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Title: Wildland Fire Monitoring

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Wildland Fire Monitoring

Taking Theory to Practice

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Los Alamos National Laboratory

2019 EMI SIG Annual Meeting

Overview

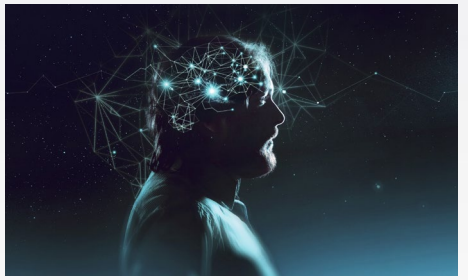
- DOE Mission Statement:
  - The mission of the Energy Department is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.
- LANL Mission Statement
  - Los Alamos National Laboratory's mission is to solve national security challenges through scientific excellence.

Overview

- Question: So who ensures LANL's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions so that LANL can solve national security challenges through scientific excellence?

- Answer: Rod Linn and Jesse Sievers of course!

The Gap



- LANL has the best and the brightest developing transformative science and technology solutions for the nation.
  - Cheat sheet: This is Rod Linn.
- Rod and his team have created cutting edge fire modeling programs funded by the USFS for wildland fire fighting and fuels mitigation efforts.
  - The FIRETEC modeling tool, developed at Los Alamos National Laboratory, leverages fluid-dynamics research originally developed for national security science and uses physics to represent the critical interactions among the multiple ignitions of a prescribed burn in very complex terrain.
  - QUIC-Fire is a wildland fire modeling tool that uses many of the FIRETEC algorithms, but can run on a laptop in a much shorter amount of time.

The Gap

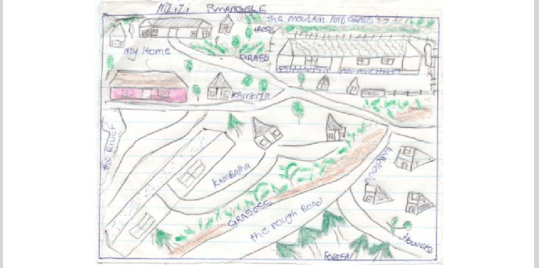
- Wildland fire is LANL's most probable and highest consequence hazard to health and safety, and the LANL mission.

- There have been two major fires that have burned onto LANL property:
  - Cerro Grande
  - Las Conchas

The Gap

- LANL's Wildland Fire Management Program has the best and the brightest staff and a mediocre Group Leader.
  - Cheat sheet: This is Jesse Sievers

- LANL's Wildland Fire Management Program has historically had cutting edge technology to prepare and respond to wildland fires.
  - Cheat sheet:



Connecting the Dots

- Former Laboratory Director Terry Wallace connected the dots between the DOE mission and LANL management and operations.

- A relationship was built between LANL Emergency Preparedness Group(EMD-EP) and Computational Earth Science Group(EES-16).

