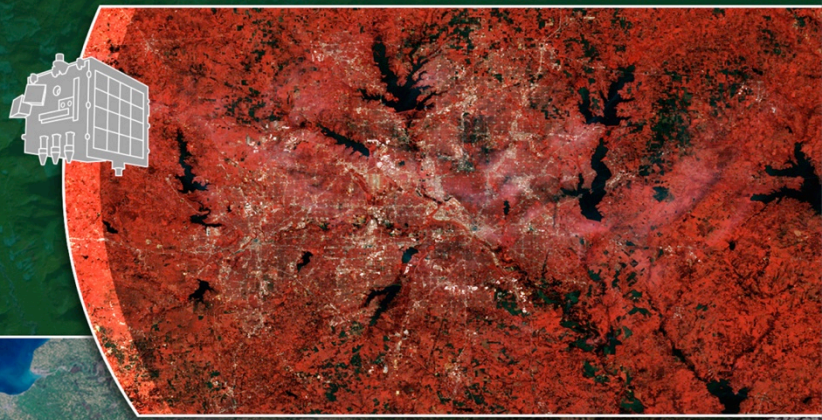
lpve

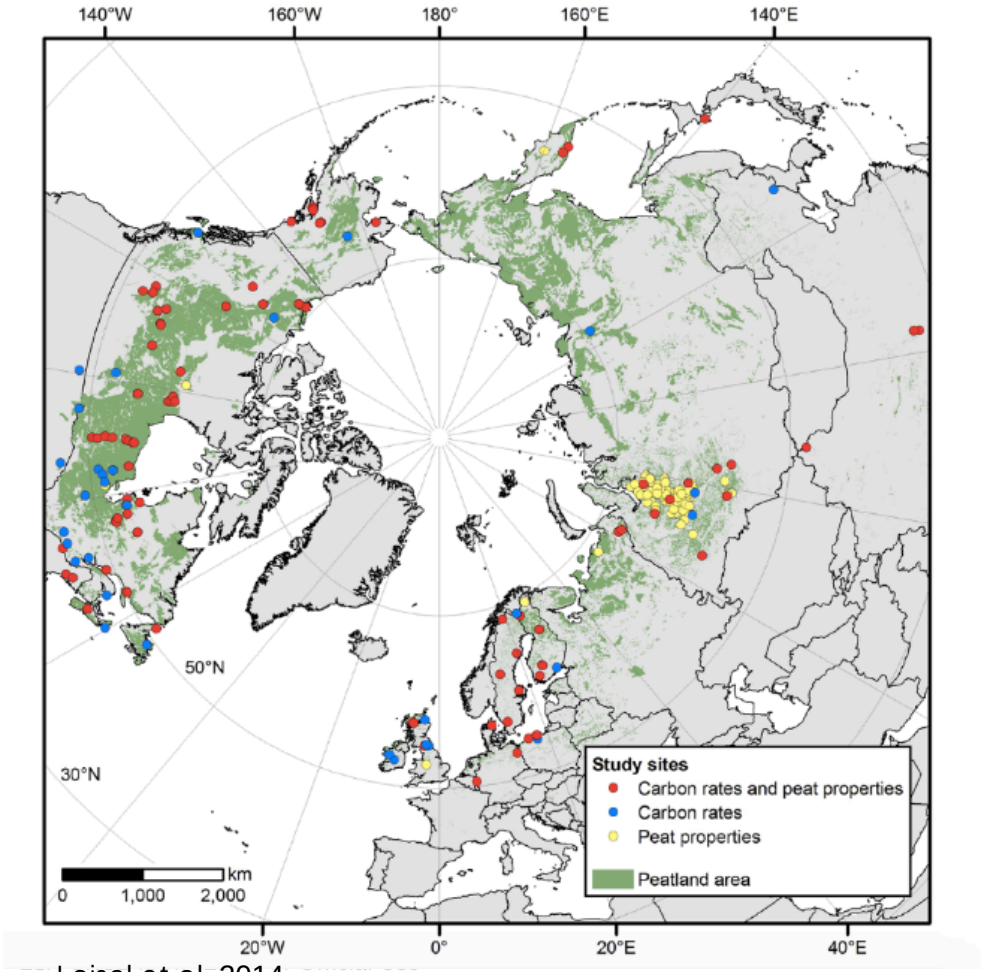
→ LAND PRODUCT VALIDATION AND EVOLUTION 2018

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



