



Hydrological modelling and remote sensing indicate changes in boreal aapa mires

Antti Sallinen (UEF, SYKE), Justice Akanegbu (Oulu univ.), Hannu Marttila (Oulu univ.),
Timo Kumpula (UEF), and Teemu Tahvanainen (UEF)



UNIVERSITY OF
EASTERN FINLAND



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Background

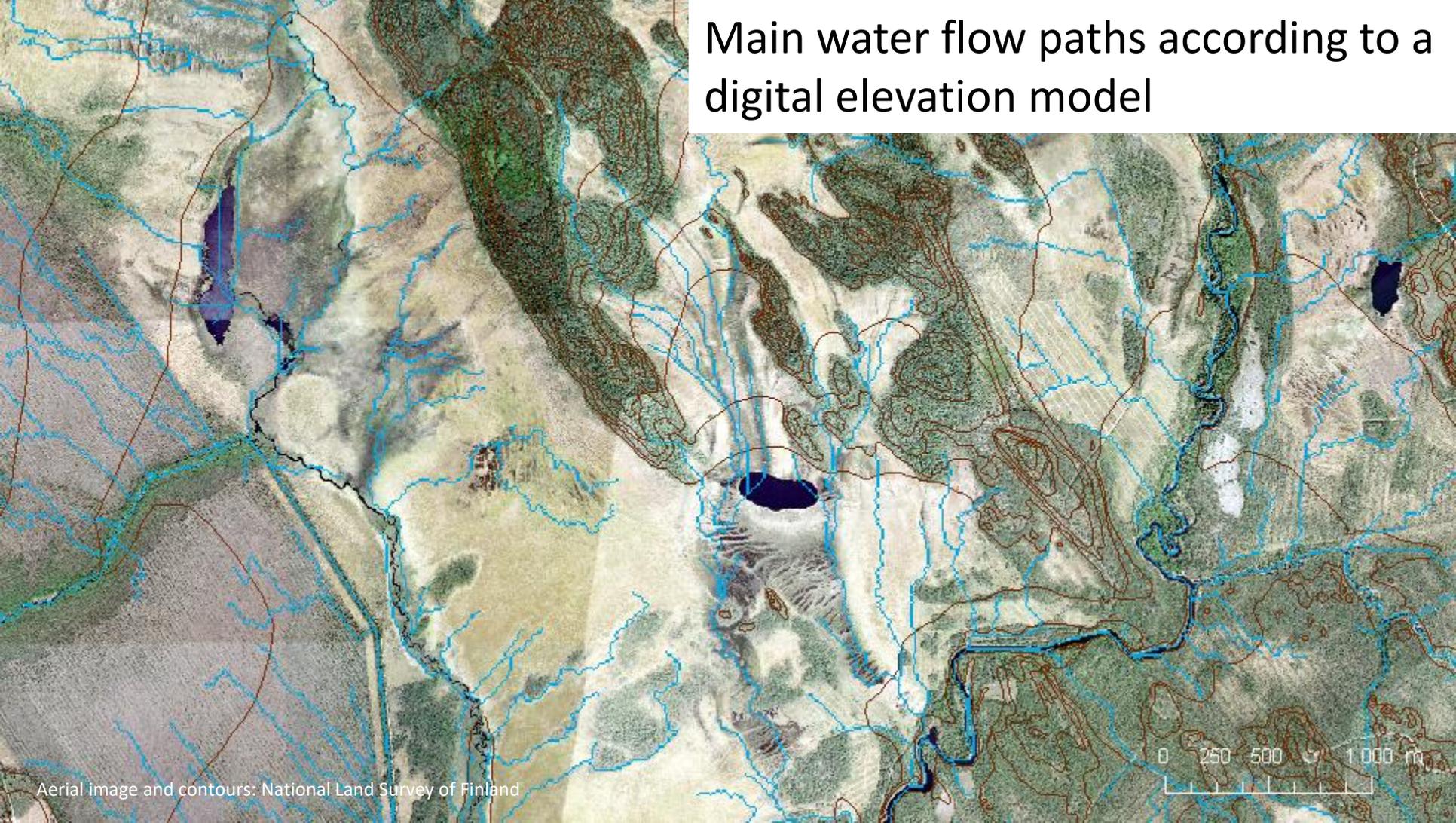
- Recent and future changes of northern mires are studied in a multidisciplinary project SHIFTMIRE, funded by The Academy of Finland (PI: Teemu Tahvanainen, UEF)
- Part of the task is to study the recent and anticipated future hydrology of aapa mires

Aapa mire?



