Linking Basin-Scale, Stand-Level, and Individual Tree Water Stress Indicators for Groundwater-Dependent Riparian Forests in Multiple-Use River Basins

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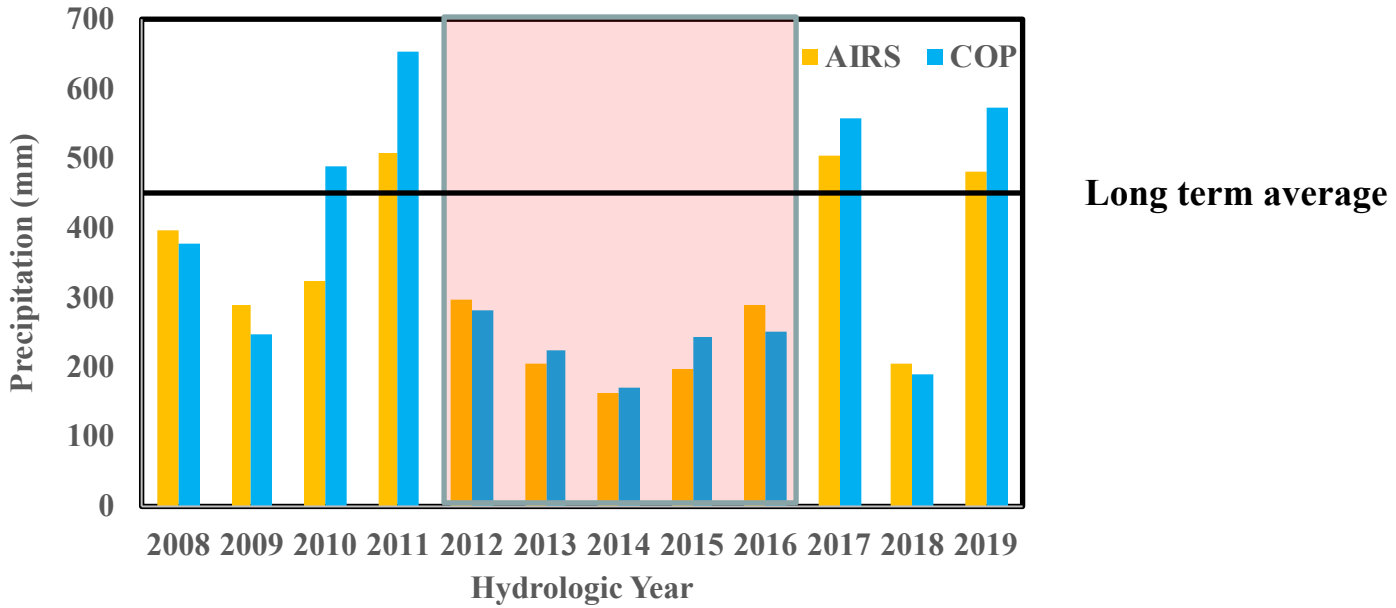
- Objectives
  - Set the stage for the ECOSTRESS exercises to follow
  - Set the stage for the afternoon field trip
- Background
  - The 2012 – 2016 Drought
  - Riparian response to drought
- Study Site
- Historical Drought Response in the Santa Clara Riparian Corridor
- What ECOSTRESS shows us

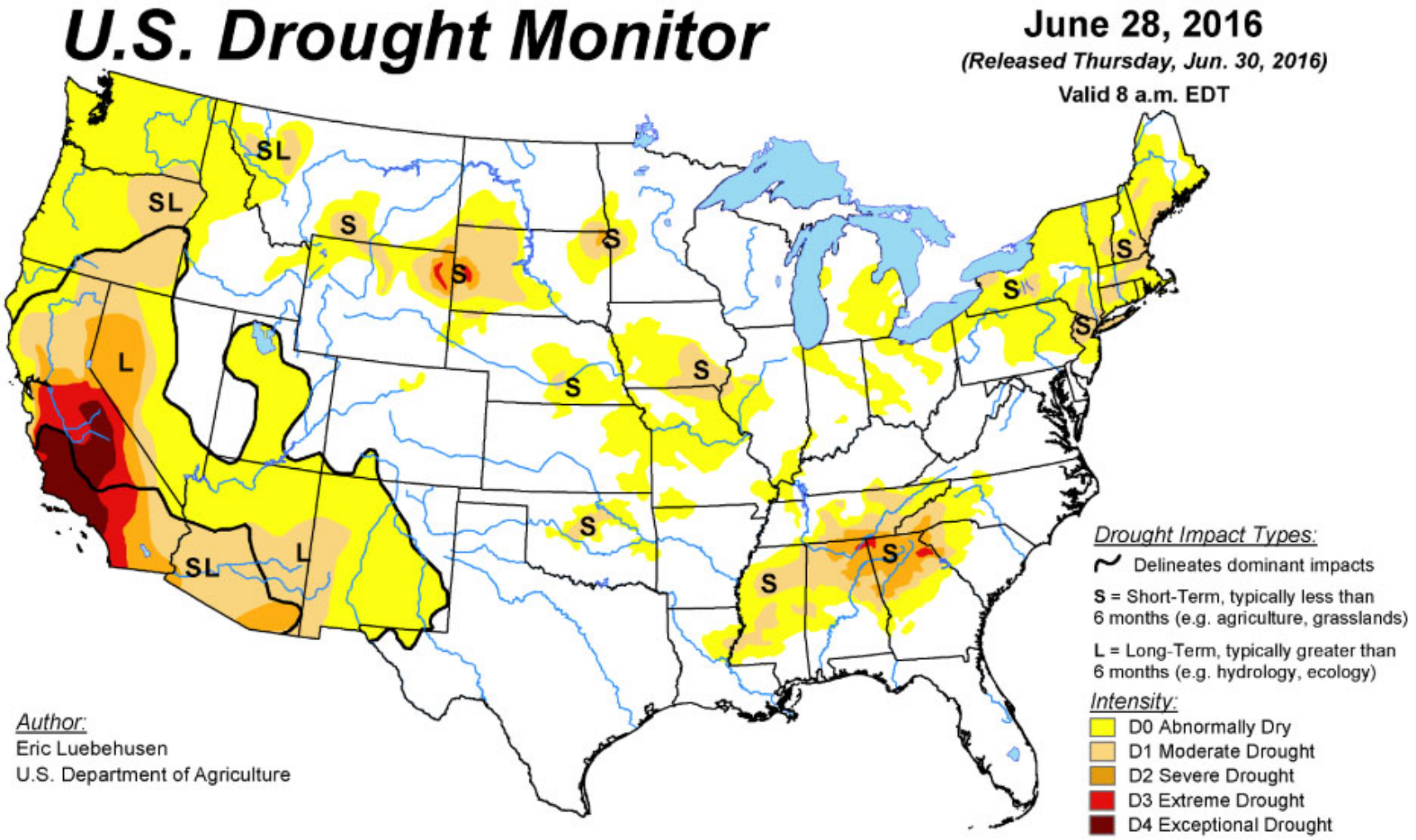
The 2012-2016 Drought

- **Drought extended from 2012 to 2016**
- **Worst drought in over 1000 years**
- **Significant mortality in shrubs and trees, increased incidence of fire**
- **How did riparian vegetation respond?**



