# Soil moisture dynamics in a semi-humid grassland to forest transition zone

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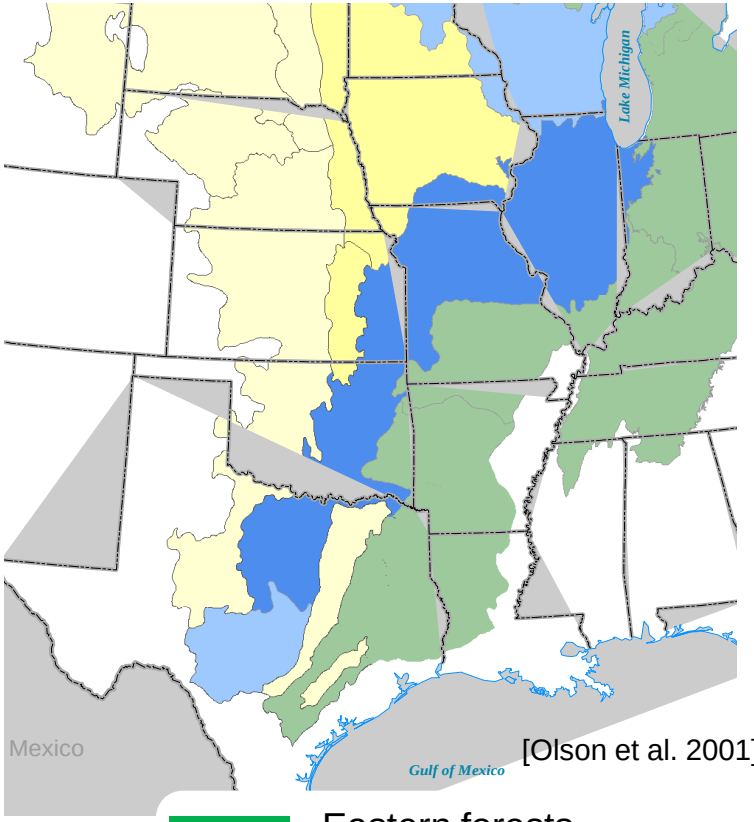
# Savanna / tallgrass prairie restoration




[Olson et al. 2001]

Eastern forests
Savanna-ecotone
Prairie

# Savanna are Unique Ecological Systems

- We believe historically widespread, although rare today
- Periodic ground fires maintain the savanna structure
- Highly productive tallgrass prairie understory
- Few long-term examples of restored or natural savanna