Aerial image and contours: National Land Survey of Finland

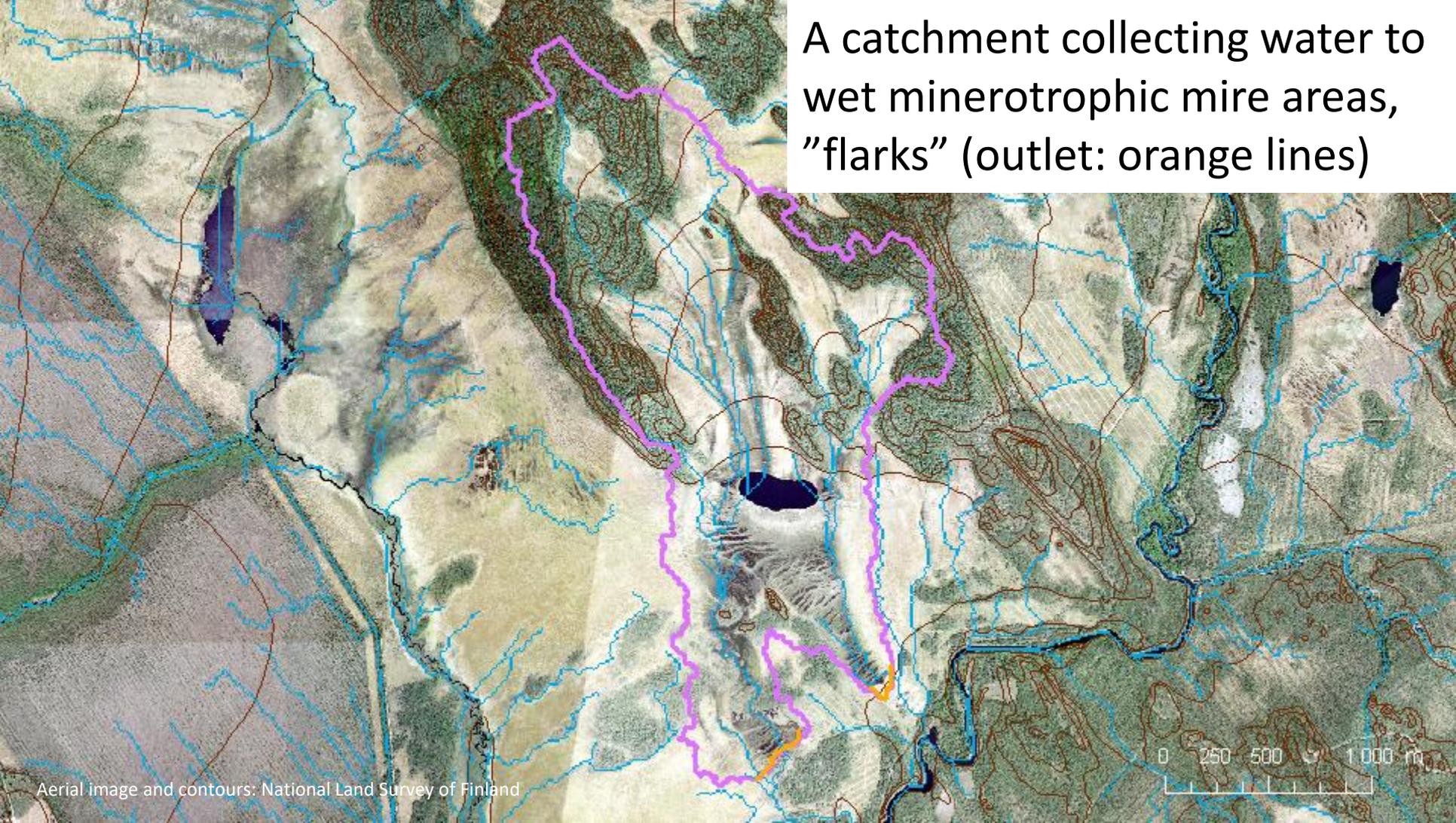
Main water flow paths according to a digital elevation model



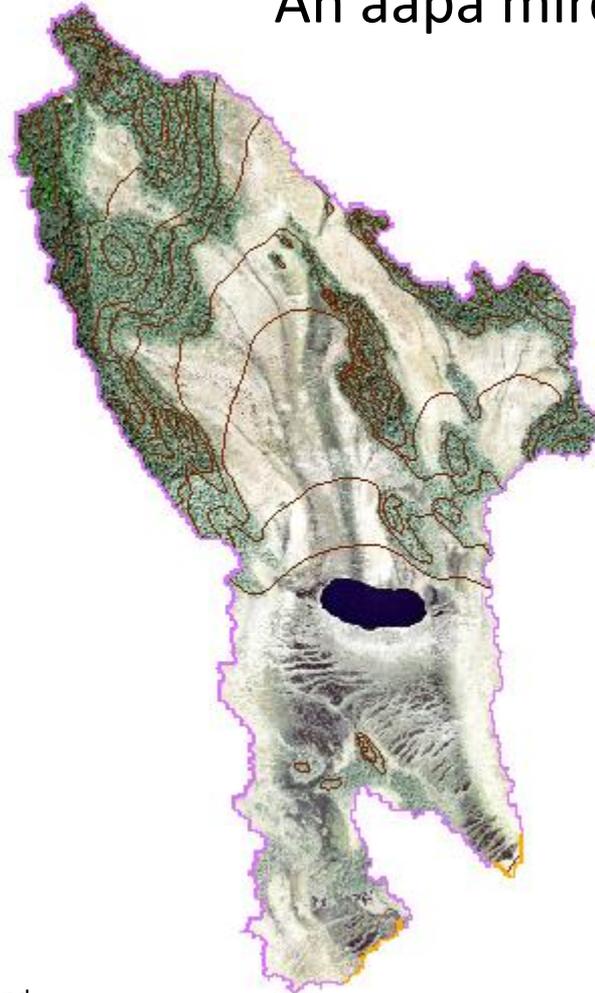
Aerial image and contours: National Land Survey of Finland



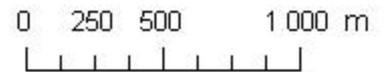
A catchment collecting water to wet minerotrophic mire areas, "flarks" (outlet: orange lines)