MULTI-TEMPORAL ESTIMATIONS OF PEATLAND NEE FROM AIRBORNE AND SATELLITE IMAGERY

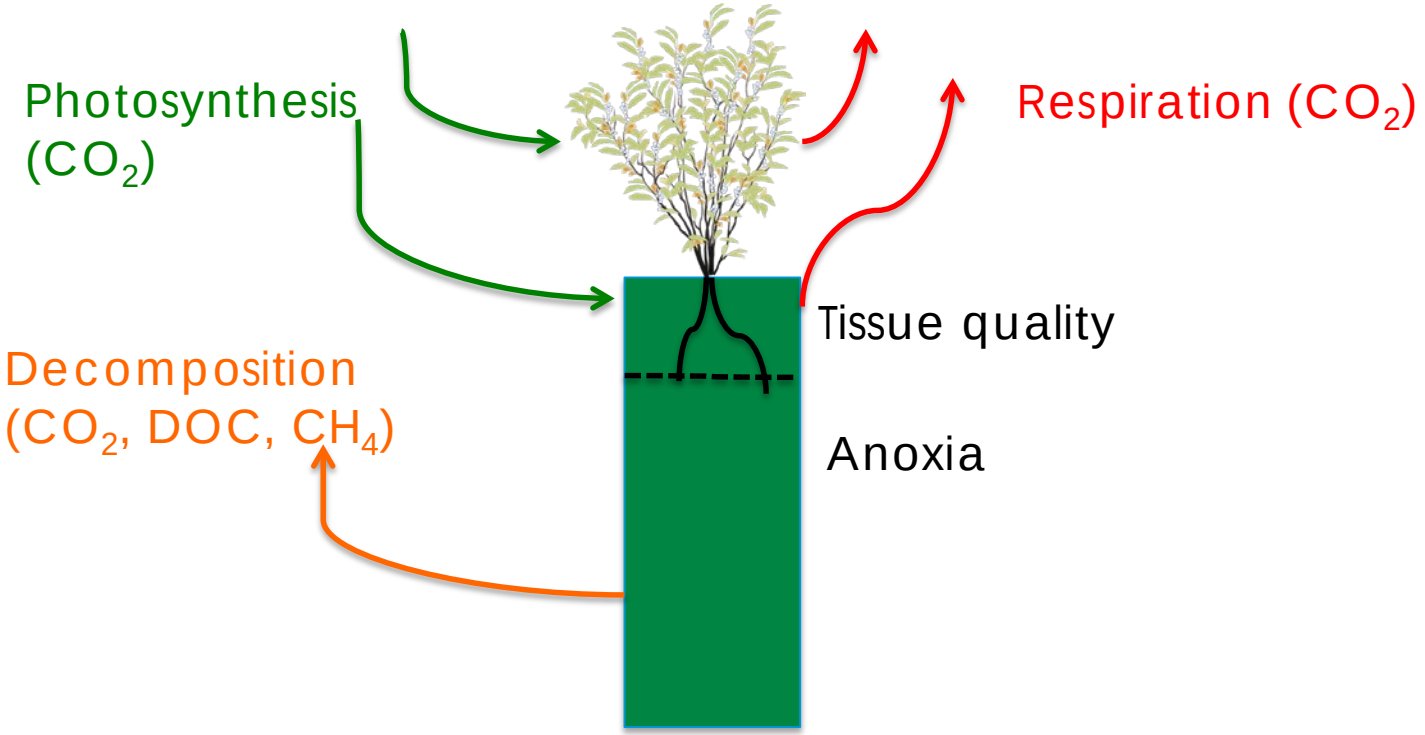
Kalacska M., Arroyo-Mora J.P., Soffer, R.J., Roulet N.T., Moore T.R., Humphreys E., Leblanc G., Lucanus O., Inamdar D.



