Downscaling eddy covariance measurements of evapotranspiration fluxes in a constructed boreal wetland.

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Sandhill Fen

"designed as an instrumented research watershed… to guide future wetland reclamation" (Wytrykush et al 2012)

2009-2011 Construction
2012 Planting Vegetation
2013 "Wetting"

Sandhill Fen

Image taken in Spring 2014

52 ha total, with approx. 17 ha of lowlands

Comprehensive water management system

(although only used in 2013)

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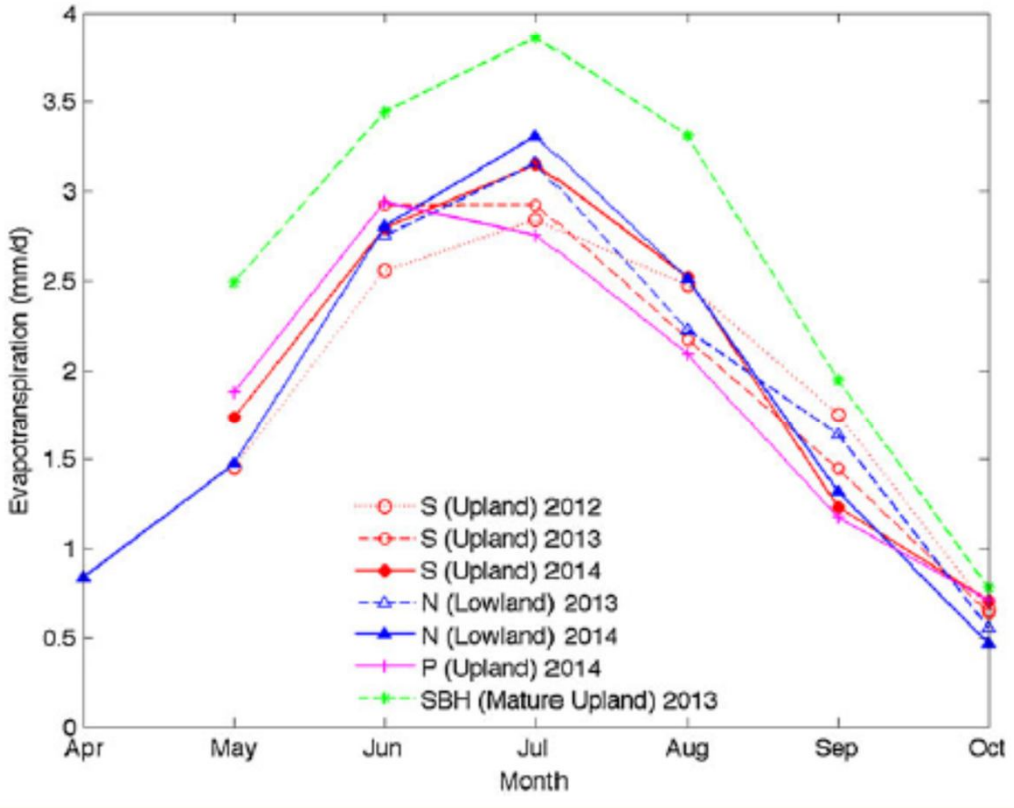
Multi-year water balance assessment of a newly constructed wetland, Fort McMurray, Alberta



ET from June 01 to Sept 30:

2013 290 mm
2014 299 mm

Nicholls et al. 2015

Methods

How is the expansion and densification of vegetation coverage going to effect the water balance of Sandhill Fen?

1. Determine the current extent of vegetation cover, and open water.
2. Determine the proportion of that cover within each measurement.
3. Since no flux is 100% from one surface type, extrapolate evapotranspiration from the surface categories as a function of incoming radiation.

Worldview 3 Image (0.3 m resolution)

