

Sierra Nevada tree die-off; lessons learned & future challenges

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Mar 27, 2010

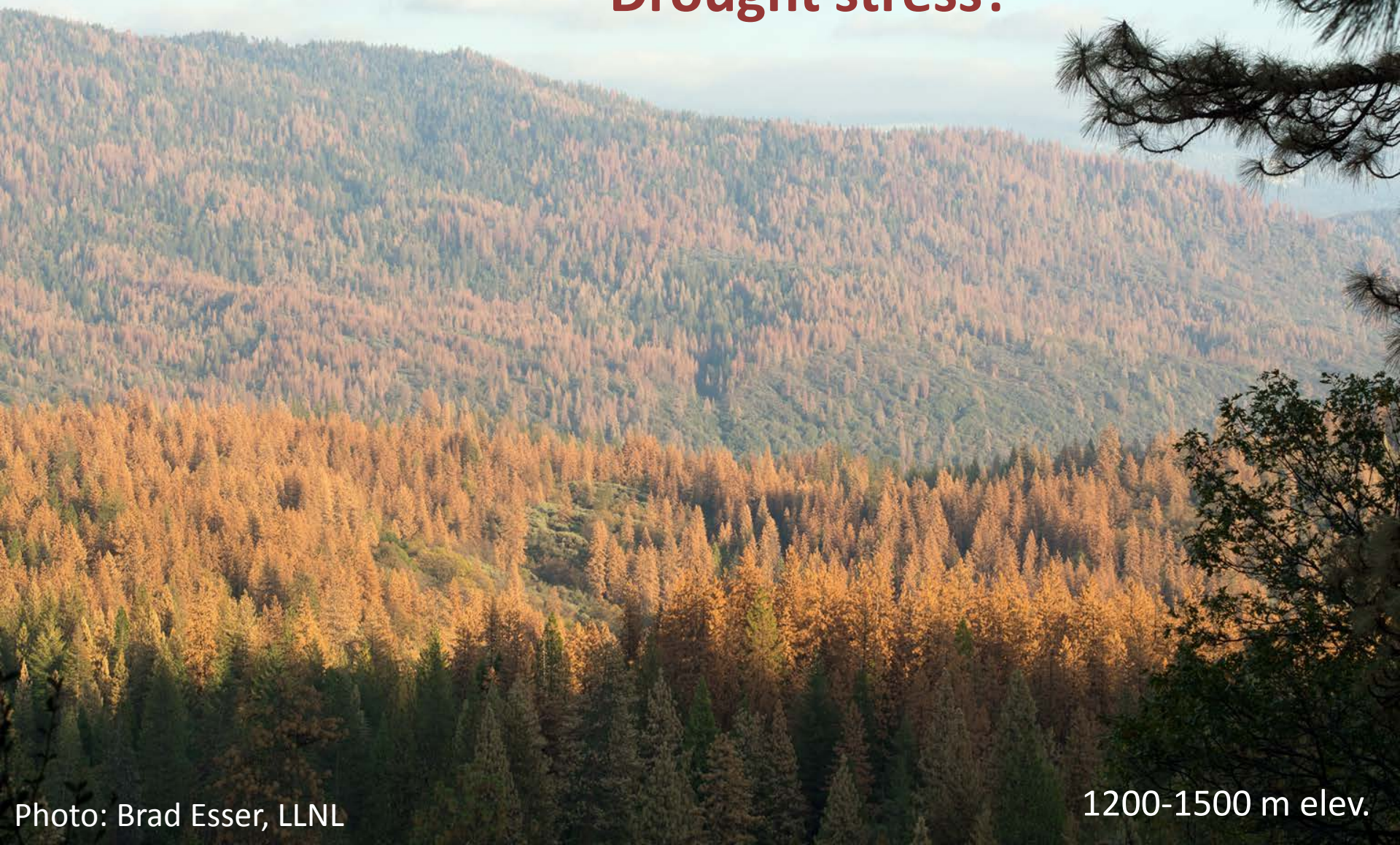
MODIS image

Mar 29, 2015

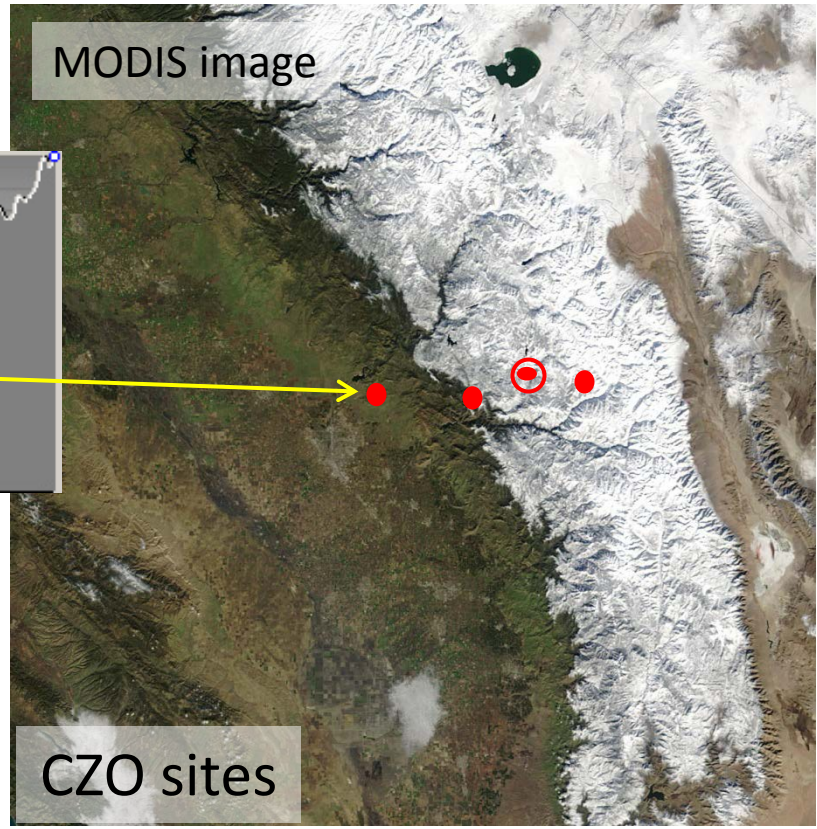
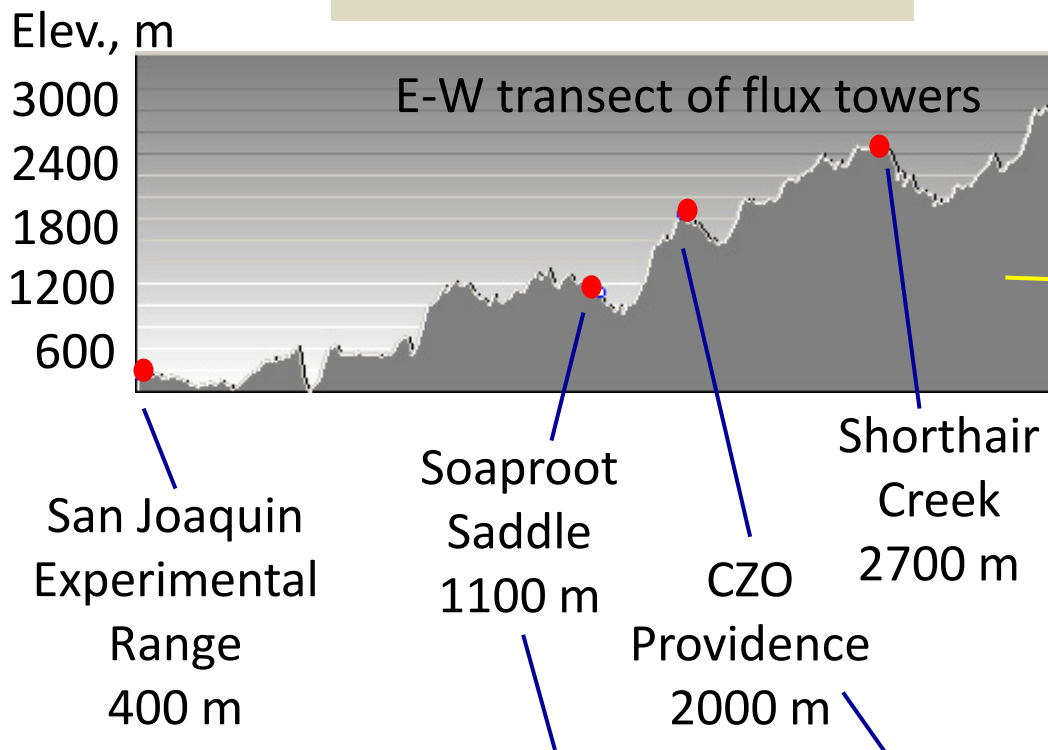


