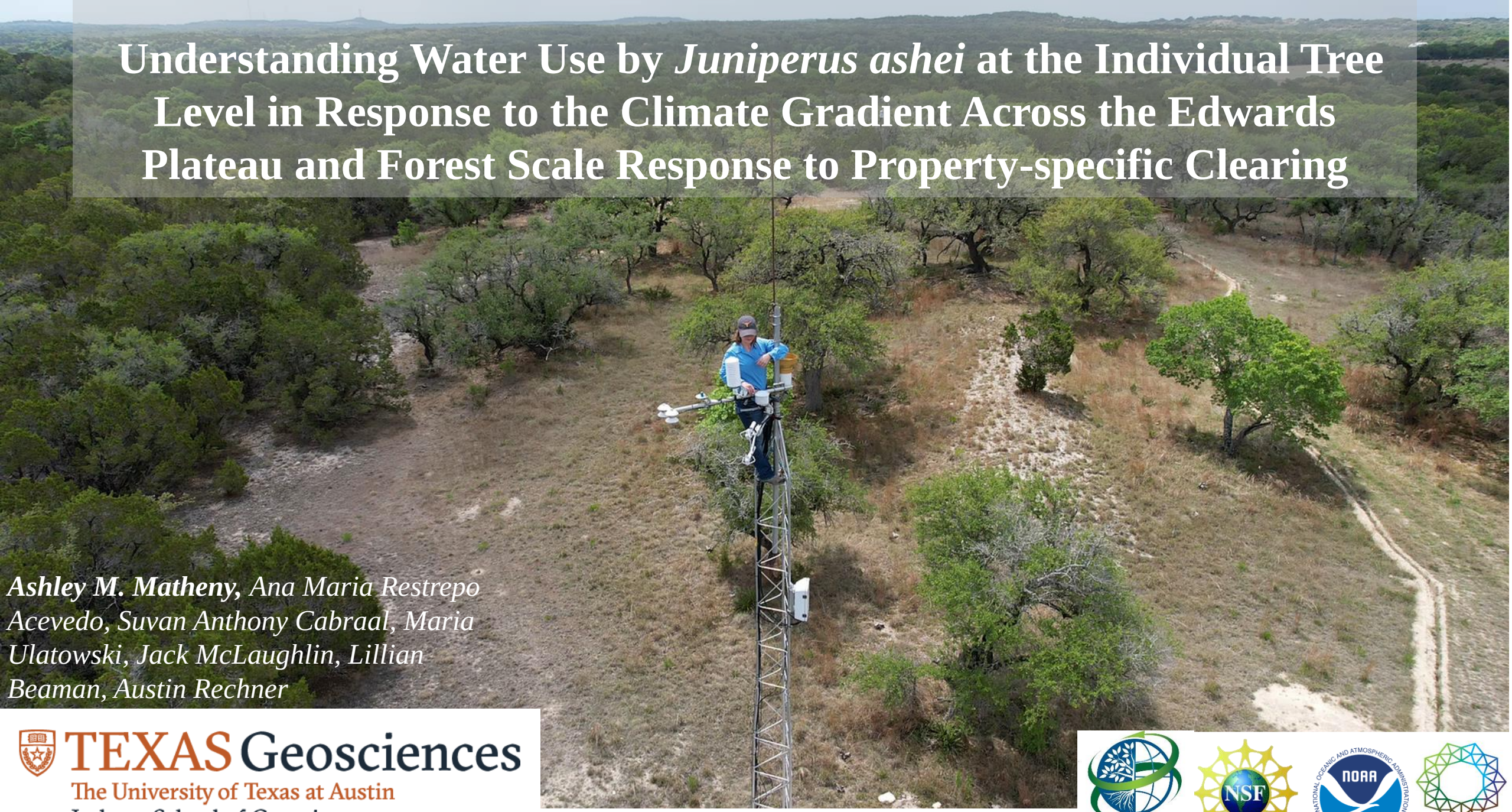
Understanding Water Use by *Juniperus ashei* at the Individual Tree Level in Response to the Climate Gradient Across the Edwards Plateau and Forest Scale Response to Property-specific Clearing



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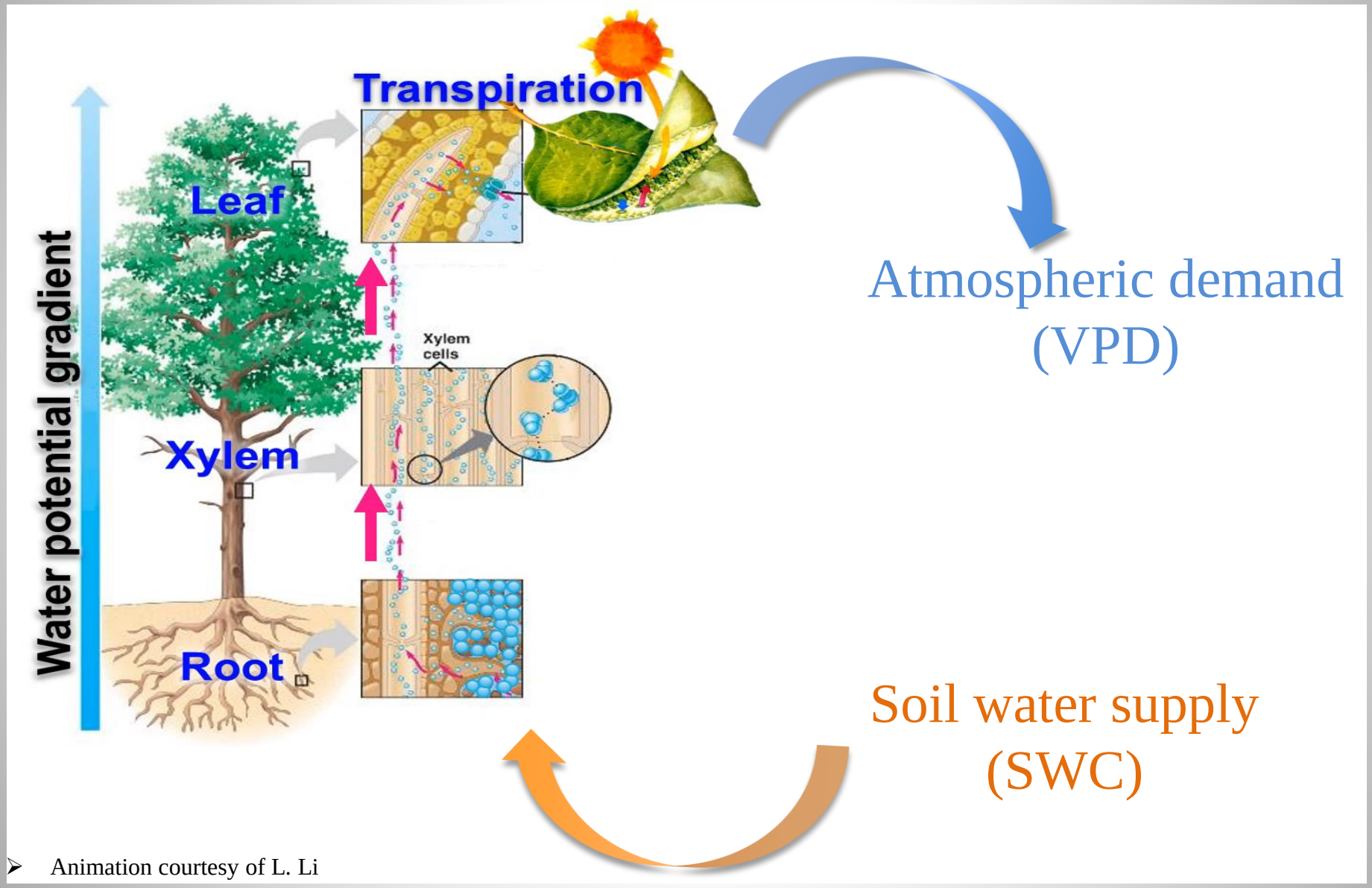
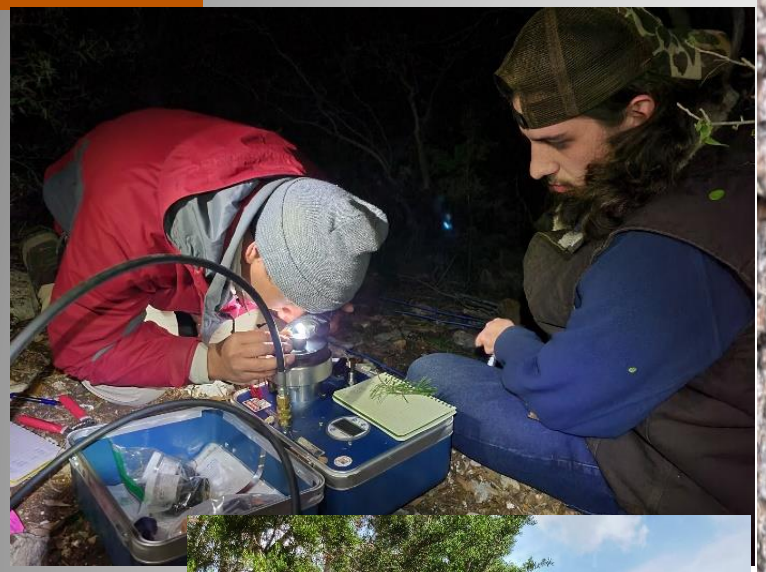
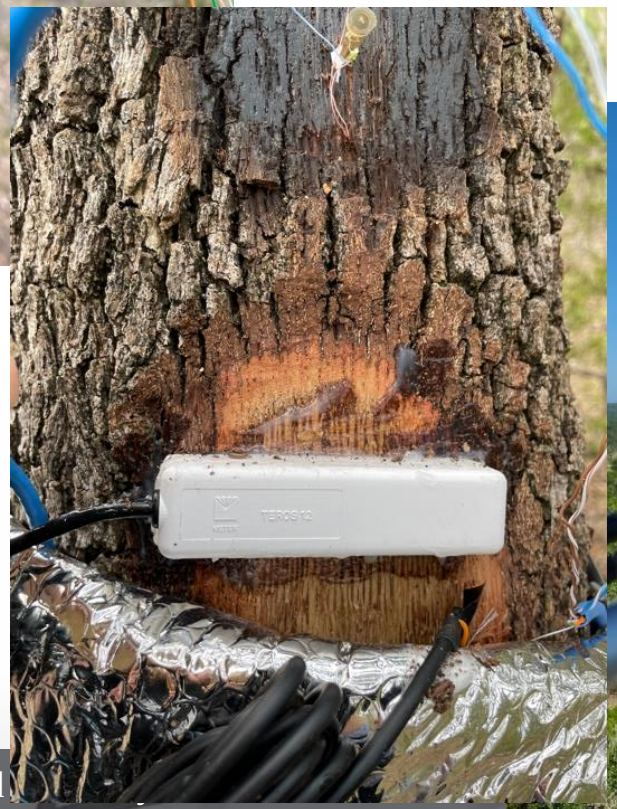
Plant water transport



