



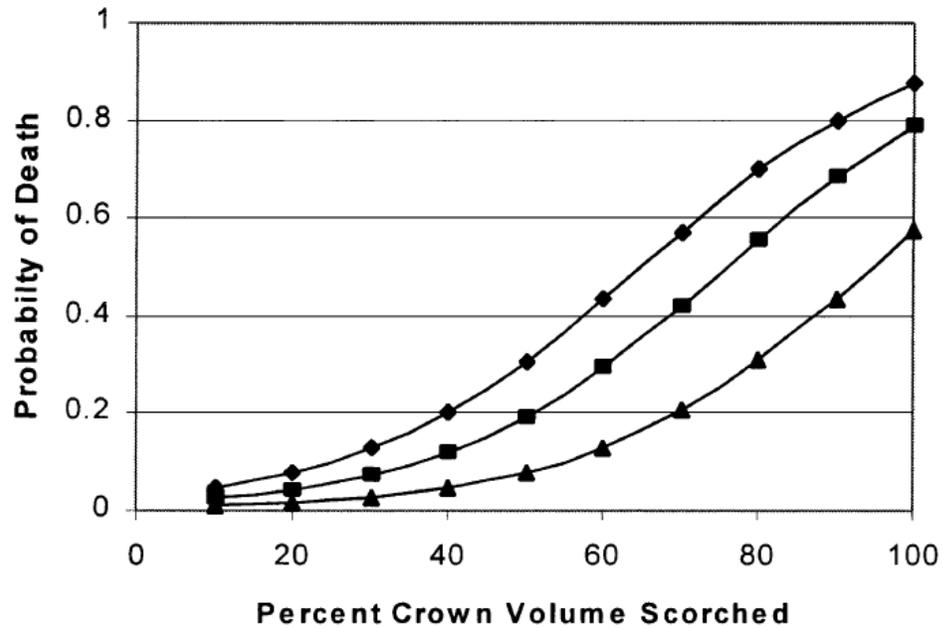
Three-dimensional fuel structure and cross-scale interactions drive post-fire tree mortality

Sean Jeronimo
US-IALE Meeting
Fort Collins, CO
April 8, 2019

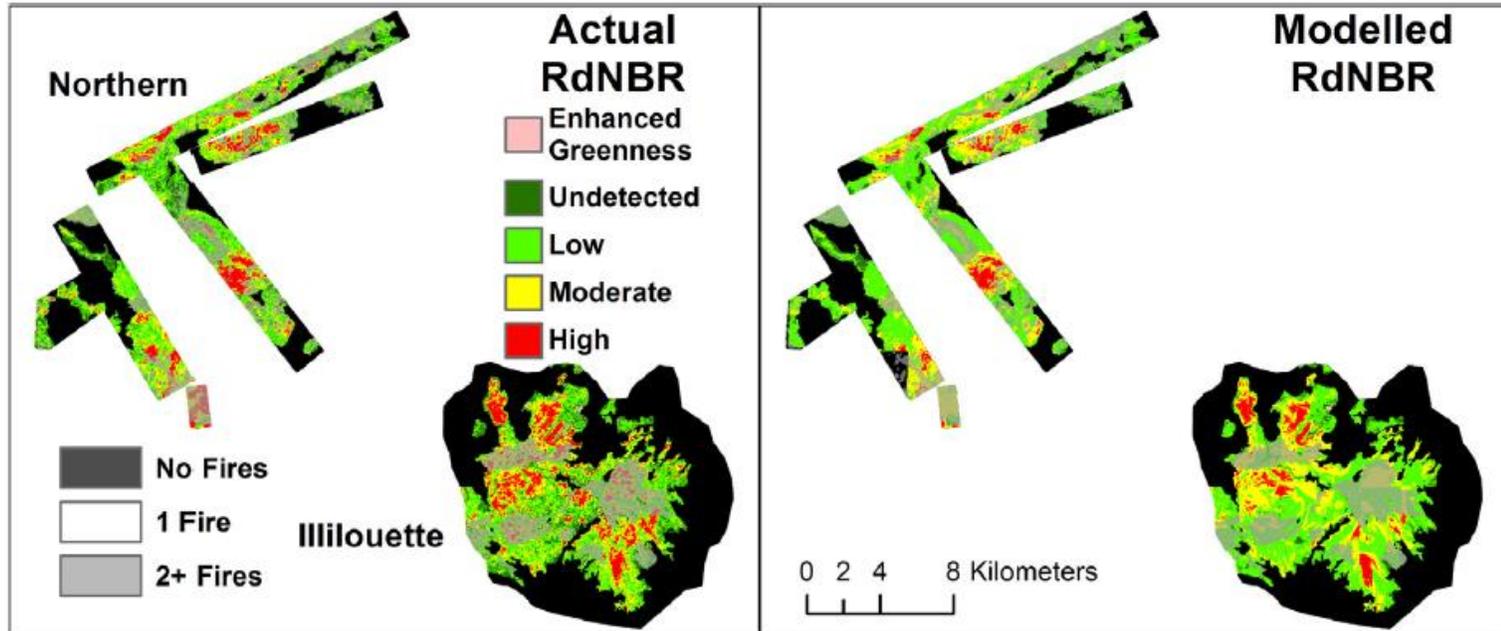
Aligning empirical post-fire tree mortality models with landscape theory