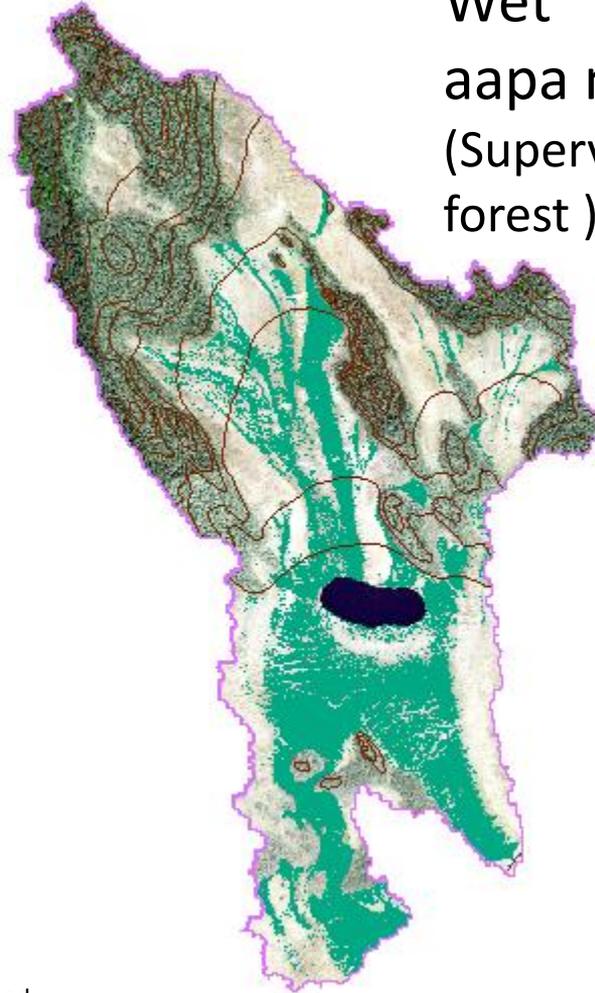
An aapa mire catchment



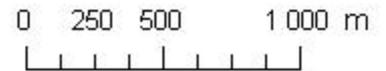
8 Pirhunsuo mire, Iломantsi



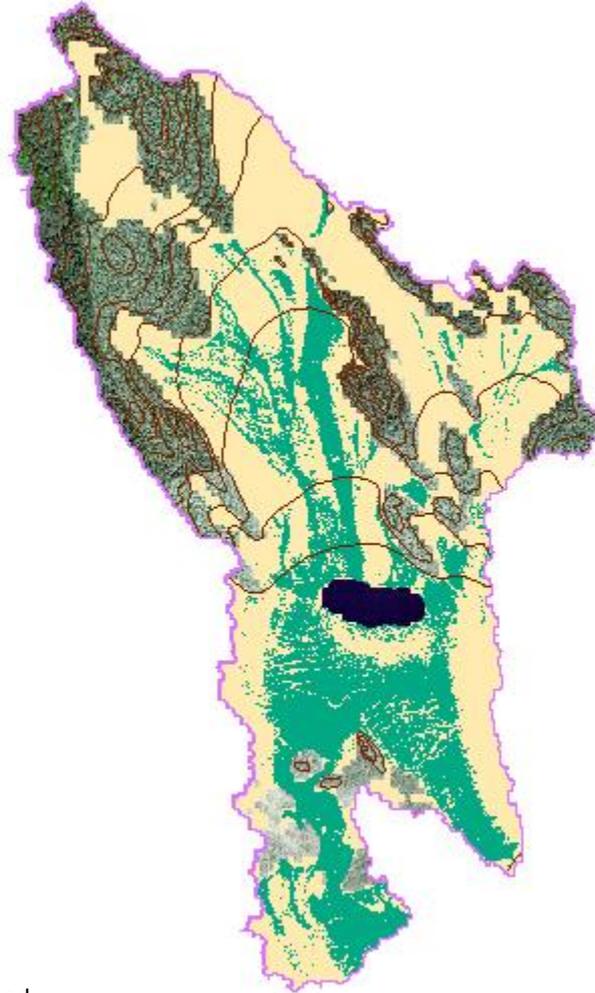
Wet "flark" areas within an
aapa mire
(Supervised classification: Random
forest)



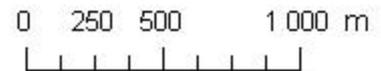
8 Pirhunsuo mire, Iloanta



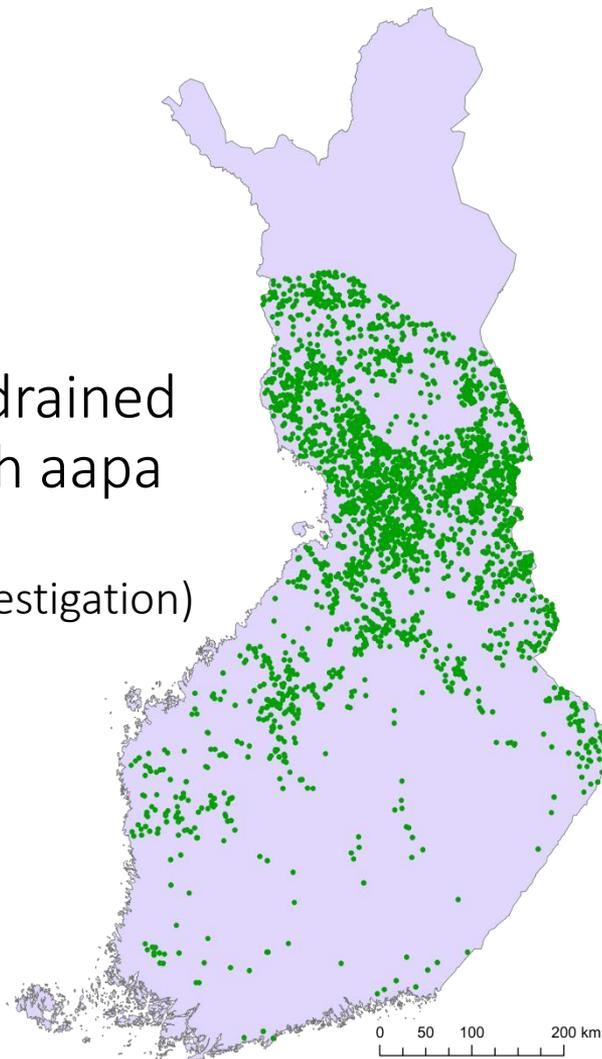
An aapa mire complex:
wet minerotrophic
areas and the
continuous peatland
upslope of them



