



# TreeMap → FVS → Wildfire Spread Simulations

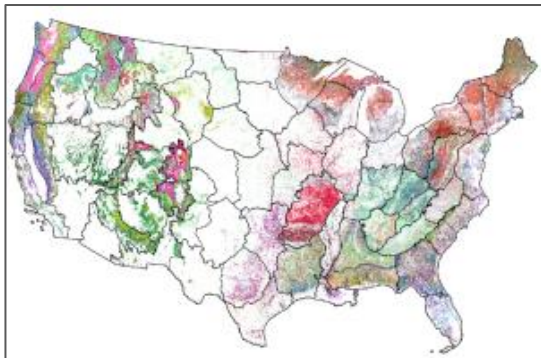
Opportunities and Limitations of Using FVS Outputs in Fire Spread Models

Kayla Johnston (presenter), David Schmidt, Carrie Levine

OLI-GMUG 2025

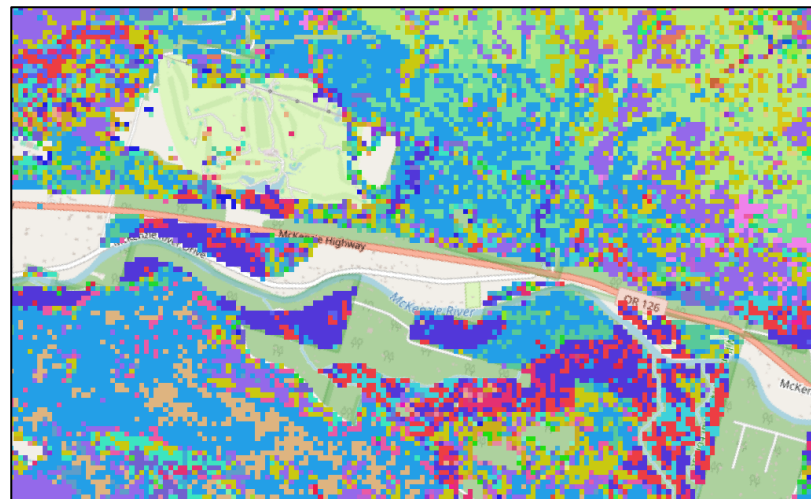
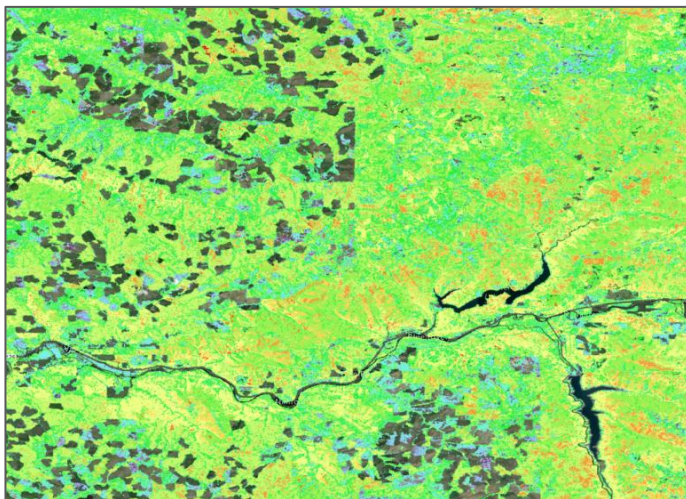


# TreeMap v2016



- USFS forest inventory data product for CONUS
- 30m spatial resolution
- Represents forest conditions in the year 2016
- Only where LandFire veg = forested

