Center for Ecosystem Climate Solutions

Translating the best available science for land management decisions

Mapping and tracking California forests over the last 40 years.

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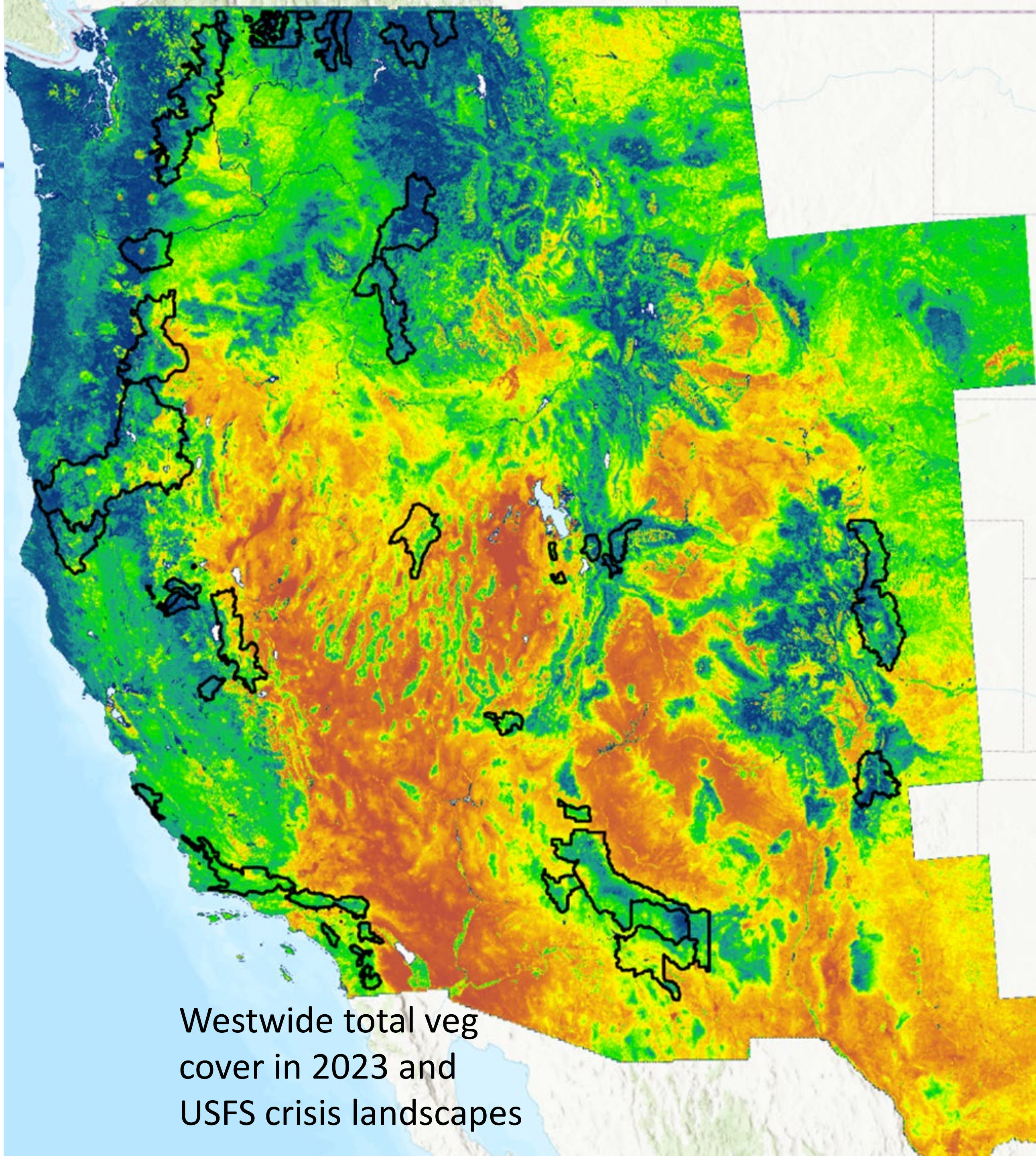
Goal

Introduce, explain and invite you to use geospatial dataset from the Center for Ecosystem Climate Solutions (CECS)

Outline

Introduce CECS geospatial dataset
Methods and approach used to create dataset
Testing and validating dataset
Results and implications
Long-term vision
Take-home messages



Westwide total veg cover in 2023 and USFS crisis landscapes

SPECS

4-dimension data cube: 30m x 30m x 40 years x 20+ core metrics

True 30-m mapping and annual mapping: ~0.5B pixels in CA, ~3B pixels Westwide, ~10B pixels CONUS

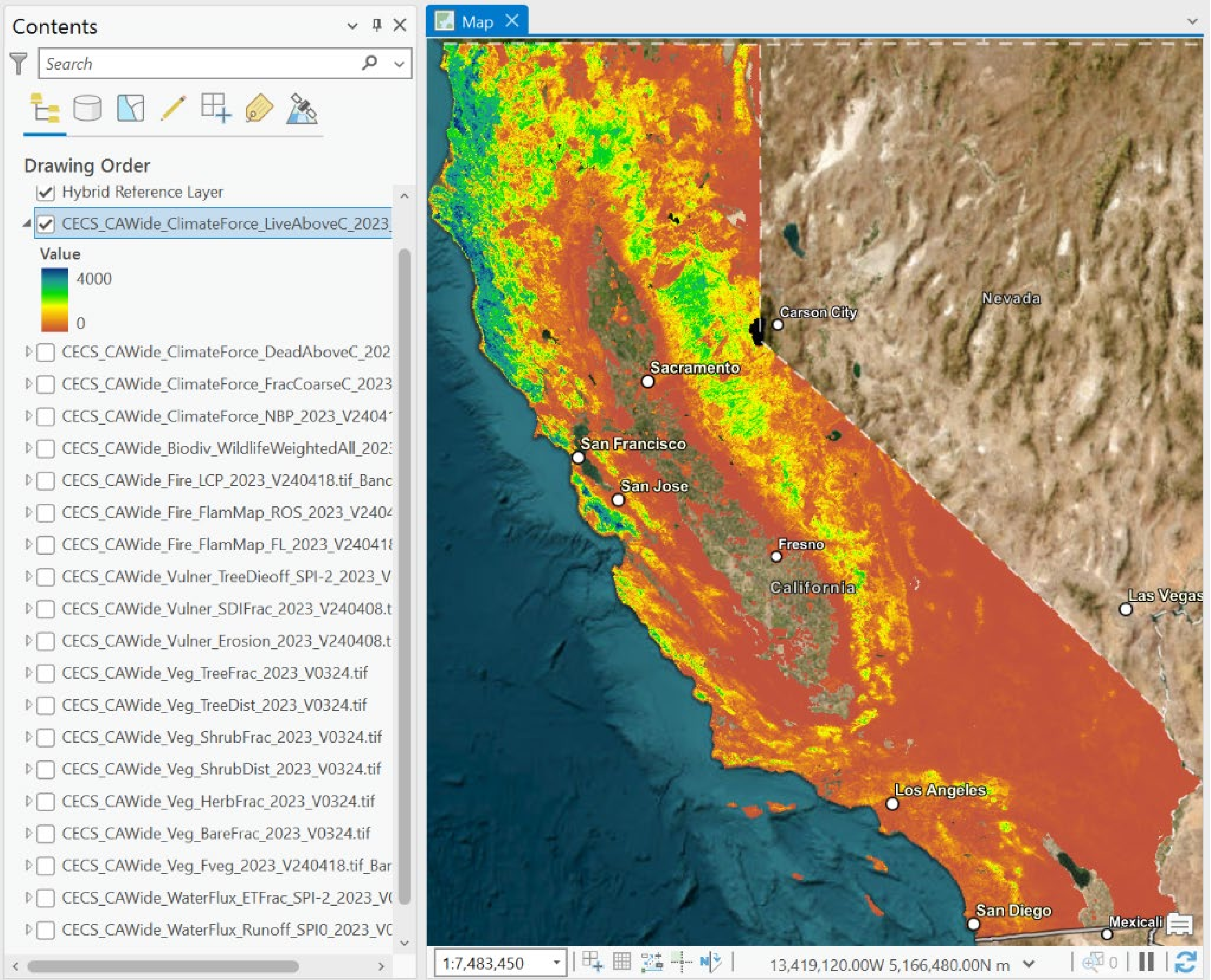
Not a turnkey program: ~50 component programs in Matlab and R and 10s of M of files - 750 TB and 2-3M/yr CPUh on UCI's HPC

Rapidly updatable: 2024 first draft was ready by end of Jan 2025

Rapidly scaled: Kings Basin in 2012 -> Sierrawide 2016 -> CAwide 2021 -> Westwide 2024 -> CONUS 2025 -> ?

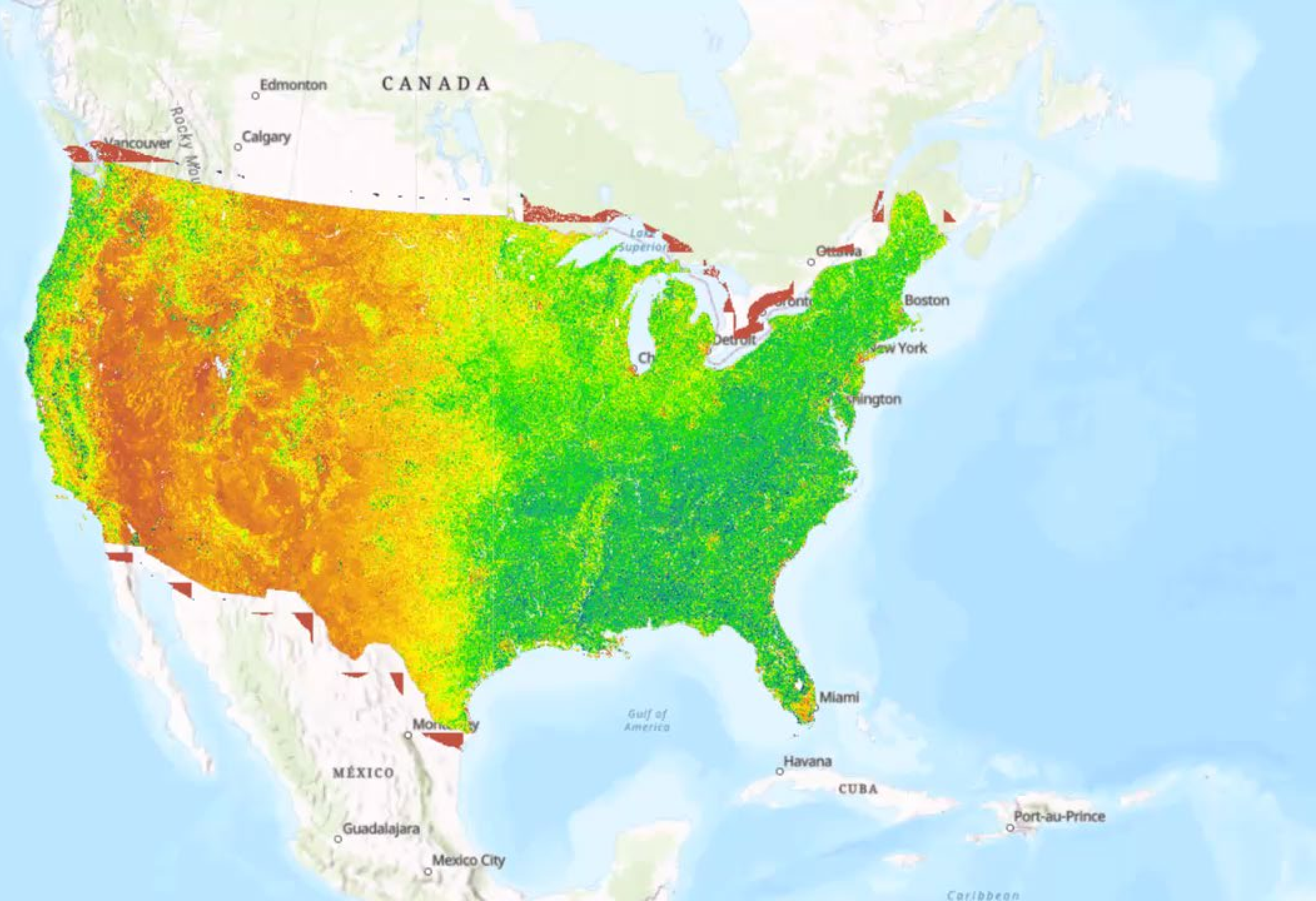
Based on lots of field data, testing, intercomparisons, feedback, iterative development

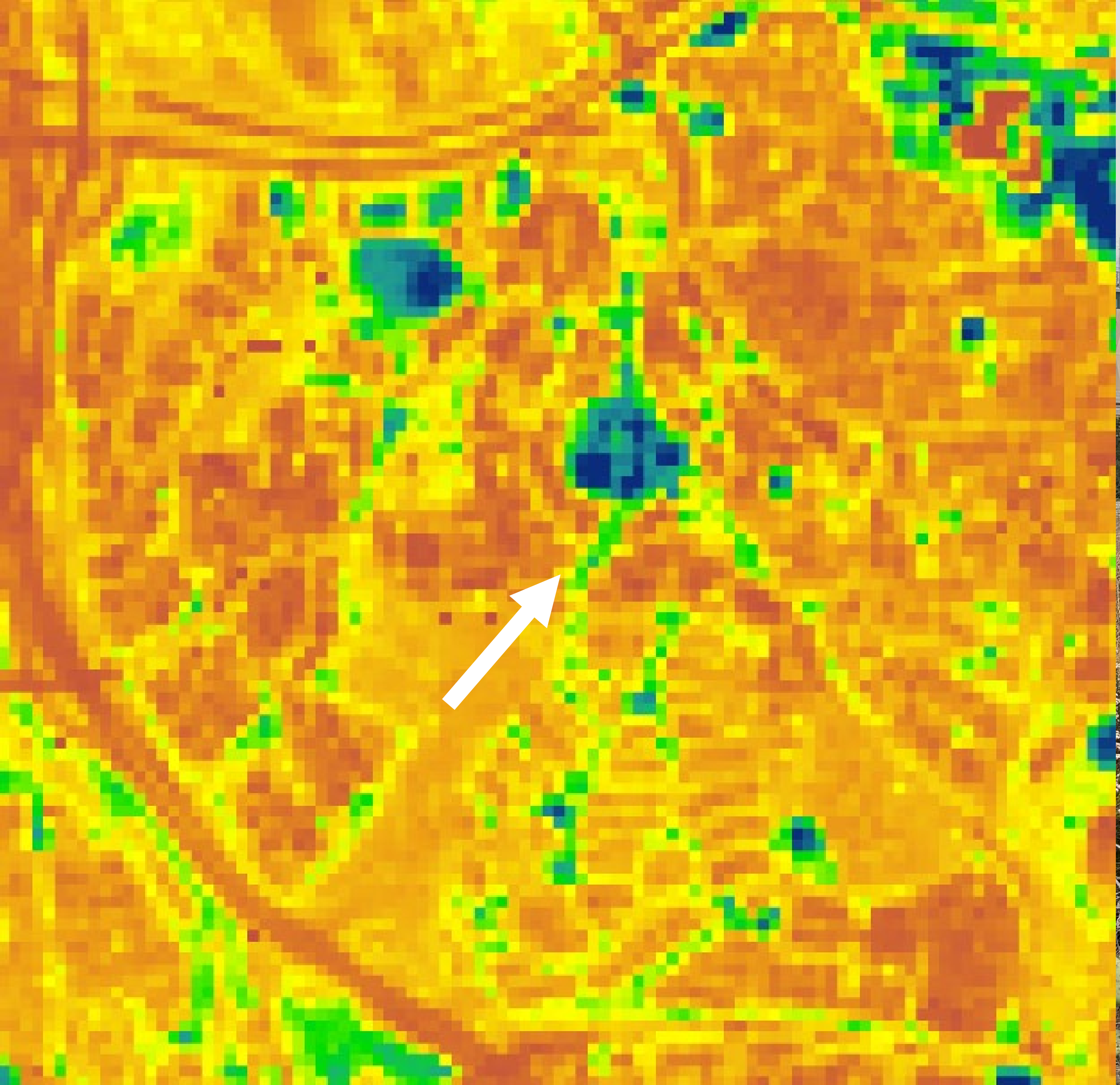
Based on previous successes/failures, experience and theory in ecosystem and biogeophysical ecology



Spatial dimensions

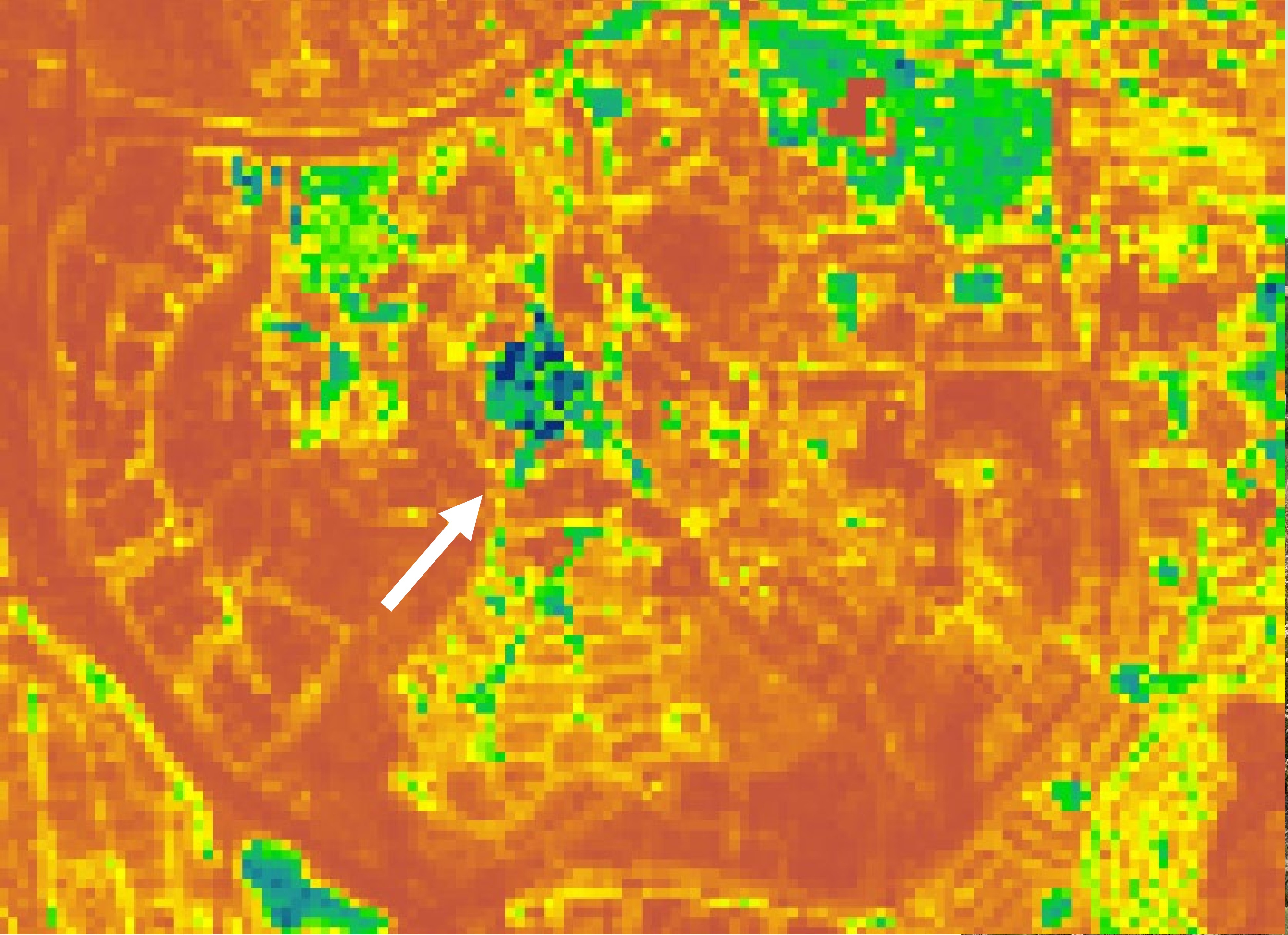
- Large (CA-wide, West-wide, CONUS) to small (30x30 m) high precision
- Image shows 2023 GPP (annual photosynthesis)



