Using ECOSTRESS to Predict Wildfire Effects on Plant Water Relations and Vegetation Structure in an Arizona Pine-oak Forest

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Southwest Frequent-fire Regime

- Lightning
- Low-severity, surface
- Every 5-15 yrs
- Regionally synchronized
- Maintained open canopy and diversity

Swetnam et al 1999
**Pines**
- fire resistant
- survive fire
- fire scar

**Oaks**
- fire resilient
- readily top-killed
- sprouting
1880-1990
Few Fires

- Livestock grazing
- Fire suppression
- Increased tree density
- Increased dead fuel

Swetnam et al 1999
“…the fear that uncharacteristic fires may convert large areas of pine forest to other vegetation such as oak brush” (Wolfson & Thode 2014).
Horseshoe 2 Fire, Chiricahua Mountains 15 May 2011
~225,000 acres
Earth Observatory, NASA
Geoff Bender, SWRS
Madrean Pine-Oak Forest
Severe Fire → Oak Sprouts

Barton and Poulos 2018, Forest Ecology and Management
Pines: isohydric, low photo capacity
Oaks: anisohydric, high photo capacity

Poulos et al. 2019 Forest Ecology and Management
Fire Resistant Post-fire Seeder Isohydric

Fire Resistant Weak Post-fire Sprouter Isohydric

Fire Resilient Vigorous Post-fire Sprouter Anisohydric

Competitive advantage in the arid, high-severity wildfire landscape
Study Objectives

1. Examine how fire severity influences post-fire field ET and ECOSTRESS ET and ESI

2. Validate ECOSTRESS ET and ESI with field sapflow and psychrometer measurements

3. Compare ECOSTRESS ET performance with MODIS-derived products

4. Examine how fire severity and post-fire vegetation structure drive ET and ESI
Weekly evapotranspiration (ET) in a burned versus unburned stand, calculated via eddy covariance at a northern Arizona wildfire site. Taken from Ha et al. (2015).

1. Relate field ET and ECOSTRESS ET and ESI to fire severity
dNBR: Miller and Thode 2007 Rem Sens Env

7 years post-fire

High

Low

Moderate
2. Validate ECOSTRESS ET and ESI with field measurements

In June 2020 Install…

• 20 sapflow sensors in each fire severity block (low, mod, high) in pine-oak forest

• 1 weather station in each block - Bowen Ratio calculations

• Additional psychrometers on oaks in each site
3. Compare ECOSTRESS ET with MODIS-derived products

4. Examine how fire severity & post-fire vegetation drive ET & ESI

- Extracted dNBR (fire severity) and ET for June 2019, at 1000 random points in CHIR at
  - 9 am
  - 11:30 am
  - 1 pm
  - 2 pm

- Regression models: effect of dNBR (fire severity) on ET
Evaluate how post-fire vegetation structure and composition influence ET and ESI

- 200 vegetation monitoring plots
- Sampled within the last 3 yrs
- 2021 field work to get 10-yr post-fire vegetation response
Thanks! Questions?