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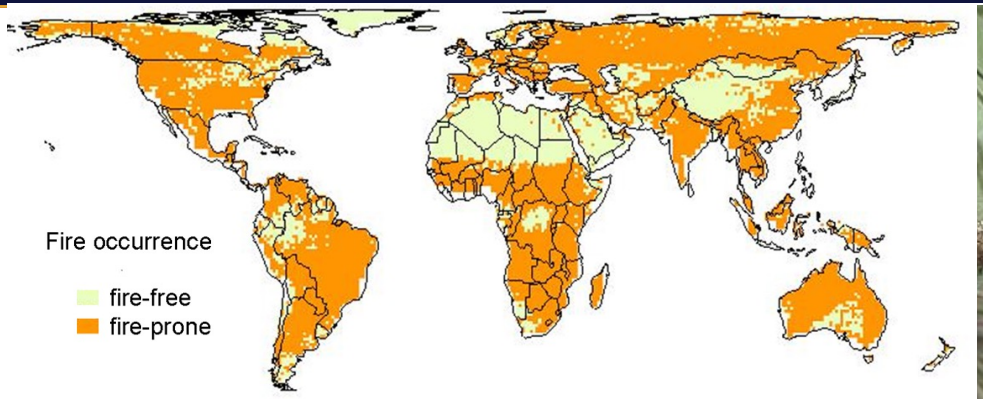
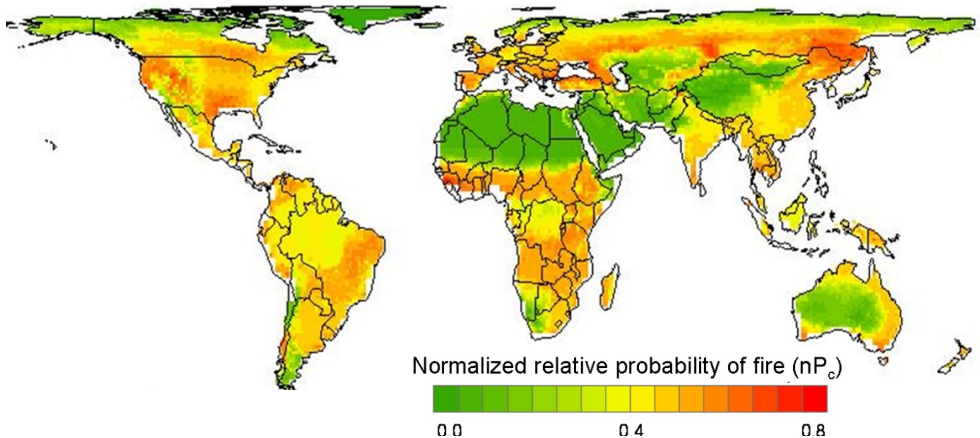
Issued:	2022-10-20

Ecosystems Need and Are Adapted to Fire





Courtesy: Krawchuck et al., 2009. PlosOne

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High-Frequency, Low-Severity and Low-Frequency, High-Severity Forests

Ponderosa pine
High-frequency, low-severity fires

Lodgepole pine
Low-frequency, high-severity fires

Structural forest differences and evolutional traits determine fire behavior and ecosystem response to fire disturbance

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Fire Suppression = High Fuel Density → High Fire Severity

Fire Suppression

Results in:

1. High-intensity wildfire
2. Loss of habitat
3. Ecosystem transition
4. Degraded water resources

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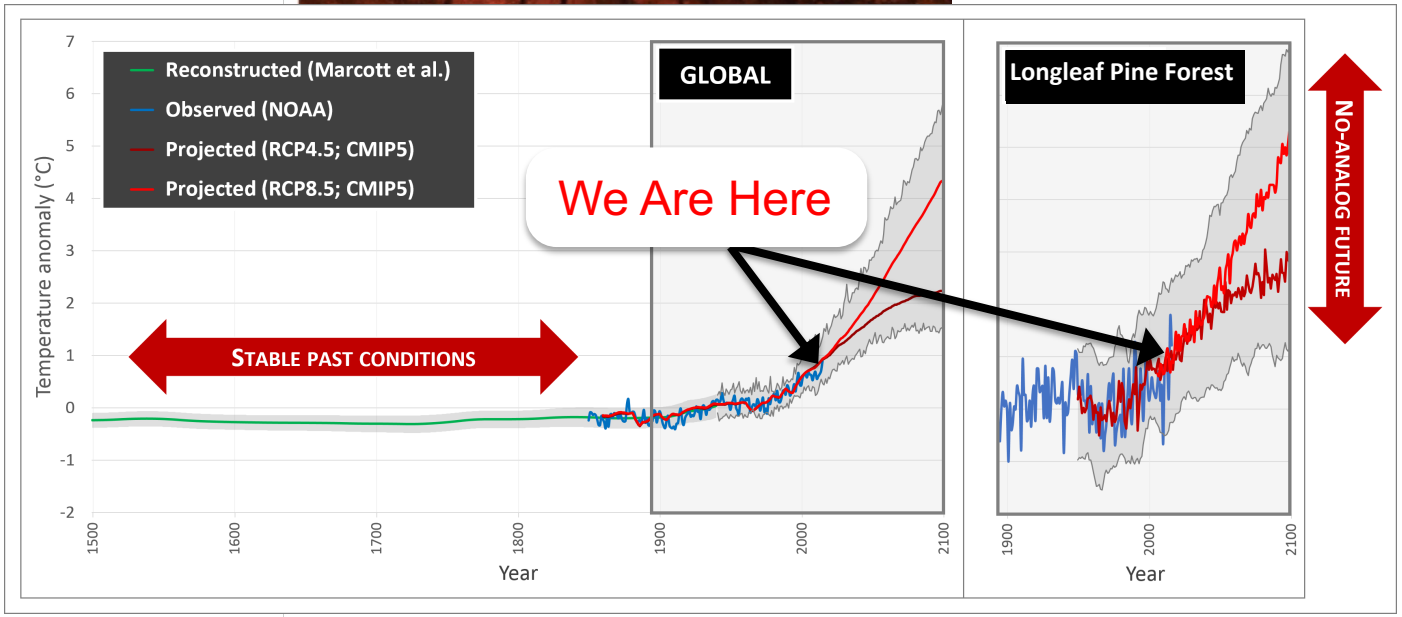
Climate Change Is Causing Extreme Wildfire & Ecosystem Transition

- **Changing Fire Conditions**
  - **CLIMATE:** Temp, precip, disturbances, extremes (hot droughts).
- **Empirical models of the past are outside of their validation range.**



BY JEFF TOLLEFSON

In California, where the state's largest wildfire on record continues to burn, fires are getting bigger and less predictable — so much so that scientists are struggling to model them. Now, two research

abnormal fire seasons around the world. The giant California fire has torched about 166,000 hectares since late July, and continues to burn in the northern part of the state. British Columbia in Canada is now experiencing its worst fire season on record (see 'Scorched earth'). And in late July, after

MARK RALSTON/AFP/GETTY

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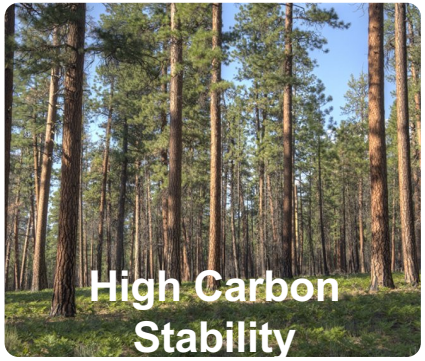
Prescribed Fire Prevents Ecosystem Transition, But Is Understudied

Fire-suppressed forest structure

No prescribed fire, high risk of severe fire

High-severity fire ~ ecosystem transition

Science-driven prescribed-fire framework



Frequent fire forest structure

- Wildland fire science has been focused on high severity wildfires, but does not address prescribed fire conditions.
- Prescribed fire takes place in marginal burning conditions where forest structure, fuel moisture ect have outsized controls on successful application.
- Success of prescribed fire depends on a new science basis and more sensitive model applications. - Heirs et al., 2020. *fire ecol* **16,** 11 (2020). https://doi.org/10.1186/s42408-020-0070-8

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Prescribed Fire in Action

Photo Credit: Sustainable Northwest, Steve Rondeau (Klamath Tribes Natural Resources Director). Klamath Tribes restoration prescription and Forest Service prescribed fire (April 2021) after the 2021 Bootleg Fire on the Fremont-Winema National Forest.