# Savanna water dynamics

**Pushmataha long-term savanna restoration experiment**

Continuous treatments since 1984


2-4 ac treatment units
completely randomized design
n=3 trt reps, 29 total units

**Pushmataha long-term savanna restoration experiment**




# Moisture dynamics

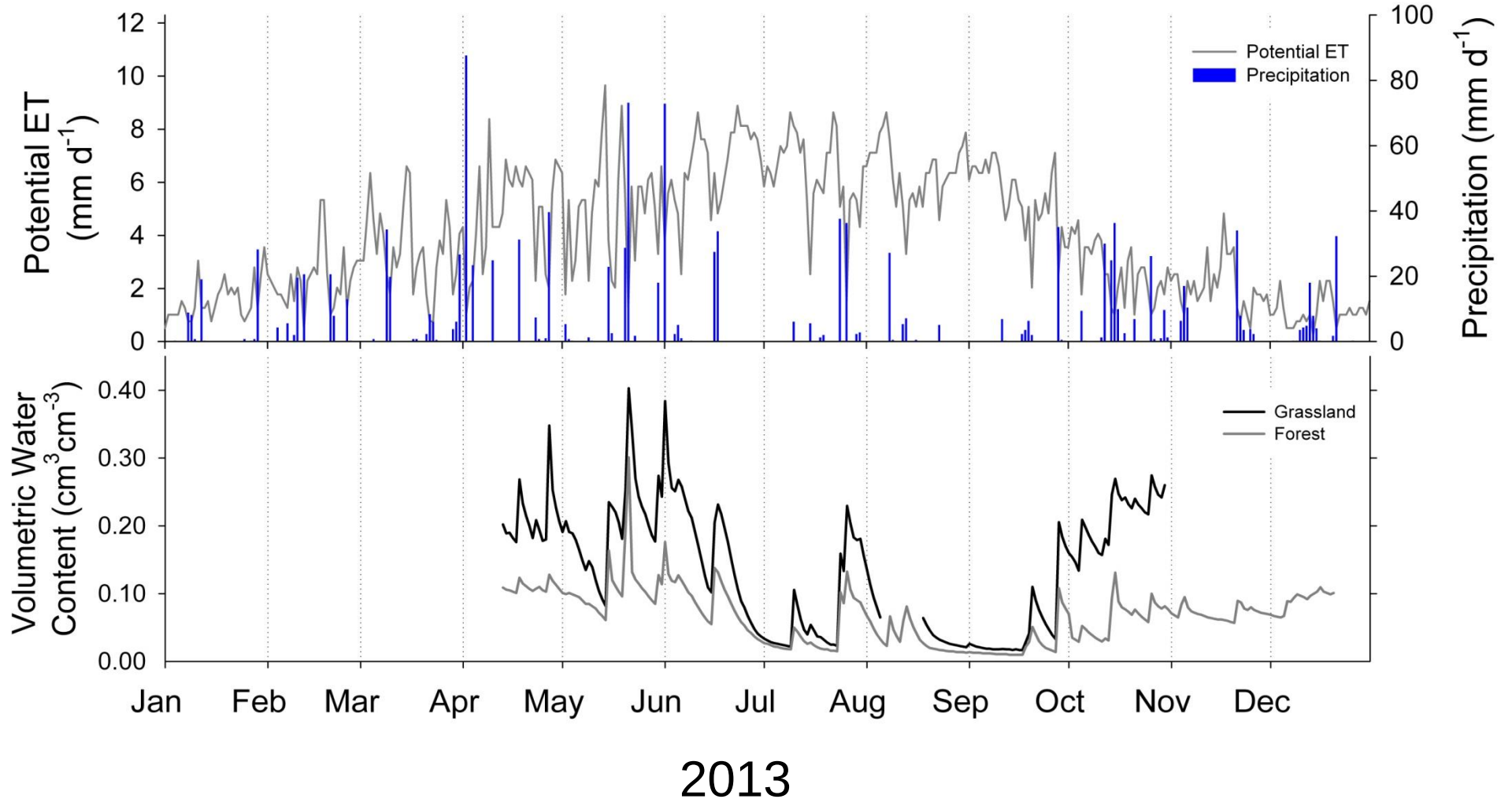