Connecting Theory to Practice

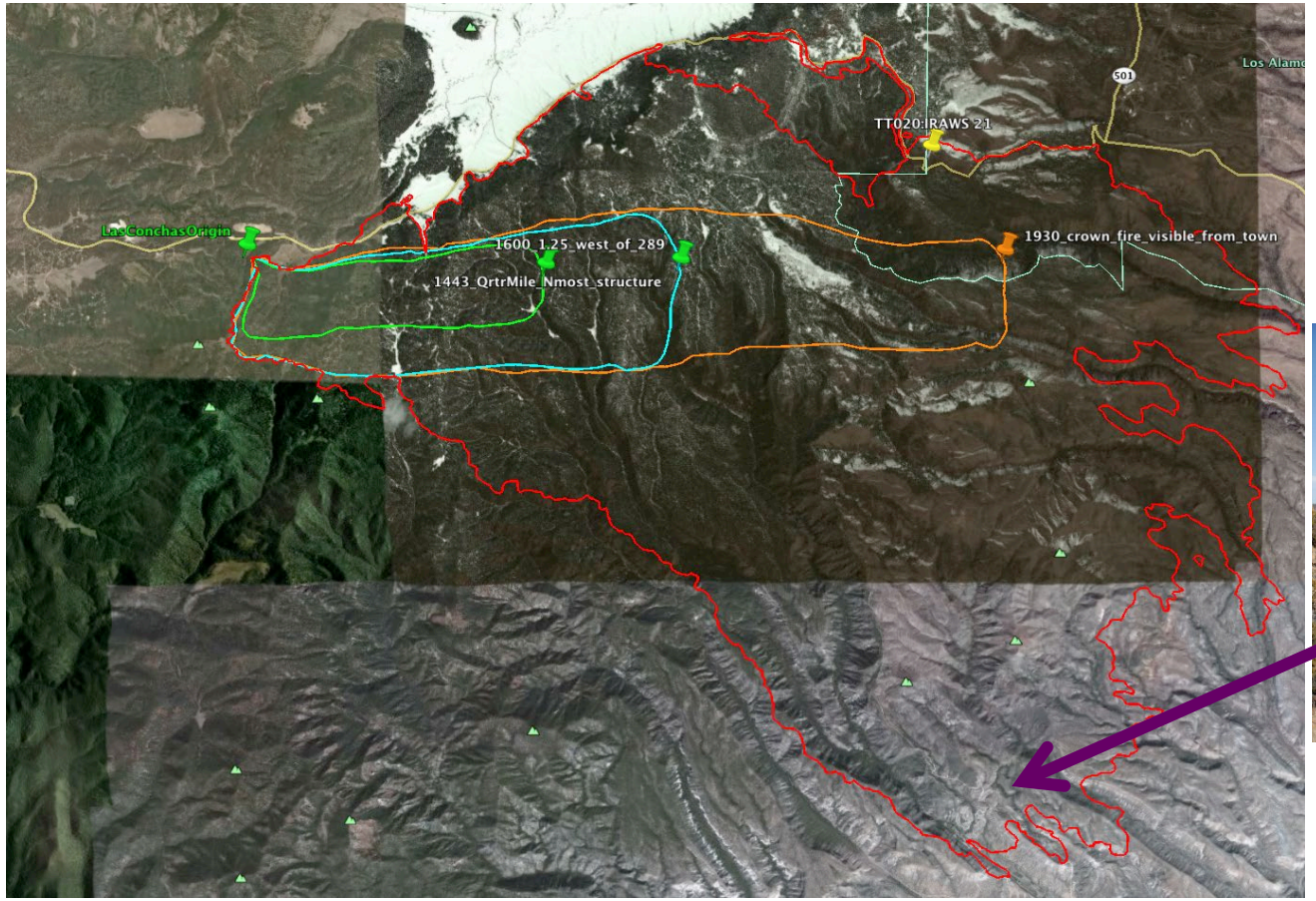
- How the relationship works:
  - EES-16 continues to conduct basic research and test hypothesis to formulate theories, but can move into the applied research realm by applying it locally.

Parameters	Basic Research	Applied Research
Type of knowledge produced	Scientific Discovery (Science)	Technological Application (Technology)
Motivation	Intellectual curiosity	Solving problems
Key questions	Is it true ?	Does it work ?
Objective	To understand	To come up with solutions

Connecting Theory to Practice

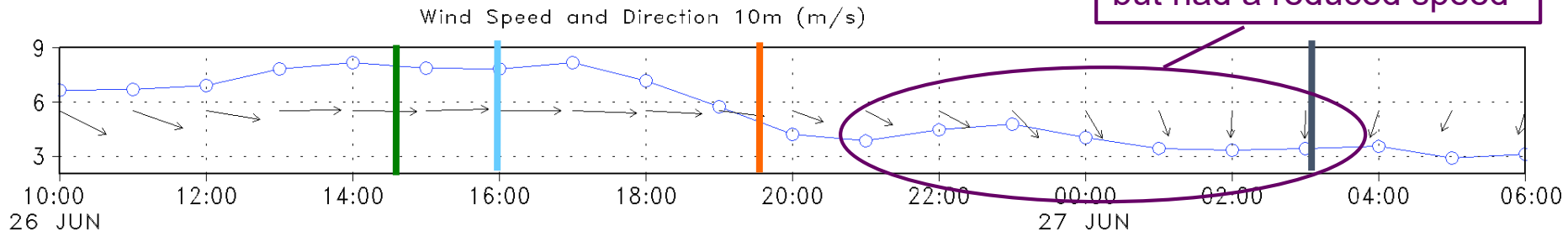
- How the relationship works:
  - EMD Wildland Fire Management Program now gets access to cutting edge science, technology, and tools to pursue it's mission of protecting life, property, and resources.
    - Use of FIRETEC to:
      - Run behavior models for fuels mitigation planning
      - Test worst-case scenarios for firing sites and other fire initiating activities
    - Leverage research field connections to pilot other wildland programs:
      - Wildland Fire Decision Support System (WFDSS)
      - Wildland Fire Assessment System (WFAS)
    - Incorporate wildland fire behavior scientist into emergency management activities such as:
      - EOC activations
      - Exercise planning
      - Money grubbing from senior management!

