What have we learned from continuous crop and forest evapotranspiration observations in the Central Sands?

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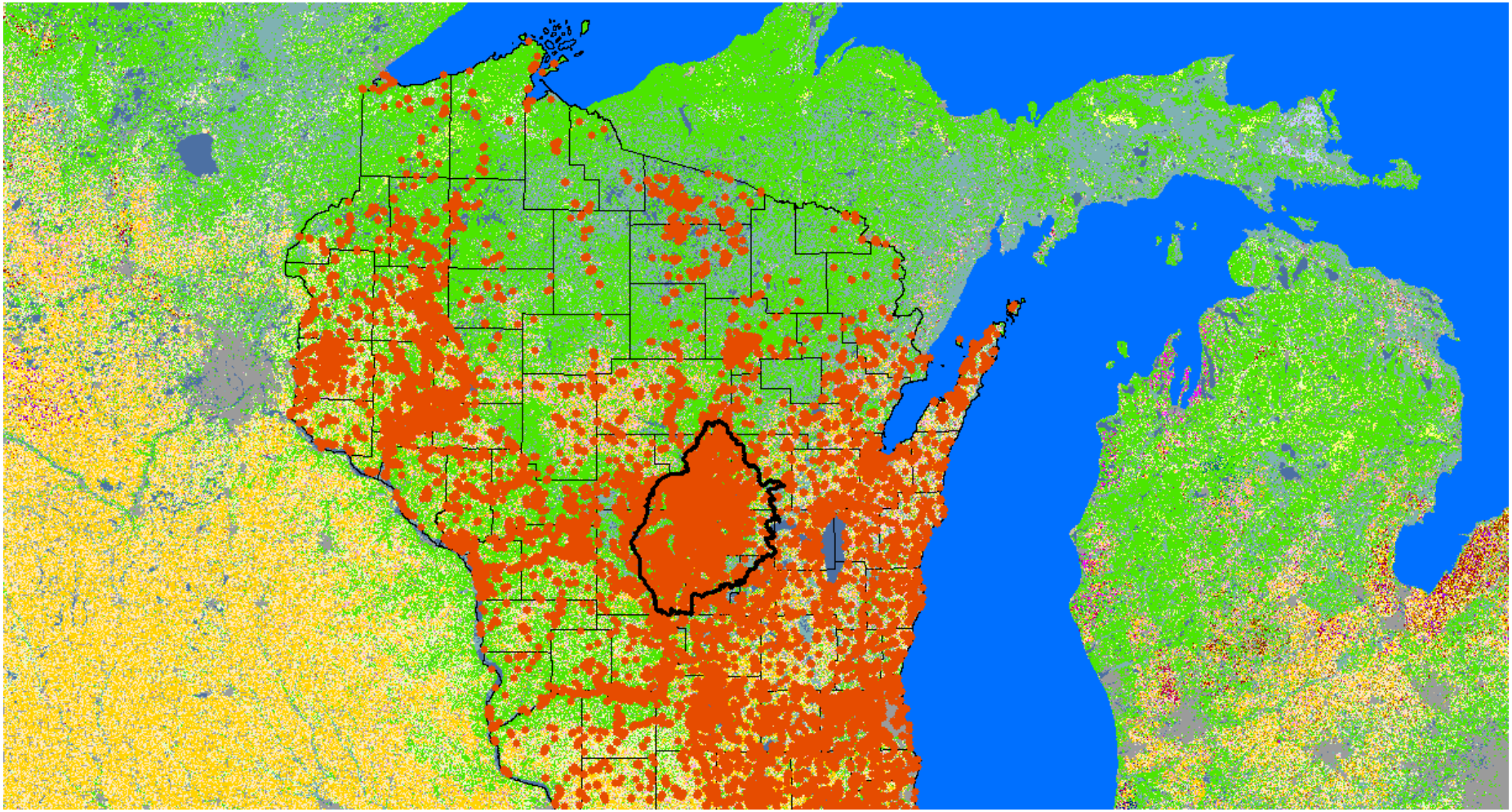
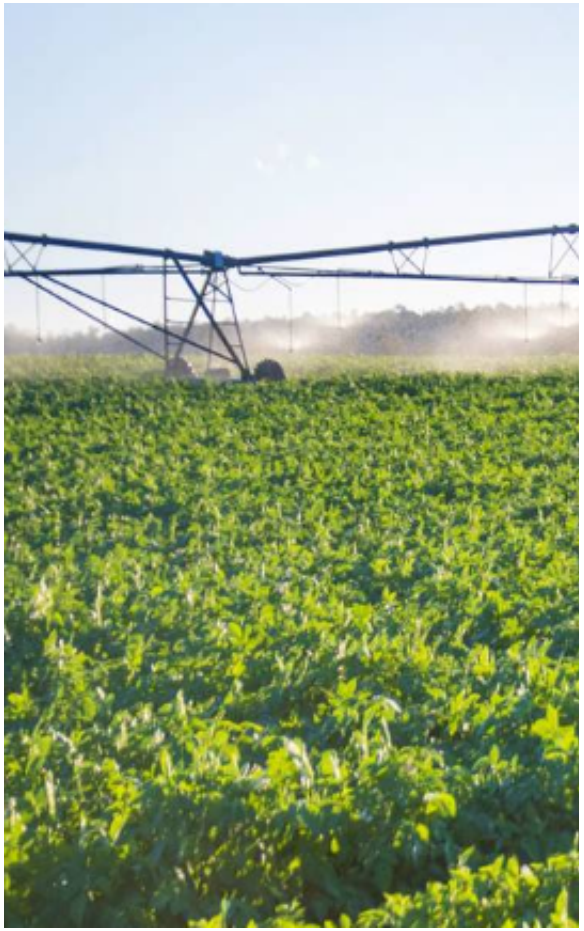
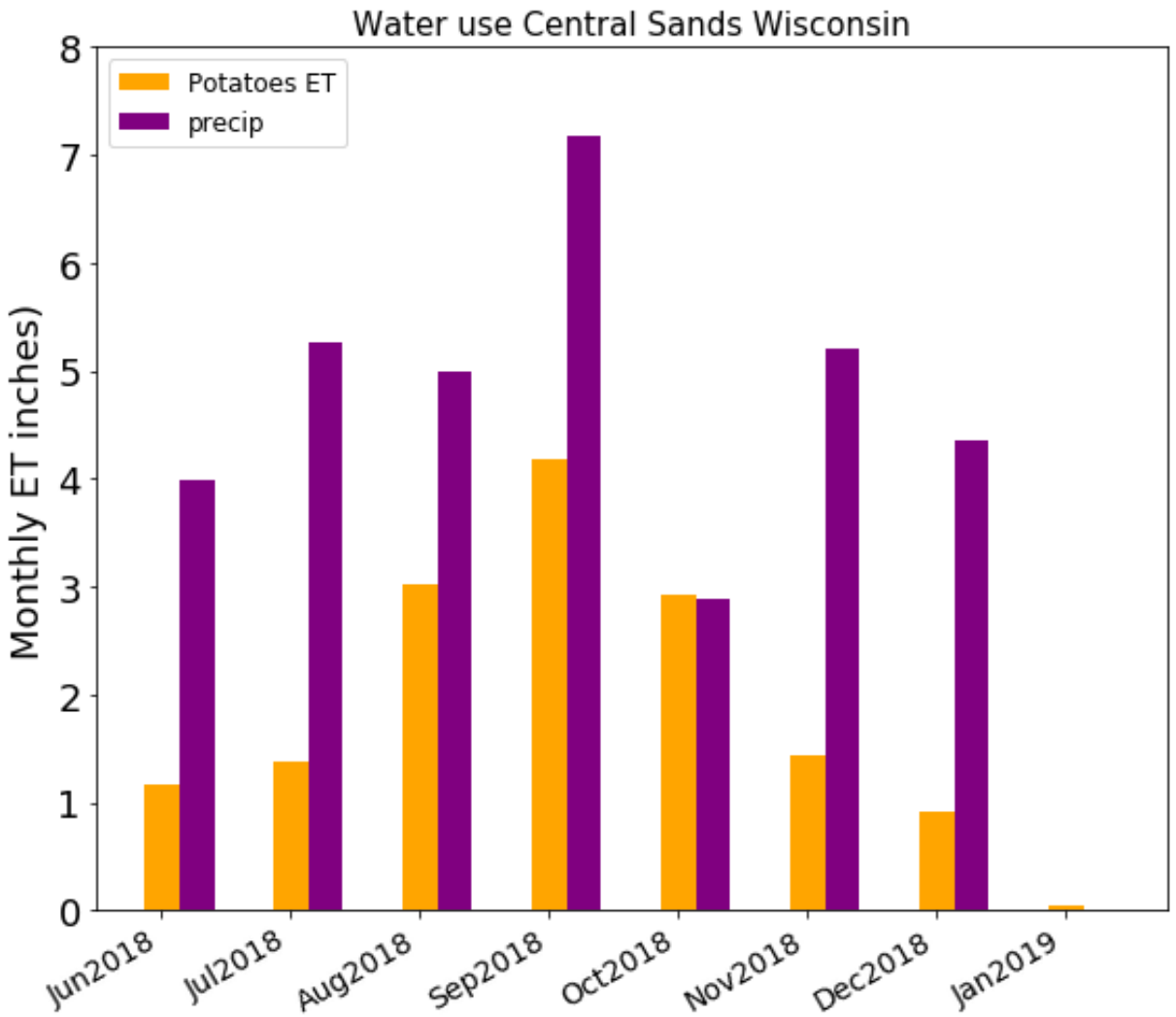
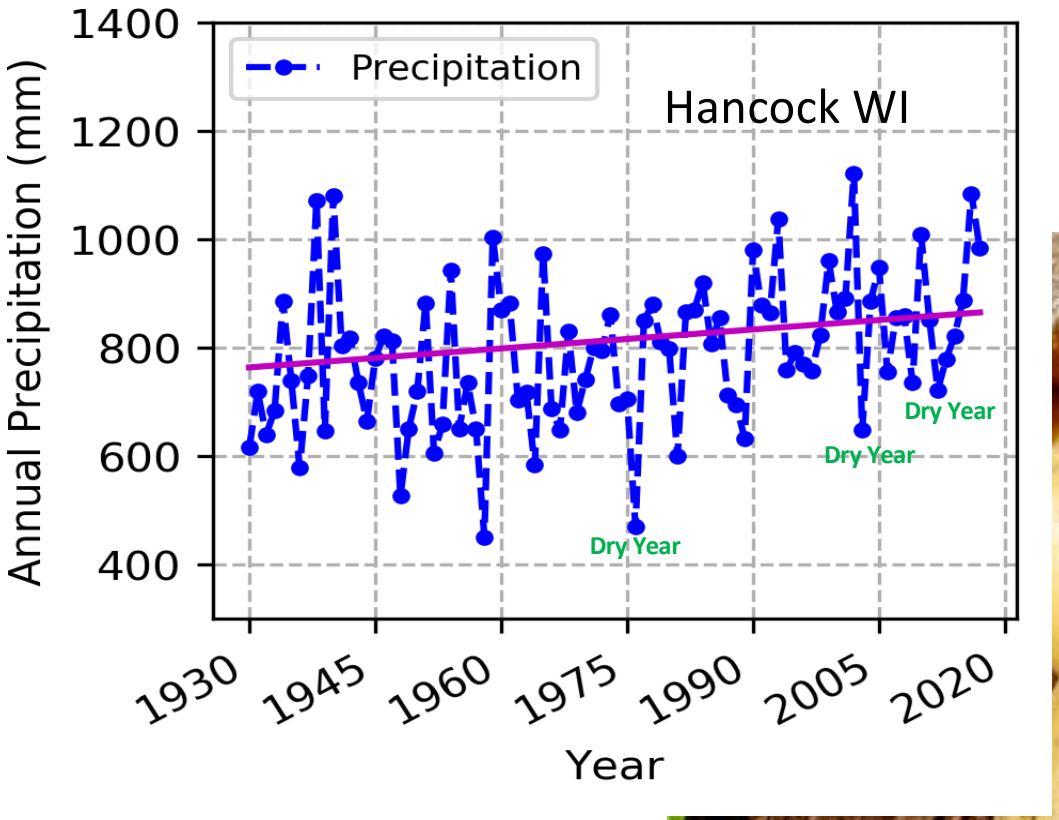