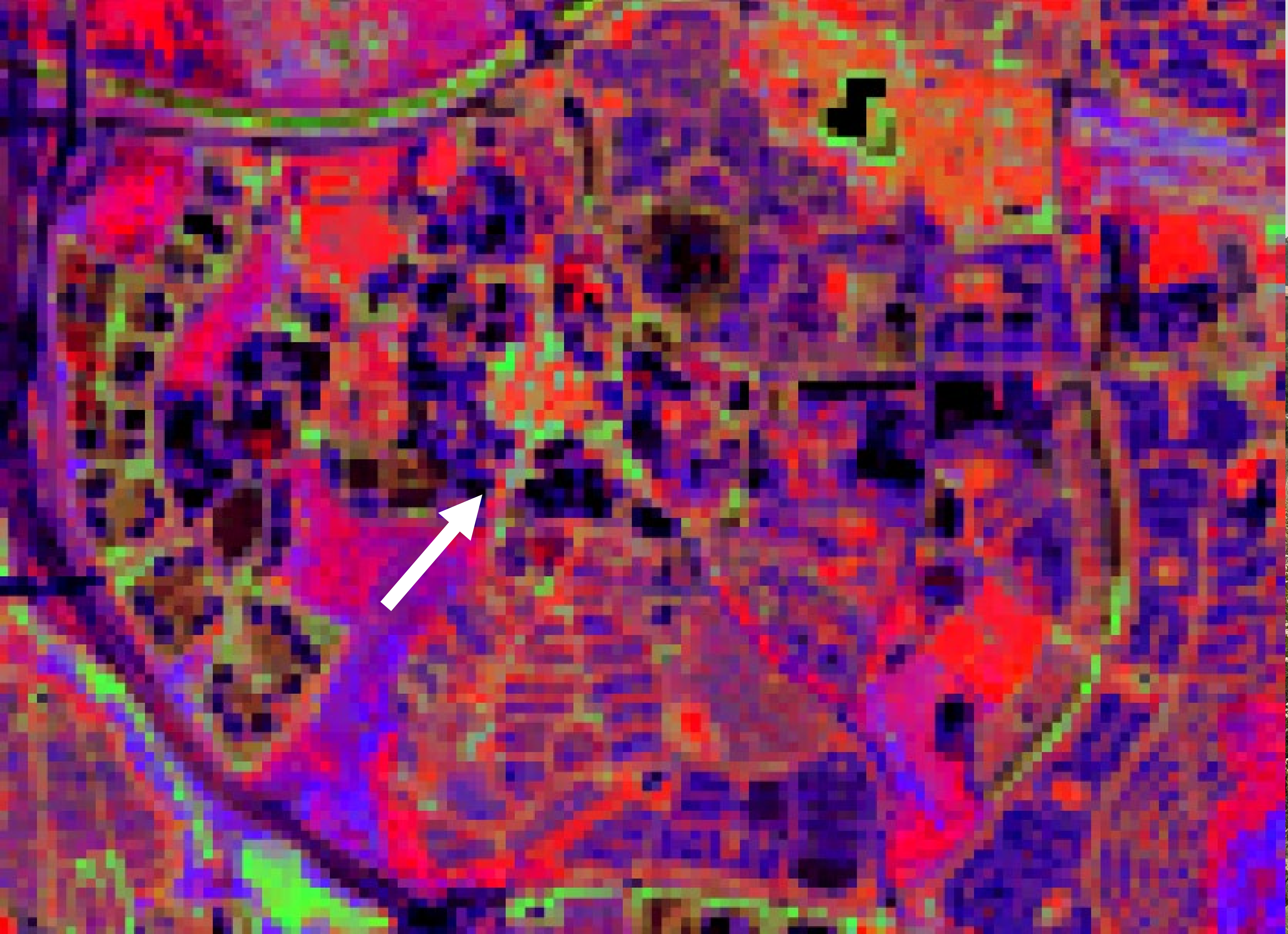


UCI's Campus
Arrow is approx camera view

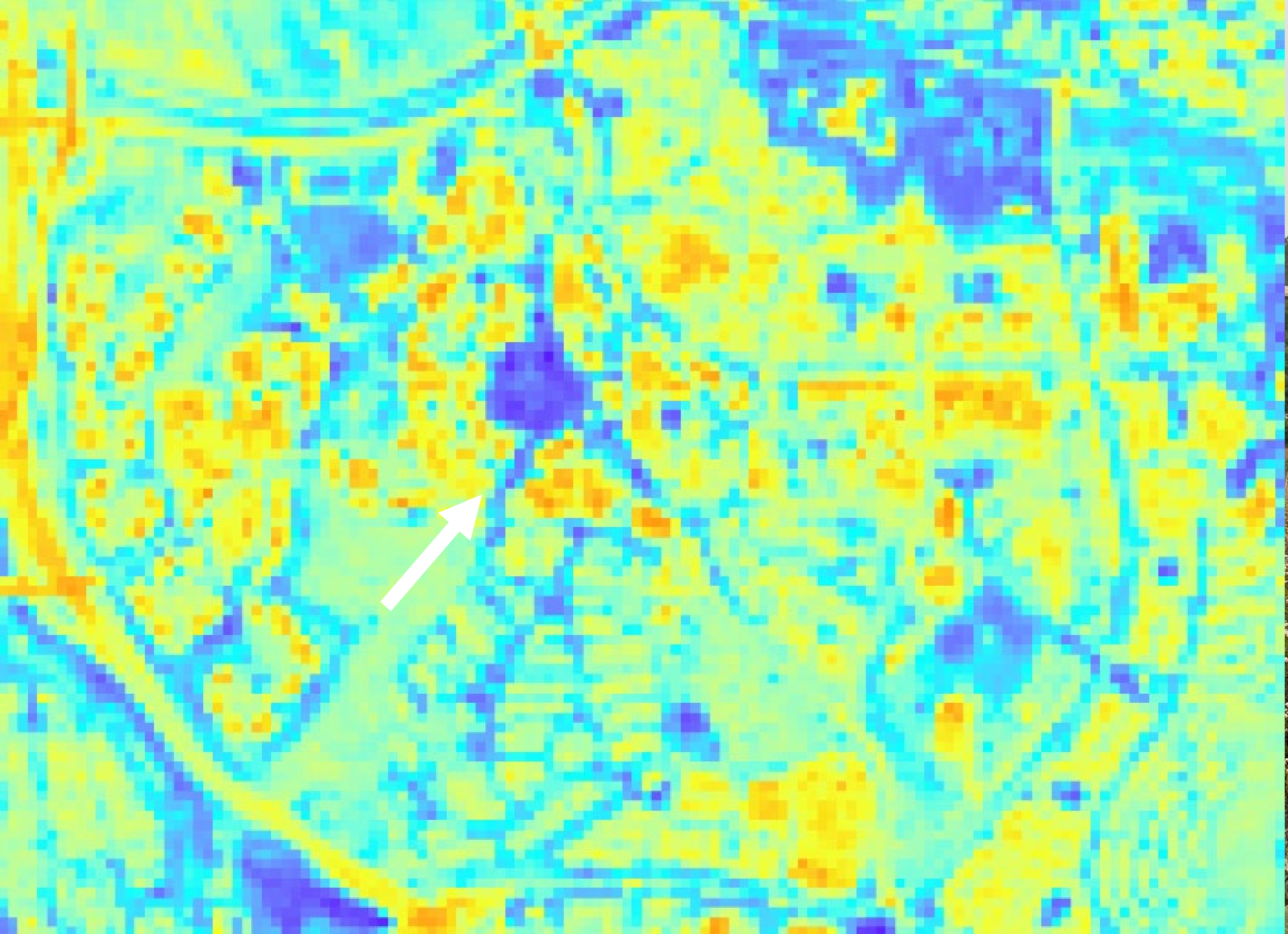
2023 GPP (annual photosynthesis)



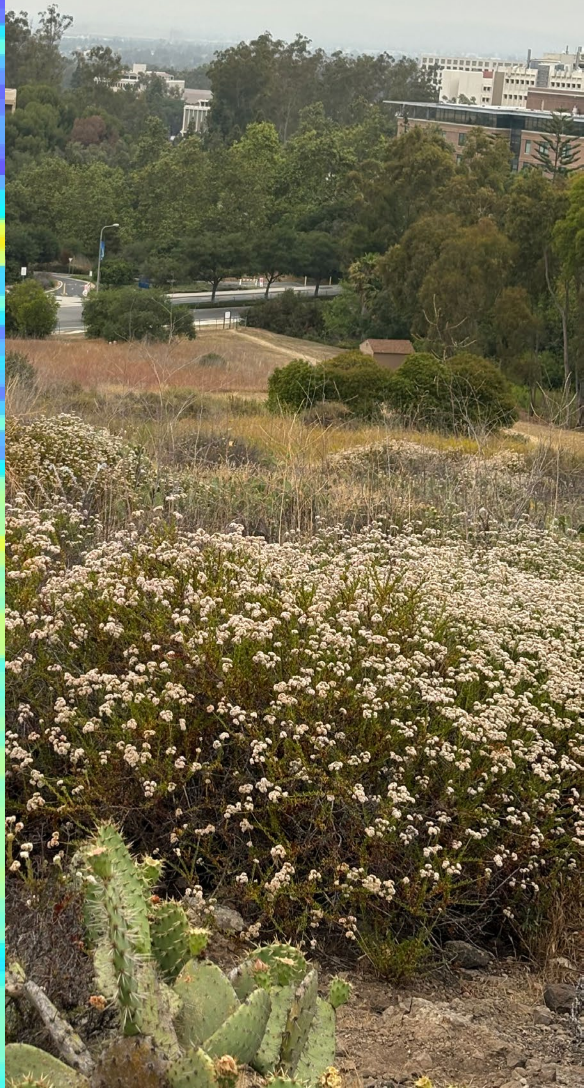
2023 Aboveground Biomass
Green/Blue = more AGB



2023 VegType
Red = Grasses
Green = Trees
Blue = shrubs



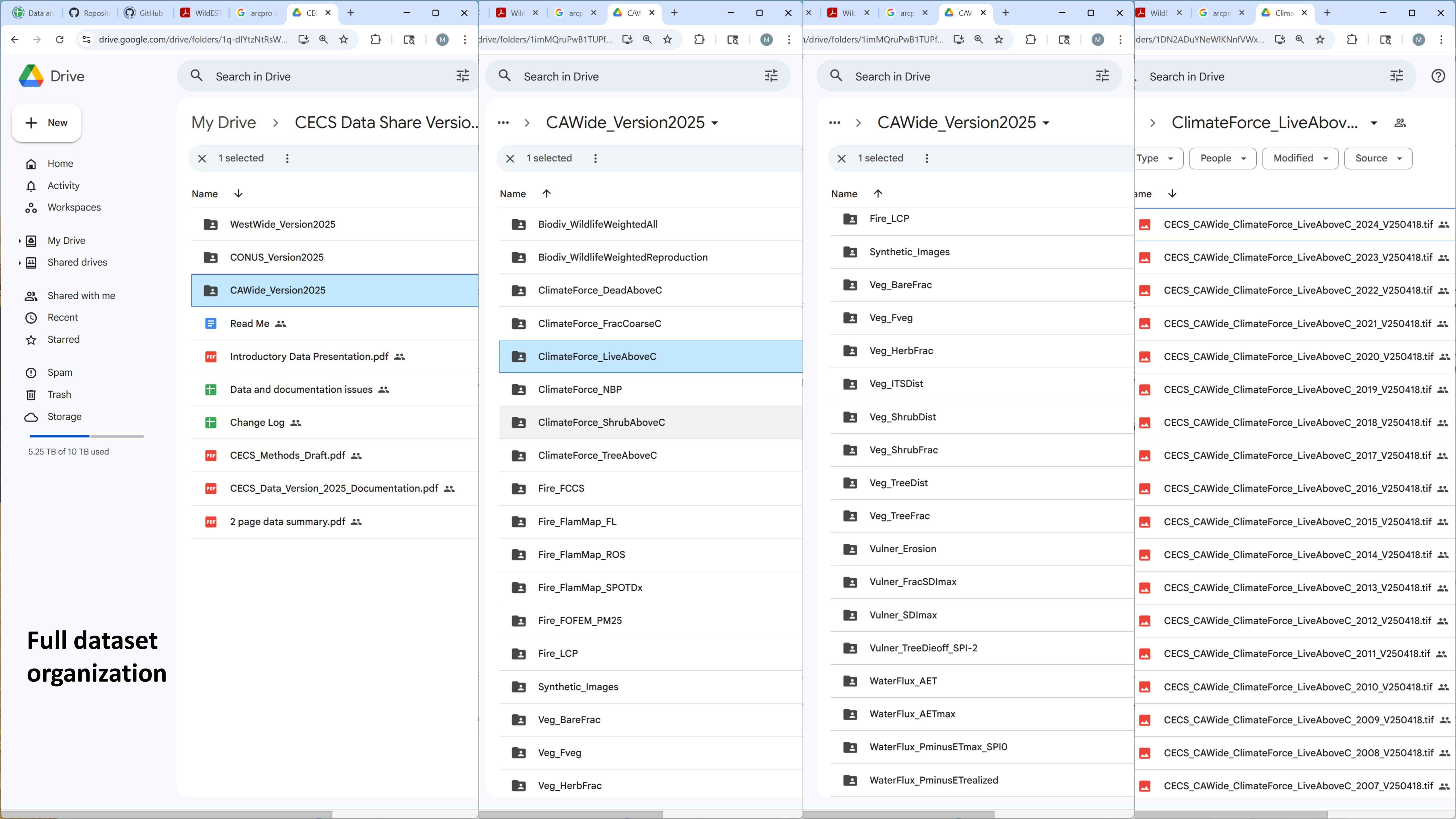
2023 Annual Actual
Evapotransporation
Blue = more AET

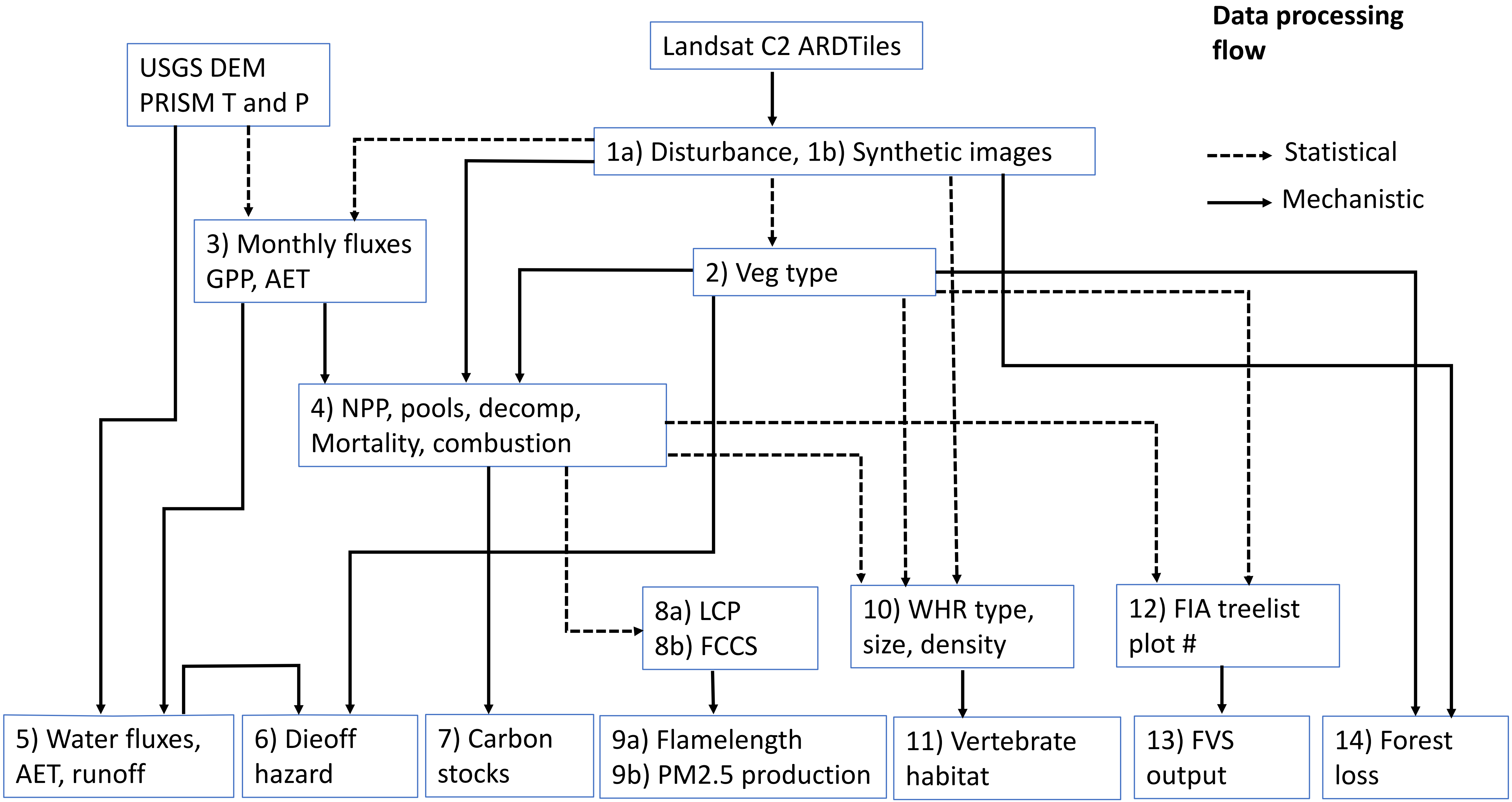


2010

Annual Conditional Flamelength in Southern CA's San Jacinto Mountains

Full dataset organization




Data processing flow
Landsat C2 ARDTiles
USGS DEM
PRISM T and P
1a) Disturbance, 1b) Synthetic images
Statistical
Mechanistic
3) Monthly fluxes
GPP, AET
2) Veg type
4) NPP, pools, decomp,
Mortality, combustion
8a) LCP
8b) FCCS
10) WHR type,
size, density
12) FIA treelist
plot #
5) Water fluxes,
AET, runoff
6) Dieoff
hazard
7) Carbon
stocks
9a) Flamelength
9b) PM2.5 production
11) Vertebrate
habitat
13) FVS
output
14) Forest
loss

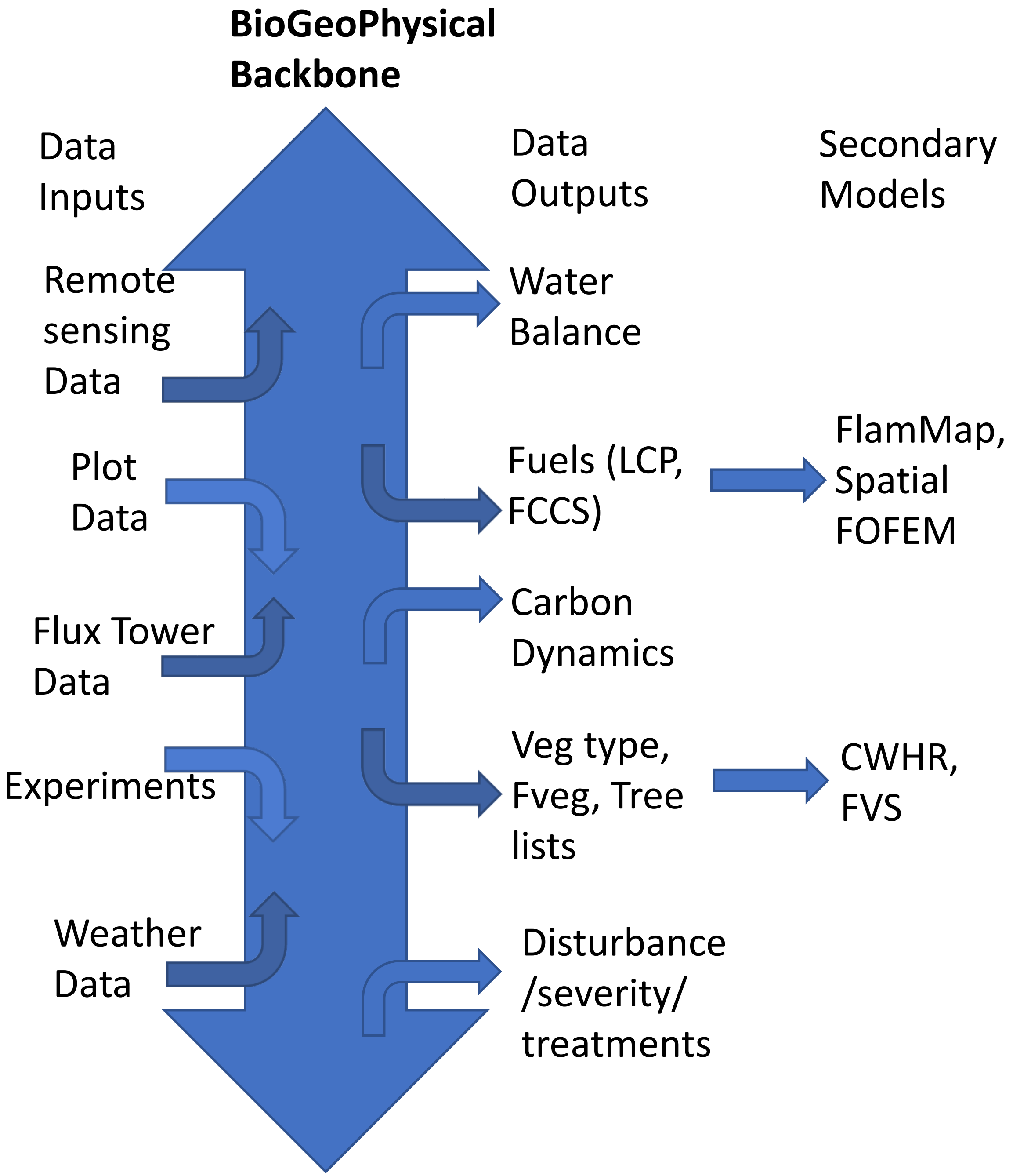
Data processing architecture

1) Data inputs
- Remote sensing, plots, flux tower, etc

2) BioGeoPhysical Backbone
- Scale across Property, Time and Space
- Builds in constraints like mass balance for water and carbon; equivalency of carbon pools and fuel; biophysical constraints on shape of plants

