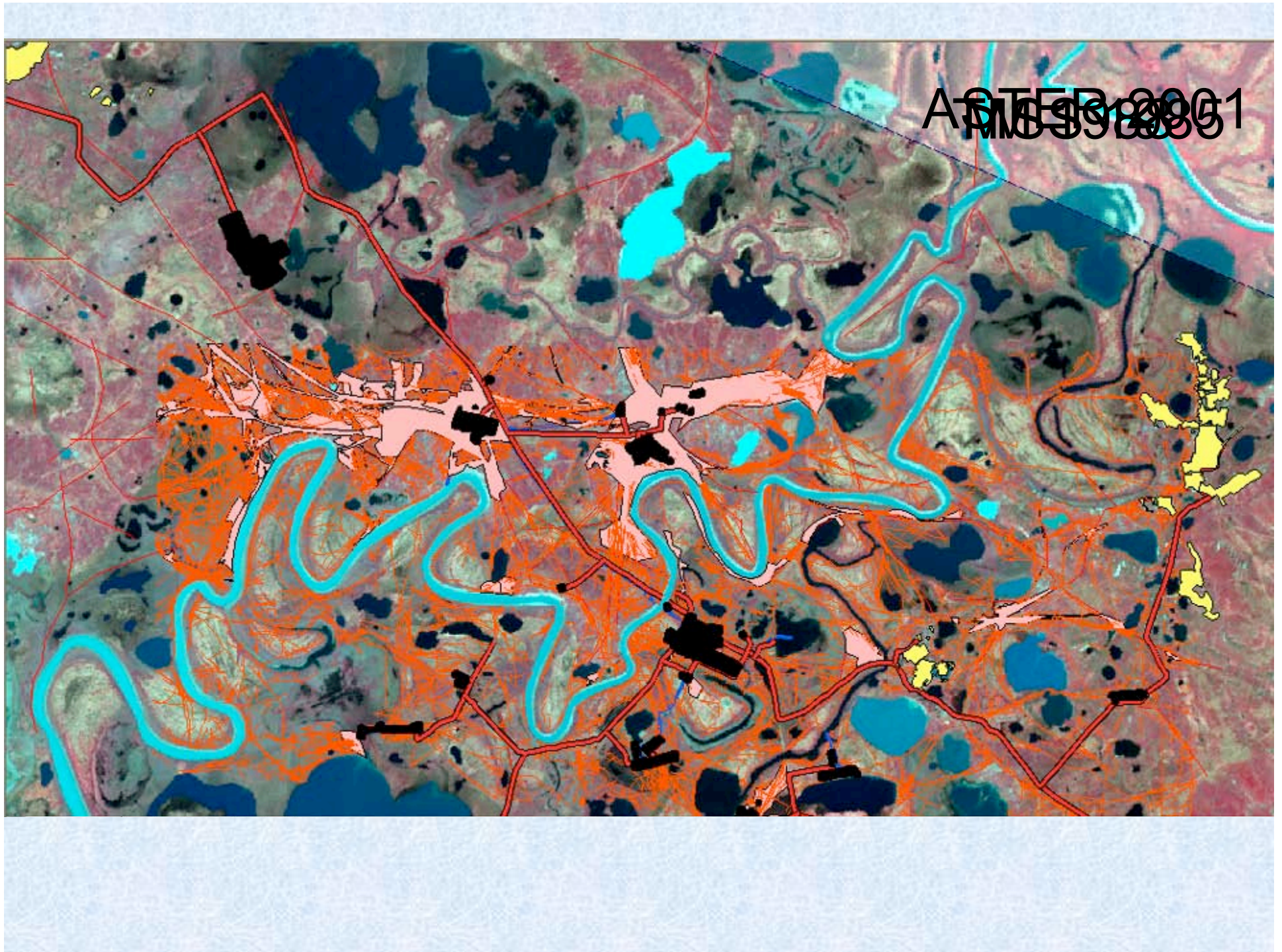
Species measurements: dry and wet

- *Alnus*
- *Dryas*
- *Empetrum*
- *Equisetum*
- *Salix lanata*
- *Salix polaris*
- *Vaccinium arctosptaphylys*
- *Vaccinium vitis/idea*
- *Vaccinium uliginosum*
- *Betula nana*
- *Festuca*
- *Polytrichum*
- *Aulacomnium*
- *Sphagnum*
- *Dicranum*
- *Racomitrium*
- Crustacea lichens