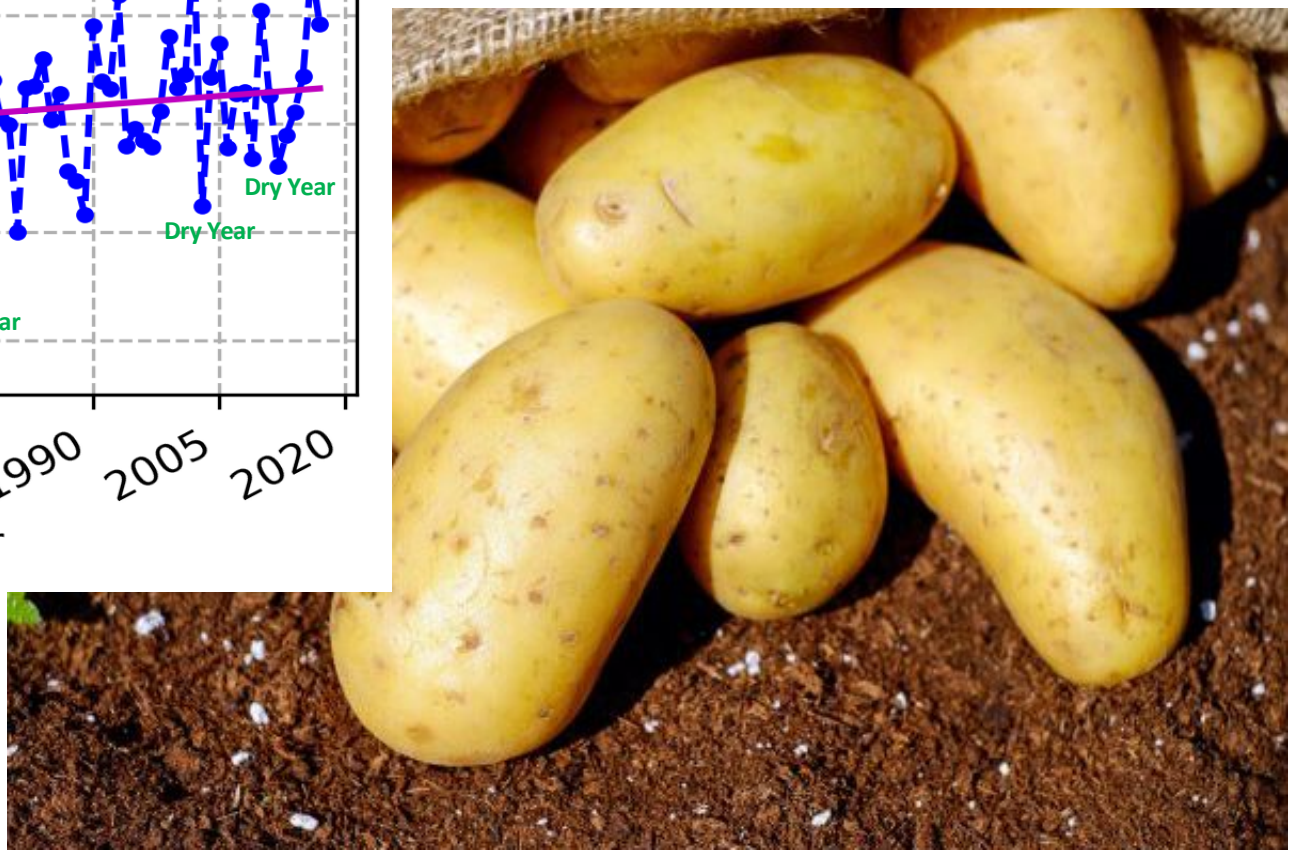
Linkage between Biosphere and Atmosphere water





Food Availability in Changing Climate





Study Site


US-CS3
Heartland Farm
US-CS2
Tri-County School Forest
US-CS1
Heartland Farm
Hancock
Pine Lake
Fish Lake
E North Lake St
O
51
KK
V
GG
39
FF
C