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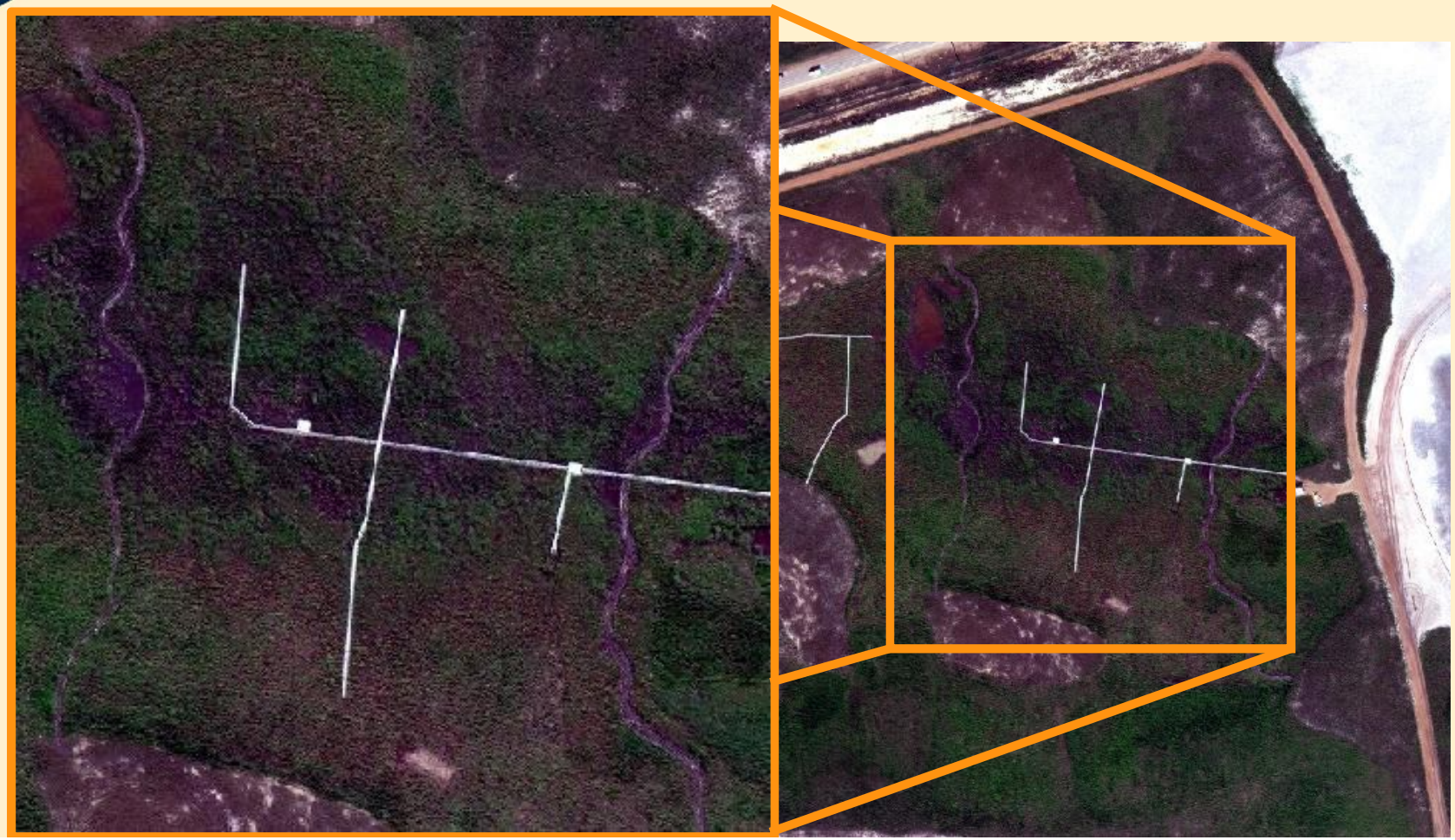
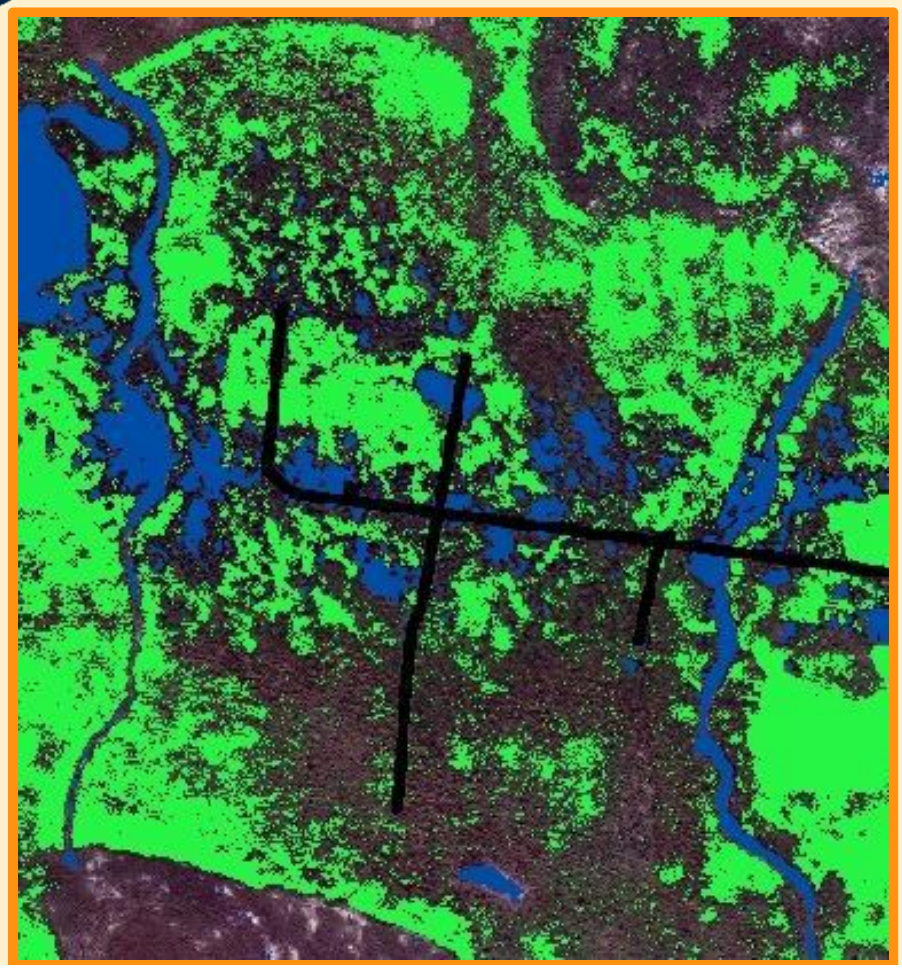