Southern Sierra CZO, Sierra National Forest
Nov. 5, 2015

Drought stress?



Field measurements

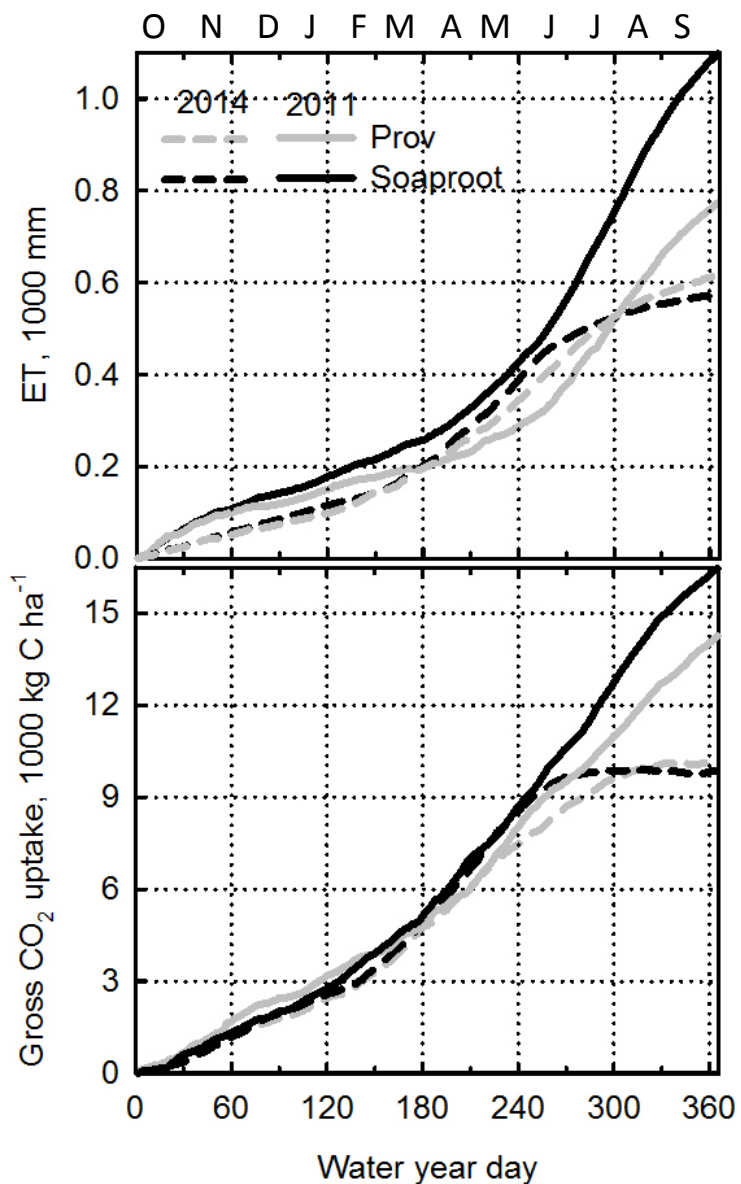


Ground measurements of precipitation, evapotranspiration, discharge, soil-moisture storage, snowpack storage