spatially structured process

factors interacting across scales



Stephens & Finney 2002

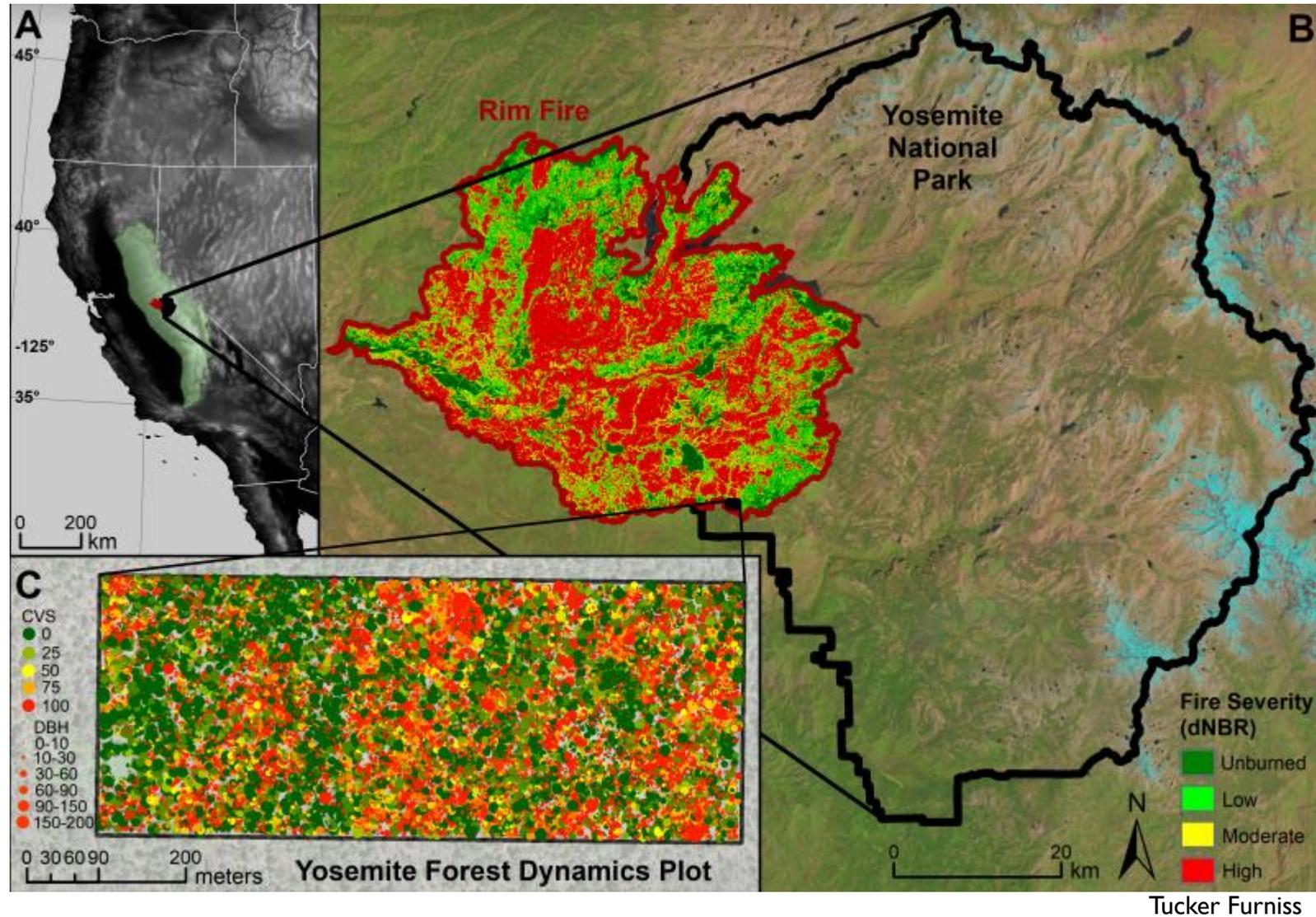


Kane et al. 2015

Questions

- Structure/pattern predictors of mortality at different scales?
- Cross-scale interactions? What direction?