- Animation courtesy of L. Li

Observational strategies and techniques





Juniper water dynamics along the Edwards Plateau

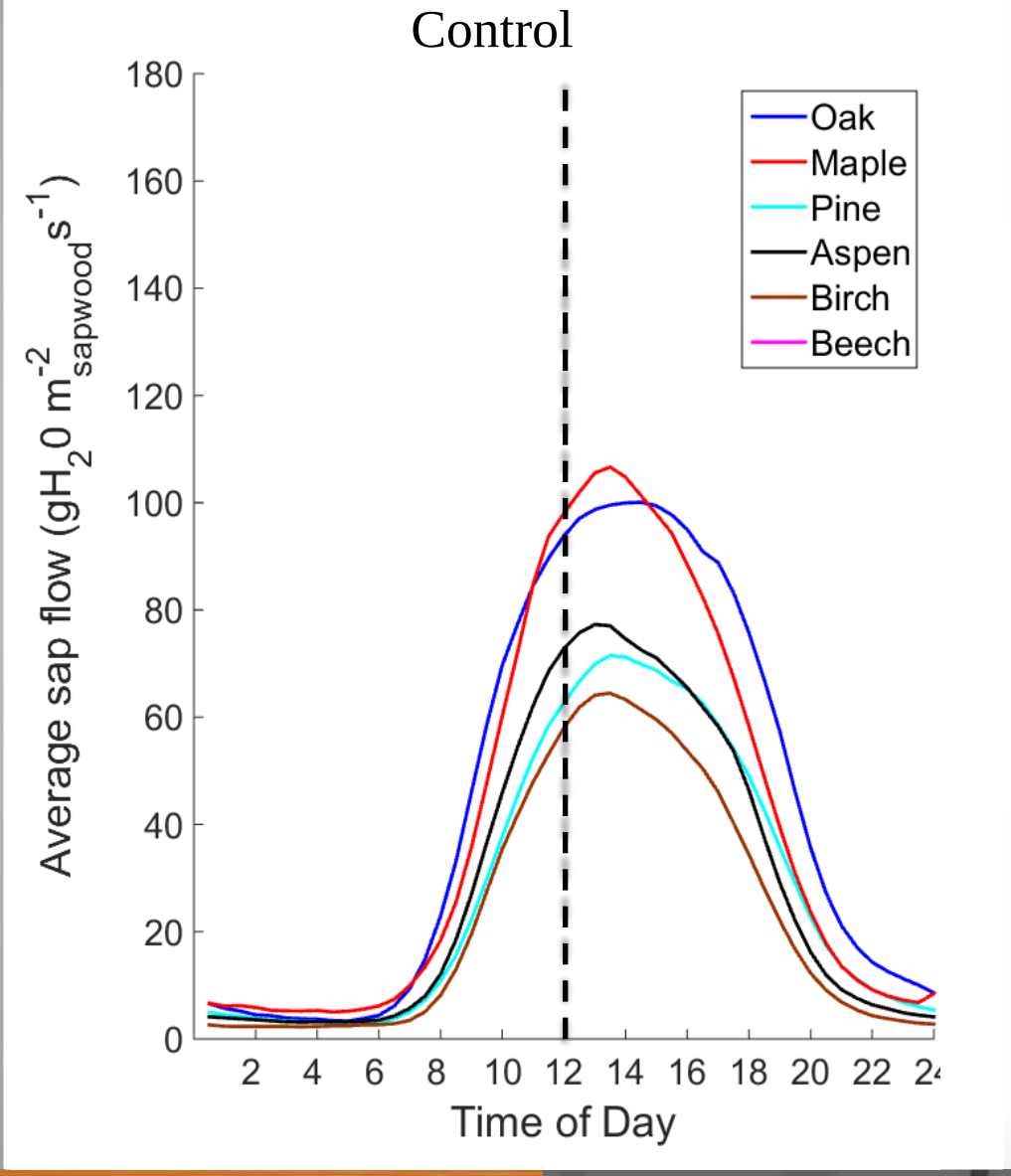
Rocksprings, TX

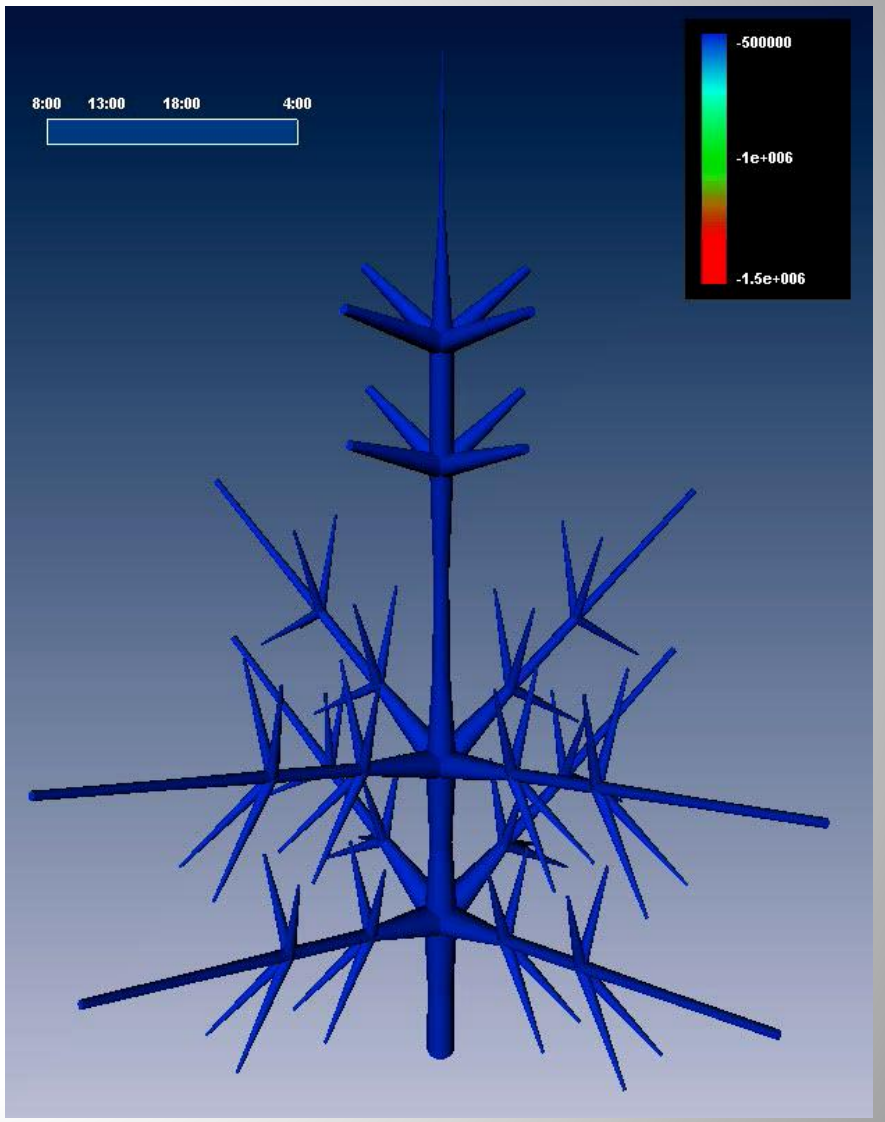
Mean annual temperature : 21.06 °C
Average annual precipitation: 680 mm
Max summer VPD: 7.6 kPa
