An approach for mapping micro-mosaic structure of plant cover through integrating field data and high resolution images of the forest –tundra ecotone in the Kola Peninsula

Olga Tutubalina, Natalia Lukina, Tatiana Kravchenko, Elena Belova, Anton Novichikhin, Annika Hofgaard

The approach

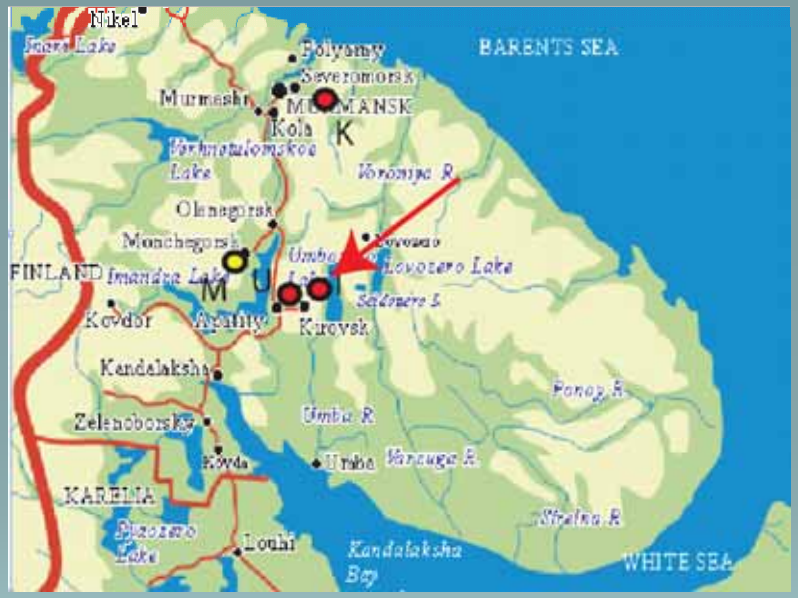
1. Plants strongly influence and to a great extent define the soil nutritional status in natural ecosystems:

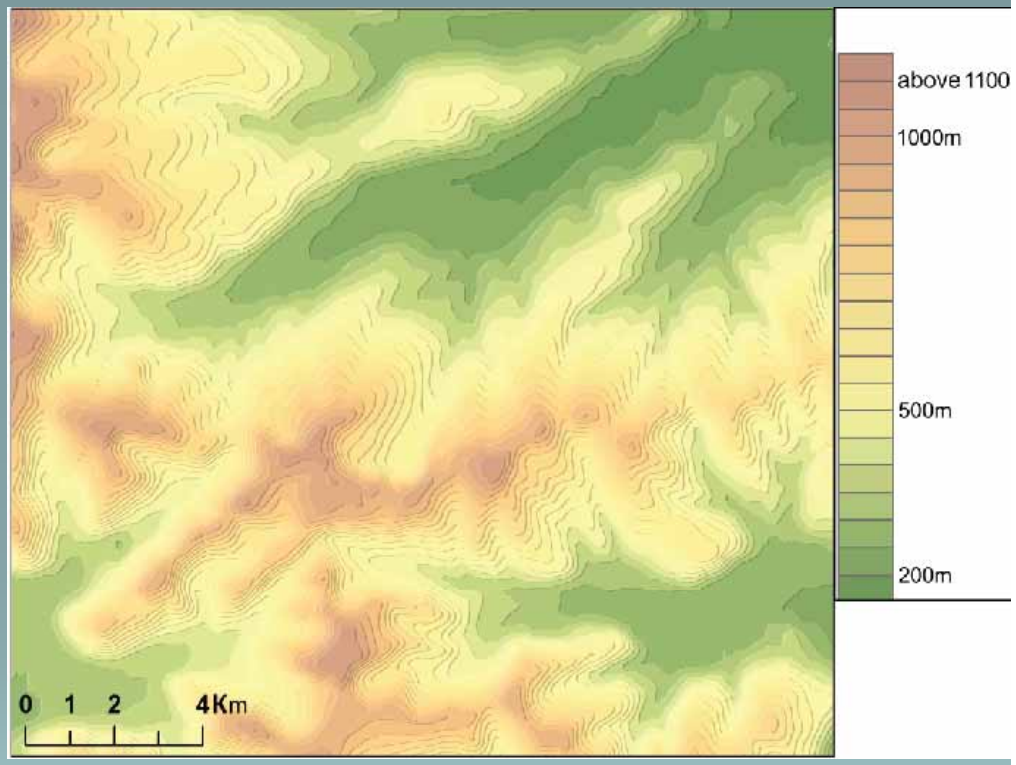
e.g. field data from Kola Peninsula (2008) show that total C , N and bio-available Ca was the highest in soils under tree crowns of mature spruce; clear differences in nutritional status are also observed under trees and between 'tree islands' in the forest tundra; and between lichen tundra microgroups and bare ground etc