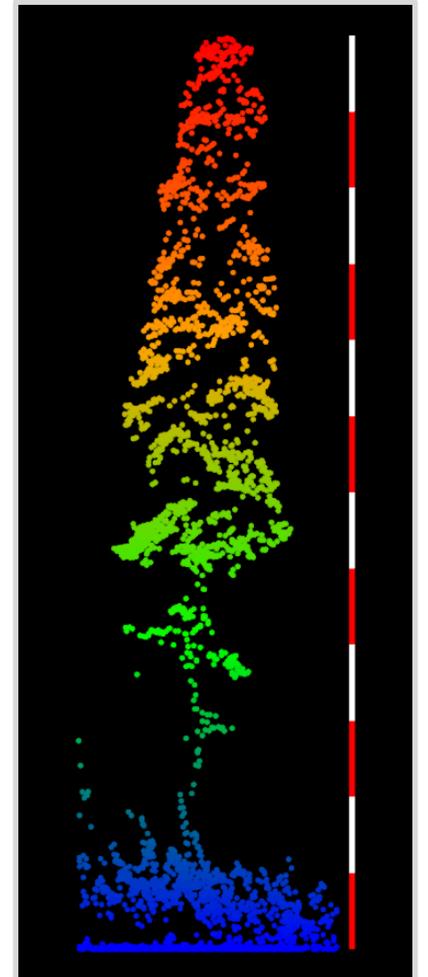
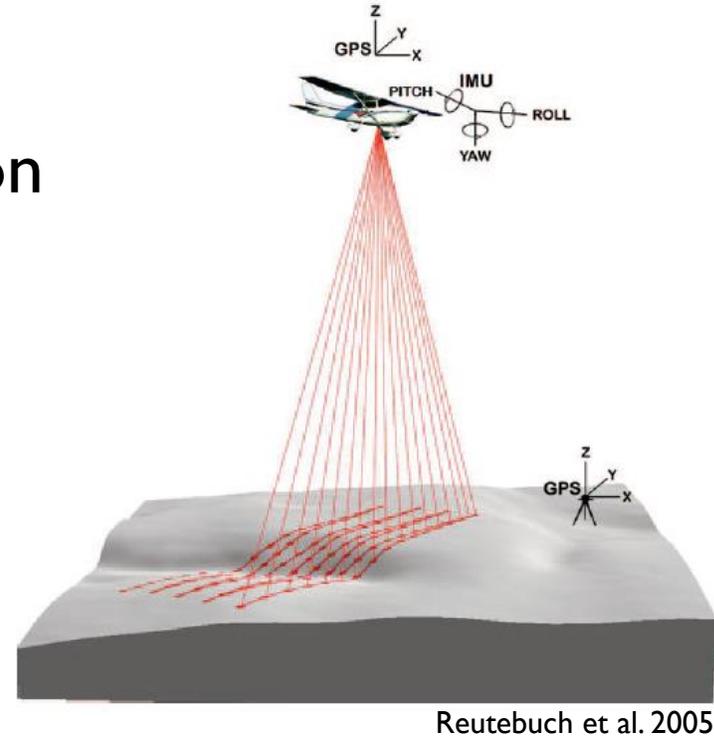
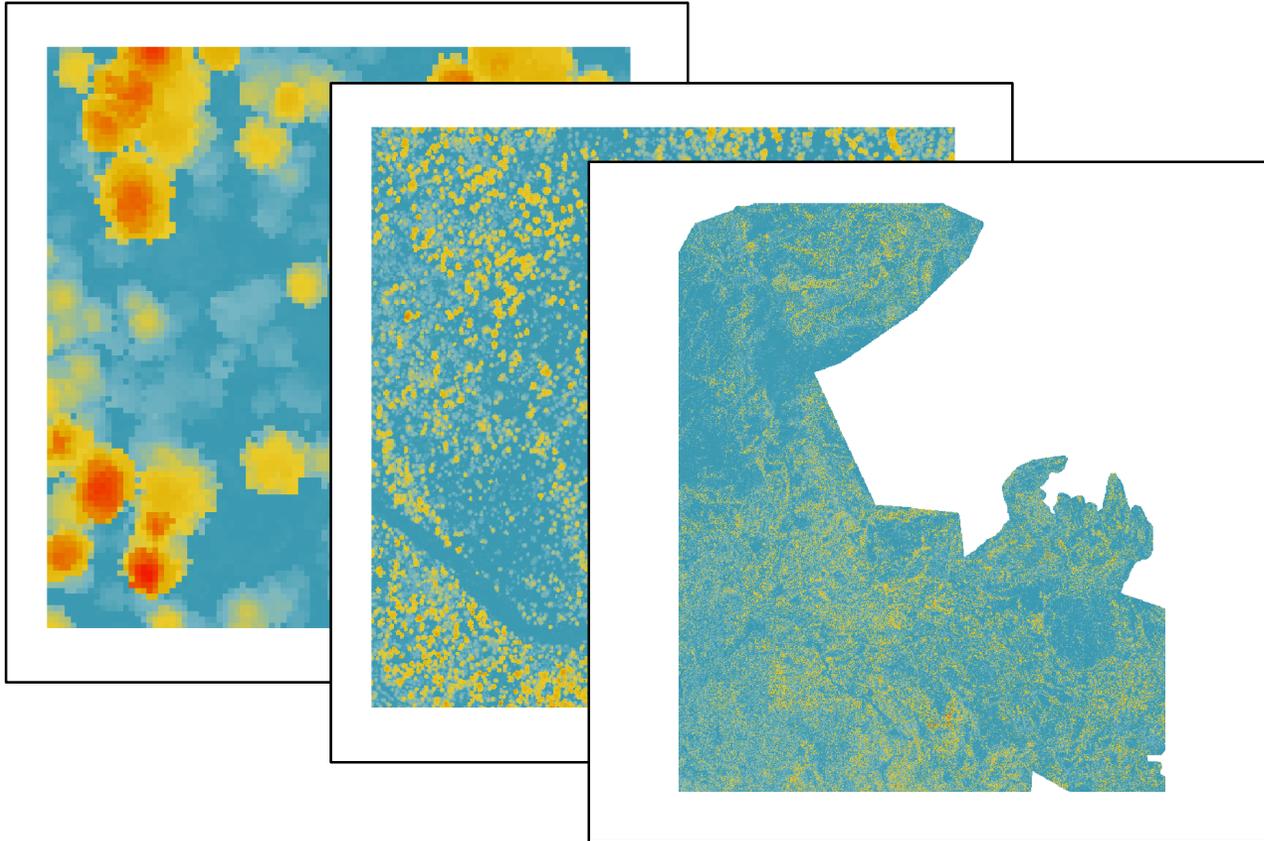
Study area: 2013 Rim Fire in Yosemite NP