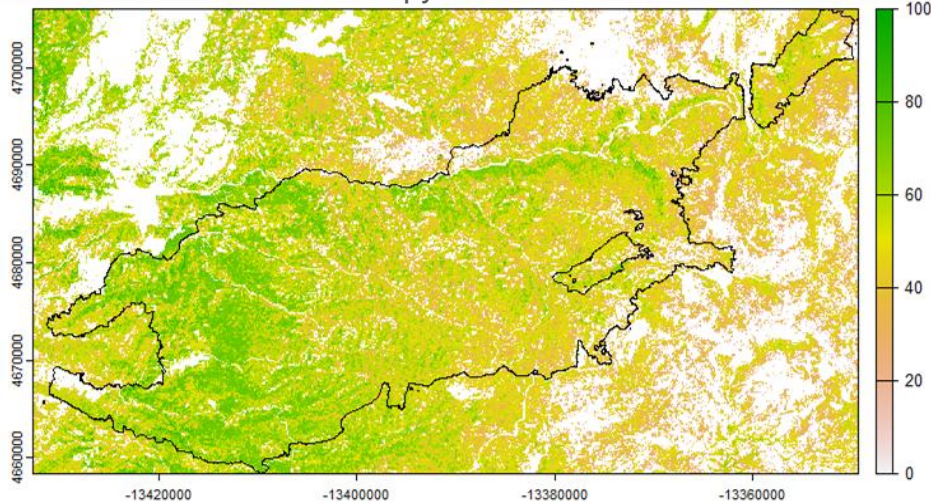
tm_id	CN	STATUSCD	TPA_UNADJ	SPCD	COMMON_NAME	SCIENTIFIC_NAME	SPECIES_SYMBOL	DIA	HT
746	139994498010854.0	1	6.018046	131	loblolly pine	Pinus taeda	PITA	9.7	67
746	139994498010854.0	1	6.018046	131	loblolly pine	Pinus taeda	PITA	11.8	75
746	139994498010854.0	1	6.018046	131	loblolly pine	Pinus taeda	PITA	9.5	72
746	139994498010854.0	1	6.018046	131	loblolly pine	Pinus taeda	PITA	13.8	75
746	139994498010854.0	1	74.965282	611	sweetgum	Liquidambar styraciflua	LIST2	3.5	23
746	139994498010854.0	1	6.018046	131	loblolly pine	Pinus taeda	PITA	9.2	60



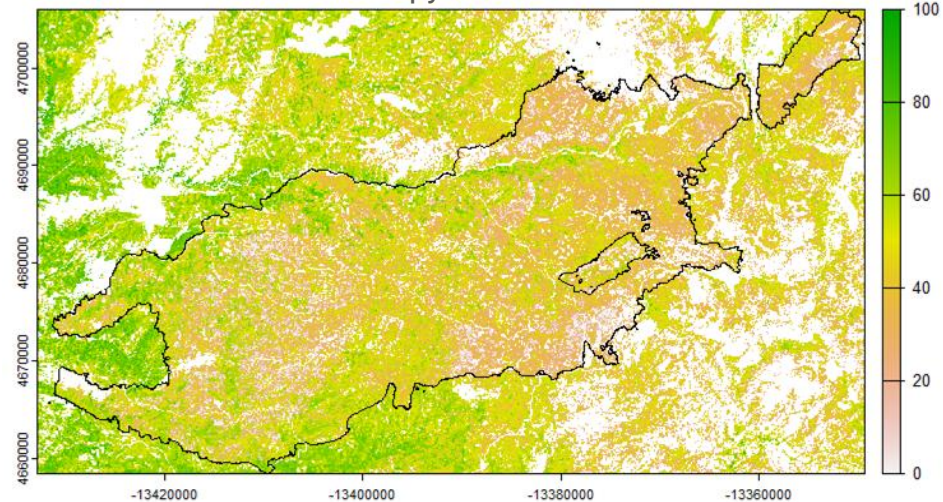
# TreeMap v2016 → FVS → Current Conditions

- Simulate known land treatments, disturbances, and wildfires
  - Only moderate- and high-severity impacts of wildfire are simulated
- FVS simulates tree growth, mortality, snag fall
- If a pixel becomes non-forested in this process, the non-forested status is currently perpetuated through time in most variants

Canopy Cover 2016



Canopy Cover 2024



Black polygon = 2021 Caldor Fire in the California Sierra Nevada

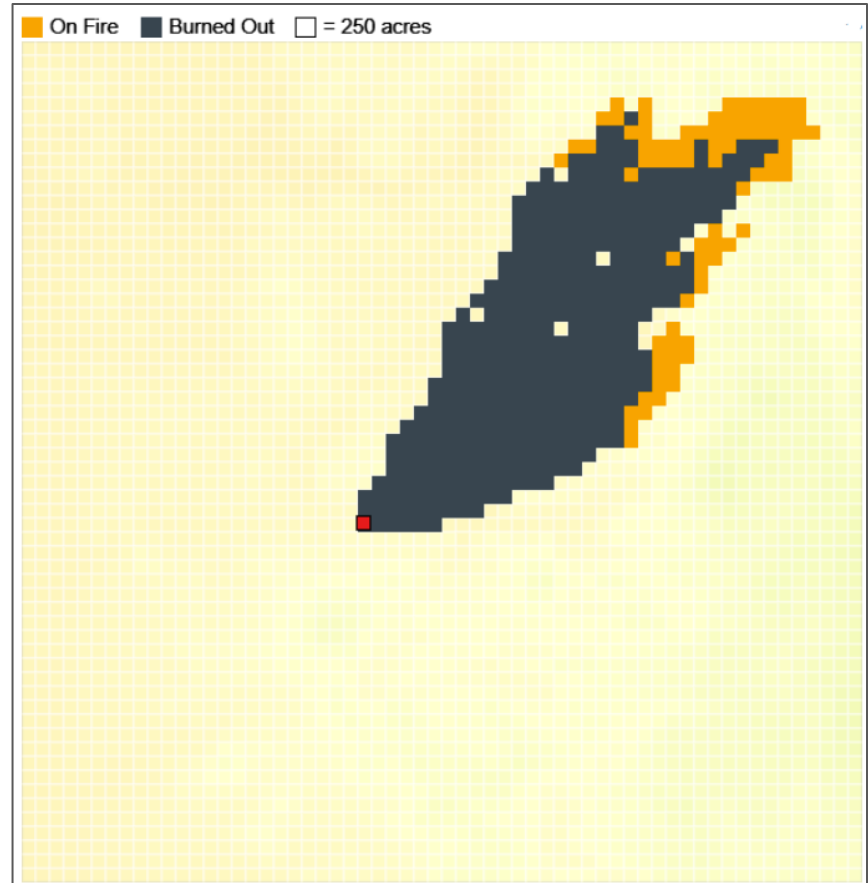
# FVS Baseline & Project Treatment Simulation