Dominant tree species: Ashe juniper (*Juniperus ashei*), Lacy oak (*Quercus laceyi*), Piñon pine (*Pinus remota*)

Dripping Springs, TX

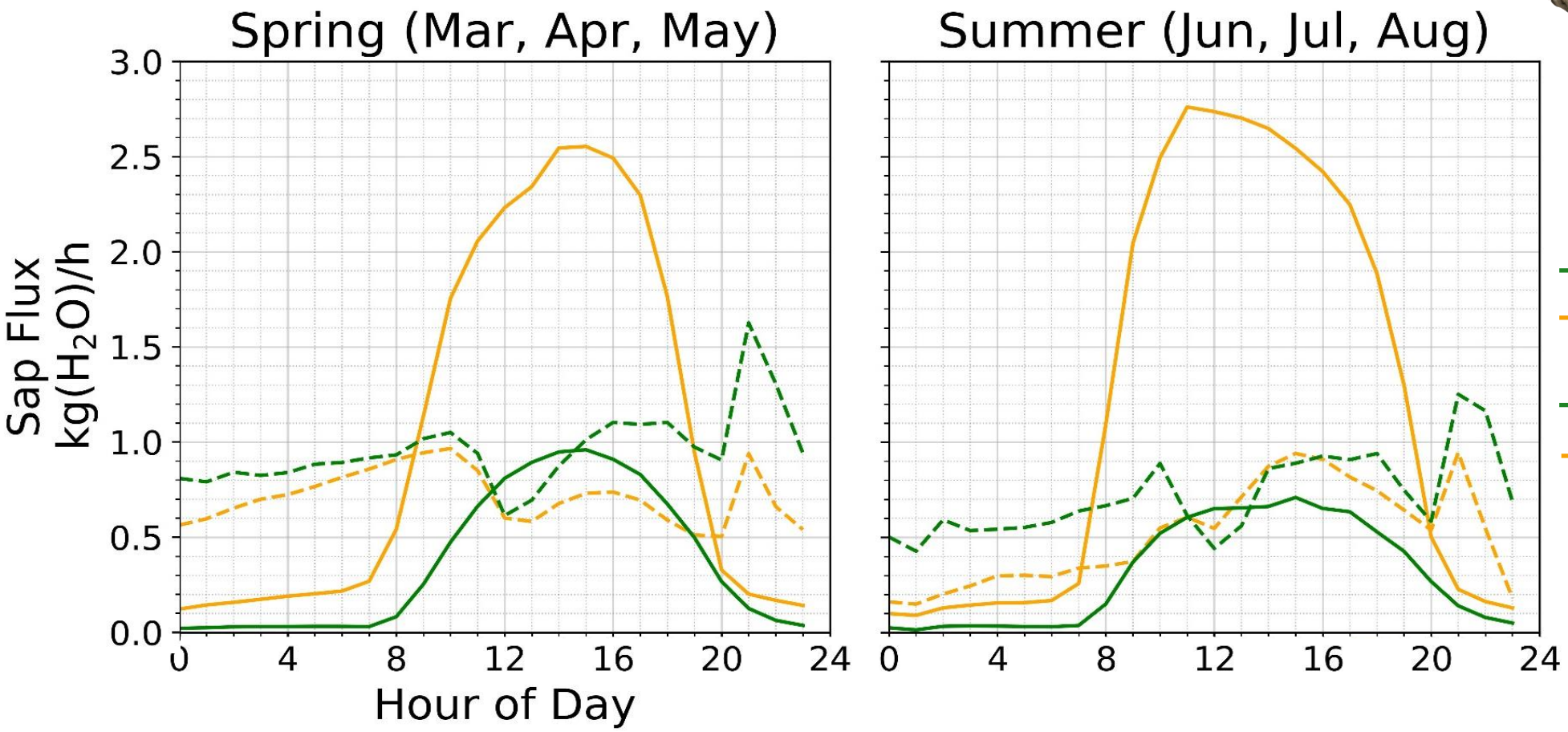
Mean annual temperature : 19.60 °C
Average annual precipitation: ~ 900 mm
Max summer VPD: 9.1 kPa
Dominant tree species: Ashe juniper (*Juniperus ashei*), Escarpment live oak (*Quercus fusiformis*)