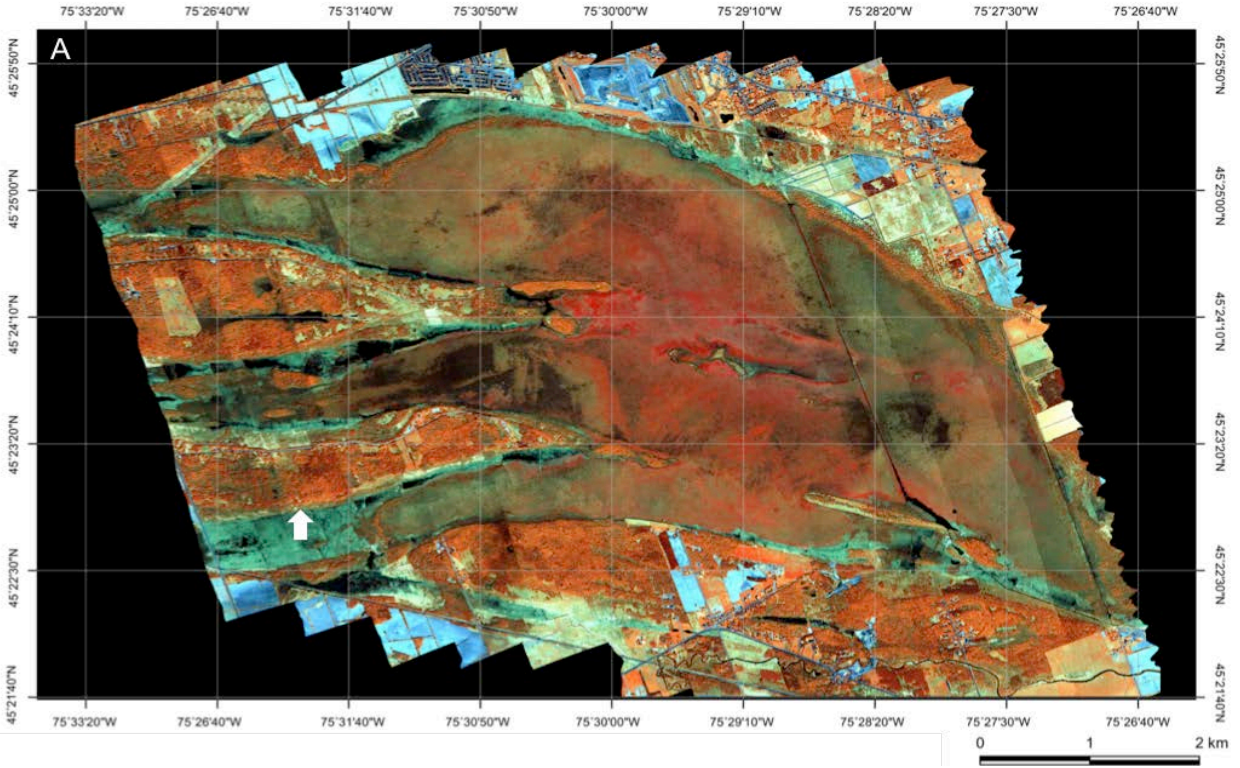
Loisel et al. 2014

- Peatlands valued for long-term C accumulation (cooling influence on climate)
- High C density (> 500 Gt C)
  - ~30% of global SOC
- Diversity – swamps, bogs, fen
- Slow decomposition of organic matter
- Globally 4-5 million km^2
- Canada - 22 million tons of C per year