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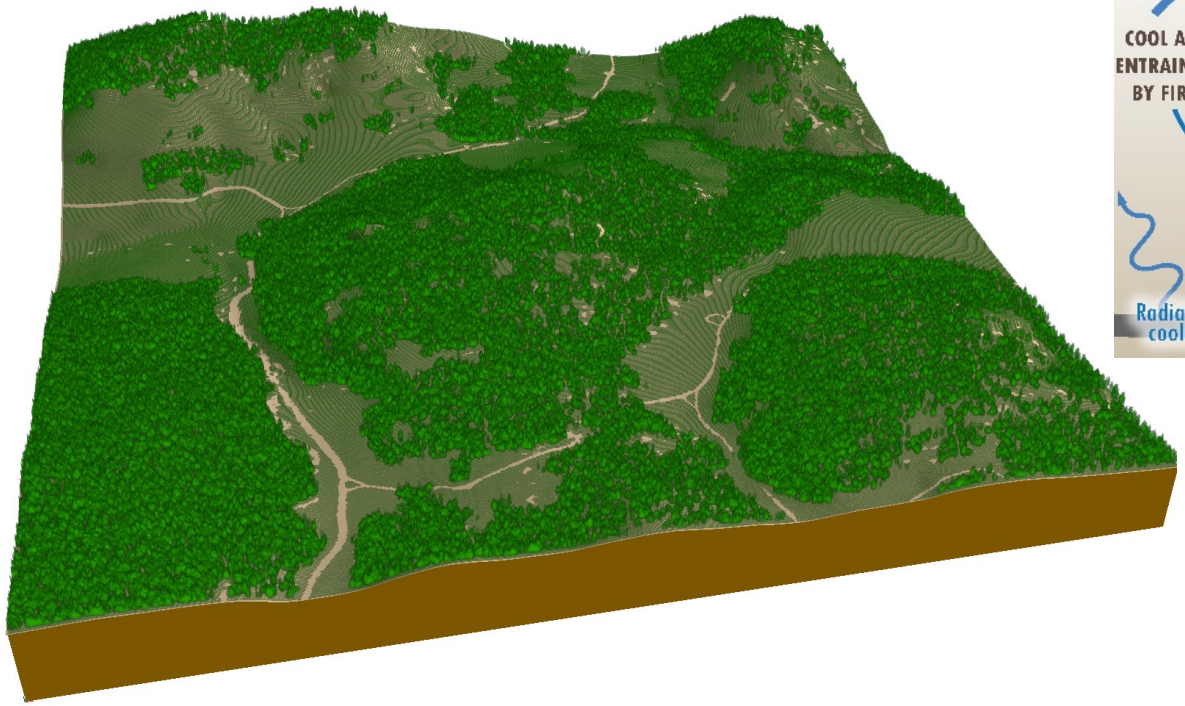
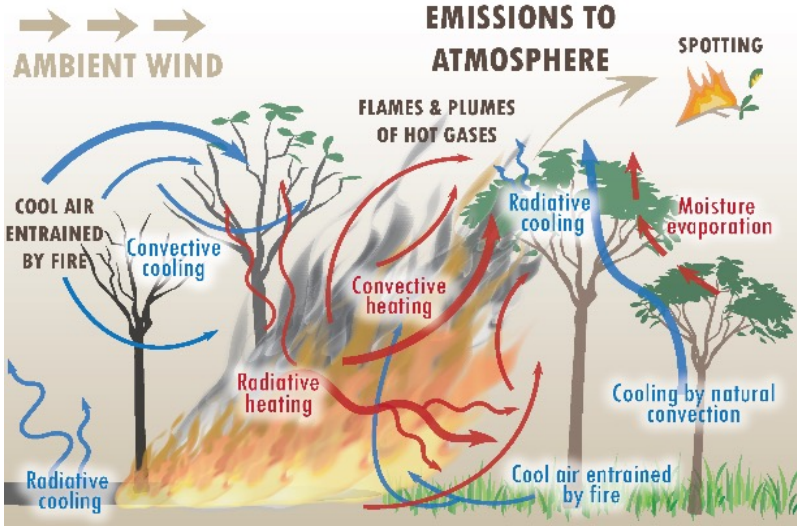
FIRETEC Simulation Informs Prescribed-Fire Planning





R&D 100

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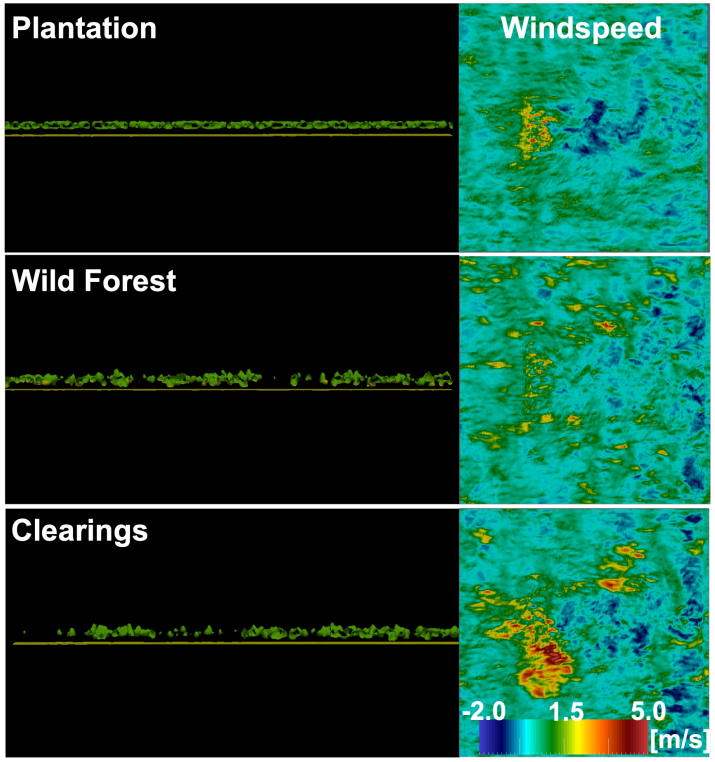
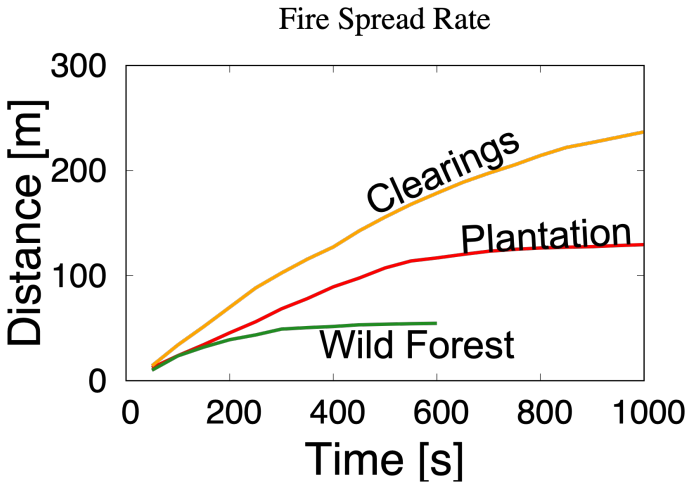
Forest Structure Influences Wind Driven Fire Behavior