Learning from past events



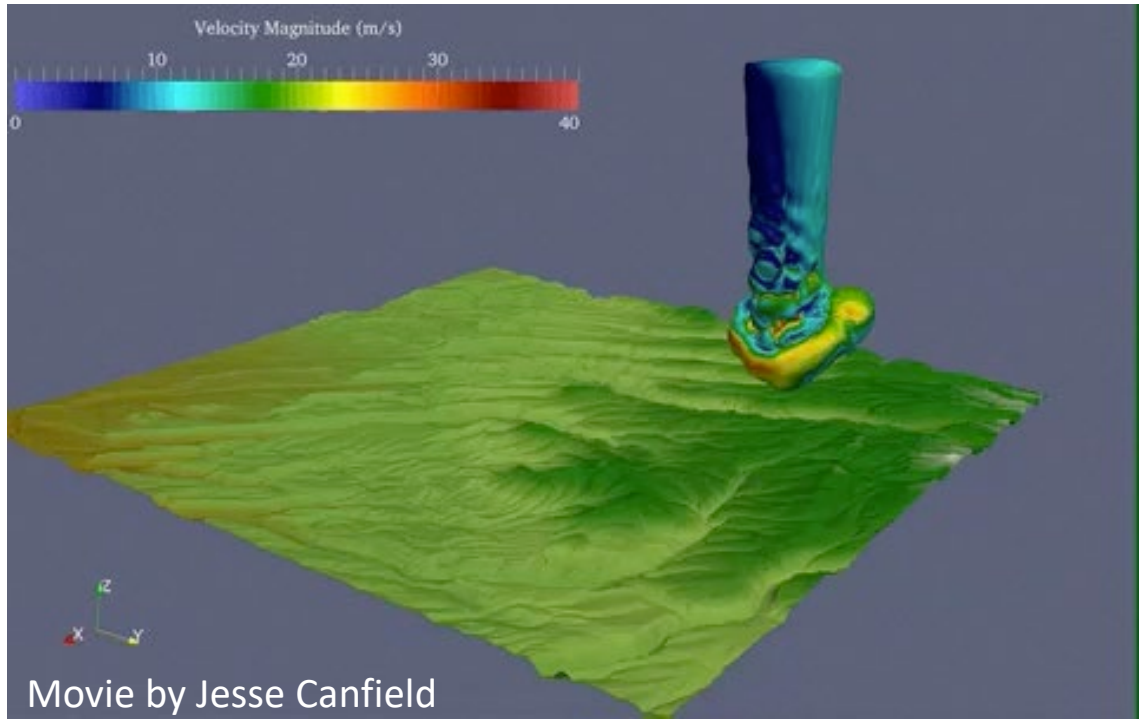
- Ignition time 13:08, 6/26/2011
- Green 14:43, 6/26/2011,
- Turquoise 16:00, 6/26/2011
- Orange 19:30, 6/26/2011
- Red 3:09, 6/27/2011
- Red perimeter is based on USFS IR data

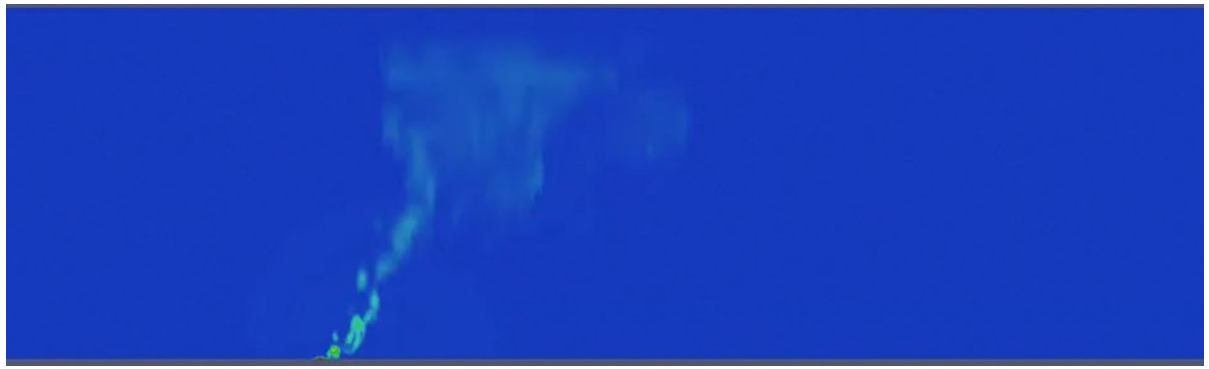
Winds shifted directions but had a reduced speed

