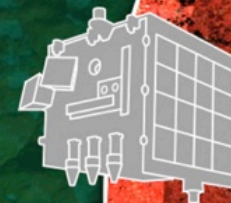


Ipve

→ LAND PRODUCT VALIDATION AND EVOLUTION 2018

27 February – 1 March 2018
ESA-ESRIN | Frascati (Rome), Italy

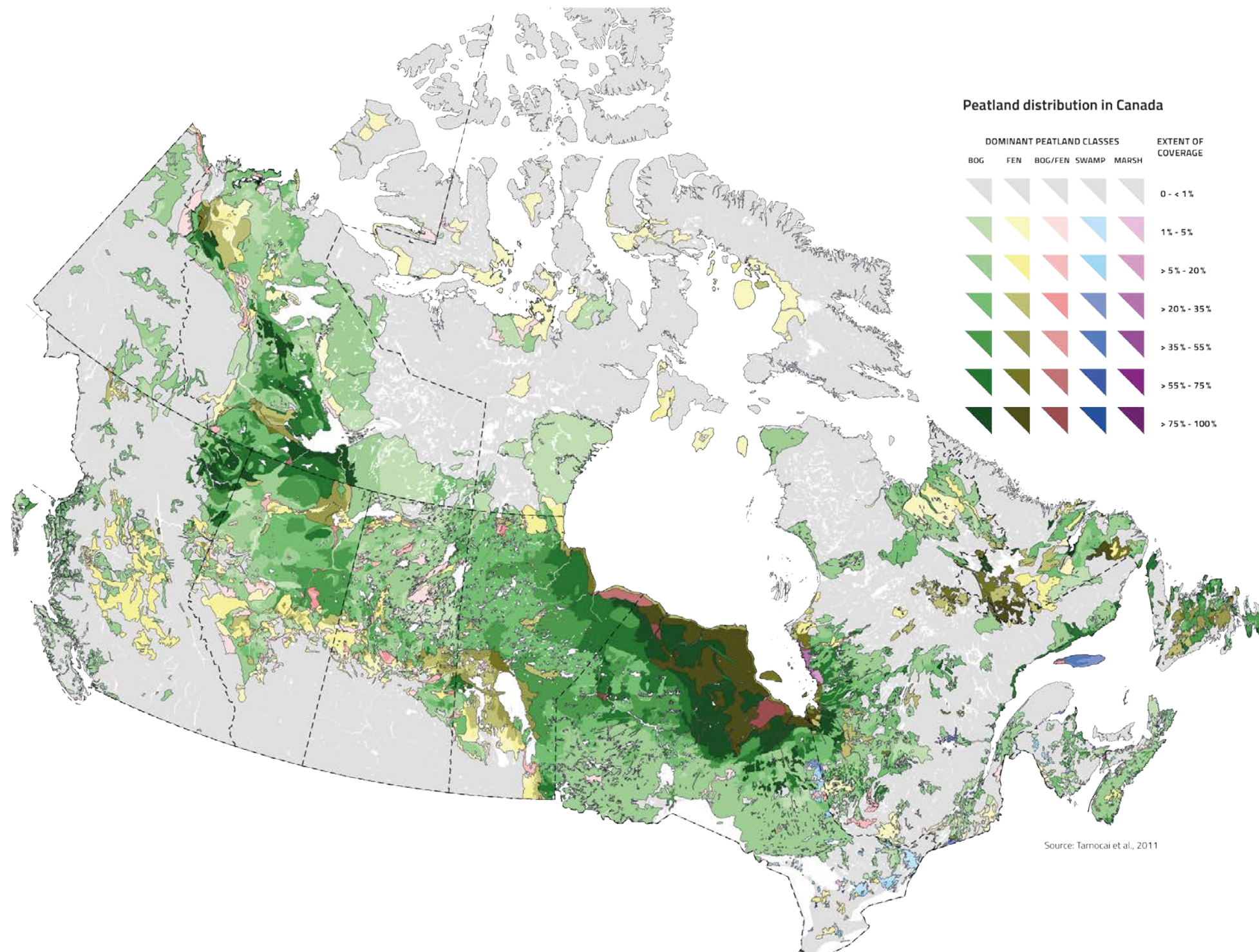


Phenological Spectral Trends at the Mer Bleue Arctic Surrogate Simulation Site

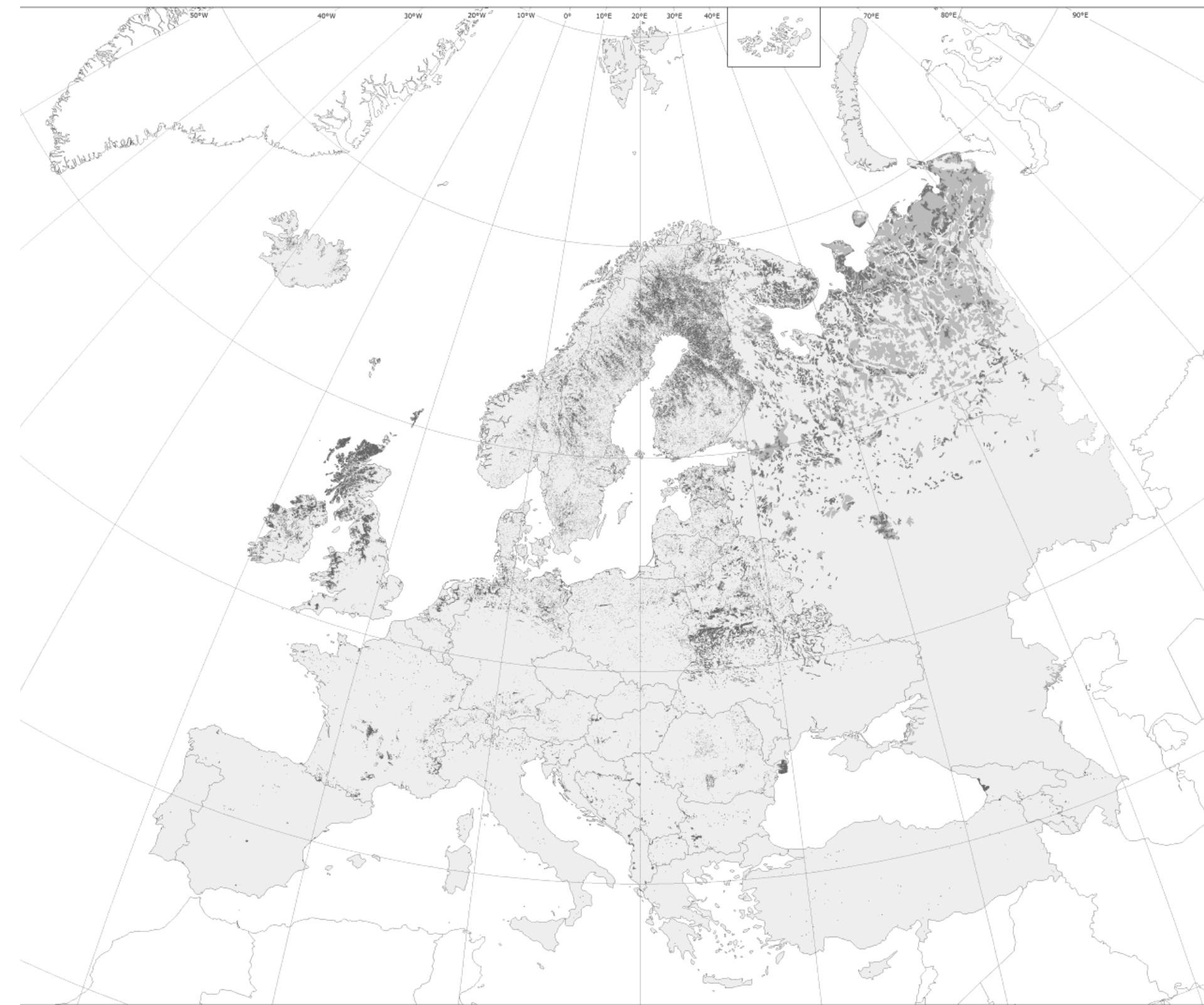
Implementation of Field Spectroscopy and Hyperspectral Airborne Multitemporal Datasets to Validate Sentinel-2 Land Products for Northern Peatlands

Arroyo-Mora J.P. , Kalacska M., Soffer R. J. , Ifimov G., Leblanc G.



