NEW MEXICO
Climate

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Office of the State Climatologist | Department of Agronomy and Horticulture
College of Agriculture and Home Economics | Agricultural Experiment Station

Where there's fire, there's smoke!

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Unplanned or unwanted fires, such as catastrophic wildfires, can pose serious threats to public health and safety, as well as to air quality.

Health Issues

Smoke contains a number of pollutants. Particulate matter is the main pollutant of concern because it can cause serious health problems. Particles below 10 microns in size (about seven times smaller than the width of a human hair) are more likely to travel deep in the respiratory system, and be deposited deep in the lungs where they can be trapped on membranes. If trapped, they can cause excessive growth of fibrous lung tissue, which leads to permanent injury. Children, the elderly, and people suffering from heart or lung disease are especially at risk.

Smoke also adversely affects the clarity of our air, which in turn, affects the distance and sharpness with which we see objects. On July 18, 1997, EPA issued new national ambient air quality standards (NAAQS) for ground-level ozone and "fine" particulate matter (particles smaller than 2.5 micrometers in diameter, or $PM_{2.5}$). Depending on the distance from the fire, the air quality standards may be exceeded by smoke from wildfires. As the atmospheric removal mechanisms for fine particles work slowly, fine particles travel long distances and have residence times up to weeks. The elimination of fine particles out of the atmosphere is mainly by precipitation.

How wildfires affect the quality of our air depends on many factors, including weather, such as wind speed and direction; humidity; atmospheric stability; the scope and severity of the fire; and the type and quantity of fuels burned. Wildfires are an intense heat source, creating heat-driven turbulence, that interacts with the atmosphere's general flow over the fire. Emissions from burning biomass ascend vertically and cool gradually as they mix with the local atmosphere. There is considerable uncertainty in estimating the height to which fire products will be transported [Garstang, 1998]. However, the horizontal spread of the plumes depends on weather conditions, micro- to macro-scale meteorological conditions occurring during the fire, chemical transformation processes and the topography [Israel, 1992]. As the plume moves horizontally, the concentration of the particulate matter decreases due to lateral and vertical dispersion or spreading of the plume. The transport mechanisms are usually nonlinear and difficult to predict [Garstang, 1998]. However a simple plume dispersion model HYSPLIT4 (1997) can give an idea of the general direction and speed of movement of a smoke plume along with concentration of particulate matter if the original fuel load from

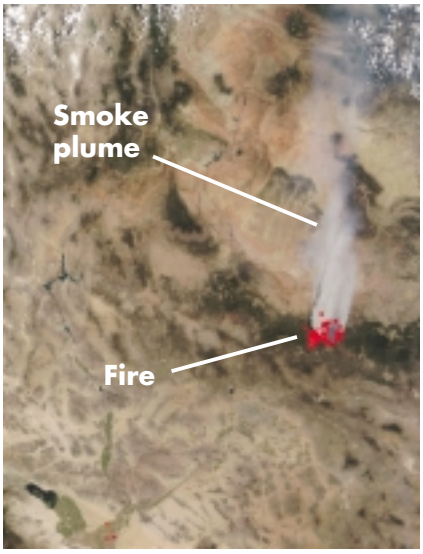

Figure 1. June 20 10:30 AM Show Low Arizona fire

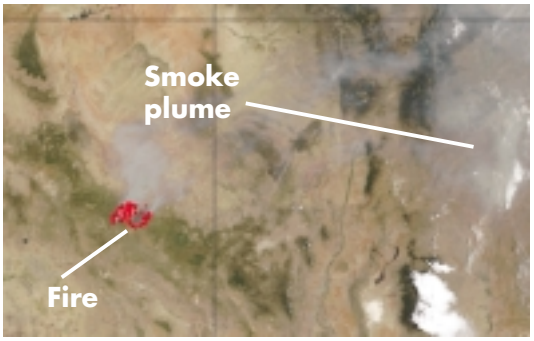

Figure 2. June 23 11:00 AM Show Low Arizona fire

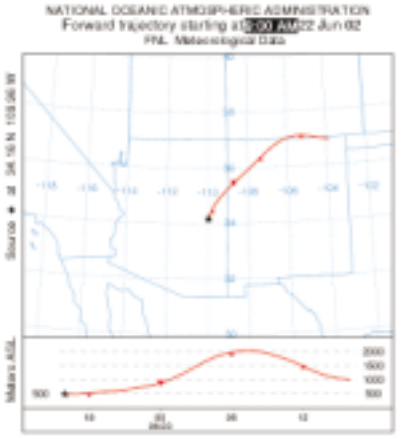

Figure 3. Path of smoke modeled from June 22 at 9 AM till June 24 at 9 AM. The time scale is (http://greenwichmeantime.com) (GMT) and elevation in meters is Above Ground Level (AGL) starting at the elevation of the location where the fire is located.

the fire is known. As the distance from the point source occurs, particulate matter decreases because the particulate matter is spread over a larger vertical and horizontal distance. The higher the particles travel, the lower the concentration at ground level where people breathe in the air.