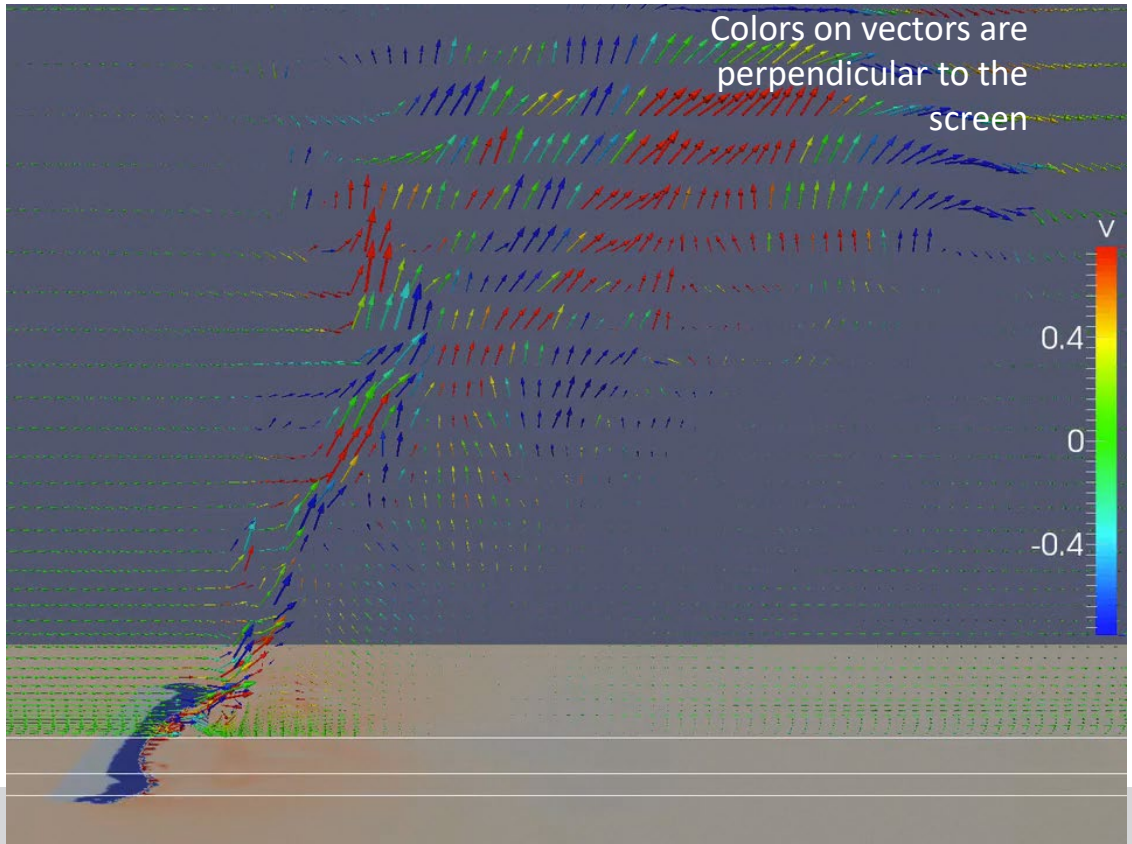


1 Km atmospheric model simulations

Exploring potential low-frequency/high-consequence events