(Shorthair not available)

Flux tower data

Comparing 2011 (wet) & 2014 (3rd drought yr)



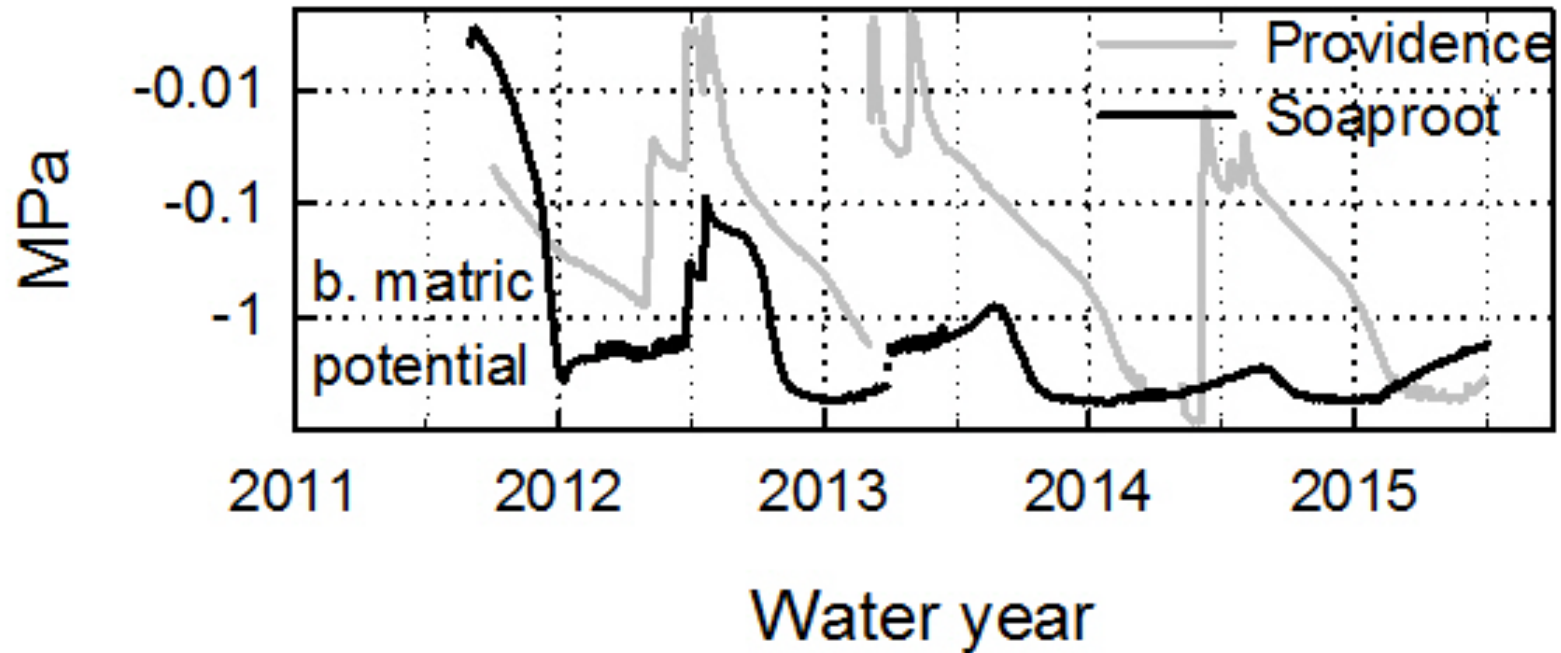
Cumulative water-year evapotranspiration

