Sensitivity of Groundwater-Dependent Riparian Woodlands to Water Table Declines

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January 21, 2021

DRAFT

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Introduction

- Riparian woodlands are important vegetation communities
  - Serve as habitat for sensitive animal species
  - Promote plant biodiversity
  - Regulate water and sediment fluxes in floodplains
- Riparian woodlands are groundwater-dependent ecosystems
  - Root systems 0-3 m
  - Draw water from the alluvial water table
  - Exceptionally vulnerable to water stress if water table declines
- Prolonged water stress leads to plant mortality

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Research Questions

1. What are the general trends of tree health in the Santa Clara River floodplain during the 2012-2019 California drought?

2. How strong is the relationship between changes in groundwater and changes in land cover in riparian woodlands?

3. Are there critical thresholds where water table declines cause stress and mortality in the riparian woodlands?

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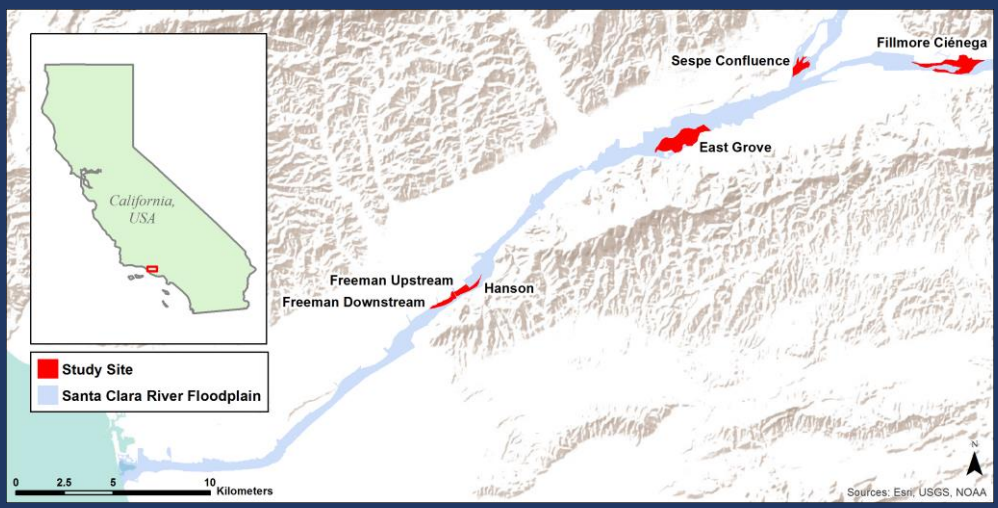
Lower Santa Clara River



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Groundwater

- For each study site, identified a well that indicated water table trends in the shallow aquifer
- The shallow aquifer is where trees access their water
- Calculated change in groundwater elevation compared to June 2011 baseline
- 2010-2011 was a wet winter, 2012-2019 drought conditions

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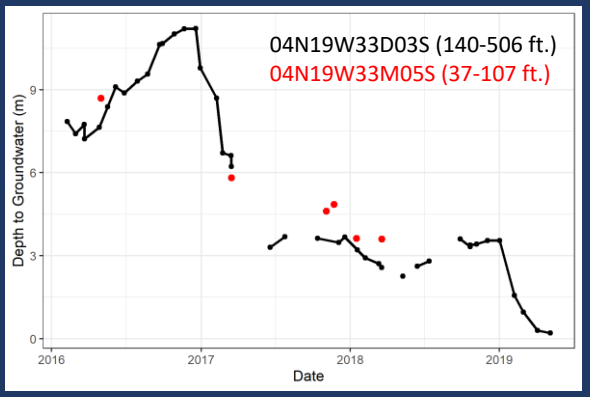
Groundwater

- Selected shallow wells with complete time series when possible
- Otherwise, benchmarked deeper wells against shallow wells with limited data

- Fillmore Cienega: 04N19W33D03S
- Sespe Confluence: 03N20W02A01S
- East Grove: 03N21W12B02S



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Remote Sensing

- Remote sensing is the analysis of satellite and aerial imagery
- Landsat satellite imagery acquired in June from 2011 to 2016
- 30-meter pixels
- Calculated change in land cover compared to 2011 baseline

- Analyzed the relationship between change in groundwater elevation and change in land cover
- Pooled observations across sites and years (n = 24 site-years)

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Remote Sensing

Green vegetation fraction:

- Percent land cover of healthy green plants

Non-photosynthetic vegetation fraction:

- Percent land cover of dead and woody plant material

Soil fraction:

- Percent land cover of soil

GV + NPV + Soil = 100%

Results

Results

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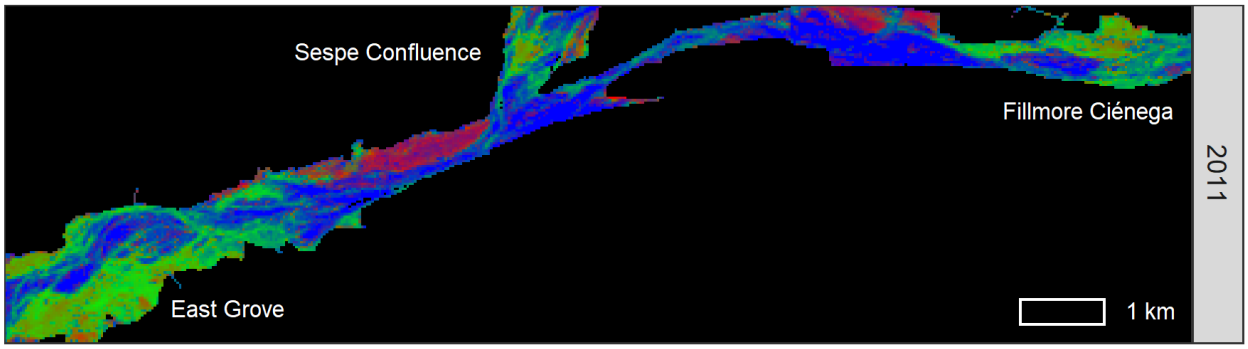
Results: Fillmore Basin



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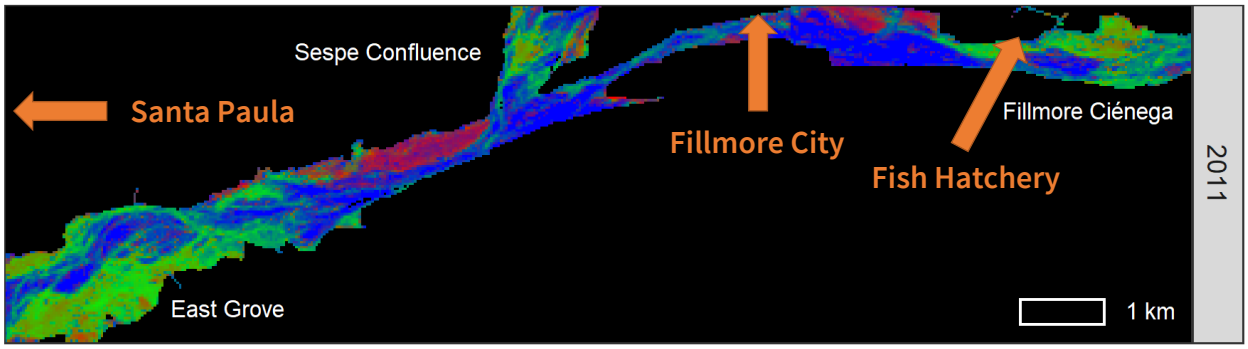
Results: Fillmore Basin



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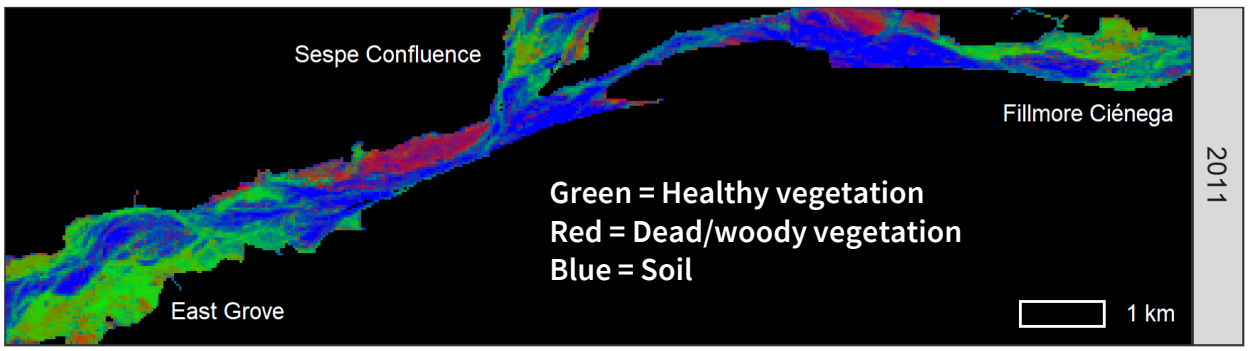
Results: Fillmore Basin