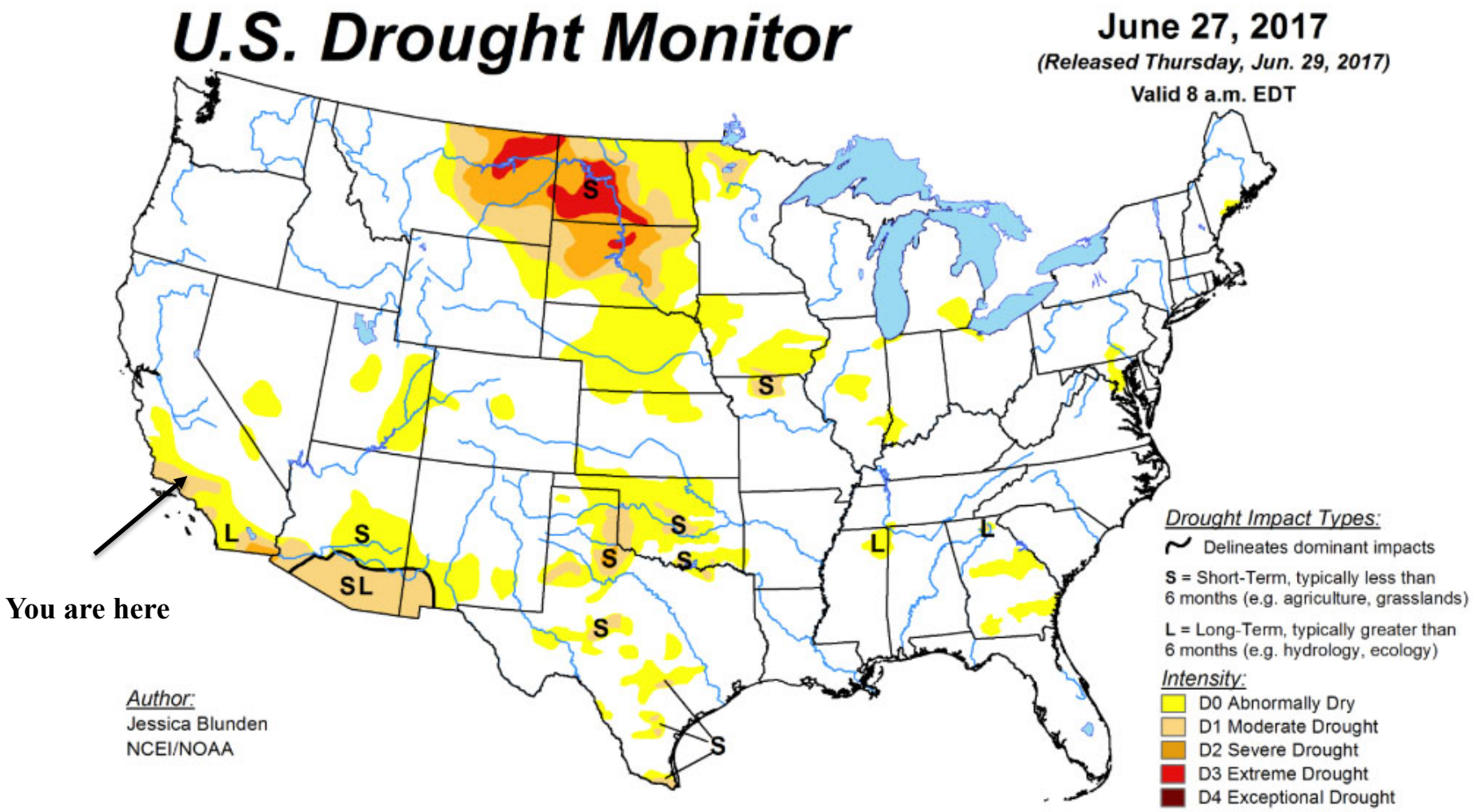
Data Source: IDEAS network, Roberts et al., 2010
www.geog.ucsb.edu/ideas

The 2012-2016 Drought



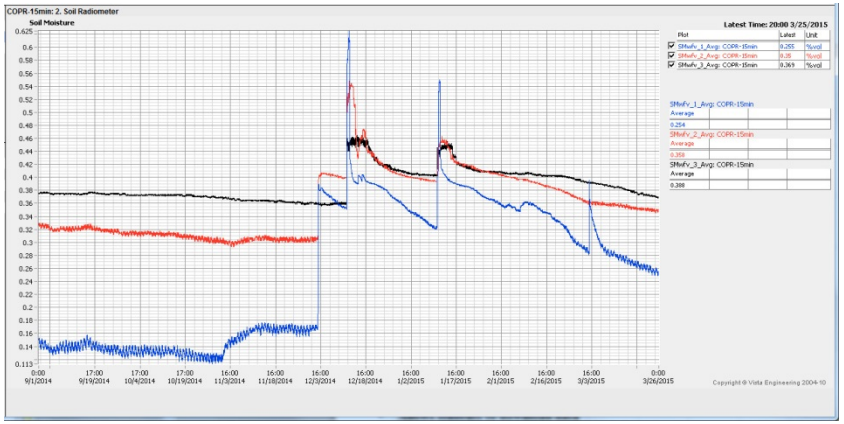
https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Regional Drought Persisted through 2017



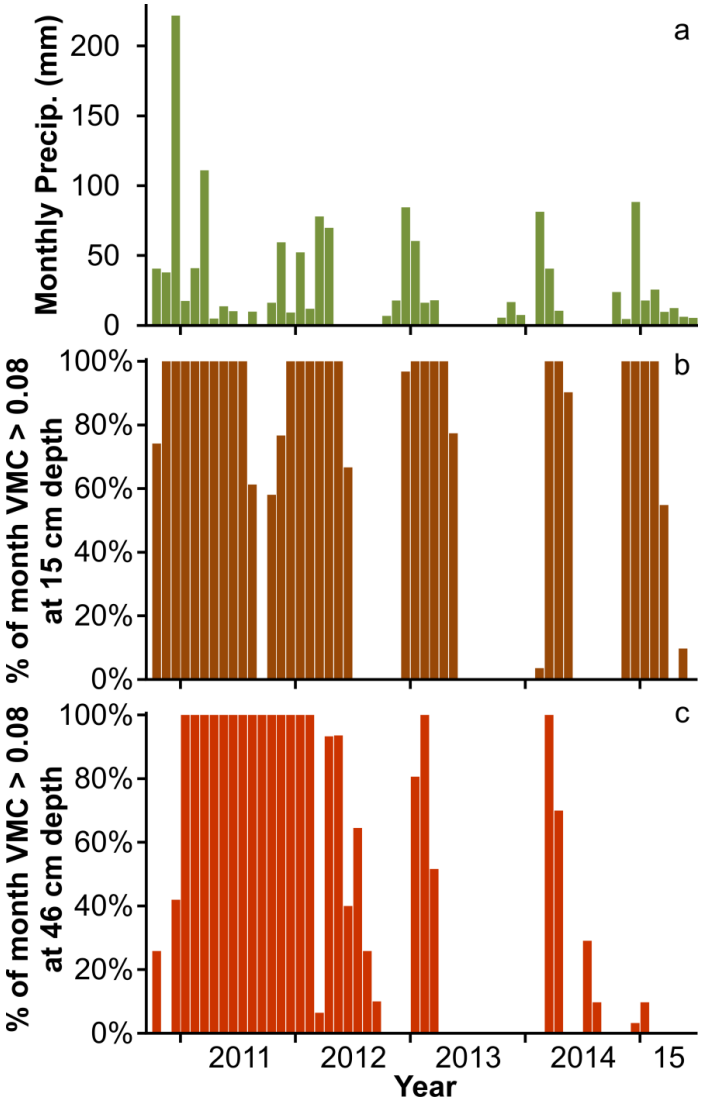
https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Droughts can Persist as Soil Moisture Deficits