Providence, mixed-conifer forest,
2000 m, 2152 vs 634 mm precip,
20% drop in ET

Soaproot Saddle, pine-oak forest,
1100 m, 1320 vs 390 mm precip,
47% drop in ET

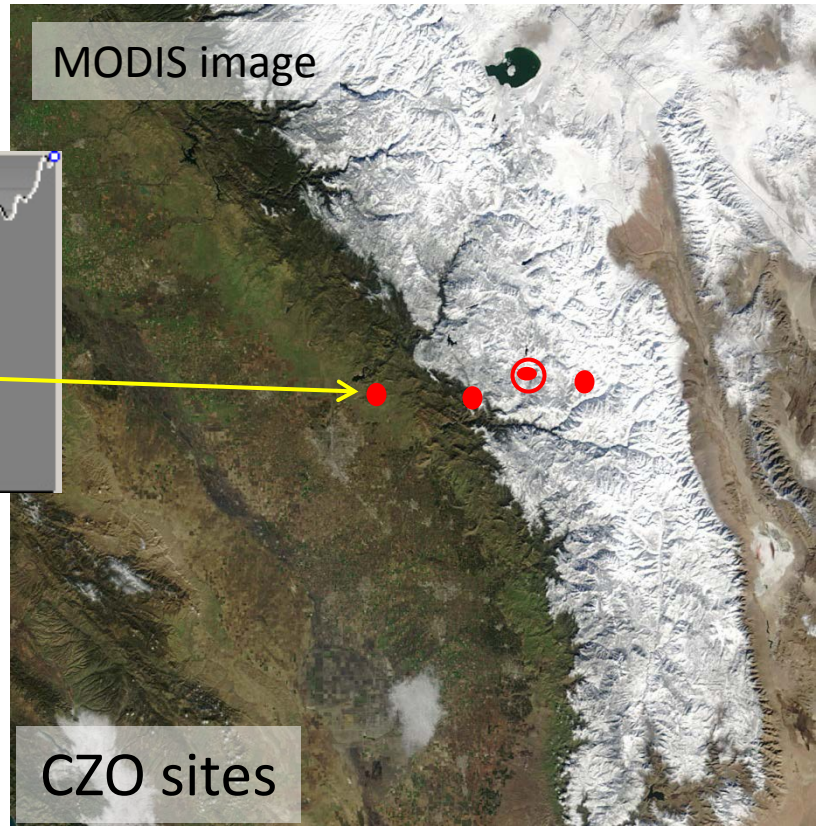
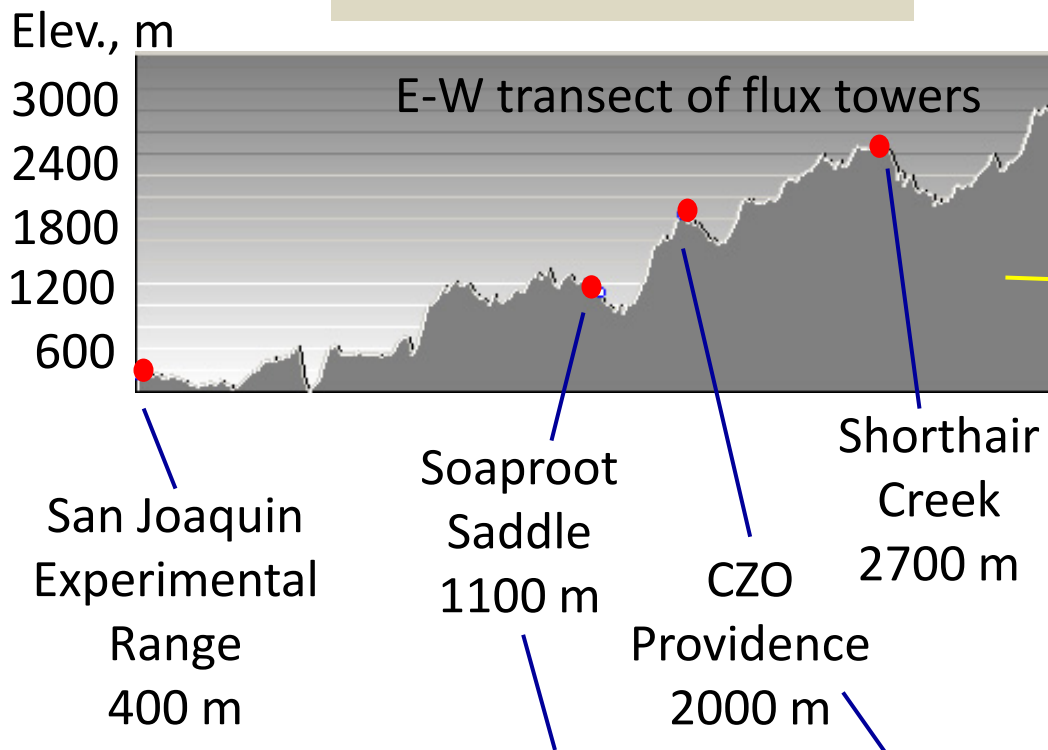
Cumulative water-year gross CO₂ uptake