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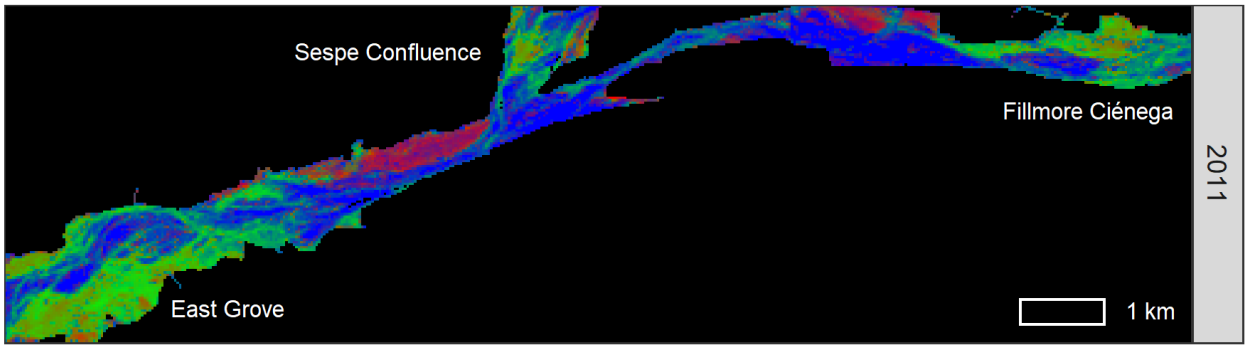
Results: Fillmore Basin



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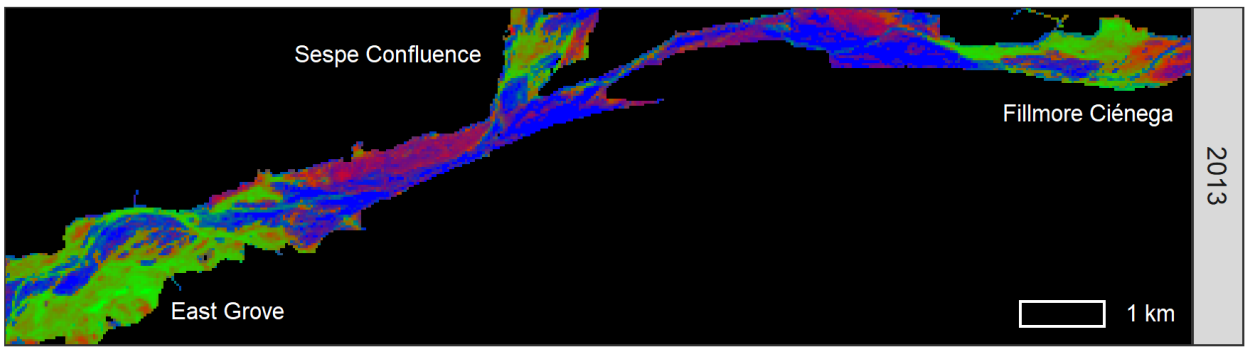
Results: Fillmore Basin



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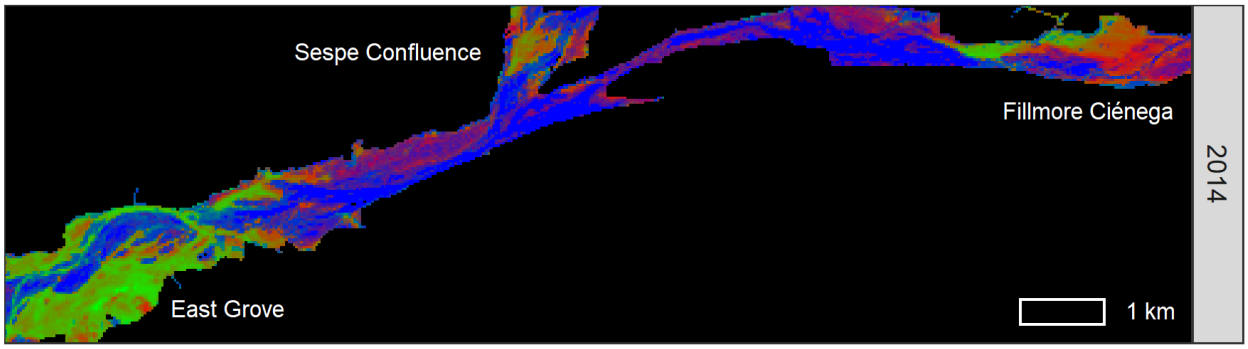
Results: Fillmore Basin