2. Detailed **ground mapping of vegetation microgroups** can help to extrapolate data of selective soil sampling to create **maps of soil nutritional status**

3. Very high resolution satellite imagery has potential to extend ground mapping for larger areas

Study area





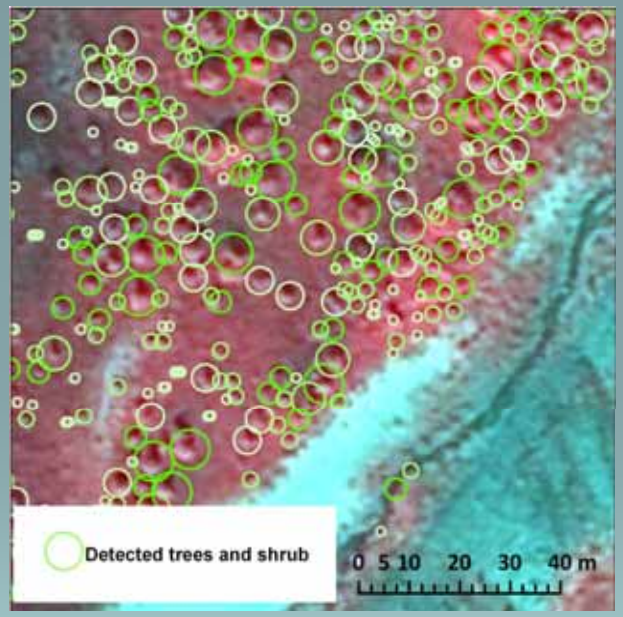
Tuliok, eastern Khibiny Mountains (continental, north facing slope, no pollution; spruce and birch forest).
Centre point: 33.790 E, 67.704 N

Data

- Detailed field mapping of 10 x 50 m plots at the scale of 1:20 Plots were georeferenced with a hand-held GPS. For the ground mapping, they were marked with a 1 x 1 m grid, and then microgroups of predominant plants were drawn on millimetre paper

- panchromatic and multispectral QuickBird image of 28 June 2006 (0.6 and 2.4 m resolution)

Identification of vegetation and trees in QuickBird imagery



The following five basic vegetation/surface groups can be readily distinguished : trees; shrubs; dwarf shrub tundra; lichen tundra; non-vegetated areas.

Trees and shrubs are mapped using both spectral and textural information and distinguished by height (below or above 2 m) using shape-from-shadow method. All other classes are mapped on the basis of spectral information.

Georeferencing difficulties

- Image delivered in Standard Ortho-Ready format :