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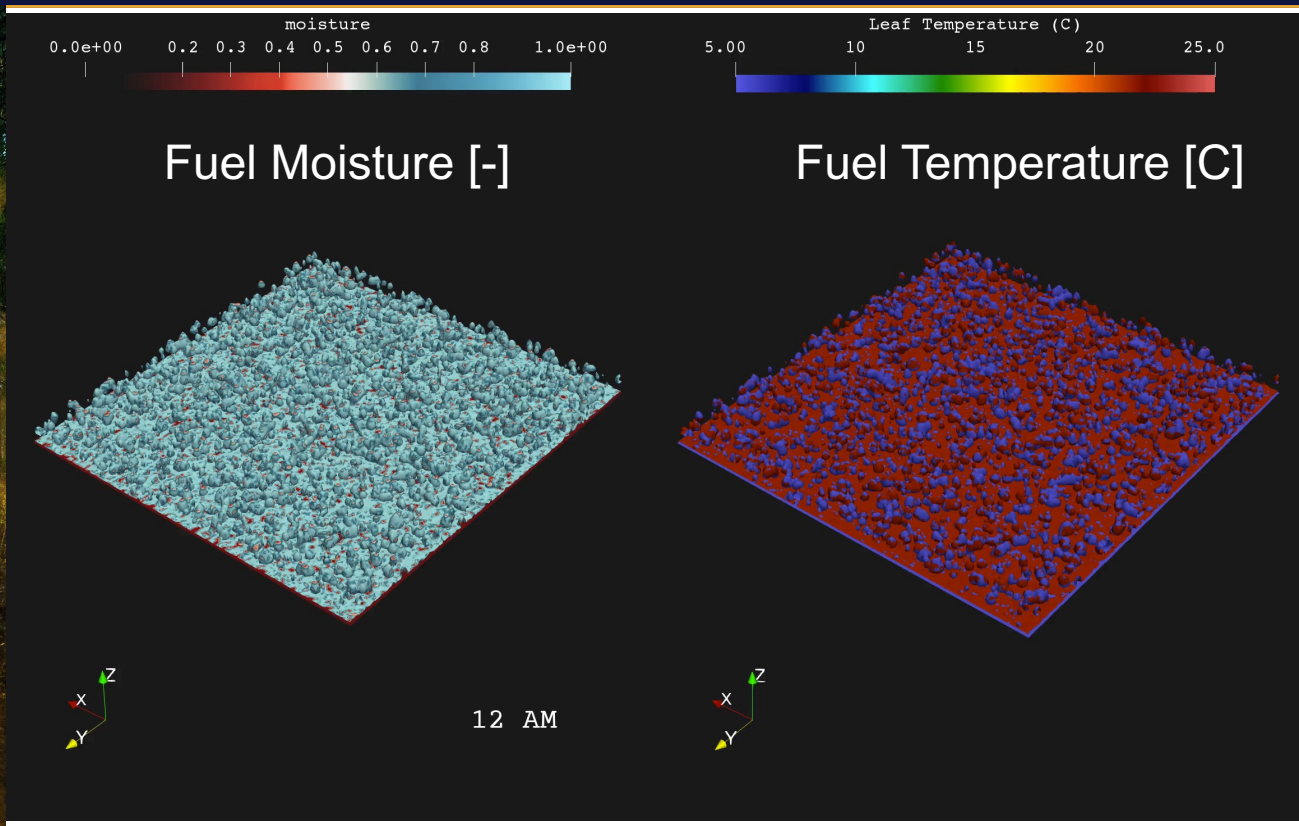
Evolving Fuel Moisture & Forest Structure