Heartland Farm Study Site

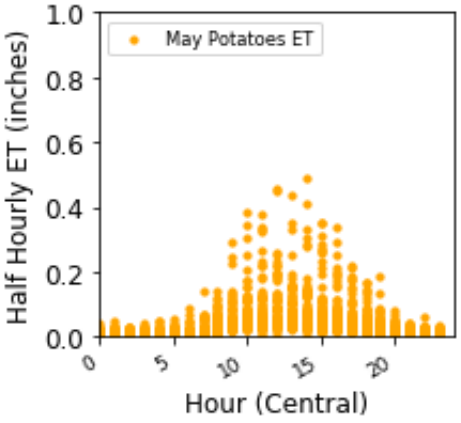
Data/Analysis Updates

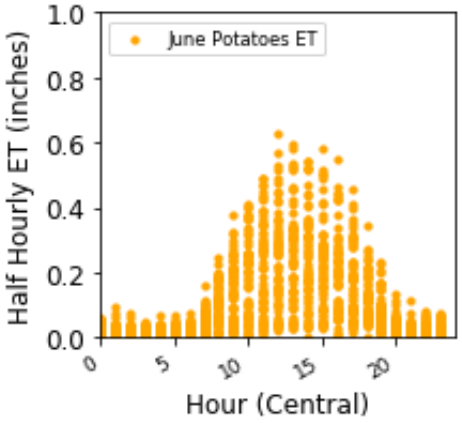
Tower Installed on June 29th 2018

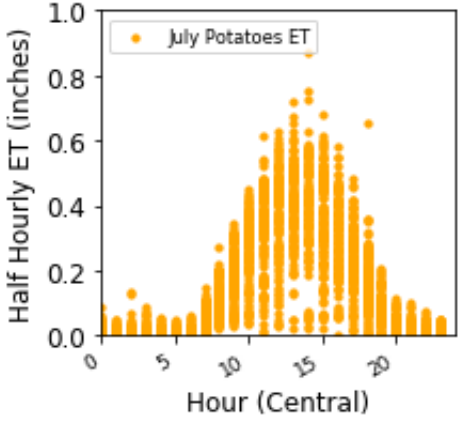
~7 feet Tall

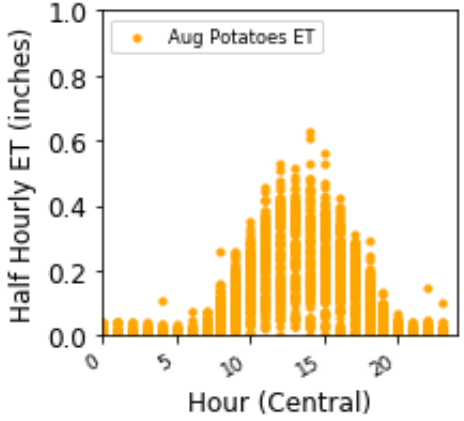
Half Hourly ET for Potatoes and Pines

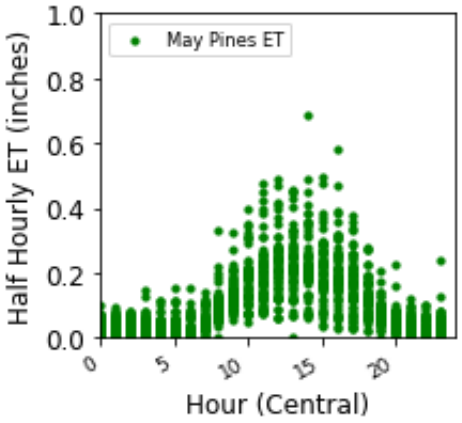
Growing Season 2018,2019, Diurnal ET

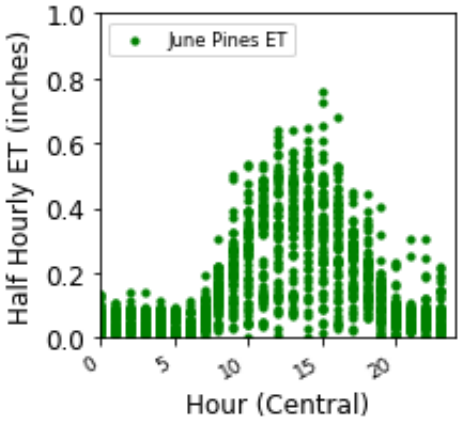


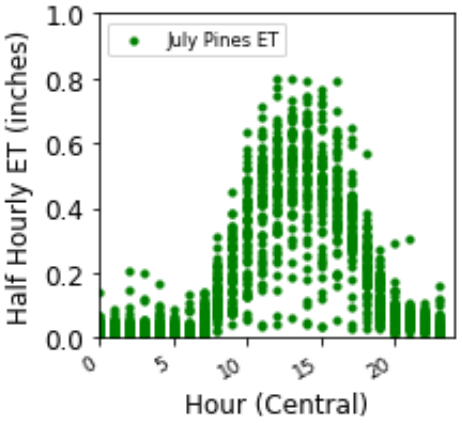


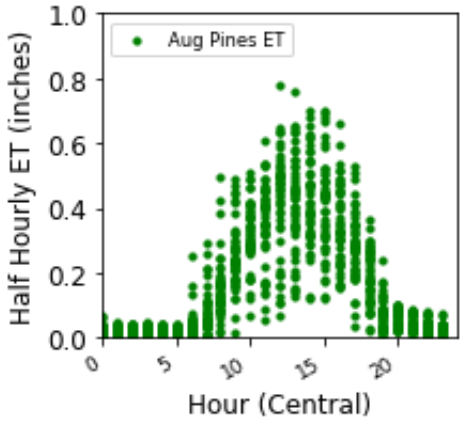




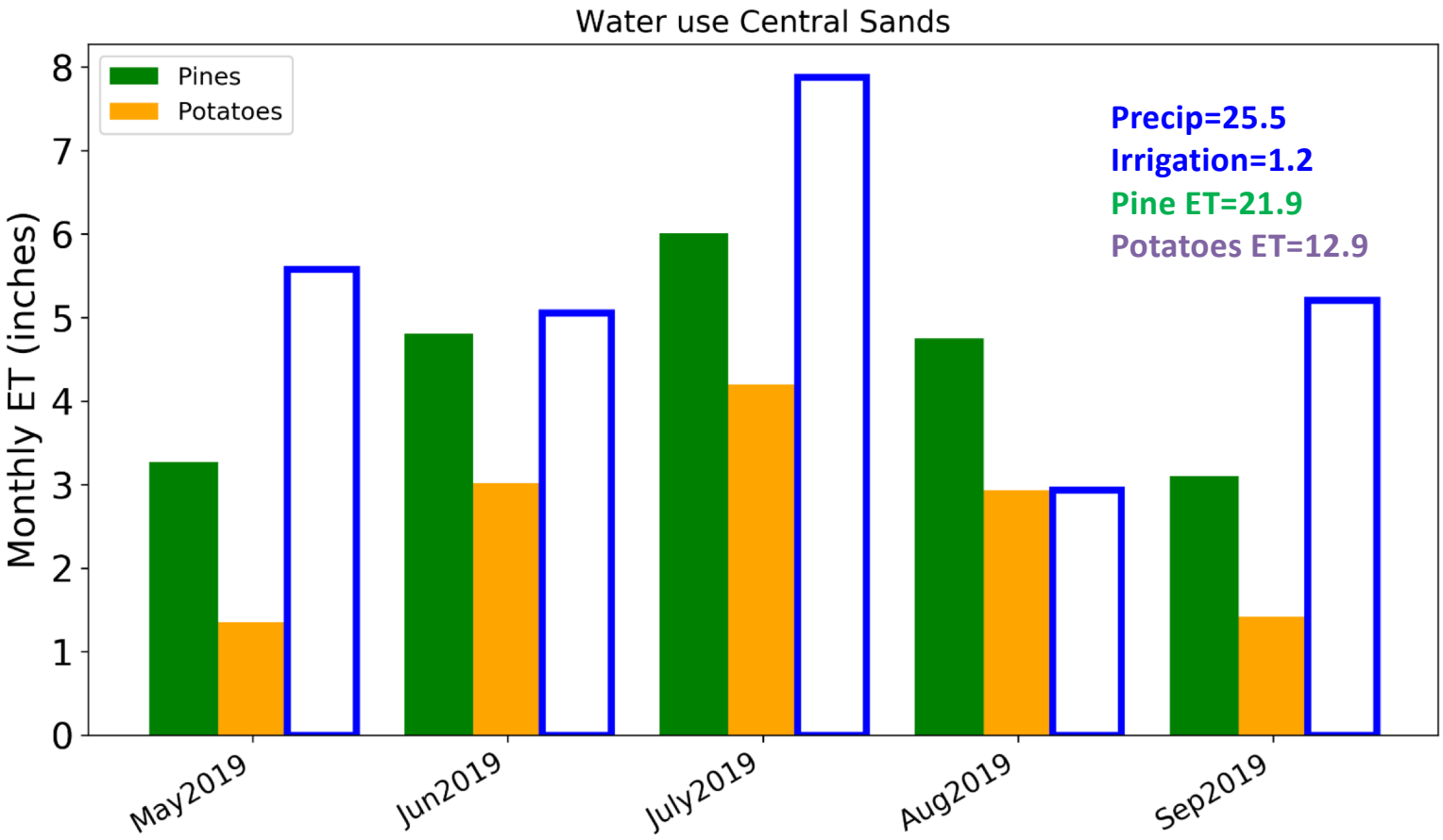






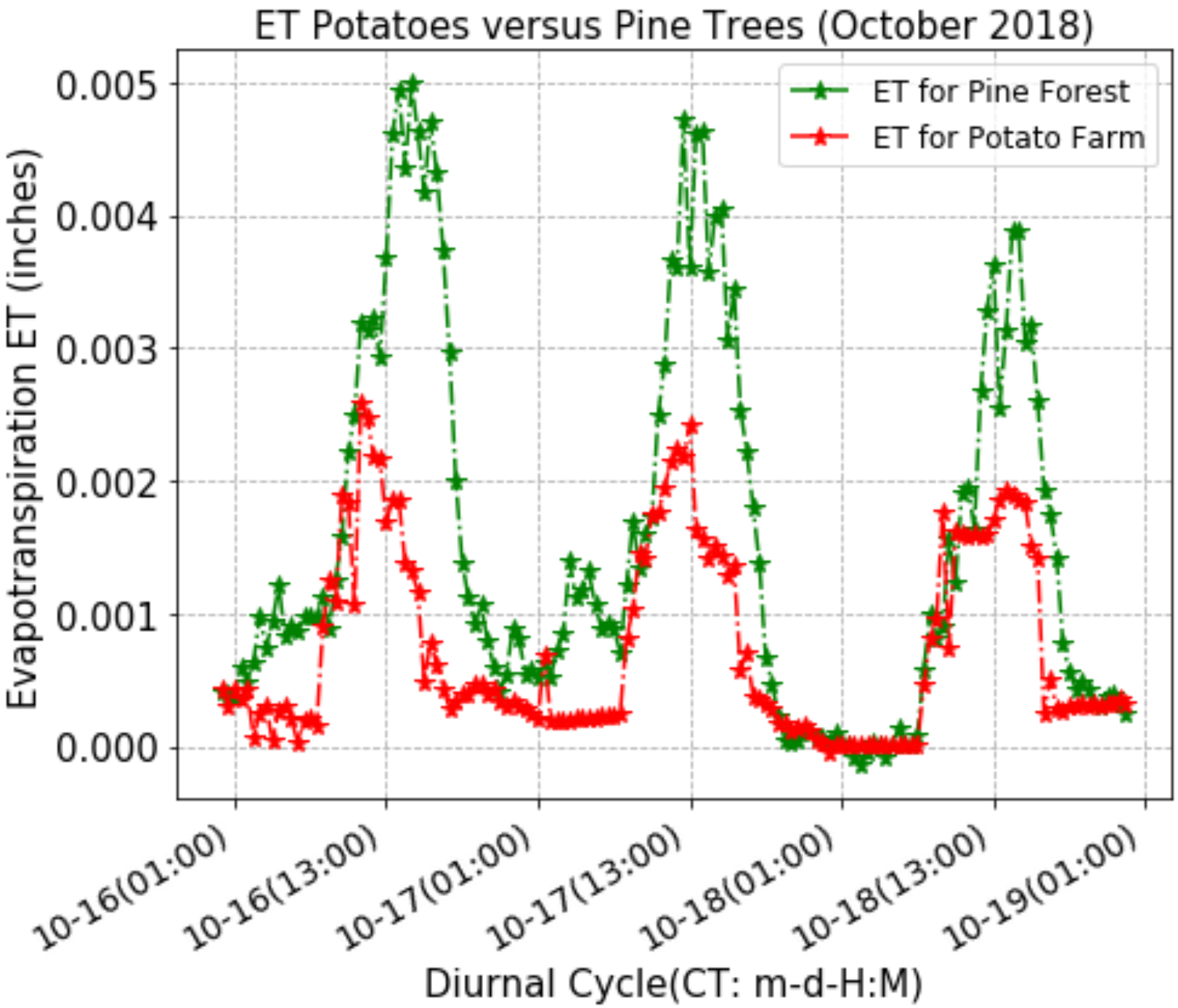


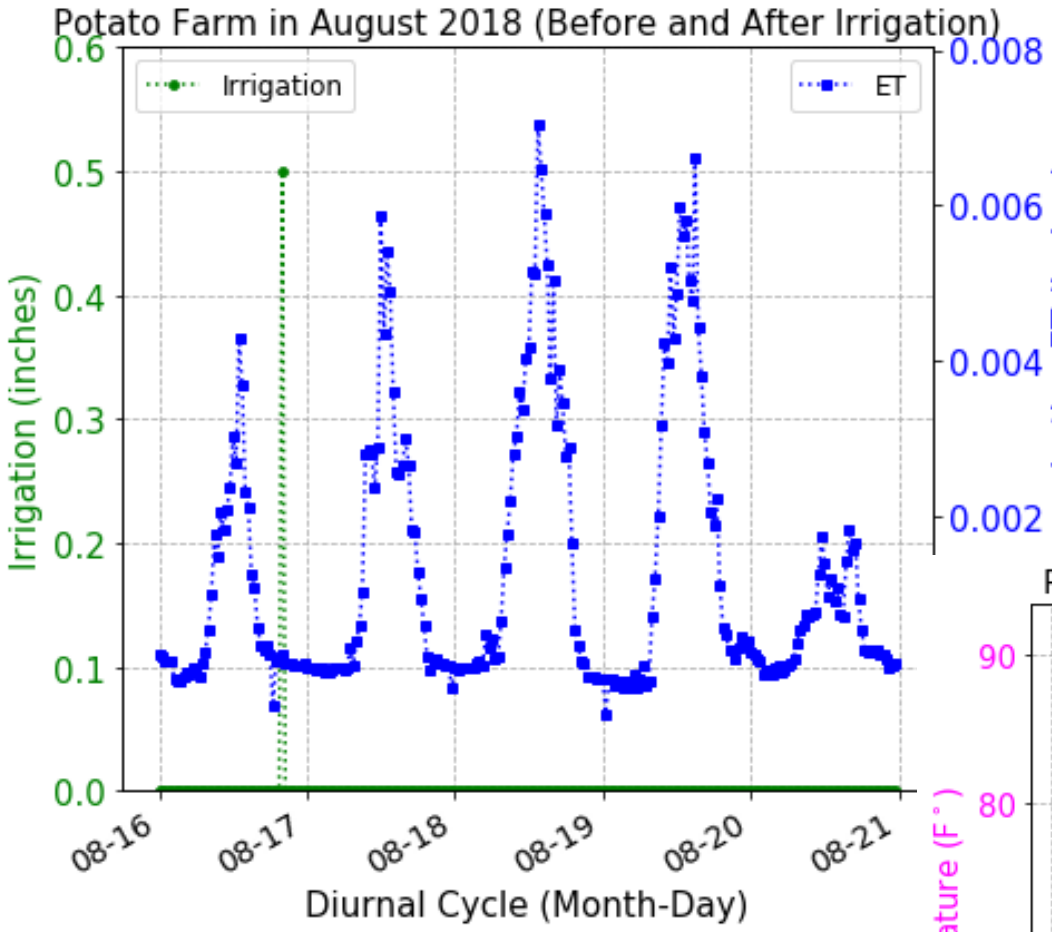
Water Use by Crop Versus Forest During Wet year



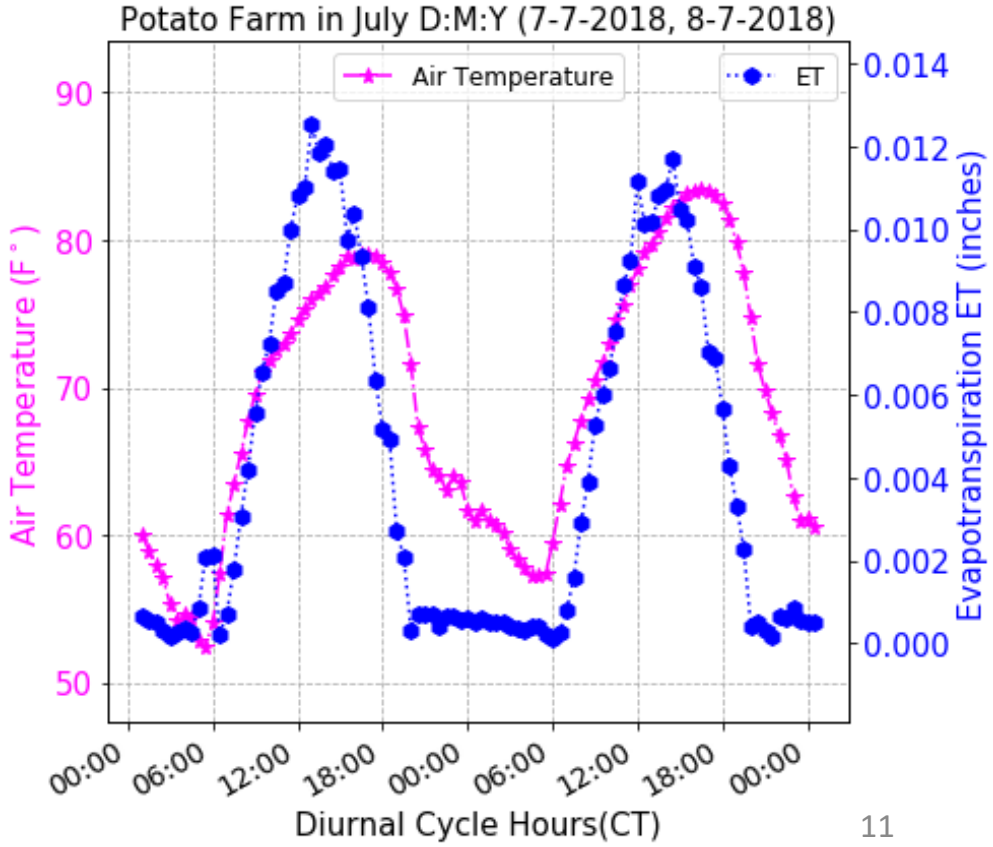
Summary For Objective 1: *Water dynamics by crops versus pines during wet year?*

- ✓ For a wet year, **pines** ET is higher than **potatoes**. In dry years when pine ET is more moisture limited, pine evapotranspiration could be lower, according to previous studies.
- ✓ **Pines** are wetter on the surface. But later the difference between **pine** and **potatoes** soil moisture decreases. Pines have more transpiration and less soil evaporation.
- ✓ Deeper in the ground (around 18 inches depth) **potatoes** have more soil moisture


ET Potatoes versus Pine Trees (October 2018)
ET for Pine Forest
ET for Potato Farm
Evapotranspiration ET (inches)
0.005
0.004
0.003
0.002
0.001
0.000
10-16(01:00)
10-16(13:00)
10-17(01:00)
10-17(13:00)
10-18(01:00)
10-18(13:00)
10-19(01:00)
Diurnal Cycle(CT: m-d-H:M)