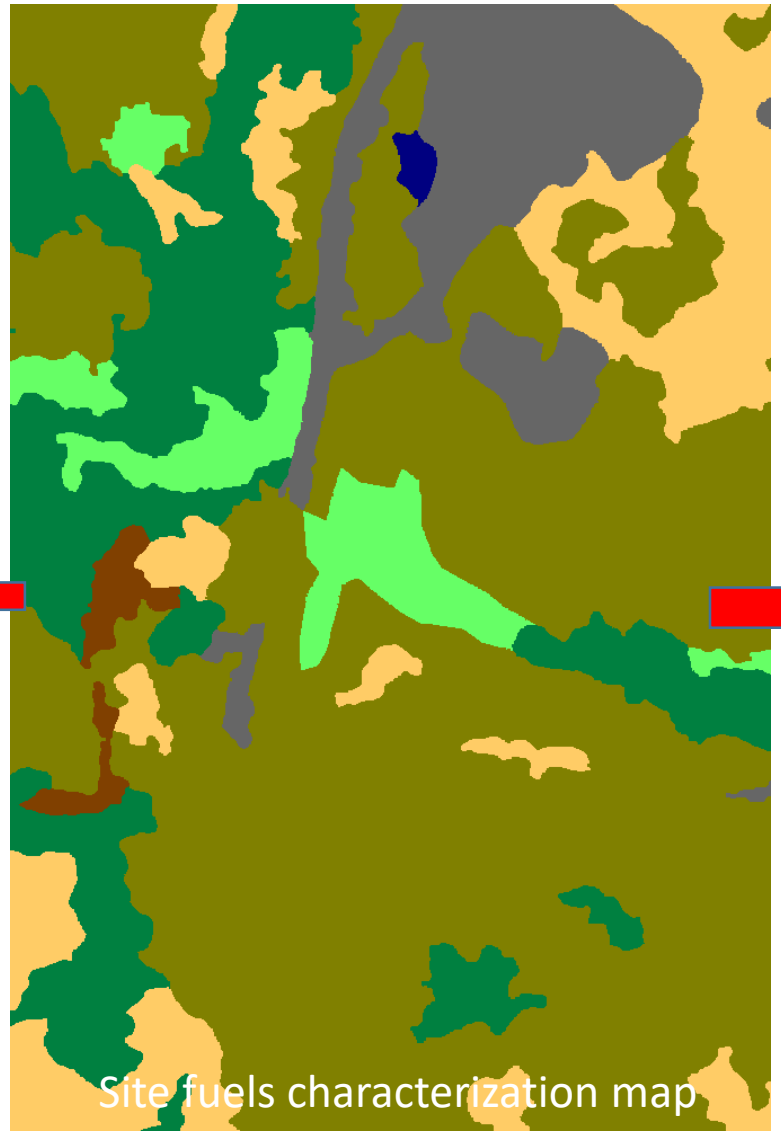




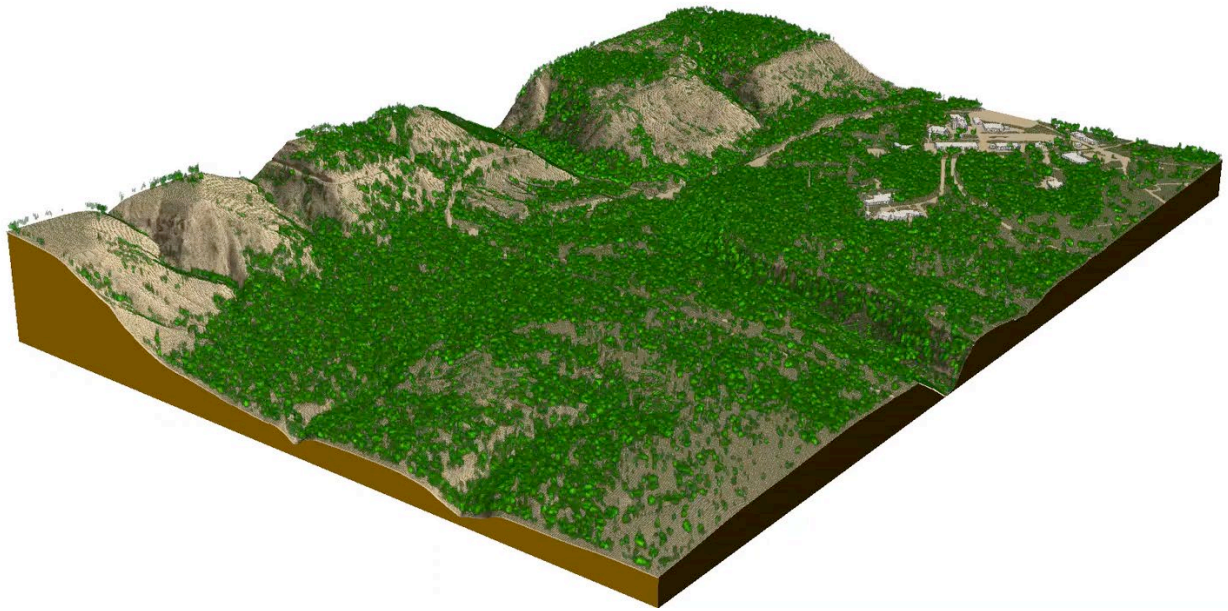
For example: Downwash events and resulting density current flow patterns