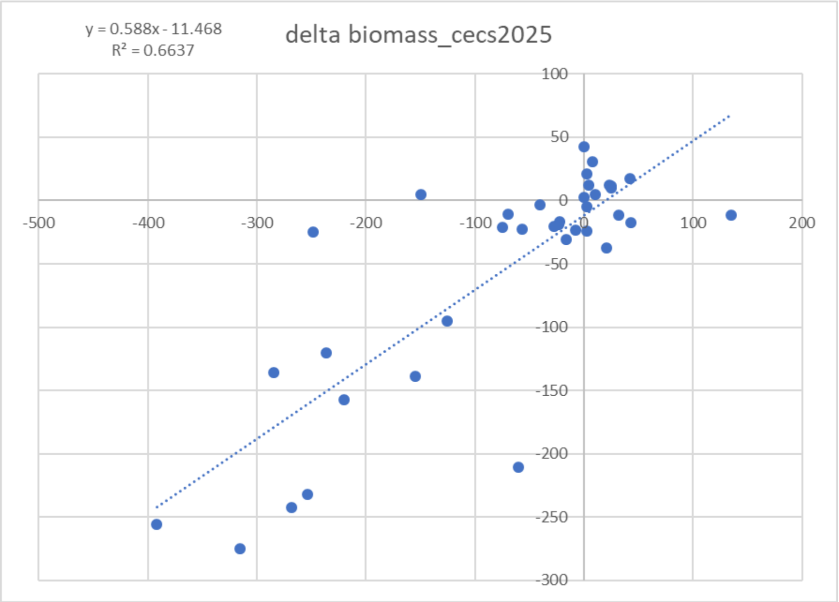
3) Data outputs
- Everything you've seen so far

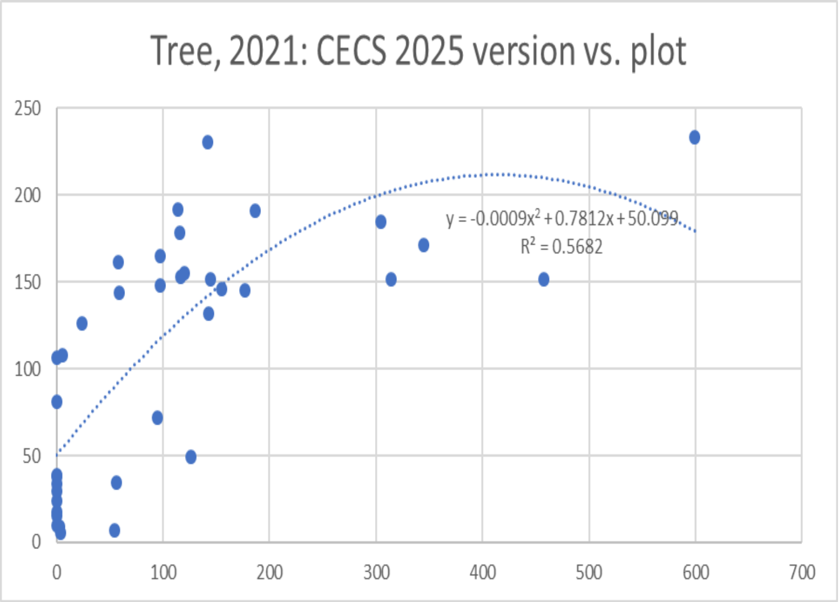
4) Secondary Models
- Flammap, CWHR, RUSLE, SpatialFOFEM, etc



Testing – best tests use large sample size, co-located field data

- Compare CECS AboveGround live Biomass (AGB for trees and shrubs) with plot data collected by UC Berkeley
- A particularly nice field dataset because it: a) includes information on true plot location, b) includes revisits, so can compare both changes in AGB over time and also spatial patterns within a set of observations
- Generally decent agreement – saturation in spatial (a good but not great data set there) – temporal is probably as good as any geospatial dataset can do

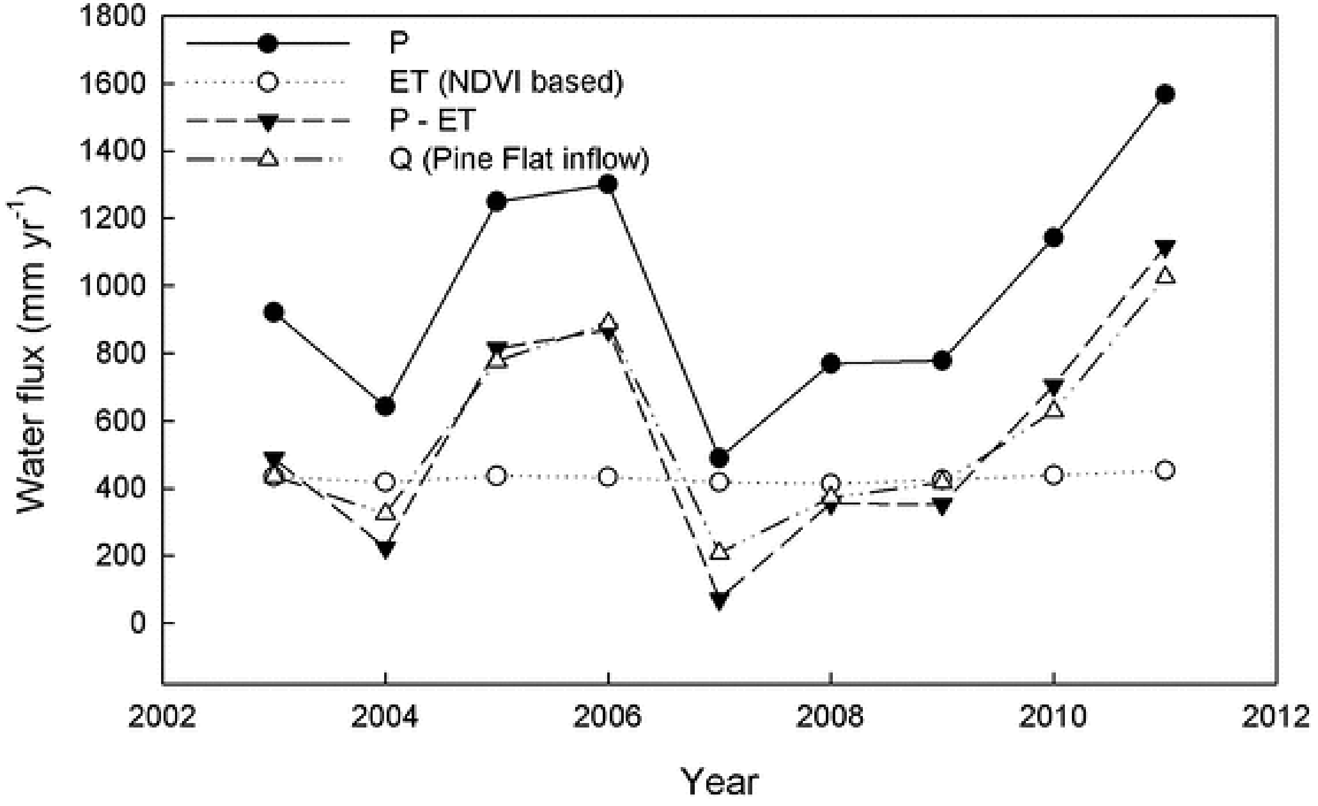




Figs from Kristin Nesbit, UC Berkeley

Testing – best tests use co-located field data

- Can get at water fluxes by comparing with river flow gauges
- Over longer periods, riverflow should = Precip minus AET summed across the full watershed
- Have done many of these comparisons – especially collaborator Roger Bales
- Generally good agreement – see adjacent sets of triangles for Upper Kings Basic vs Inflow to Pine Flat



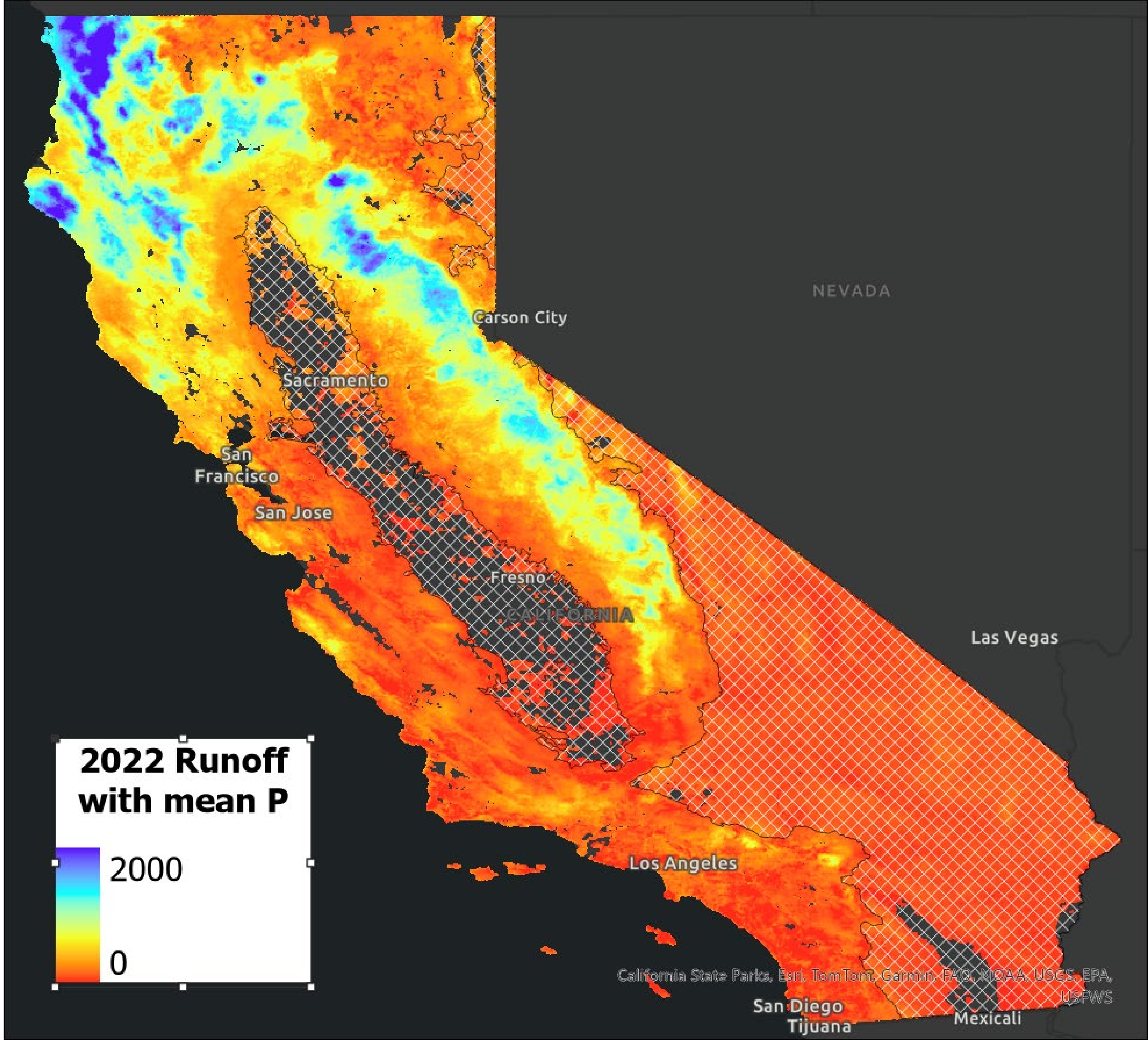
Testing

Some of the easiest testing is just to compare with alternative, established geospatial datasets

Can't really tell what's best (don't know absolute truth)

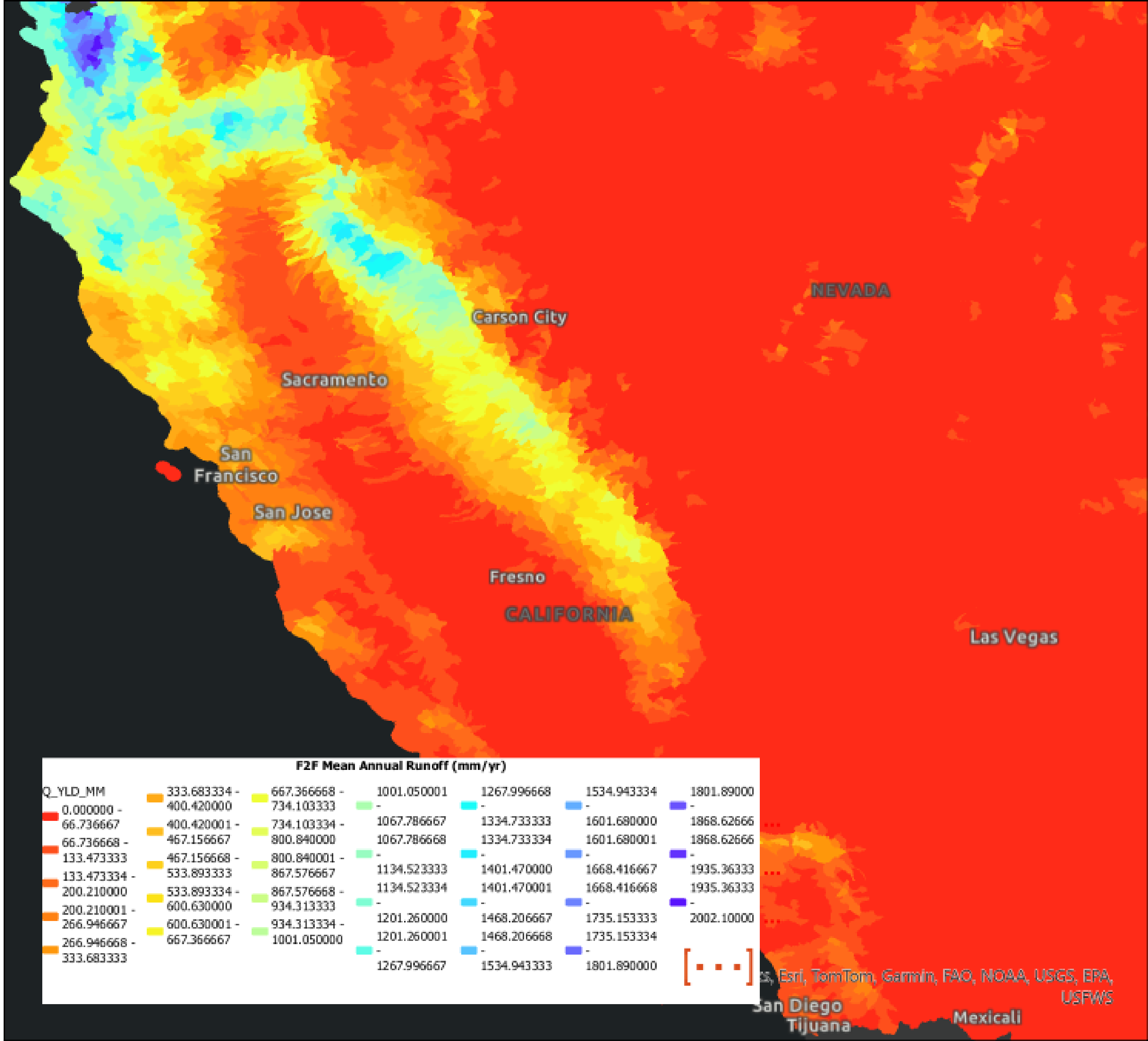
But can quickly tell what is and isn't credible, and whether we're in that upper group of solid datasets

CECS Runoff during average P year – Blue is more runoff on average



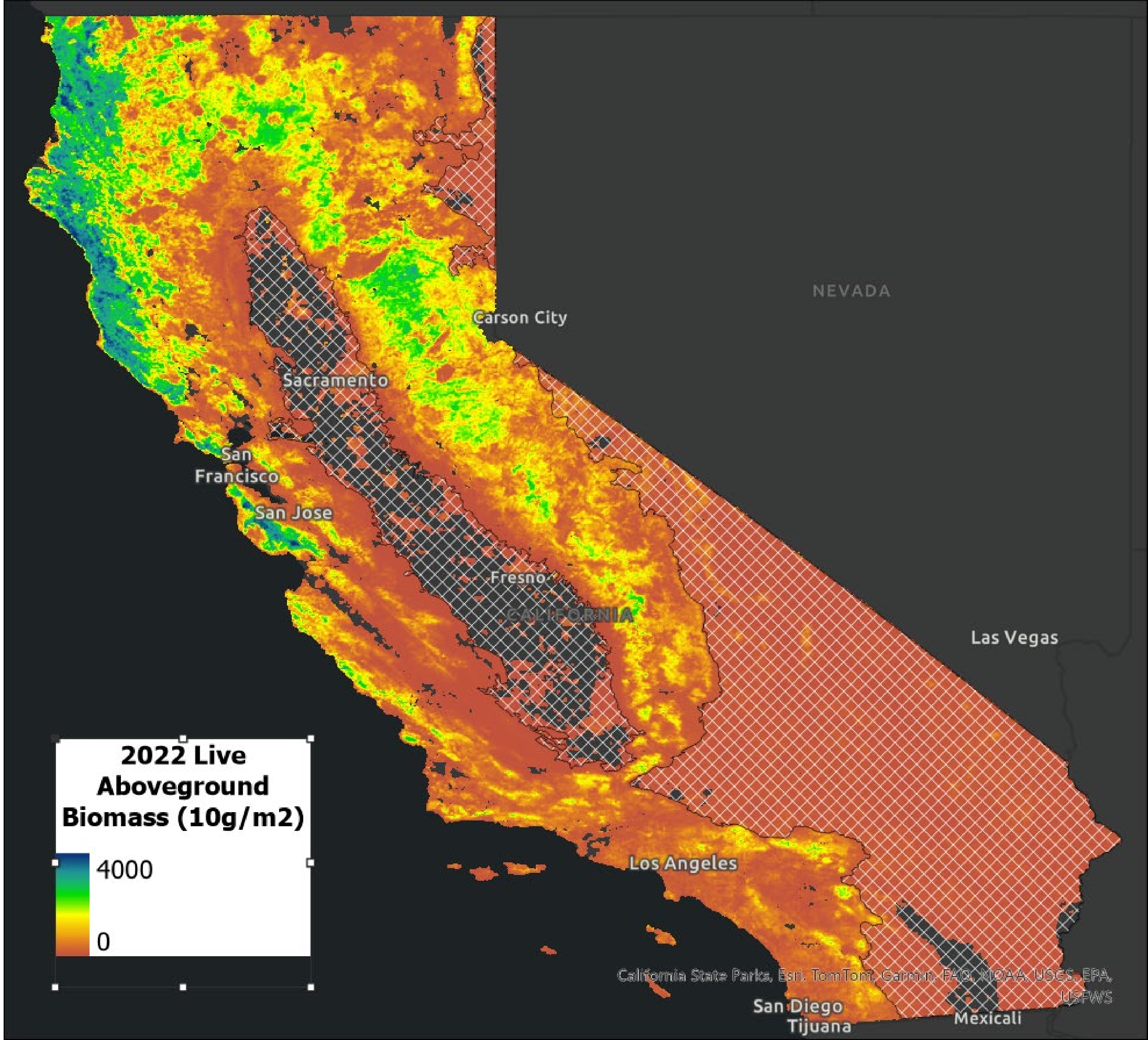
Testing

Forsts2Faucets (USFS) - Runoff during average P year – Blue is more runoff on average