8 Pirhunsuo mire, Iloanta

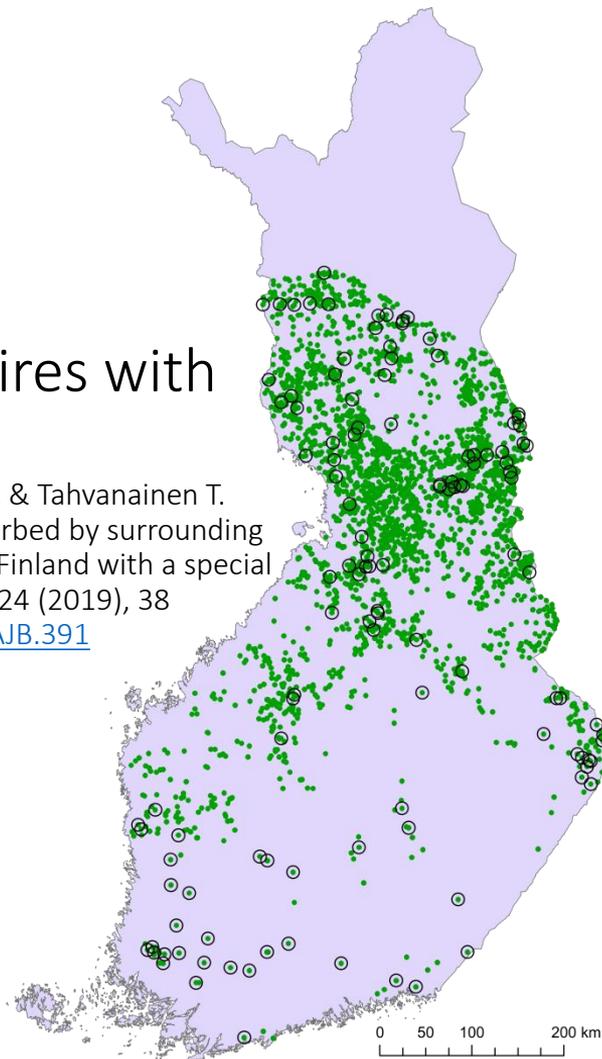


Large (> 50 ha) undrained
peatland areas with aapa
features
(Data: SYKE air photo investigation)

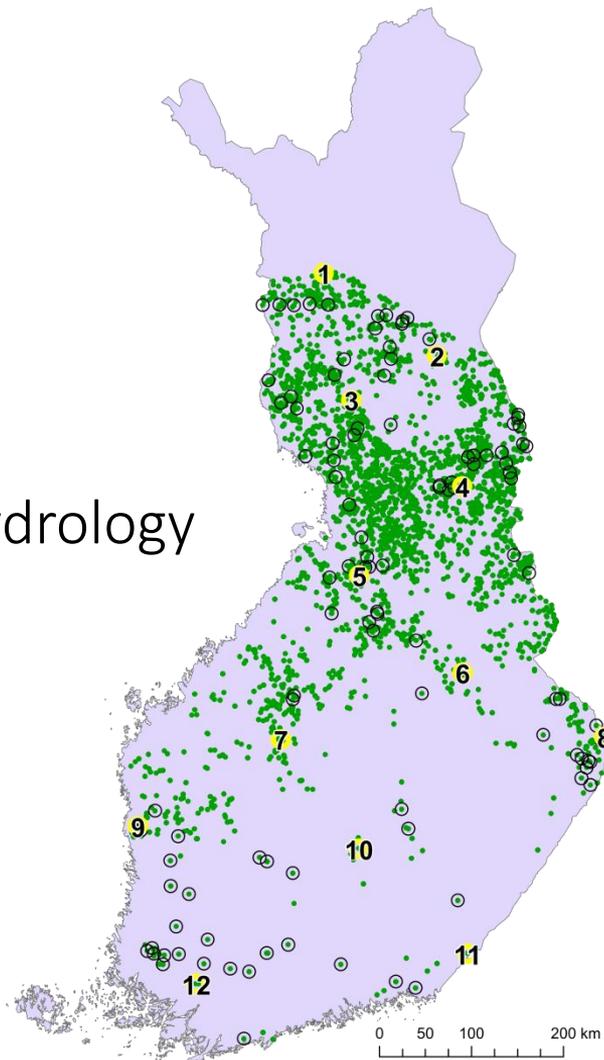


A sample of 120 mires with aapa features

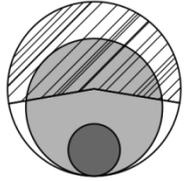
Sallinen, A., Tuominen, S., Kumpula, T. & Tahvanainen T.
2019. Undrained peatland areas disturbed by surrounding
drainage: a large scale GIS analysis in Finland with a special
focus on aapa mires. *Mires and Peat*, 24 (2019), 38
<https://doi.org/10.19189/MaP.2018.AJB.391>