- Moving faster than ambient winds
- Containing “back-spin” vorticity
- Amplifies multiple aspects of fire

Developing vegetation beds



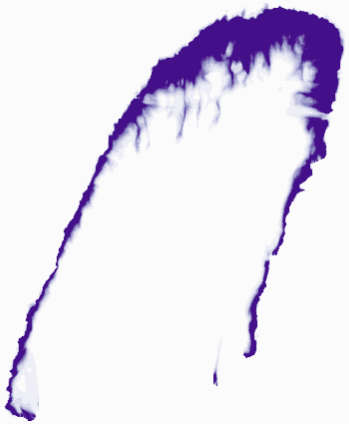
Performing high-resolution coupled fire/atmosphere simulations



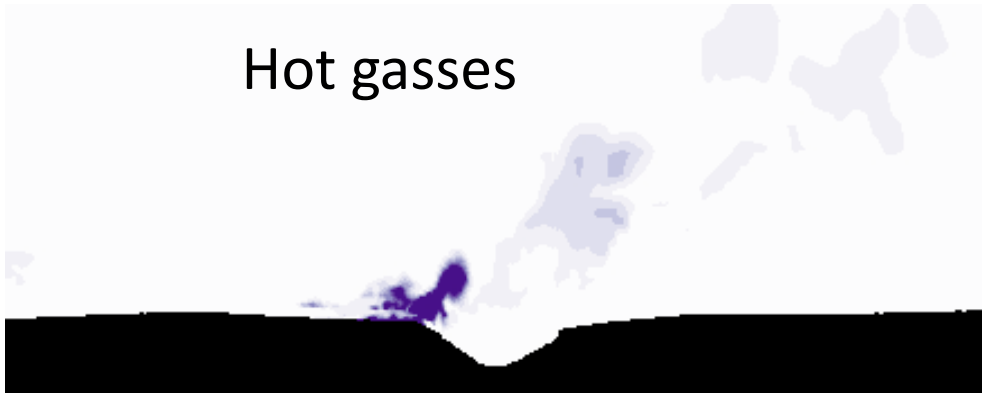
Simulation using FIRETEC coupled fire/atmosphere model