## Soil moisture dynamics

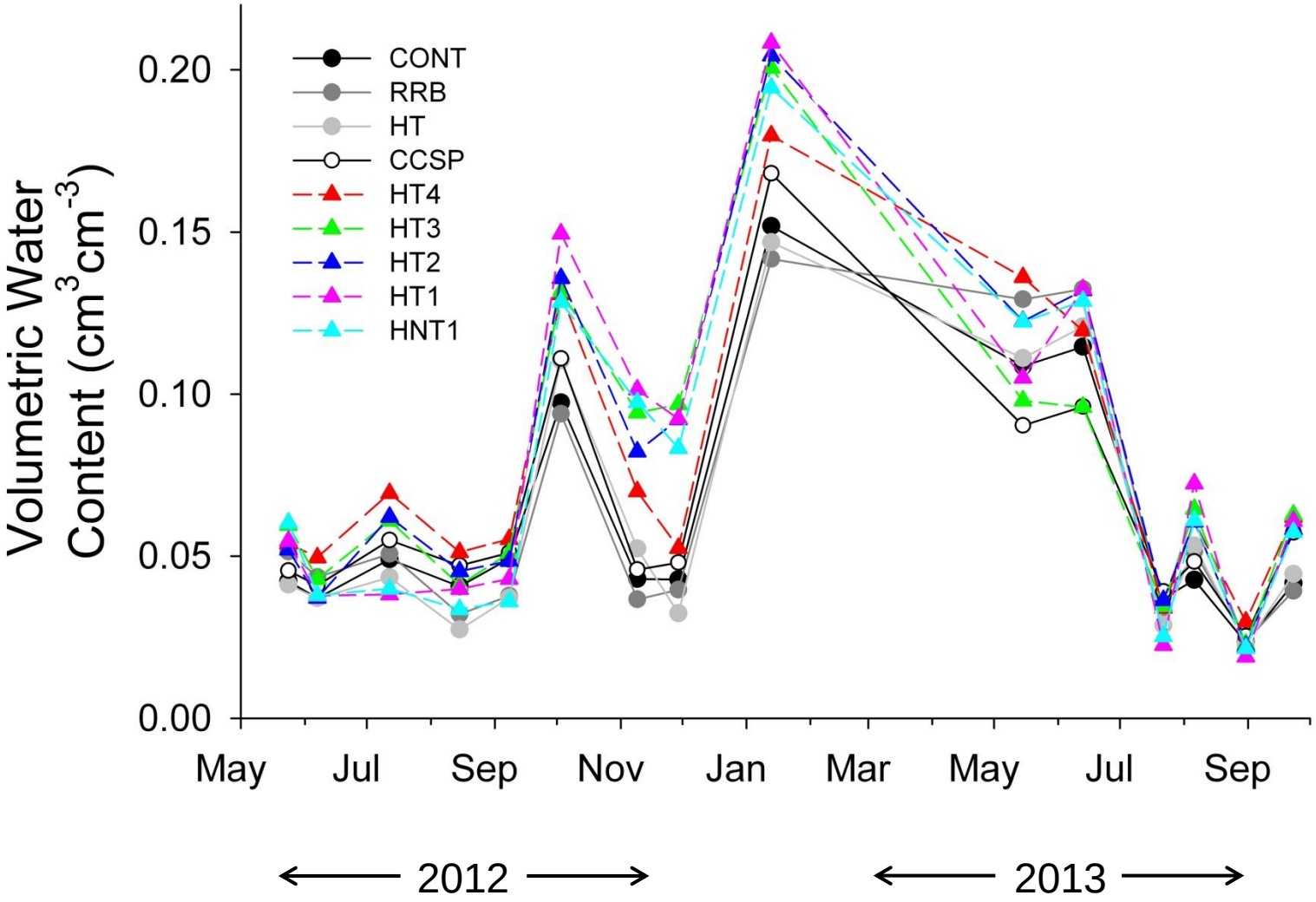
Continuous (30 min)

- Campbell Sci. CS655 & CWS655
  - 0-12 cm (30 locations)
  - 25 cm (6 locations)
  - 50 cm (6 locations)

Periodic

- Campbell Sci. HydroSense
  - 260 locations (n=10 per treatment unit)
  - 15 samples dates so far
  - 0-12 cm only
  - linked to 2012 & 2013 biomass productivity