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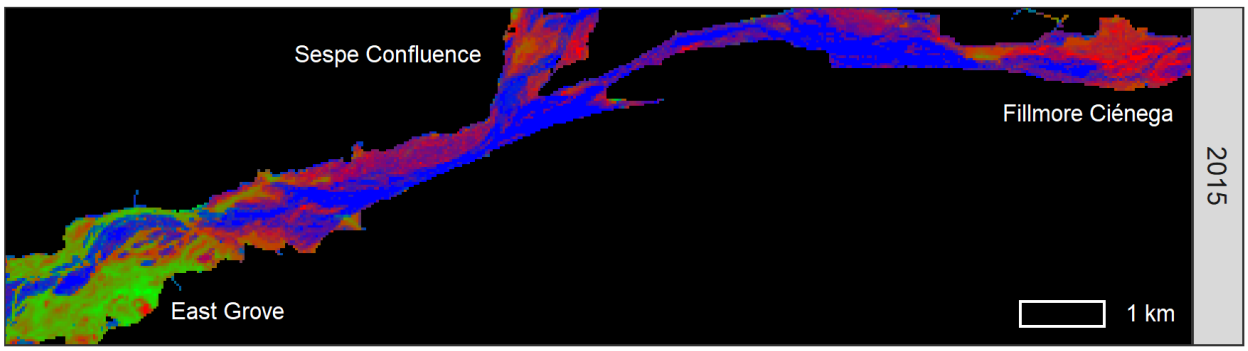
Results: Fillmore Basin



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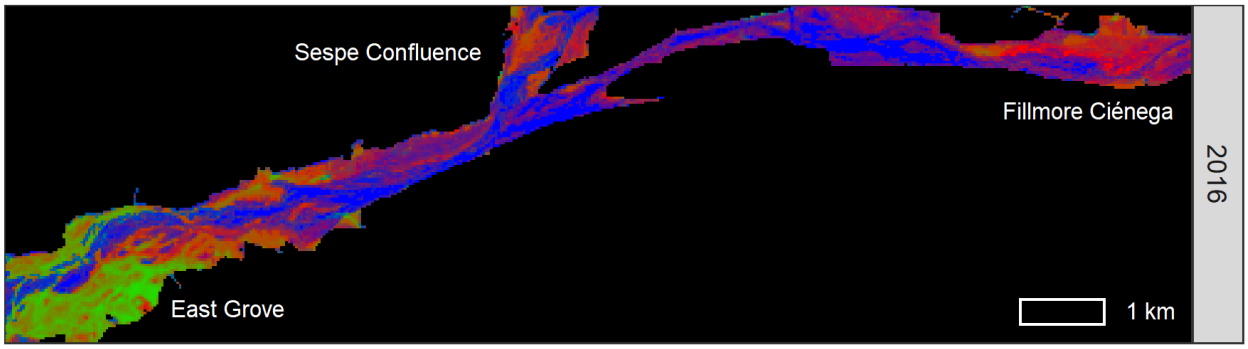
Results: Fillmore Basin



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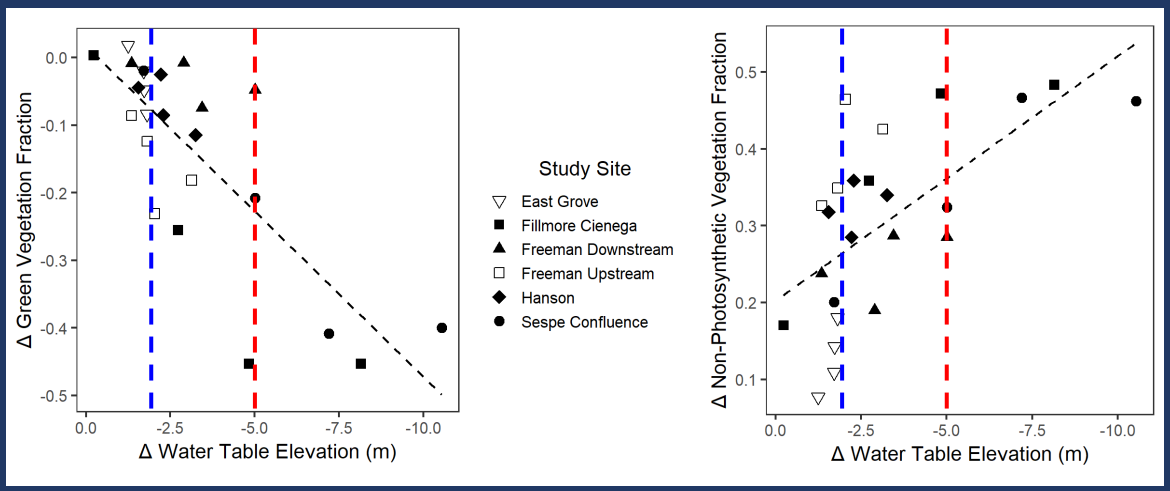
Results



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Discussion

- Groundwater declines drove widespread mortality of riparian trees between 2011 and 2016
- Limited impact at sites with <2 m water table decline
- Widespread mortality at sites with >5 m water table decline
- Observed threshold may be related to changes in subsurface water fluxes, and not just tree root systems

Discussion

- Floods and scouring events needed for riparian tree species to regenerate
- Increased prevalence of droughts, decreased prevalence of floods could lead to less natives and more invasives
- Trees might not recover in the same way that they have in the past
- Potential for permanent loss of riparian woodlands

Questions?