Matric potential



At 2-m depth at Providence (2000 m) shows recharge during drought, but not at Soaproot (1100 m)

Field measurements



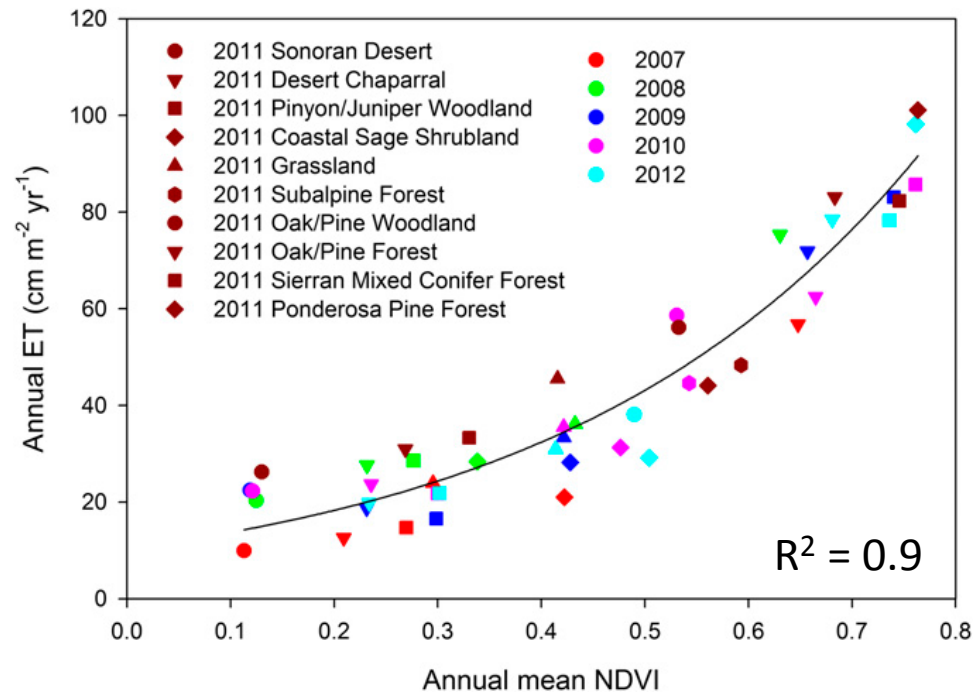
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Approach to scaling

