INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

Volume 3, No.4 **Fall 1994** **January 1995**

IMPROVE MONITORING UPDATE

Preliminary data collection statistics for the Fall 1994 season (September, October, and November) are:

Data Type	Collection Percentage
Aerosol Data	94%
Optical (transmissometer) Data	98%
Optical (nephelometer) Data	83%
Scene (photographic) Data	84%

Figure 1 is a map of the current IMPROVE and IMPROVE Protocol sites. The CASTNet program has adopted IMPROVE optical and scene monitoring protocols, but is using different aerosol monitoring techniques. Aerosol data for the Fall 1994 season are complete and seasonal summaries have been submitted to the NPS. Transmissometer-based visibility data have been reported through the Spring 1994 season.

The first nephelometer-based visibility data report including seasonal summaries for the Spring 1993 through Spring 1994 seasons has been completed. Nephelometer data will now be reported on a seasonal basis.

IMPROVE protocol monitors have recently been installed at the following Fish and Wildlife Service and Forest Service sites:

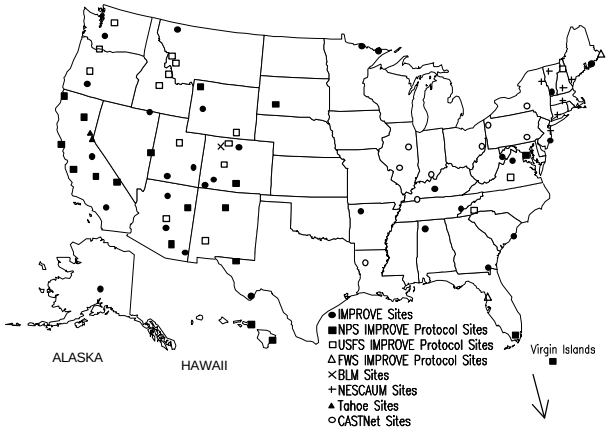

Figure 1. IMPROVE and IMPROVE Protocol Sites January 1995

- An IMPROVE aerosol sampler and a 35mm camera system at Cape Romain National Wildlife Refuge, South Carolina.
- An IMPROVE aerosol sampler and a time-lapse video monitoring system at Moosehorn National Wildlife Refuge, Maine. The time-lapse video system was installed to document the dynamics of visibility in the refuge and visual emissions from a nearby industrial source.
- An IMPROVE aerosol sampler and camera at the James River Face Wilderness, Virginia.

VISIBILITY NEWS....

IMPROVE STEERING COMMITTEE MEETING

An IMPROVE Steering Committee meeting will be held at the University of California - Davis (UCD) on February 16 and 17, 1995. The meeting, hosted by the Air Quality Group at UCD, will be comprised of two parts. The first day will cover the business agenda of the Steering Committee and will include a tour of the UCD facilities. On the second day, the committe will focus on a technical review of the state of the science of aerosol sampling and analysis and hold discussions concerning the implications for IMPROVE aerosol monitoring protocols.

SPECIAL STUDIES

Mt. Zirkel Reasonable Attribution Visibility Study

The monitoring program for the Mt. Zirkel Reasonable Attribution Visibility Study is underway. Sites selected throughout northwestern Colorado began collecting data in December. The annual monitoring program will be supplemented by three intensive monitoring periods. The first intensive is scheduled for February 1995. The other two intensives will occur during the summer and fall. A Technical Steering Committee (TSC) has been established to direct the study. The TSC is chaired by the Colorado Department of Public Health and Environment and includes representatives from Public Service Company of Colorado, Tri-State Generation and Transmission Association, and the U.S. Forest Service. A Technical Advisory Commmittee (TAC) has also been established to provide additional technical input to the steering committee. The study will be completed by June 30, 1996.

Dallas-Fort Worth Winter Haze Project

The Dallas-Fort Worth Winter Haze Project (DFWWHP) Defining Study has scheduled two intensive monitorng periods during the Winter 1994-95 season. The first month-long intensive was December 6, 1994 through January 6, 1995 and the next is scheduled for February 1995.

