

"Real-time" air quality monitoring data displayed at Great Smoky Mountains

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In Great Smoky Mountains National Park (Tennessee and North Carolina), air pollution seriously damages park resources. Visibility is impaired by a uniform haze that affects scenic vistas. Landscape features and colors fade, diminishing the experience of visitors to the park. Air pollution in the form of ground-level ozone threatens human health and vegetation. A variety of plant species (black cherry, yellow poplar, sassafras, tall milkweed, and cutleaf coneflower) show symptoms of ozone injury to foliage. Other airborne pollutants, including sulfur and nitrogen compounds, result in acidification of some high-elevation streams, soils, and plants.

Data collection for the assessment of air pollution impacts on resources in national parks has been successful in addressing this resource management concern. Public awareness, however, should not be underestimated as a partner to science as an effective means of protecting park air resources. An informed public can be a strong ally in these efforts. Now, using modern communication methods, computer exhibits can show visitors real-time visibility, air pollution concentrations, and weather conditions.

Real-time data exhibited

Currently, Great Smoky Mountains National Park is using real-time visibility data in an interpretive exhibit on air quality at the Sugarlands Visitor Center. Park Superintendent Karen Wade is excited about the exhibit. "It is important for the public to understand how air pollution affects park resources, since the public plays a key role in bringing about those actions necessary to prevent air pollution impacts," Wade said. "The park should use the best information and tools available to increase public awareness."

The exhibit at Sugarlands Visitor Center consists of two 3 ft x 9 ft panels located in the visitor center. The panels display information about the cause and effect of air pollution at the park (fig. 1). Monitors in each panel are linked to air monitoring equipment at the park's Look Rock air quality station and observation tower and show current visibility, ozone concentrations, and meteorological

conditions. An air quality brochure is also available at the visitor center for individuals who would like more in-depth information about air pollution impacts at the park.

At Look Rock, a digital zoom camera captures visibility images (fig. 2), a nephelometer gathers optical visibility data, an ozone analyzer measures ozone concentrations, and meteorological monitoring equipment collects weather-related information (fig. 3). The digital camera, mounted atop Look Rock observation tower, is aimed toward the crest of the Great Smoky Mountains to capture images characteristic of the park and familiar to visitors. The camera is equipped with a personal computer modem. The camera and support computer, housed in a secure, environmentally controlled enclosure, have the following capabilities:



Figure 2. Capturing a new visibility image every 15 minutes, the digital camera is mounted inside the observation tower at Look Rock. The digital image is transmitted by telephone line and short-haul modem to the Look Rock air quality shelter (right).



Figure 3 (below). Instruments at Look Rock record weather data, measure ozone, and analyze visibility distance (visual range). A data logger collects the information and forwards it to Sugarlands Visitor Center.



1. Acquisition of a digital image at selected time intervals
2. Automatic light-level and color-balance adjustment
3. Image capture across a wide dynamic range
4. User-selectable camera field of view
5. Off-site reconfiguration and reset capabilities
6. Reliable operation over a wide ambient temperature range

The digital image is transmitted by telephone line and short-haul modem to the Look Rock air quality shelter. There, a data logger and computer record measurements from the nephelometer, ozone analyzer, and meteorological sensors. Data are sent every 15 minutes through a telephone line to a computer at Sugarlands Visitor Center and to a local Internet service provider in Knoxville, Tennessee. The visitor center computer performs the following functions:

1. Acquires image and data files
2. Validates the data and image files
3. Formats the image and data files for display on exhibit monitors
4. Cycles visitor display screens
5. Provides for on- and off-site modifications of the display programs
6. Provides for on- and off-site system troubleshooting

The computer operates a Windows-based program that is easy to use. Park staff can troubleshoot individual computer system components and change the displayed information. The staff have dial-up computer access to the digital camera and to the data logger to make changes in operational modes, reboot the camera computer, or conduct troubleshooting activities.