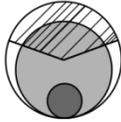
12 mires for the hydrology study



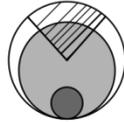
1. Palvivuoma



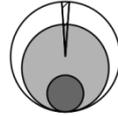
2. Hämeenjätkä



3. Letonaapa



4. Ruostesuo



Wet minerotrophic "flark" area
in the center of aapa mire complex



Aapa mire complex, i.e. flark area and
the continuous peatland upslope of it

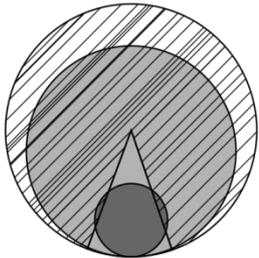


Aapa mire catchment, i.e. the area
collecting water to aapa mire

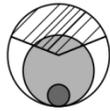


Part of aapa mire catchment that is
behind ditches or drained areas

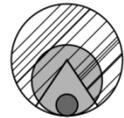
5. Jauranneva



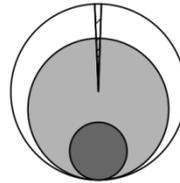
6. Löytynsuo



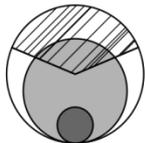
7. Laskuneva



8. Pirhunsuo



9. Stormossen



10. Rokasuo



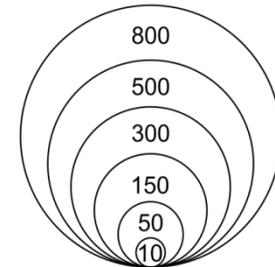
11. Joussuo



12. Juomakivenrahka



Scale (ha)



- Aapa mire distribution is controlled by climate and local hydrological conditions
- Mire hydrology is difficult to measure directly, since mires seldom discharge via single outlets
- We thus **modelled** the runoff from aapa mires, based on temperature and precipitation data
- Years 1962 – 2099

- ‘CPI snow’ model (Akanegbu et al 2017, 2018)
- From weather data to runoff values
- Historical weather records and predicted values based on climate scenarios
 - Finnish Meteorological Institute FMI’s gridded weather data (res. 10 km)
 - Future data based on two emission scenarios (RCP4.5, RCP8.5) and five climate models of CIMP5 project (MIROC5, HadGEM2-ES, GFDL-CM3, CNRM-CM5, CanESM2)

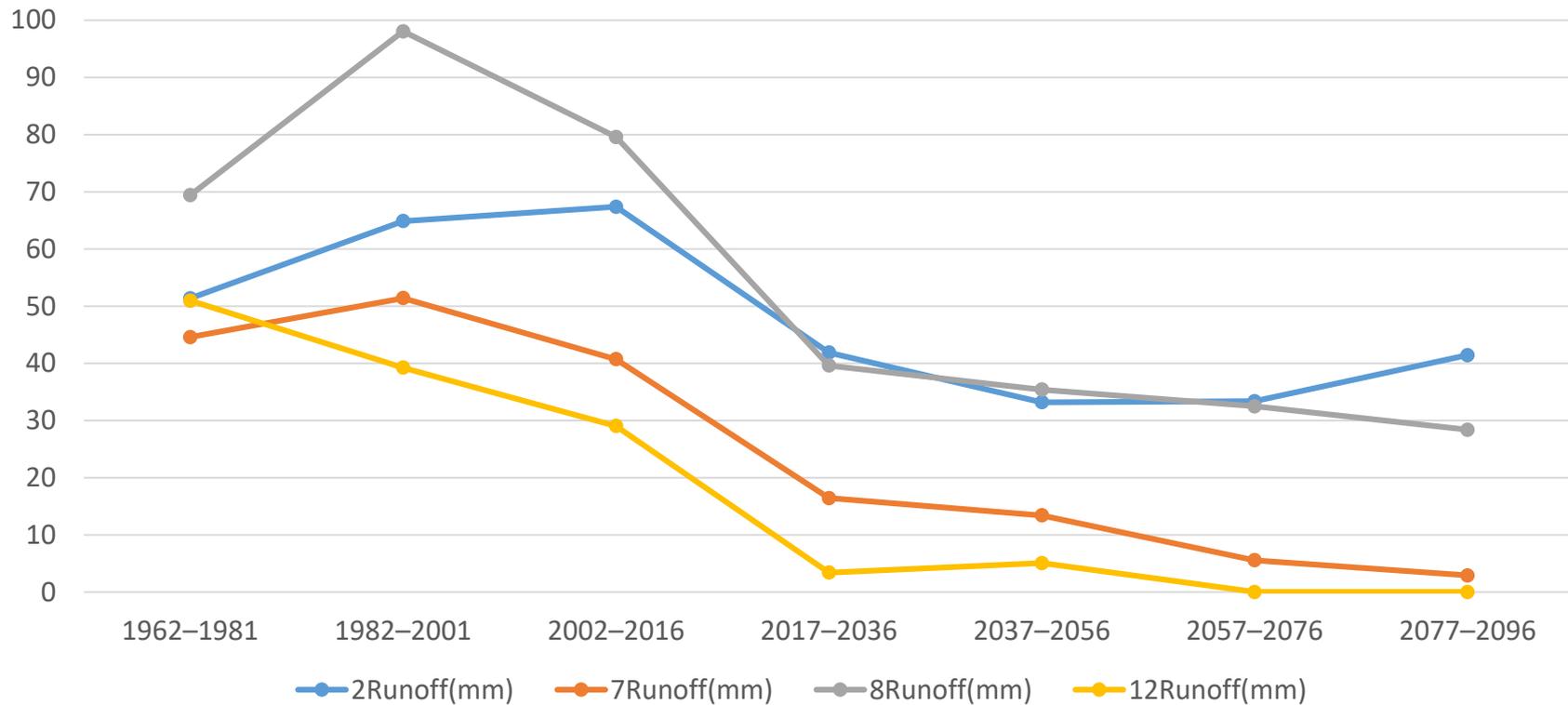
CPI snow references:

