A short introduction to some of my latest research

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Photo: Tarmo Virtanen

Research questions

1. What are the pros/cons of two vegetation mapping methods: (1) regression of floristically defined plant communities (2) classification of predefined land cover types? (Räsänen et al. 2019. Journal of Vegetation Science)
2. What kind of changes there are in land cover type classification accuracy when (1) spatial resolution of data is changed, (2) datasets are included/omitted? (Räsänen et al. 2019. Remote Sensing of Environment)
3. What kind of differences are there in vegetation patterns and their mappability between different northern peatland study sites? (Räsänen et al. Submitted)

Study areas

- RQ 1 & 2: Kaamanen (the northernmost site):

- RQ3: All three sites

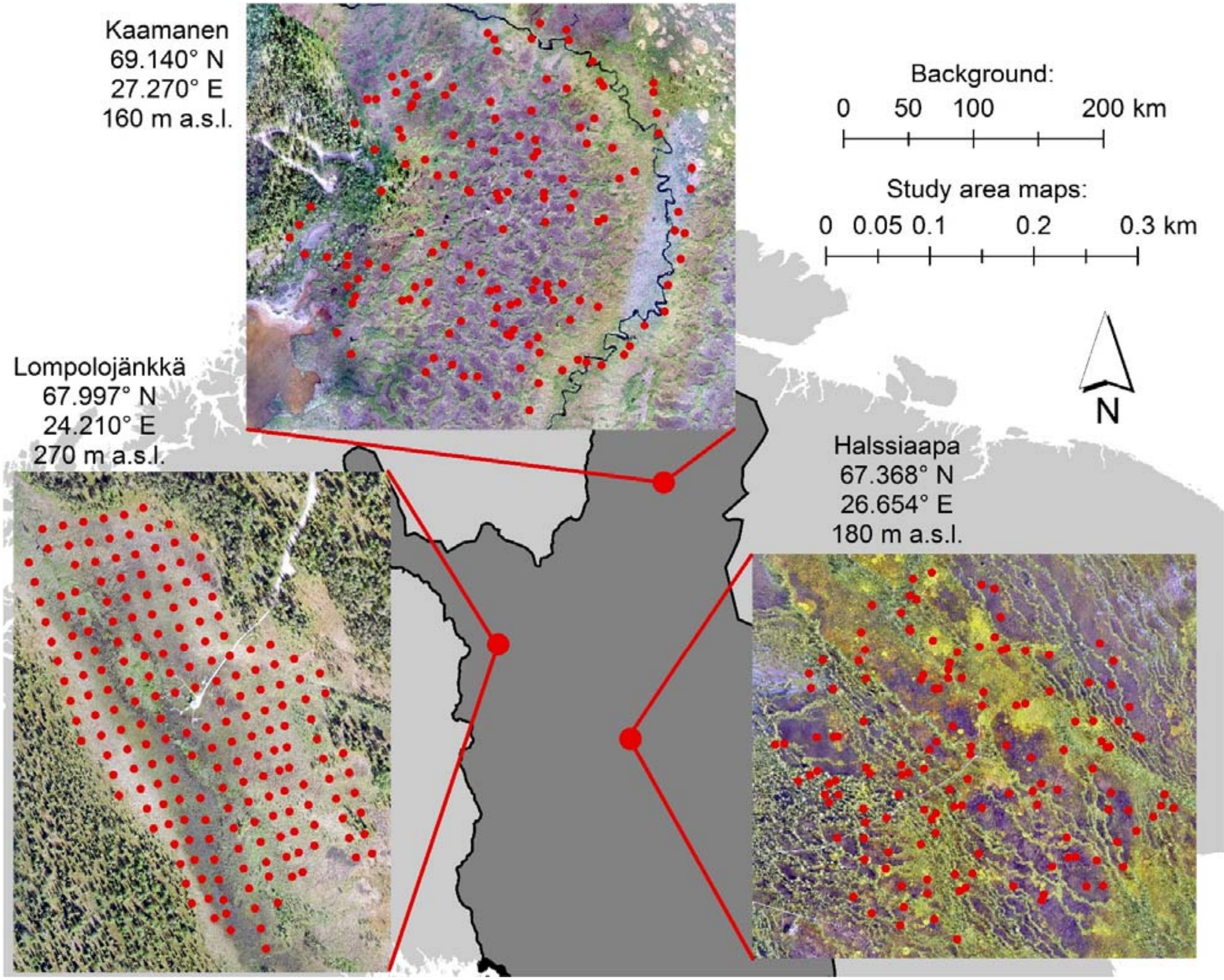
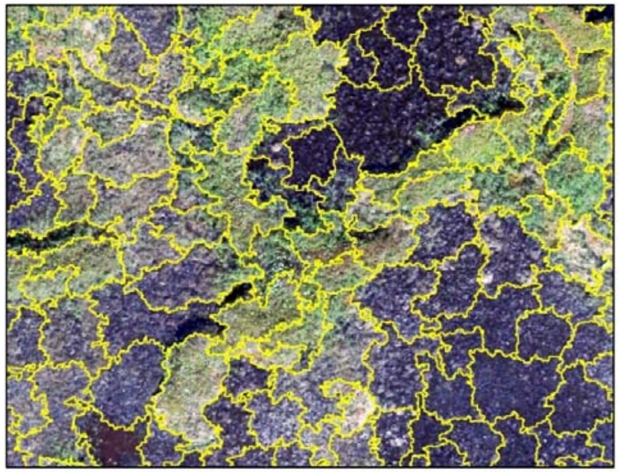