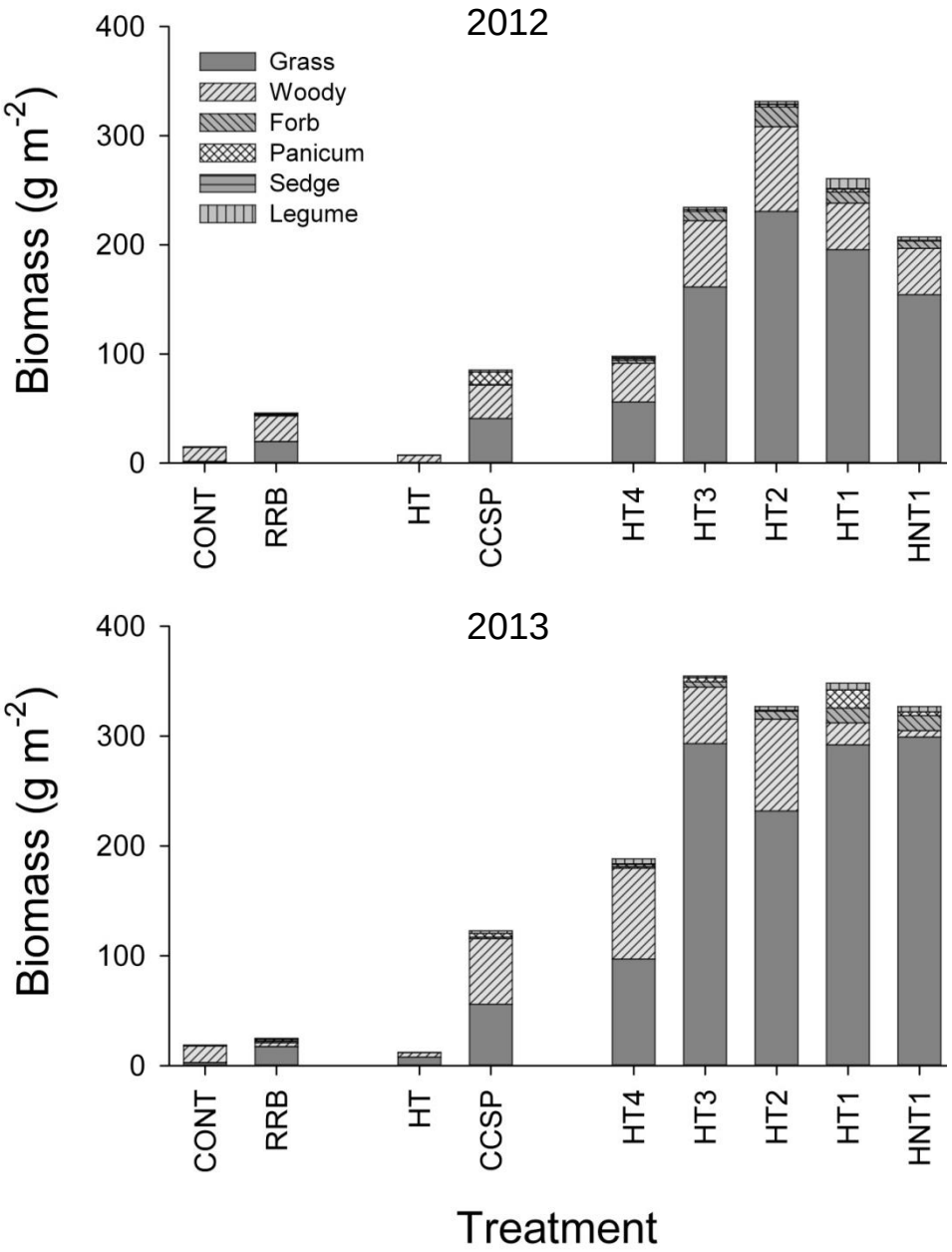

Potential ET
(mm d-1)
Precipitation (mm d-1)
Potential ET
Precipitation
Volumetric Water
Content (cm3cm-3)
Grassland
Forest
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2013


Volumetric Water Content (cm3cm-3)
0.20
0.15
0.10
0.05
0.00
CONT
RRB
HT
CCSP
HT4
HT3
HT2
HT1
HNT1
May
Jul
Sep
Nov
Jan
Mar
May
Jul
Sep
2012
2013

# Strong prairie response

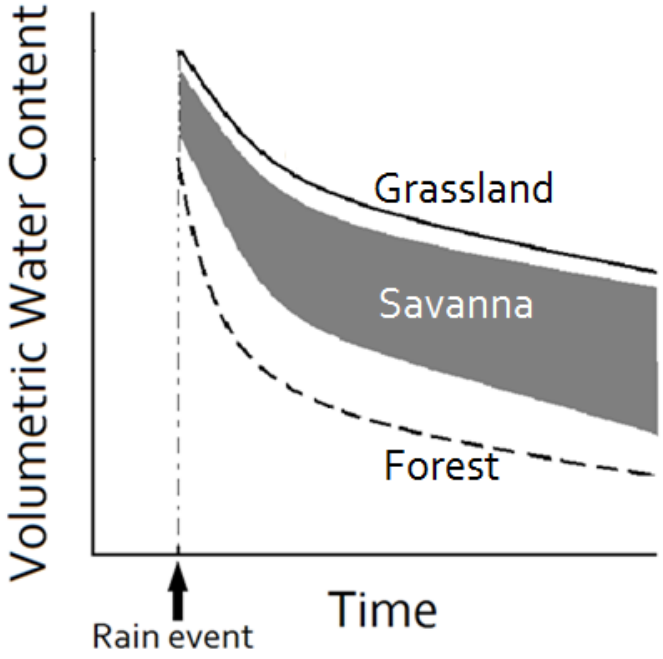
- warm season grasses
- oak/pine sprouts