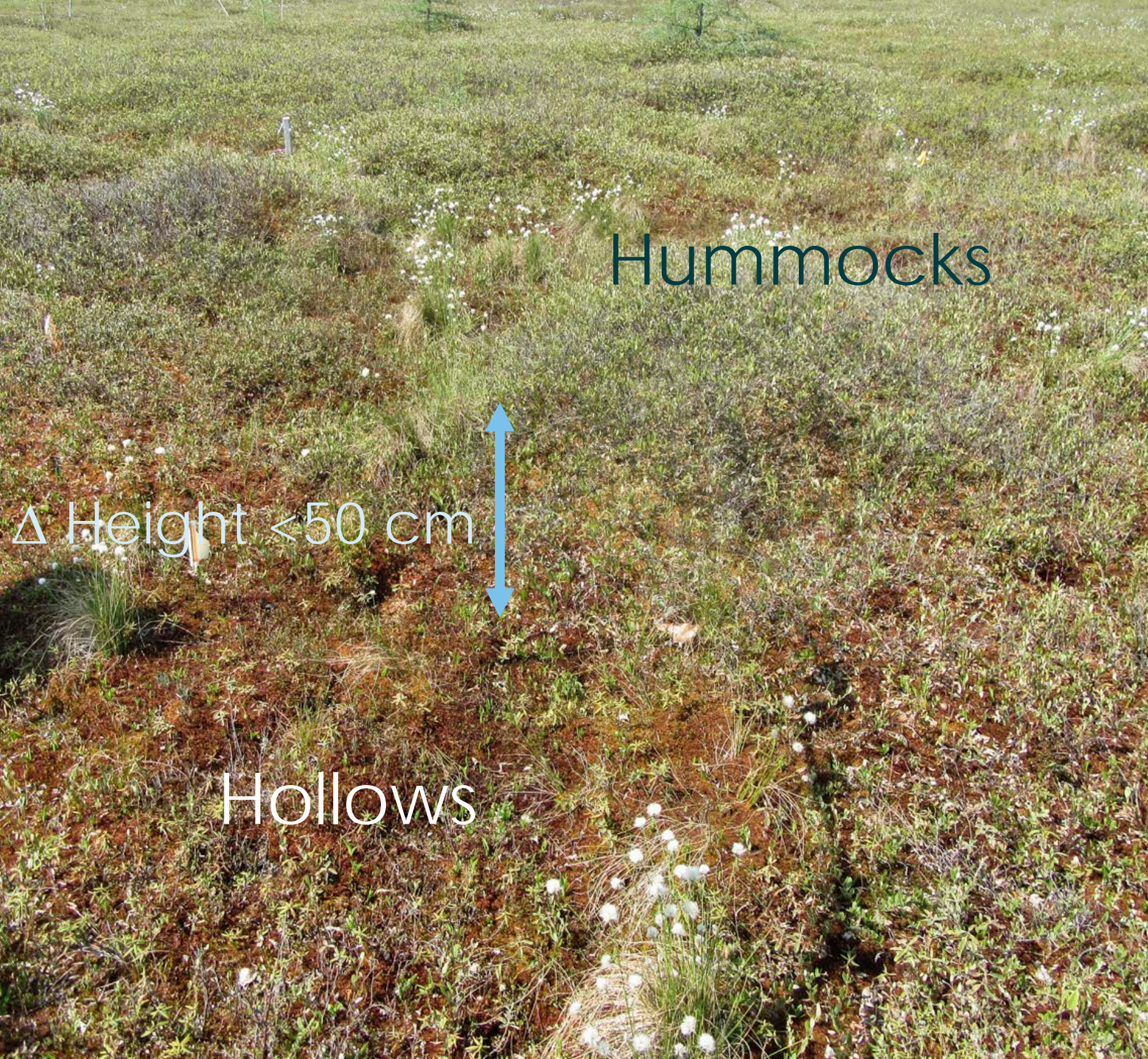


- Peatlands are wetlands with at least 40 cm of accumulated peat (3% global surface).
- Peatlands play a significant role in the global carbon cycle and climate regulation (30% C).
- Peatlands cover 113.6 M hectares in Canada (13% surface area)
- Response to climate change?

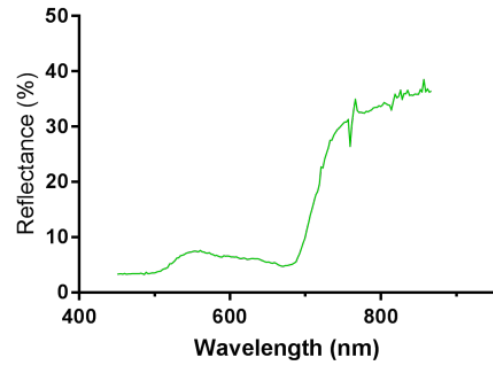


- Europe: 593,727 km² (>30 cm depth)
- > 1,000,000 km² (incl. <30 cm).
- Approximately 10 % of the total surface area
- Still peatlands are ignored in most global models
- Aggregated with other wetlands

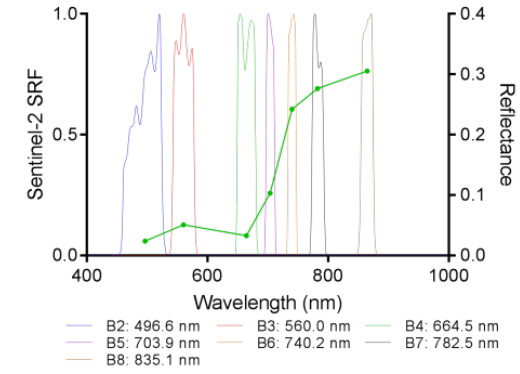
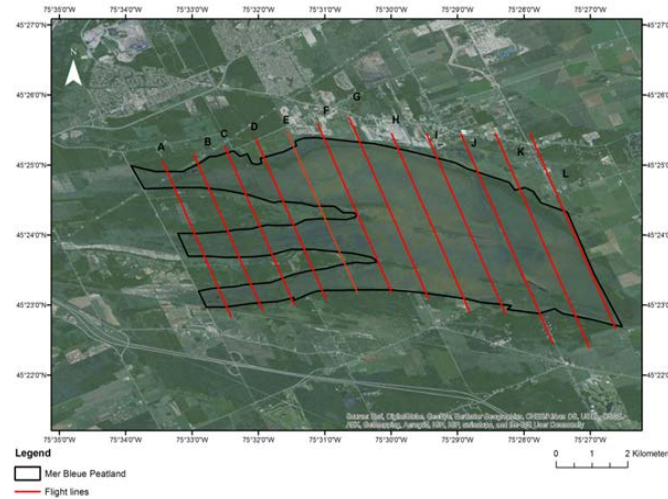
Tanneberger et al. 2016.
The peatland map of Europe . *Mires and Peat*



Phenological changes (Greening up)



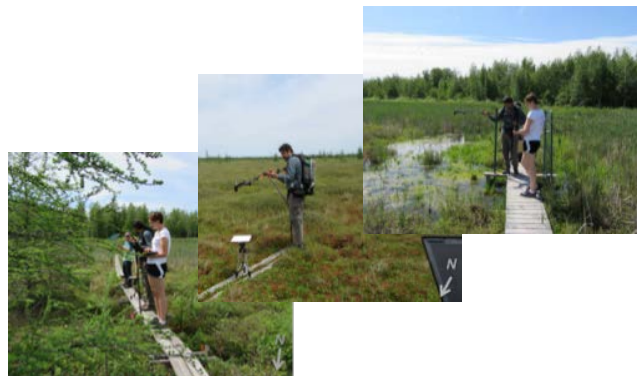
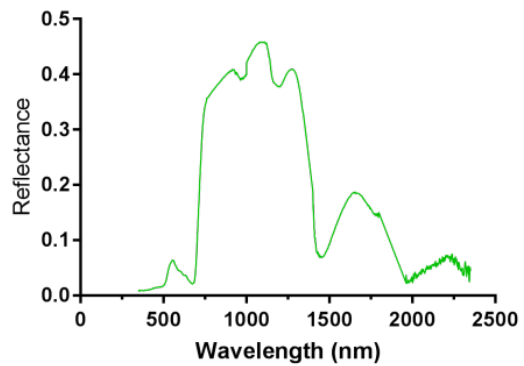
Airborne HSI