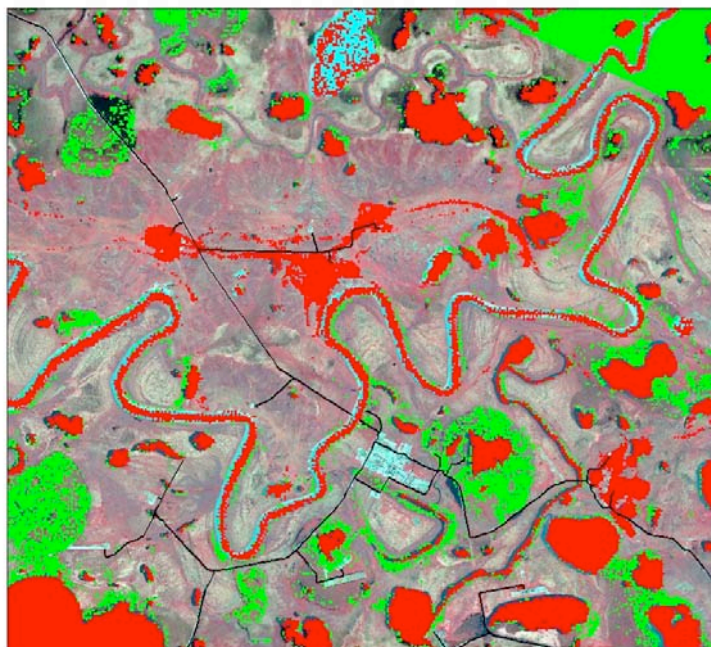
+

- Sand
- Gravel
- Bare soil
- Quarry





Legend
 — Main_road
 high_ndvi_84_88.img
 Class_Names
 Background
 Decreased
 Increased
 Some Decrease
 Some Increase
 Unchanged



**1984-1988
 NDVI change**

Legend
 high_ndvi_88_99.img
 Class_Names
 Background
 Decreased
 Increased
 Some Decrease
 Some Increase
 Unchanged
 — Main_road



**1988-1999
 NDVI**

Legend
 high_ndvi_88_99.img
 Class_Names
 Background
 Decreased
 Increased
 Some Decrease
 Some Increase
 Unchanged
 — Main_road



In Bovanenkov gas field:

Visually interpreted affected area covers 448 km²

Premanently changed

Infrastructure 2,1 km²

Quarries 4,3 km²

Road 79 km 2,9 km²

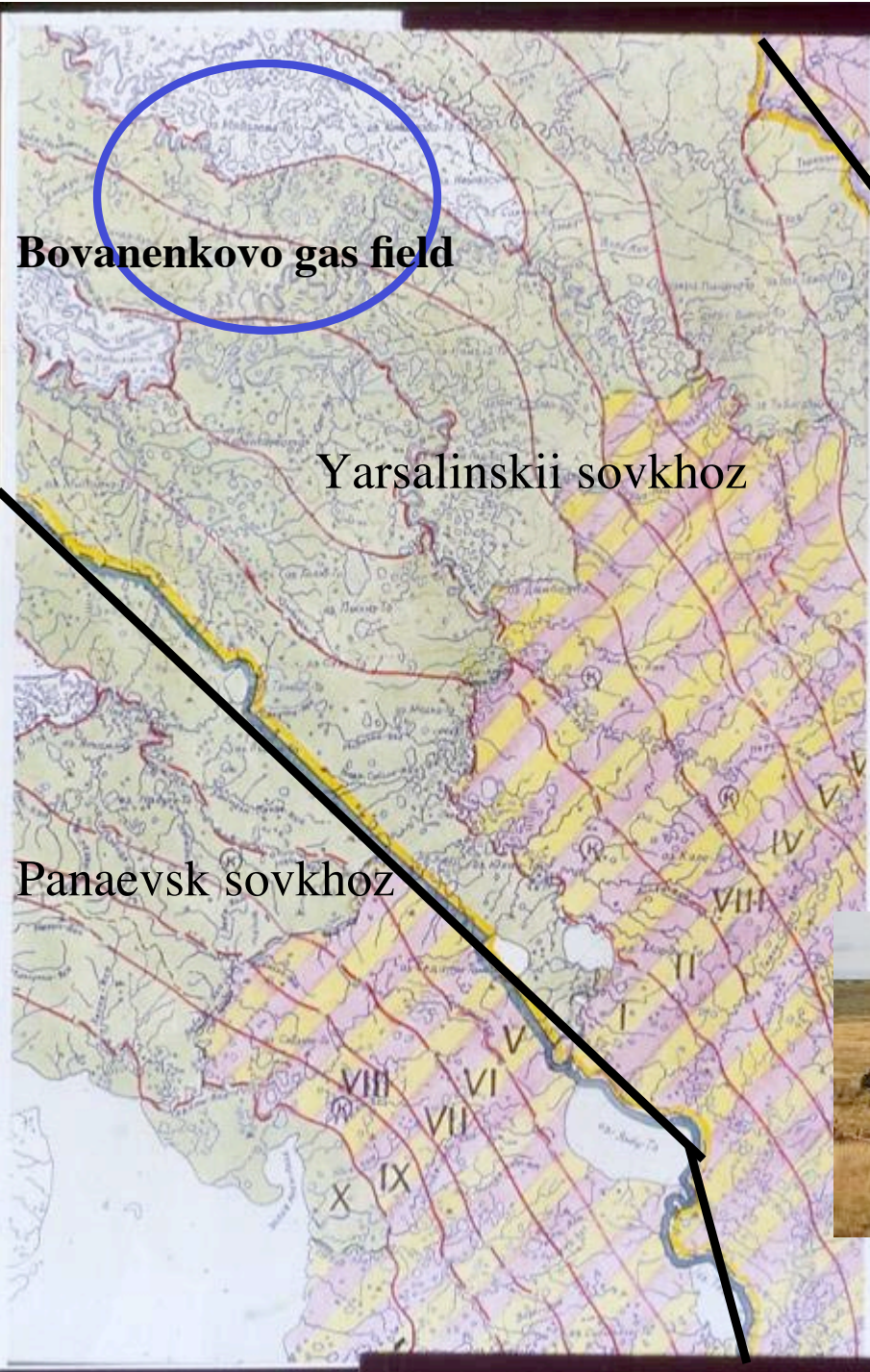
Total 9,3 km²

Changed vegetation (mainly shrubs to graminoids)

Off road tracks: 2500 km (Quickbird-2 & ASTER image)