- Akanegbu, J.O., H. Marttila, A. Ronkanen, and B. Kløve (2017), A current precipitation index-based model for continuous daily runoff simulation in seasonally snow covered sub-arctic catchments. J. Hydrol., 545, 182-196, <https://doi.org/10.1016/j.jhydrol.2016.12.020>
- Akanegbu, J.O, Meriö, L-J., Marttila, H., Ronkanen, A-K., Kløve, B., 2018. A simple model structure enhances parameter identification and improves runoff prediction in ungauged high-latitude catchments. J. Hydrol. 563; 395-410. <https://doi.org/10.1016/j.jhydrol.2018.06.022>

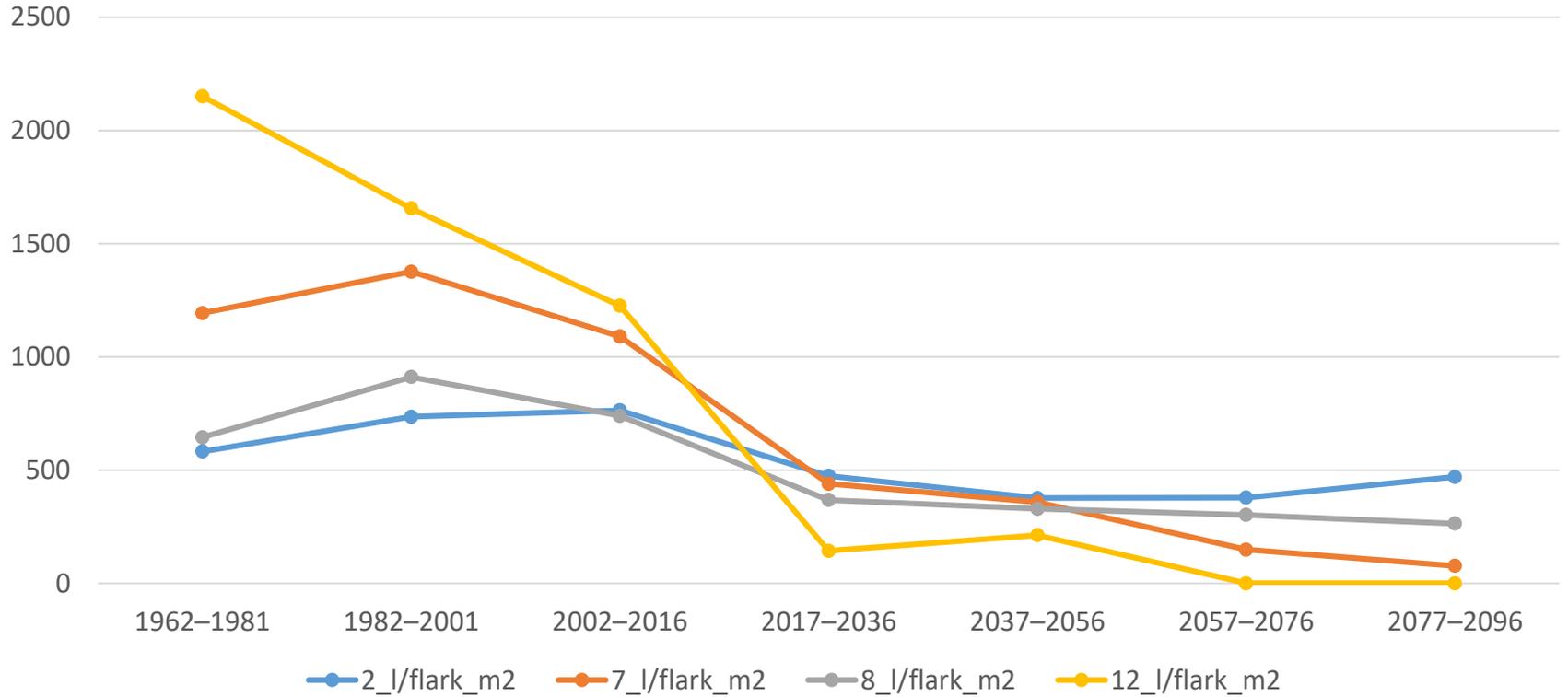
FMI data references:

- Lehtonen, I., Venäläinen, A., Kämäräinen, M., Peltola, H., & Gregow, H. (2016). Risk for large-scale fires in boreal forests of Finland under changing climate. Natural Hazards and Earth System Sciences, 16, 239–253. <https://doi.org/10.5194/nhess-16-239-2016>
- Lehtonen, I., Kämäräinen, M., Gregow, H., Venäläinen, A., & Peltola, H. (2016). Heavy snow loads in Finnish forests respond regionally asymmetrically to projected climate change. Natural Hazards and Earth System Sciences, 16(10), 2259–2271. <https://doi.org/10.5194/nhess-16-2259-2016>

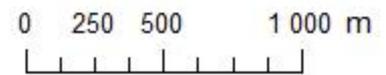
Spring flood runoff (mm)



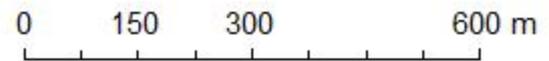
Spring flood volume per flark area (l/m²)