Typical daily patterns for transpiration

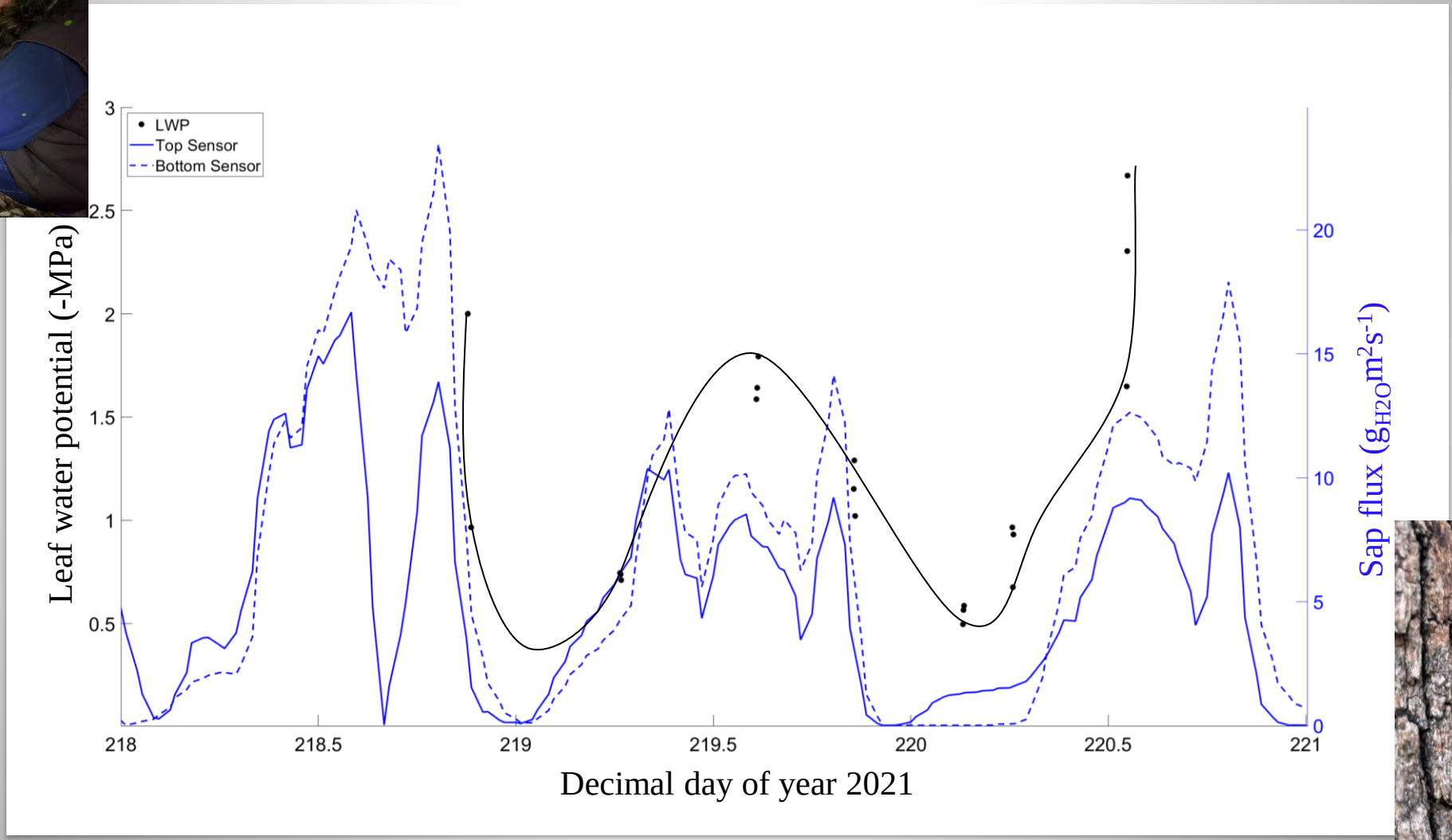




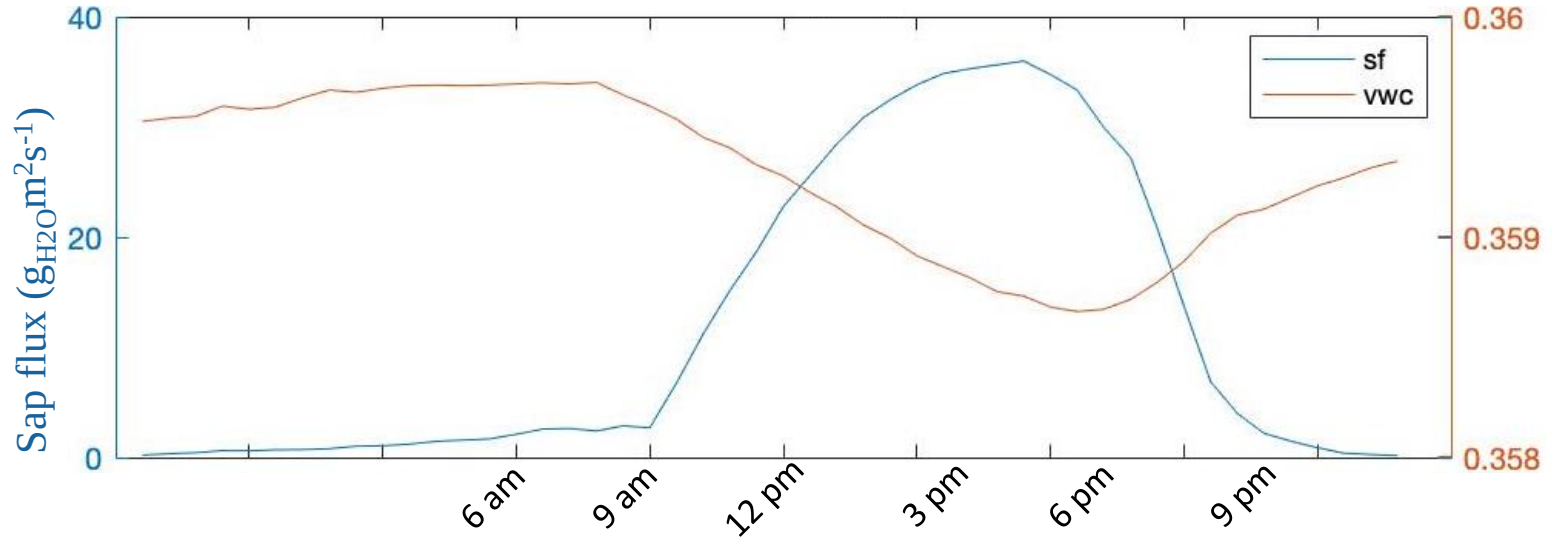
Typical daily patterns for transpiration in TX