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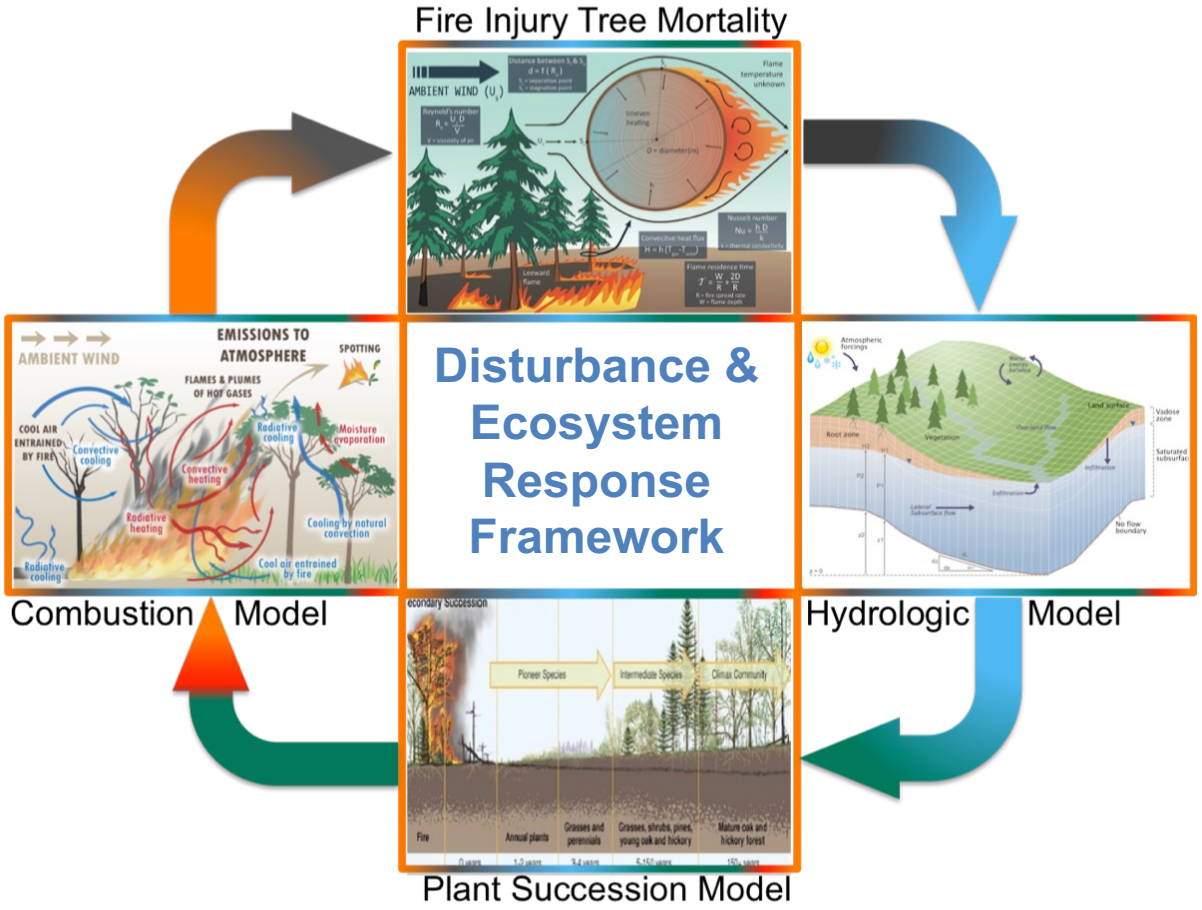
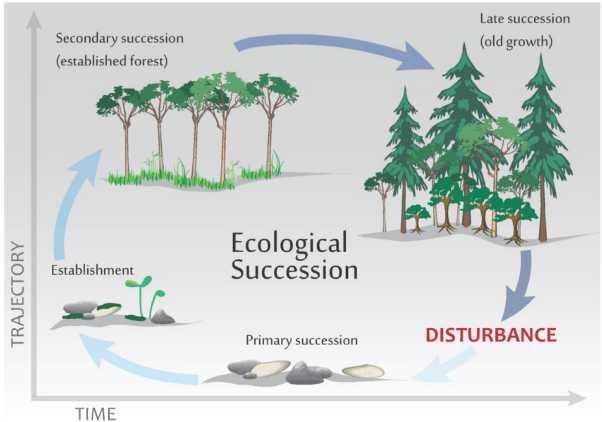
Disturbance and Response-Modeling Framework



- Simulates ecohydrology response to fire disturbances.
- Loops fire disturbance and ecohydrological response to simulate future fire disturbances and ecosystem trajectory.