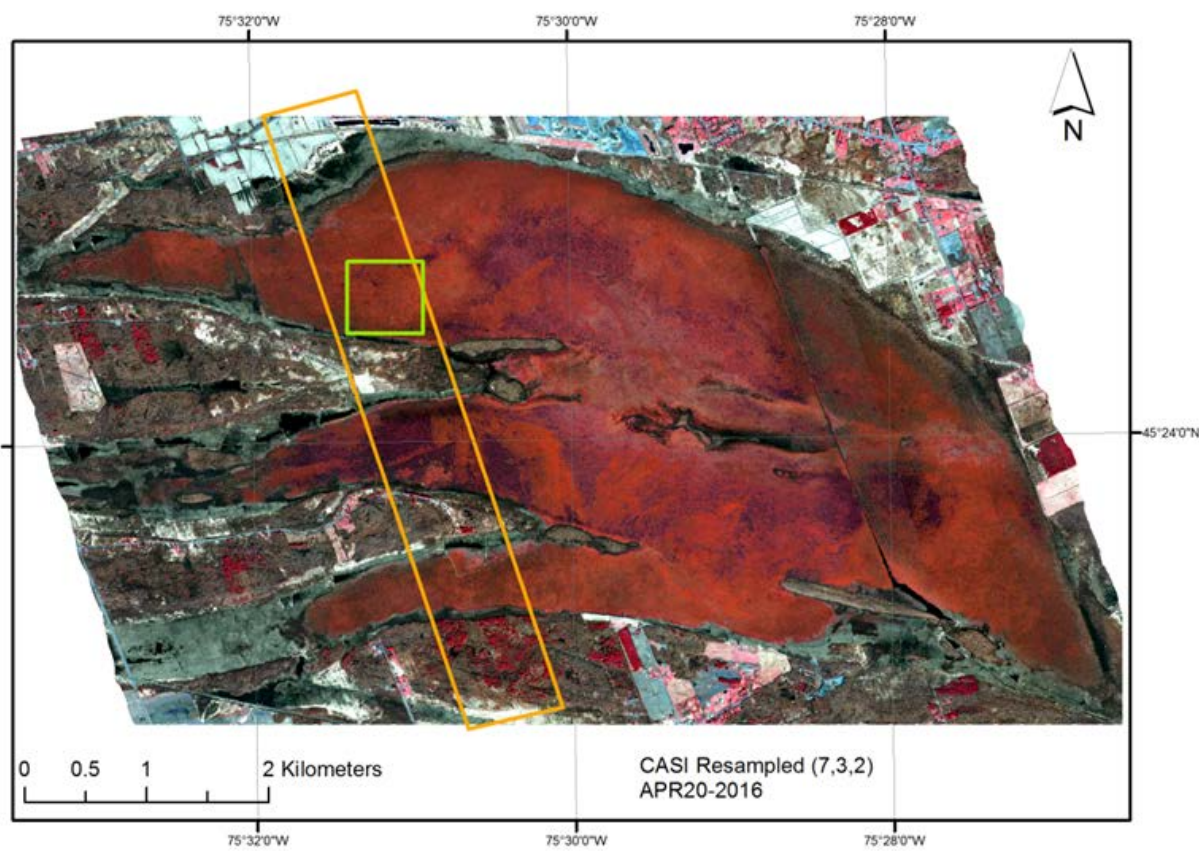
Sentinel-2 Satellite



Field Spectroscopy



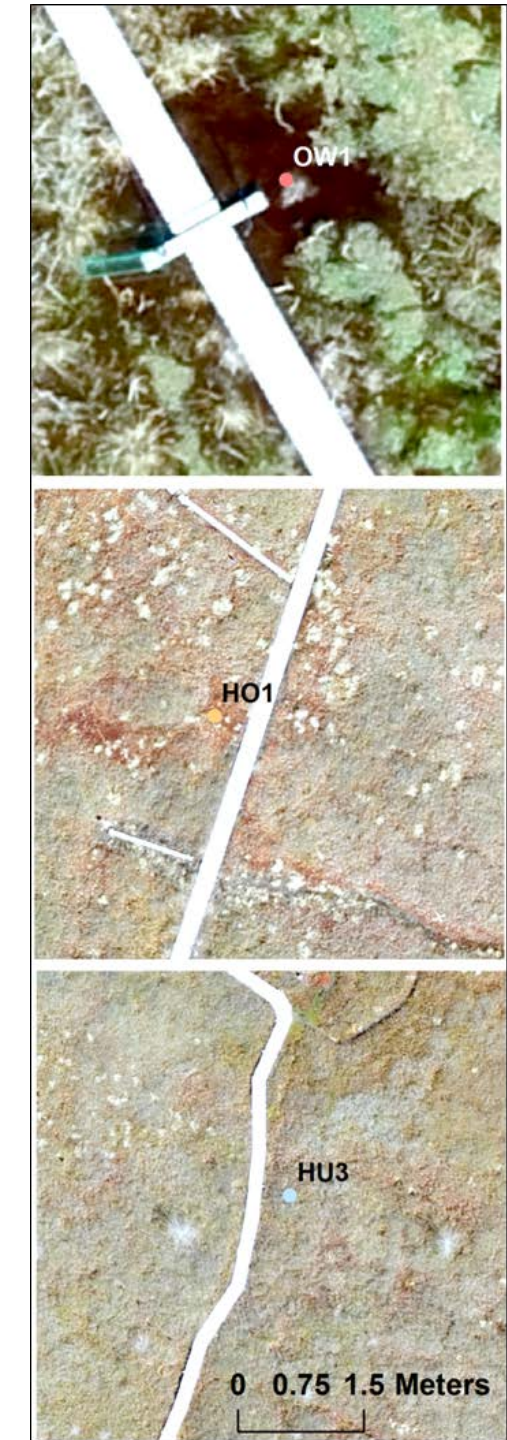
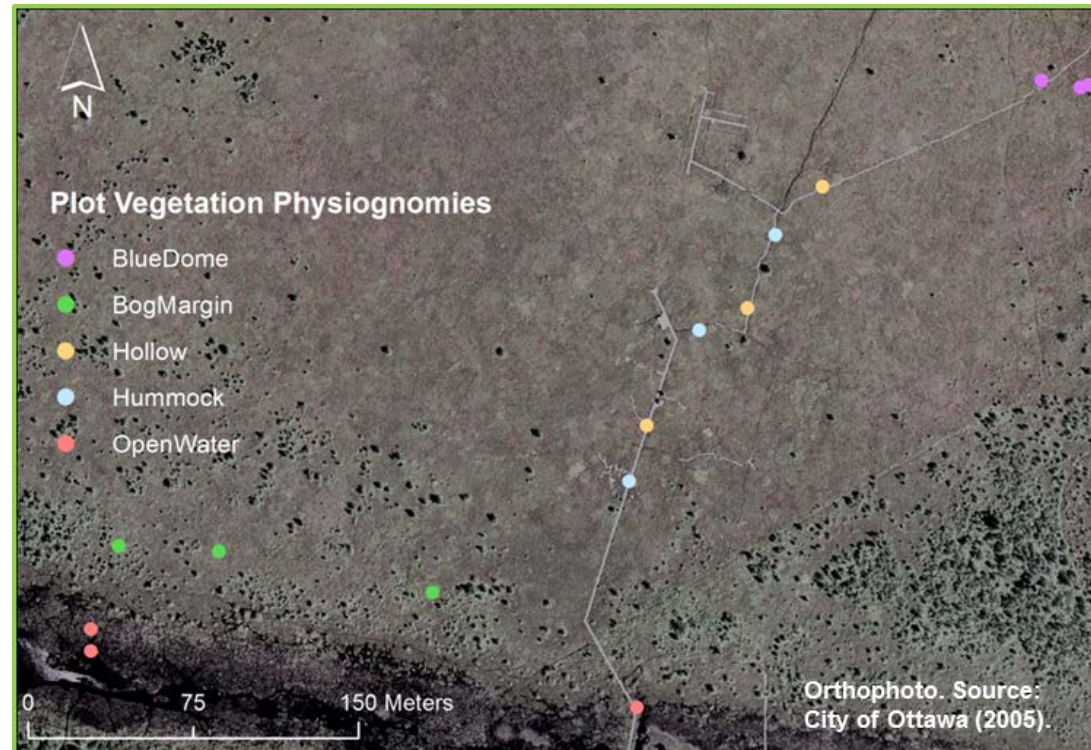
- To compare data products (reflectance and vegetation indices) for hyperspectral airborne and Sentinel-2 imagery, for four time periods. Aim is to capture phenological changes (greening up) at the landscape level at the Mer Bleue ombrotrophic peatland.



Field Plots for Field Spec.

Mer Bleue Conservation Area

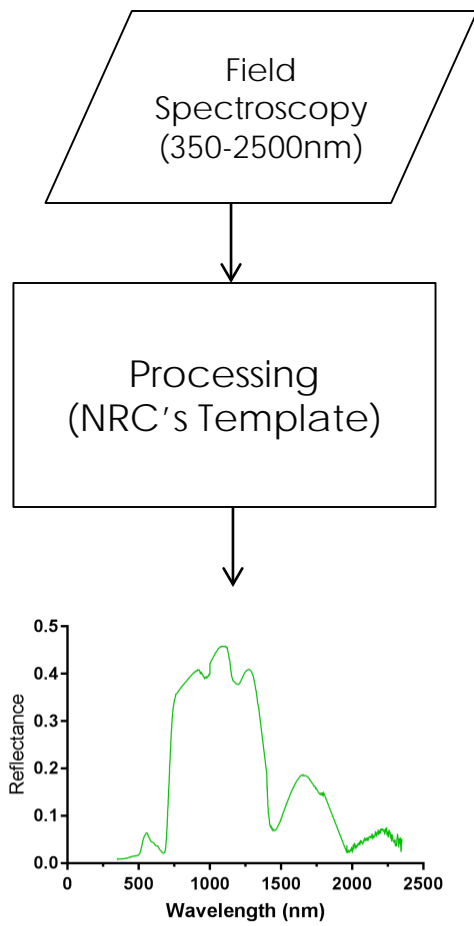
- Surrogate site for high latitude peatland ecosystems
- 35 km²
- 10 km from Ottawa Int. Airport
- Long-term peatland research site
- Tower measurements since 1988