- Simulate baseline (no action) scenario through time
- Simulate project (treatment) scenario through time
- FVS models effects of the treatment
- Fire behavior fuel model, canopy base height, canopy height, canopy bulk density, and canopy cover output by FVS and the Fire & Fuels Extension are spatialized for every cycle



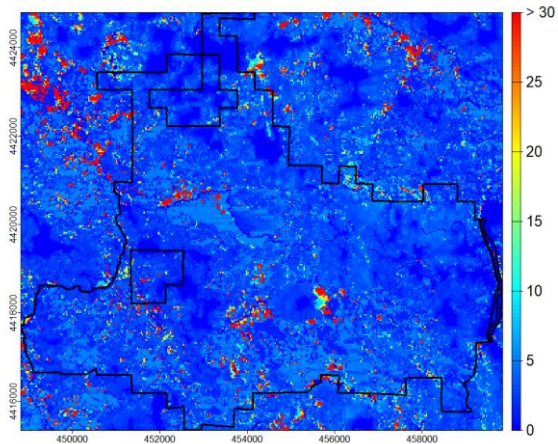
# Monte Carlo Simulation of Wildfire Spread & Behavior

- Where there is no TreeMap data, we fill with fuels data from FireFactor (an annualized fuels data product derived from LandFire)
- Simulate thousands of wildfires
  - Randomly located ignition points
  - Burn window of 8 hours
  - “Extreme” (97th percentile) weather and fuel moisture conditions

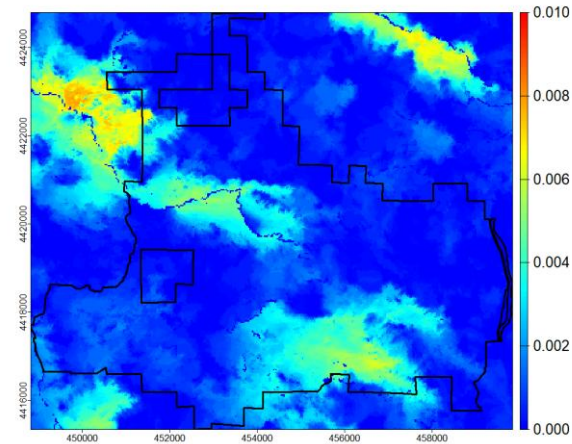


# Monte Carlo Simulation of Wildfire Spread & Behavior

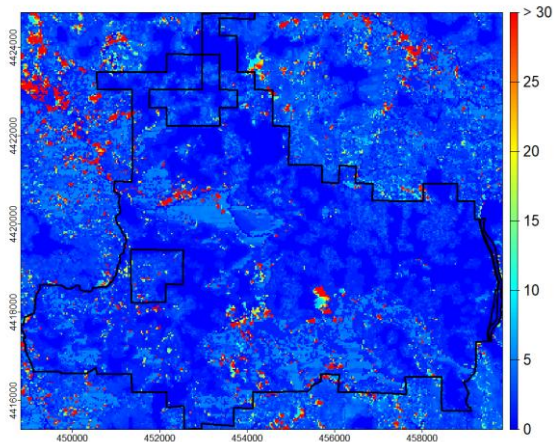
Baseline Conditional  
Max Flame Length  
Average = 3.86ft  
(1.18m)