# Model Form

- simple exponential decay
- hierarchical mixed-effects model




$$VWC = \alpha \cdot e^{-\beta \cdot t}$$

$\alpha$ *normalized to unity at end of precipitation event* ($t = 0$)

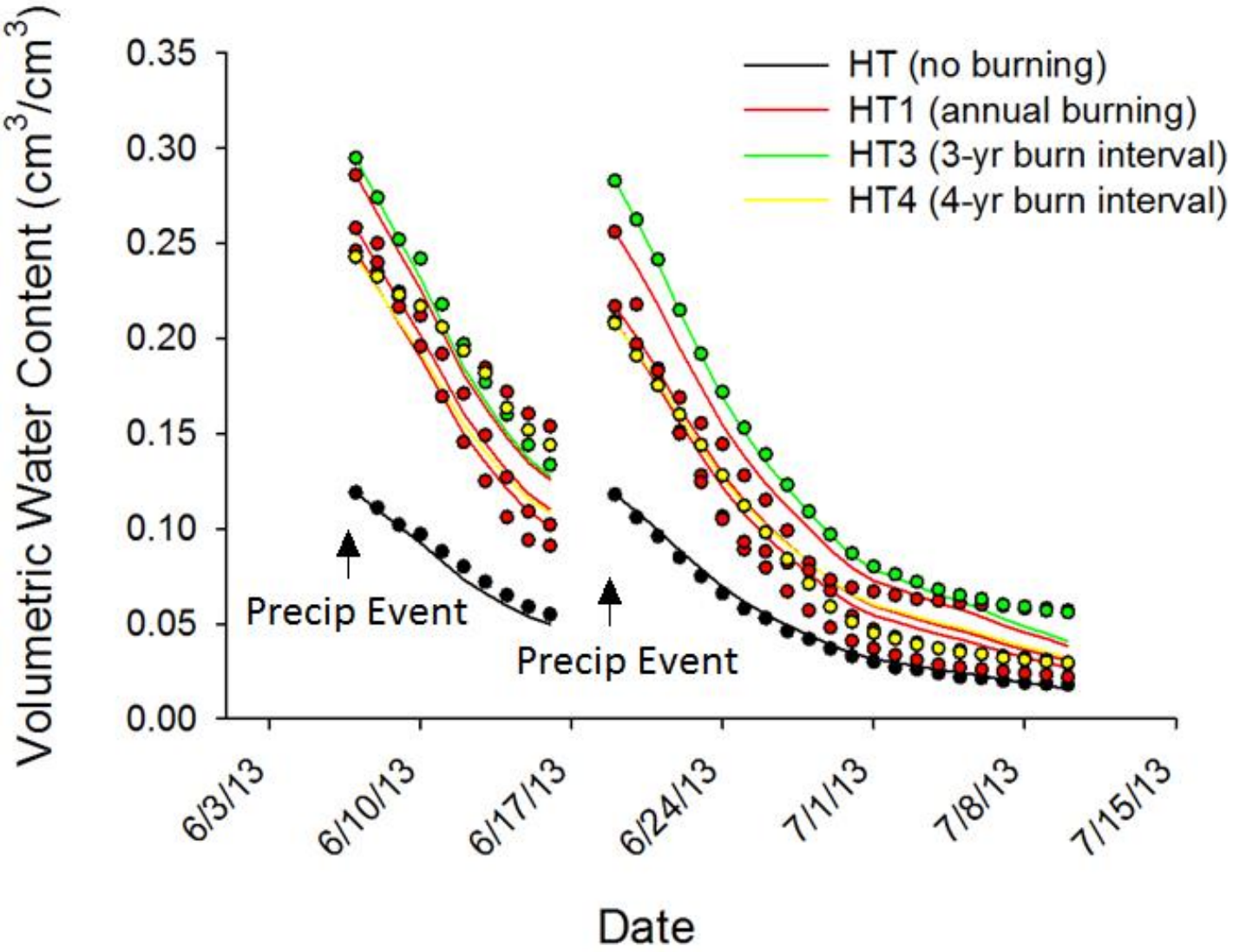
$$ln\left(\frac{VWC_t}{VWC_{t-1}}\right) = -\beta$$