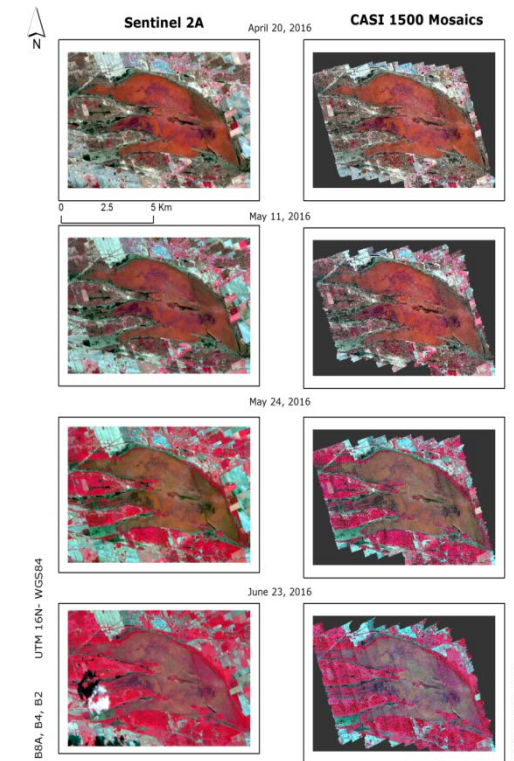
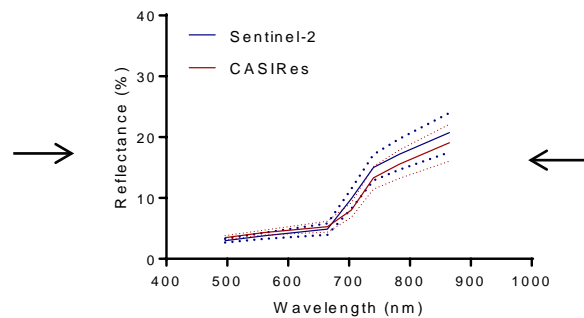
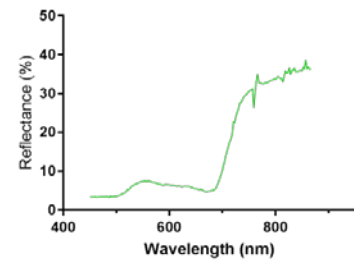
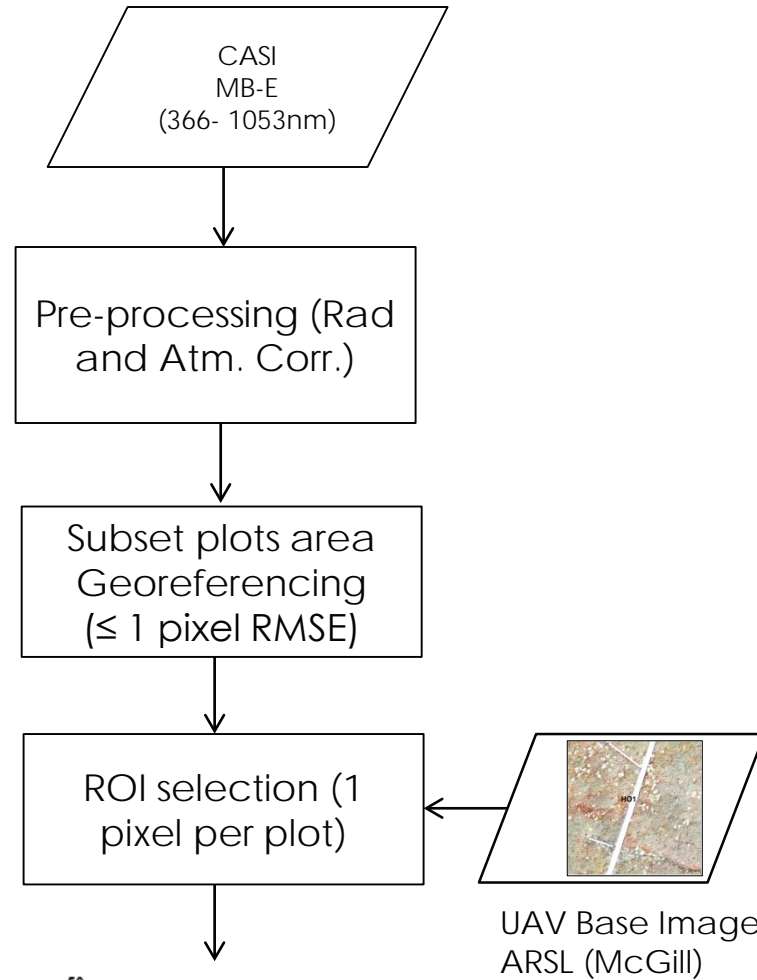
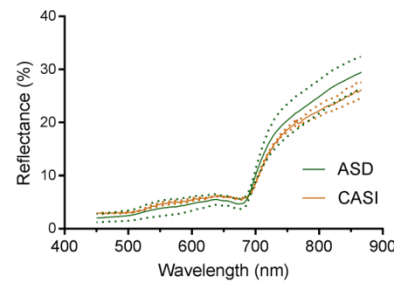
UAV Base Image ARSL (McGill)

Field Spec. vs CASI Assessment

CASI Res. vs S-2 Assessment

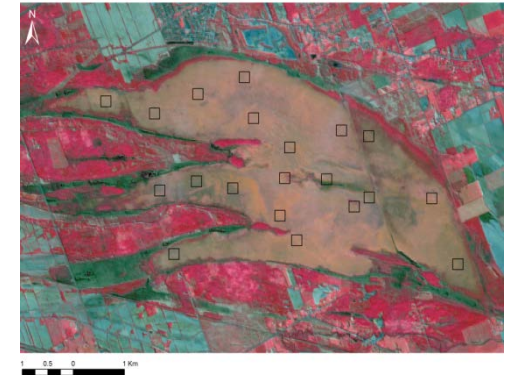


Average 3 plots per vegetation physiognomies (Sentinel-2 spectral range)



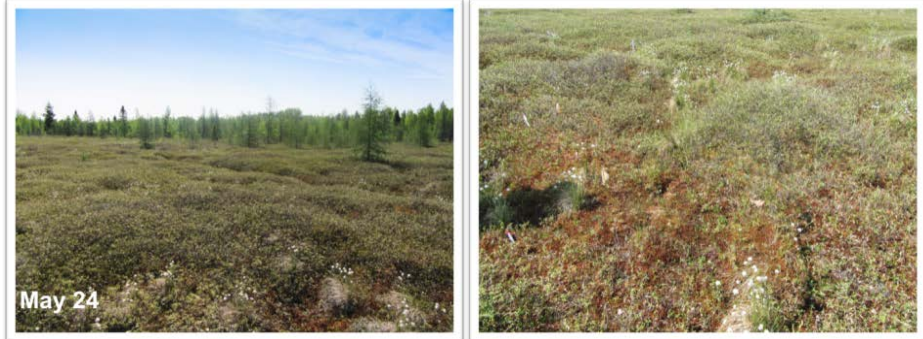
Bottom of the atmosphere reflectance Sentinel-2 Image (June 23, 2016)

- CASI resampled to Sentinel-2 pixel size and Spectral Response Function (SRF)
- 20 random plots (5x5 pixels= 1ha)
- ROIs reflectance values (2 datasets)

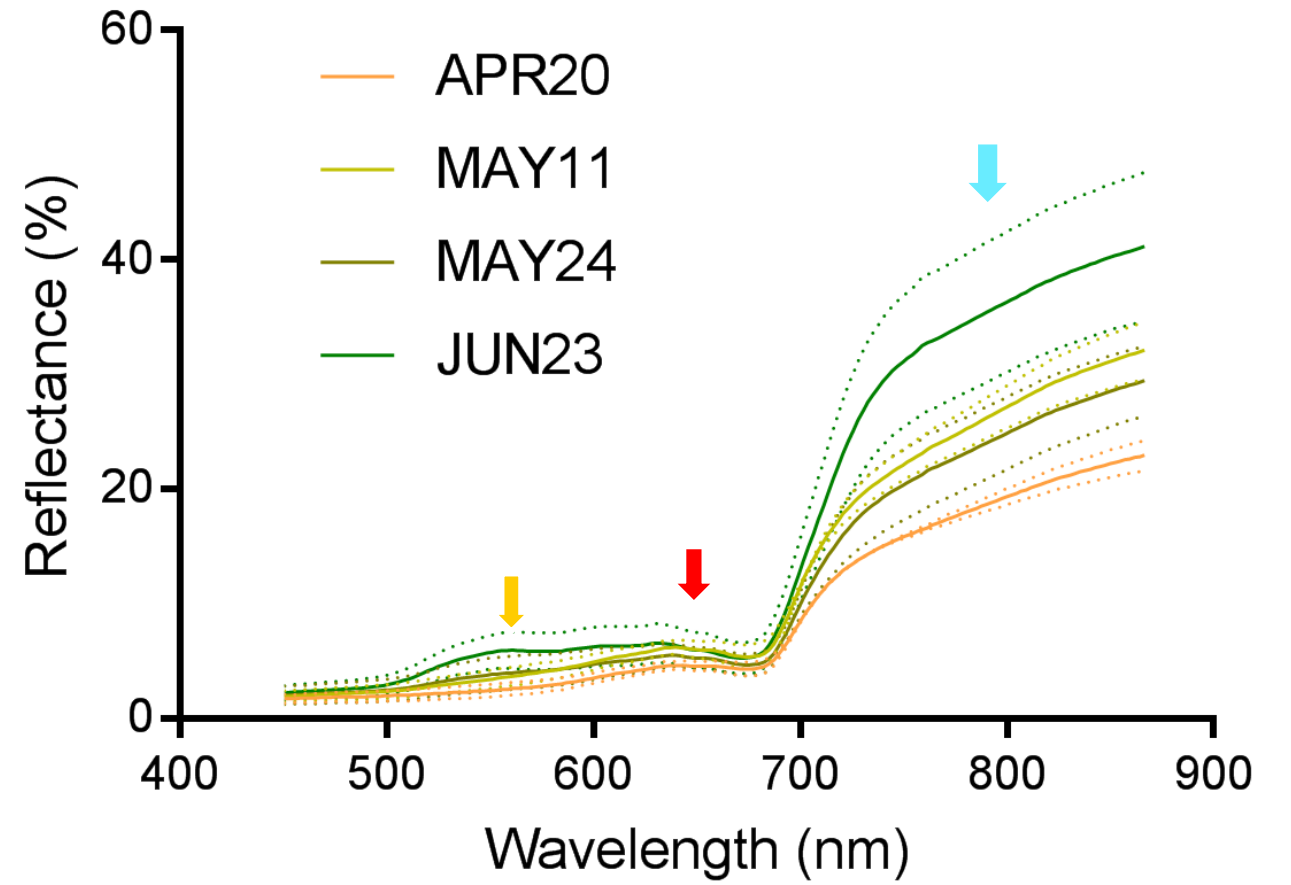


Vegetation Index	Formula (Sentinel-2 reflectance channels)	Reference
NDVI	$(NIR_{B8} - R_{B4}) / (NIR_{B8} + R_{B4})$	Rouse et al. (1974)
SR	NIR_{B8} / R_{B4}	Birth and McVey (1968)
RENDVI	$(NIR_{B6} - NIR_{B5}) / (NIR_{B6} + NIR_{B5})$	Gitelson and Merzlyak (1994)