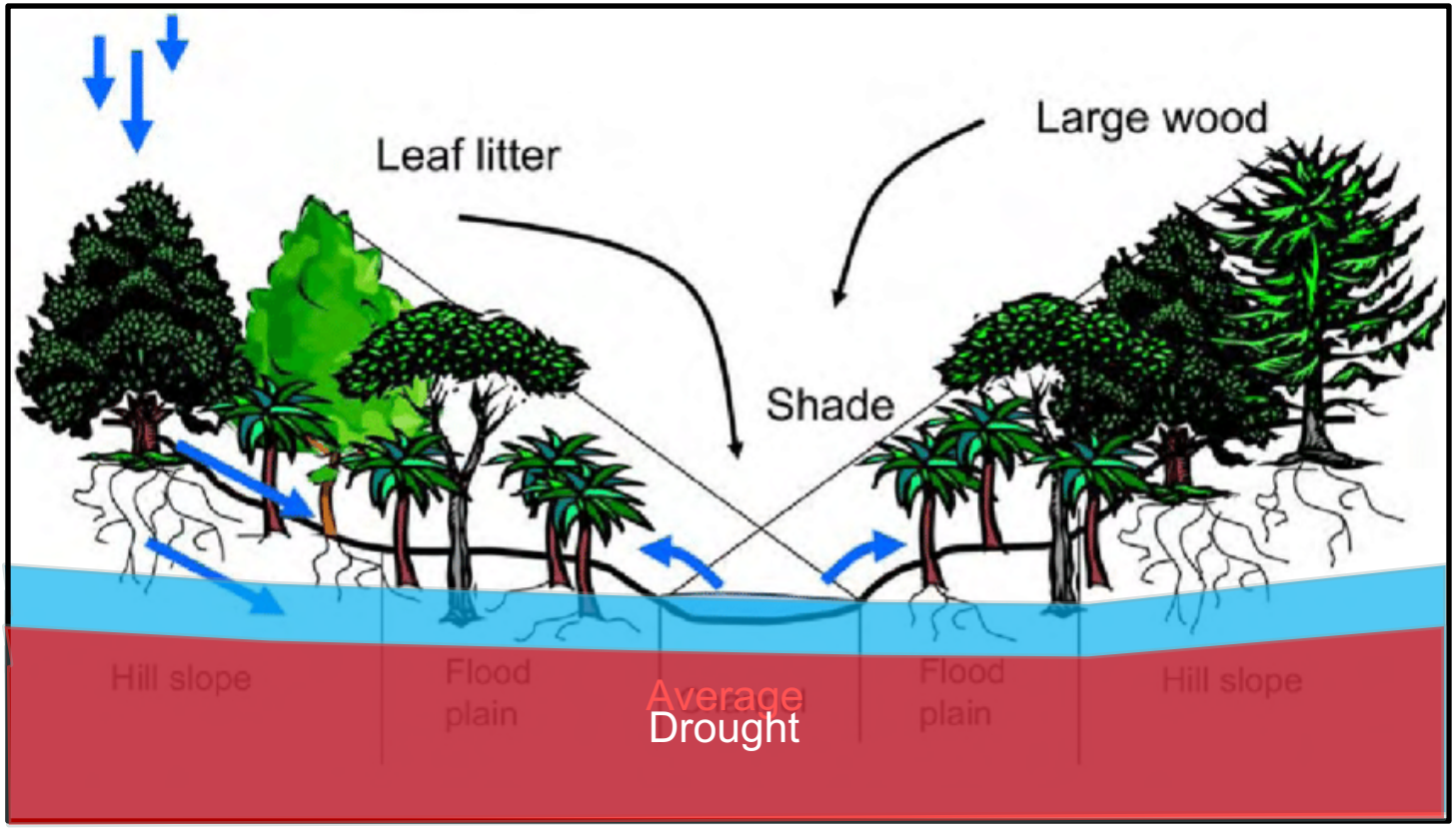
Volumetric Moisture Content
Coal Oil Point Station
Three levels, 2014-2015

- The 2012-2016 drought persists as a soil moisture deficit
- Above average, cascading storms are required to moisten deeper soils



Coates et al., 2015

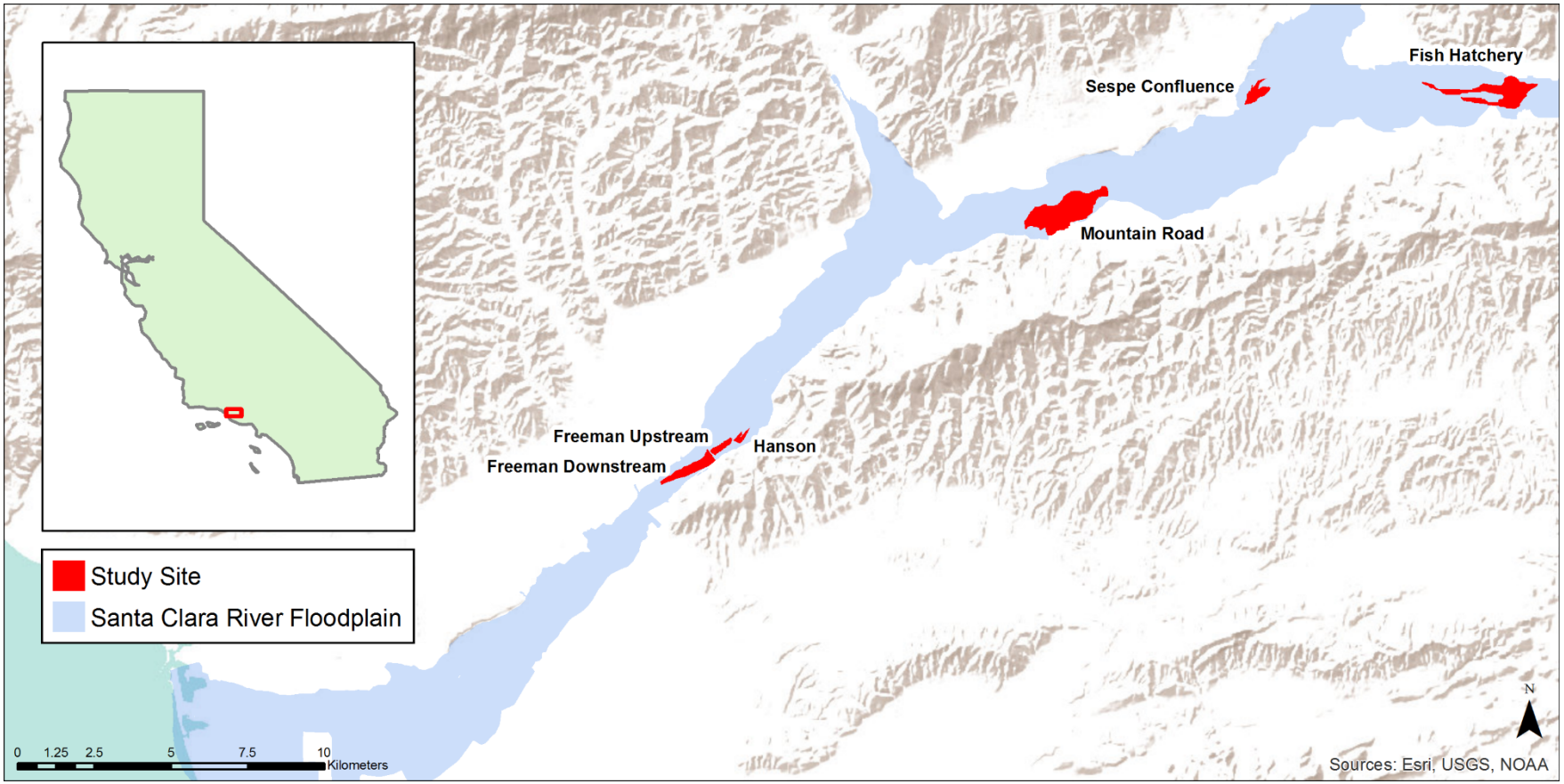
Drought Response in Riparian Vegetation



- In Ground Water Dependent (GWD) vegetation, drought response will depend on whether roots intersect the water table
- Species response will vary depending in root depth
- Plant response will include leaf loss, mortality and reduced ET