Feature Article

AEROSOLS AND VISIBILITY AT LAKE TAHOE

INTRODUCTION

Scenic Lake Tahoe straddles the California-Nevada boundary almost 2 km high in the Sierra Nevada mountains. To protect the air quality at this national treasure, the Lake Tahoe Air Basin was established in the 1970s. Air quality standards developed for this basin are more stringent than in other areas of California.

Over the last five years, IMPROVE protocol monitoring has been used by the Tahoe Regional Planning Agency (TRPA) to monitor visibility and fine aerosols and investigate the region's compliance with these standards.

TRPA VISUAL AIR QUALITY STANDARDS

The stringent standards in the Lake Tahoe Air Basin were based on a study performed by the EPA and TRPA in the early 1980s. Fine aerosols were monitored with stack filter units at the urban area in South Lake Tahoe and at two clean sites: Sugar Pine Point on the west shore and at Sierra Ski Ranch over the Sierra Mountains to the southwest. Regional visibility was estimated with teleradiometer measurements and photography from the north shore of the lake.

This study, along with inputs from the public and participating agencies, resulted in visibility standards for the Lake Tahoe Air Basin that included the following two categories:

Regional Visibility

- Achieve a visual range of 171 km (103 miles) at least 50% of the year as measured by particulate concentrations;
- Achieve a visual range of 97 km (58 miles) at least 90% of the year as measured by particulate concentrations;
- Reduce wood smoke emissions by 15% from the 1981 base values.

Sub-Regional Visibility

- Achieve a visual range of 87 km (54 miles) at least 50% of the year as measured by particulate concentrations;
- Achieve a visual range of 26 km (16 miles) at least 90% of the year as measured by particulate concentrations;
- Reduce wood smoke emissions by 15% and suspended soil particles by 30% from the 1981 base values.

Regional visibility is the overall prevailing visibility in the Basin. The primary impact of regional visibility degradation is a reduction in clarity, contrast, and color of vistas seen through the regional haze. The haze itself is not the dominant visual effect but rather causes a flattening out of the color and depth of the vistas.

Sub-regional visibility is characterized by a layer of perceptible haze that spreads over the urban areas, especially the south shore. The visual impacts of this haze depend on a number of factors, including scattering angle, viewing background, and illumination conditions. The effect of reduction in sub-regional visual air quality can appear as an overall degradation, or as a discontinuity of color and brightness, depending on the position of the observer.

TRPA VISUAL AIR QUALITY MONITORING PROGRAM

The TRPA monitoring program was implemented in 1989 to determine compliance with the Lake Tahoe Air Basin standards. Two fully instrumented monitoring sites, operating according to IMPROVE protocols, track the regional and sub-regional visual air quality (see Figure 2).

The regional site is located at Bliss State Park on the southwest shore of Lake Tahoe. The site is 700 feet above the lake and about 1/4 mile from the Desolation Wilderness, a designated Class I area. The sub-regional site is located in the urban area of the city of South Lake Tahoe about 100 yards from and 30 feet above the lake shore. Both sites have the following instrumentation:

- a full, four-stage IMPROVE aerosol sampler to monitor:
  - Module A: 25mm teflon filter - $PM_{2.5}$ mass, b_{abs} by laser integrating plate, elements (Na to Pb) by Particle Induced X-ray Emission (PIXE) and Hydrogen by Proton Elastic Scattering Analysis (PESA)
  - Module B: 47mm nylasorb filter with denuder - nitrates by ion-chromatography
  - Module C: 24mm quartz filter - organics by thermal optical reflectance (TOR) combustion analyzer
  - Module D: 25mm teflon filter - PM_{10} mass
- one ambient Belfort 1590 integrating nephelometer
- meteorological instrumentation: wind speed, wind direction, temperature, and relative humidity.

In addition, a transmissometer operates across the southern end of Lake Tahoe (Bliss State Park to Zephyr Cove) to monitor regional extinction, and an automatic 35mm camera system operates from the South Shore site viewing north across the lake.