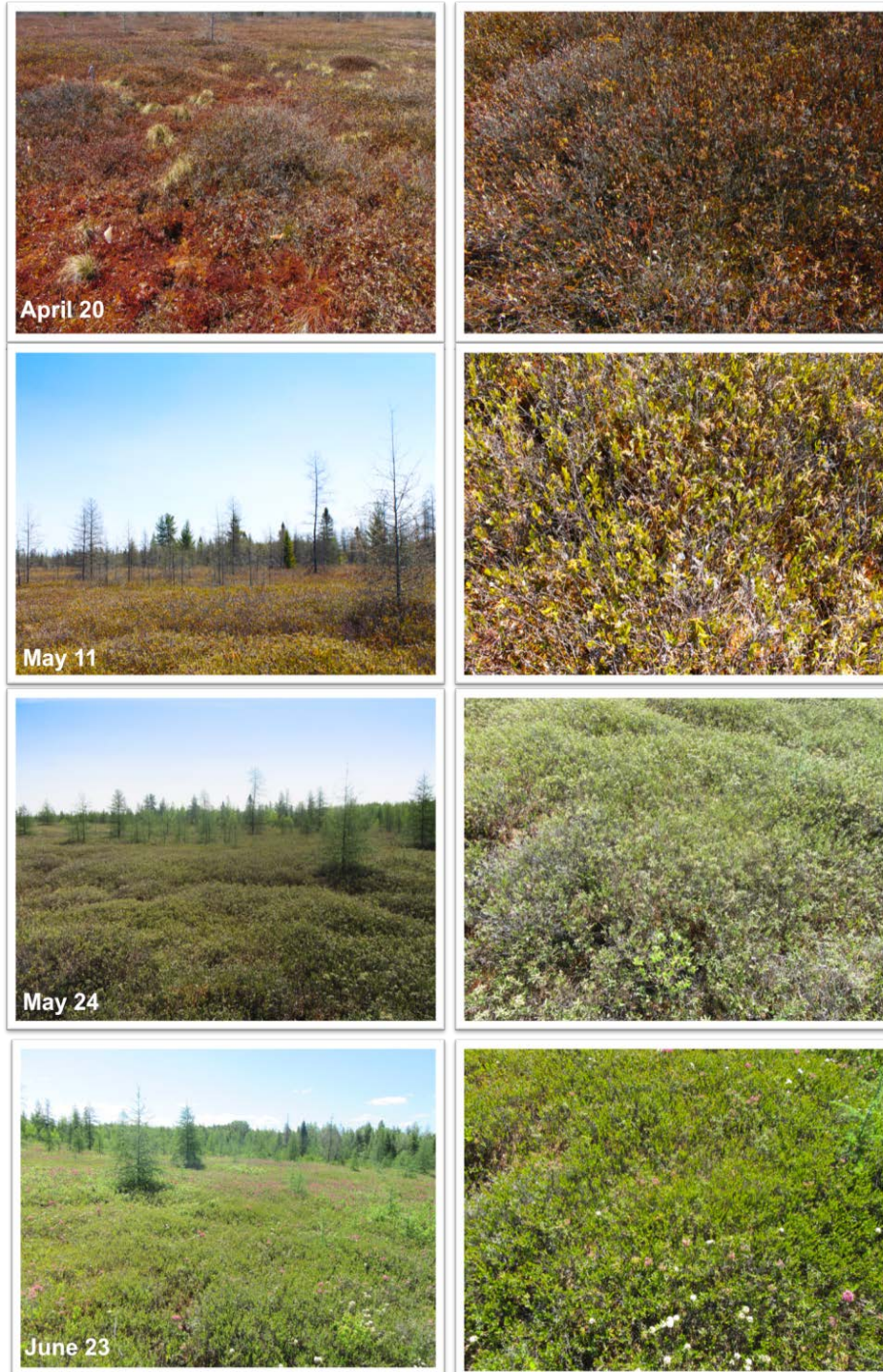
HOLLOWS



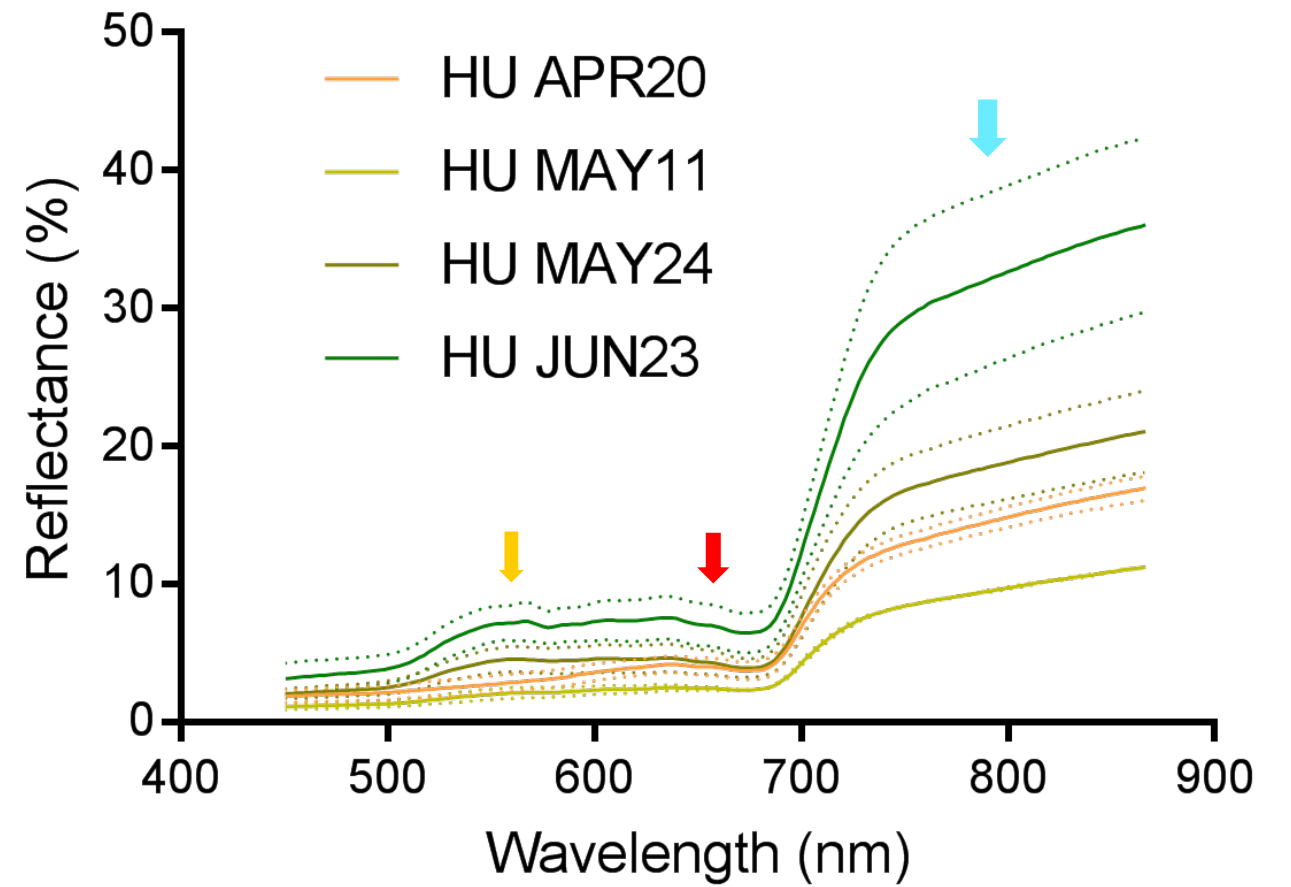
UAV: 2 cm res.