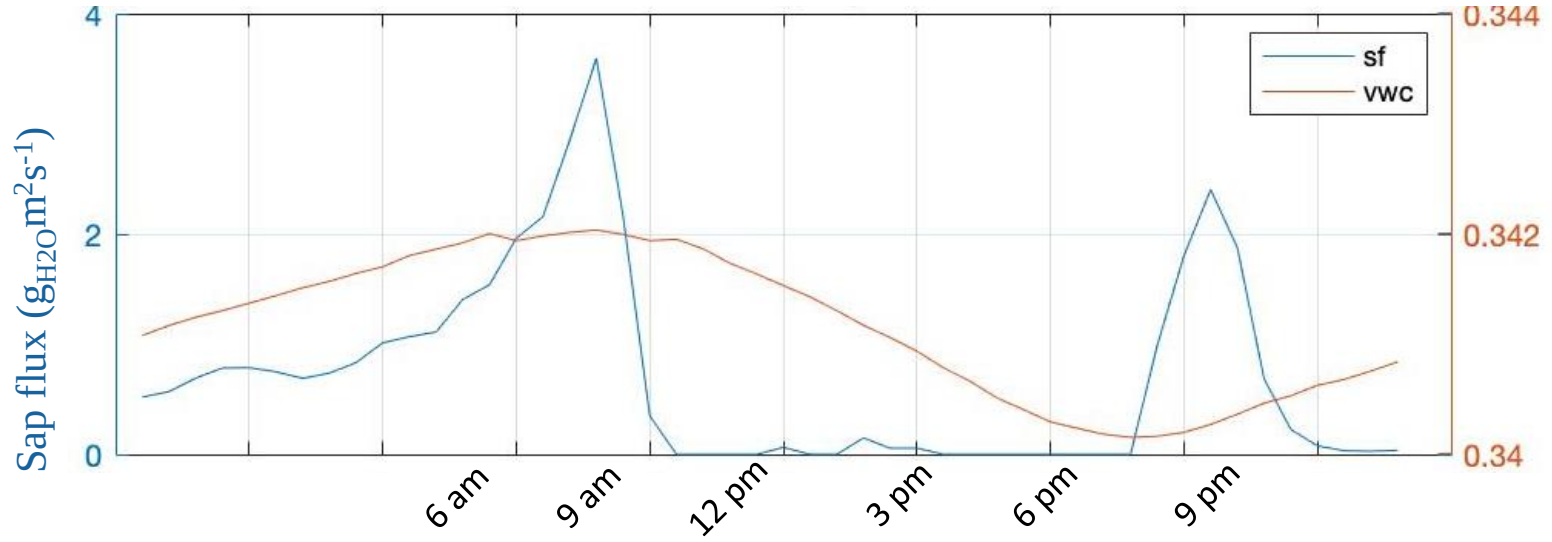
Leaf-level confirmation of sap flux observations



Extreme responses to heat and drought

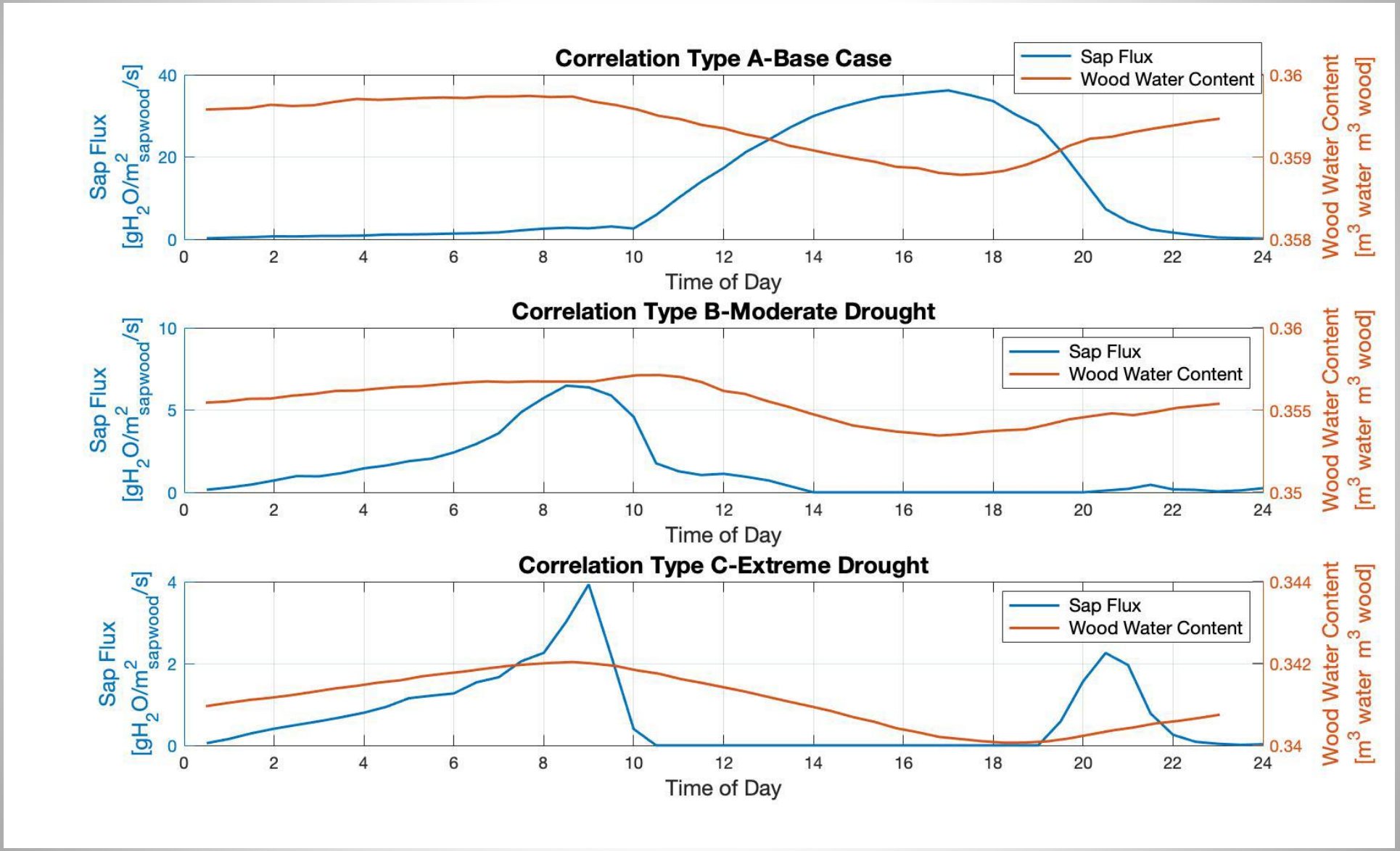


Juniper #7
April 18, 2021



Juniper #7
Aug. 14, 2021

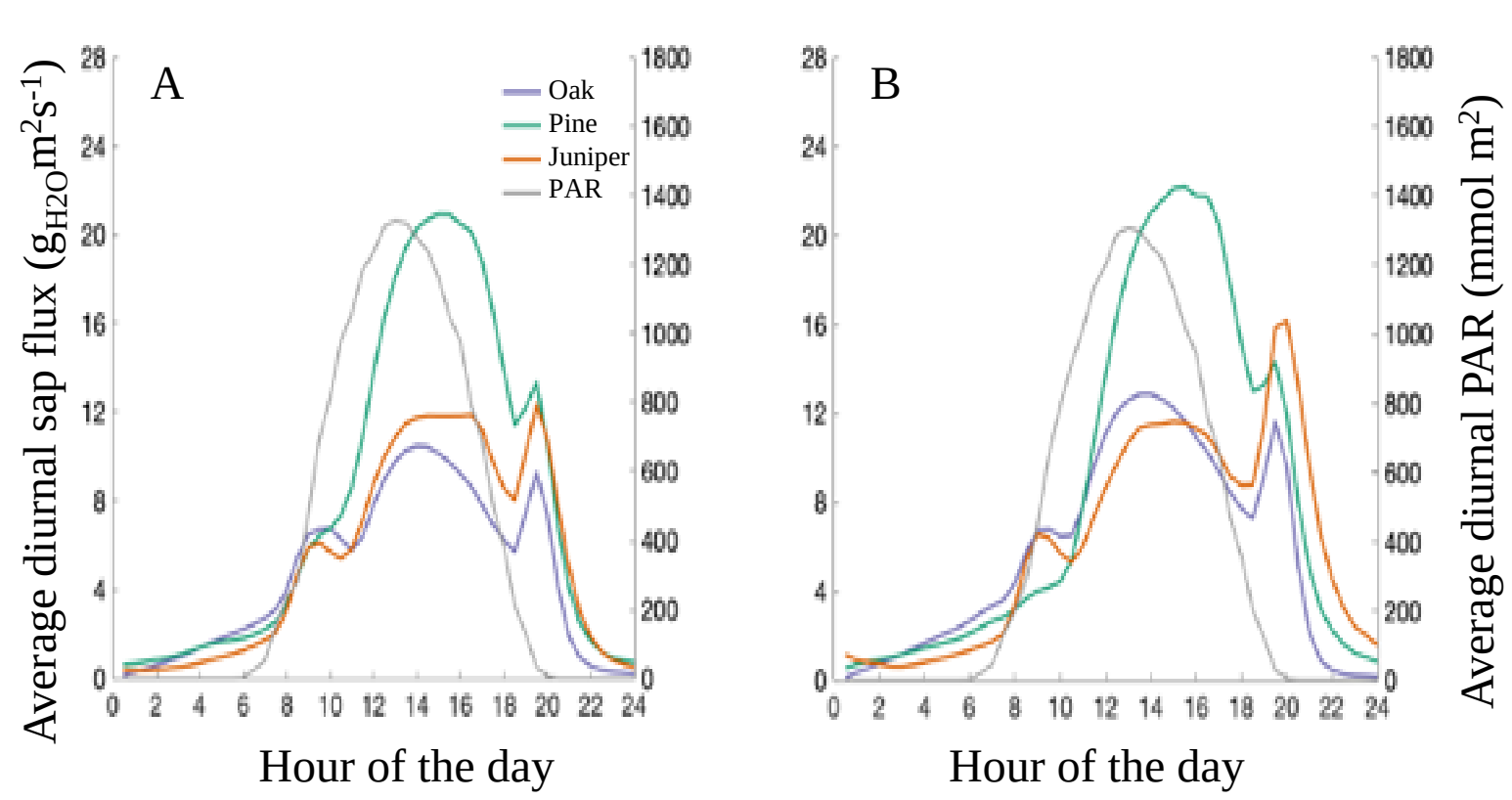
Hook ‘em horns appear when its hot and dry