Carbon budget



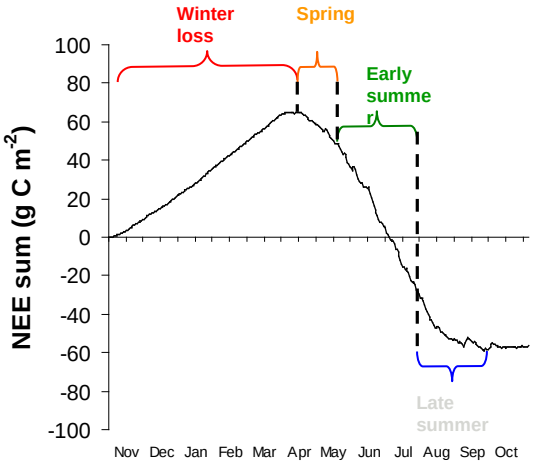
Mer Bleue

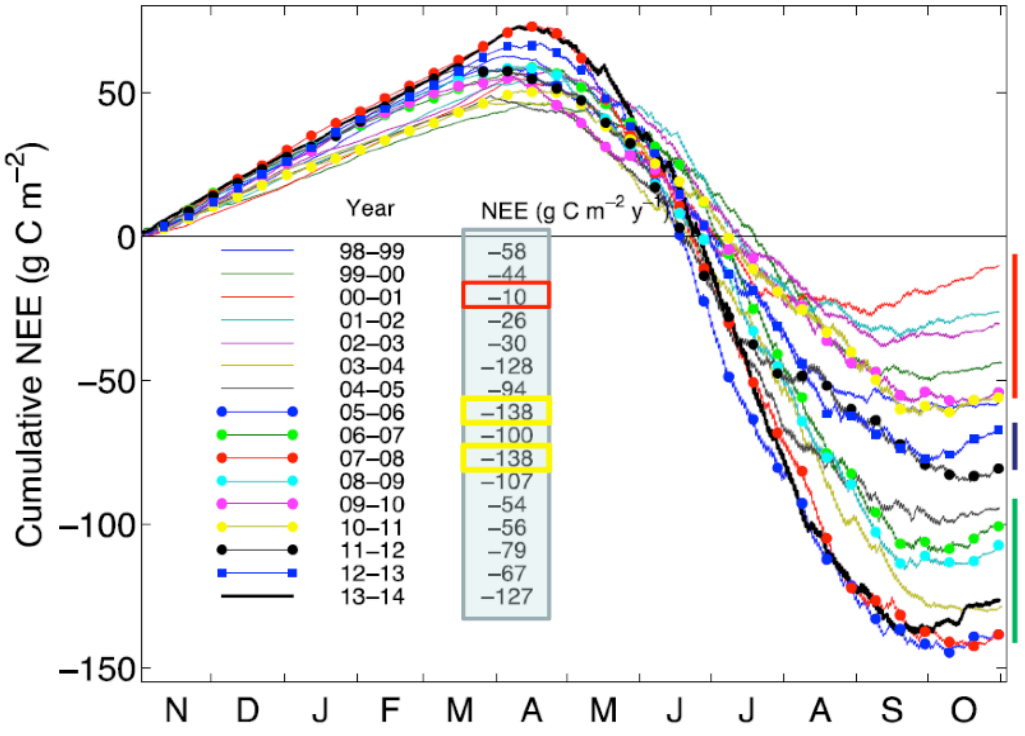

A
75°33'20"W
75°26'40"W
75°31'40"W
75°30'50"W
75°30'00"W
75°29'10"W
75°28'20"W
75°27'30"W
75°26'40"W
45°25'50"N
45°25'00"N
45°24'10"N
45°23'20"N
45°22'30"N
45°21'40"N
0
1
2 km

- Longest continuous EC measurements from a northern peatland
- Since May 1998
- Focal point of the Mer Bleue Arctic Surrogate Simulation Site (MBASSS): Sentinel 2 Product Validation Project

- Net sink of atmospheric CO_2 of ~60 g C m^{-2} yr^{-1}
- Loses C via CH_4 efflux and DOC (each ~5-10 g C m^{-2} yr^{-1})
- Net Ecosystem Exchange (NEE) highly variable between years
  - GPP-R

16 yr NEE





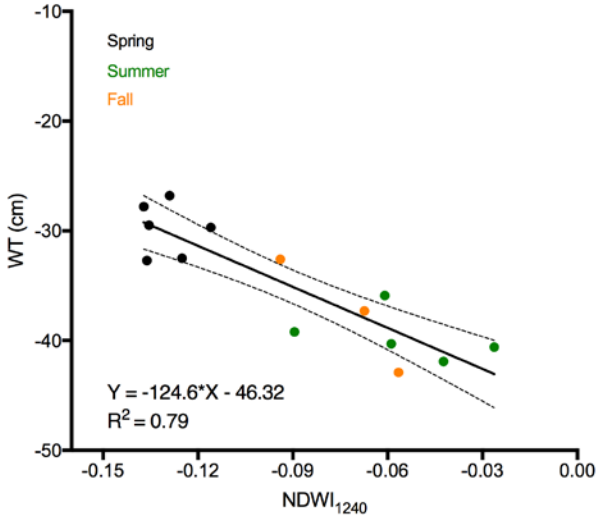
Source: Humphreys E.

