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Wildland Fire Research to Protect Health and the Environment

Researchers lift a monitoring balloon to track smoke from a prescribed fire in Camp Lejeune, N.C.

Fires are increasing in frequency, size and intensity partly due to climate change and land management practices, yet there is limited knowledge of the impacts of smoke emissions —both short term and long term. EPA is using its expertise in air quality research to fill the gaps in scientific information and to develop tools to prevent and reduce the impact of wildfires and controlled or prescribed burns. The wildland fire research has three main goals:

- Provide new science to understand the impacts of smoke on health, and how this knowledge can instruct smoke management practices and intervention strategies to reduce health impacts.
- Provide essential novel data on smoke emissions to construct the national emission inventory used to understand air quality across the country.
- Improve understanding of how smoke from fires affects air quality and climate change.

Health Effects Research

Wildfires increase air pollution in surrounding areas and affect air quality regionally. Public health officials warn residents about the respiratory problems for those exposed to wildfire smoke, but more information is needed to understand the full extent of smoke's toxic effects. The goal is to improve understanding of the health effects from wildfires and provide information and tools that can be used to prevent or reduce health impacts.

Researchers are conducting studies to answer these and other questions:

- What is the full extent of health effects from smoke exposure?
- Who is most at risk?
- What strategies and approaches are most effective in protecting public health?
- What are the environmental, social and economic impacts of wildfire emissions?

A study on the 2008 North Carolina peat wildfire revealed an increased incidence of hospital visits for heart problems as well as breathing problems related to lung disease. Researchers also found that more people went to the hospital for treatment in counties of lower socio-economic status.

Researchers are also comparing the toxic effects of wildfire smoke components—like particulate matter (PM)—to other outdoor air pollutants emitted from different sources such as industry and motor vehicles. It is important to determine whether different vegetation fuel types and combustion conditions produce different toxic emissions. A study found:

- Coarse PM affects lungs, while fine and ultrafine PM affect heart health.
- PM particles in smoke released during a fire are more toxic than PM particles lingering after the active fire.

Wildfires can cause loss of life and property in communities. Smoke emissions can have wider impacts outside the immediate fire area. A social science focus is providing EPA insights into the health and economic costs due to changes in air quality. This societal burden is calculated in terms of incidence and cost of visits to emergency departments, hospital admissions, and loss of productivity, school absences and other similar outcomes. EPA is also developing tools to provide real-time forecasts of likely health impacts from wildfires. Planned case studies in North Carolina and Sydney, Australia, where public health surveillance programs are in place, will be used to further evaluate impacts and test tools.

Modeling Research

Smoke from fires affects local, regional and global air quality as plumes are transported and dispersed into the atmosphere. Furthermore, the particulate material and gases emitted by wildfires contain carbon, so these fires contribute both directly and indirectly to climate change. Modeling emissions from wildfires helps researchers better predict how future fires can impact air quality, regional climate and public health. Questions being addressed include:

- How does a fire affect regional air quality as it spreads and the smoke disperses?
- What is the estimated smoke exposure for those near fires, and how does it relate to observed health effects?
- How do prescribed burns contribute to air pollution concerns?

Researchers want to use this information to improve the capabilities of models, such as EPA's Community Multiscale Air Quality Model (CMAQ) so that they can be used to track and evaluate smoke emissions on air quality and climate change. The findings can be used to better protect public health.

EPA researchers conducted a study using a model developed by the National Oceanic Atmospheric Administration (NOAA) to simulate how a warning advisory might mitigate the health and economic repercussions of wildfires. They found in the simulation that people can protect their health by responding to advisories, thus lowering economic costs of wildfires from hospital visits, productivity losses and mortality. The team is currently working to adapt this model to other wildfire outbreaks.

Emissions Measurement Research

Measuring smoke emissions enables researchers to understand how fires contribute to air pollution and climate change. Field studies use air monitoring on the ground and aerial samplers on planes and balloons to estimate the amount and dispersion of emissions near wildfires and prescribed burns. Research questions that guide the science include:

- Does the smoke from differing kinds of vegetation found throughout the country (oak, pine, chaparral and peat) produce different types and levels of pollution?
- How does the intensity of a fire affect the emissions of air pollution and the greenhouse gases and black carbon that contribute to climate change?

Researchers have developed and integrated sensors and lightweight samplers into instrument systems that can be more safely deployed during active fires and prescribed burns to provide more robust smoke emissions data. Unlike ground sensors that are used around the perimeter, air sensors have a great advantage in that they can be placed in balloons and other aerostats to take air samples at different locations and altitudes in the fire zone. These sensors are being tested for their ability to measure emissions, including air concentrations and the dispersion of smoke plumes.

Preliminary findings in one study suggest that less intense fires with lower combustion efficiency produce less black carbon but more volatile organic compounds, a type of hazardous air pollutant.

For more information, please visit:

Joint Fire Science Program:
https://www.firescience.gov/

Fire and Your Health:
http://airnow.gov/index.cfm?action=topics.smoke_events

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