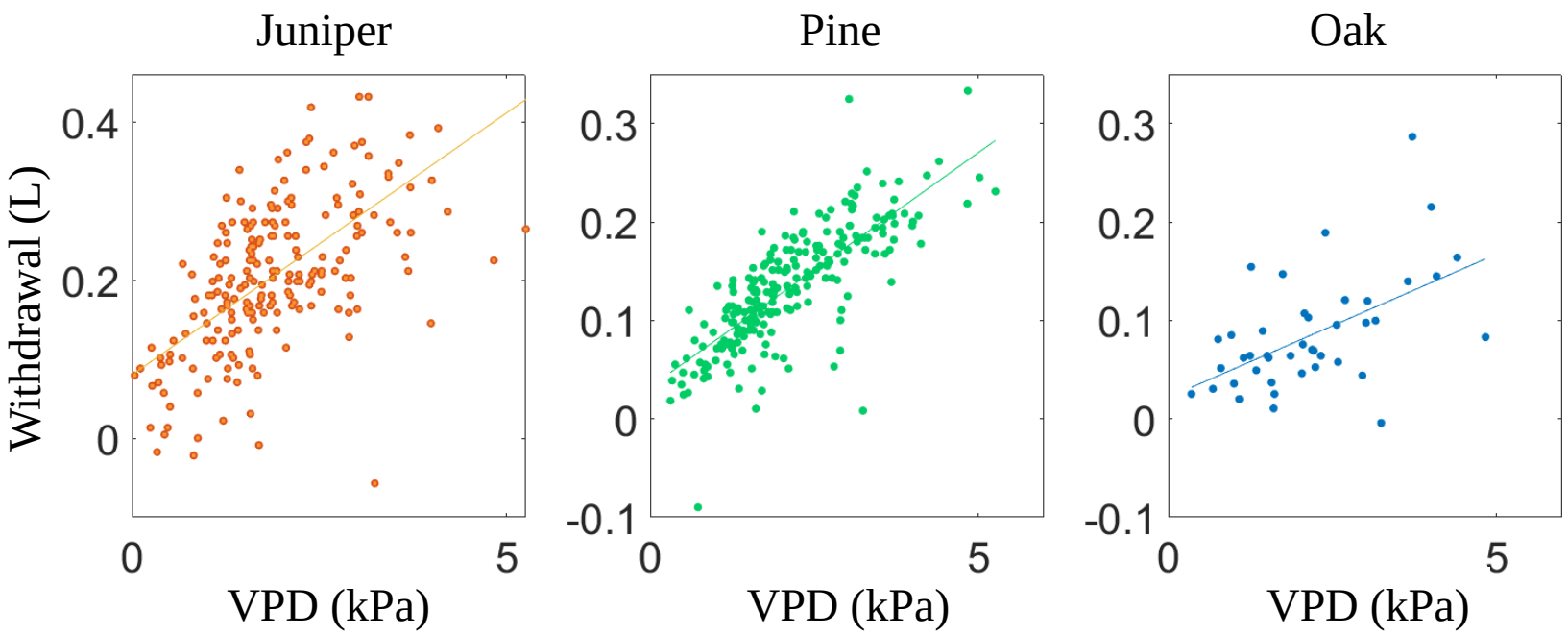
Responses persist across species and years in Rocksprings, but not Dripping Springs

2018

2019



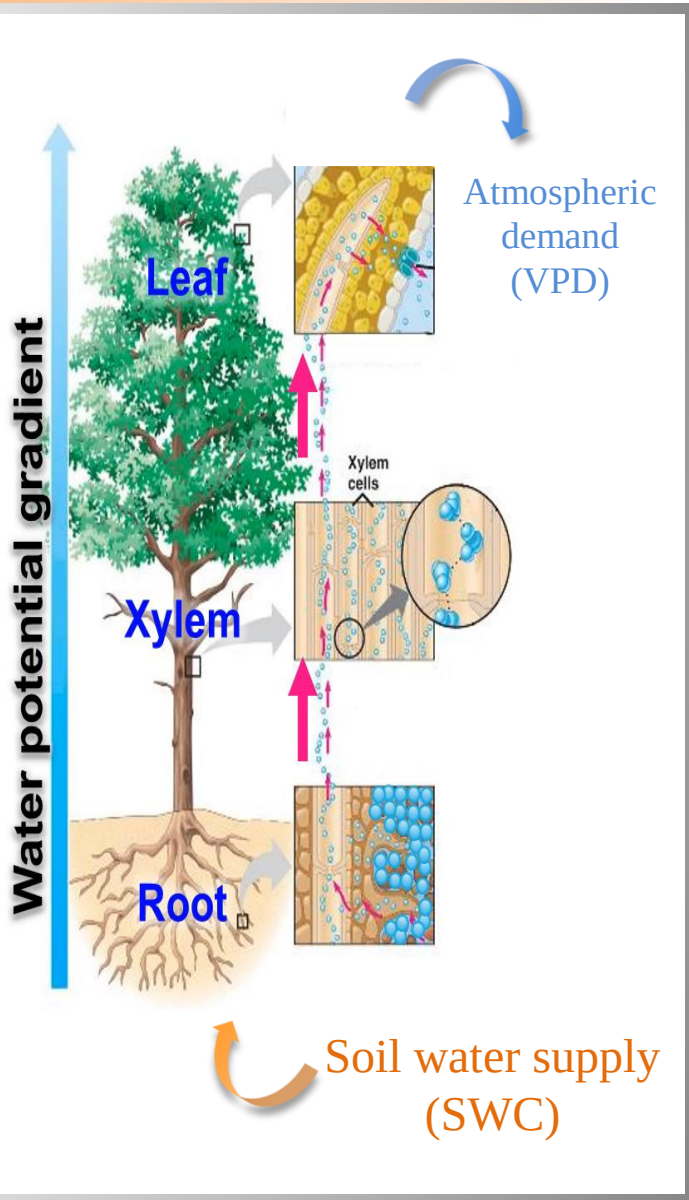
VPD is driving water withdrawals for all species