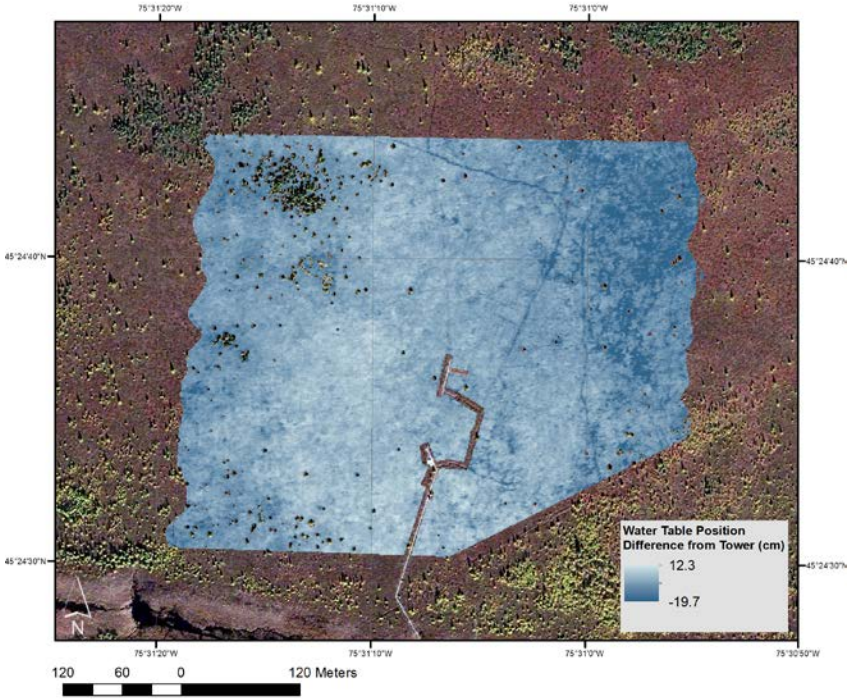
Research Questions

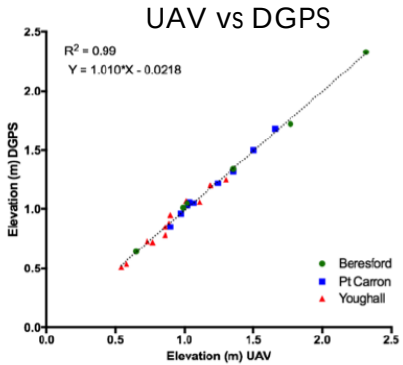
- Can NEE and Water Table Depth be modeled at the ecosystem scale from satellite/airborne imagery?
  - Eddy covariance towers are limited in number (also data is not spatially explicit)
  - Satellite imagery allows for historical observations – important to identify patterns at the landscape level
  - New sensors (Sentinel 2, Landsat 8) provide finer spectral resolution and higher radiometric resolution, better SNR: potentially useful for mapping ecosystem processes

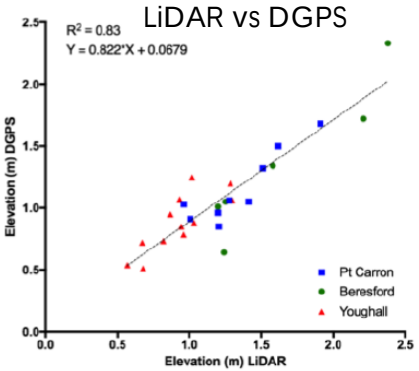
Water Table Depth

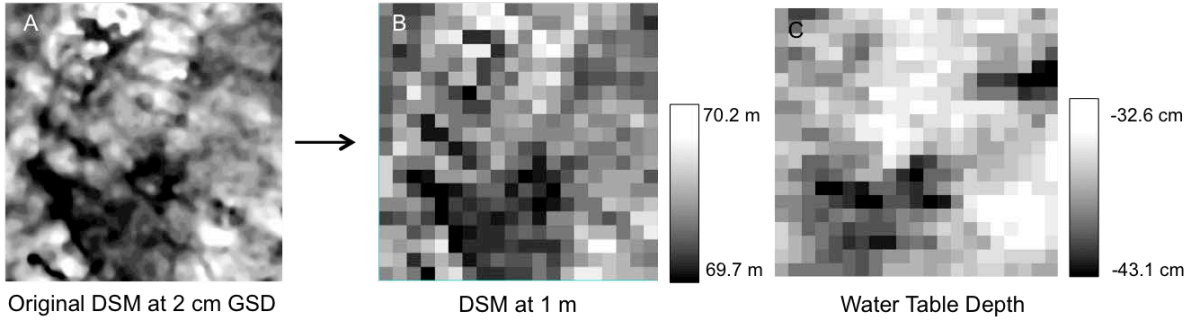
- 18 SASI airborne flight lines (2011-2016)
- $NDWI_{1240}$ related to in-situ WT data



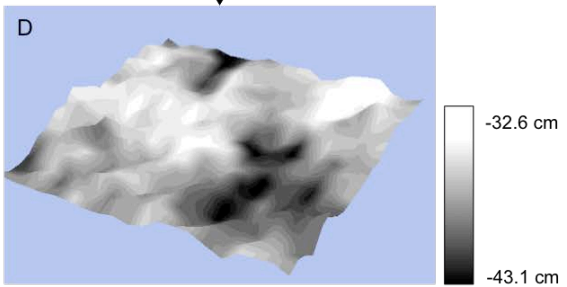



UAV vs DGPS
R² = 0.99
Y = 1.010*X - 0.0218
Elevation (m) DGPS
Elevation (m) UAV
Beresford
Pt Carron
Youghall

