

Visibility Monitoring in the USDA Forest Service

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Introduction. The Clean Air Act assigns the USDA Forest Service (USDA/FS) an affirmative responsibility to protect and improve visibility in 88 wildernesses. Our sister agencies, The National Park Service and the US Fish and Wildlife Service have similar responsibilities for certain parks and refuges, respectively. As a significant part of satisfying this requirement, these three federal land managers have established a highly professional visibility monitoring program in coordination with the US Environmental Protection Agency and many state agencies. The monitoring data are used to assess current visibility conditions and trends and to help create emissions management strategies for the future. And, in fact, each of the 50 states is currently writing a state strategy that must be reviewed by each of the federal land managers and approved by the USEPA before the end of 2007. As these plans are implemented, the visibility monitoring network (IMPROVE) will be used to show progress (or lack of it) towards the national visibility goal. This goal is to attain a natural visibility condition in each of the class I areas by 2064.

The Equipment and the Sites. A visibility monitoring site can take three complementary forms of equipment; optical equipment (e.g., nephelometer (figure 1) or transmissometer (figure 3)) that directly measures light extinction, scene monitoring by cameras (figure 4) showing highly resolved images of distant targets and aerosol monitoring (figure 2) with filters. In aerosol monitoring, the types and quantity of particles on the filters are used to estimate the likely resulting light scattered or absorbed and thus the amount of visual acuity, coloration and fidelity lost when viewing a distant object.



Fig 1. Integrating nephelometer



Fig 2. Aerosol Sampler



Fig 3. Transmissometer

The most useful equipment for technically determining how to design emissions reductions programs is the aerosol sampler. It can be used to identify types of sources causing the haze, the likely locations of the sources and principle types of controls necessary to improve the visibility. They collect a 24 hour long sample every third day. The samples are always collected at every site on Tuesdays by Forest Service technicians or contractors. The samples are mailed to the Crocker Nuclear Laboratory at the University of California in Davis. New blank filters are mailed to the local operator for installation.

The most useful site for interpreting visibility conditions is the camera or scene monitor. High resolution images are used to show different visibility conditions across a wide spectrum of visibility days. Images from some sites are viewable online in realtime while at other sites the data must be transported by mail for downloading to the website. When these images are related to the aerosol data, the policy-maker and the scientist/technician can work together with air quality modelers to decide on the level of control needed to meet visibility objectives.

All Forest Service scene data from 75 sites dating to the early 1980's are viewable online on the agency scenes website (Figure 5).

The optical devices are usually used by scientists to accurately corroborate the results from the aerosol monitors and also to provide continuous visibility data since the aerosol data are averaged over a day and the camera data are instantaneous.



Fig 4. Scene Monitoring System (digital camera)

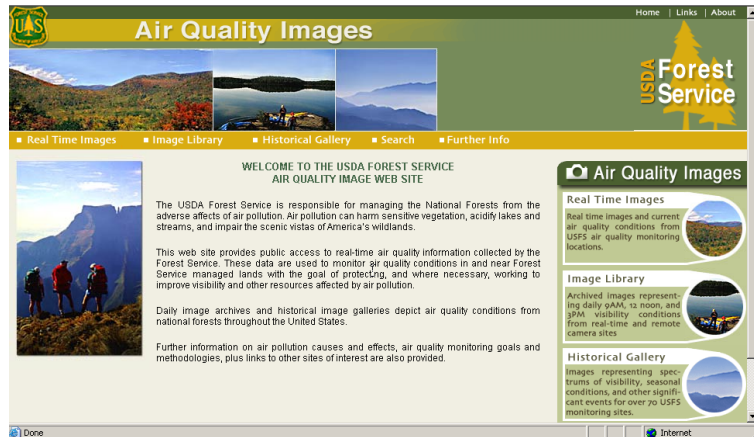


Fig 5. Forest Service Scene Monitoring Website. This site has about a half dozen realtime webcam images from class I areas plus all the historical scene data representative of most of the agency's class I areas. Go to: <http://www.fsvisimages.com>

The Partnerships. IMPROVE monitoring is a complex but highly efficient partnership.

Currently, the IMPROVE program has about 170 sites nationwide. Of these, 110 sites are run by the federal land managers. Of these, 50 are run by the Forest Service. In most case this means that the USEPA pays for the capital and analytical costs of aerosol samplers. But half a dozen aerosol samplers are bought and operated by the Forest Service. All cameras and the scenes website are paid for by the Forest Service. A handful of optical devices at Forest Service sites are operated fully by Forest Service funding. A full time visibility data analyst who assists any and all Forest Service staff and contractors interpret and properly use the visibility data. And, most importantly, most all operators at Forest Service sites are agency staff although a few are contractors paid by the Forest Service. The operator costs borne by FS field units range from a few thousand of dollars per year for easy to-get-to sites to \$36,000 per year for remote sites (e.g., two snowmobiles traveling 20 km one way).

The National Park Service invests heavily in visibility research ensuring that the data from all sites is interpreted properly. NPS also manages three national contracts to perform aerosol filter analyses that the Forest Service uses at its 50 aerosol sites. The Forest Service sends funds by agreement to NPS for these and other services. Besides underwriting the costs at aerosol sites, the USEPA establishes the rules by which the states work with the federal land managers to manage visibility and associated data in an orderly fashion. The states then must work with the federal land managers to ensure that visibility objectives established by the FLMs for the class I areas are met. USEPA can impose sanctions if this does not happen. The Forest Service works well with states to ensure that sites are operated in a way that the state can use the data to best advantage to protect the Forest Service class I areas. The Forest Service is also generous with its technical expertise in helping to interpret the data.

For efficiency, the Forest Service set-up a process to streamline the collection of funds from regional offices for use in visibility monitoring. Without this, each region or many forests would have to go through the cost and expense of obtaining their own contractual services and establishing their own agreements. Besides the substantial compounded overhead, consistency would be at risk. Funds identified at the headquarters (Washington Office) are sent to the Rocky Mountain Research Station where centralized national contracts and agreements have been established to accomplish the variety of work described above.

This acquisition system at RMRS is available to air program staff nationwide who frequently use it to quickly acquire needed support. For example, the highly successful wildland smoke monitoring program (which is very similar to visibility monitoring) including public website is run through the RMRS national air program acquisition process in Fort Collins.

For further information: Contact Rich Fisher (WO/WFW) 970-295-5981 rwfisher@fs.fed.us in Fort Collins.

The receiver for an [Optec LPV-2 transmissometer](#), which measures the light extinction coefficient by measuring the attenuation of light from a light source.

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