A concept for using unmanned aerial vehicle mapping and ground penetration radar to map peatland structures as a planning tool for peatland rewetting and paludiculture.

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Intro

Ground penetration radar (GPR) offers the possibility to map peat depth and stratigraphy with low effort. Combining this data with digital elevation models obtained by unmanned aerial vehicles (UAV) may offer a comprehensive picture of the spatial structure of peatlands. This detailed knowledge is necessary when planning peatland restoration projects and implementing paludiculture, e.g. Sphagnum farming. The feasibility of combining GCP and UAV has been demonstrated (with a different focus) in a small peatland site (3ha) in Arkhangelskaya oblast, Russia.

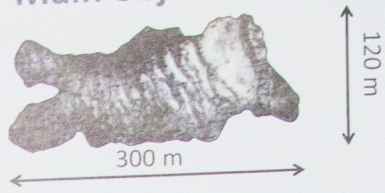
Aim

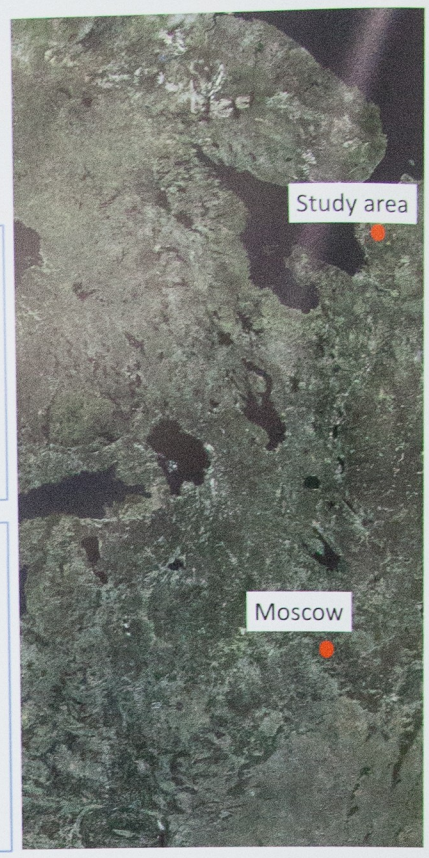
To develop approach of peatlands mapping based on geophysics (ground penetration radar (GPR)) and unmanned aerial vehicle imaging (UAV).

Methods

We used a consumer grade multicopter (DJI Phantom 4) equipped with a 12 MP camera to retrieve air-borne images. A GPR – Zond 12e advanced with shielded antenna 300 Mhz was used. Velocity of the electromagnetic waves was determined by peat stratigraphy researches using russian peat core.

Main object



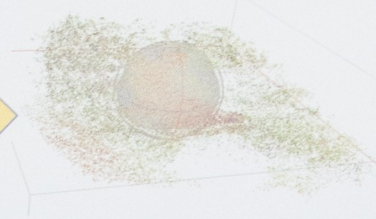


UAV

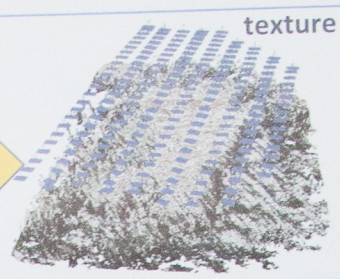
50 m height flight
9 mins
6 ground control points