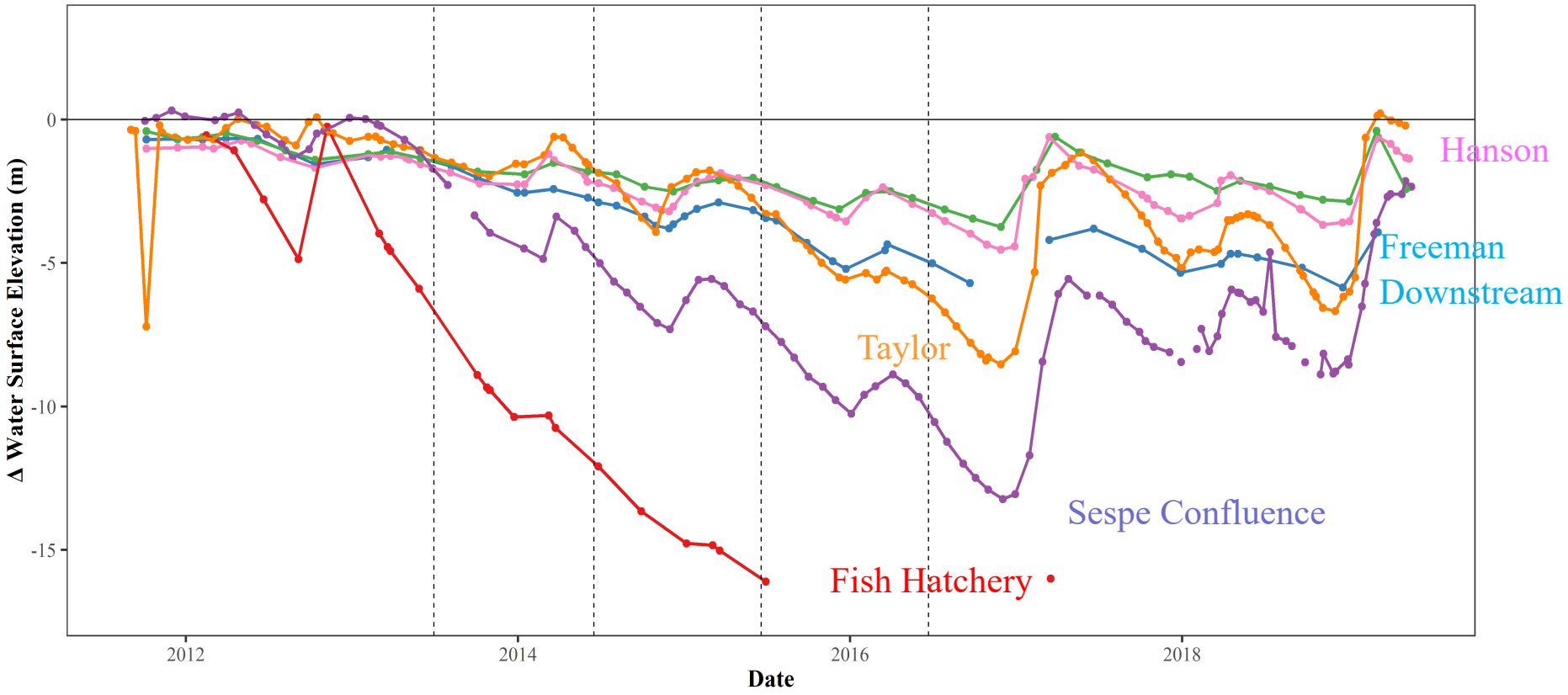
Figure modified from Harding et al., 2009

The Santa Clara River Flood Plain



From Kibler et al., 2019 (AGU presentation)

Ground Water Well Observations



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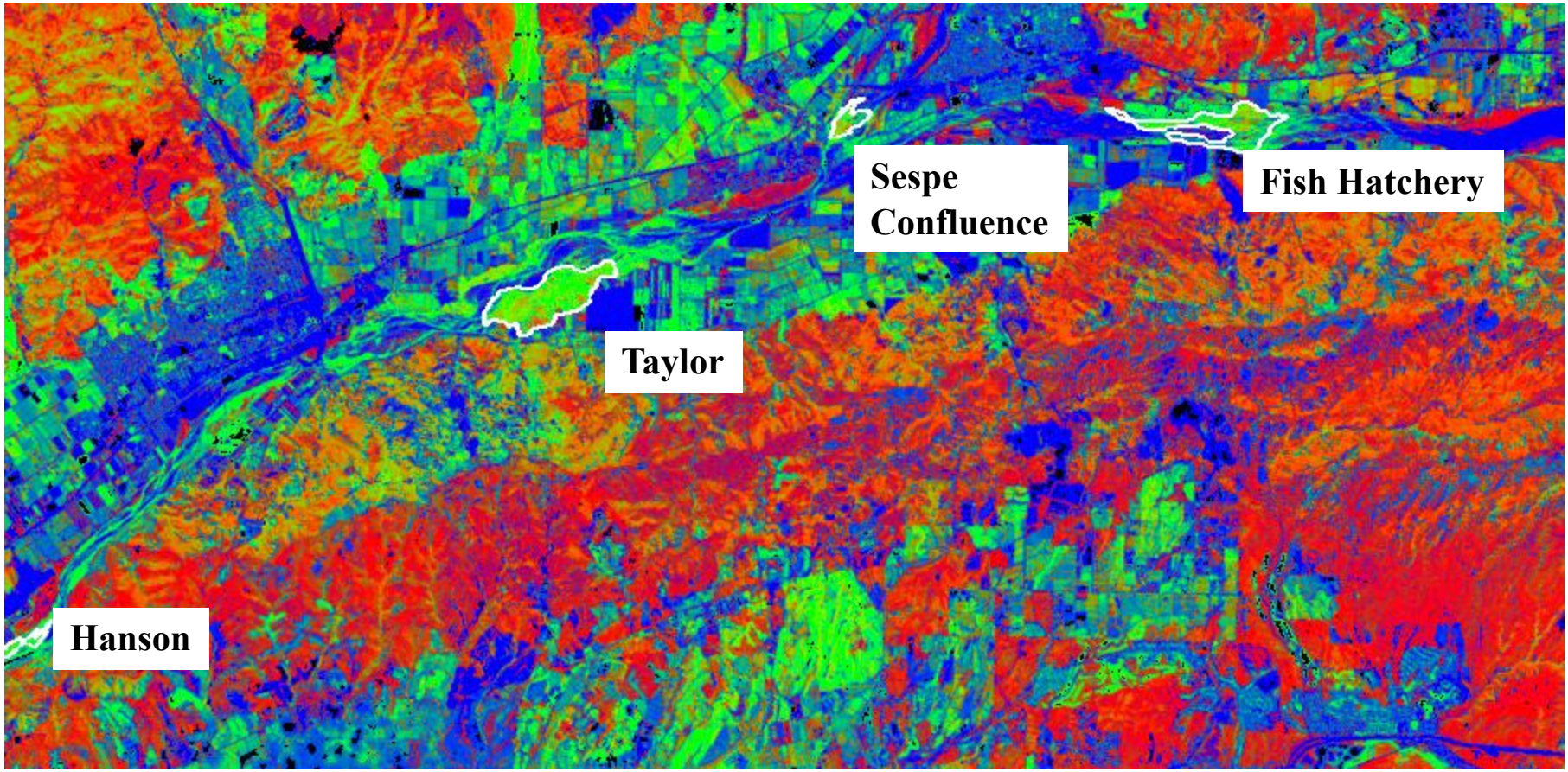
Vegetation Composition: The Mixing Model