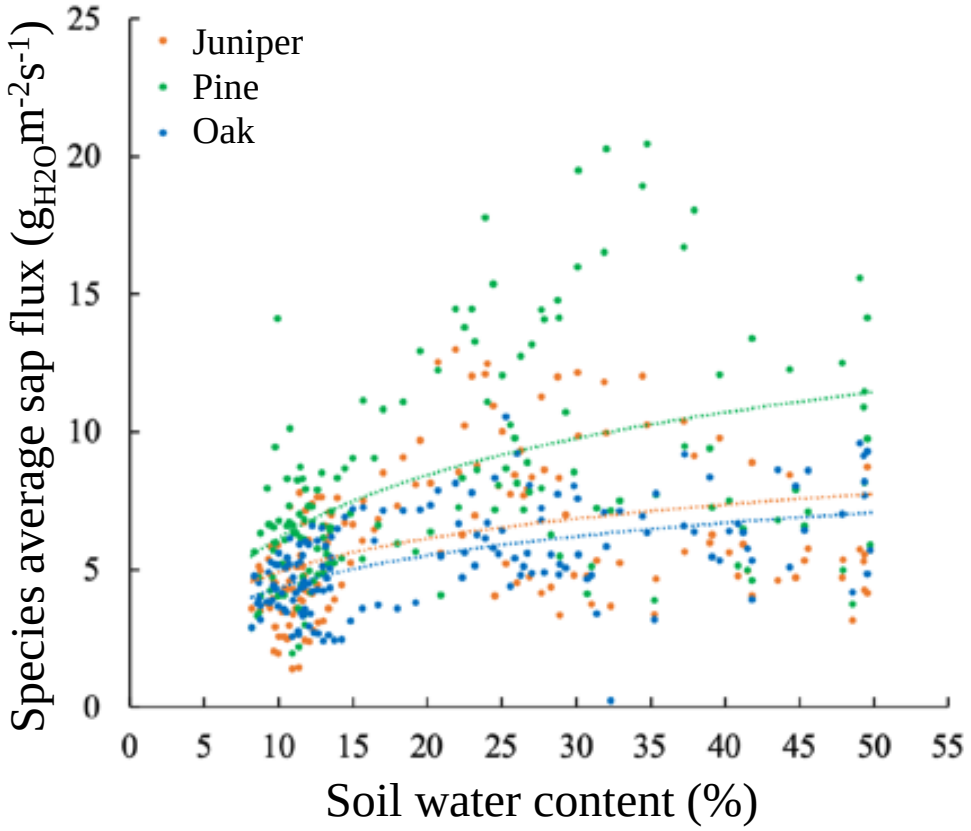
$R^2 = 0.28$
$P = 3 * 10^{-12}$

$R^2 = 0.63$
$P = 1.5 * 10^{-32}$

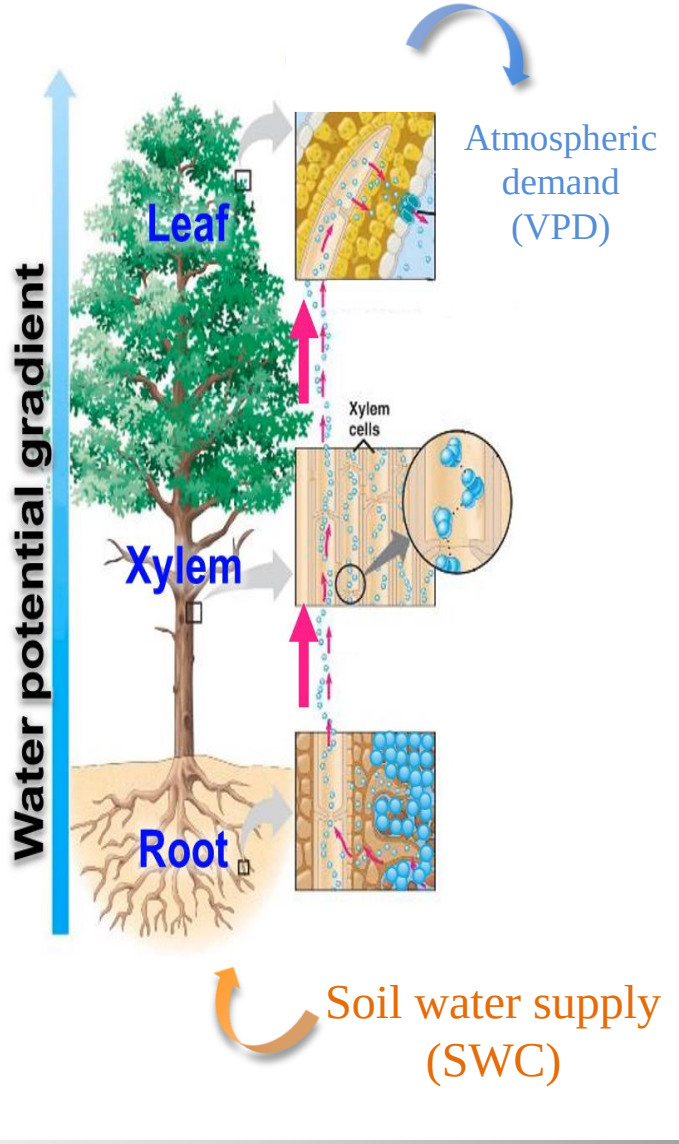
$R^2 = 0.28$
$P = 1.1 * 10^{-3}$



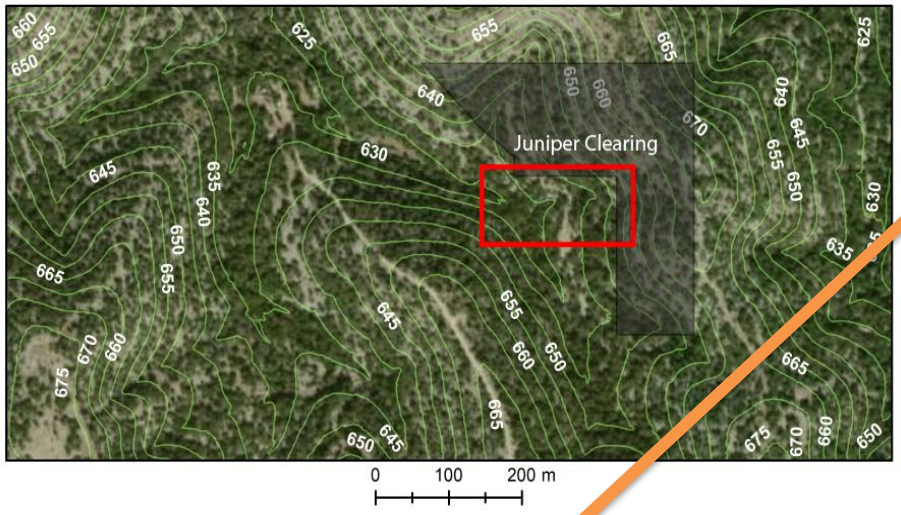
There is also a strong relationship to water availability