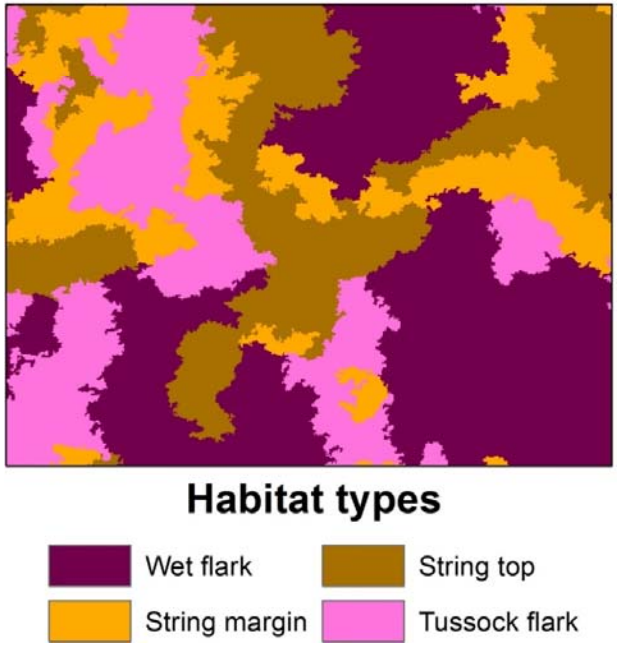
Figure source: Räsänen, A., Aurela, M., Juutinen, S., Lohila, A., Kumpula, T., Penttilä, T., Virtanen, T. Detecting northern peatland vegetation patterns at ultra-high spatial resolution. Submitted manuscript.

Methodological overview

- Multiple remote sensing datasets merged in an object-based analysis
  - UAV/aerial/satellite image segmentation followed by
    - Land cover classification (random forest)
    - Plant community, plant functional type & ordination axis regression (boosted regression trees / random forest)
- For each segment, features are calculated from multiple datasets

Data	Spatial resolution
UAV: spectral, topography & vegetation height	Ca. 0.05 m
Aerial imagery: spectral	0.5 m
Lidar: topography & vegetation height	2 m
Satellite imagery: spectral	2-3 m





Results (1): Different methods

- Comparison of two methods
- Classification of predefined land cover types has higher classification accuracy (72%)
- Regressions of plant communities show the fuzzy nature of peatland vegetation more realistically (R^2 0.27-0.67)