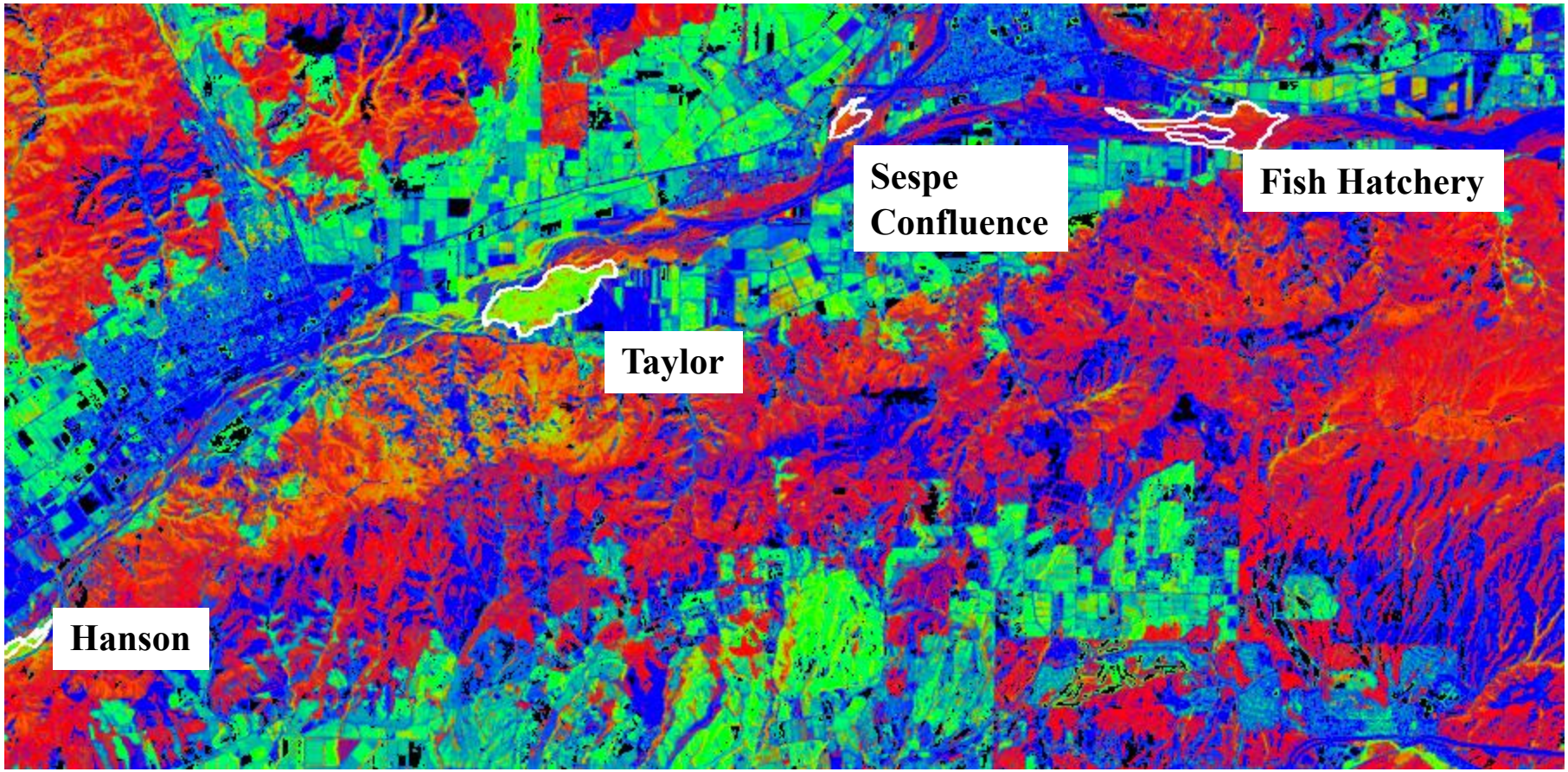


2011

NPV, GV, Soil, RGB: Generated using Multiple Endmember Spectral Mixture Analysis

Kibler et al, in prep

Vegetation Composition: Peak Drought

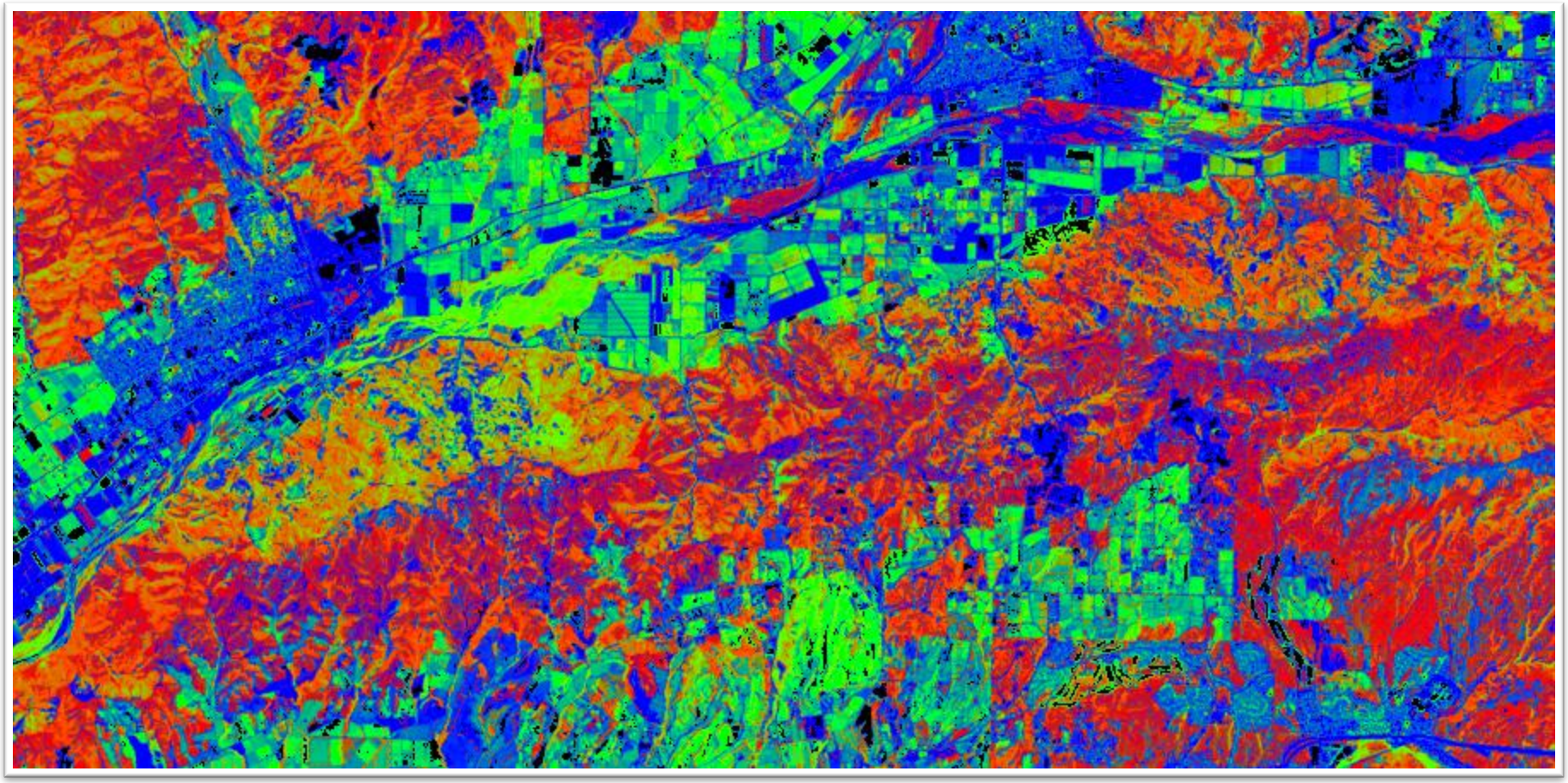


2016

