United States Department of Agriculture
Forest Service

Rocky Mountain Research Station

Air, Water, and Aquatic Environments Program

Providing scientific knowledge and technology to sustain our nation's forests, rangelands, and grasslands

Science BRIEFING

March 5, 2014

Ozone in Mountain Ecosystems

BACKGROUND

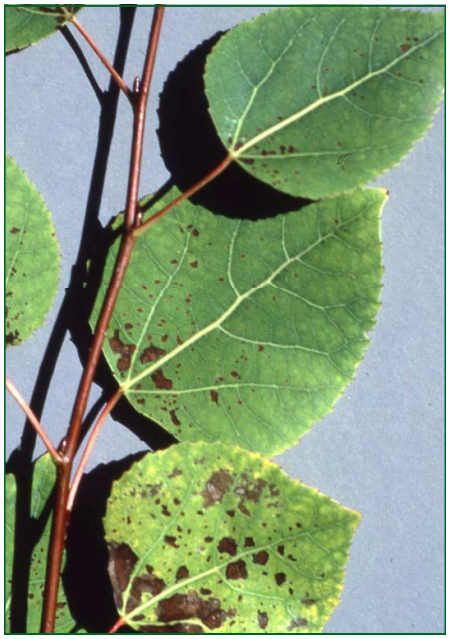
Ozone (O_3) in the lower atmosphere is highly reactive and can damage the tissues found in the leaves of plants. However, little is known about ambient O_3 concentrations at remote, non-urban mountainous areas of the western U.S.

RESEARCH

Research Activity: Ozone levels were measured from 2007-2011 at high elevation sites in national forests in Colorado and northeastern Utah. Data from this monitoring showed that O_3 was primarily in the mid-concentration range, rarely exceeding 100 ppb or dropping below 30 ppb, yet these sites have O_3 concentrations high enough to contribute to exceedance of the current National Ambient Air Quality Standard. The small daily changes in concentration indicate mixing ratios of nitrogen oxides (from fossil fuel combustion, fires, fertilizers, and lightning) and volatile organic compounds (released by industrial processes, car emissions, and vegetation) that favor stable O_3 concentrations and higher nighttime concentrations. Highest nighttime O_3 concentrations occurred at the highest elevations, while there was no relationship between daytime O_3 concentrations and elevation. Higher O_3 concentrations in springtime suggest that stratospheric intrusion may contribute to ambient O_3 at remote sites.

Management Implications: There were significant year-to-year differences in O_3 concentrations at each of the remote locations studied, but even in low O_3 years some of these sites had concentrations above the National Ambient Air Quality Standard. The large number of mid-level O_3 concentrations contributed to a high W126 cumulative O_3 exposure index, a secondary standard proposed to protect sensitive vegetation. This suggests that the proposed W126 secondary standard would be difficult to achieve at most remote national forest sites and other rural locations in the western U.S. These findings will allow National Forests to determine O_3 levels in remote areas, determine if O_3 at these sites exceed the federal standard, and examine long-term changes in O_3 in remote regions.

RMRS researchers are using a portable battery powered monitor to evaluate ozone at Trout Creek Pass, Colorado and several other high-elevation locations in the Rocky Mountain West.



Ozone injury on aspen, a sensitive species used for ozone biomonitoring.

KEY POINTS

- Ozone (O_3) is a widespread air pollutant formed primarily by nitrogen oxides reacting with volatile organic compounds on warm, sunny days.
- O_3 can kill leaf tissue, reduce plant growth, and make plants more susceptible to other stresses such as drought.
- Portable battery powered monitors can be used for determining O_3 values at remote locations.
- O_3 levels increase with elevation and exceed air quality standards in remote ecosystems in Colorado and Utah.

MORE INFORMATION

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Keywords: *air pollution, forests, high elevation, National Ambient Air Quality Standard, nighttime exposure, stratospheric intrusion, W126*

 Science Briefings can be found online at: http://www.fs.fed.us/rm/boise/AWAE_home.shtml