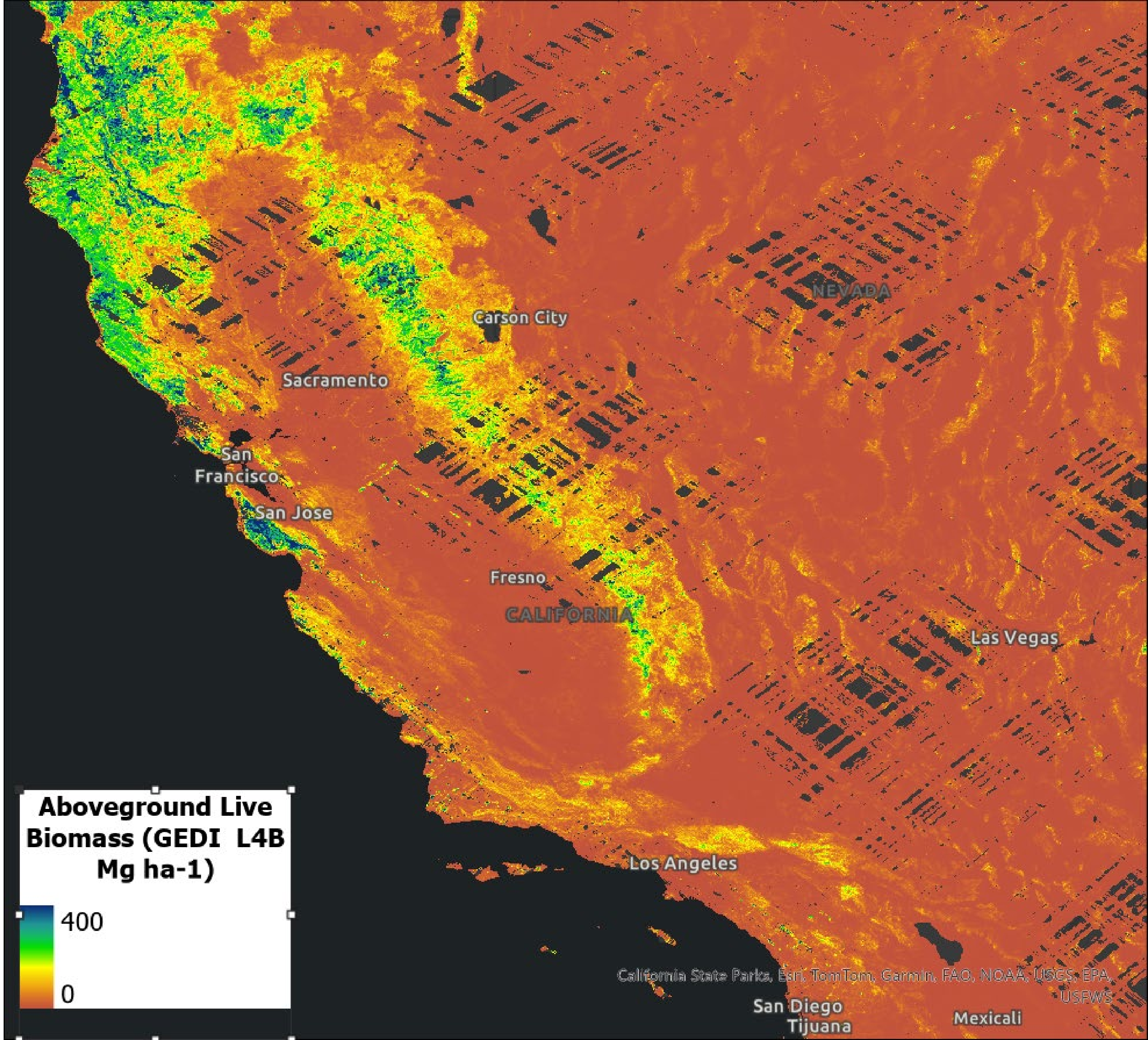
Testing

- CECS Biomass – Green is more biomass



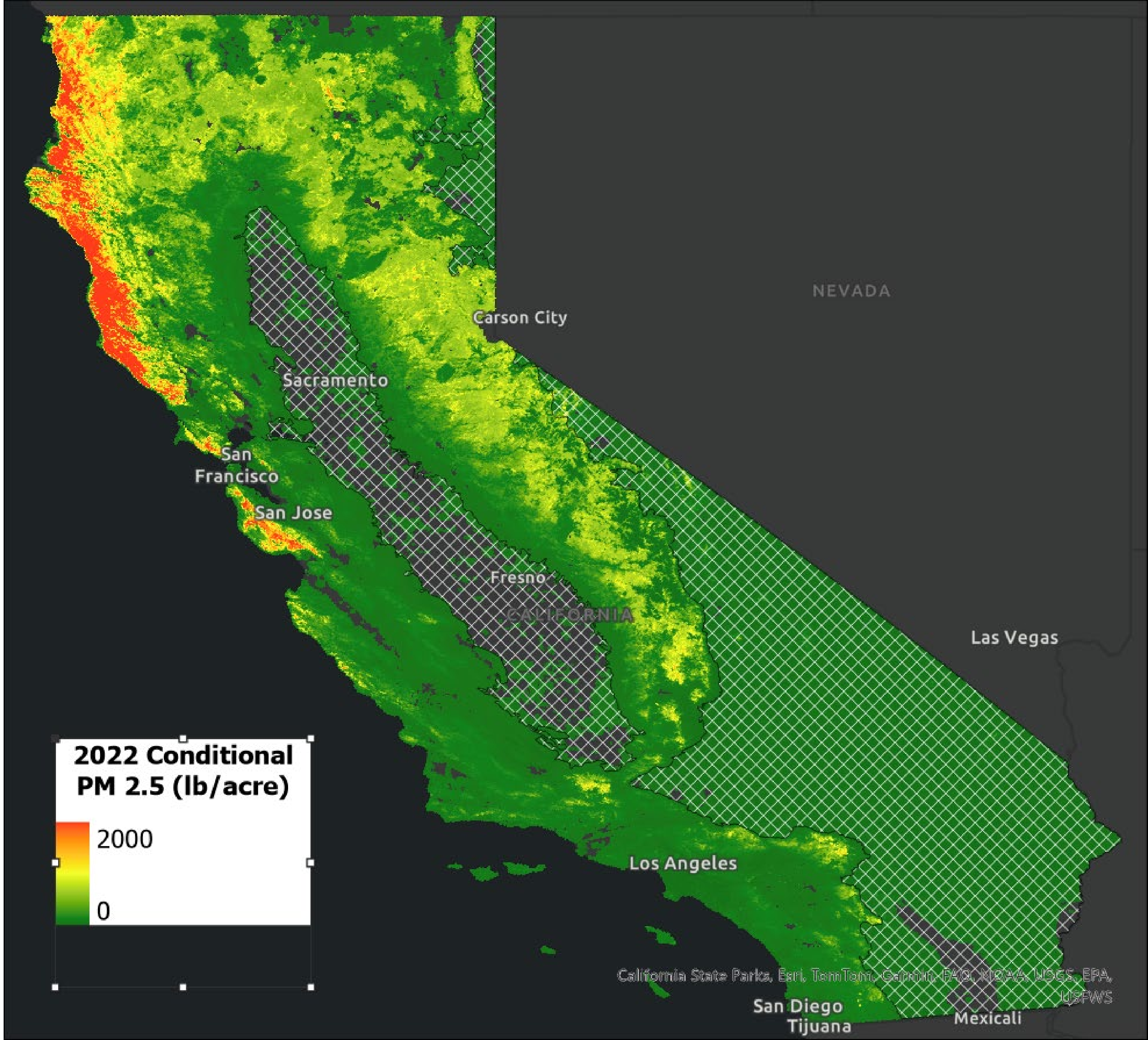
Testing

GEDI Biomass –
Green is more biomass



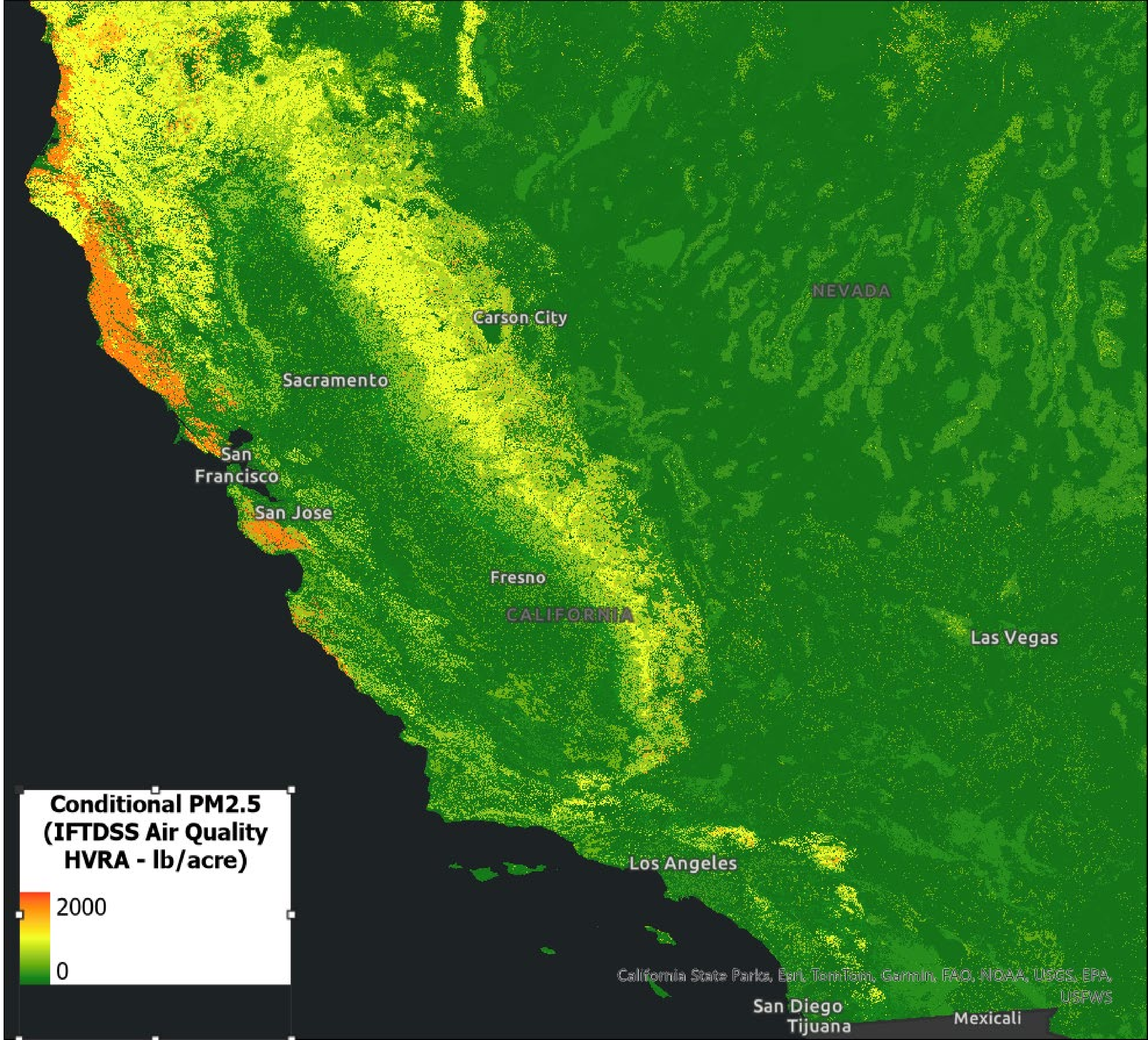
Testing

CECS conditional PM2.5 emissions



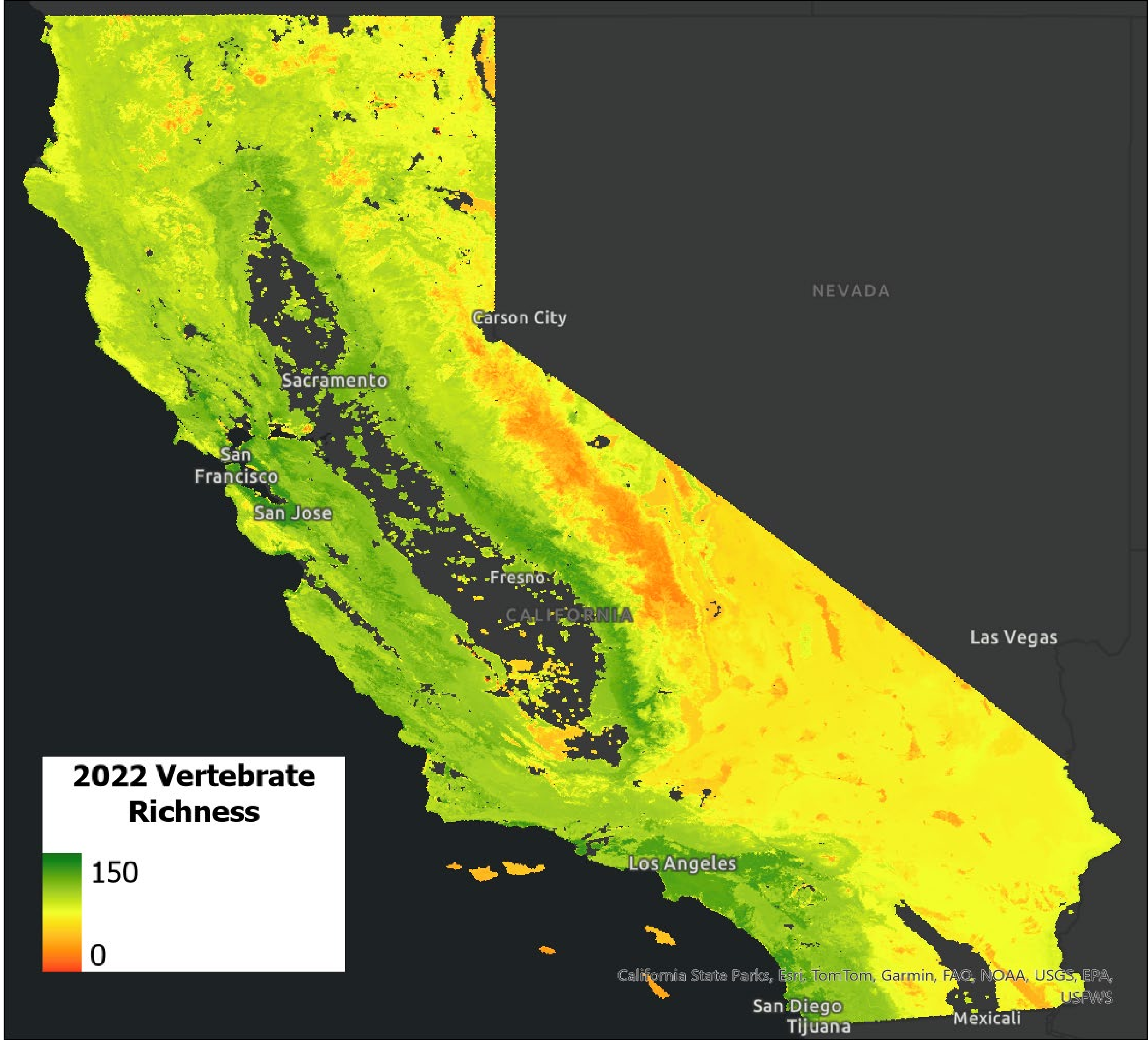
Testing

- National HVRA
  - Data Air Quality (IFTDSS Air Quality HVRA raster)



