Groundbreaking software helps tame blazes

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Massive wildfires are scorching forests and brush country more frequently—an unintended consequence from decades of fire suppression and buildup of combustible fuels. Wildfire managers needed a tool to help cope with the risks of these high-intensity wildfires as well as proactively moderate fire behavior.

Los Alamos National Laboratory researchers and their collaborators invented QUIC-Fire to meet that need. The team included researchers in the Earth and Environmental Sciences and Analytics, Intelligence, and Technology divisions at Los Alamos along with partners at the United States Forest Service and Tall Timbers Research Station.

This near real-time simulation software offers 3D modeling of fire progression that incorporates critical influences: 3D vegetation structure, variable winds, and complex topography. QUIC-Fire's most important capability is running on a laptop, offering mobility and rapid information for fire managers. This first-of-its-kind tool will allow fire managers to explore different options for prescribed burns and fire control to maximize impact while keeping personnel safe. It is a groundbreaking technology—one that will help fight against catastrophic wildfires and increase ecosystem sustainability.

Feedback between fire and atmosphere

QUIC-Fire takes into account the feedback between a burning fire and the atmosphere. These aren't fixed variables that can be easily modeled or parameterized. As a fire burns, the wind, temperature, and smoke all change. These variables then influence the fire spread, which influences the variables. QUIC-Fire acknowledges this feedback loop to produce more accurate and realistic simulations while avoiding the burden of computational fluid dynamics simulations.

QUIC-Fire combines physics-based models of combustion, heat transfer, aerodynamic drag, and turbulence with a fast-running wind solver that represents the fire, fuel, and topography-influenced wind flow around the fire. Fire managers can use this powerful tool to simulate different ignition scenarios for prescribed burns while ensuring safety, smoke exposure, and fire behavior are all within specifications.

Future training and a changing climate

Firefighters will also benefit from QUIC-Fire by using it as a training tool. Like a flight simulator, a fire simulator built on QUIC-Fire will transform a training experience into

a virtual reality session where firefighters can explore the effects of both their ignition strategies and changes in burn conditions on fire and smoke outcomes.

This type of training is increasingly important as vegetation and weather change with the changing climate, creating circumstances that have never been encountered before. Firefighters and fire managers will need to know how to handle these new complex variables and their interactions in order to ensure safety of the public and surrounding infrastructure.

In fall 2020, QUIC-Fire was awarded an R&D 100 Award and a Gold Medal for Corporate Social Responsibility.

Funding and mission

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Los Alamos National Laboratory   **www.lanl.gov**   **(505) 667-7000**   **Los Alamos, NM**

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