Yosemite Forest Dynamics Plot

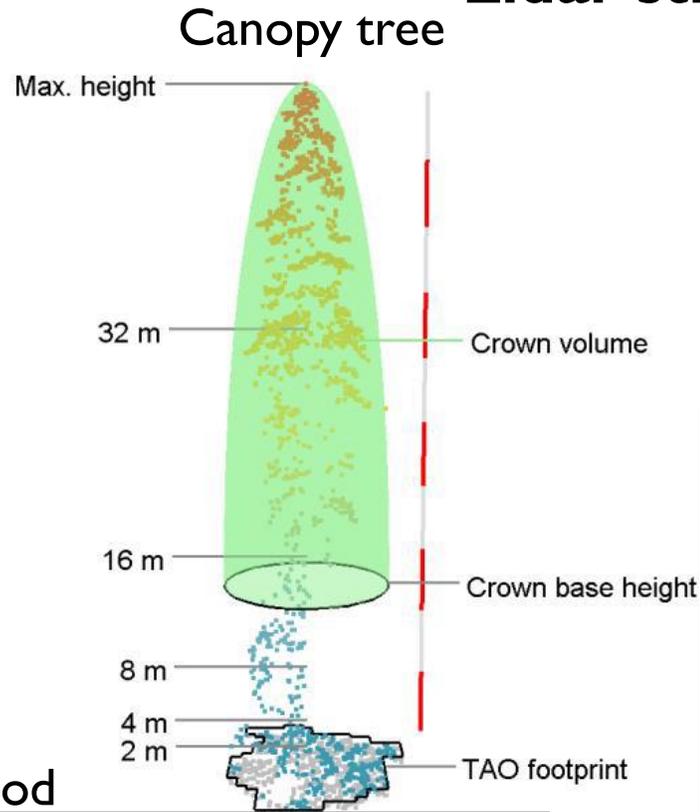
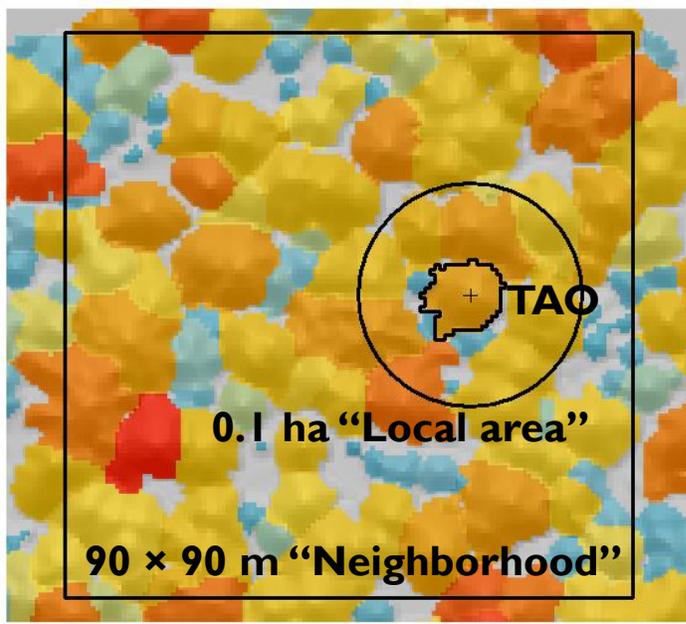
Lidar