7 Laskuneva mire, Kyyjärvi



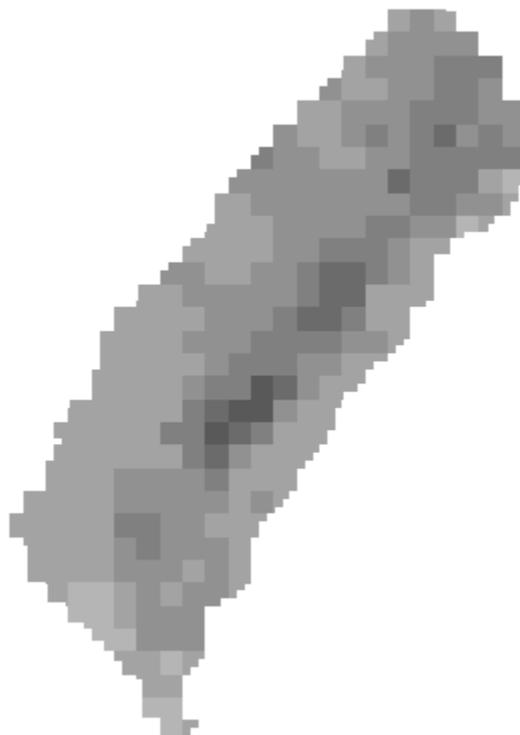
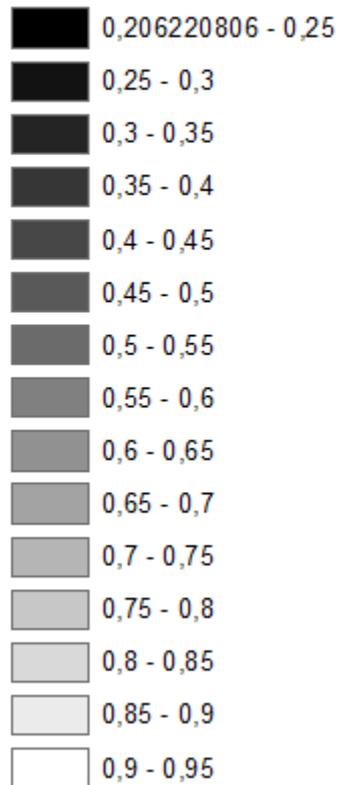
7 Laskuneva mire, Kyyjärvi
Undrained area



Legend

Early_NDVI

<VALUE>



7 Laskuneva mire, Kyyjärvi
Undrained area

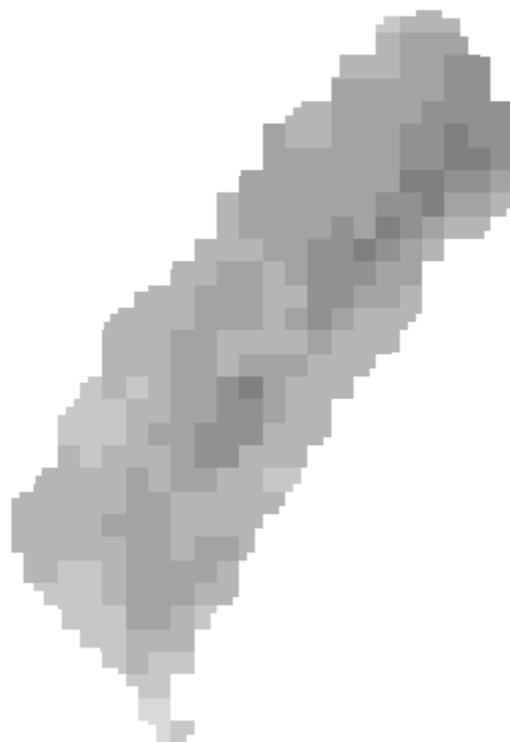
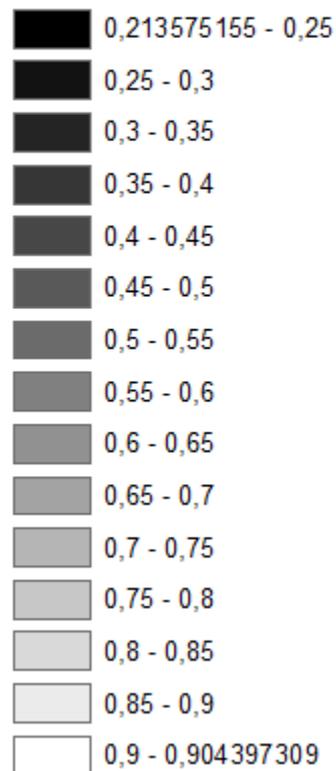
Landsat
NDVI
1985



Legend

Late_NDVI

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7 Laskuneva mire, Kyyjärvi
Undrained area

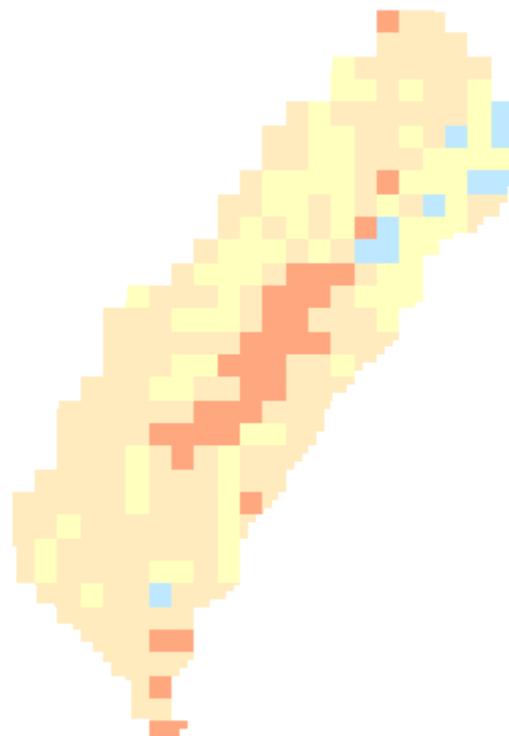
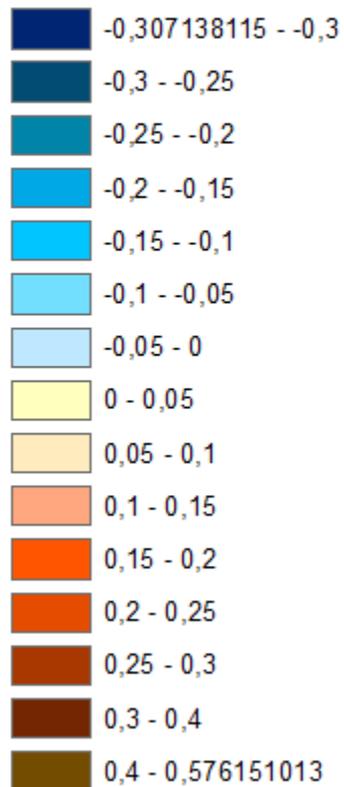
Landsat
NDVI
2015