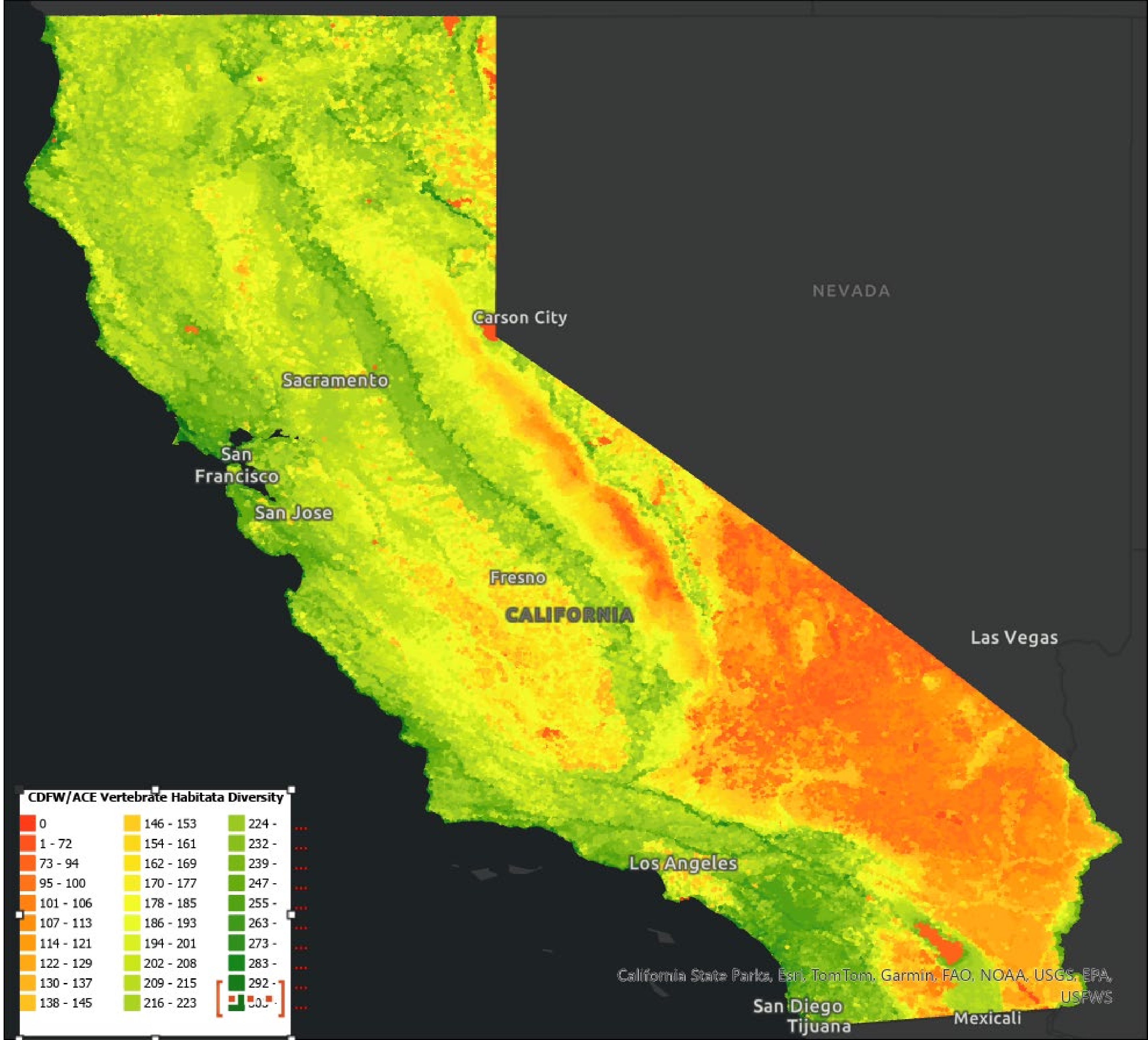
Testing

CECS Vertebrate habitat diversity – Green is more possible vertebrate species



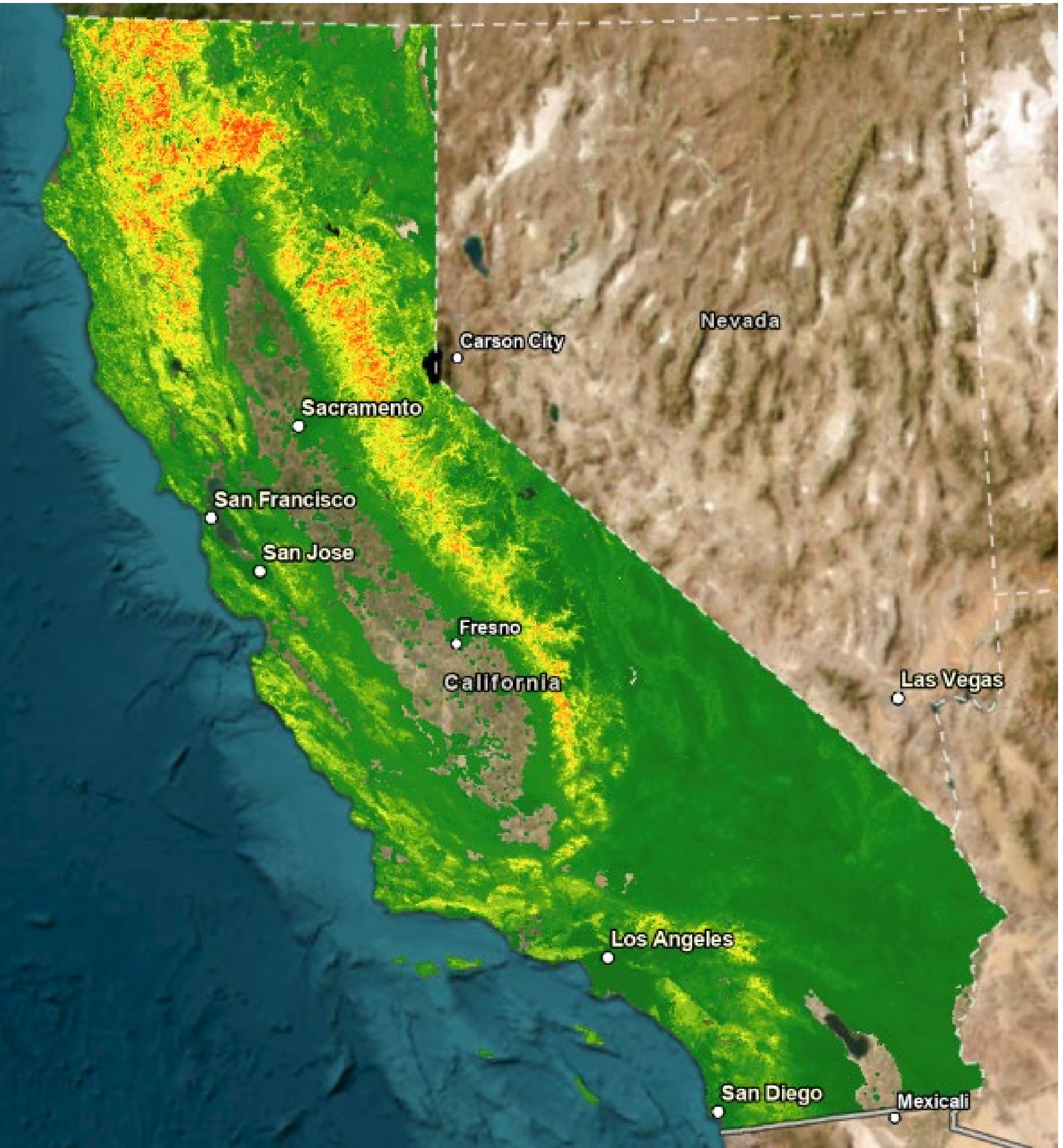
Testing

ACE/CDFW
- Vertebrate habitat diversity – Green is more possible vertebrate species

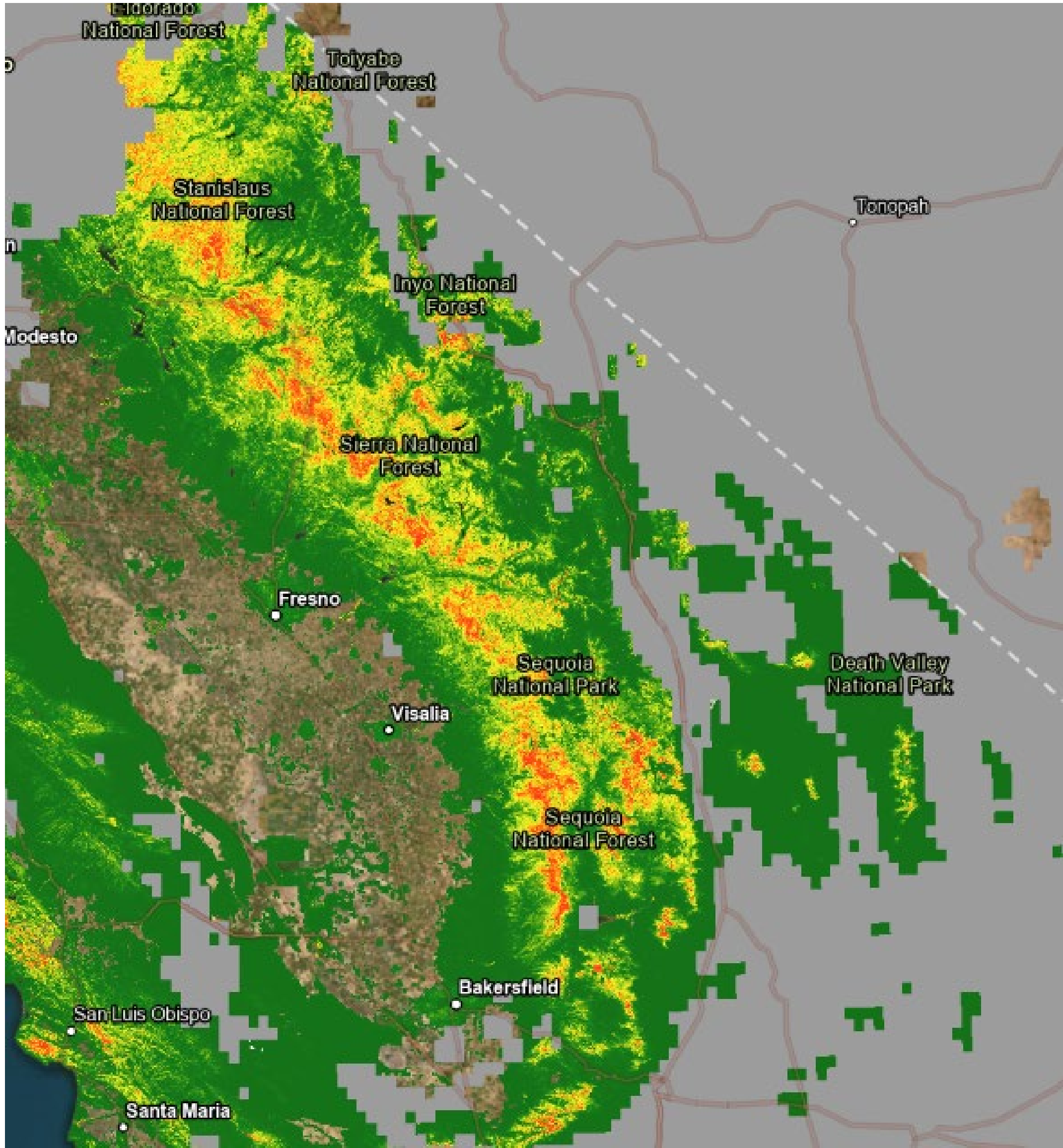


Testing – for risk of disturbance we can roll the hazard datasets back in time and see whether they could have predicted subsequent spatial patterns of wildfire and drought beetle dieoff

2010 Fire Hazard: could we have predicted what burned?

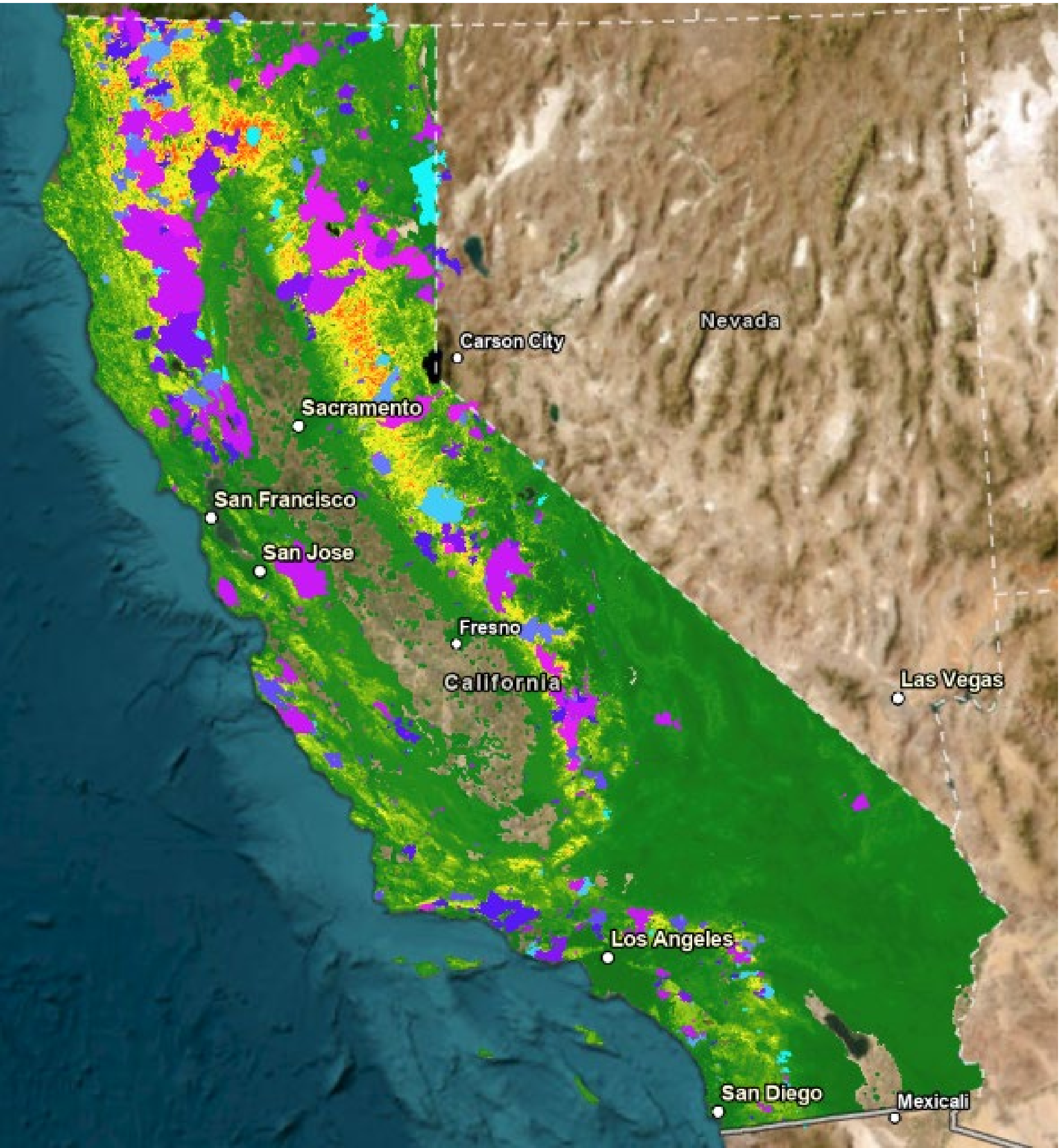


2010 Dieoff risk: Could we have predicted what died?

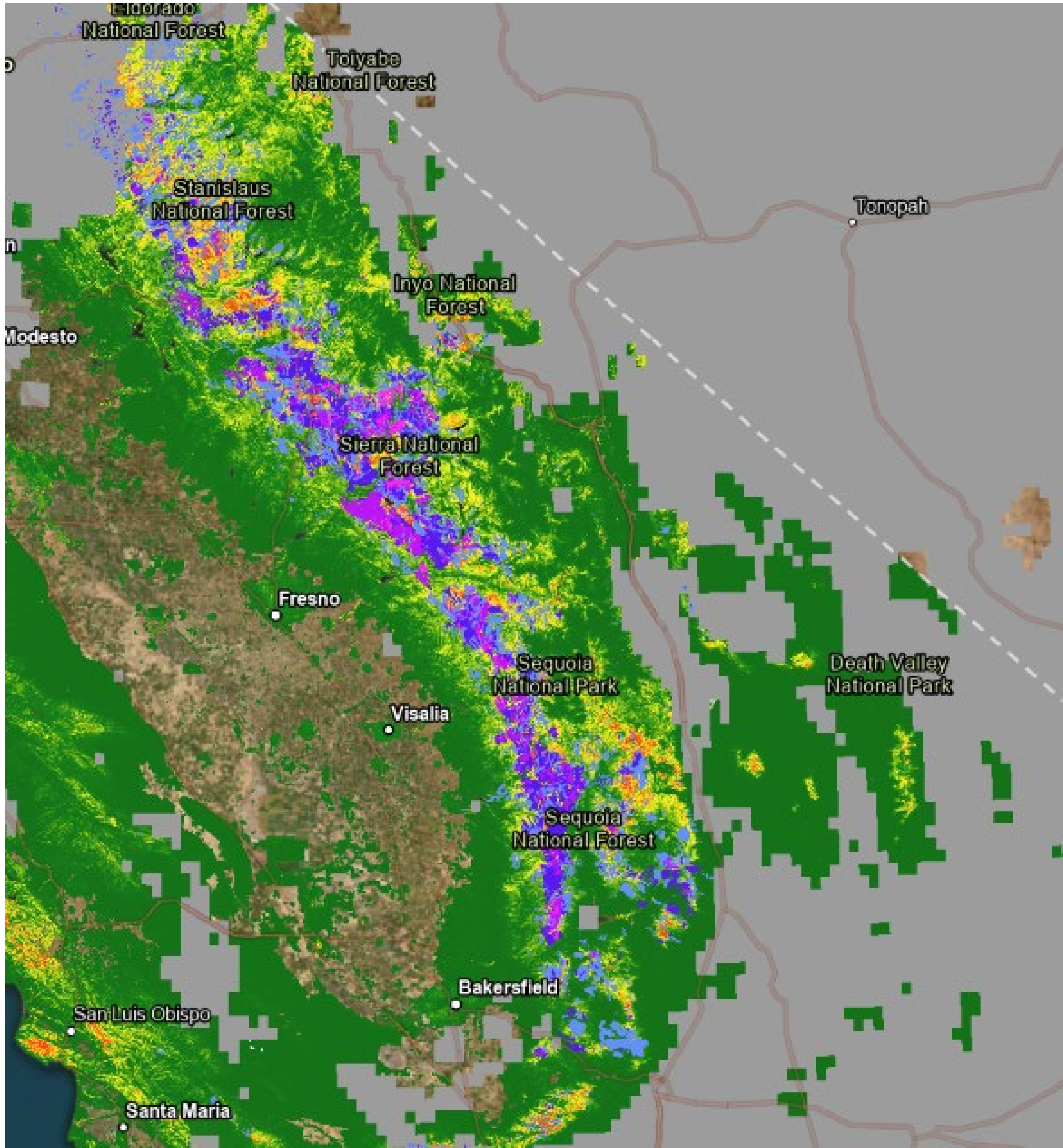


Testing – for risk of disturbance we can roll the hazard datasets back in time and see whether they could have predicted subsequent spatial patterns of wildfire and drought beetle dieoff