- A unique combination of fine resolution and large extent
- Ideal for large, multiscale analyses

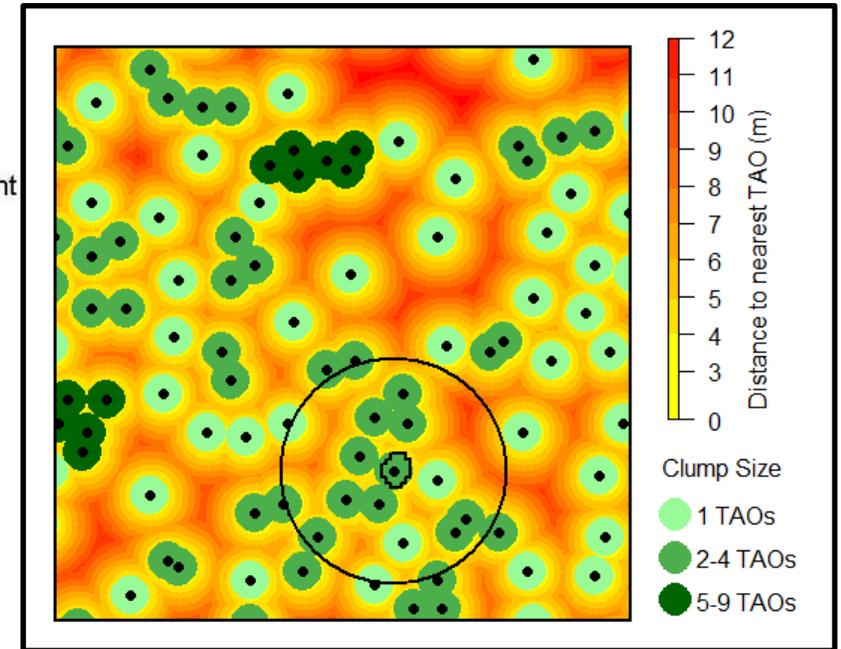


Lidar structural measurements

Height (ft)
200
150
100
50
0

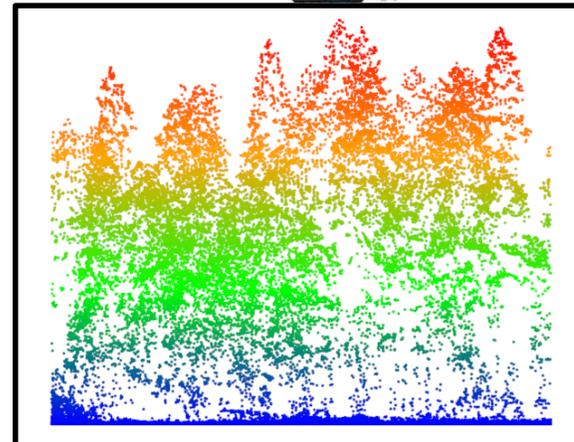
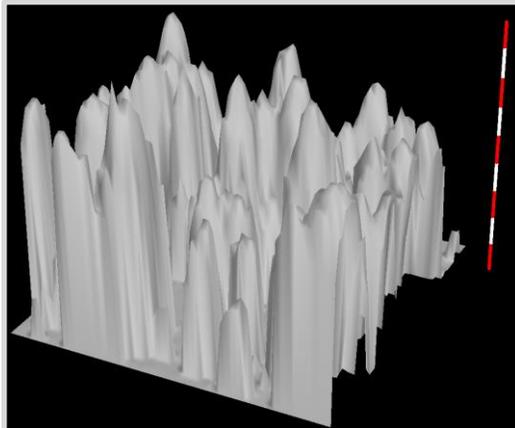