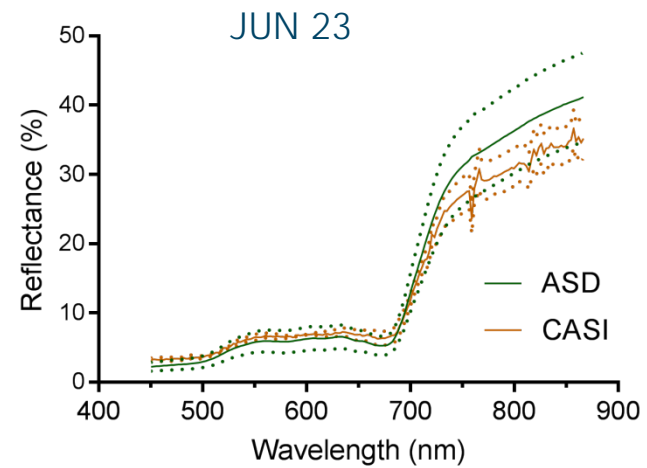
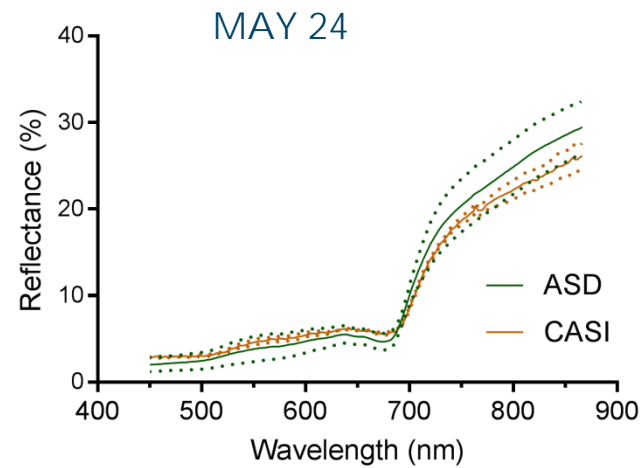
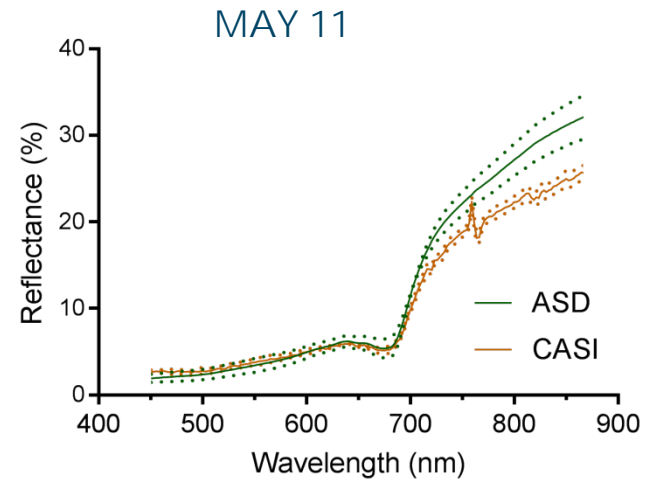
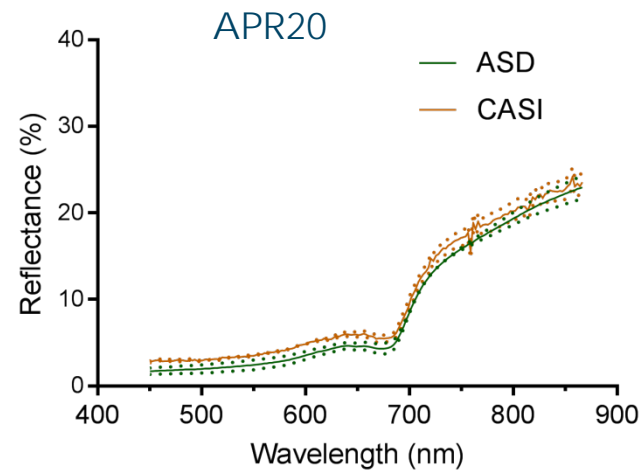
HUMMOCKS



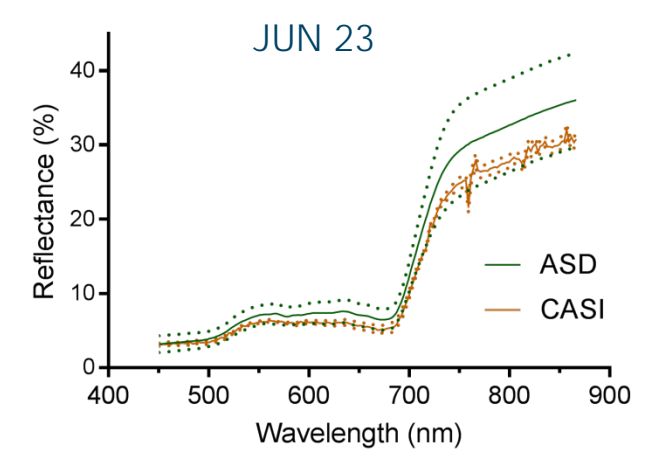
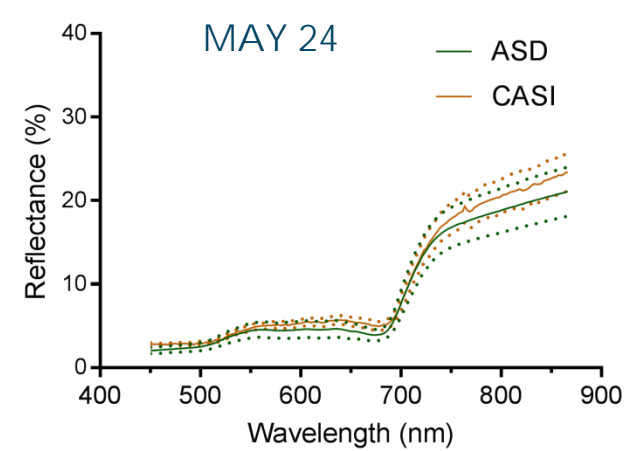
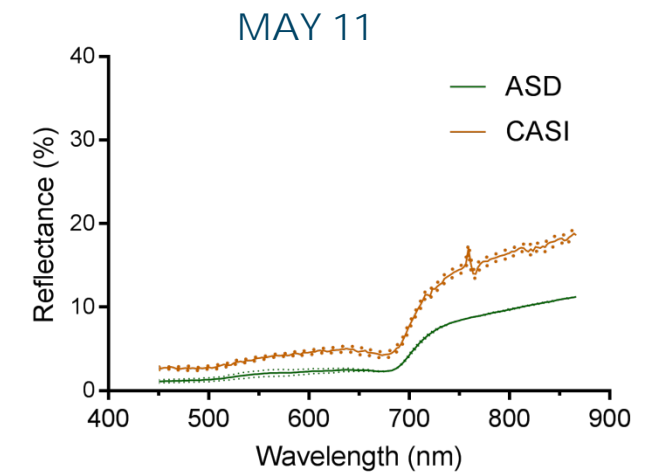
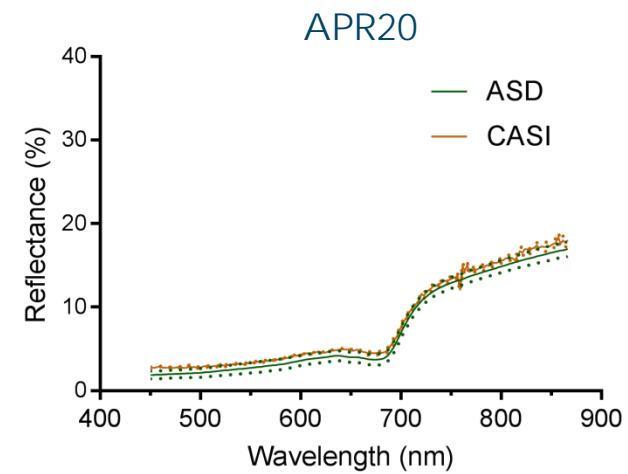
UAV: 2 cm res.

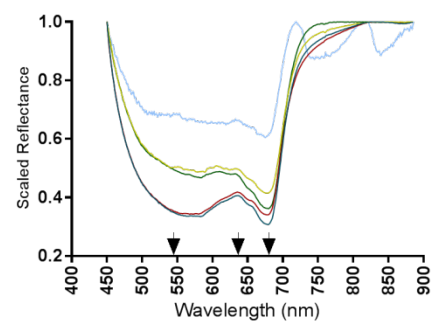


HOLLOWS



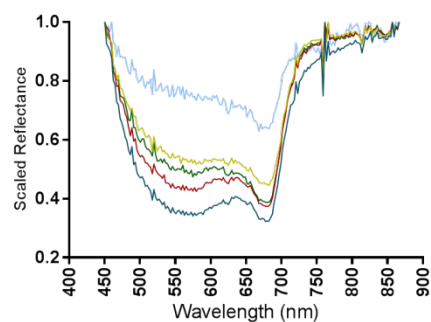
HUMMOCKS





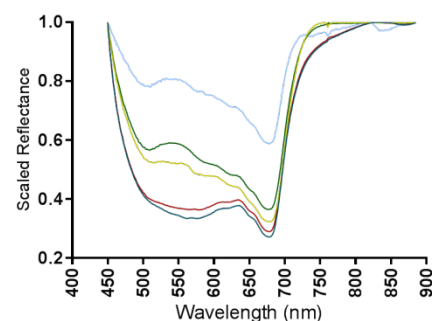
— BD
— BM
— HO
— HU
— OW

a)



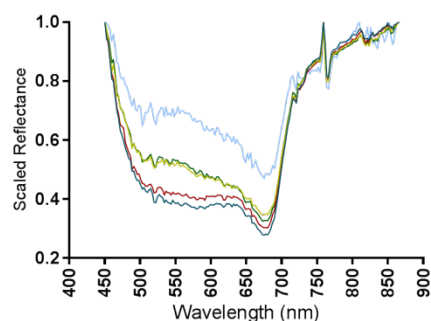
— BD
— BM
— HO
— HU
— OW

b)



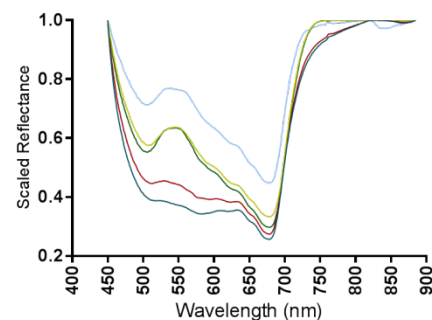
— BD
— BM
— HO
— HU
— OW

c)



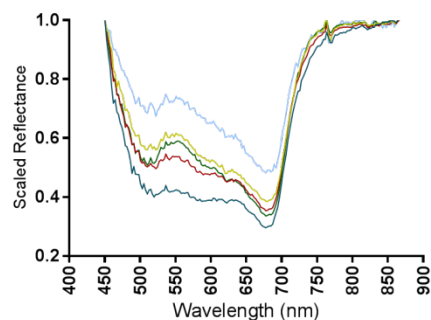
— BD
— BM
— HO
— HU
— OW

d)



