

HIGRAD/FIRETEC: A Coupled Atmospheric/Wildfire Modeling Tool

HIGRAD/FIRETEC is the first physics-based, three-dimensional (3-D) computer code designed to simulate the constantly changing, interactive relationship between fire and its environment. It does so by representing the coupled interaction between fire, fuels, atmosphere, and topography on a landscape scale (hundreds to thousands of meters). HIGRAD/FIRETEC combines physics models that represent combustion, heat transfer, aerodynamic drag, and turbulence with a computational fluid-dynamics model that represents airflow and its adjustments to terrain, to different types of fuel (vegetation), and to the fire itself. Unlike the empirically-based models currently used in the field, HIGRAD/FIRETEC simulates the dynamic processes that occur within a fire and the complex way those processes interact to alter and alter the fire behavior.

Currently HIGRAD/FIRETEC is the cornerstone for a growing collaboration between Los Alamos National Laboratory and the USDA Forest Service Rocky Mountain Research Station, which also reaches out to eight domestic university campuses, and multiple research institutions in France.

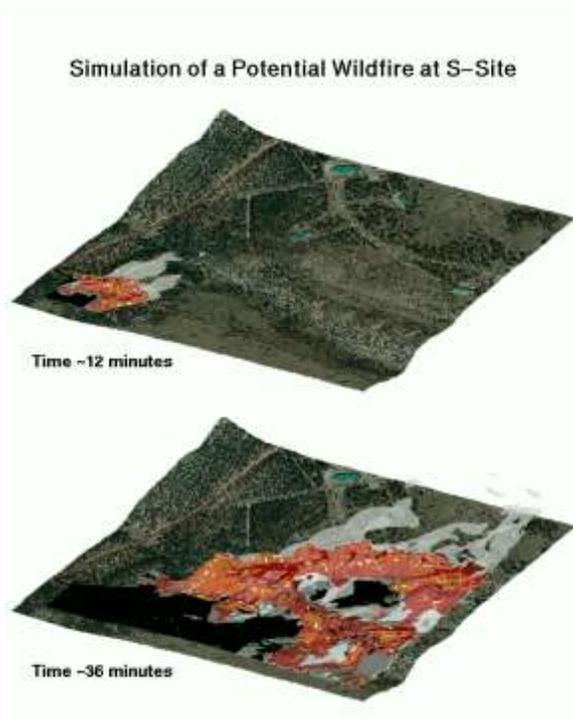


Figure 1. This simulation of a potential fire near the southwest corner of Los Alamos National Laboratory (S-site) illustrates the use of HIGRAD/FIRETEC to simulate a wind driven fire that is heavily influenced by topography, heterogeneous vegetation, and the interaction between the atmosphere and the fire. The simulated fire moved slowly down a gradual slope and then into a steep canyon (depicted by the image at 12 minutes). After reaching the bottom of the canyon 30 minutes after ignition, it climbs quickly out of the canyon and across a grassy upslope area (the blackened patch surrounded by fire in the 36 minute image).

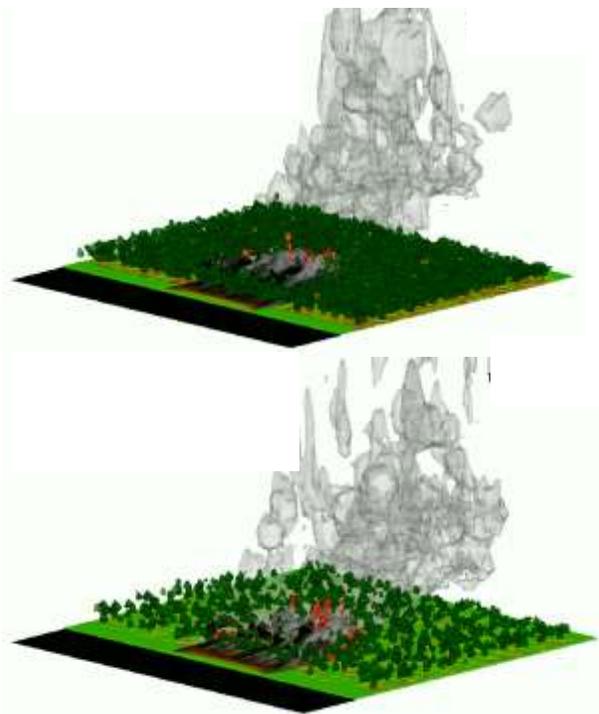
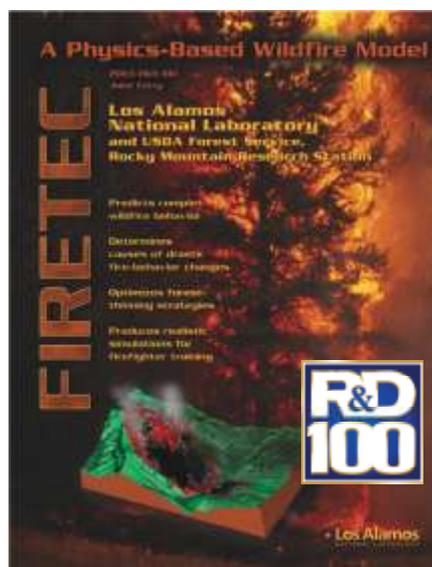


Figure 2. The top image shows a simulated fire in a forest with tree distributions and densities similar to those measured near Flagstaff AZ. The bottom image shows a fire moving through the same forest after removing all of the trees with less than 28 cm trunk diameter. In these simulations, HIGRAD/FIRETEC has been used to simulate fire propagation amongst trees that are individually represented. This capability and its physics-based representation enables HIGRAD/FIRETEC to examine the way different physical processes change if the vegetation structure is changed. This is critical for learning how to better define vegetation management strategies.



HIGRAD/FIRETEC has won a 2003 R&D100 Award as well as a 2004 Midwest Region Federal Laboratory Consortium Outstanding Technology Development Award.