Traditional Succession model

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Predicting Ecosystem Response to Fire Over Time

Multiple Prescribed Fire Path

No Prescribed Fire Path

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Optimizing the Use of Prescribed Fire for Carbon, Water, & Fire Risk

- **How does forest structure influence 1) ecosystem stability (carbon storage), 2) water resources, 3) wildfire risk?**
- **How do we optimize for these ecosystem services?**

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BurnPro3D Platform Next-Generation Fire Science, Data and AI

Los Alamos NATIONAL LABORATORY EST. 1943

Optimize prescribed burns at the scale needed to reduce wildfire risk

LAND PRIORITIZATION

Help **land managers** identify high-risk areas for 5-year plans

BURN PLANNING

Help **burn planners** optimize prescribed fires

BURN IMPLEMENTATION

Help **burn bosses** manage burns adaptively

POWERED BY

WIFIRE Data and Model Commons

1

2

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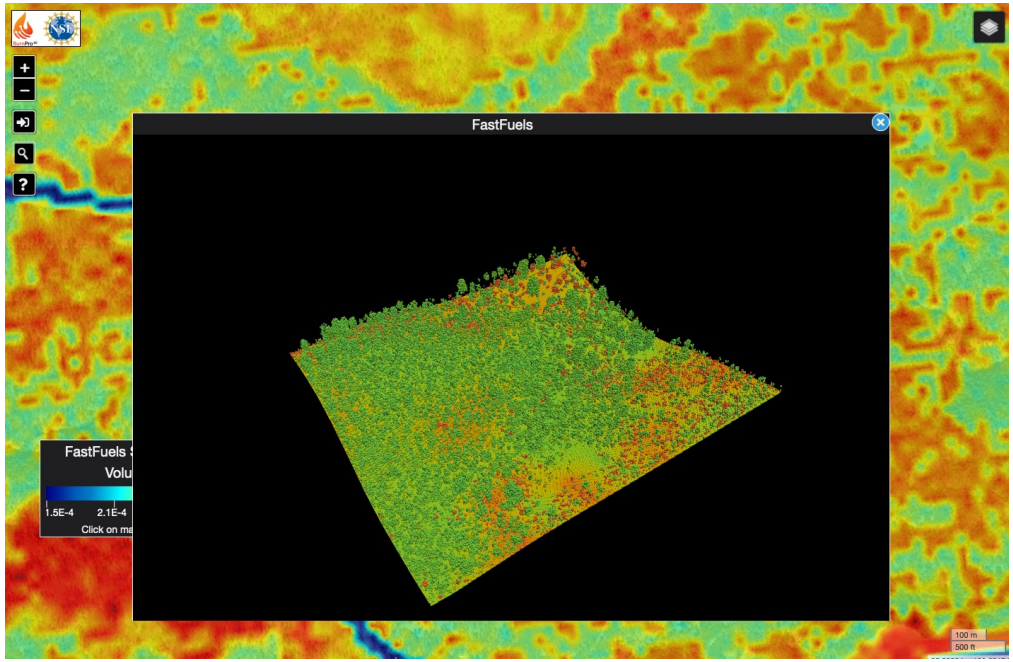
4

Ilkay Altintas (UC San Diago), Melissa Floca (UC San Diago), Yolabnda Gil USC, Kevin Hiers (USGS) Rod Linn (LANL)

BurnPro^{3D} Platform Next-Generation Fire Science, Data and AI

Nation-wide database of 3D fuels, weather, and burn history



- Delineate burn units
- Define burn objectives
- Scenario generation for a burn unit
  - identify the burn strategies and *conditions*
  - find fire behavior that is safe and accomplishes *objectives*