Surface Layers

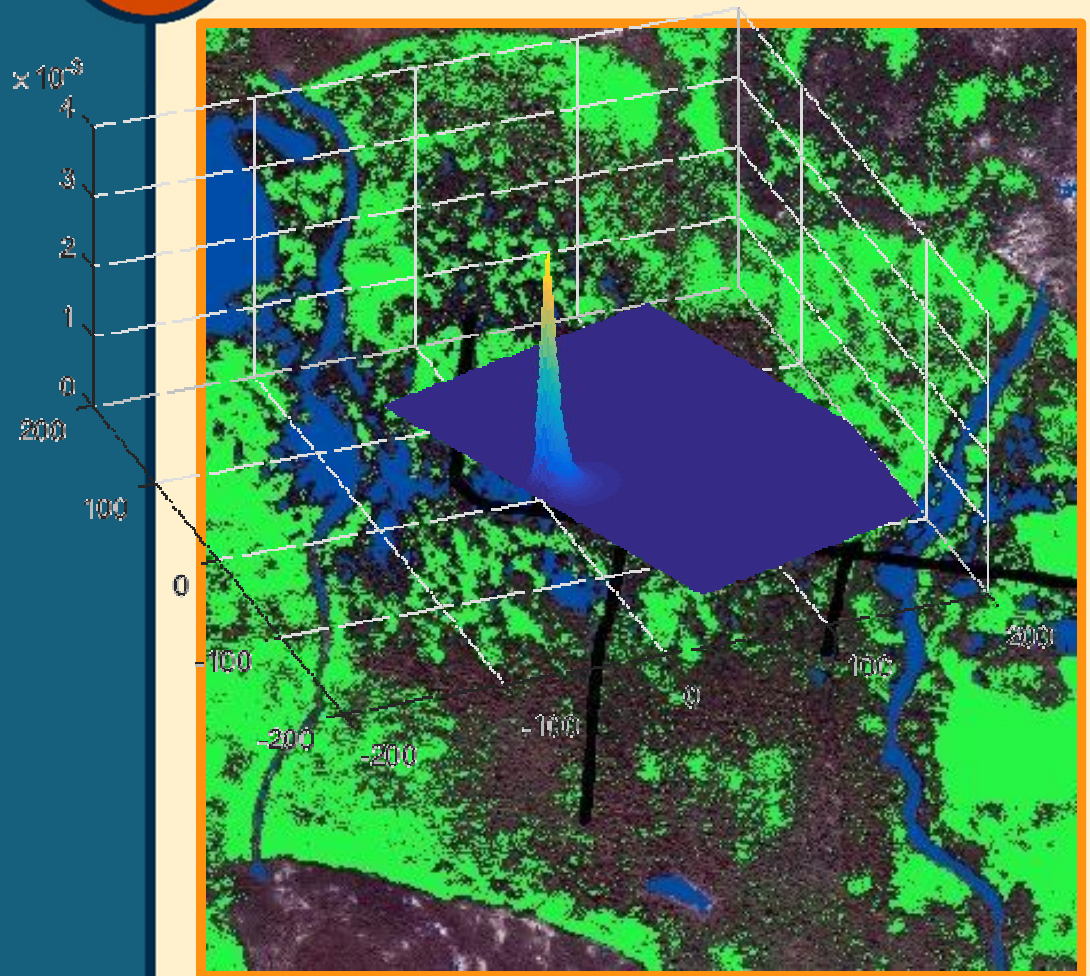


Open Water (NDWI > 0)