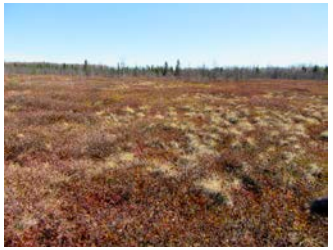

LiDAR vs DGPS
R² = 0.83
Y = 0.822*X + 0.0679
Elevation (m) DGPS
Elevation (m) LiDAR
Pt Carron
Beresford
Youghall


A
B
C
70.2 m
69.7 m
-32.6 cm
-43.1 cm
Original DSM at 2 cm GSD
DSM at 1 m
Water Table Depth


E
0.6 cm GSD


D
-32.6 cm
-43.1 cm

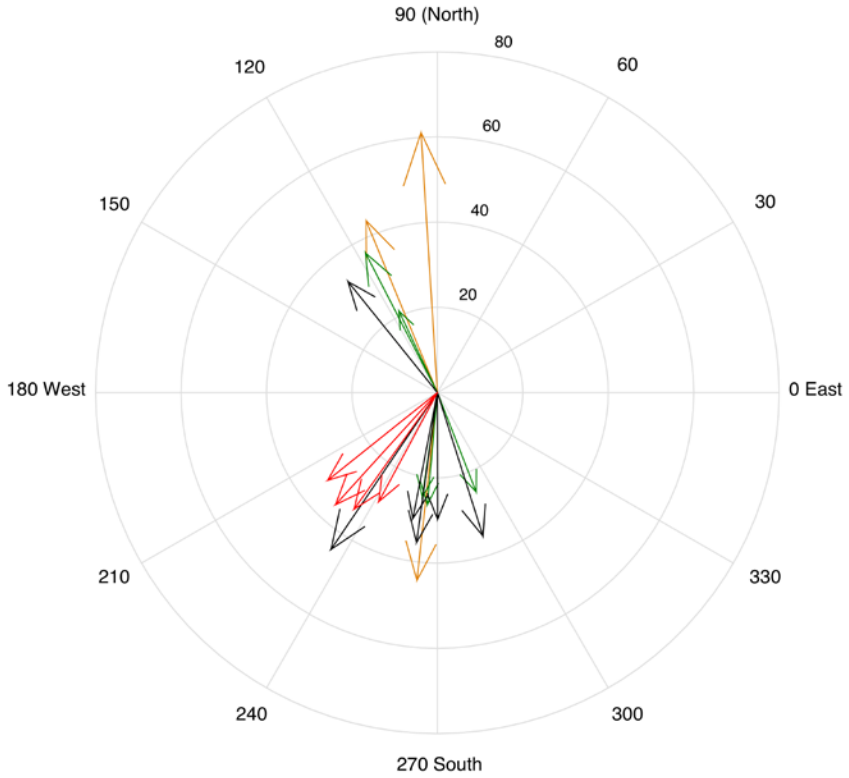
Relative Azimuth Angle



Spring

Summer

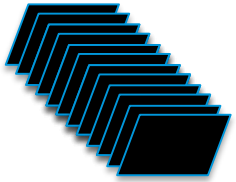
Fall



- Anisotropy
- Considerations for mission planning
- Effects on satellite products from SWIR?

Net Ecosystem Exchange

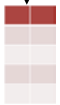
Landsat TM-5
(10 years)



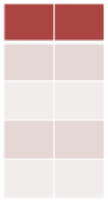
Google Earth Engine (MWI)