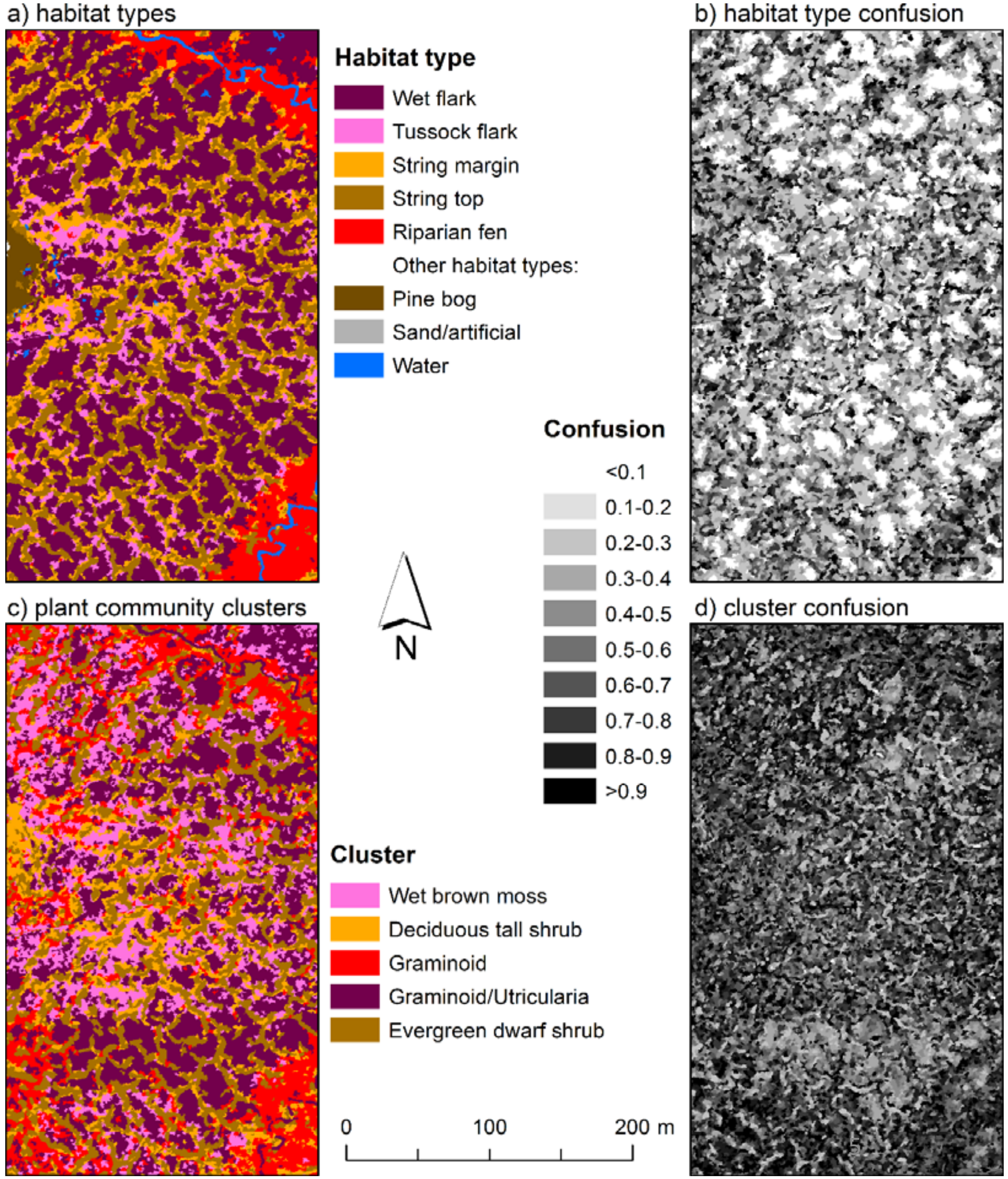
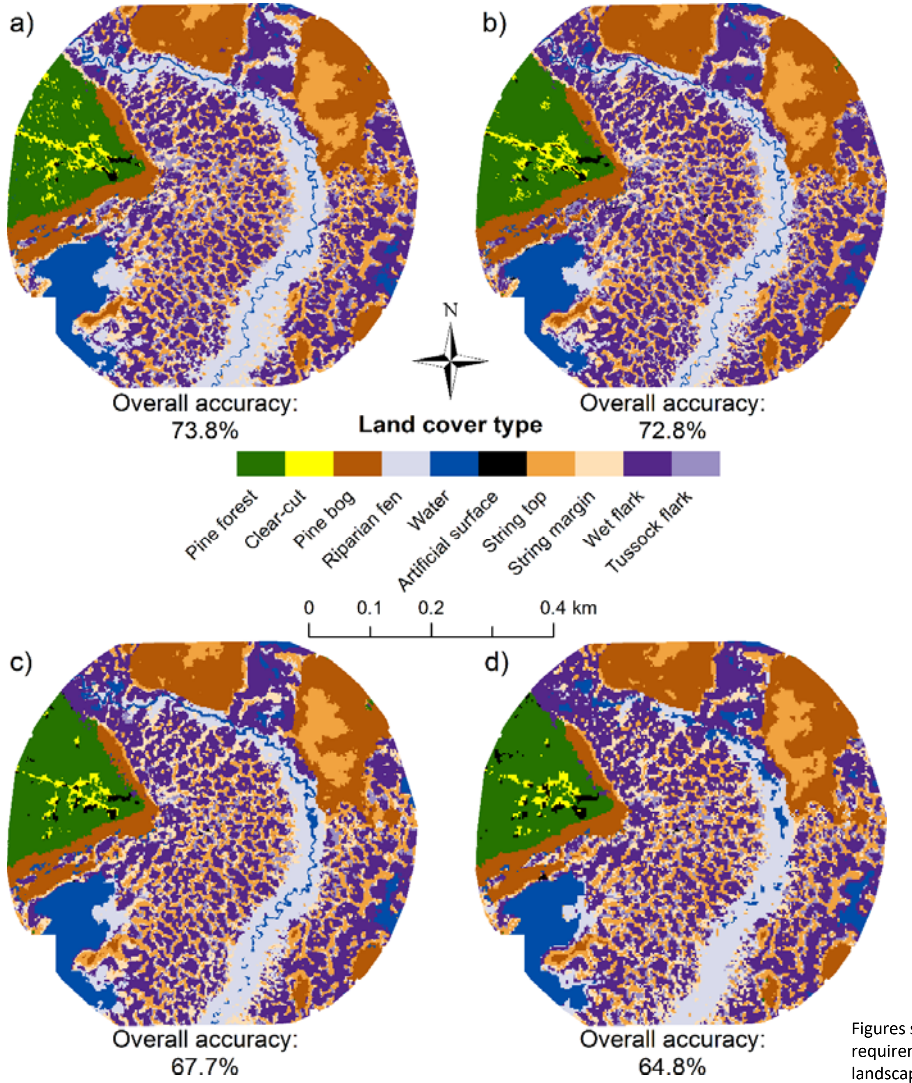