Areas that burned 2011-2022



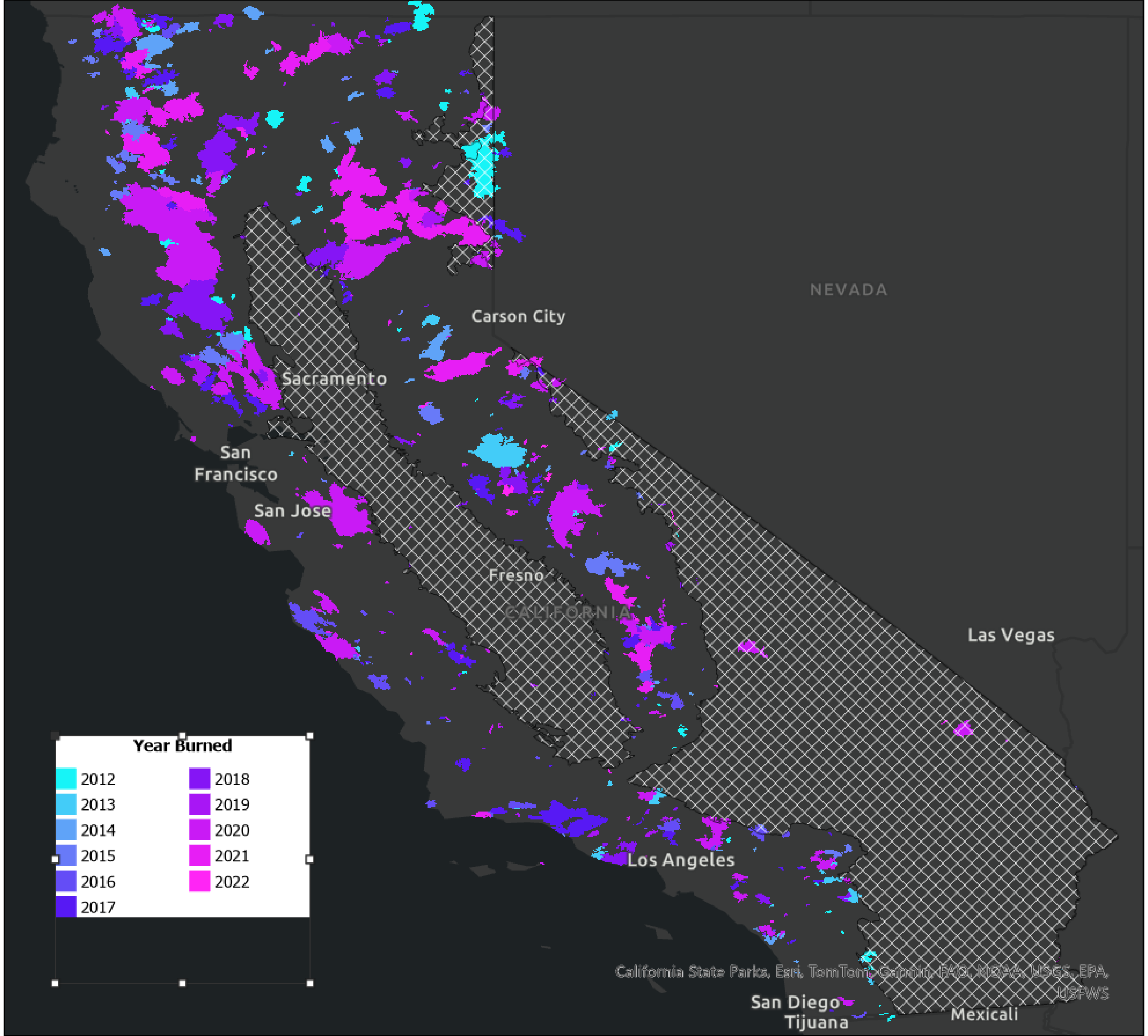
Areas that died 2014-2017



Results and implications – effects of fires on CA's landscape

Burned areas 2012-2022, color is year of burn – purple is more recent

MTBS data

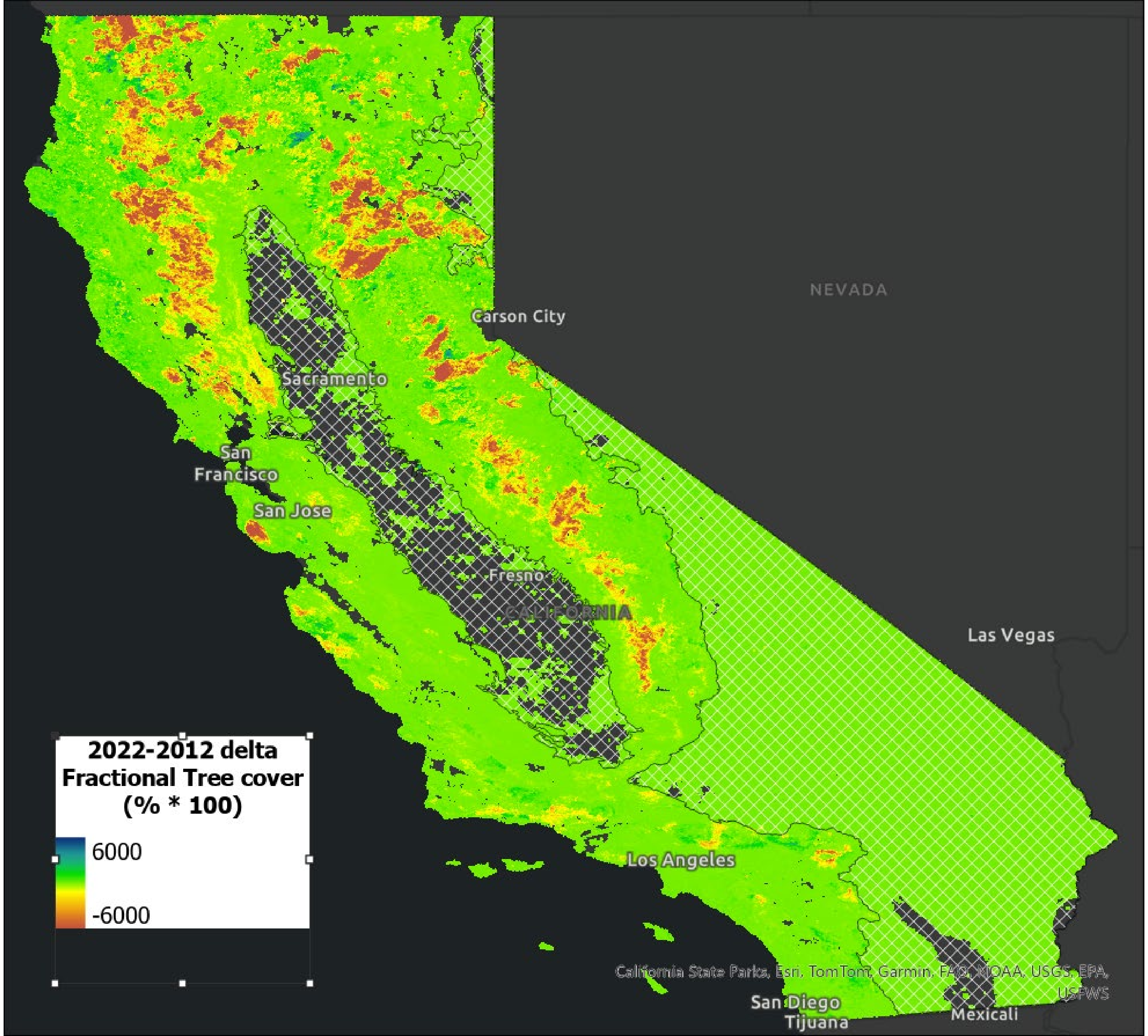


Results and implications – effects of fires on CA's landscape

Simply subtract two years to see changes

2022 minus 2012

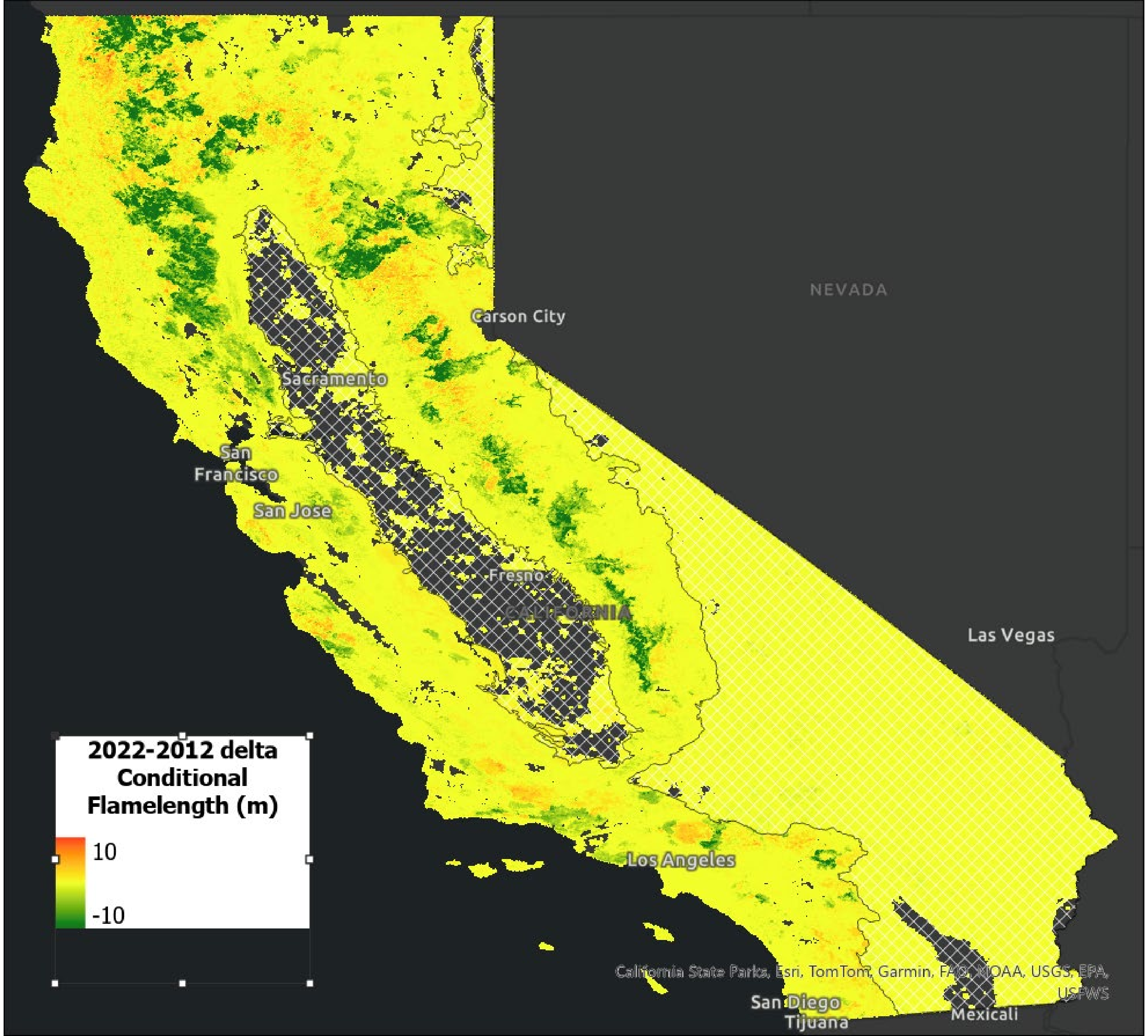
Change in **tree cover – Brown is loss of tree cover**



Results and implications – effects of fires on CA's landscape

2022 minus 2012

Change in **flamelength – Green is reduced is flamelength**

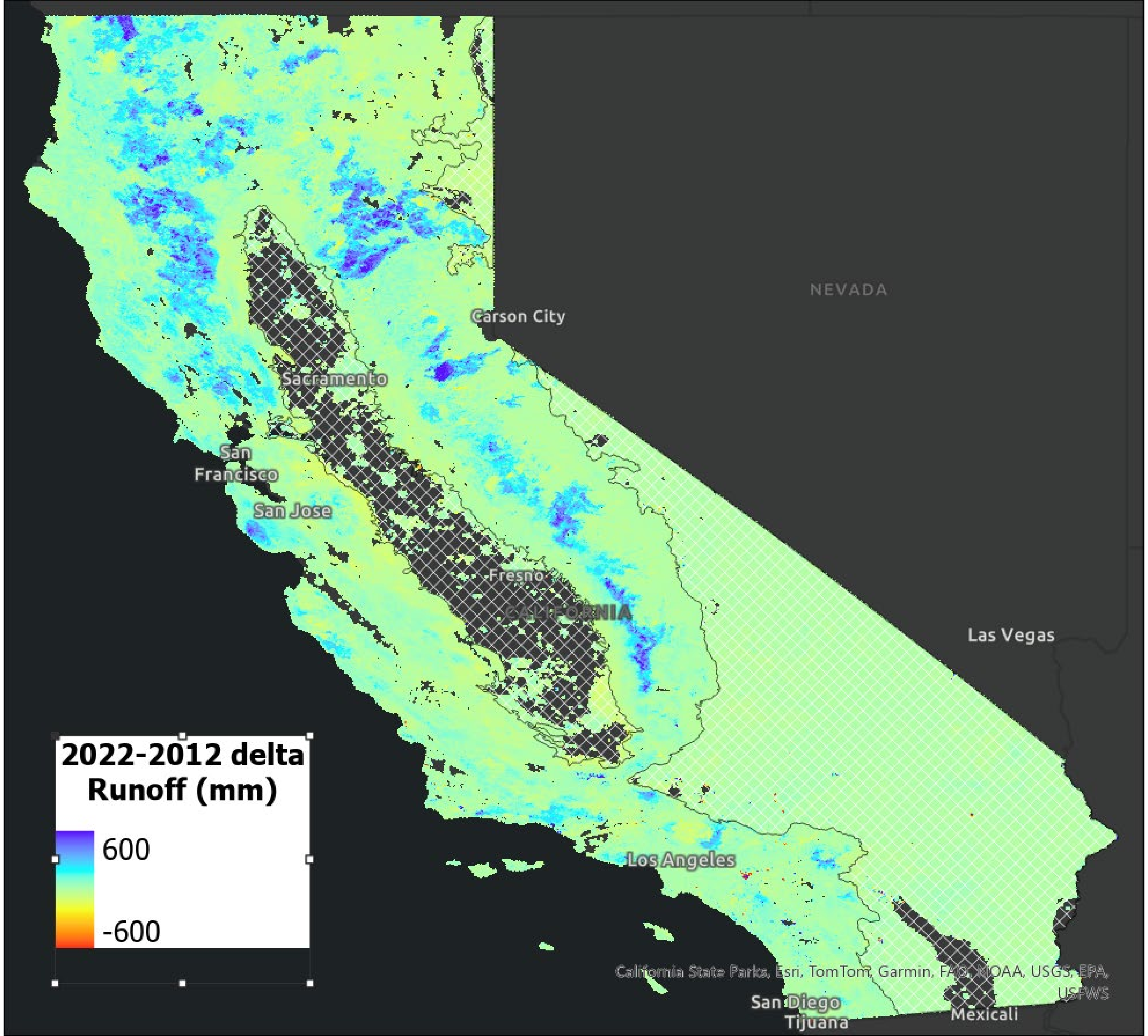


Results and implications – effects of fires on CA's landscape

2022 minus 2012

Change in **runoff**

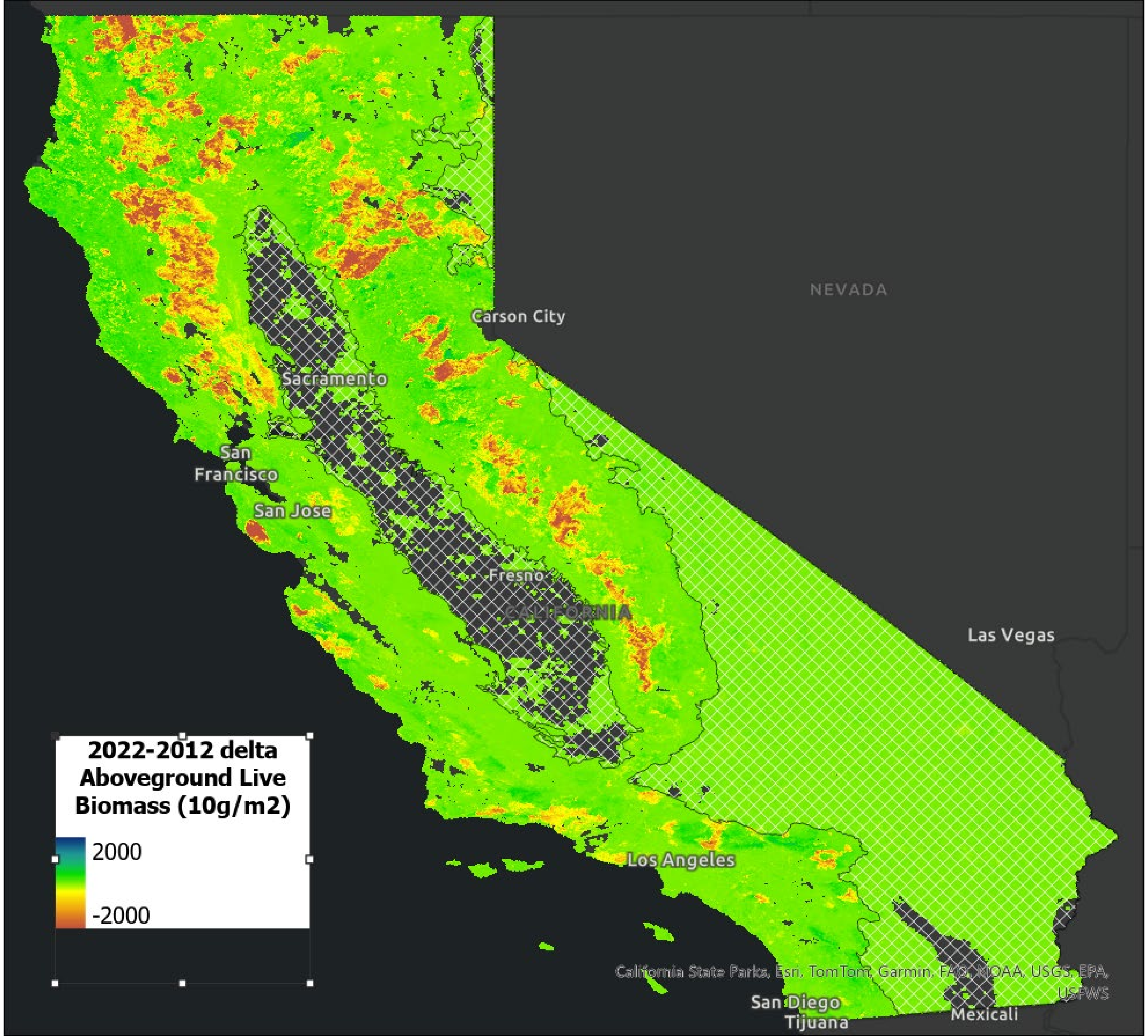
Blue is more runoff



Results and implications – effects of fires on CA's landscape

2022 minus 2012

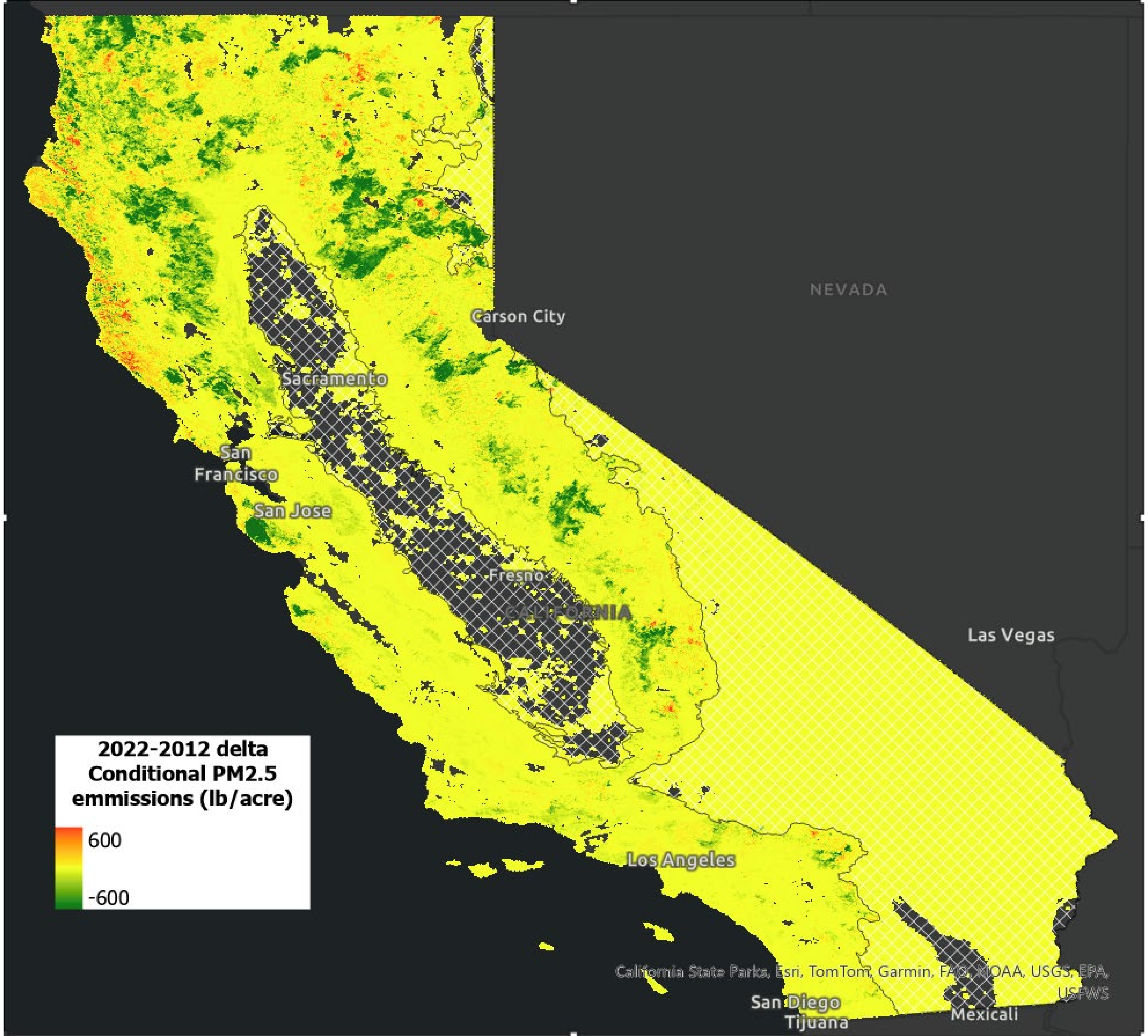
Change in **aboveground live biomass – Brown is less biomass**



Results and implications – effects of fires on CA's landscape

2022 minus 2012

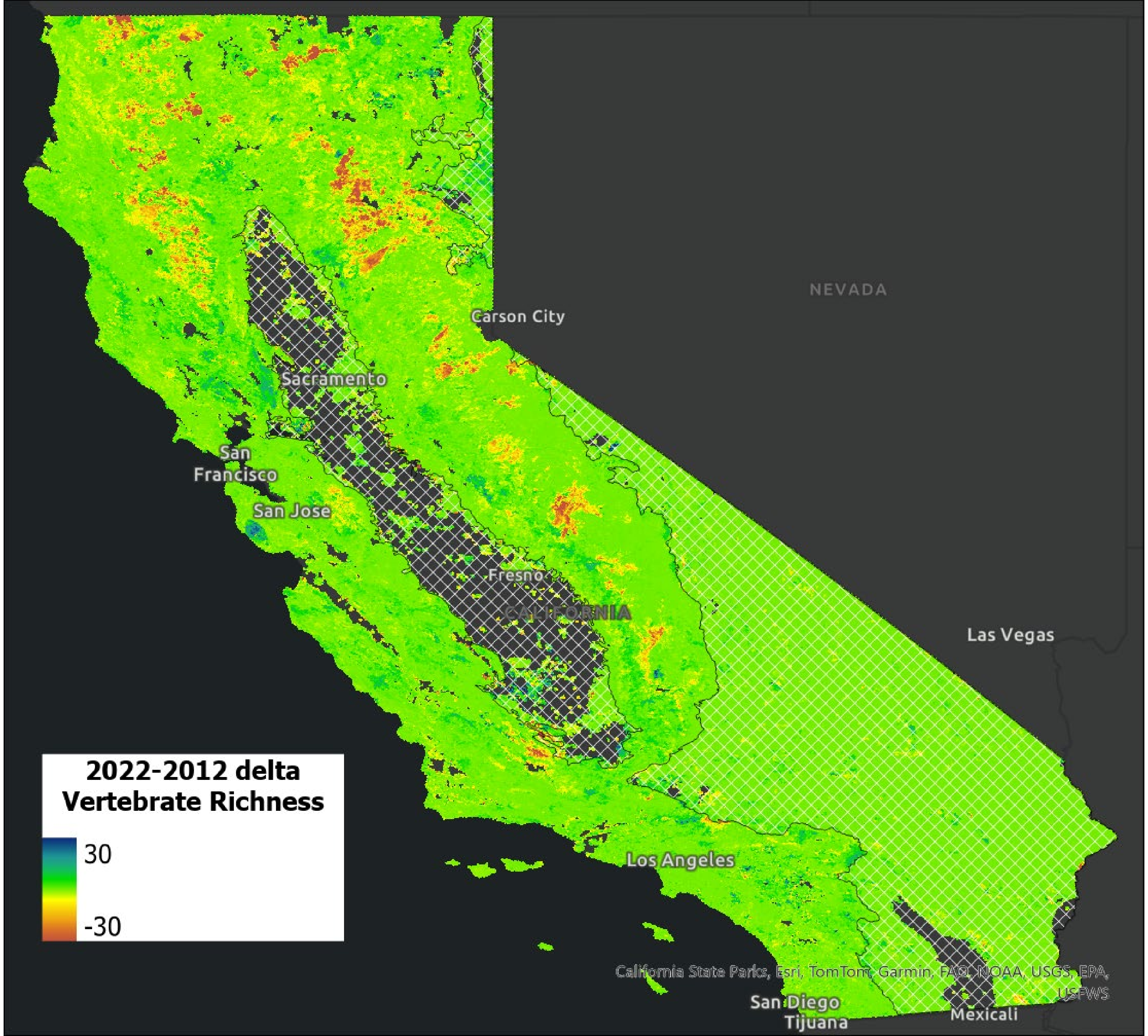
Change in **potential smoke emissions** if a location burns (PM2.5) – **Green is reduced PM2.5 – red is increased PM2.5**