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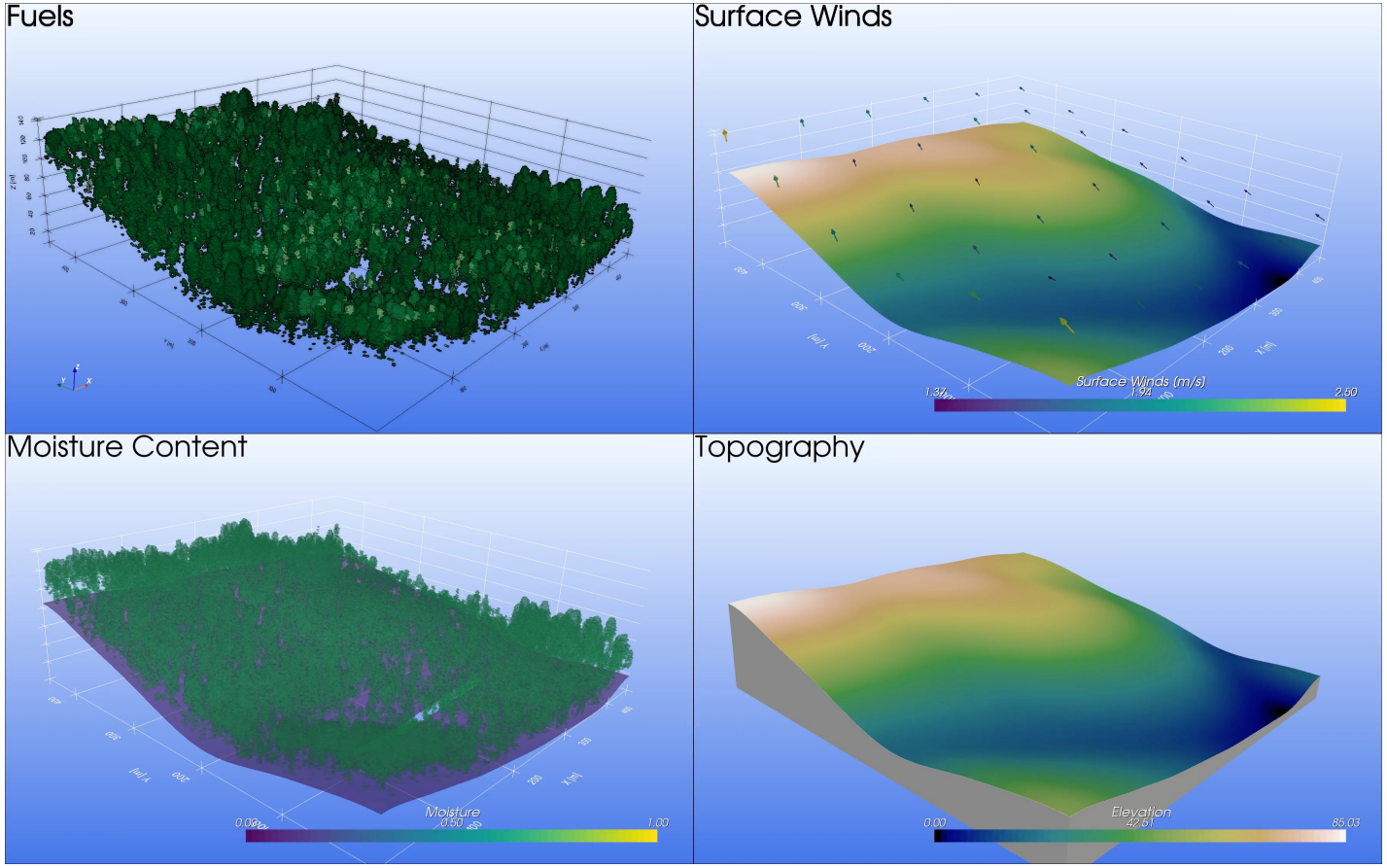
Fuels Database Feeds Directly to the LANL QUIC-Fire Model



2020 R&D 100 WINNER

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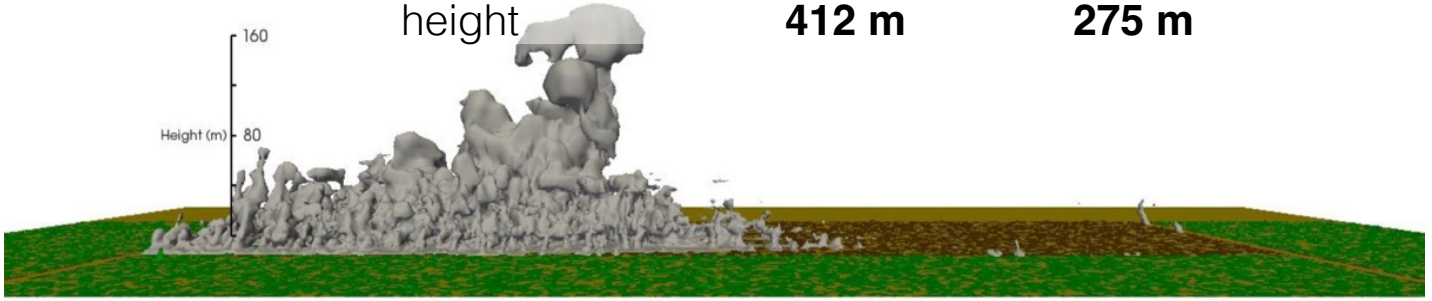
Simulating and Measuring Smoke Plumes