Dense Veg (NDVI > 0.4)

Boardwalk

Footprints using FFP from Kljun et al. 2015



Determine the probability surface for each flux, based on backwards Lagrangian models of Kljun et al. 2002.

Partitioning Fluxes

Determine the proportion (γ) of surface n (φ_n) in each probability surface (α)

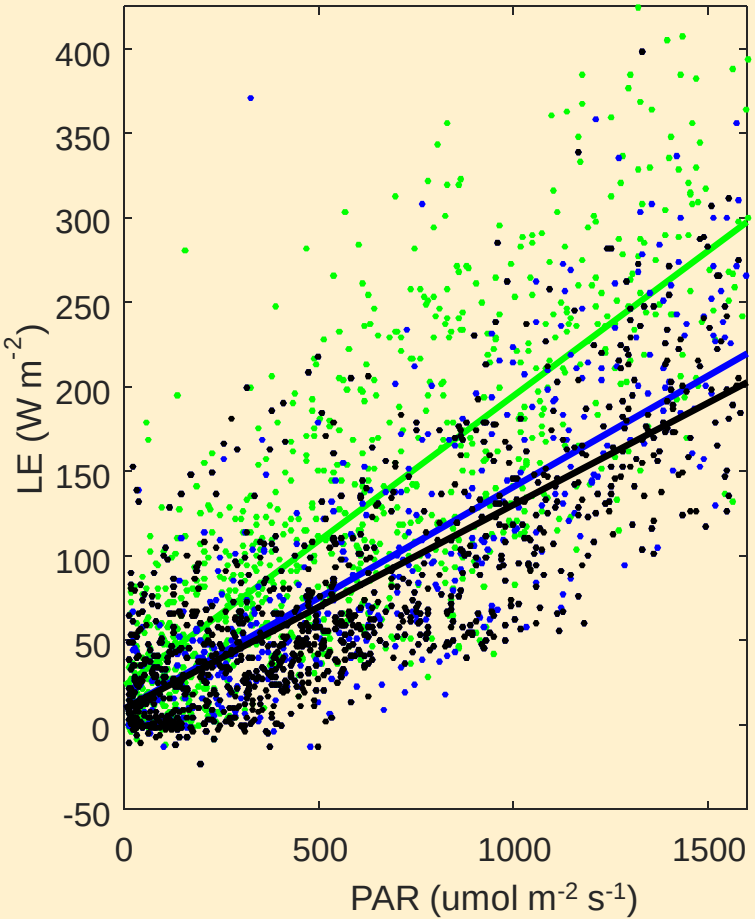
$$\gamma_i = \sum_{x=-200m}^{200m} \sum_{y=-200}^{200m} \alpha(x,y)\varphi_n(x,y)$$

Use the proportions to determine the top ⅓ of the data with the largest representation of that surface category.

The 66.6 percentile (top ⅓ cutoff) for each category:

Dense Vegetation	31.6%
Open Water	29.6%
Boardwalk	9.8%

Evapotranspiration vs PAR



Dense Vegetation

$\beta_1 = 0.1715 \pm 0.0085$ LE PAR^{-1}

$R^2 = 0.63$

Open Water

$\beta_1 = 0.1315 \pm 0.0064$ LE PAR^{-1}

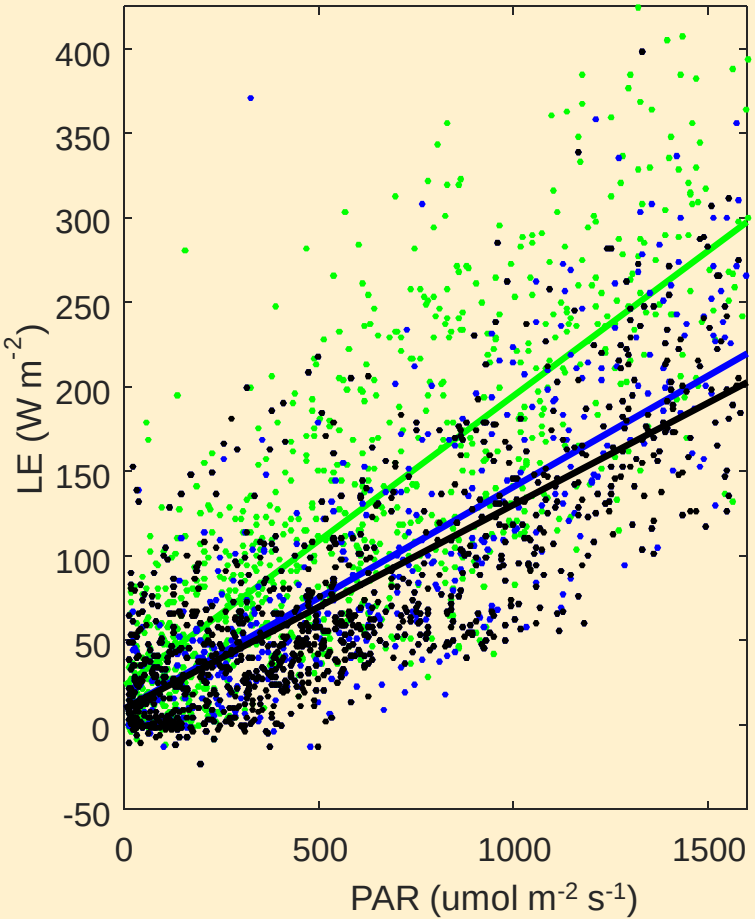
$R^2 = 0.61$

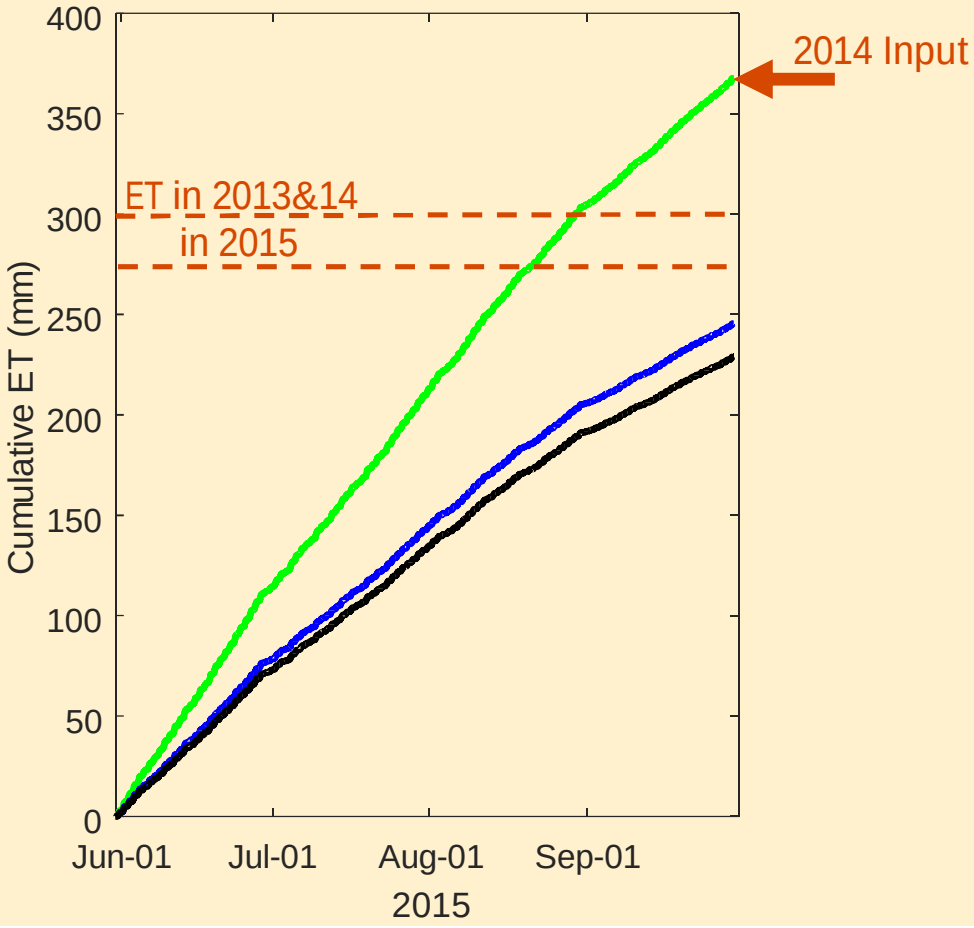
Boardwalks

$\beta_1 = 0.1208 \pm 0.0061$ LE PAR^{-1}