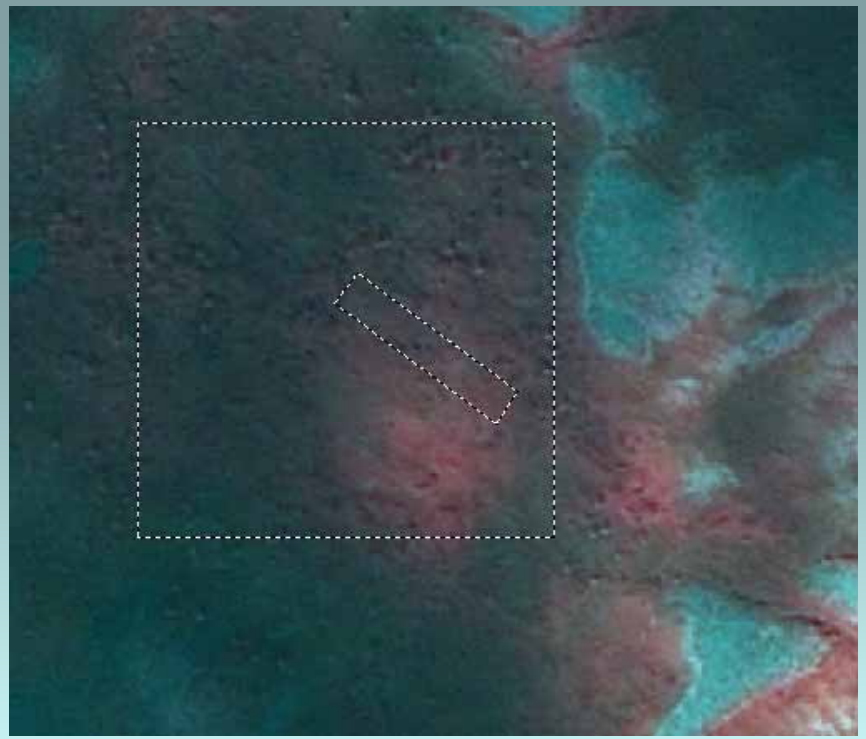
georeferenced and projected to mean height of the area (528 m asl), position errors up to 80 m due to mountain terrain

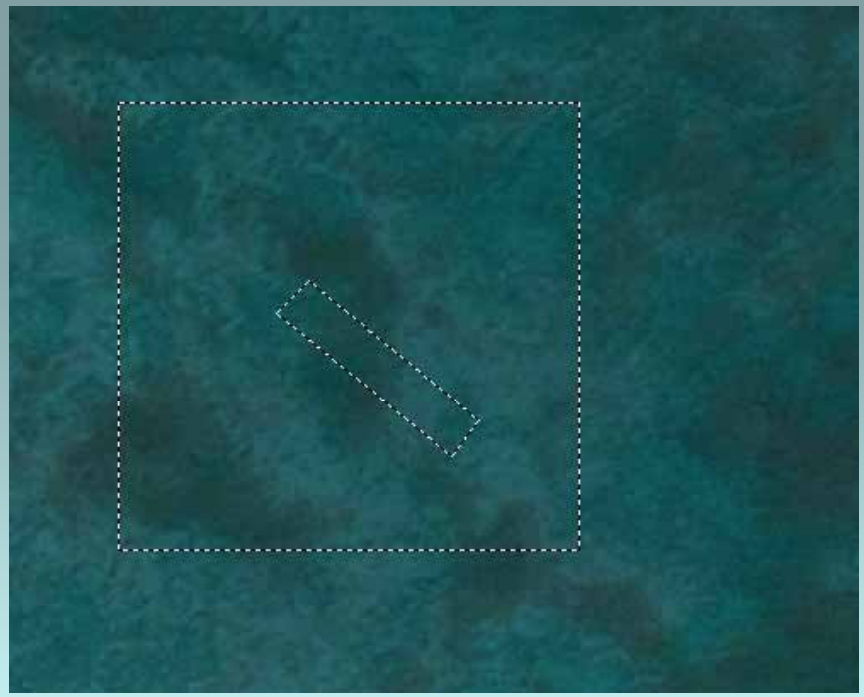
Further georeferencing on the basis of 9 ground GPS control points

Only coarse DEM available (1:100 000)

Resulting positioning error about **20 m (not enough!)**

100x100 m squares around field plots





Comparison of areas: forest-tundra site

Colours: dwarf shrub and moss tundra; hatching: trees; 16 microgroups in total (see poster)

Areas, %

Class	Ground plot	100x100 m image subset
Trees and shrubs	1.3	3.1
Dwarf shrub tundra	98.7	96.9

