Wildland Fire

Toward improved forecasts and a safer nation

Summer 2013

I. People and Property at Risk

Since 2000, U.S. wildland fire suppression has cost more than $2 billion per year (2012 dollars). The economic impacts from natural resource loss, land rehabilitation, and lost business and recreation are far greater—as much as 10 to 50 times the fire suppression costs, according to some economists. Studies suggest that U.S. fire seasons as damaging as 2012’s could occur two to four times more often by midcentury. One example: Colorado’s most destructive fire on record struck near Colorado Springs in June 2013, killing two people and destroying more than 500 homes. Among the factors involved are

- dramatic increases in home building in the wildland-urban interface
- a century of fire suppression that has altered the state of wildlands
- drought overlapping with flame-fanning weather events

Wildland fires can degrade air quality for days to weeks across large areas, affecting the health of thousands of people located far from the flames. After a fire, flooding and water quality threats increase.

II. Problem-Focused Research

Models that simulate weather-and-fire interaction. NCAR develops, maintains, and supports two public-domain computer models that combine weather simulation with fire behavior, thus capturing not just wildfire response to environmental conditions but also how fires create their own weather. The models allow scientists to reproduce destructive fires and analyze the unique characteristics of each one. They are also being used as prototype forecasting systems to predict where and how quickly a particular wildland fire might grow during its lifetime. Fine-scale simulations can also shed light on extreme behaviors that can threaten firefighters and cause fires to grow especially rapidly, such as fingers of flame shooting well ahead of a fire’s core area.

Measuring smoke and chemical emissions from fire. A satellite-borne instrument based at NCAR has been measuring the global spread of carbon monoxide from wildfires and other sources for more than a decade. An online resource at www.acd.ucar.edu provides observations from the MOPITT instrument, global fire emissions data using other satellite products as inputs, as well as global forecasts of atmospheric composition. NCAR also maintains a suite of high-end instruments (ground- and aircraft-based) to gather precise data on airborne chemicals and air quality for field campaigns and other focused observations.
**Improving air quality and fire growth predictions.** NCAR is a leader in data assimilation—incorporating diverse types of observations into forecast models to improve their skill. Researchers are developing techniques to integrate data collected by satellites, aircraft, and remotely piloted vehicles. Using such tools, NCAR carries out post-event analyses of the impacts of fires on air quality and health. These impacts models do not yet predict fire behavior. Coupling the two capabilities would create the capacity to predict wildfire impacts on air quality over periods of a few days. Simulations of large wildfires are being improved using new active fire detection via satellite monitoring and airborne fire mapping data.

### III. Advantages & Applications

**Weather-and-fire models:**
- Science-based guidance on fire behavior
- Real-time input available for firefighting and public safety efforts

**Emissions measurement:**
- Data on wide range of spatial scales, from global to site-specific
- Measurements tailored as needed for local and regional studies
- Improved knowledge of fire-related air chemistry can help identify effects of future fires and serve as a foundation for public health benefits

**Air quality modeling:**
- Software developed with world-class specialists in data assimilation
- Used for estimating air-quality impacts from current fires and capable of forecasting fire impacts
- Global analyses and forecasts highlight areas that will be affected by spread of fire emissions and can be used to drive regional air quality forecasts

### V. Funding and IP Status

NSF (core funding, interdisciplinary grants, CISE support), NASA, FEMA

**Seeking additional funding for the following goals:**
- **Weather-and-fire models/air quality models:** Improve and extend forecasts of fire growth by integrating satellite and land-surface data; combine weather-and-fire models with regional and global air quality models to simultaneously predict fire behavior and air quality; analyze the response of wildland fires to future climate conditions; tailor models and visualization tools to specific users, including first responders, foresters, and watershed managers.
- **Emissions measurement:** Provide enhanced deployment of scientific instrumentation during ongoing fires to improve understanding of emissions and air chemistry to benefit fire impact analysis and forecasting

### VI. Research Partners

Colorado Department of Public Health and Environment
NOAA
USDA Forest Service
University of Maryland

---

**Contact**

Scott Rayder, Senior Advisor to the UCAR President
+1 303-497-1673 | rayder@ucar.edu | president.ucar.edu/development