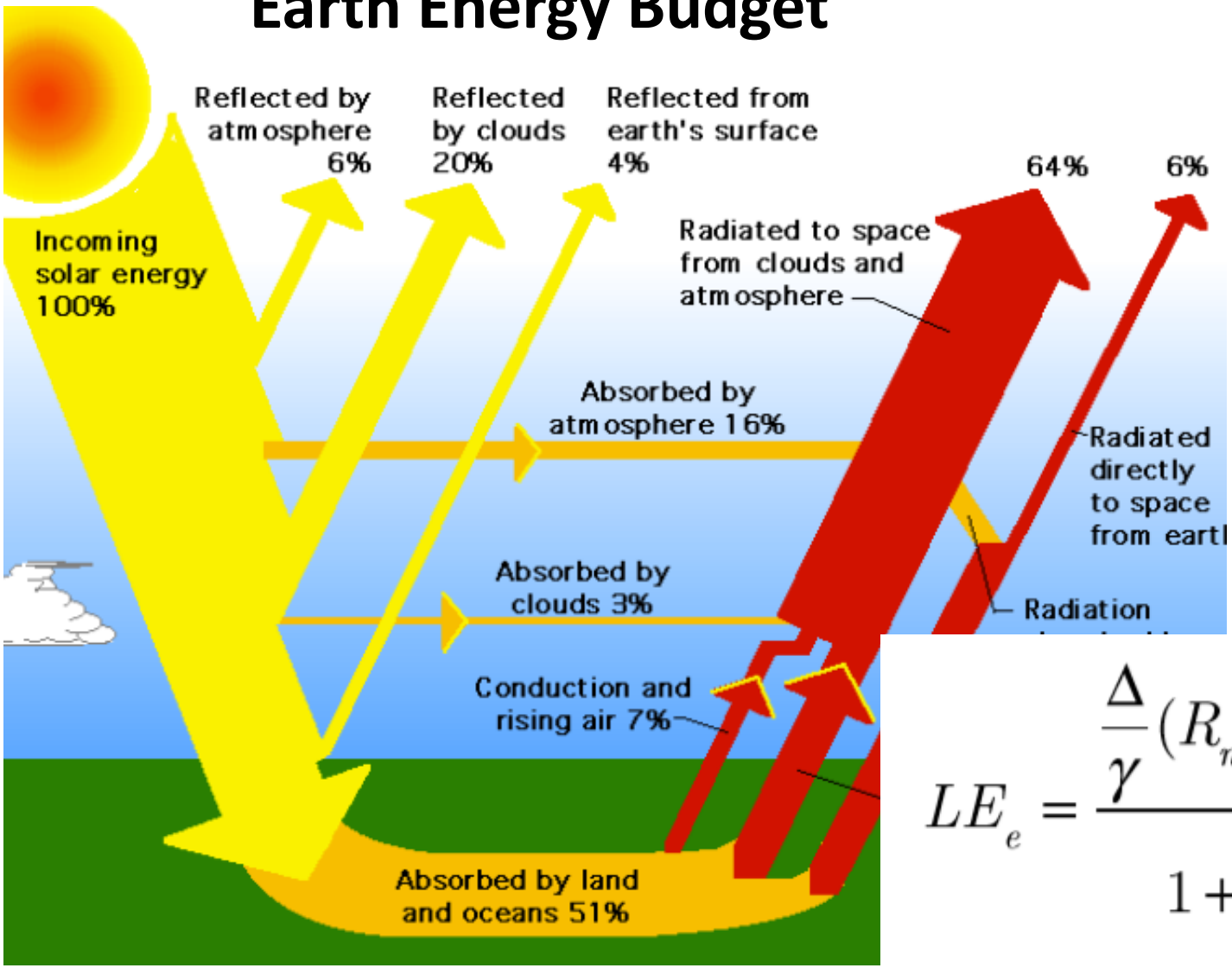


Maximum water loss right after solar noon



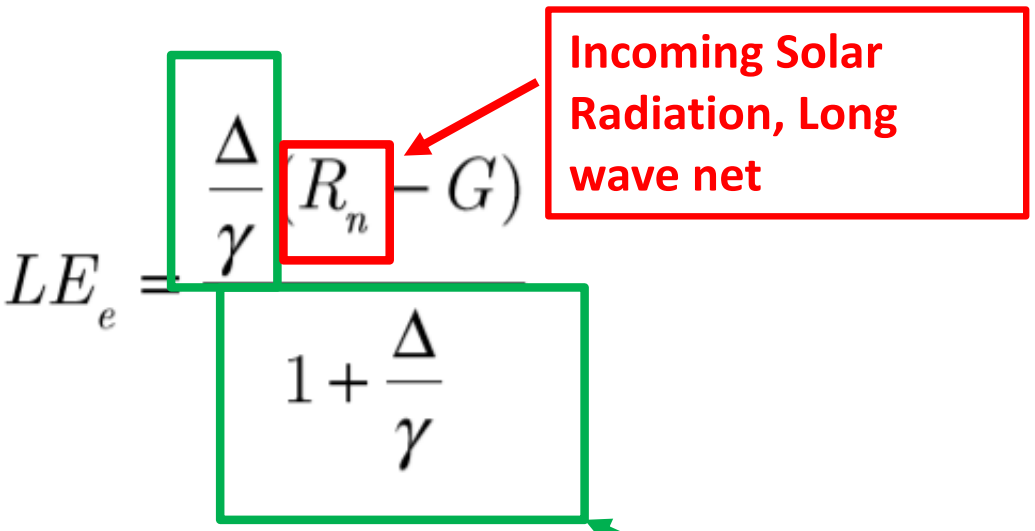
How to Model Evapotranspiration

Earth Energy Budget



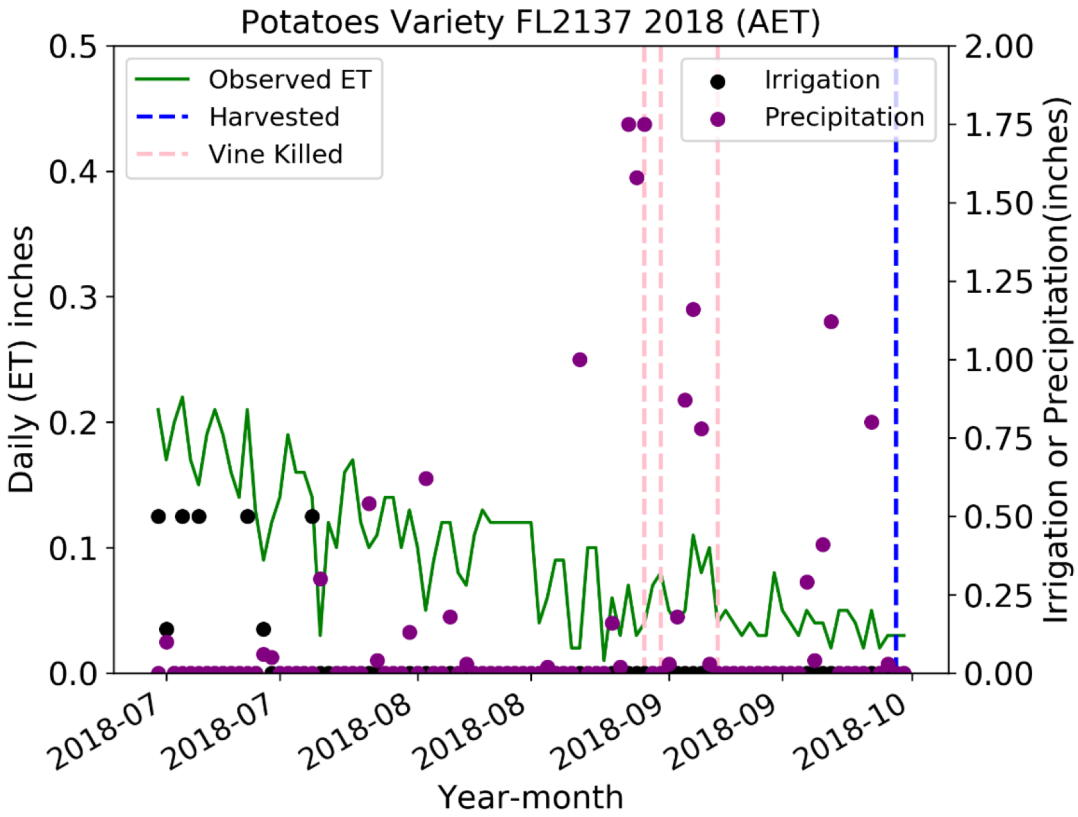
$$LE_e = \frac{\frac{\Delta}{\gamma}(R_n - G)}{1 + \frac{\Delta}{\gamma}}$$

How to Model Evapotranspiration



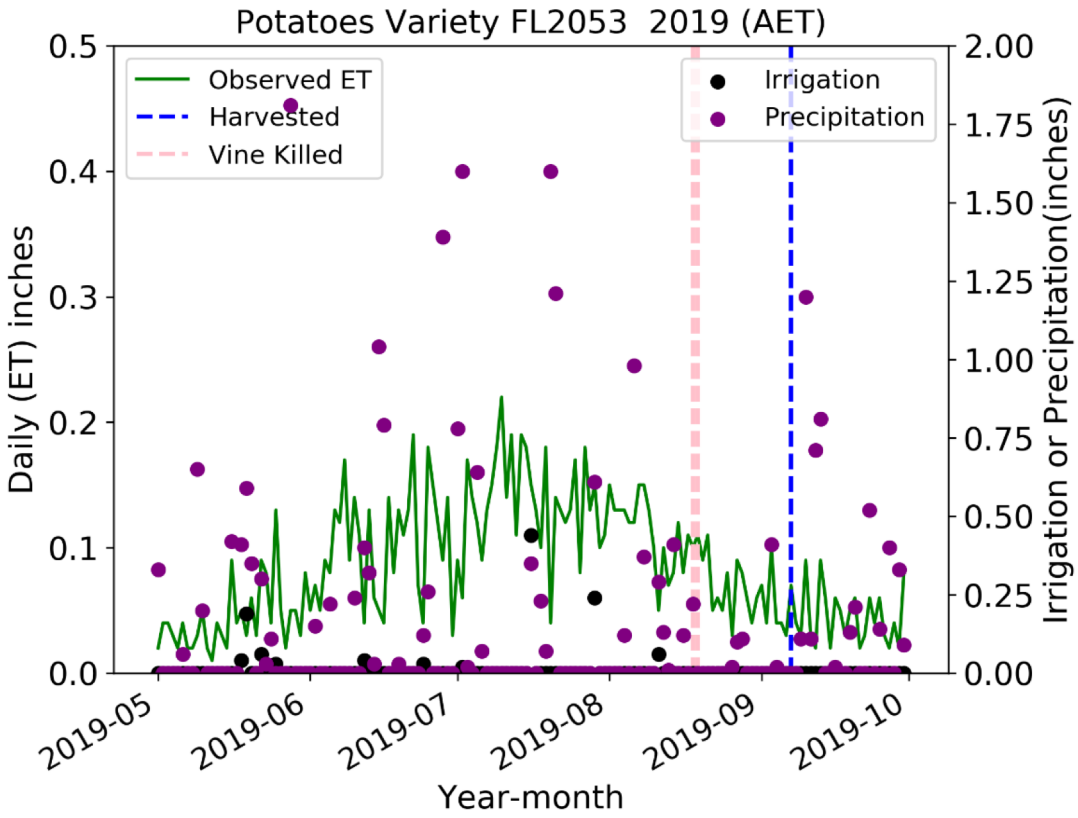
- ✓ Air Temperature
- ✓ Vapor Pressure
- ✓ Long wave Net Radiations
- ✓ Incoming Solar Radiations