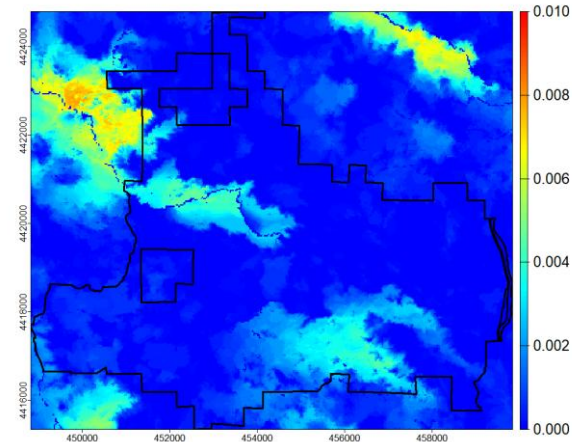
Baseline Conditional  
Burn Probability  
Average = 0.0012



Project Conditional  
Max Flame Length  
Average = 2.48ft  
(0.76m)



Project Conditional  
Burn Probability  
Average = 0.0007



# Limitations: Unrealistic FBFM assignments

- FVS logic for assignment of fire behavior fuel model varies by variant but is generally based on:
  - Canopy cover
  - Habitat type
  - Amount of large (>3" diameter) woody debris
- FVS can assign unrealistic fire behavior fuel models post-treatment or post-disturbance
  - We are working on improved logic for post-treatment/disturbance fire behavior fuel model assignment



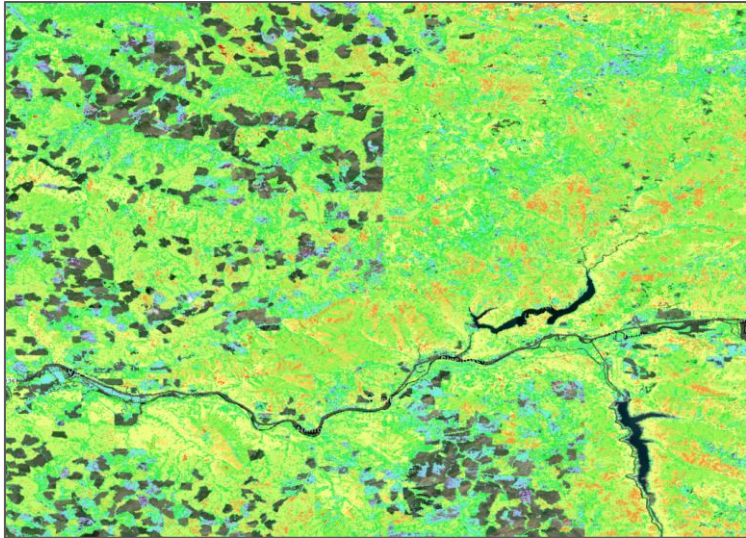
# Limitations: Uncalibrated Mortality & Snag Fall Submodels

- FVS often predicts [potentially unrealistically] high mortality for densely forested areas in the TreeMap data
  - Is TreeMap over predicting stand density?
  - Is FVS over predicting growth?
    - Currently we rely on FVS defaults for site index - need a robust and small-scale spatial site index dataset
  - Is FVS over predicting mortality?
- FVS has been shown to over predict snag fall rates in the Sierra Nevada, particularly in the first 5 years (Northrop et al. 2024) - high snag fall rates can lead to over assignment of slash/blow down fire behavior fuel models
  - We are working on calibration of snag fall models for the Sierra Nevada (SN) - and hopefully more variants or districts



# Limitations: Non-Forested Stands

- Non-forested conditions are perpetuated through the end of the simulation for most variants
  - Non-forested pixels in the TreeMap v2016 data
  - Pixels that become non-forested via high severity treatment, disturbance, or wildfire during the update to current conditions
- Impacts estimates of fire behavior fuel model and canopy metrics
- What SIG is working on:
  - Machine learning algorithm with remote sensing data to identify reforested stands
    - Potentially will include estimates of species & density



# Limitations: Lack of Full Establishment Submodels

- 'Inland Empire' (IE) and 'Southeast Alaska and Coastal British Columbia' (AK) variants are currently the only ones with full establishment models
  - We are using field data from forest monitoring and reforestation projects to develop natural regeneration and seedling survival models for other variants
- Spatial & temporal complexities of regeneration in large extents of high severity



# Questions and Discussion

---

Thank you for your attention

## Contact Information

Kayla Johnston (presenter): [kjohnston@sig-gis.com](mailto:kjohnston@sig-gis.com)

Dave Schmidt: [dschmidt@sig-gis.com](mailto:dschmidt@sig-gis.com)

Carrie Levine: [clevine@sig-gis.com](mailto:clevine@sig-gis.com)

Spatial Informatics Group (SIG) website:

<https://sig-gis.com/>