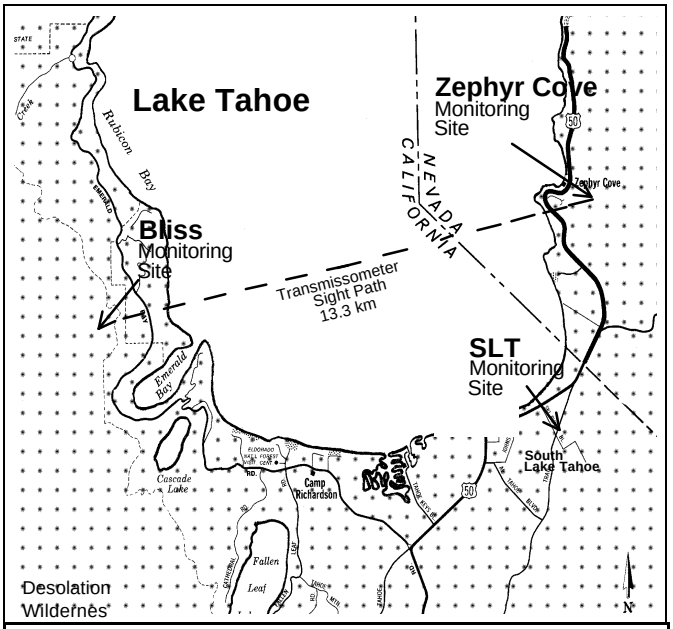

Figure 2. Monitoring Site Locations.

DATA SUMMARIES

Figure 3 presents the mean concentrations and chemical composition of aerosols measured at the Bliss State Park and South Lake Tahoe sites. The total fine mass and component concentrations of the aerosol types are higher during all seasons at South Lake Tahoe.

Regional data from Bliss and the transmissometer indicate relatively constant visual air quality in the basin throughout the year with only a slight increase in the scattering coefficient (b_{scat}) and extinction coefficient (b_{ext}) during the summer months. In sharp contrast, the large seasonal pattern at South Lake Tahoe, with winter b_{scat} twice the summer value, indicates the strong effect of local sources in the urban South Lake Tahoe area.

DATA ANALYSIS AND INTERPRETATION

Because TRPA's visibility standards require that visibility be estimated (reconstructed) from particulate concentrations, a model must be used to translate collected aerosol data into estimates of b_{scat}, b_{abs}, and b_{ext}, and to convert the b_{ext} value into visual range. The equation widely used to estimate b_{scat} from aerosol data is:

$$b_{scat} = 4.25\ (sulfates) + 4.25\ (nitrates) + 3.25\ (OC) +$$

$$1.5\ (LAC) + 1.25\ (Fine\ Soil) + 0.8\ (Course\ Mass)$$

where b_{scat} is the scattering coefficient in Mm^{-1} and aerosol concentrations are in ug/m^3. This equation was applied to mean aerosol compositions to derive aerosol scattering values.

Aerosol absorption (b_{abs}) was determined from absorption measurements from channel A of the IMPROVE aerosol sampler. Clean air (Rayleigh) scattering (b_{ray}) was determined from the elevations of the monitoring sites. The b_{ext} was calculated by combining b_{scat}, b_{abs}, and b_{ray}. The b_{ext} was then converted to visual range by:

$$Visual\ range\ (km) = 3.912/b_{ext}(Mm^{-1})$$

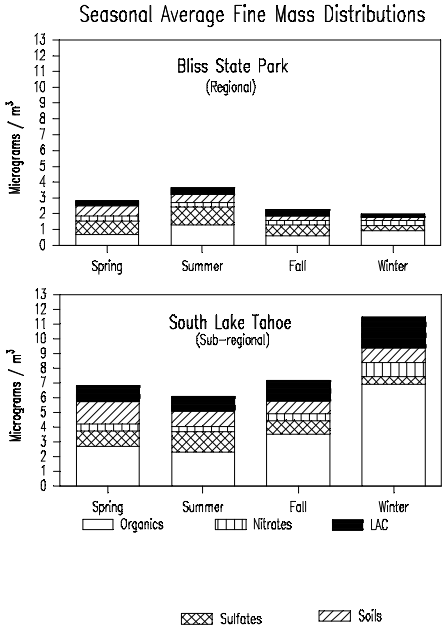

Figure 3. Seasonal Mean Aerosol Compositions.