NASA (http://rapidfire.sci.gsfc.nasa.gov/gallery/) monitors wildfires from satellites and the smoke plume direction and speed can be seen if cloud cover does not obscure the area. A fire started near Show Low, Arizona June 17 showed up on the satellite phone on June 19.

By June 20 (figure 1) the smoke plume can be seen moving north, parallel to the New Mexico border.

By June 23 (figure 2) the wind direction has changed and the smoke path has moved to a northeasterly direction over Albuquerque, NM and northern New Mexico. In the center of the picture can be seen the Rio Grande River. The plume model predicts that the smoke from 9 AM June 22 would reach Santa Fe at 11 AM June 23. The plume model (figure 3) predicts the center of the plume path and agrees with the satellite photos.

By June 30 (figure 4) the wind direction had again changed and the smoke was moving in a southeasterly direction. The plume model (figure 5) predicted that smoke from the fire burning at 9:30 AM on June 30 would travel to Southern New Mexico in 12 hr and would be 1500 m above the fire elevation at ground level (AGL) which was in agreement with the satellite photos.

Air quality particulate matter is monitored in New Mexico throughout the state

Figure 4. June 30 11:00 AM Show Low Arizona fire

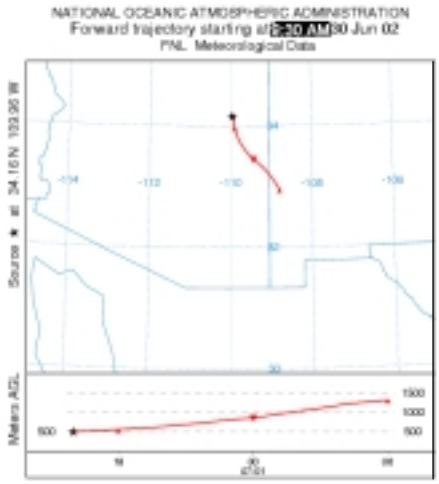

Figure 5. Path of smoke modeled from June 30 at 9:30 AM till June 30 at 9:30 PM. The time scale is (http://greenwichmeantime.com) (GMT) and elevation in meters is Above Ground Level (AGL) starting at the elevation of the location where the fire is located.

(figure 6), (http:www.epa.gov/air/data/monloc.html?st~NM~New%20Mexico) and air quality alerts are announced over the radio and television. People with health or safety (visibility) concerns can monitor this site to determine if and when wildfire may pose personal health and safety risks. Prediction of when the smoke from a wildfire may pose personal health and safety risks or prediction of when the smoke from a wildfire may reach a site in New Mexico can be determined by running HYSPLIT4 (1997) using forecast climate data.

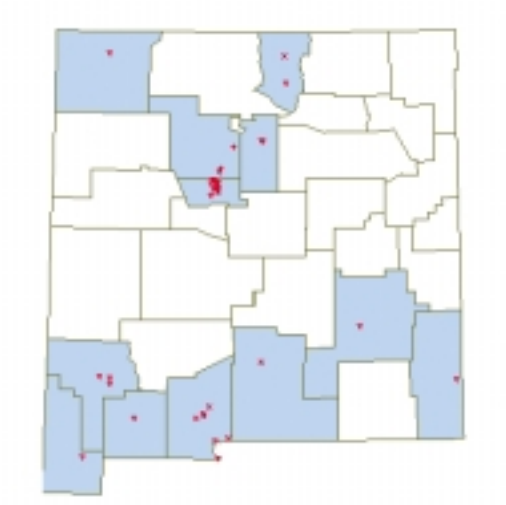

Figure 6. Location of EPA air quality samplers for PM10

References:

Garstang, M.(1998): The Role of the Atmosphere in Fire Occurrence and the Dispersion of the Fire Products. Background Paper submitted to the WHO Meeting on Health Guidelines for Forest Fires Episodic Events, 6-9 October 1998, Lima, Peru.

HYSPLIT4 (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model, 1997. Web address: (http://www.arl.noaa.gov/ready/hysplit4.html), NOAA Air Resources Laboratory, Silver Spring, MD.

Israel, G. et al (1992): Analyse der Herkunft und Zusammensetzung der Schwebstaubimmissionen. Technische Universität Berlin.

About NMSU's Climate Center

NMSU s Climate Center is home to the state climatologist who helps New Mexicans understand the impact of climate changes on the environment, human health, and agricultural production.

The state climatologist is responsible for archiving weather data and distributing climate information to the public. Unlike meteorologists, climatologists do not provide weather forecasting or up-to-the-minute bulletins. Instead, they use a computerized data collection system to provide statewide weather reports for previous days, as well as for historical information.

The state climatologist puts climate data into a form people can use to make decisions about their lives. During fire season, people use climate data to assess potential fire hazards and to evaluate fire-fighting conditions. Engineers use information about rainfall and flooding to design bridges, culverts, storm sewers, and sanitary sewers. Business owners use climate data to evaluate new business or relocation sites. Farmers use it to anticipate outbreaks of insect pests or crop diseases. People also use climate data when making their recreation and travel plans.

The office of the state climatologist and its head, the state climatologist, are described in New Mexico Statute 75-4-1 through 75-4-4.

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