Results and implications – effects of fires on CA's landscape

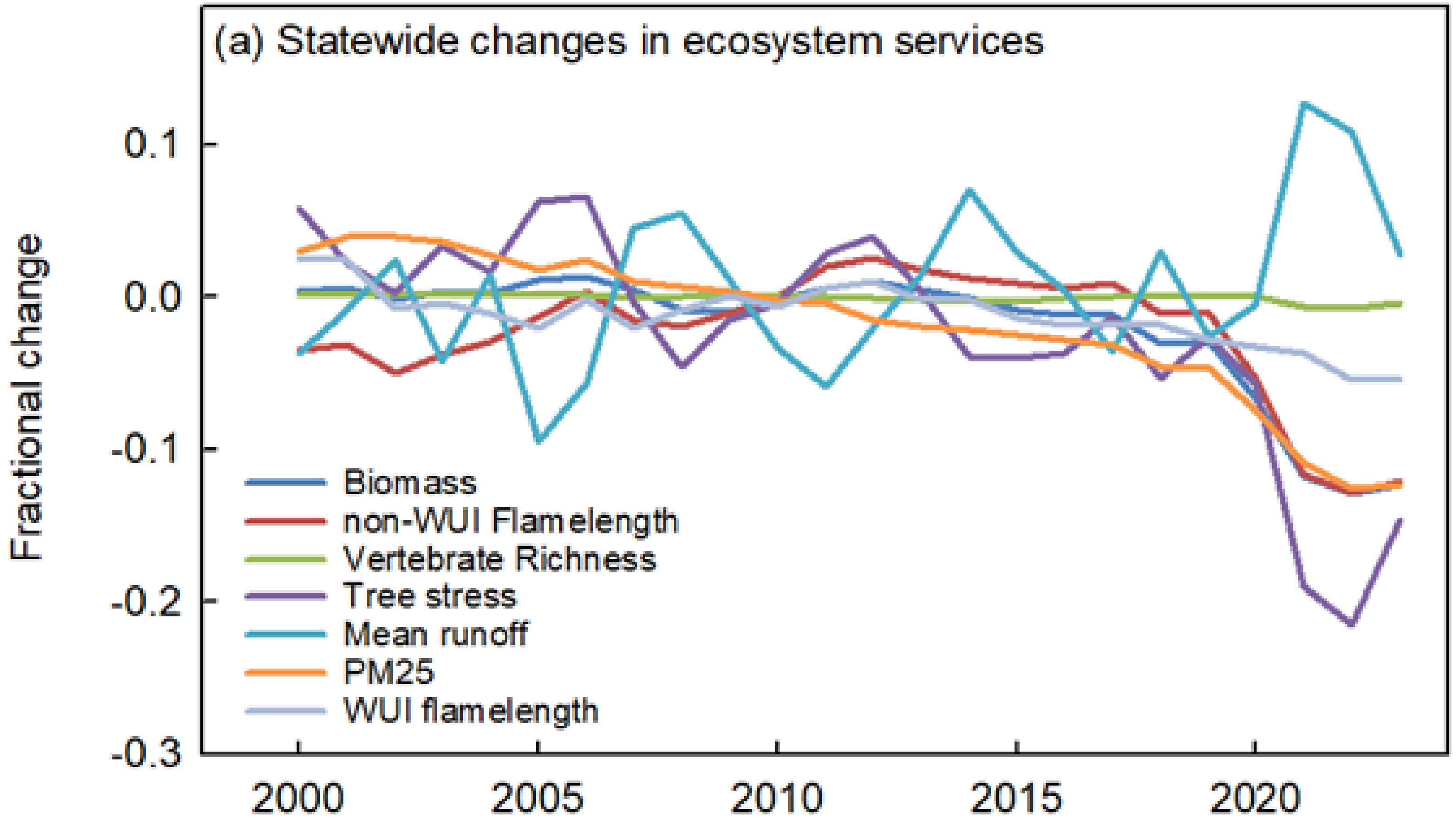
2022 minus 2012

Change in **vertebrate species habitat** – Blue is more possible species



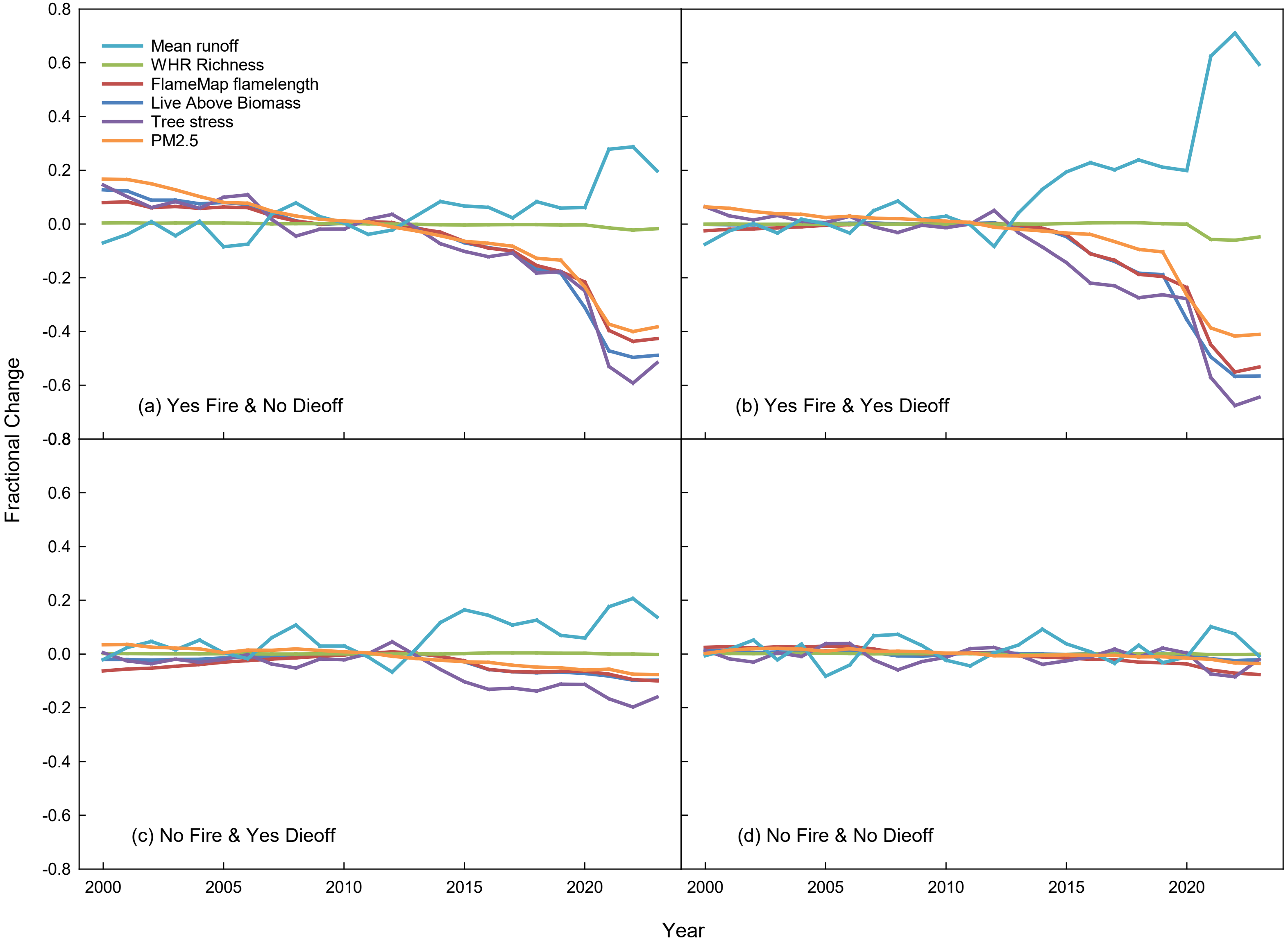
Can sum things up across CA's wildlands - data to track changes in CA's conditions

- Big changes over last 5 years – as much as 10%



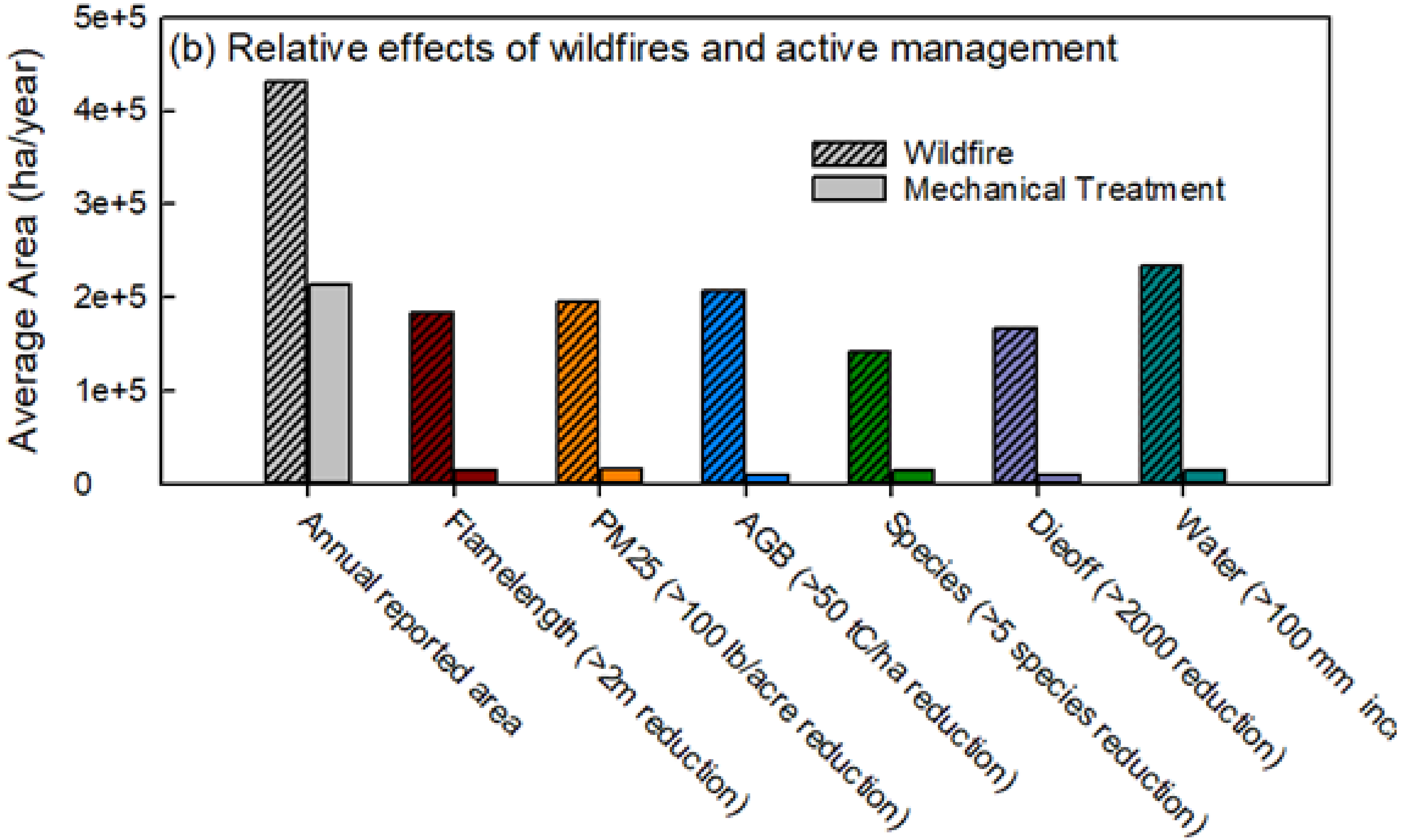
What is causing statewide trends?

- Compare time series for areas that neither burned nor died off (d), only burned (a), etc
- It’s fire
- Some dieoff
- Some interaction (dieoff and then fire had the biggest effect)



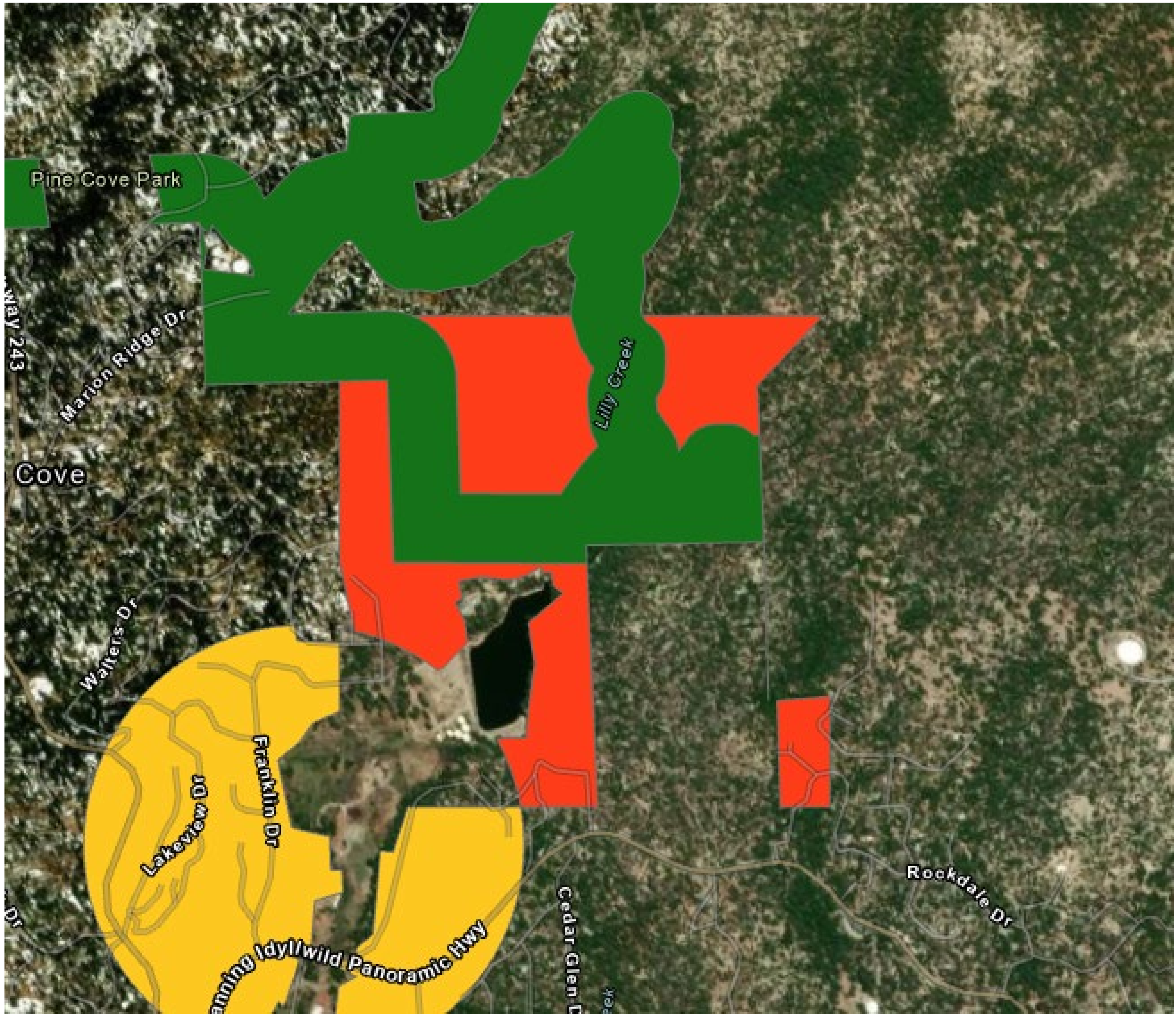
Are we starting to see much of an effect of mechanical fuels treatments?

- Pretty small compared to effect oif wildfire
- Lots of area reported as treated (long term average about half of area that burned)
- But effects on ecosystem services not that great so far



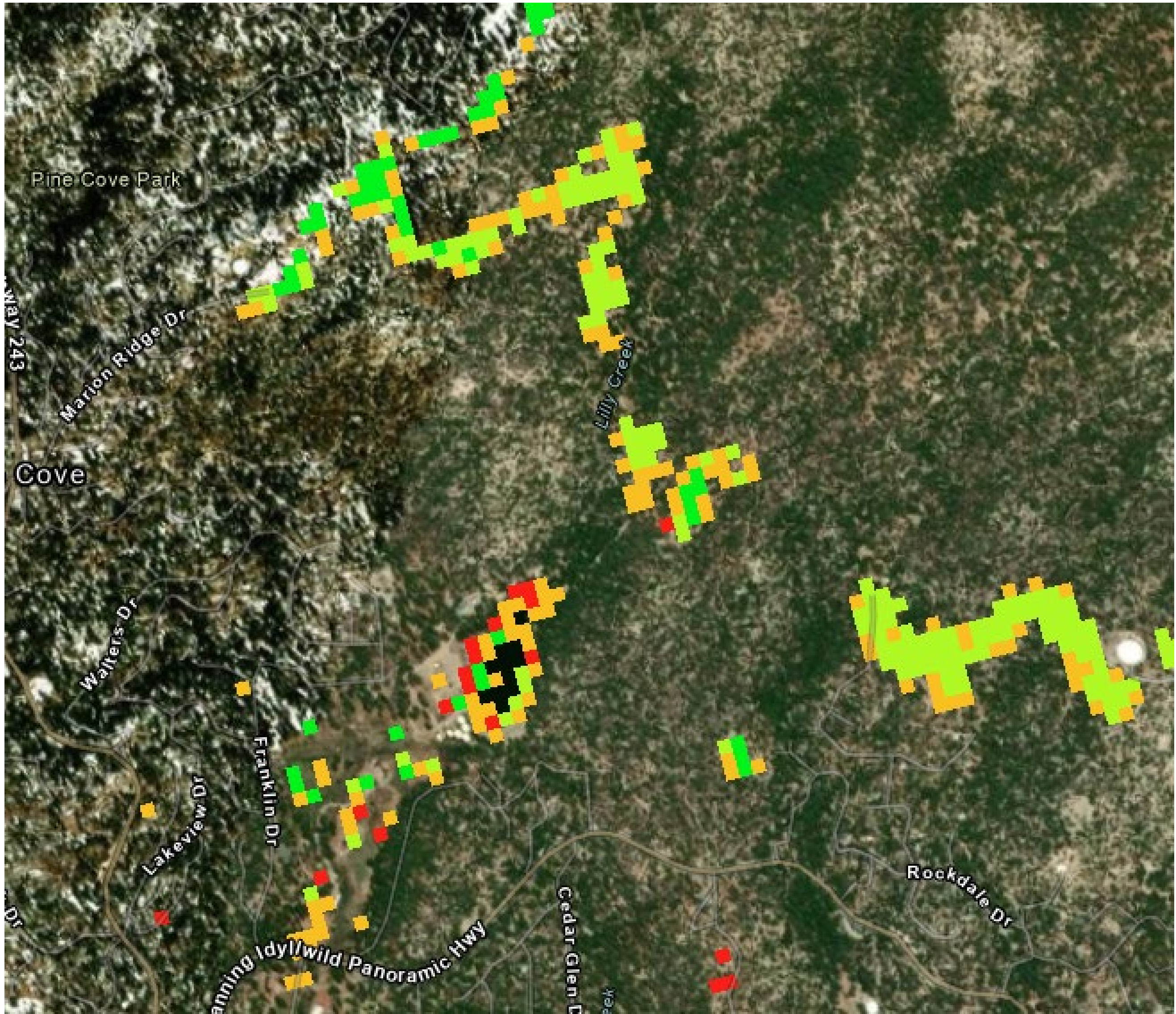
Are disturbances mapped by CECS consistent with treatments reported in Interagency Treatment Tracker?