226 Images, 80% overlaps

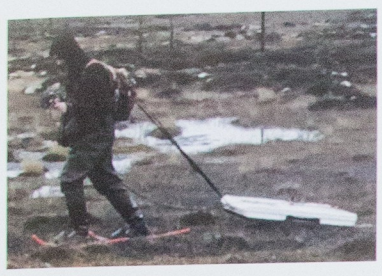
dense cloud



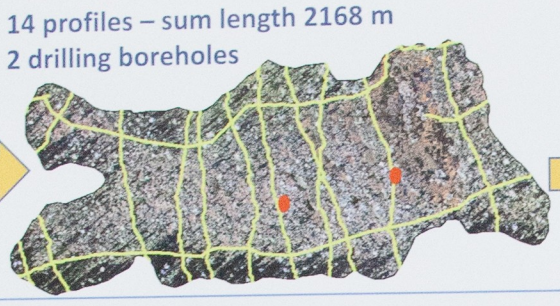
texture

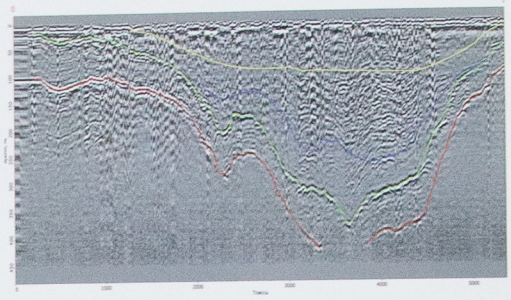


GPR



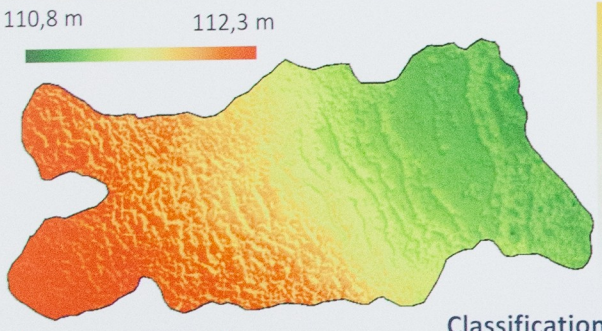
14 profiles – sum length 2168 m
2 drilling boreholes





Results

DSM – 8 sm/pix, height prec. 5 sm



The UAV processing resulted in image mosaic with 2 sm spatial resolution. Detailed UAV mapping shows water ability, saturated peat, type of vegetation, condition, with high precision level. Map of different peat layers can be generated by GPR data processing including different decomposition, density, structure, water quality and ability.

Orthophoto, 2 sm/pix

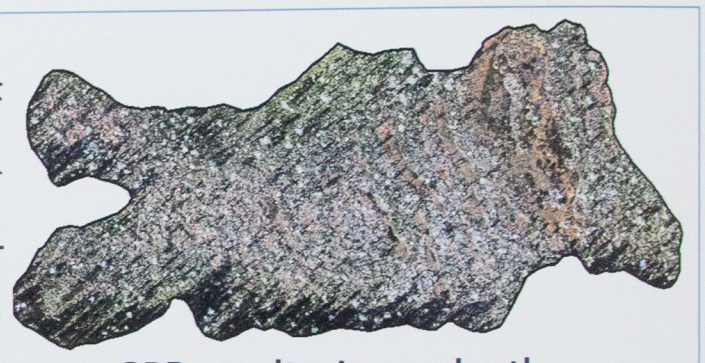
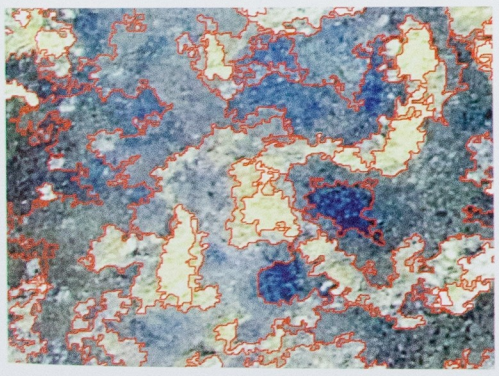
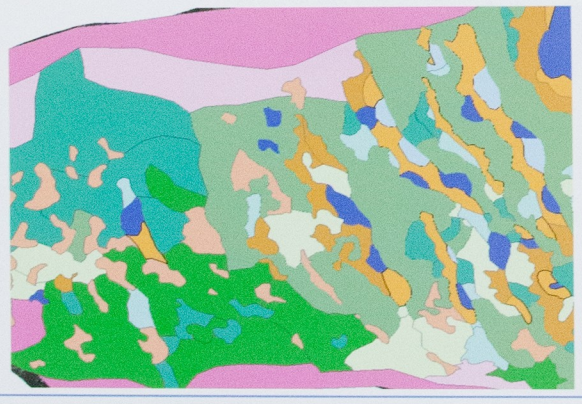