NPV, GV, Soil, RGB: Generated using Multiple Endmember Spectral Mixture Analysis

Kibler et al, in prep

Riparian Response to Drought

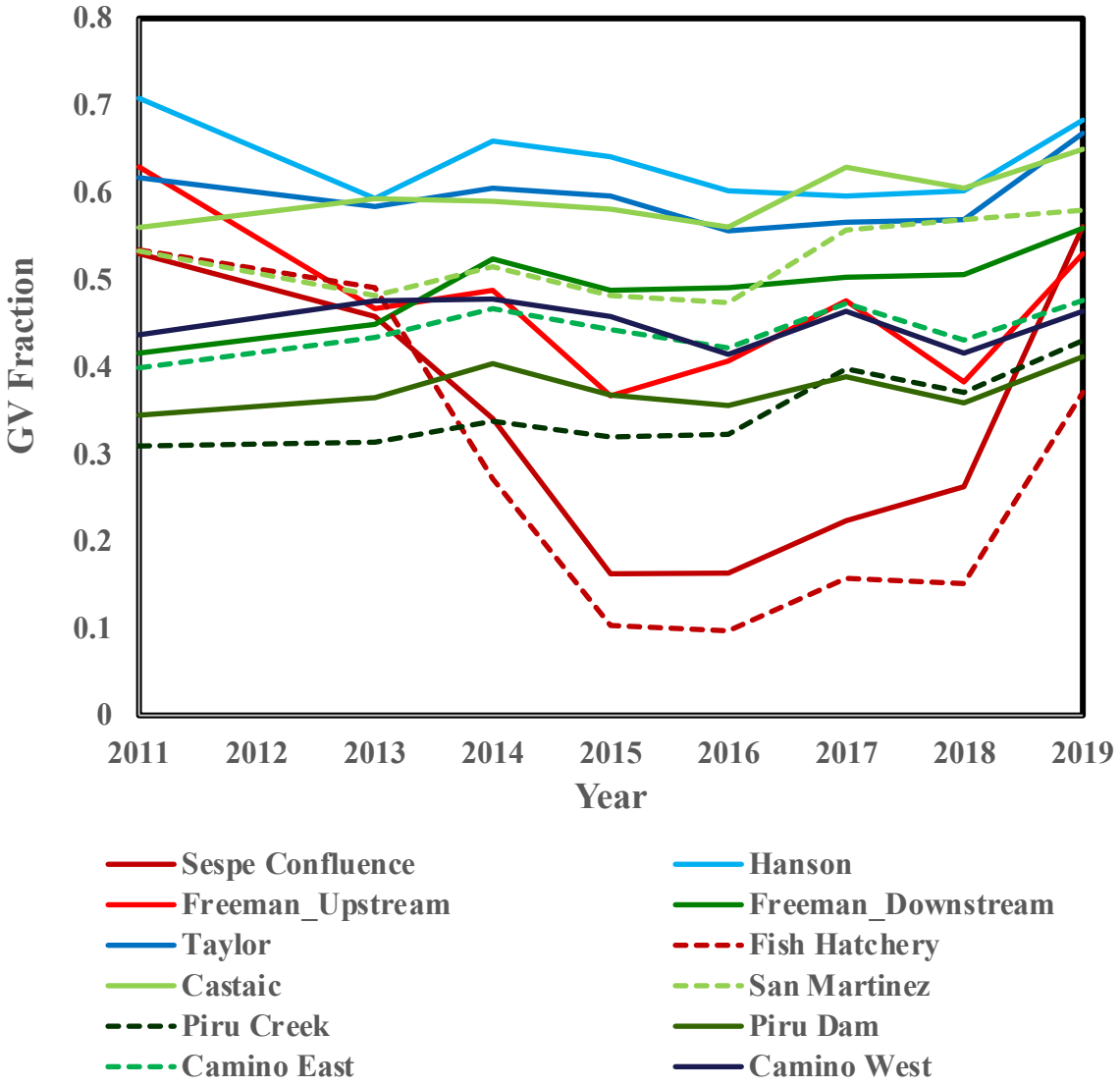


2011 to 2019

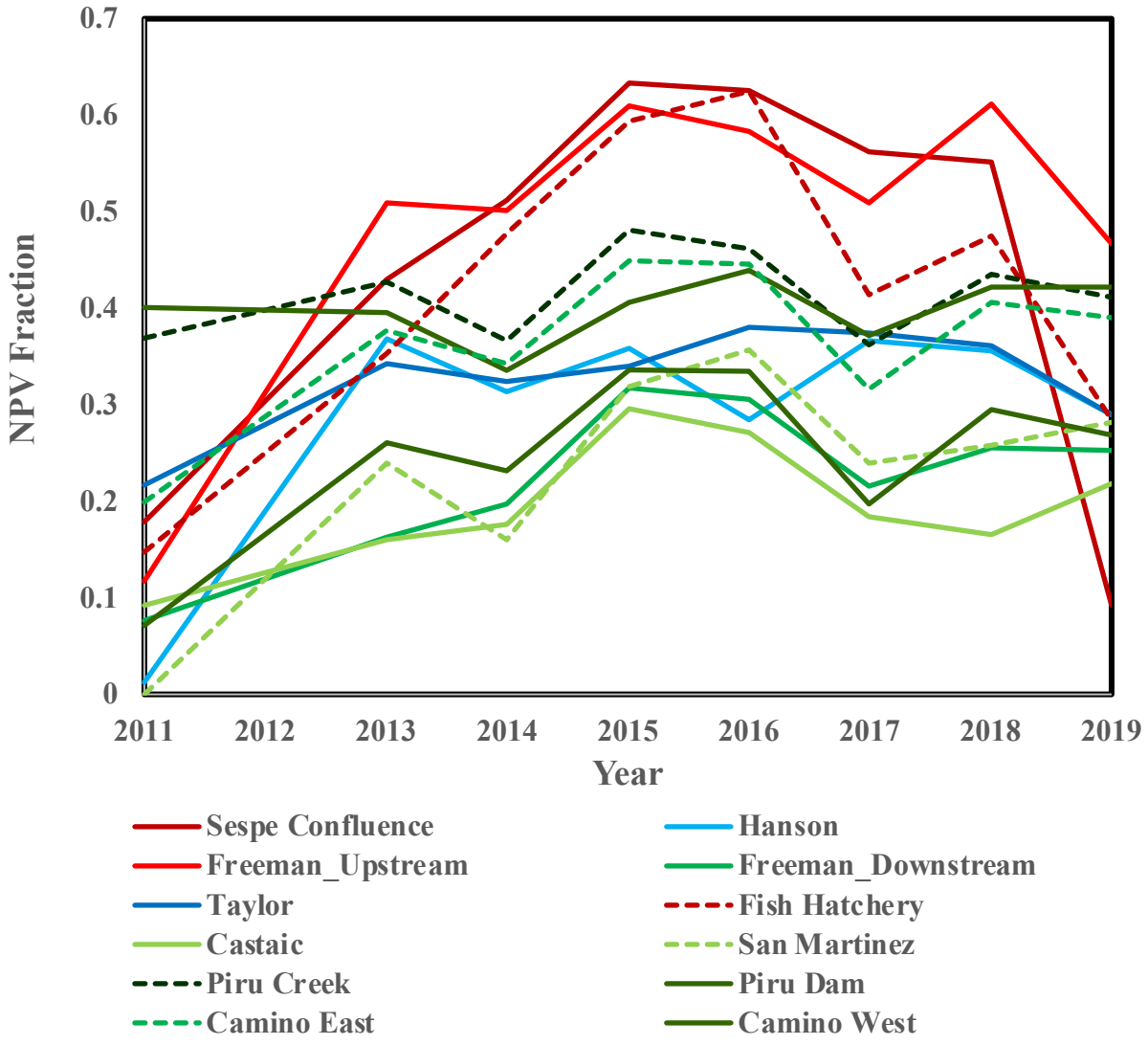
NPV, GV, Soil, RGB: Generated using Multiple Endmember Spectral Mixture Analysis