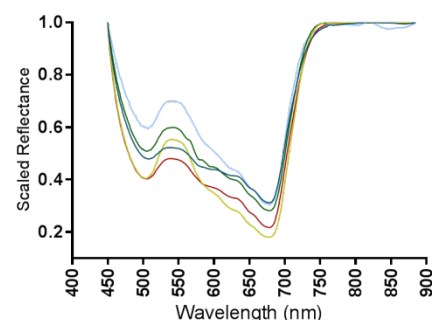
— BD
— BM
— HO
— HU
— OW

e)



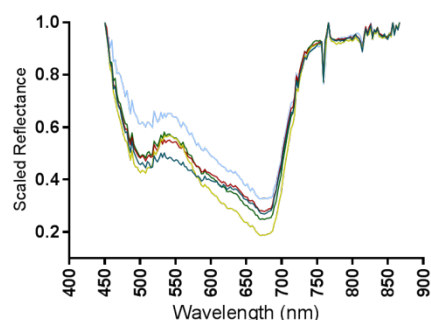
— BD
— BM
— HO
— HU
— OW

f)



— BD
— BM
— HO
— HU
— OW

g)



— BD
— BM
— HO
— HU
— OW

h)

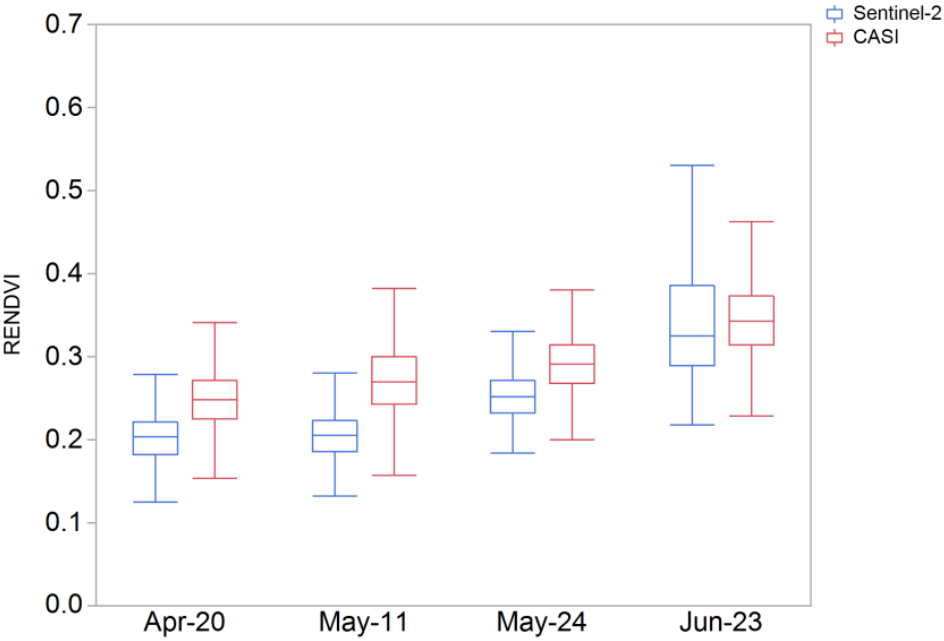
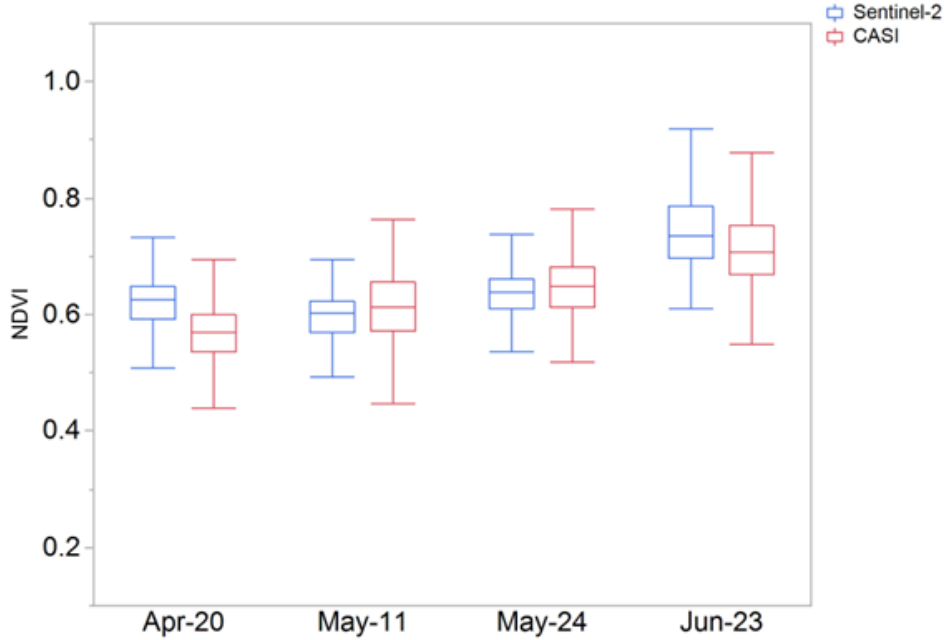
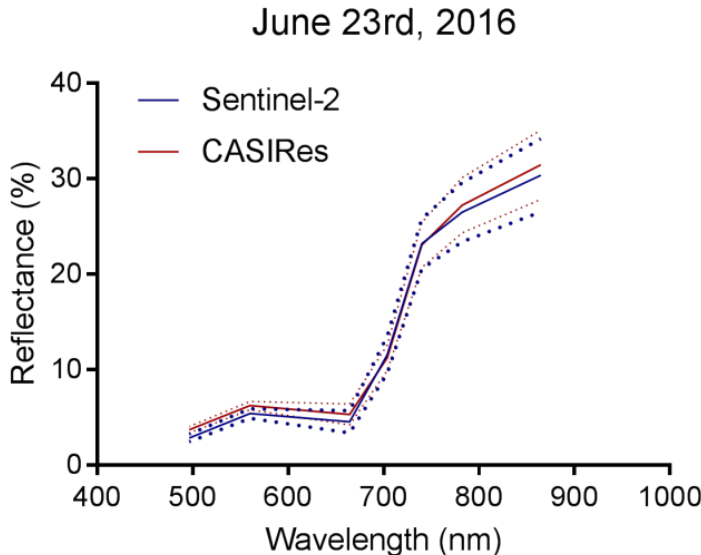
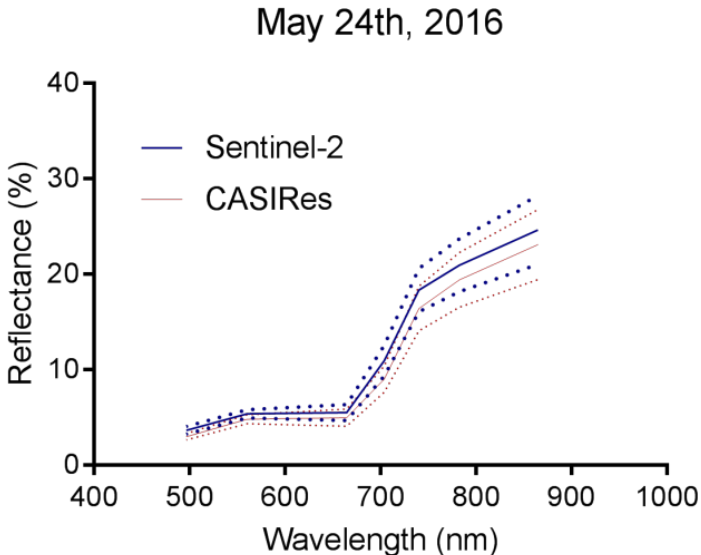
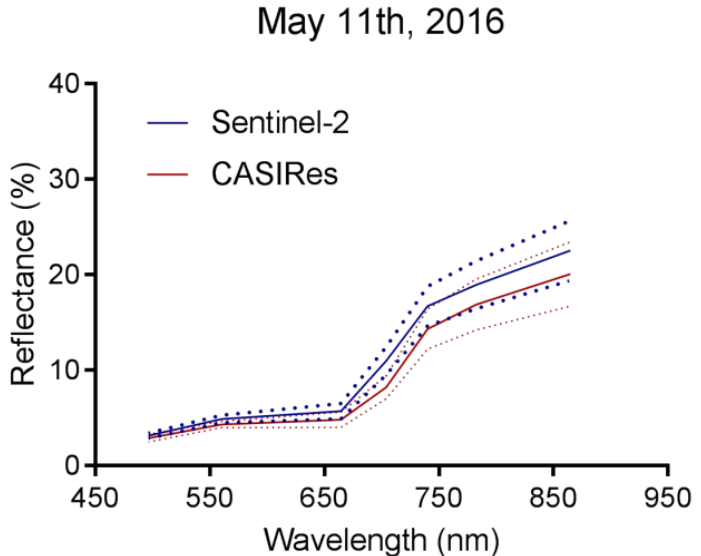
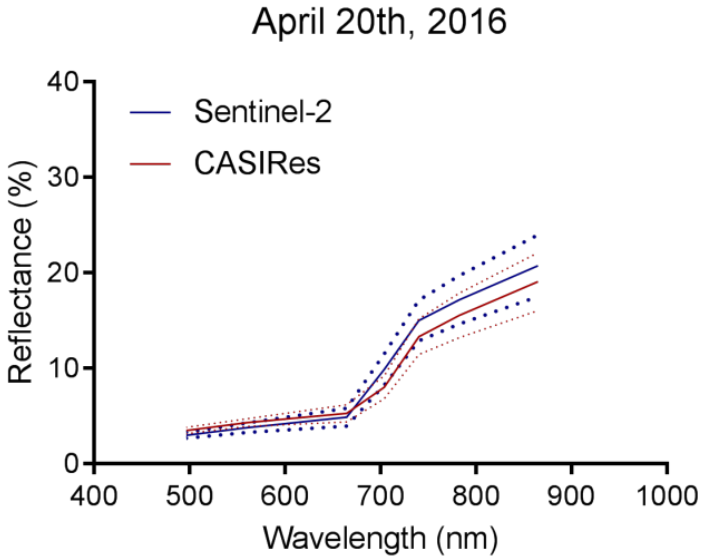
- Three spectral features revealed by the continuum removal analysis and consistent between Field-Spec and HSI:

- Global minima: 675-680 nm, 668-682 nm
- Local maxima around 650 nm APR-MAY specially Hollows and Blue Dome
- Global maxima in green region captures vegetation greening

- First derivative results consistent with spectral features revealed by continuum removal

- Second derivative results indicate wider inflection points around the green peak for field spectra

CASI Res. vs S-2 Assessment



- Unique approach with the integration of field spectroscopy, airborne hyperspectral and Sentinel-2 for validating satellite products over time.
- Three datasets with different spectral and spatial characteristics captured Mer Bleue phenological changes between April and June 2016.
- Results consistent with what we know about Mer Bleue, but now capture at the landscape level for the first time.



uCASI (400-900 nm)

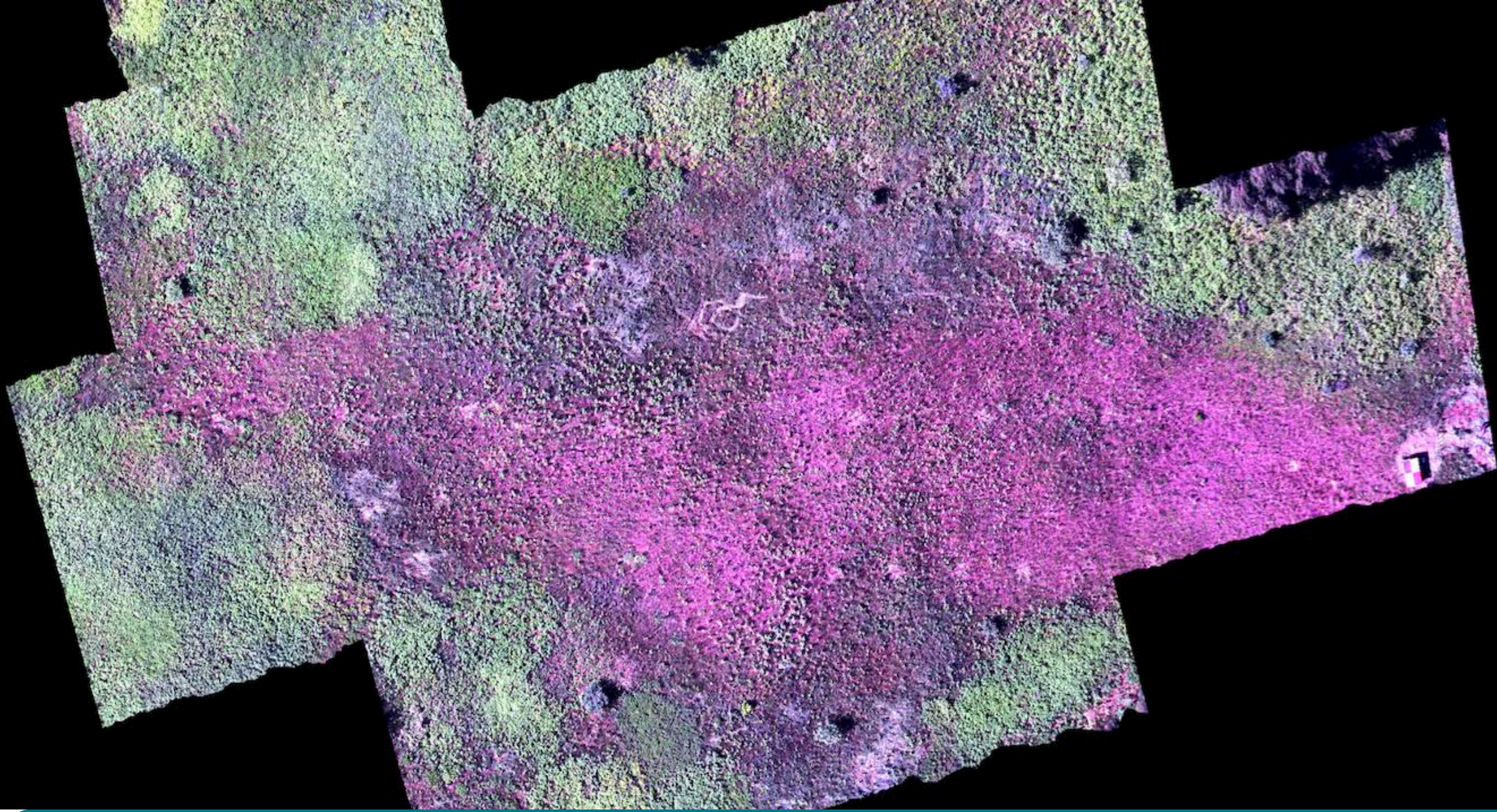
- Matrice 600 Pro (D-RTK)
- uCASI-UAV system 16 kg
- IMU/GPS
- 3 axes gimbal
- Vibration isolation

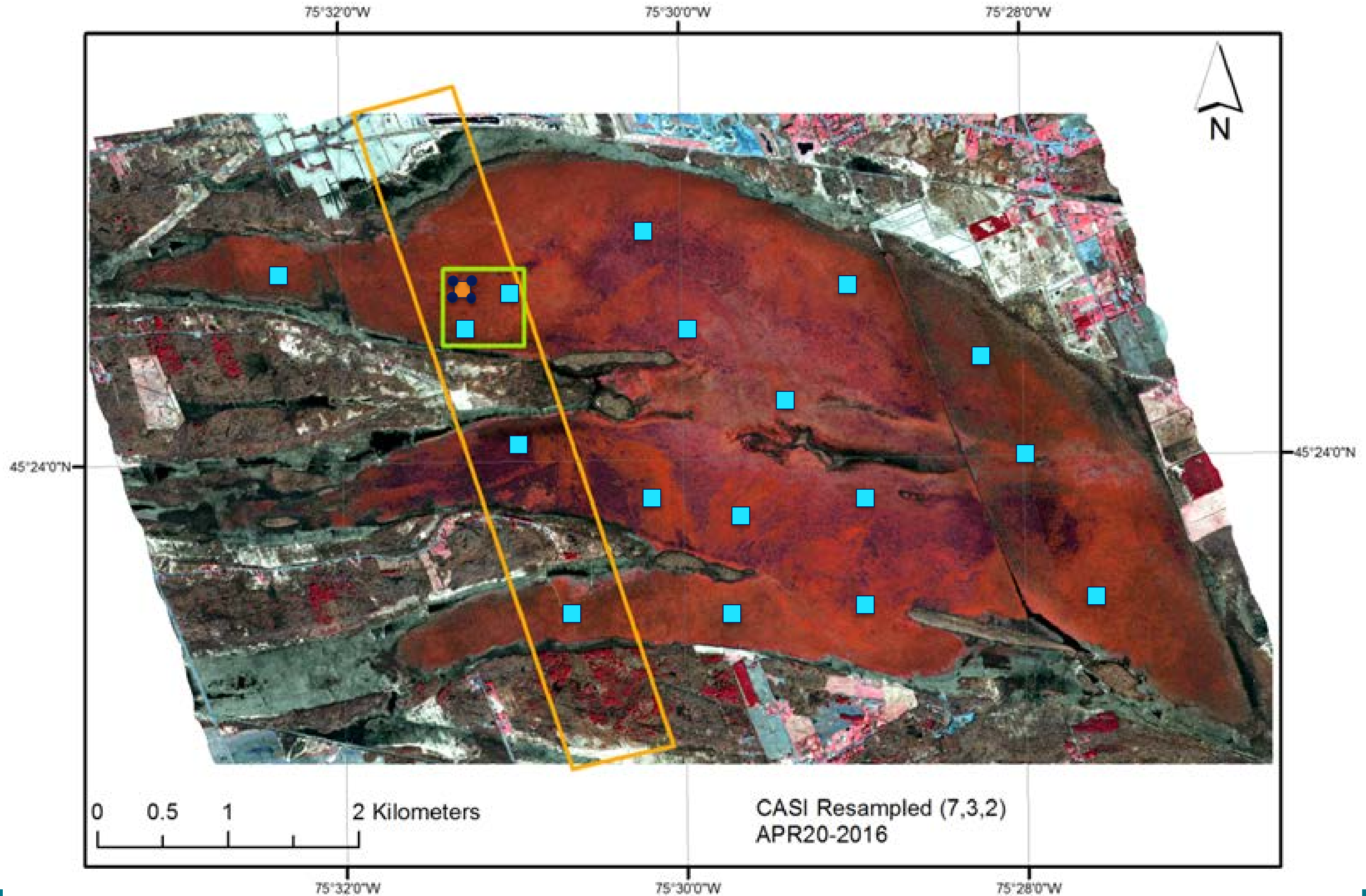
Inspire 2

- X5S camera
- M4/3 sensor
- 20.8 Megapixels
- 72 FOV
- 5280 x 3956 pixels

M600Pro

- Canon 5D MarkIII
- D-RTK Geotags





Thank you

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