Covers area of 24 km²

Total change 33 km²



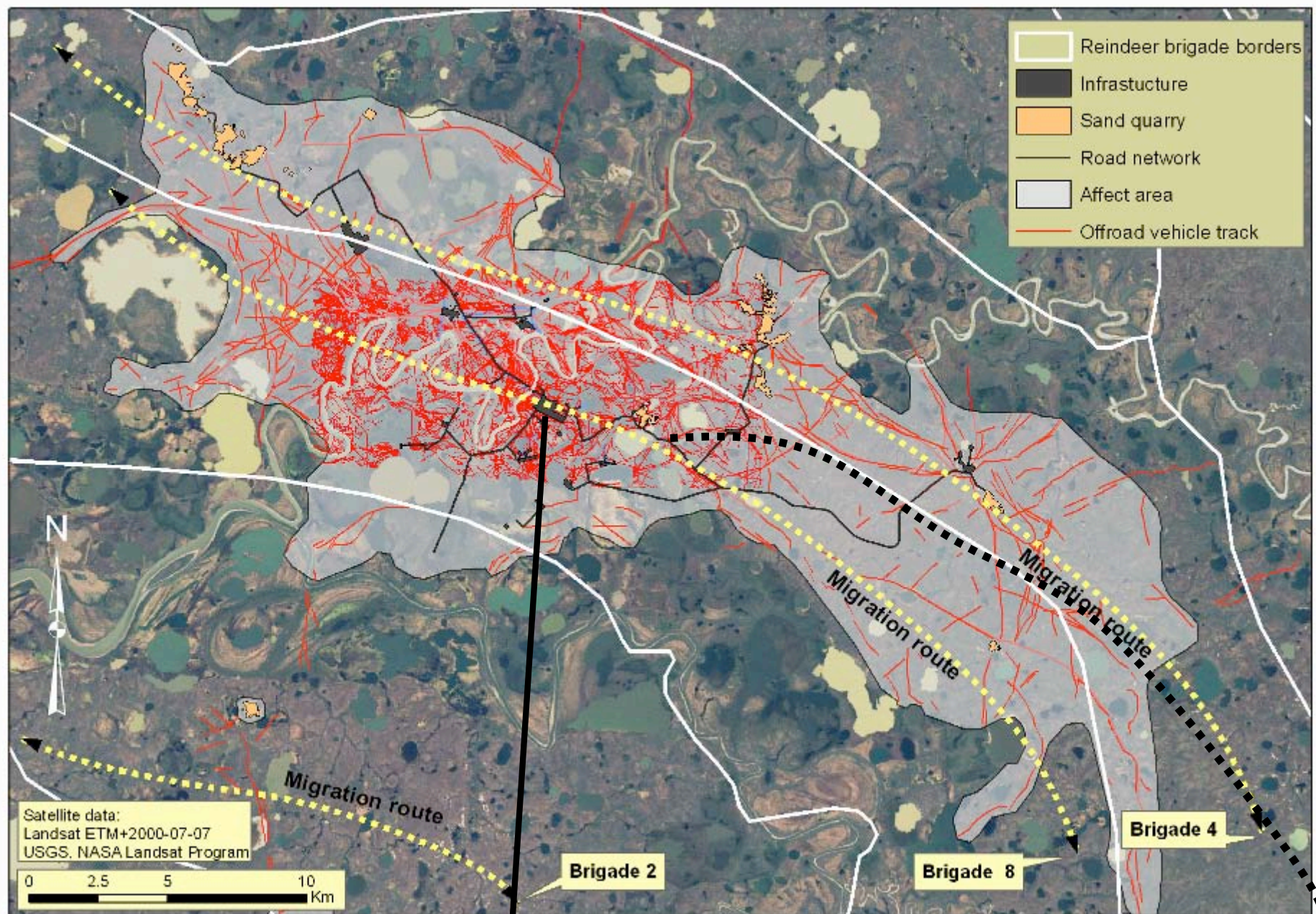
Bovanenkovo gas field

Yarsalinskii sovkhos

Panaevsk sovkhos

Yamalskii sovkhos





Forbes, Stammeler, Kumpula, Meschtyb, Pajunen & Kaarlejärvi (2009).

Impacts of Bovanenkovo gas field to brigades 4 and 8 of Yarsalinski sovhoz:

Brigade 4:

- Summer pasture July-August 1019 km²
- 225 km² in Bovanenko gas field affected area

Brigade 8:

- Summer pasture July-August 796 km²
- 200 km² in Bovanenko gas affected area

Conclusions

- Impacts of drilling sites are quite local, but affects strongly to certain brigades which may cumulate the effects by increasing grazing pressure to neighbouring brigades, sovhozes
- Old and gas drilling sites, offroad vehicle tracks may have increased value in reindeer fodder by increased amount of gramioides.
- Devaluation of pasture land:
 - hoof injuries and infections caused by metal and glass garbage, can be leathal to reindeer so herders avoid such places
- Limited or restricted accessibility to pasture land:
 - Linear constructions cause problems to migration
 - Too low build pipelines, high road banks
 - Restricted accessibility
 - By oil and gas companies
 - Areas between barriers left unused
- → decreased amount of pastureland

Conclusions...

- very high resolution images can detect the impacts of industrial sites, but some factors which are important to quality of pasture are undetectable, like metal and glass garbage
- VHR satellite imagery is a reliable source to monitor the construction and also to supervise that licences and regulations are followed