Kibler et al, in prep

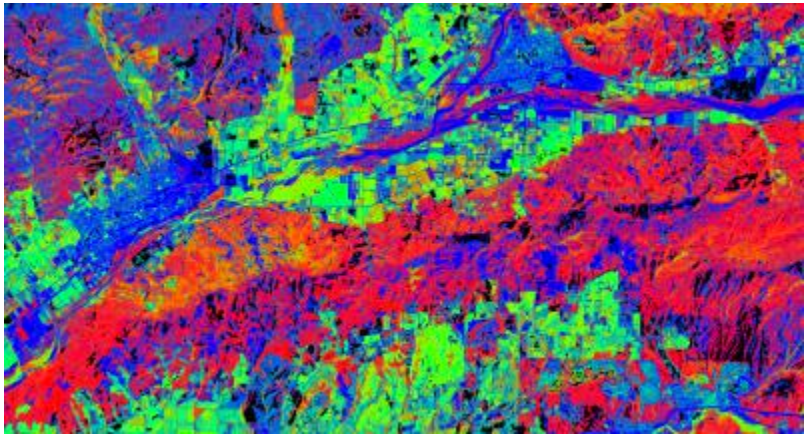
Riparian Response is Highly Variable: GV



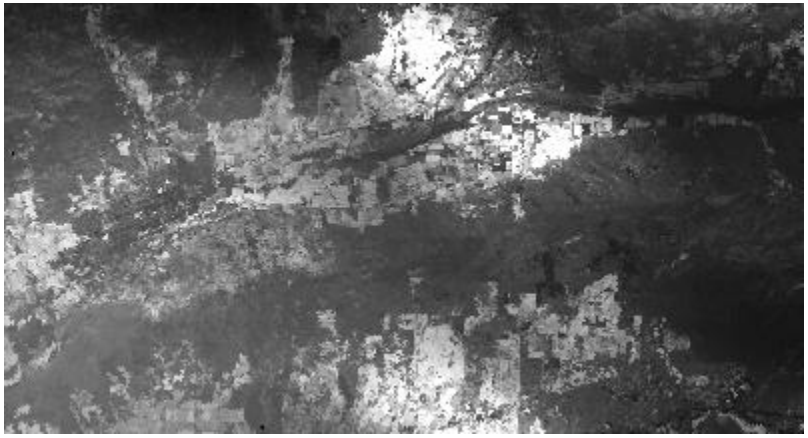
Riparian Response is Highly Variable: NPV



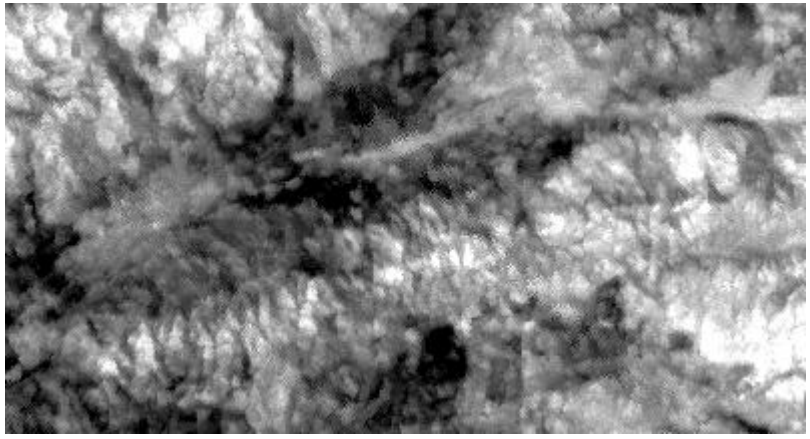
What ECOSTRESS Shows us



NPV, GV, Soil, JD 225, 2018



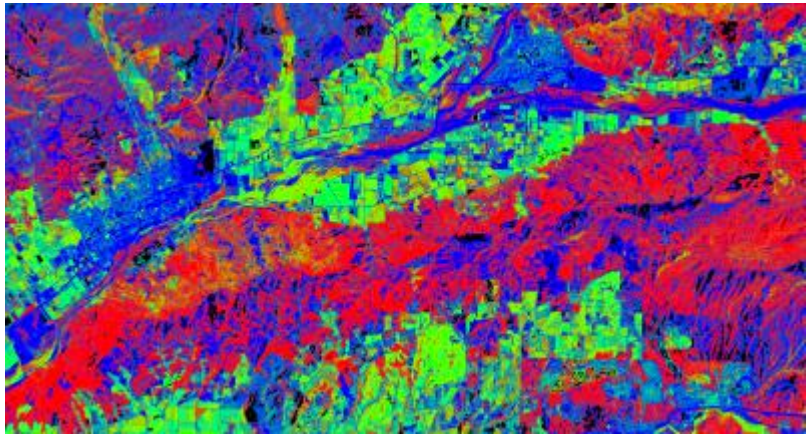
ET, JD 214, 2018



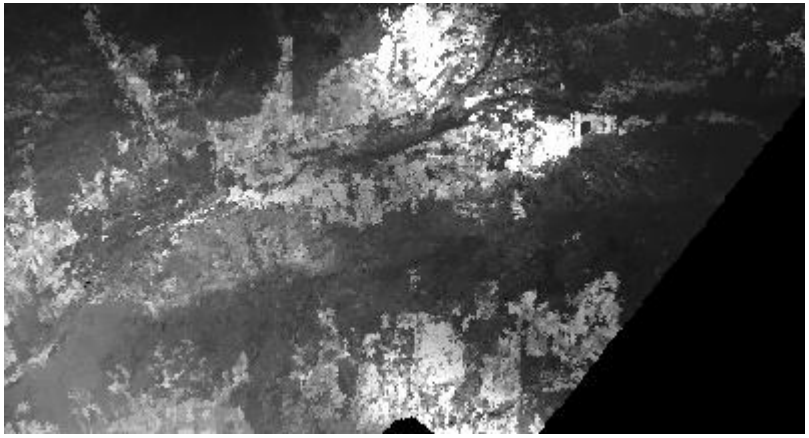
LST, JD 214, 2018

			23:01	20:45		
	GV2018	NPV2018	LST214	LST239	ET214	ET239
Sespe	0.264	0.552	314.366	314.338	76.328	165.922
Hanson	0.602	0.356	311.275	306.583	79.349	174.894
Freeman up	0.382	0.612	312.772	308.711	59.699	163.726
Freeman dw	0.507	0.256	312.186	307.985	66	166.576
Taylor	0.57	0.36	307.817	305.673	66.648	173.236
Fish Hatchery	0.152	0.474	316.083	315.526	24.087	81.868
Oxnard	0.562	0.193	304.769	304.15	117.077	224.73

