UAS Imaging Applications to Monitor Restored Peatlands

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Background

- Peatlands are globally threatened by land use and drainage.
- Most of the Finnish peatlands have been drained for forestry, agriculture and peat extraction.
- Pristine vegetation and peat-forming processes have been lost.
- Lowering water table initiates oxidation of peat to CO₂.
- Restoration activities can help drained peatlands:
  i) to increase biodiversity by recovering the mire habitats
  ii) to return natural functions in the catchment hydrology
  iii) to reactivate natural storage of carbon and nutrients

- Monitoring of restored peatlands is important for several reasons:
  i) to determine the technical success of restoration
  ii) to see if the recovery process is activated
  iii) to further develop restoration methods

- Traditional monitoring methods are laborious and time-consuming.
  New UAS-based datasets provide potential prospects:
  i) to ease the demanding monitoring field work
  ii) to decrease the subjectivity of the data
  iii) to increase the monitoring coverage at the sites

Sites

- During the Hydrology LIFE project, 5 200 ha of peatlands are restored in 95 Finnish Natura 2000 protection areas.
- The sites have originally been drained for forestry purposes but protected later due to their natural value.
- Olvassuo and Mujejärvi sites were selected for the UAS study, since they include not only new restoration sites, but also former sites with historical vegetation and hydrological data available.
- The study focuses on open fens that have been drained 40-70 years ago and restored 0-20 years ago.
- For the new restoration sites, the flights will be performed before the restoration as well as one and two years after the restoration.
- In addition, data will be acquired from pristine reference sites to control the natural processes effect on the data.

Data and Methodology

- Hydrology LIFE project produces UAS imaging data for the study:
  i) Visible (VIS)
  ii) Near-Infrared (NIR)
  iii) Thermal IR

- Restoration success indicators to be derived from the data:
  i) Manual and automated interpretation of the orthomosaics
  ii) Classification of vegetation cover types
  iii) Digital elevation models (DEM) for the site run-off model
  iv) Vegetation and moisture indices
  v) Water table elevation
- UAS-carried "wild cards" to be tested:
  i) Lidar
  ii) Hyperspectral
  iii) Ground penetrating radar

- Reference data:
  i) Manual visual field observations
  ii) Soil moisture observations
  iii) Vegetation and hydrological long-term monitoring
  iv) Satellite imagery

Figure 1. Aerial photograph and map comparisons between pre-drainage and pre-restoration conditions of strongly groundwater-fed Iso Leväniemi site in Olvassuo. Drainage was implemented in 1975 and forest growth has been intensive since then, for 44 years. The UAS study site (green border) has been left unditched, but the surrounding ditches have lowered the water table of the site.

Figure 2. UAS-imaging-derived RGB orthomosaic picture and partial NDVI map (resolution 50 mm) for pre-restoration conditions of Loukkosuo site in Mujejärvi.

Figure 3. UAS-imaging-derived datasets and products with potential to correlate with peatland restoration success.