- ITS treatment polygons around Idyllwild in San Jacinto Mountains – color is year



Are disturbances mapped by CECS consistent with treatments reported in Interagency Treatment Tracker?

- CECS mapped canopy disturbance in San Jacinto Mountains – color is year
- Anecdotally from hiking all of these treatments multiple times – CECS is more correct
- Complementary information – CECS datalayer CECS_CAWide_Veg_ITSDist intersects and merges data from ITS and CECS CCDC/COLD disturbance runs to produce datalayers where ITS reports planned/permitted projects and CECS shows timing and location of actual disturbance



Large scale reporting – trends in CA AGB

- Crazy variation between data sets
- Who knows what's right – clearly an issue though
- Very preliminary - more work to do…..

Monitoring – Changes in CA's AGB over time (relative to 2000)

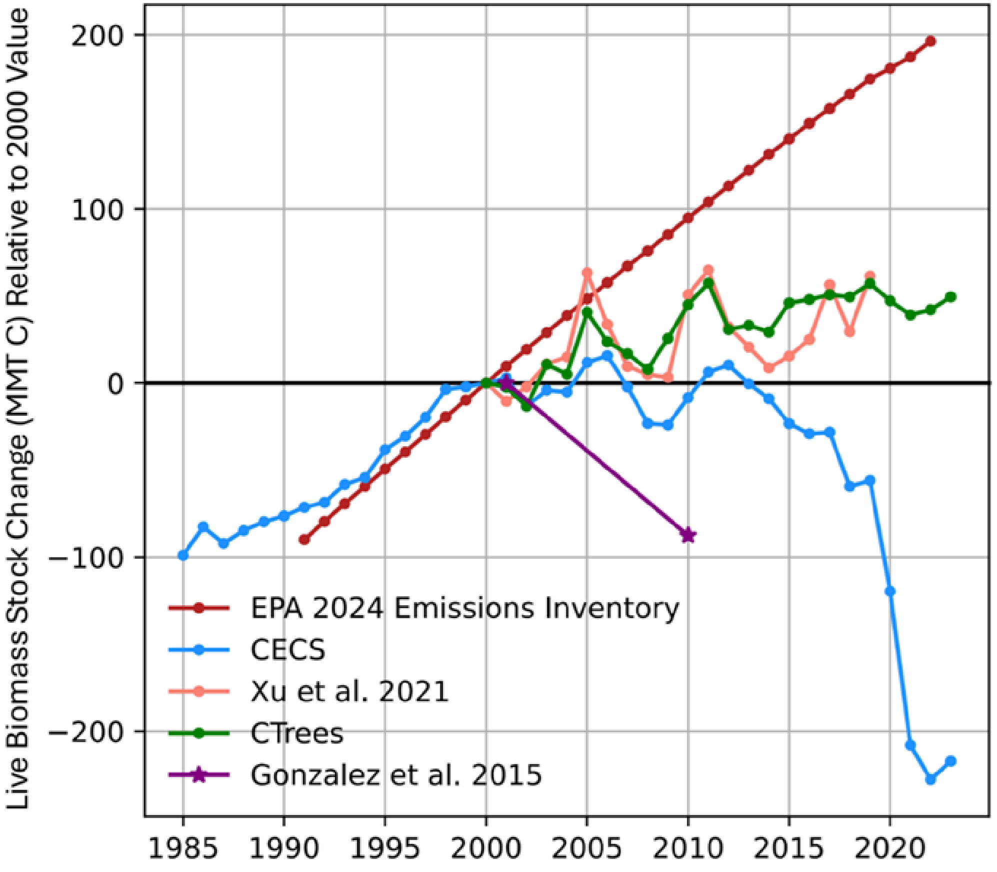
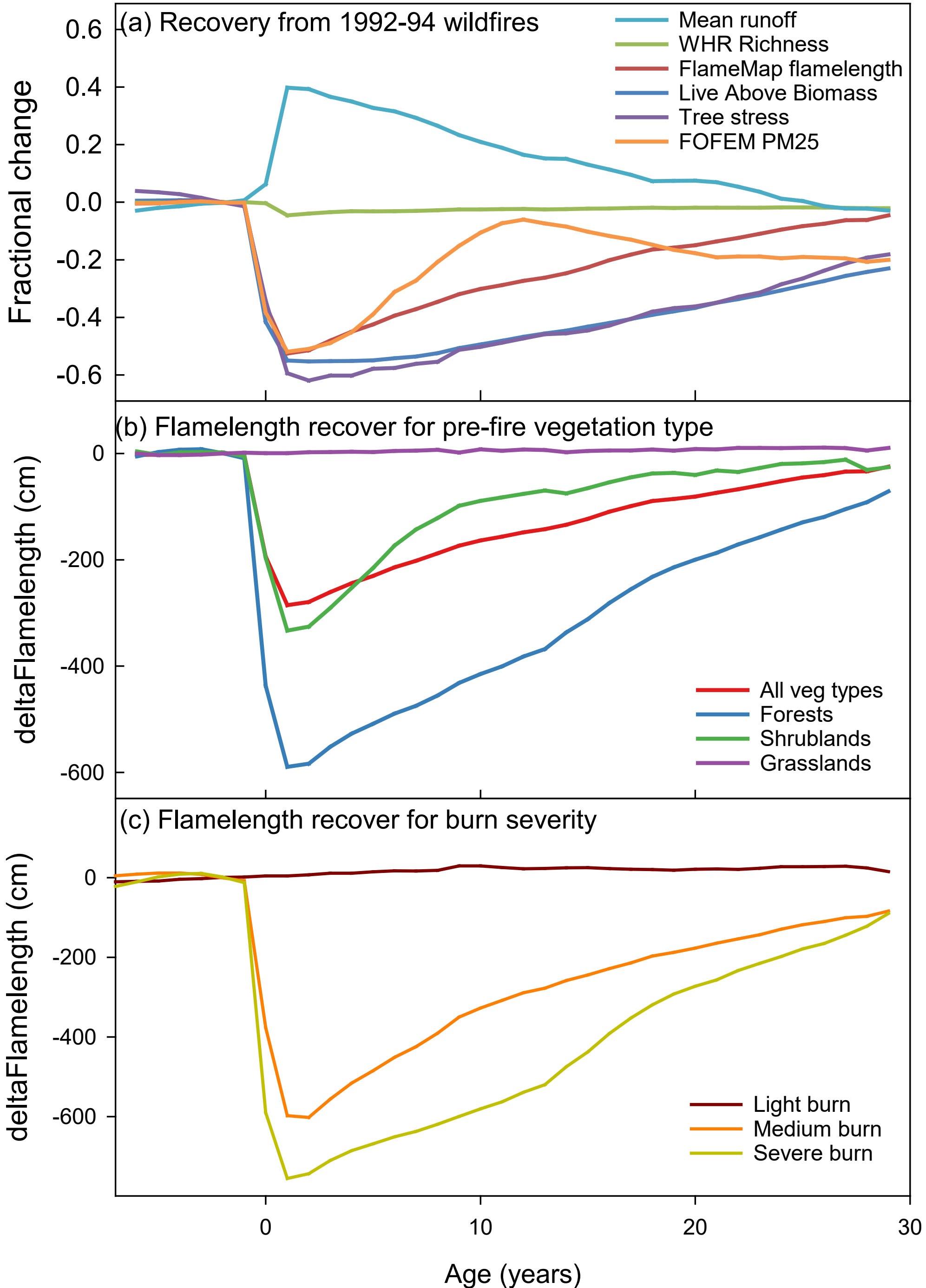


Fig from Claire Zarakas, CarbonPlan

How will things change as they recover from big 2020, 21 fires?

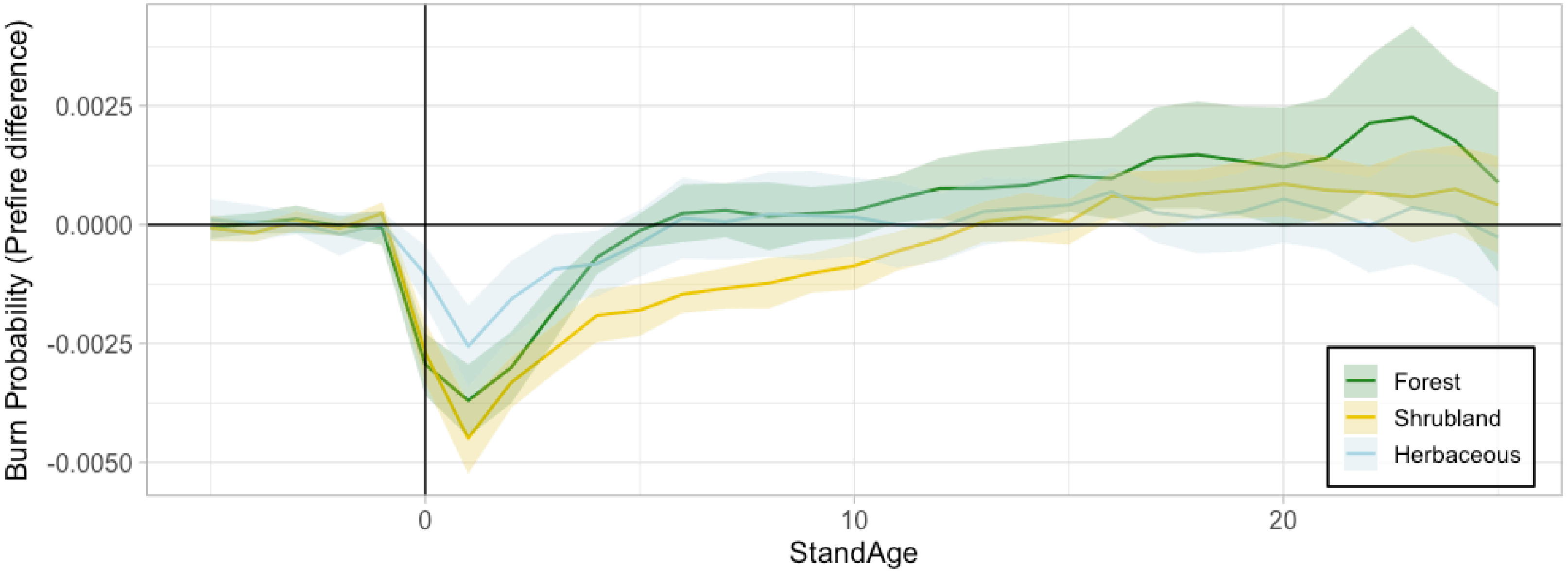
- Space for time/Chronosequence approach
- Can map out patterns of recover – this will play out across CA landscape over next 30 years



The recovery of burn probability and flame length

- BP recovery curves indicate:
  - Forest fires recover their prefire BP after ~5 years
  - Shrubland after ~12 years
  - Herbaceous after ~5 years

- FL recovery, as proxy for how severe the subsequent fire can be, takes ~25 years for all



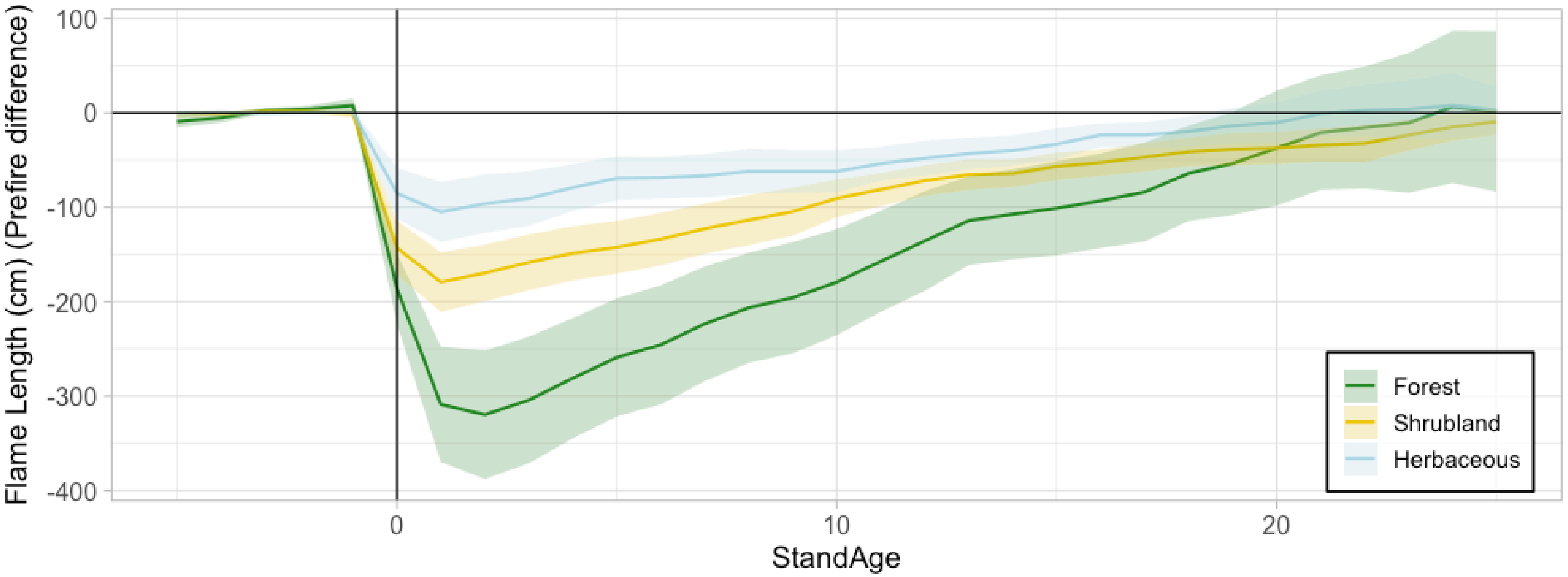


Fig from Ved Bhoot, UC Irvine

The vision:
Use timeseries for adaptive management

Each step done with comparable metrics calculated in consistent ways

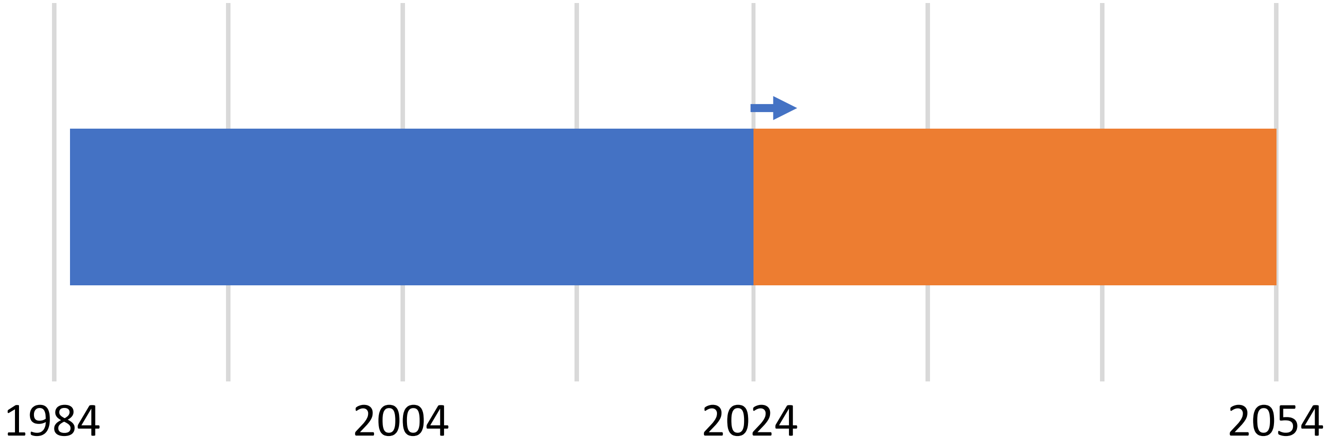
Turn the crank for continuous improvement – maybe it will work, maybe it won't – should be ready to try for CA in ~3 months

Parallels TF RRK strategy

Implement treatments and update datasets

Evaluate effects of past management over time

Predict conditions with treatment options – compare alternative what-if scenarios



Center for Ecosystem Climate Solutions

Translating the best available science for land management decisions

Punchlines

Please use these data if they are useful to you; Please forward to colleagues who might find these data useful

Comprehensive dataset that crosses silos and disciplines - one stop shopping for a range of issues

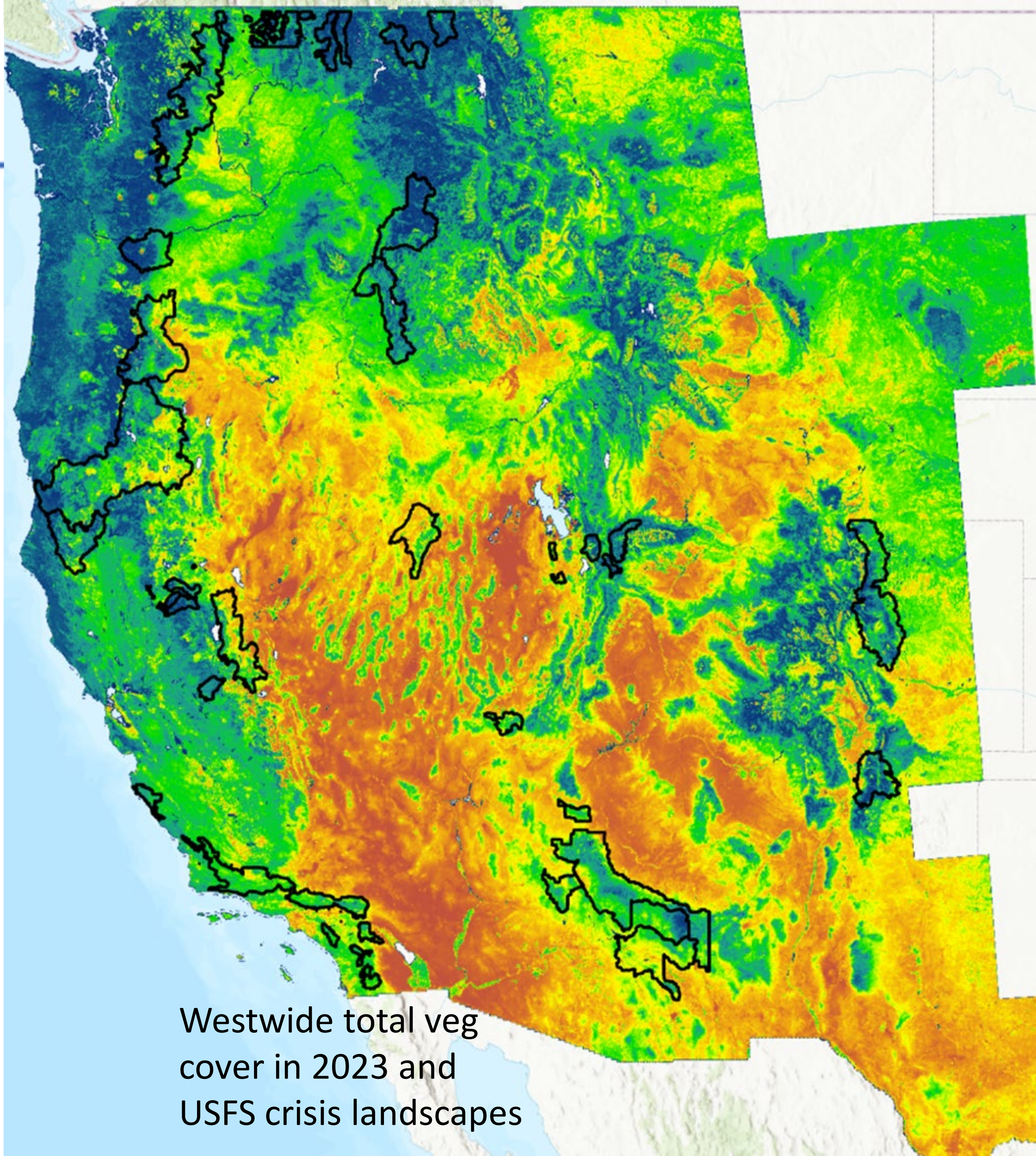
Data are already updated through Fall 2024 - you can start answering questions today

CA- and West-wide, 30 m, all wildlands, 1985-2024 time series. CONUS is running and will roll out this summer

Future updates every 6 months with ~2 month latency – expect 2025 WY data in ~Jan 2026

Built with best science by UC experts

Data free for non-commercial use - minimal strings attached (CC BY-NC-SA 4.0)



Westwide total veg cover in 2023 and USFS crisis landscapes