Annual ET measured by flux towers, correlated with MODIS NDVI

ET calculated across the Southern Sierra using this calibration

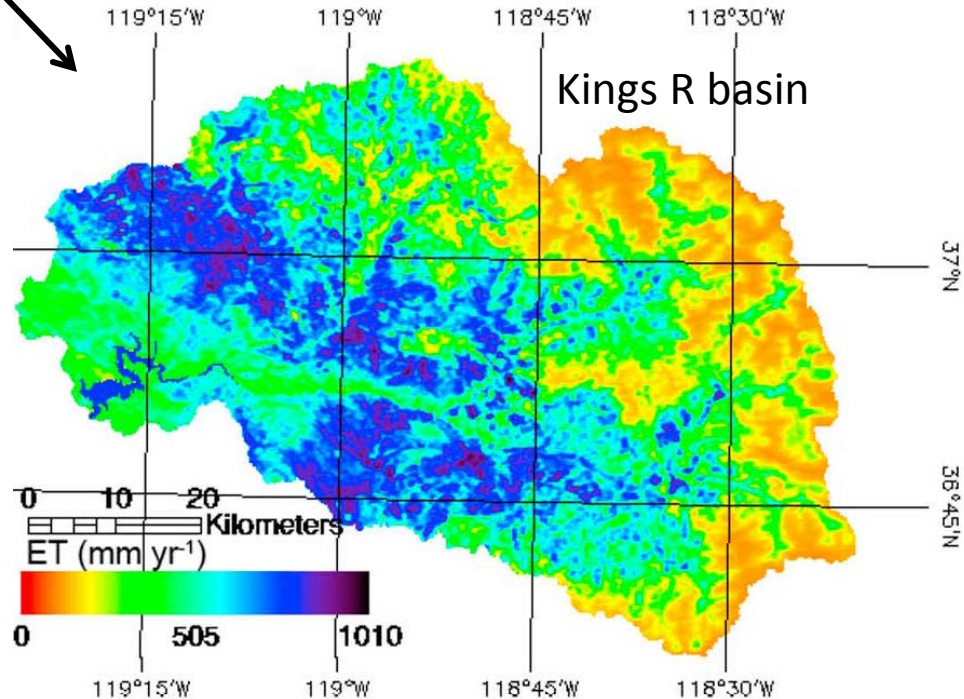


Conceptual

High LAI ↔ Feedback over a few yrs ↔ High ET & NPP

High LAI → High NDVI

NDVI indicates ET needed to support the current LAI

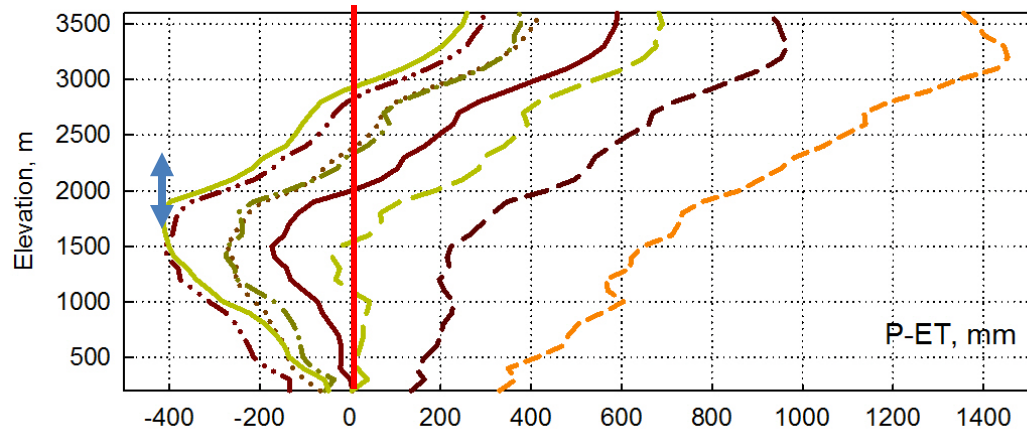
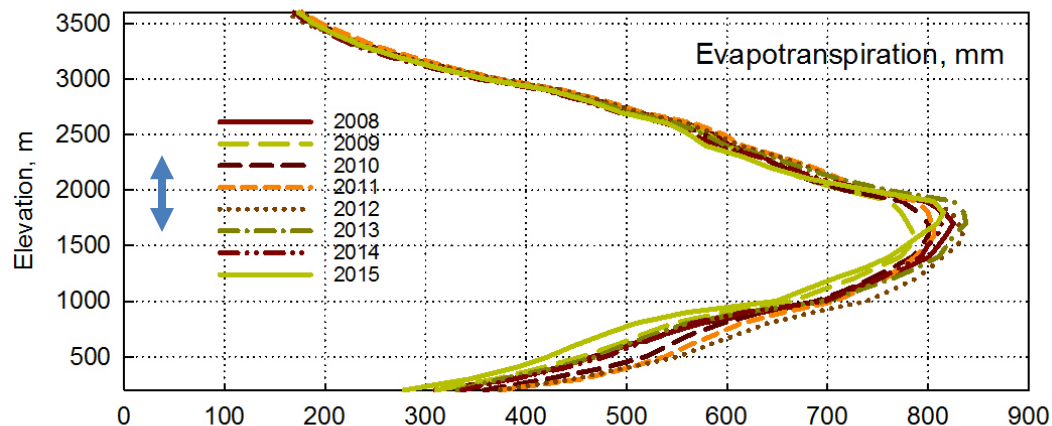
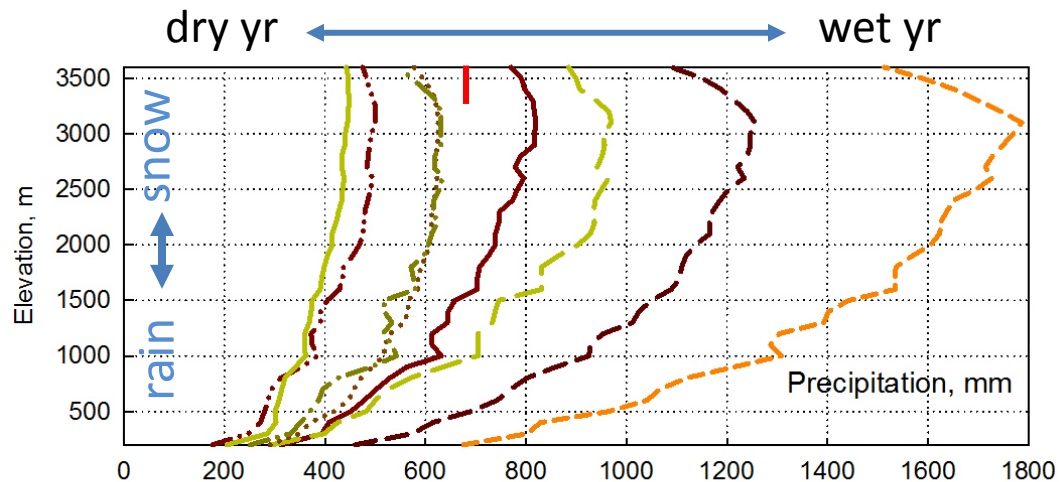


Southern Sierra averages

Precipitation (P) from PRISM

Evapotranspiration (ET) from NDVI: “canopy-acclimated ET”

$P - ET$ is difference



Forest – interpretation

Tree dieoff greatest where recharge to deeper root zone was limited
Regolith storage buffers drought if mean annual precipitation
exceeds annual ET

Southern Sierra CZO, Jun 2015



Low precip., high LAI &
higher ET demand in rain
zone → one-yr subsurface
water-storage buffer at
1100 m

Higher precip., slightly
lower LAI & ET demand in
snow zone → multi-year
subsurface water-storage
buffer at 2000 m



Photo: Margot Wholly

Dec 14, 2015



Photo: Margot Wholly

Dec 14, 2015





Photo: Margot Wholly

Dec 14, 2015



Photo: Margot Wholly

Dec. 14, 2015

A photograph of a forest with large trees and a person in the distance. The forest floor is covered in fallen branches and pine needles. The trees are tall and thin, with some showing signs of being cut down. A person wearing a yellow hard hat and a green jacket is walking through the forest in the middle ground. The text "Restore (thin) forest → reduce ET" is overlaid in yellow on the right side of the image.

Restore (thin) forest → reduce ET

What is a sustainable forest density for the Sierra Nevada?

Acknowledgements: NSF Critical Zone Observatory (CZO) program, Sierra Nevada Adaptive Management Project, California DWR, U.S. Forest Service, UC-CITRIS, UC Water, many collaborators