Model Versus Observations for water use Estimate by Crops

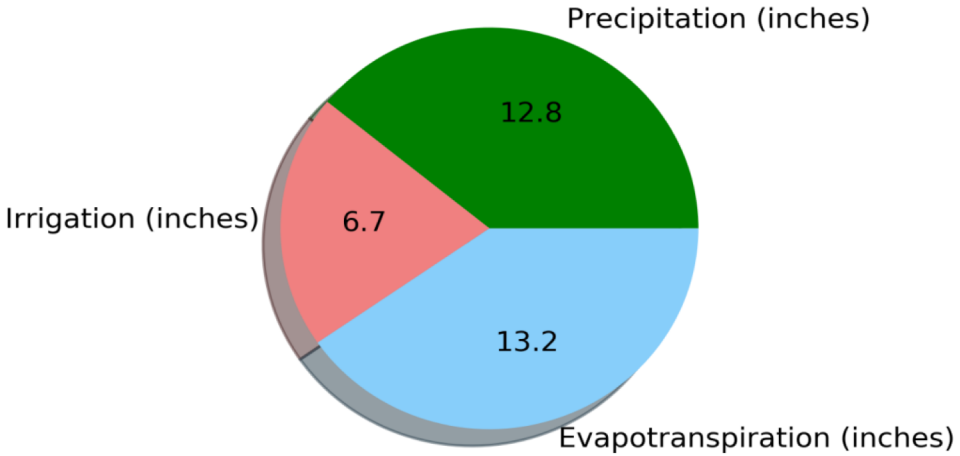


- Planted on April 30th
- Vine Killed End of Aug
- **Harvested End of Sep**

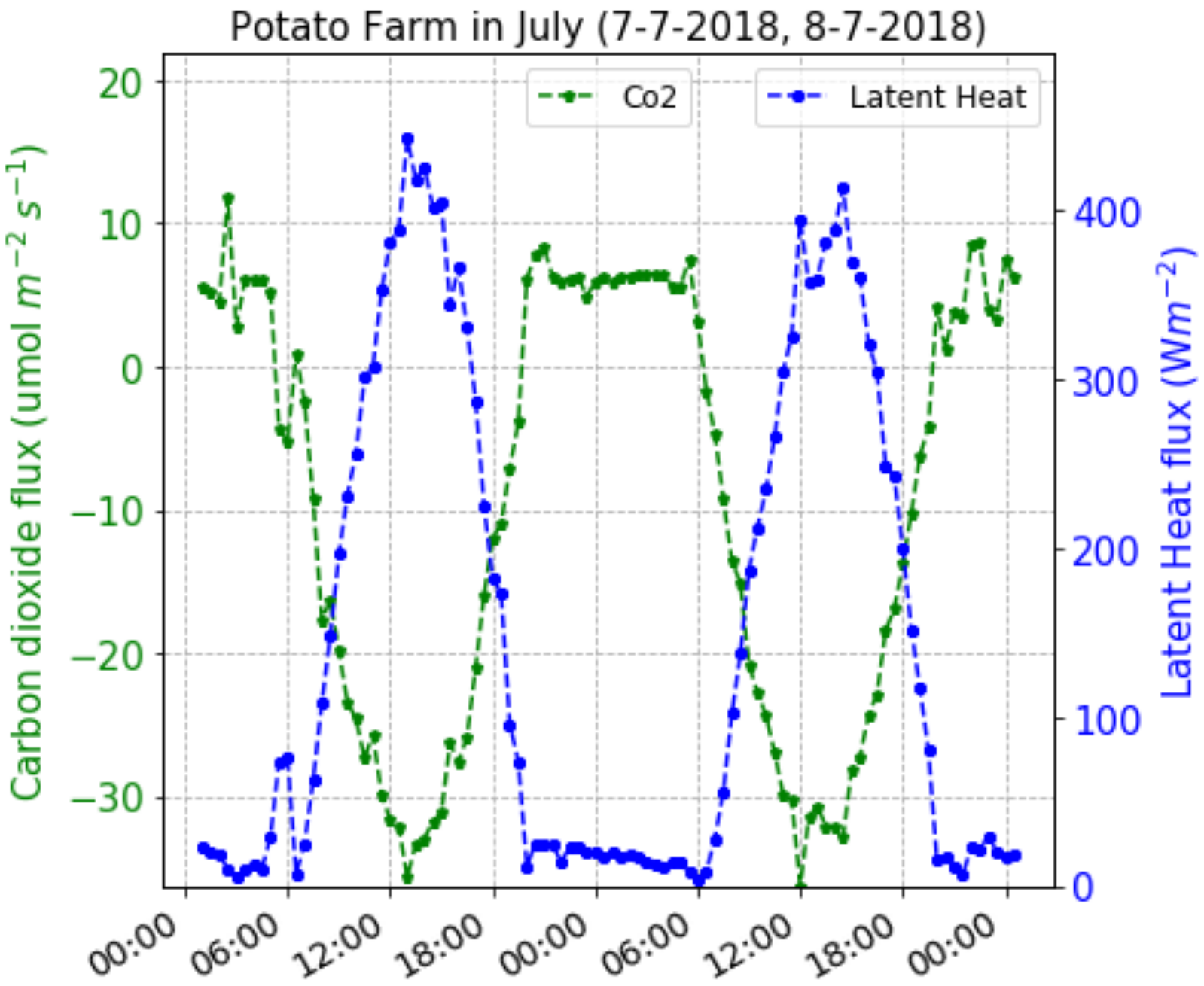
Model Versus Observations for water use Estimate by Crops

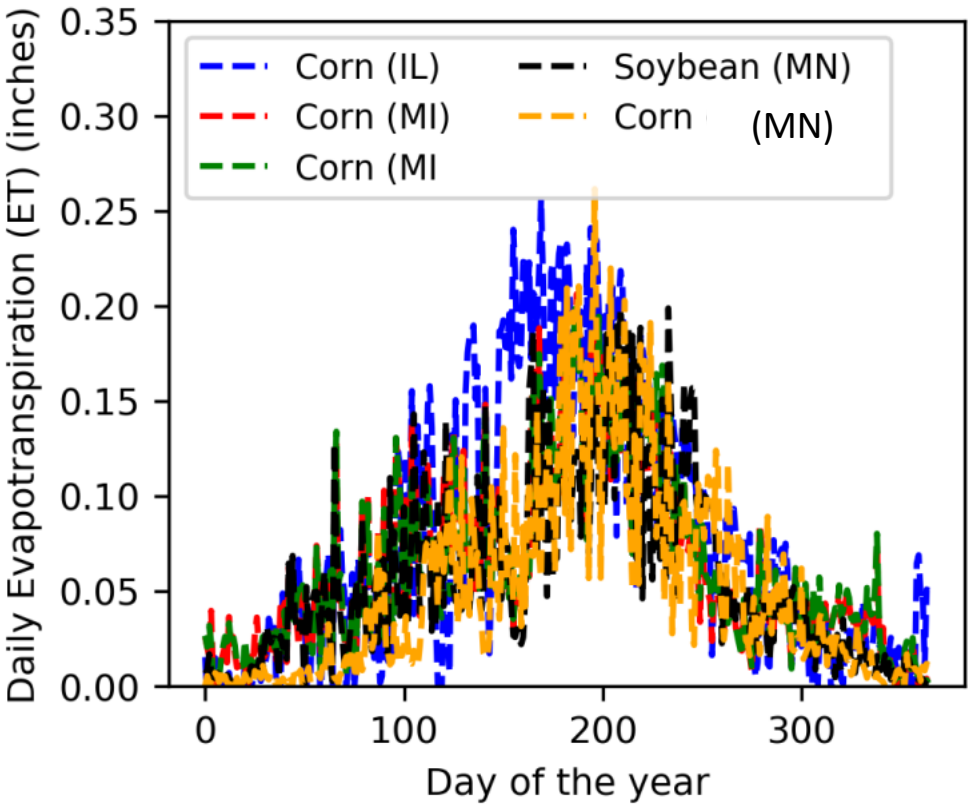


- Planted on April 26th
- Vine Killed 19th Aug
- **Harvested 7th Sep**

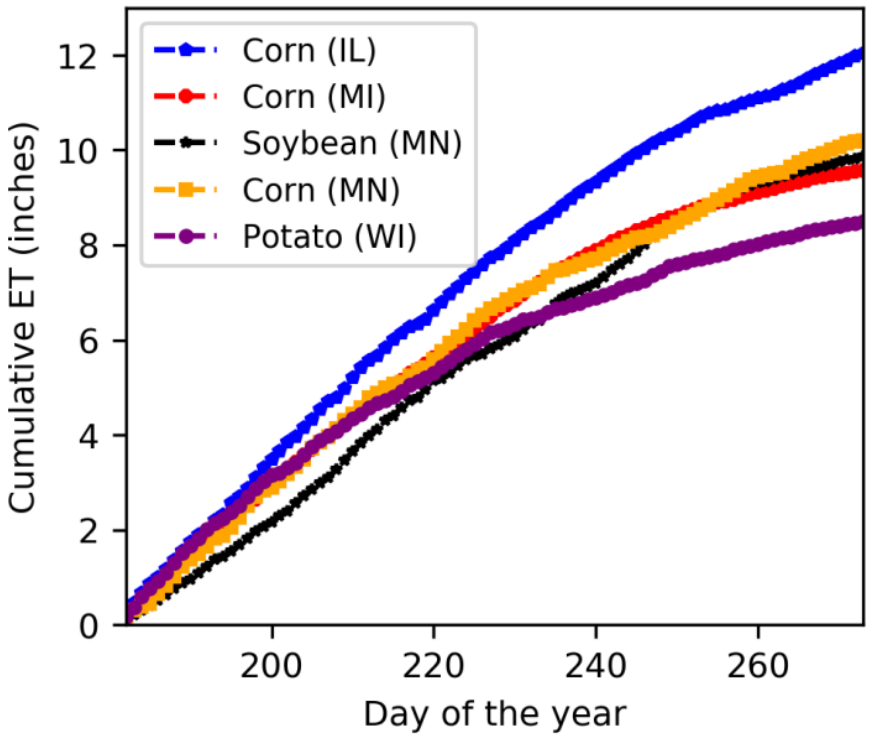


Average Water Supply and demand for Potatoes in Isherwood farms and Heartland farms in WI for Growing season (June, July, and August) for (2013-2018)


Potato Farm in July (7-7-2018, 8-7-2018)
Co2
Latent Heat
Carbon dioxide flux (umol m^{-2} s^{-1})
Latent Heat flux (Wm^{-2})
20
10
0
−10
−20
−30
400
300
200
100
0
00:00
06:00
12:00
18:00
00:00
06:00
12:00
18:00
00:00