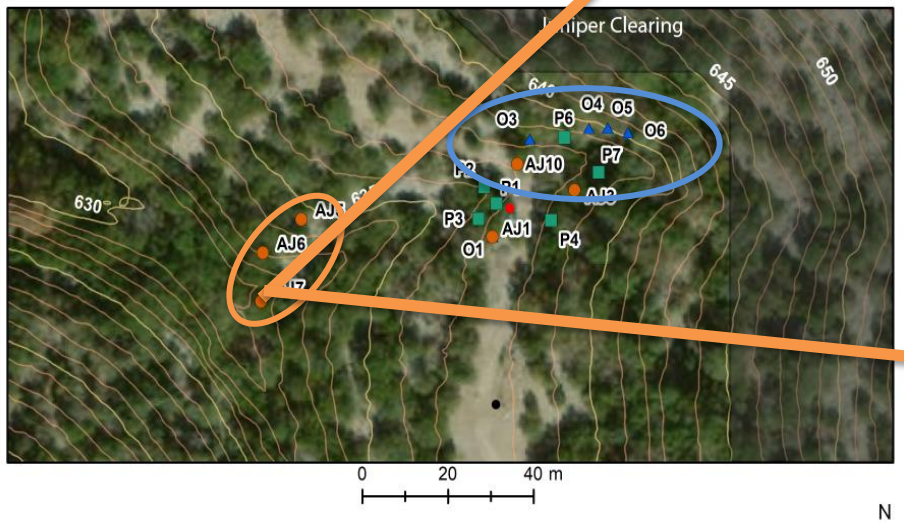


	2018		2019	
	R^2	Equation of fit	R^2	Equation of fit
Juniper	0.14	y = 1.77ln(x) + 0.82	0.37	y = 3.02ln(x) + 10.80
Pine	0.22	y = 3.29ln(x) - 1.42	0.20	y = 2.99ln(x) + 14.45
Oak	0.28	y = 1.71ln(x) + 0.40	0.67	y = 3.82ln(x) + 14.27



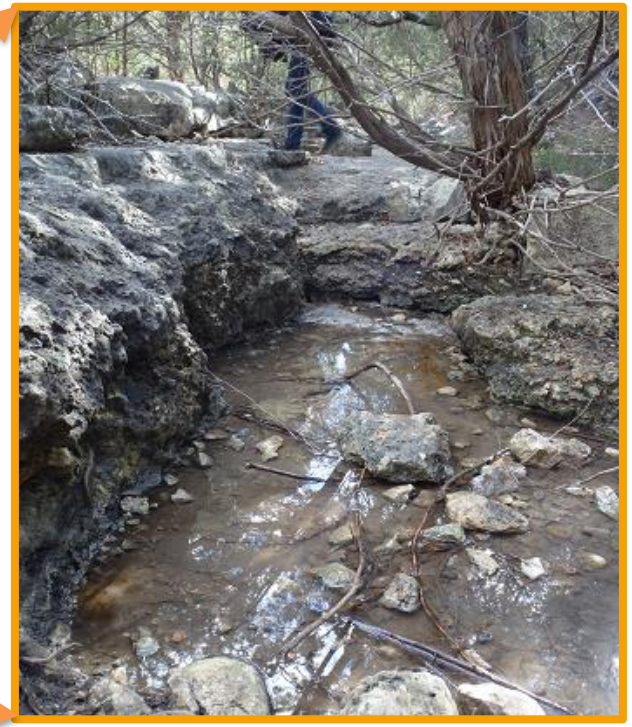
Clearing dynamics with juniper removal





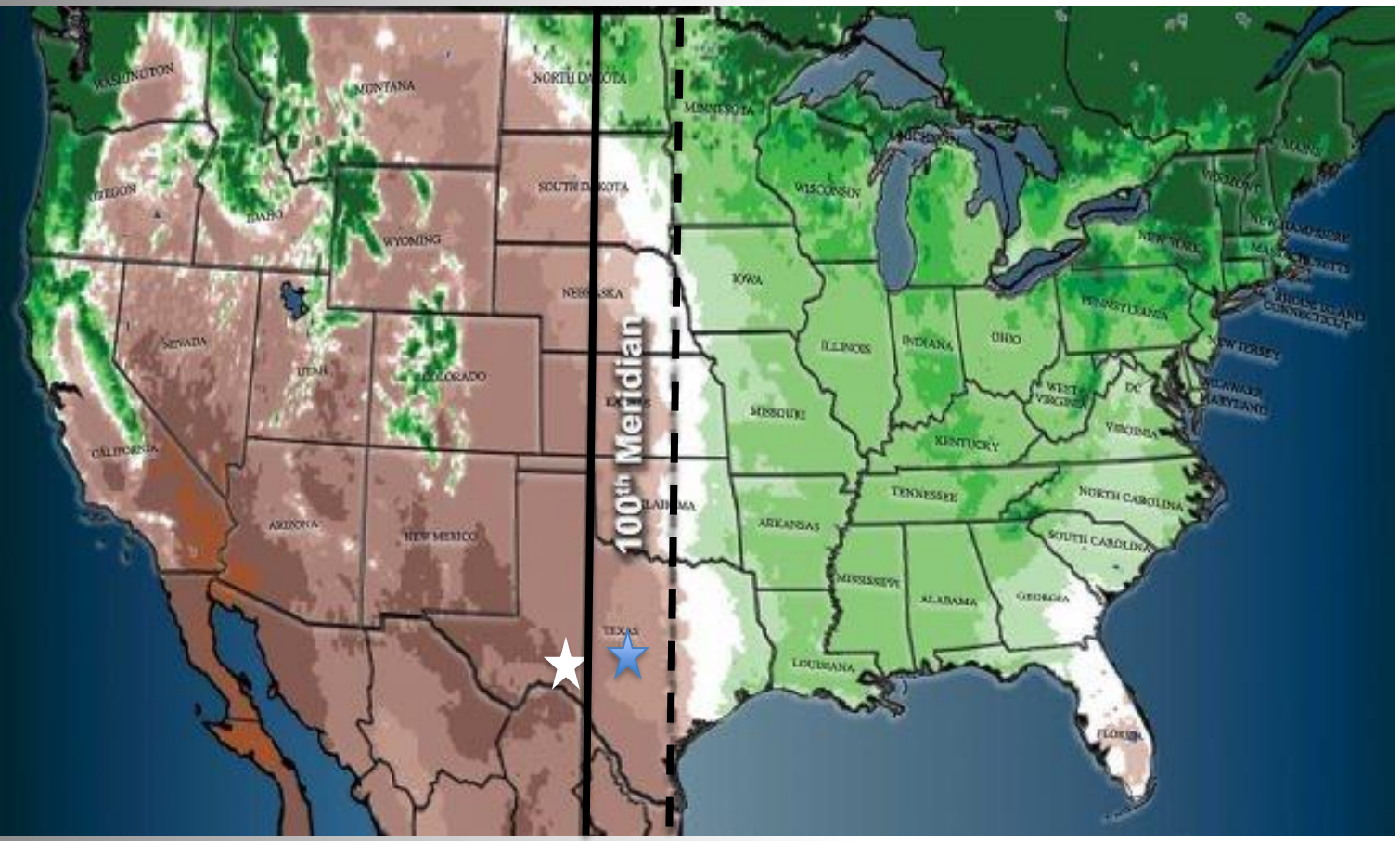
Map Created by: A. Rechner & F. Ochoa
Projection: UTM Zone 14N
Datum: WGS 84
Elevation data provided by UT BEG

Juniperus ashei
Quercus laceyi
Pinus remota
Hunting Blind
Weather Station
Contour 1 m interval
Contour 5 m interval
N



- Juniper were removed from the shaded area in the early spring of 2019
- Post clearing
  - Juniper 14.5%
  - Pine 21.5%
  - Oak 55.7%
- Transpiration increased
- Spring flow unaffected

Implications for Texas's future



As aridity pushes eastward

- Higher VPD
- Lower soil moisture

- Less wood and leaf water content (lower live fuel moisture content)

- Less carbon uptake for photosynthesis

- Less transpirative cooling → increased air temperatures

➢ Lamont-Doherty Earth Observatory, Columbia University

Acknowledgements and questions

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