Figures 4 and 5 indicate Regional and Sub-regional average seasonal and yearly extinction budgets for the Lake Tahoe Basin, respectively. Yearly mean b_{ext} from transmissometer measurements and the appropriate visibility standard are also indicated on each figure. Yearly regional mean reconstructed b_{ext} from aerosol measurements at Bliss agree well with the transmissometer b_{ext} measurements, indicating that the visibility model employed to reconstruct b_{ext} is reasonable.

These graphics illustrate that the TRPA regional and sub-regional yearly mean visual air quality standards are not being met. TRPA will address this issue in the coming year. TRPA plans to operate the visibility monitoring program as a long-term commitment.

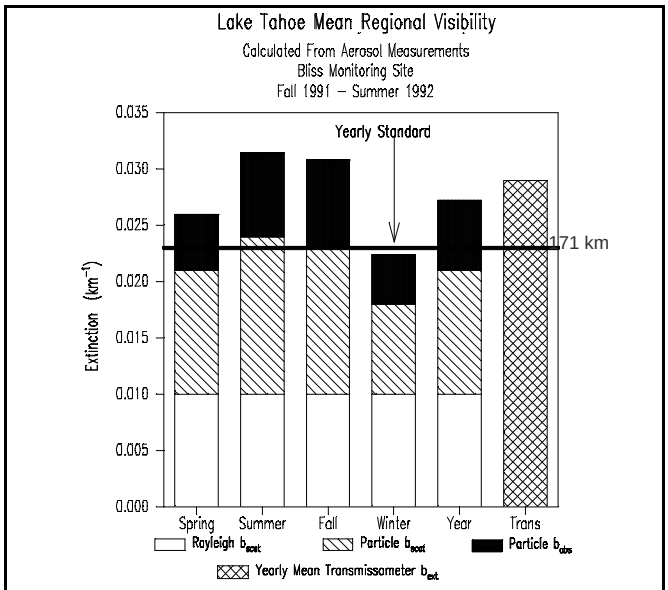

Figure 4. Regional Mean Seasonal and Yearly Extinction Budgets.

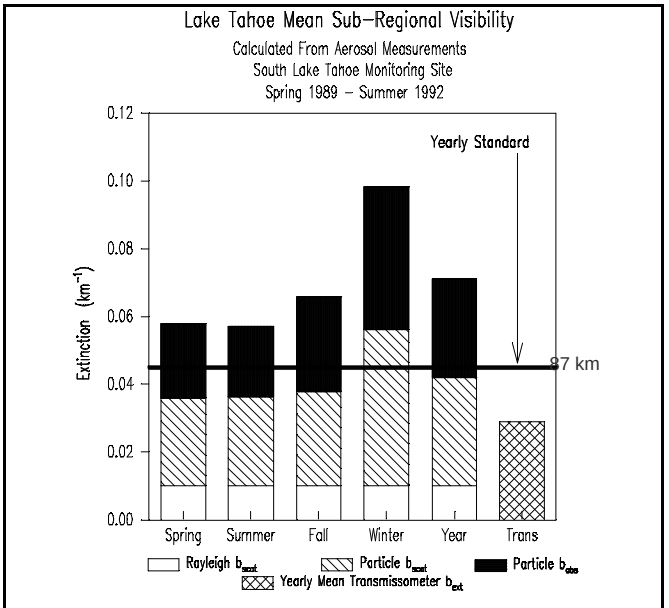

Figure 5. Sub-regional Mean Seasonal and Yearly Extinction Budgets.

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