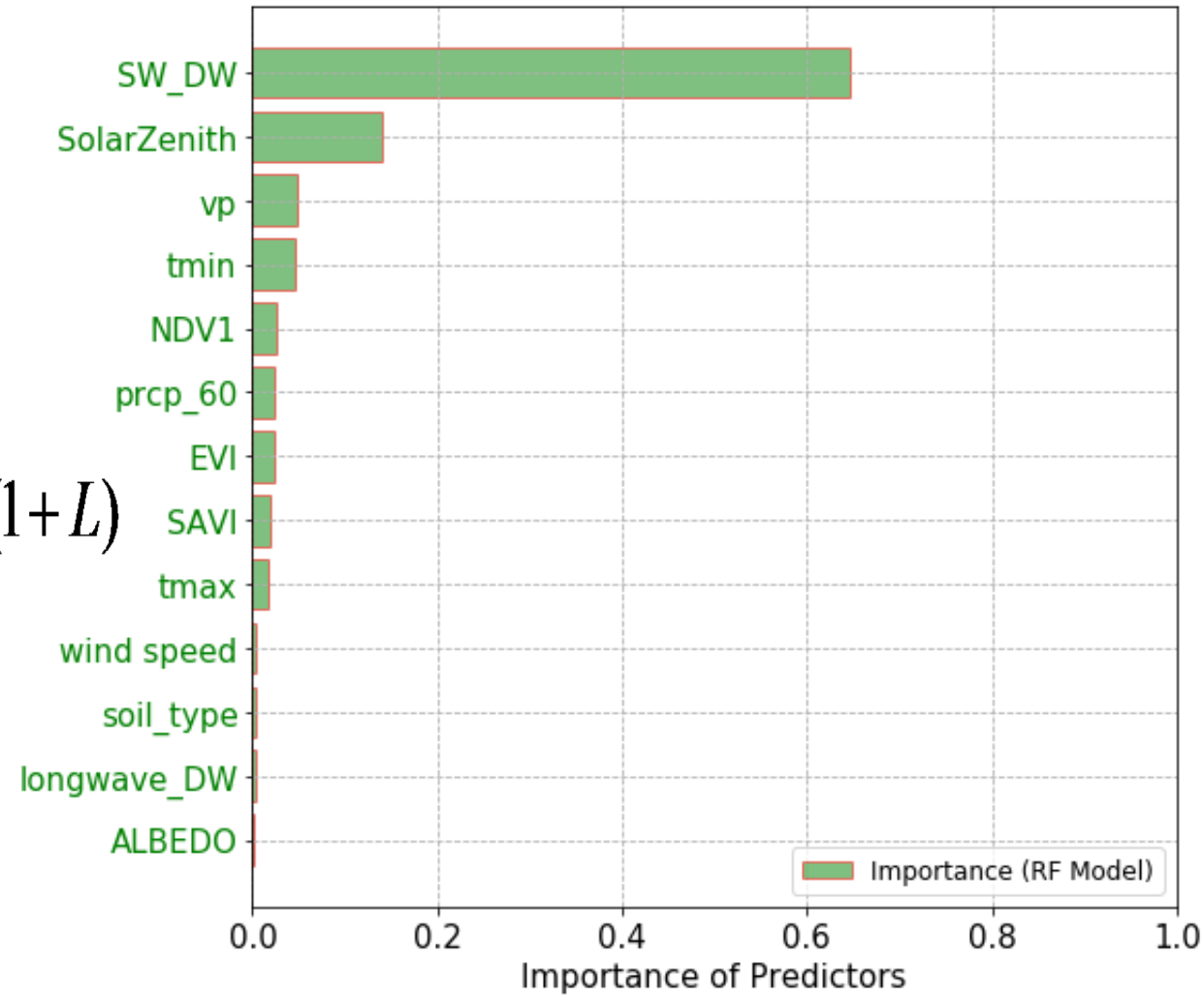


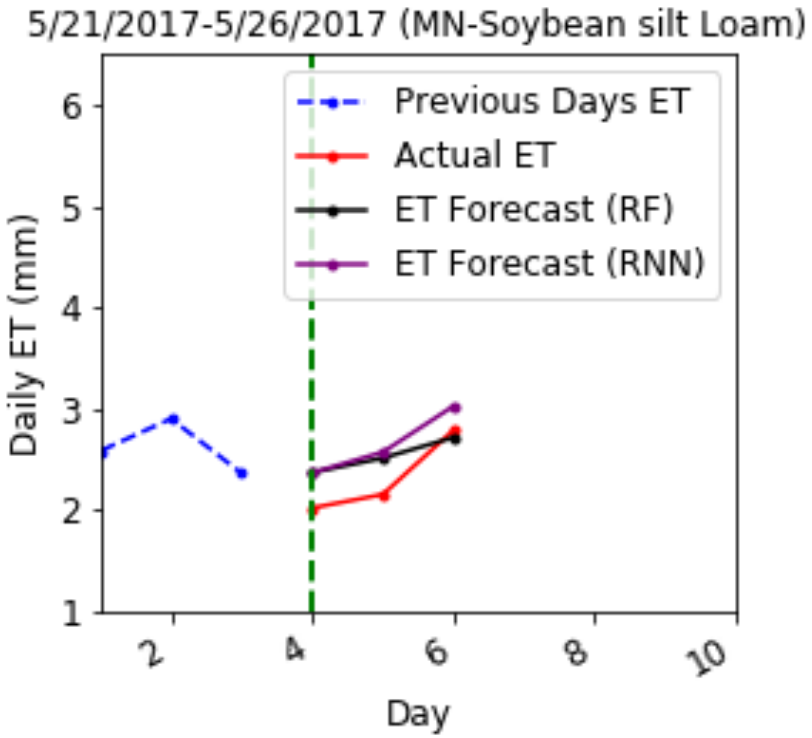
Training data for Learning Algorithm



Water use by different crop types in Midwest (2017,2018) under different soil types. Even same crop type can lead to different water used based on soil condition. Cumulatively IL corn water loss was about four inches higher than WI potatoes.

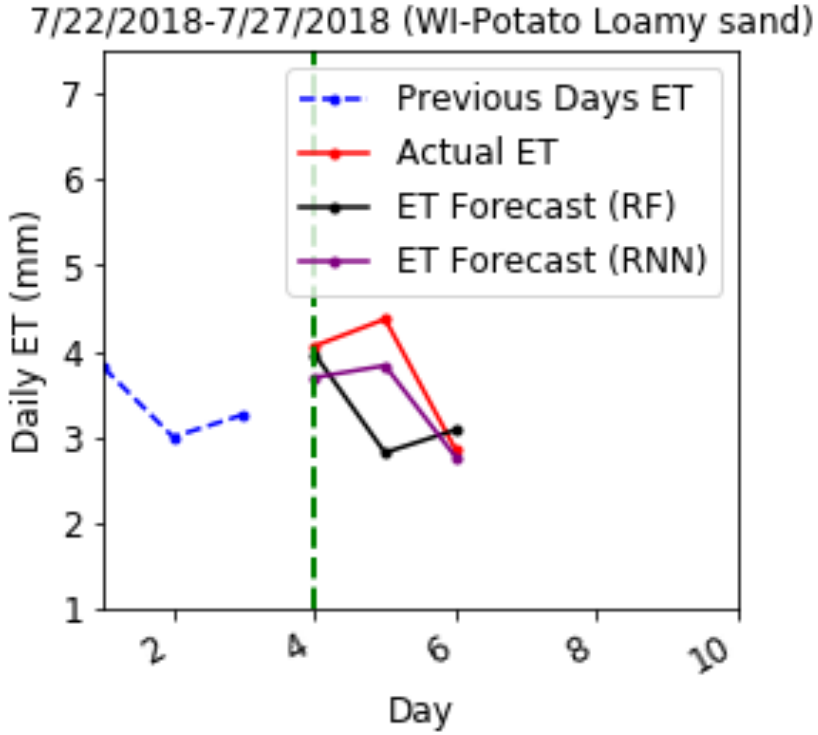
$$SAVI = \frac{NIR - RED}{(NIR + RED + L)} * (1 + L)$$