Detailed analysis of critical phenemena

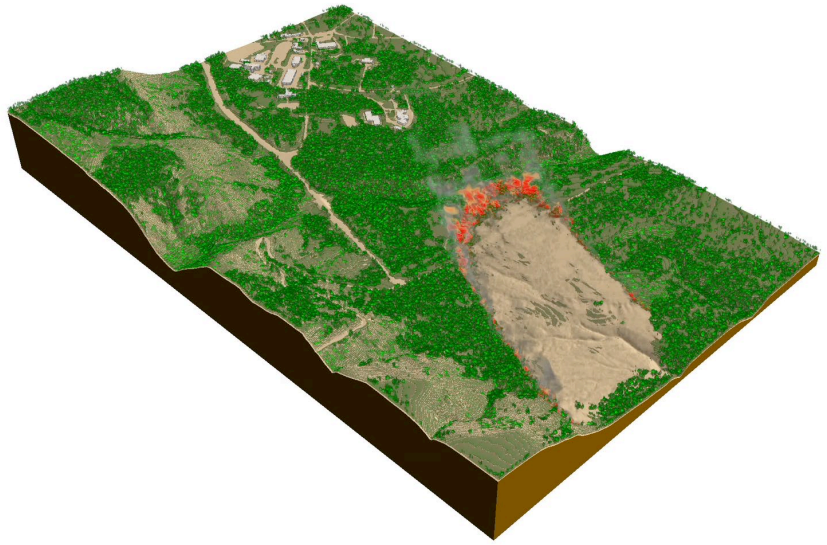
Hot gasses



Hot gasses



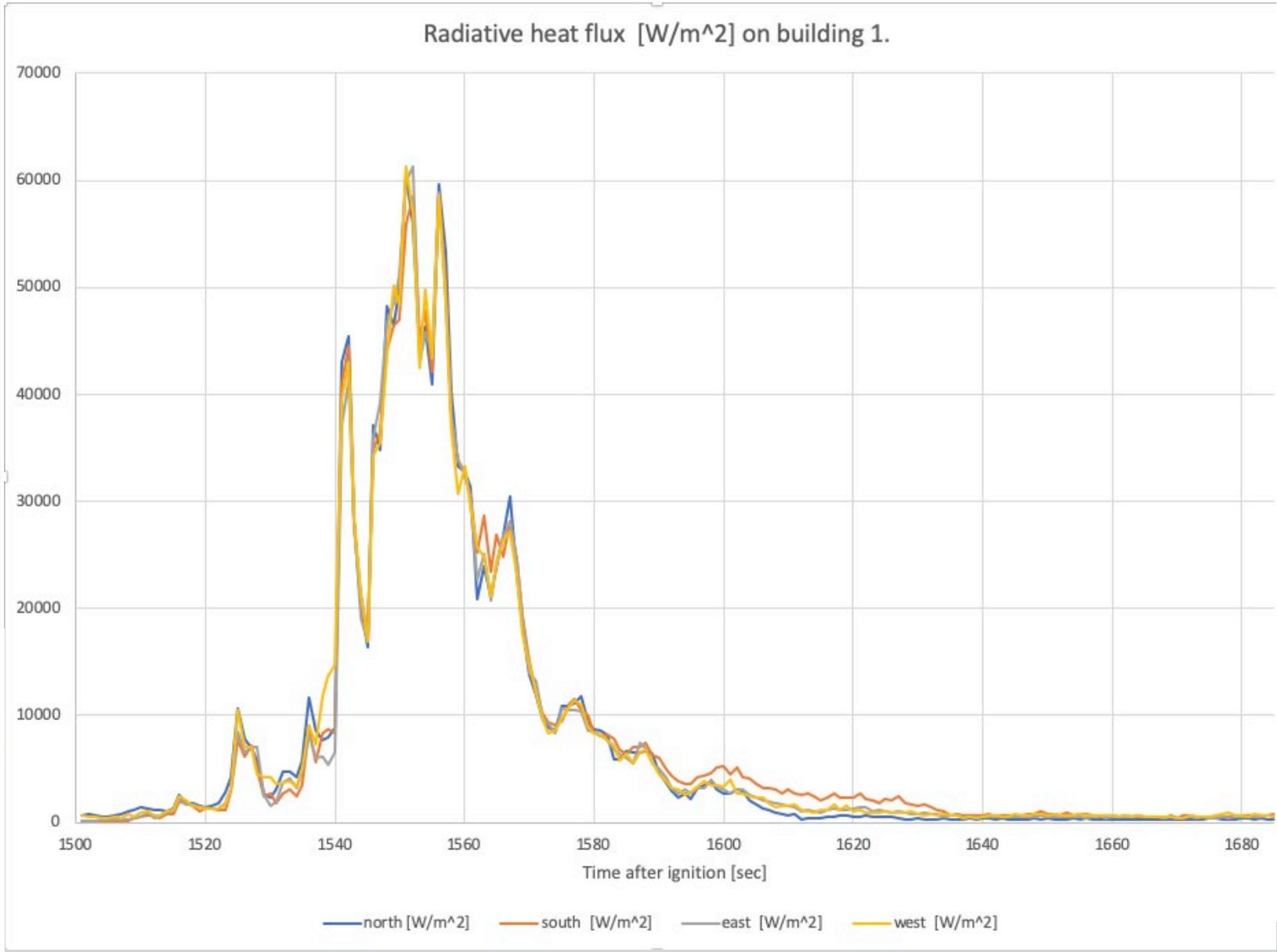
Fire behavior



Burning Fuel

Examination of possible fire behavior near critical facilities:

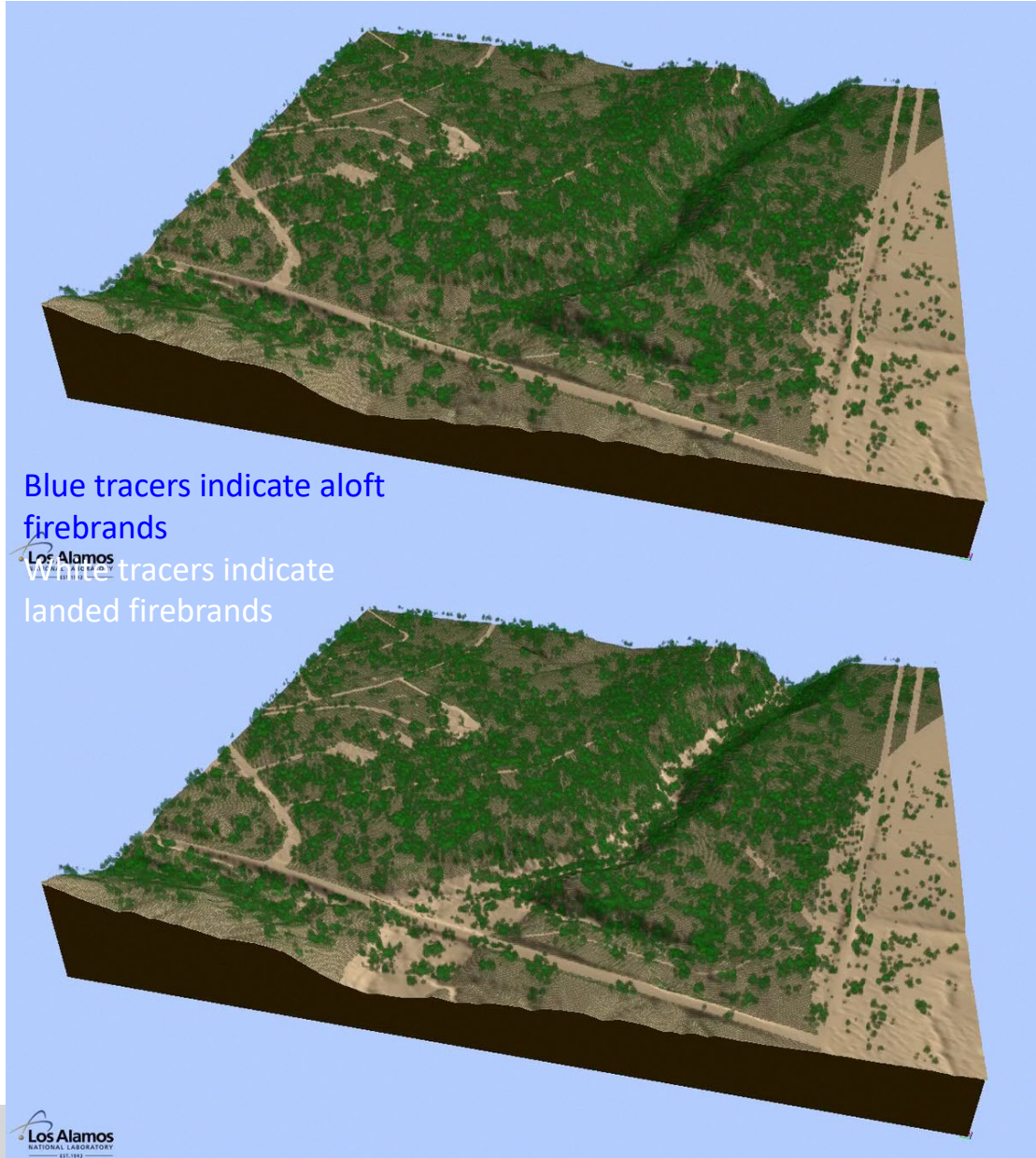
Performing high-resolution coupled fire/atmosphere simulations



Analysis of vegetation changes

Simulations suggest potential impact of changes in vegetation (fuels management or gully-washing rain events) for managing fire risk.

However, these simulations also remind us of the importance of considering longer range spotting for facility protection.



Examination of worst-case scenarios

Examination of fire prone sites and mitigation efforts

- Assessment of potential events at LANL test sites
- Evaluation of fire risk management efforts
- Provide basis for site-specific operations prescriptions

Back to the Future

- Connecting back to the DOE Mission with future questions and project applications:
  - Can QUIC-Fire be used as a wildland modeling tool for wildland fire response at LANL and across the complex?
  - Can QUIC-Fire be used to develop interactive training, drills, and exercises?
  - Can the Wildland Fire Assessment System be integrated into the fire restriction process for activities at LANL?
  - What can technical planning and consequence assessment professionals and technology glean from FIRETEC and QUIC-Fire?
  - What's the application for FIRETEC to Documented Safety Analysis scenarios at LANL and across the complex?
  - What are the national homeland security and emergency management applications for LANL's wildland fire modeling science?

Questions?