Local area and Neighborhood

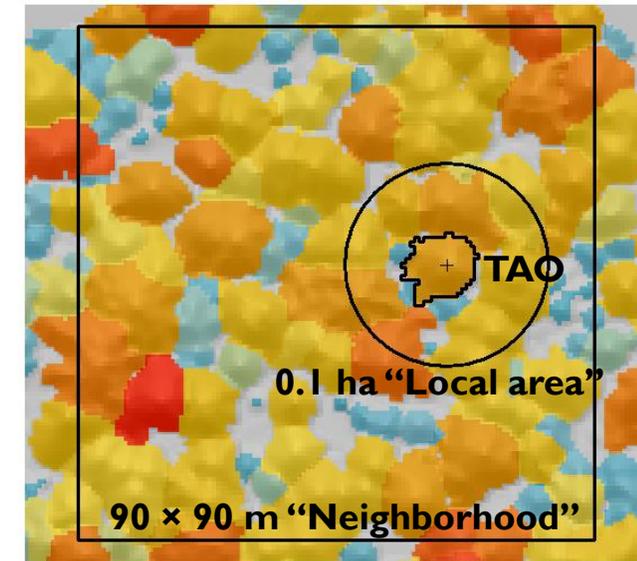
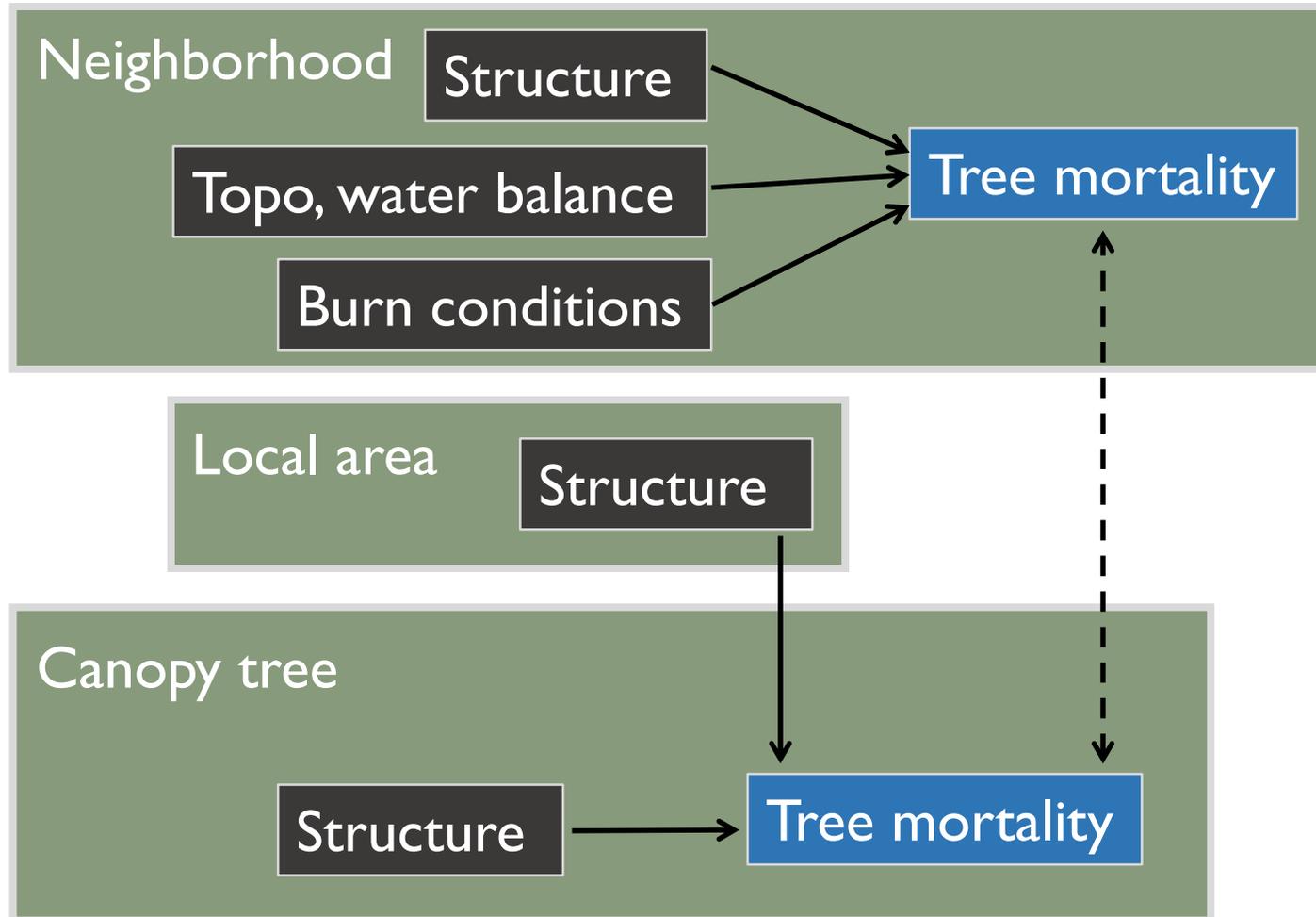