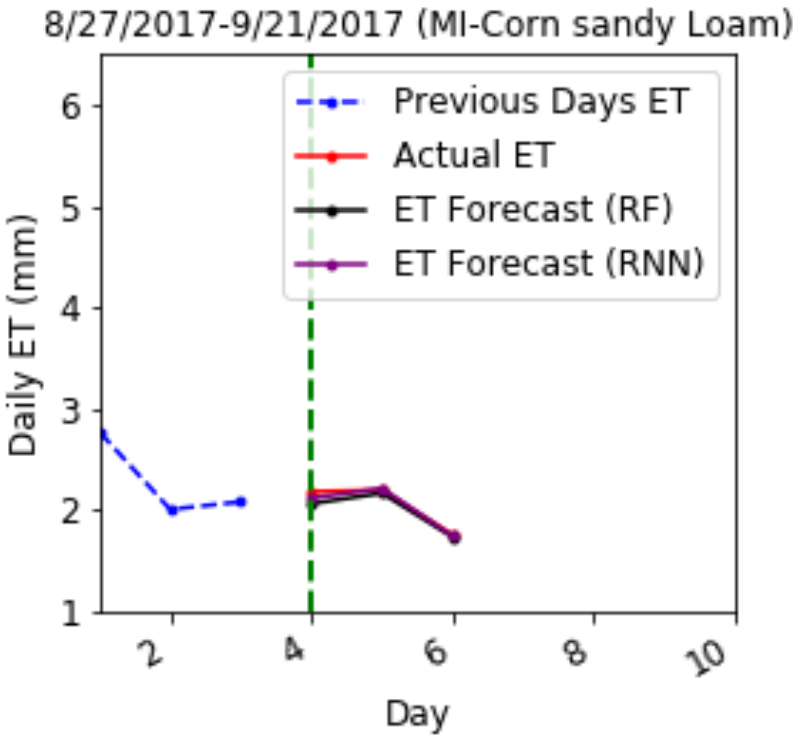




Forecasting Models

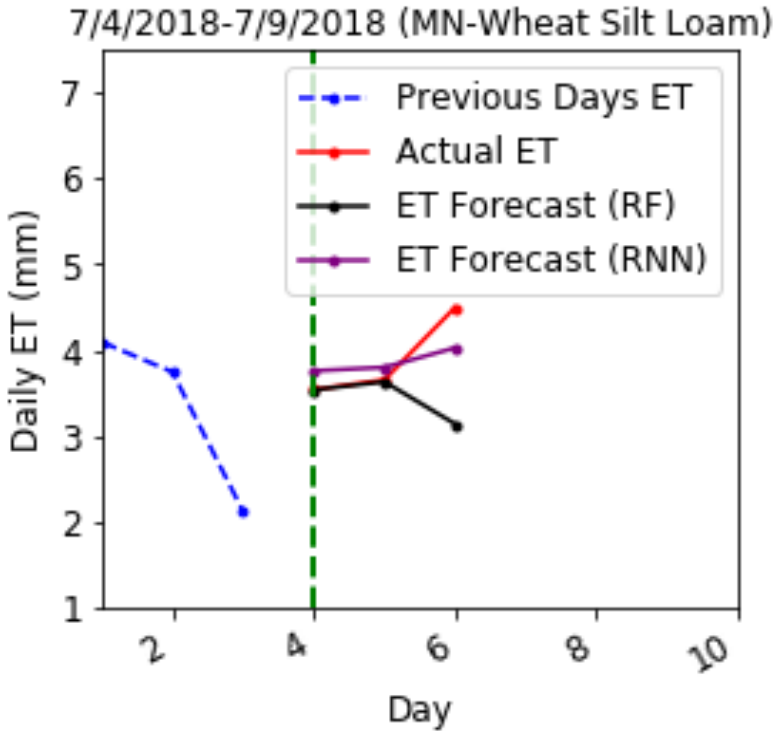
- RF
- RNN





Forecasting Models

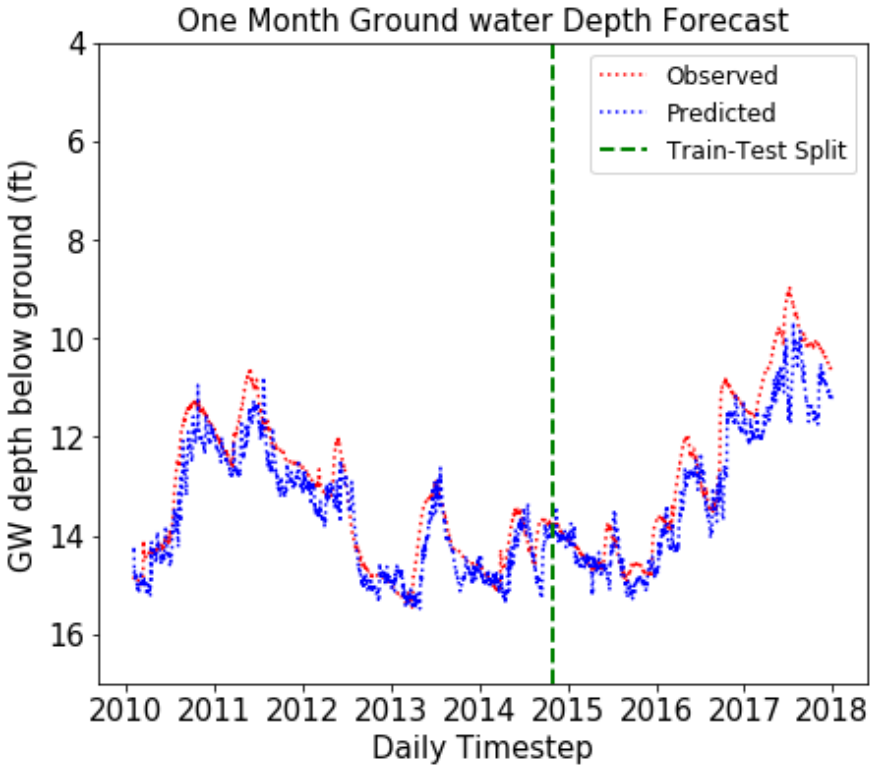
- RF
- RNN



Model Inputs for one month Forecast:

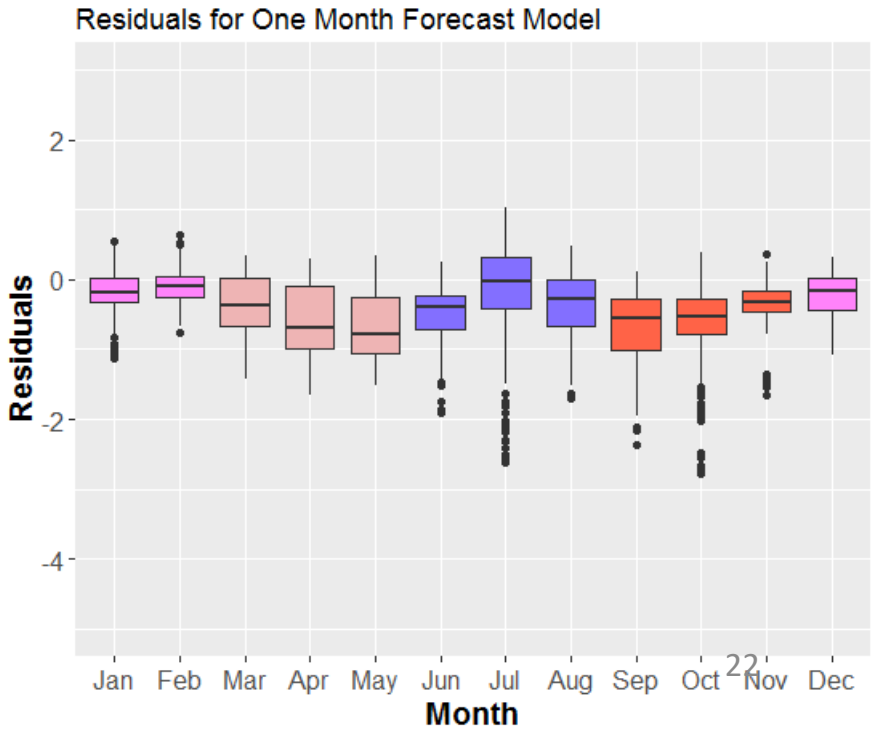
- GW (t-30)
- Max Air Temp (t-30)
- Min Air Temp (t-30)
- Precipitation (t-30)
- PDO (t-30)
- Soil Moisture (t-30)
- Soil Temperature (t-30)
- Relative Humidity (t-30)
- Net Radiations (t-30)

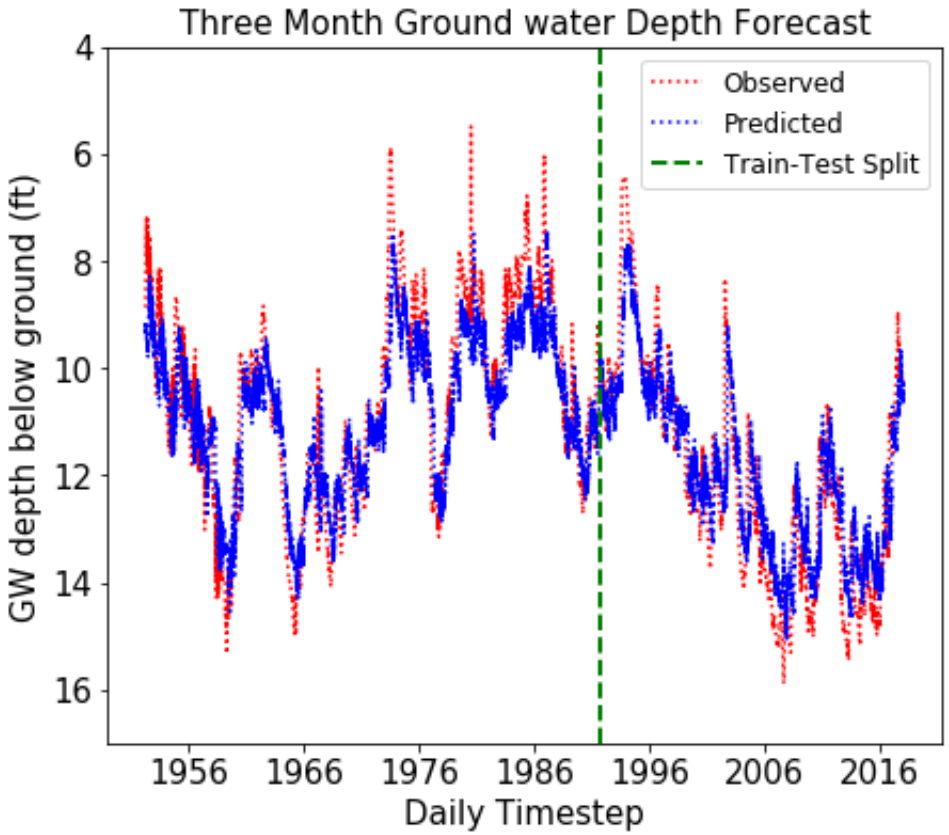
Model Output
GW (t)



Training Period : 2010-2014

Testing Period: 2015-2017

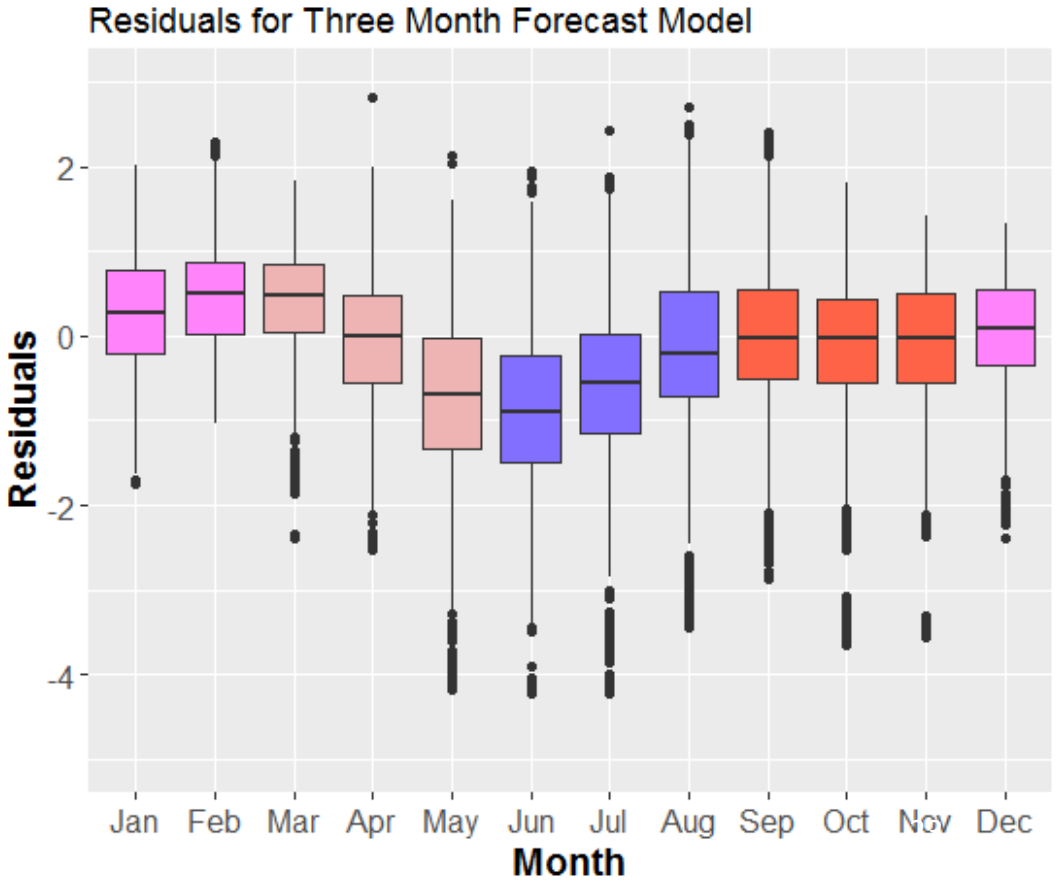




Lower GW depth means shallower GW

Residuals= (observed-simulated)

Model overestimated GW depth especially during summer months for three month forecast model



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QUESTIONS

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