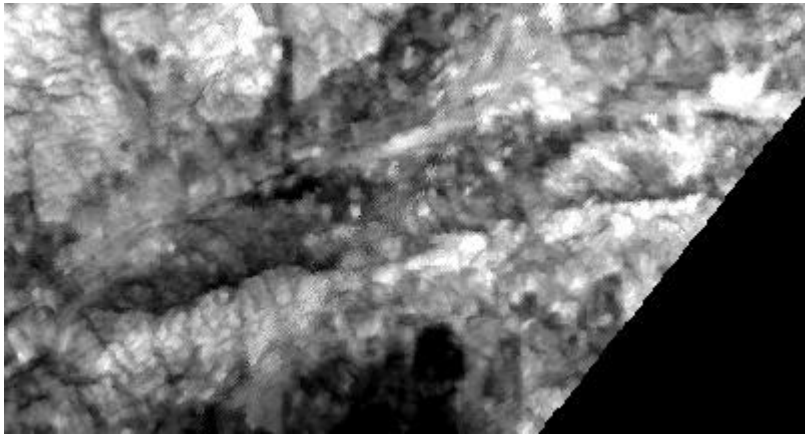
What ECOSTRESS Shows us



NPV, GV, Soil, JD 243, 2018



ET, JD 239, 2018



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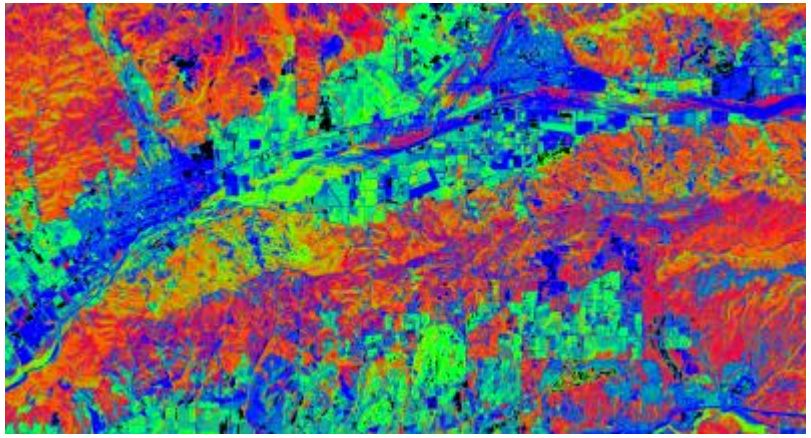
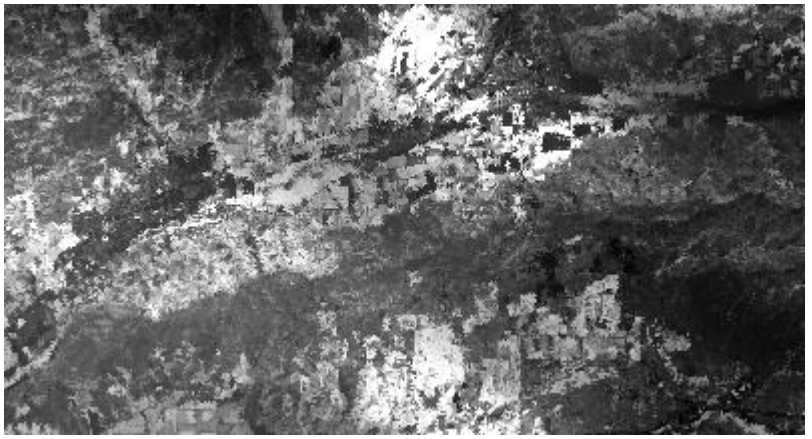
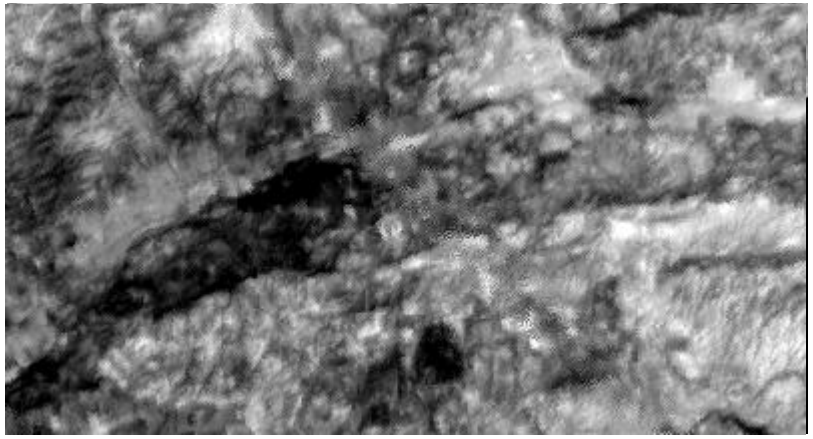


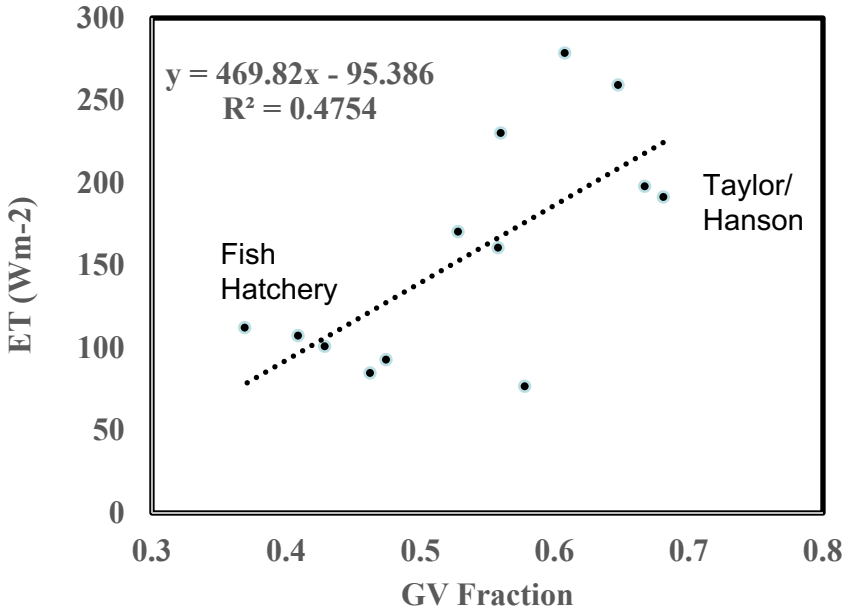
NPV, GV, Soil, JD 182, 2019



ET, JD 220, 2020



LST, JD 220, 2019



Conclusions

- **Riparian Drought Response depends on rooting depth and depth to ground water**
- **Mixture models show clear declines during the drought, expressed as declining GV and increased NPV**
- **ECOSTRESS shows elevated LST and decreased ET in the afternoon**
- **LST and ET varies spatially, correlated to GV, but with local variation**
- **Drought impacted stands show persistent decreased ET**