- density
spatial patterns:
- clump sizes
 - canopy openings

Water balance
Burning conditions
Slope, aspect, topo. position Neighborhood



Multi-scale modeling framework



Scales

Predictors

Responses

Average neighborhood-scale mortality

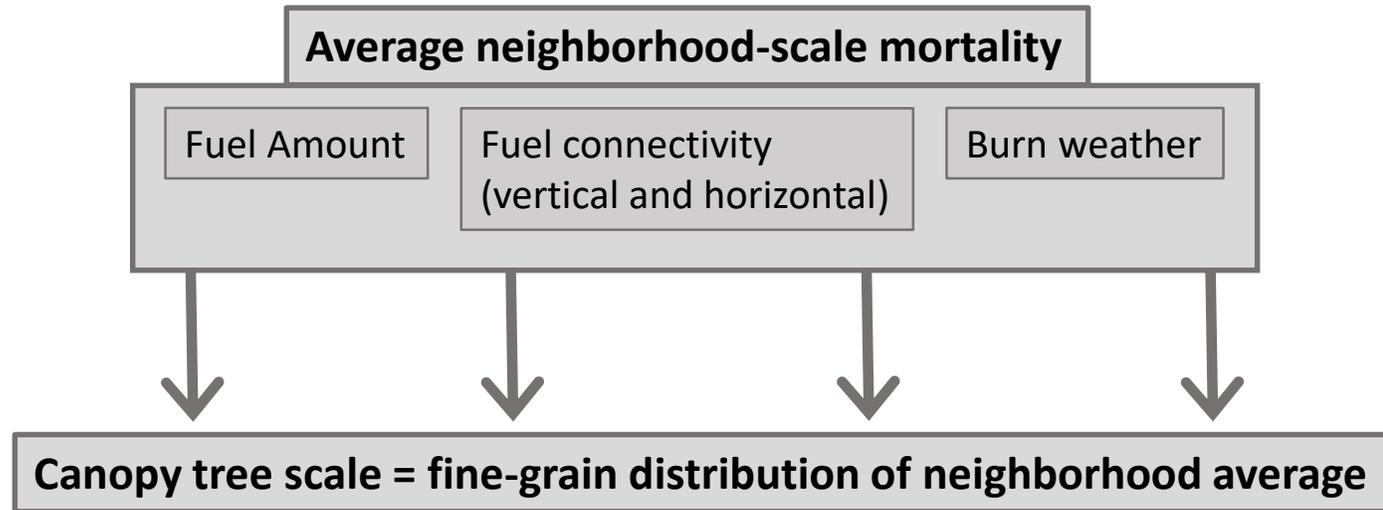
Fuel Amount

Fuel connectivity
(vertical and horizontal)