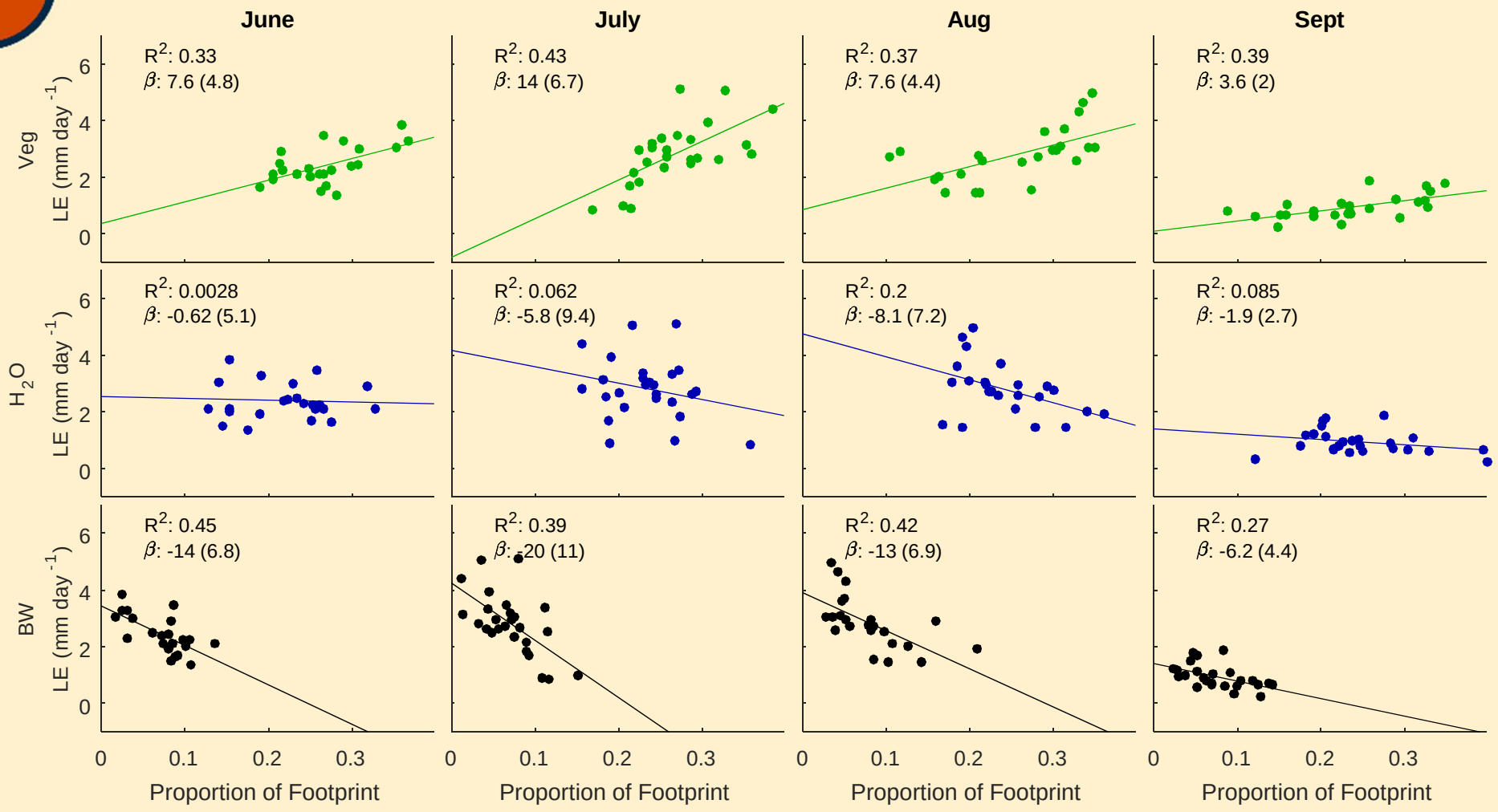
$R^2 = 0.61$

Extrapolated Evapotranspiration





Effects of the variable surface proportion



Conclusions

- As the vegetation continues to develop, ET will increase
- Currently, closed canopies evaporate 50% more H_2O than open water

Thanks!

Syncrude

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