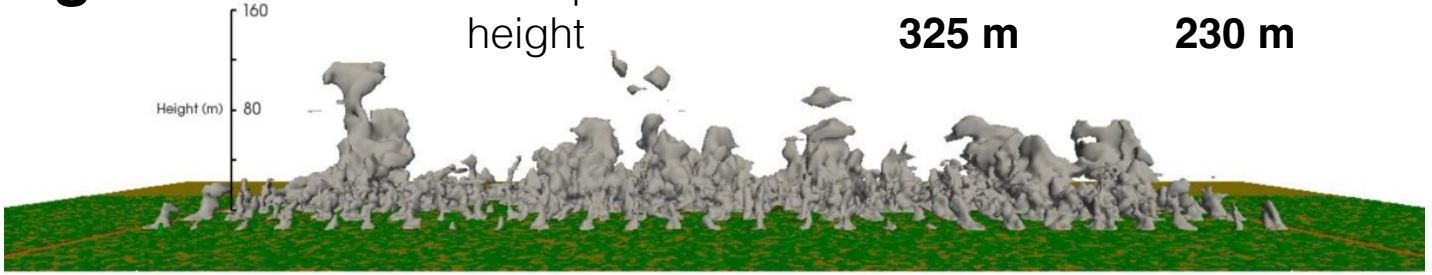
ATV ignition

	5 mph winds	12 mph winds
Max. plume height	**412 m**	**275 m**



Aerial ignition

	5 mph winds	12 mph winds
Max. plume height	**325 m**	**230 m**



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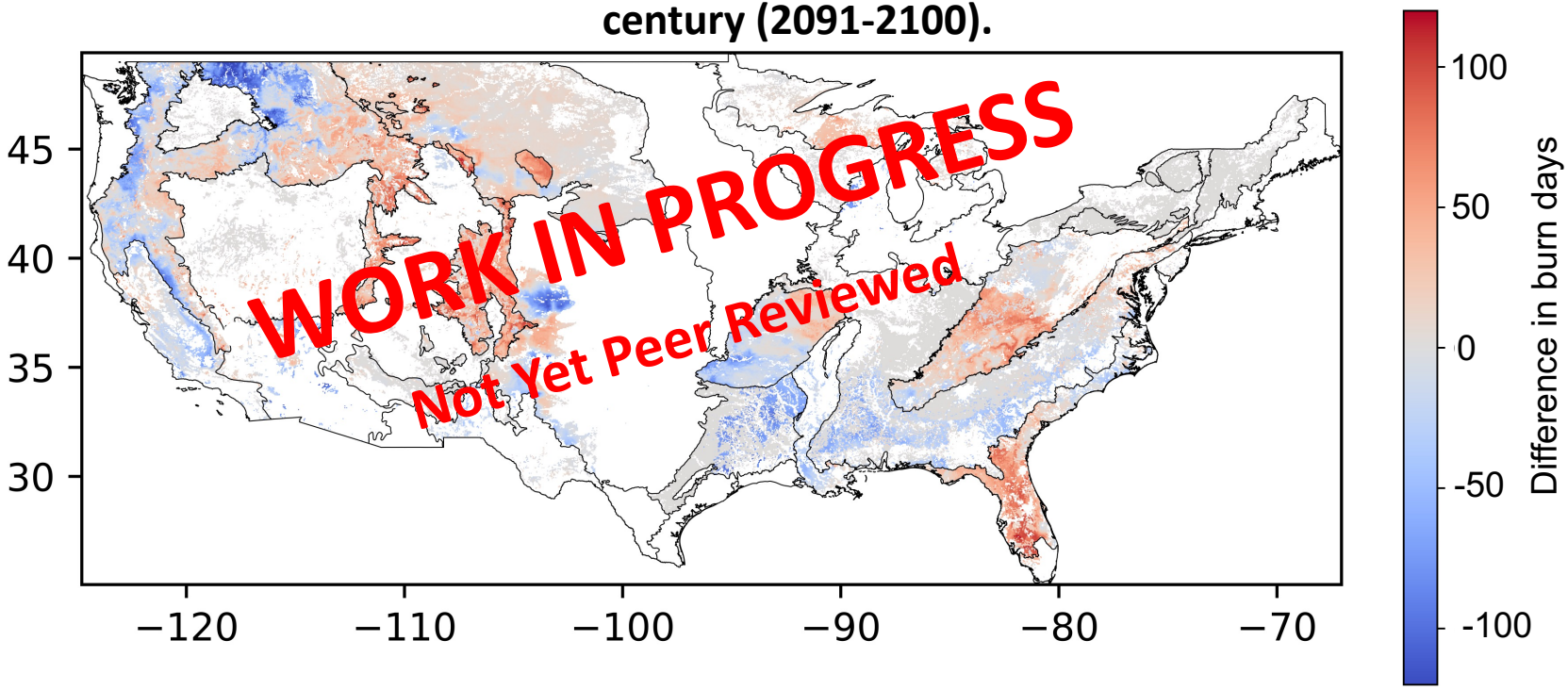
Prescribed Fire Windows in a Changing Climate

Climate change is shifting frequency of safe prescribed-fire burn days.

Change in available burn days comparing present day (2006-2015) with the end of the century (2091-2100).



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An Extensive Team

LABORATORY DIRECTED RESEARCH & DEVELOPMENT

BurnPro3D

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