$$-\beta_{ij} = b_1 + b_2(ET_{PAN}) + b_{3..n}(Env\ Covs) + v_j + u_i$$

$$v_j \sim \mathrm{N}\left(0, \sigma^2_{month\ x\ year}\right)$$

$$u_i \sim \mathrm{N}\left(0, \sigma^2_{probe\ x\ event}\right)$$

# Soil Moisture



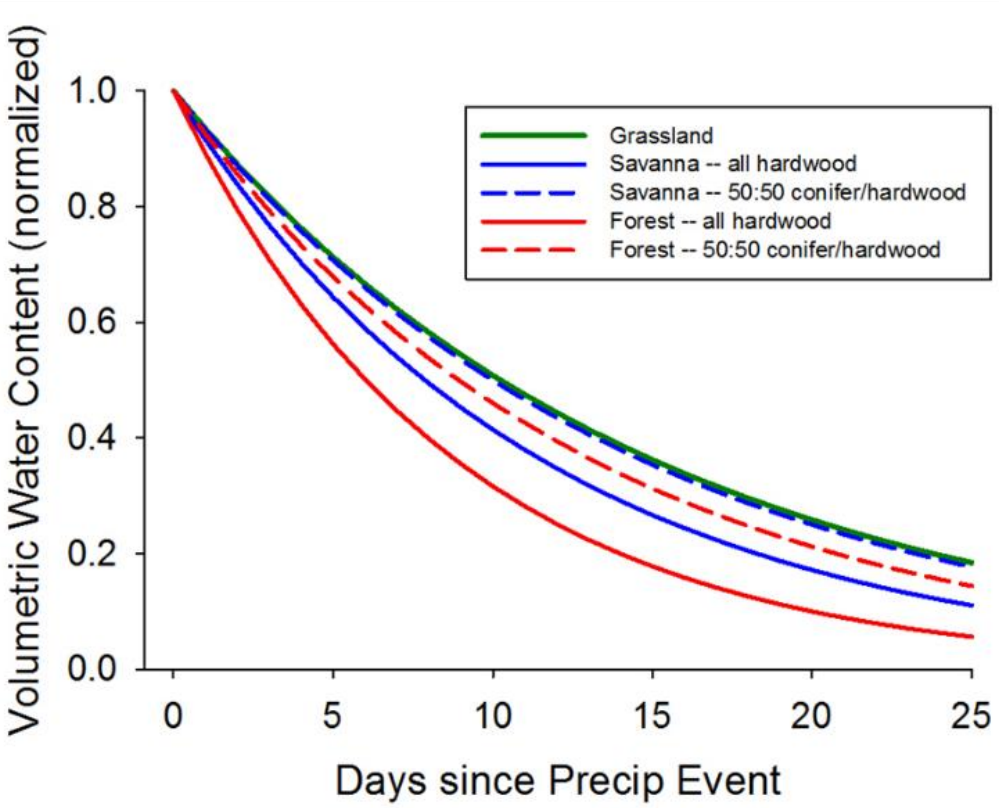
# Soil Evapotranspiration

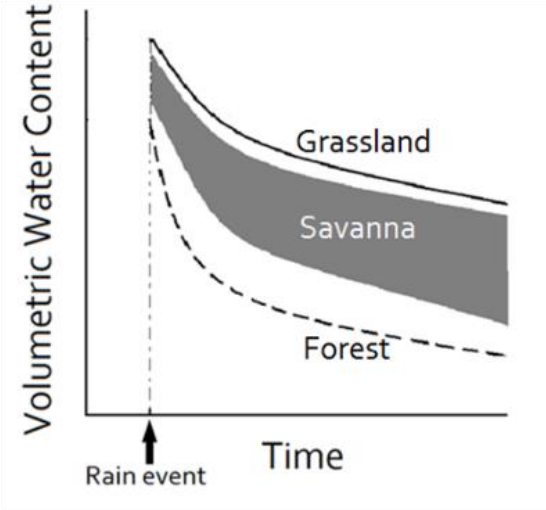
## Model sensitivity to stand basal area