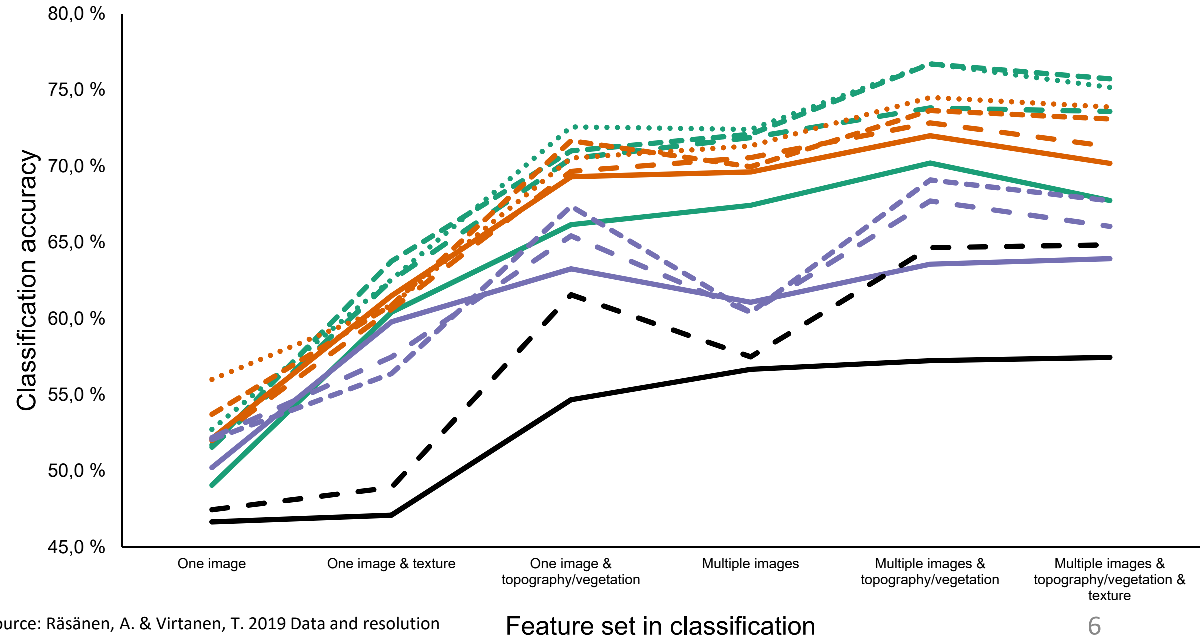