Comparison of areas: tundra site

Areas, %

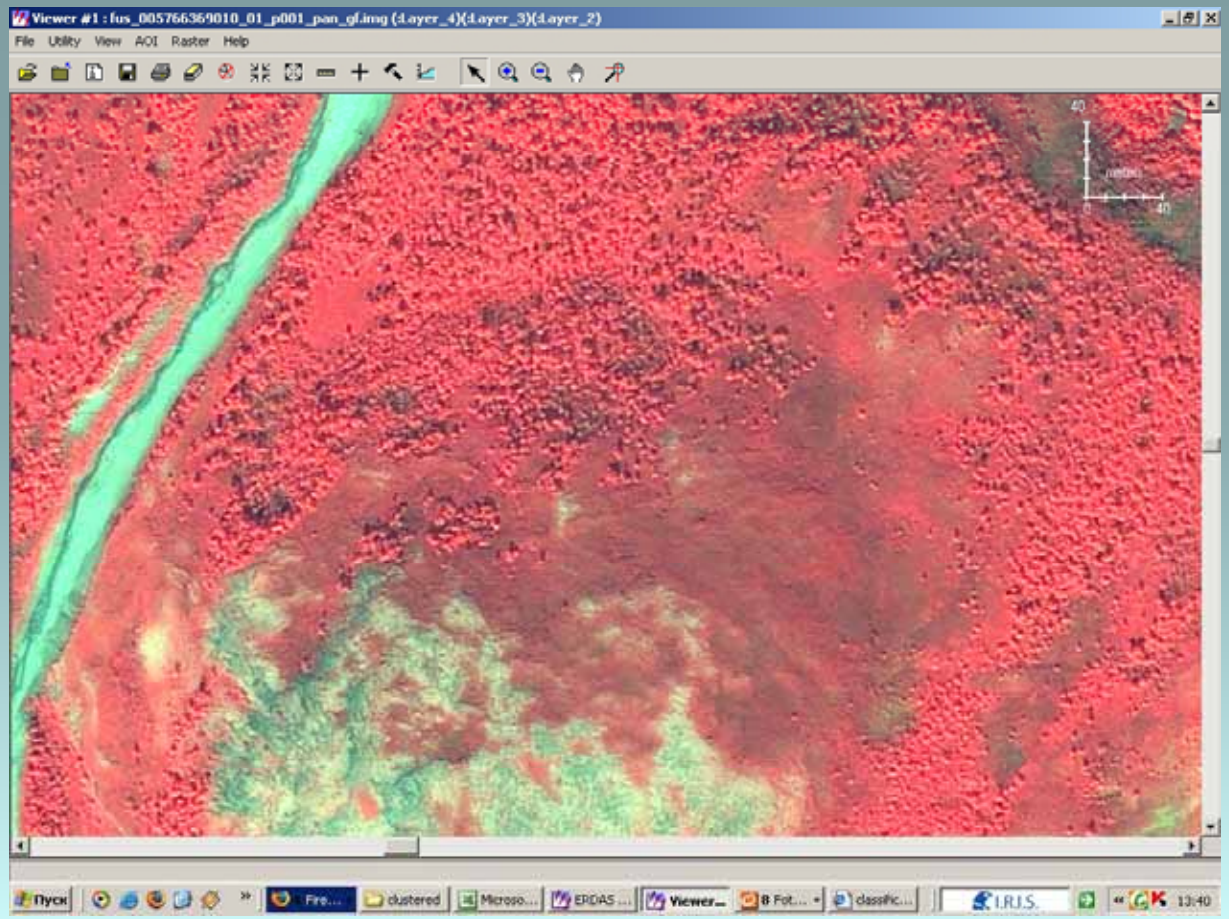
Purple: lichen dwarf shrub tundra; light rose: stones; light blue: dwarf shrub tundra; 10 microgroups in total (see poster)

Class	Ground plot	100x100 m image subset
Lichen tundra	61.5 (lichen-dwarf shrub)	35.8
Dwarf shrub tundra	15.0	35.5
Bare rock	23.5	28.7

Future work

- pre-selection of new ground plots at treeline and above up to the lichen tundra belt
- Ground mapping using a generalised legend to match satellite image-derived classes
- Individual trees and other landmarks as well as corners of the sub-areas will be located with differential GPS receivers. A procedure for Quickbird image orthocorrection will be developed
- Ground spectroradiometry data may be utilised to improve the accuracy of image-based vegetation classification
- Ground mapping data will be extrapolated to characterise vegetation diversity and soil nutritional status of the territory

Plot 1 for 2009



Plot 2 for 2009