Image segmentation



Classification of segmentation

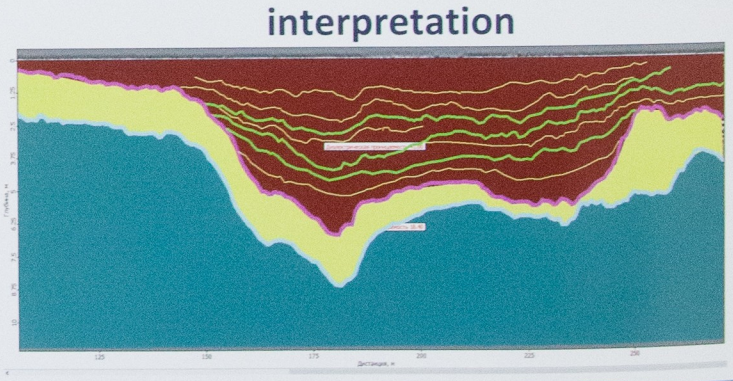


hollows

ridges

Flat and hummock surfaces

GPR results. Layer depth interpretation



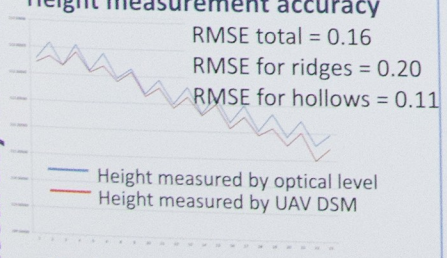
Spatial resolution

Satellite image 0.5 m/pix

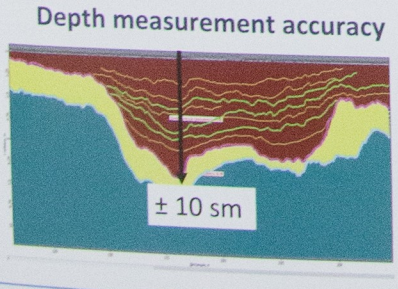
UAV image 0.02 m/pix

Accuracy estimation

Height measurement accuracy



Depth measurement accuracy



Combination of UAV and GPR results

High part of the ridge

High part of the hollow

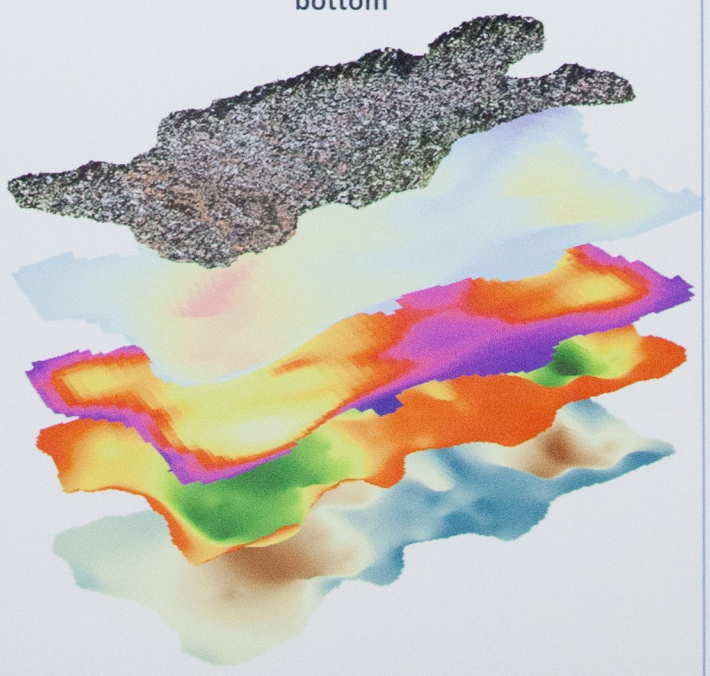
Main ridge surface

Low hollow

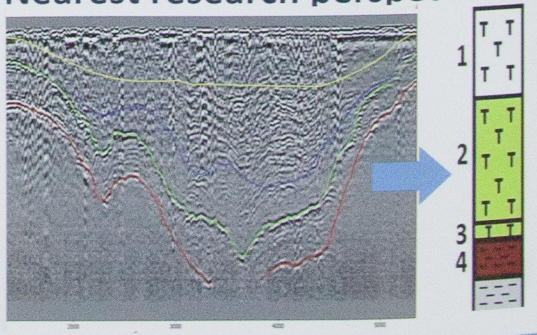
Low ridge (loan)

Hollow with water (lowest)

Surface + peat layers + bottom +under bottom



Nearest research perspectives



Applying for rewetting and paludiculture projects

In context of paludiculture, combined data can be used to plan necessary excavation work to level the peat surface or to get a peat surface with homogeneous properties (e.g. for sphagnum farming). DEM data can be used to place walls for rewetting. Hence combined GPR and UAV data offers a useful tool for biomass production on wet peatlands.

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