Figure source: Räsänen, A., Juutinen, S., Tuittila, E.-S., Aurela, M. & Virtanen, T. 2019 Comparing ultra-high spatial resolution remote sensing methods in mapping peatland vegetation. *Journal of Vegetation Science,* In press.

Results (2): Data and resolution

- Habitat type classification with changing segmentation & feature set
- Multiple different types of features needed
  - Incl. Topography and spectral features at multiple scales
- Aerial/UAV data needed to get the best accuracy





Figures source: Räsänen, A. & Virtanen, T. 2019 Data and resolution requirements in mapping vegetation in spatially heterogeneous landscapes. *Remote Sensing of Environment* 230: 111207.

Results (3): Different landscapes

- Regressions of plant functional types, ordination axes and plant communities
- Notable between-site variation in mapping performance
  - Good performance in Kaamanen, worse in two other sites
  - Different types of approaches were the most valuable in the different sites
- Most important remote sensing features differed between dependent variables and study sites
  - Coarse-scale and fine-scale datasets needed

Regression	Kaamanen (R^2)	Lompolojänkkä (R^2)	Halssiaapa (R^2)
Salix	-	0.55	-
Evergreen shrubs	0.62	0.01	0.23
Deciduous shrubs	0.41	0.11	0.46
Shrubs total	0.62	0.22	0.44
Forbs	0.49	0.14	0.41
Graminoids	0.26	-0.03	0.04
Vascular plants total	0.69	0.15	0.54
Sphagnum	0.16	0.32	0.63
Wet brown mosses	0.38	0.16	0.57
Feather mosses	0.44	0.04	0.03
Mosses total	0.15	0.36	0.14
MDS1	0.82	0.64	0.68
MDS2	0.53	0.49	0.22
MDS3	0.31	0.26	0.40
MDS4	0.15	0.21	-0.09
Cluster 1	0.45	0.16	0.59
Cluster 2	0.76	0.29	0.58
Cluster 3	0.43	0.44	-
Cluster 4	0.82	0.26	-
Cluster 5	-	0.58	-

Table source: Räsänen, A., Aurela, M., Juutinen, S., Lohila, A., Kumpula, T., Penttilä, T., Virtanen, T. Detecting northern peatland vegetation patterns at ultra-high spatial resolution. Submitted manuscript.

Conclusion & next steps

- Multiple different datasets needed to capture spatial patterns in peatland vegetation
- There are large differences between peatland landscapes which method and data should be used
  - Multiple maps should be tested and produced
- Ultra-high resolution (< 1 m) data necessary for mapping vegetation patterns
- Next steps
  - Inclusion of hyperspectral UAV data
  - Links to carbon fluxes together with FMI
  - Scaling: moving from a scale to another & larger extent

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Thank you!

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Timo Kumpula

Timo Penttilä

References:

Räsänen, A., Juutinen, S., Tuittila, E.-S., Aurela, M. & Virtanen, T. 2019 Comparing ultra-high spatial resolution remote sensing methods in mapping peatland vegetation. *Journal of Vegetation Science,* In press.

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