Legend

Change_NDVI

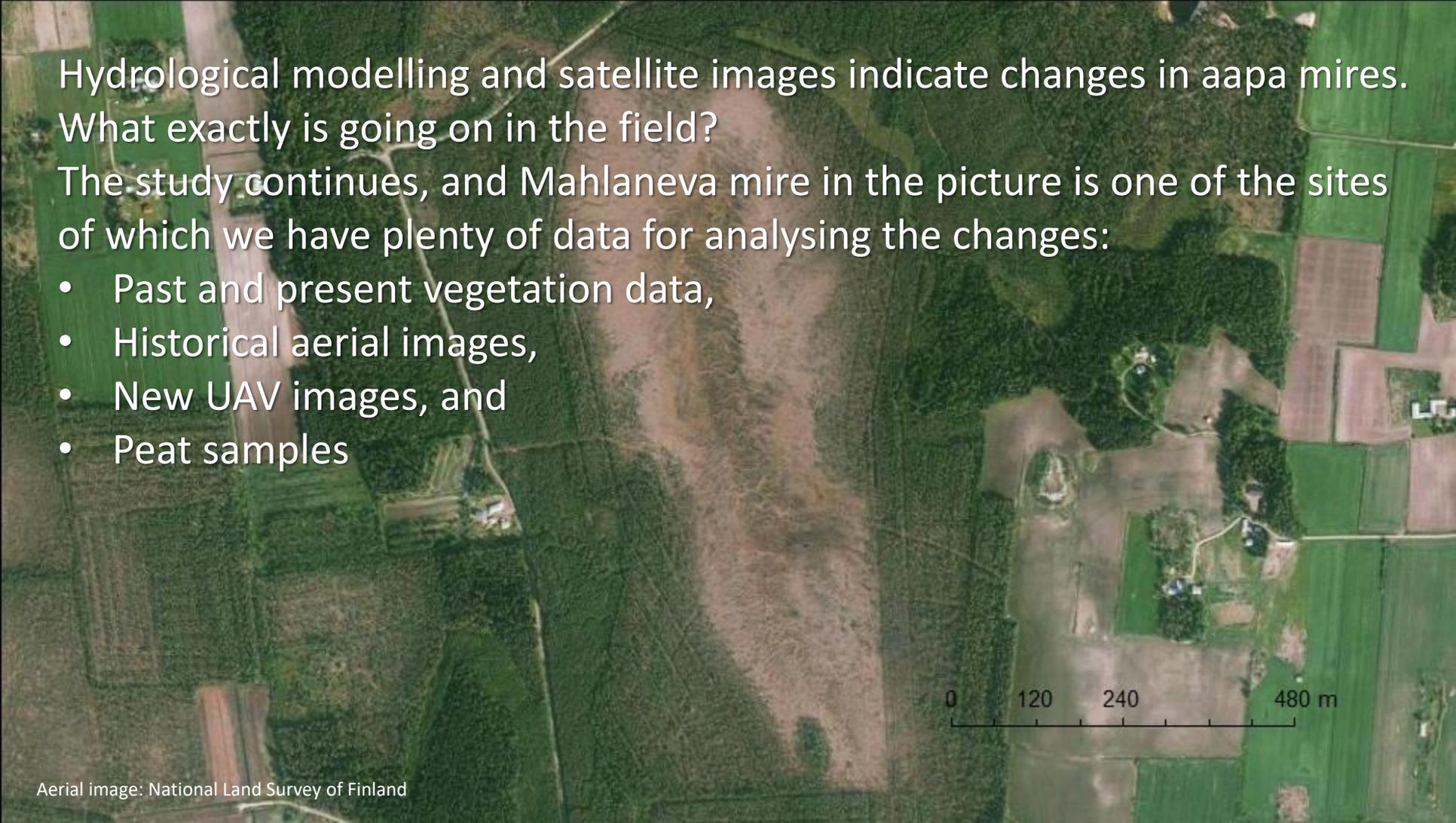
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7 Laskuneva mire, Kyyjärvi
Undrained area

Landsat
NDVI change
1985-2015



An aerial photograph showing a landscape with a large, irregularly shaped brownish area in the center, surrounded by green fields and forests. A scale bar at the bottom right indicates distances of 0, 120, 240, and 480 meters. The brownish area is the Mahlaneva mire, which is the focus of the study mentioned in the text.

Hydrological modelling and satellite images indicate changes in aapa mires. What exactly is going on in the field?

The study continues, and Mahlaneva mire in the picture is one of the sites of which we have plenty of data for analysing the changes:

- Past and present vegetation data,
- Historical aerial images,
- New UAV images, and
- Peat samples

0 120 240 480 m



Thank you for your attention

Contact: anttsal@uef.fi, antti.sallinen@ymparisto.fi



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