Burn weather

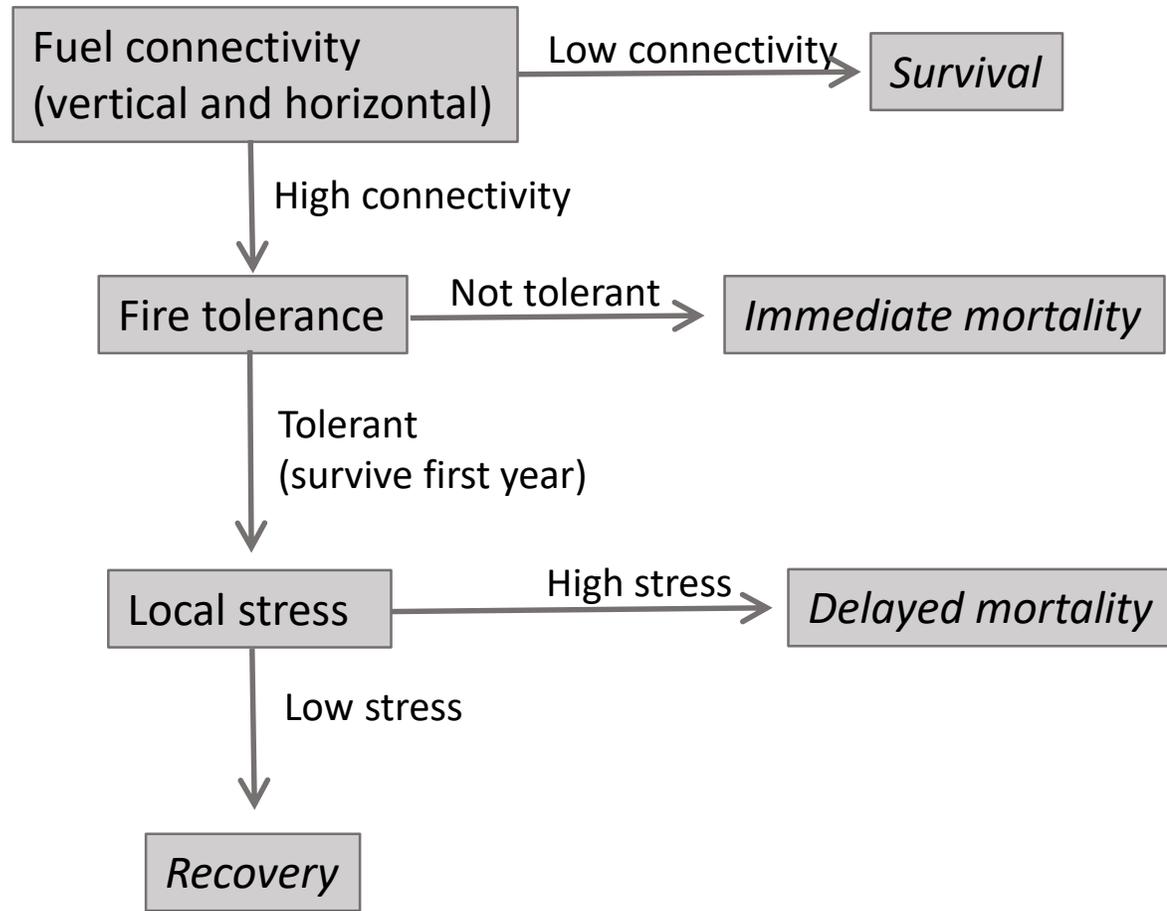
- AET
- CC >2 m
- Open space
- Canopy roughness
- Max temp
- ERC

Mortality driven primarily at coarser scales,
with local variation



Canopy tree scale:

Series of filters determine mortality



Conclusions

Variation in post-fire tree mortality is arranged according to landscape-scale controls exerted by burn weather and fuel amounts and configuration

Which trees die within a neighborhood depends on a series of conditions: tree stature, initial fire effects, acute fire tolerance, and chronic stresses

It is valuable to incorporate spatial patterns, spatial context, and scale when studying fire effects on vegetation

This research made possible by...



And:

Van Kane

Jim Lutz

Jerry Franklin

Andrew Larson

Average neighborhood-scale mortality

- Fuel Amount
- Productivity
 - Canopy cover

- Fuel connectivity (vertical and horizontal)
- Canopy complexity
 - Openings

- Burn weather
- Max. temperature
 - Energy release component

Tree-group scale = fine-grain distribution of neighborhood average

- Fuel connectivity (vertical and horizontal)
- Ladder fuels
 - Openings

Low connectivity → *Survival*

High connectivity

- Fire tolerance
- Tree size
 - Specific constitution

Not tolerant → Tree size, clump size

Larger
Smaller

Tolerant (survive first year)

- Local stress
- Local density
 - Canopy mass

High stress → Vertical connectivity, local density

Higher
Moderate
Lower

Low stress

Survival

Tree-scale mortality agents

- Immediate mortality
- *Stem kill*
 - *Crown kill*

- Delayed mortality
- *Delayed first-order fire effects*
 - *Root rot*
 - *Bark beetles*