On each of the 21-inch monitors in the exhibit, three different display screens are cycled for the public to view. One screen provides a current video image from Look Rock and information on current visibility conditions (fig. 4), shown as visual range in miles. Static images of a good visibility day and a typical day (i.e., the current seasonal average) are also presented on the screen, inviting comparisons with current visibility conditions. A second screen provides information about current ozone concentrations at Look Rock. The current hourly concentration is displayed on the screen along with the previous day's maximum and minimum hourly ozone concentrations. In the lower half of the screen, a static scale shows public health-related effects from ozone. A third screen provides meteo-

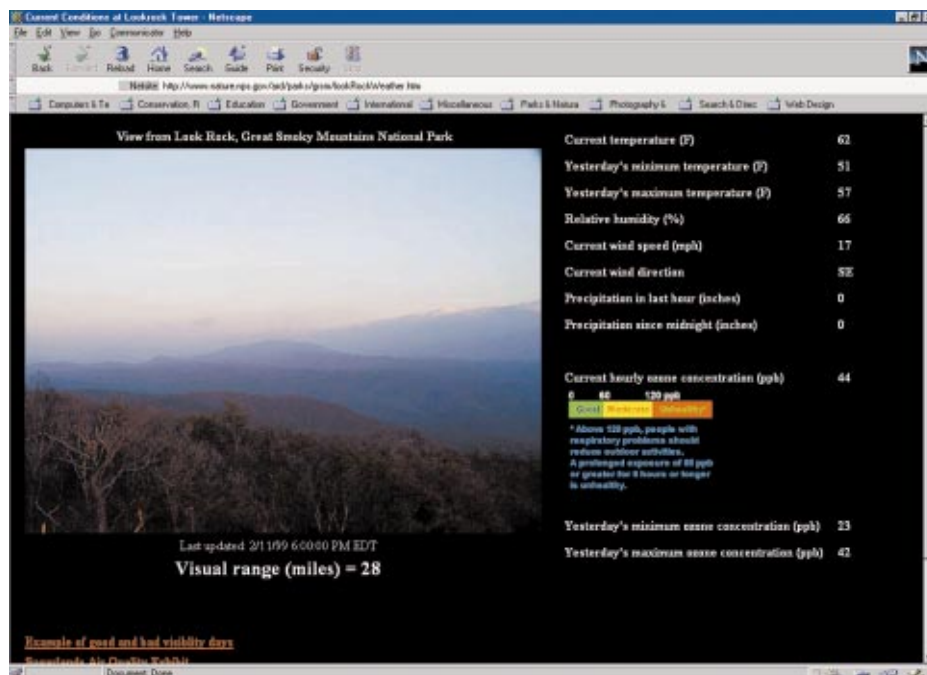


Figure 4. A "real-time" photograph of the view from the Look Rock observation tower is published on the World Wide Web every 15 minutes. The caption documents the time when the image was made and the visual range depicted in the scene. Meteorological data including temperature, relative humidity, precipitation, and wind speed and direction are updated every 15 minutes. Ozone concentrations are updated hourly.

rological information from Look Rock. This includes current wind direction and speed, ambient temperature, relative humidity, and precipitation.

First on the Web

The real-time interpretive air quality exhibit at Sugarlands is also the first exhibit of its kind to present current monitoring data in a national park on the World Wide Web. The information from Look Rock is sent via the Internet to the Air Resources Division in Denver, Colorado. There it is published on the World Wide Web at www.nature.nps.gov/ard/parks/grsm/lookRockWeather.htm.

The technology used for this exhibit can also be used to present monitoring data from a variety of other natural resource management activities in a park. This interpretive approach serves as a very effective resource management tool. The presentation of real-time monitoring data not only enables park managers to provide the public with current data, but it also provides an opportunity to easily modify and update the presentation of data results.

Funding for the exhibit and its link to the monitoring equipment was provided through a partnership with the NPS Air Resources Division, U.S. Environmental Protection

Agency, Great Smoky Mountains Natural History Association, and Great Smoky Mountains National Park.

The total cost for this project at Great Smoky Mountains National Park was approximately \$50,000. The cost, however, was unique to the monitoring setup at the park and may be approximately the same or lower at other units of the national park system, depending on configuration and location of the monitoring equipment. The Air Resources Division has limited funds available each fiscal year to assist with the development of real-time exhibits in units that are monitoring air quality parameters. **P_S**

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