Grassland: BA=0

Savanna: BA = 16 $m^2$ $ha^{-1}$

Forest: BA = 32 $m^2$ $ha^{-1}$

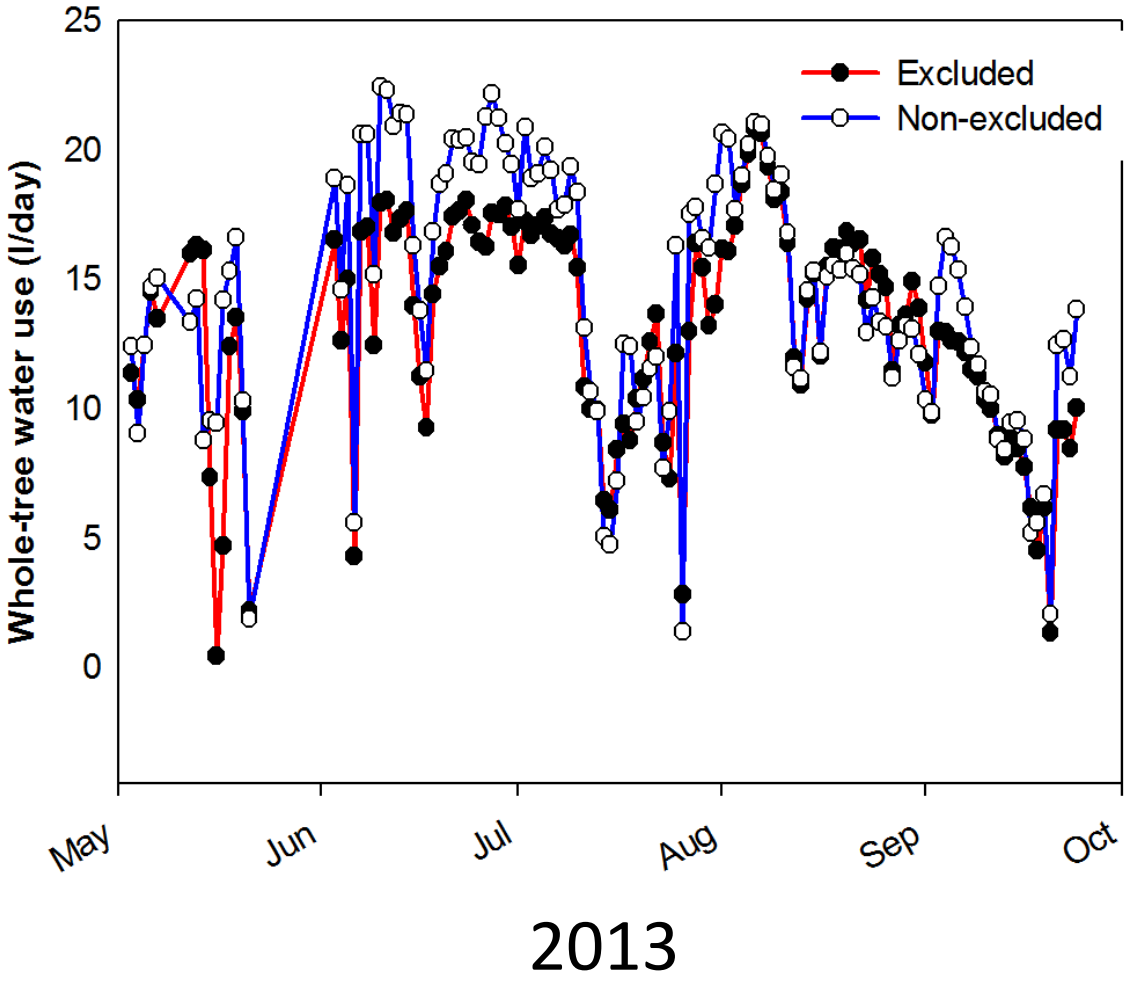


# Loblolly Pine & Climate Change

- South wide USDA “CAP” grant
- Unabashedly commercial plantations focused
- Model integrated physiology, genetics & bio-physical conditions

# Sapflux estimated whole-tree water use (loblolly pine)



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