~700 scenes

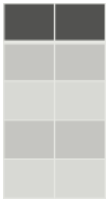
QA: 238 scenes



MWI



MWI

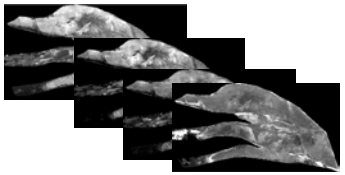


NEE Tower Data

Regression Analysis

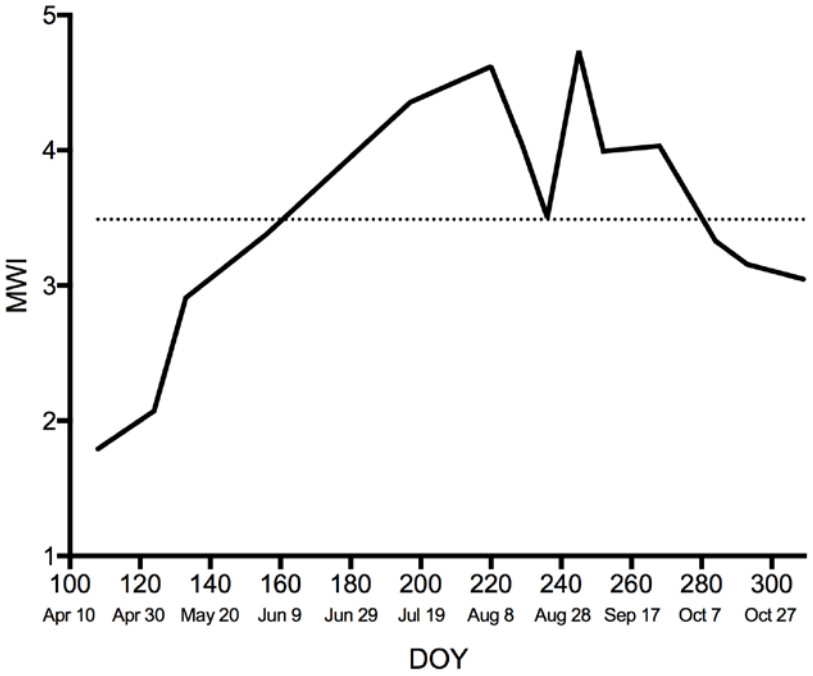
Sentinel 2
L1C
Sen2cor
L2A (20 m)

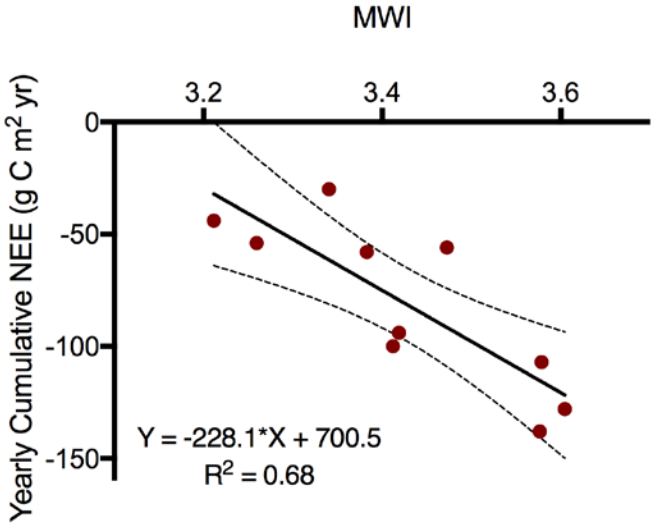
CASI Mosaics (HSI)
288 spectral bands
1 m pixel
ATCOR
Resampled to S2



Spatio-temporal NEE

Net Ecosystem Exchange



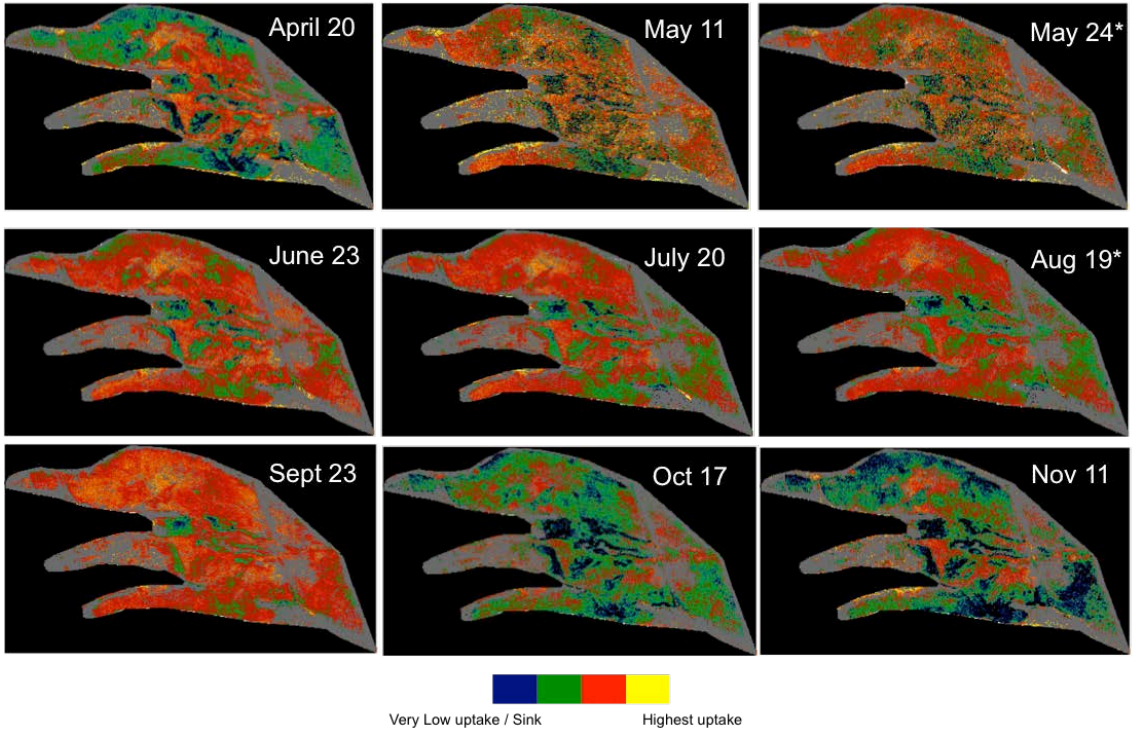


Net Ecosystem Exchange

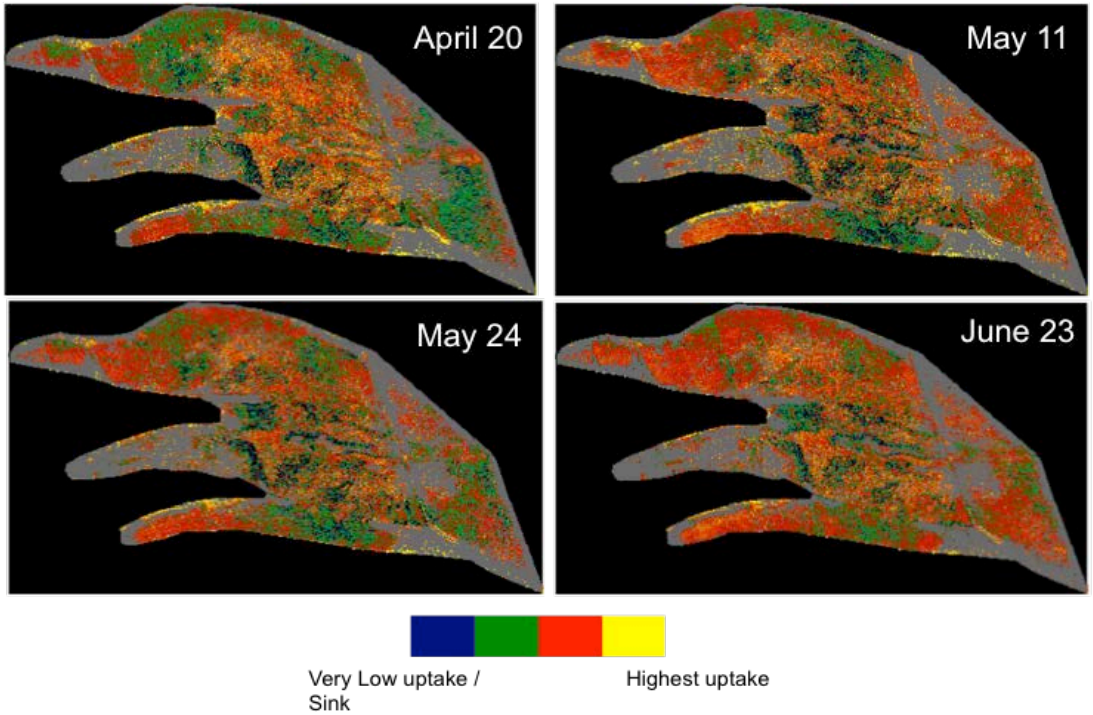
Correlation between CASI NEE and tower observations: -0.91 (daily) and -0.85 (30 min)

Correlation between S2 NEE and tower observations: -0.68 (daily) and -0.72 (30 min)

Net Ecosystem Exchange – S2



Net Ecosystem Exchange – CASI



Final Considerations

- Peatland anisotropy
- Implications of illumination for flight planning coincidental with satellite overpasses
- Satellite estimations of peatland properties in the SWIR?
- Radiometric (SNR, Rad. Res), spectral (response function), geometric and spatial (PSF) properties of the sensors
- Band to band registration – especially for cloud masking / cirrus
- Atmospheric correction: LEDAPS, LaSRC, Sen2Cor, FLAASH, ATCOR
- Multispectral vs hyperspectral
- **Inclusion of peatlands as a separate ecosystem for cal/val

Thank you

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http://bit.ly/merbleue