INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

Volume 1, No. 3 **Spring 1992** **July 15, 1992**

IMPROVE MONITORING UPDATE

Preliminary data collection statistics for the Spring 1992 monitoring season (March - May 1992) are:

Data Type	Collection Percentage
Aerosol Data	93.0%
Optical (transmissometer) Data	99.4%
Scene (photographic) Data	76.3%

Figure 1 is a map of the current IMPROVE and IMPROVE Protocol sites. Changes to the network during the last three months included installations of camera systems at Mammoth Cave National Park, Brigantine Wilderness, Okefenokee National Wildlife Refuge, and Sipsey Wilderness; removal of the aerosol and camera systems at Arches National Park; and installation of an aerosol sampler at Great Basin National Park.

Reprocessing of all transmissometer optical data from Spring 1991 through Spring 1992 is underway to incorporate pre- and post-calibration values for final lamp drift corrections. Aerosol data reduction for the Spring 1992 season is underway.

The Forest Service, Pacific Northwest Region, recently announced that it will be installing two IMPROVE Protocol sites within the region. The final site selection is pending. At least one of the sites will be operational by the end of 1992.

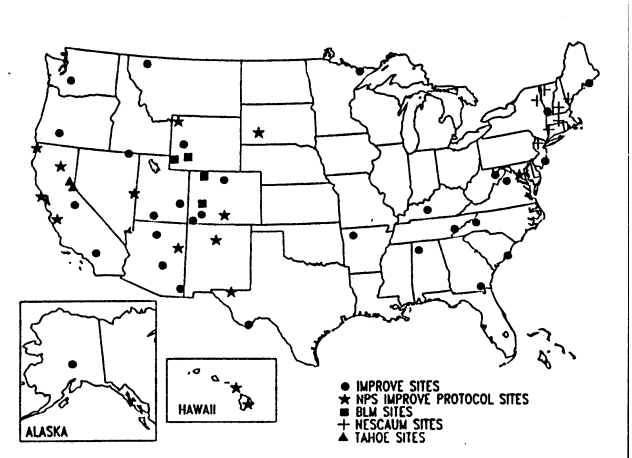


Figure 1. IMPROVE and IMPROVE Protocol Sites July 1992

PROJECT MOHAVE UPDATE

Summer Intensive

The summer monitoring intensive for Project MOHAVE is scheduled from July 12 to September 3, 1992. Congress allocated specific funds for the Environmental Protection Agency (EPA) to conduct a "pollution tracer study at the Mohave Power Plant." Project MOHAVE (Measurement Of Haze And Visual Effects) is EPA's response to this congressional mandate. The primary goal of Project MOHAVE is to determine what contributions the Mohave Power Plant and other sources make to haze at Grand Canyon National Park and other mandatory Class I areas where visibility is an important air quality issue. During the summer intensive, instrumented sites throughout the desert southwest will monitor optical and scene visibility, particulates, surface and upper air meteorology, tracers, emissions, and a range of additional supporting parameters. Collected data will be compiled and analyzed in conjunction with various modeling strategies. The organizations participating include:

Project MOHAVE Partners
Southern California Edison Company
U.S. Environmental Protection Agency

Project MOHAVE Participating Sponsors
California Air Resources Board
Electric Power Research Institute
National Oceanographic and Atmospheric Administration:
- Air Research Laboratory
- Wave Propagation Laboratory

National Park Service
University of Nevada Desert Research Institute
U.S. Department of Energy:
- Brookhaven National Laboratory
- Environmental Measurements Laboratory

Consultants and Contractors	Responsibility
Aerosol Dynamics	Aerosols
Air Resource Specialists, Inc.	Optical and Scene Visibility and Meteorology
Brigham Young University	Aerosols
Colorado State University	Meteorology Modeling
ENSR Consulting and Engineering	Quality Assurance
Harvard University	Aerosols
T & B Systems, Inc.	Upper Air Meteorology
Washington University - CAPITA	Meteorology Modeling
University of California, Davis	Aerosols and Gases
University of Minnesota	Aerosols

PROJECT MOHAVE UPDATE ***Continued On Page 3***

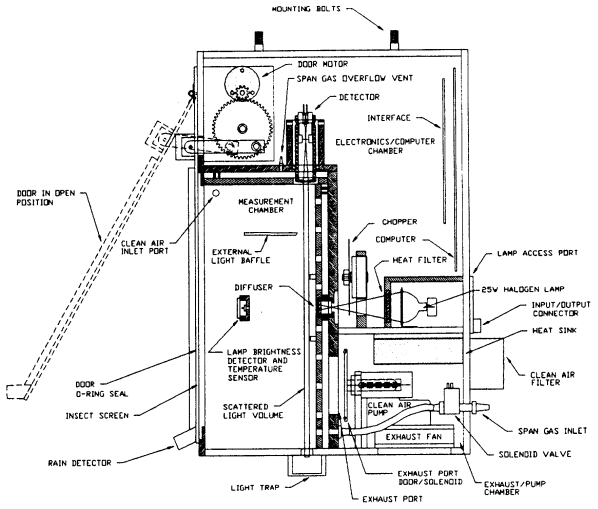
OPTEC NGN-2 AMBIENT NEPHELOMETER

A major challenge in the field of visual air quality monitoring has been the ability to make continuous measurements of ambient atmospheric scattering (b_{scat}). The Optec NGN-2 nephelometer now appears to have met this challenge.

The Optec NGN-2 overcomes the sampling deficiencies of previous nephelometer designs to provide a method that continuously and accurately measures the scattering coefficient of ambient air. The NGN-2 features low-power operation (13.8 VDC), a rugged compact design, and digital electronics that ensure stable, linear performance over a wide range of environmental conditions. The optical chamber features a large door that opens a complete side of the chamber to unrestricted, unmodified ambient air flow. The optical design of the detector field of view, illumination cone, and cylindrical scattering volume allows for integration of scattered light from 5 to 175 degrees.

An environmentally-sealed compartment in the unit contains the CMOS computer, lamp assembly, motors, pumps and electronics. The CMOS computer controls all operating functions of the NGN-2 which include:

- scattered light measurement
- clean-air, zero calibration
- span gas calibration
- moisture detection to close the optical chamber door during rain or snow
- optical chamber temperature measurement
- initial data reduction
- various error detection schemes
- diagnostic tests



OPTEC NGN-2 AMBIENT NEPHELOMETER
INSTRUMENT SPECIFICATIONS

Center Wavelength: 550 nm, with an 100 nm band pass
Scattering Angle Integration: 5 degrees to 175 degrees
Measurement Range: 0.01 km^{-1} (Rayleigh) to over 20.00 km^{-1} (0 to 32,768 counts)
Resolution: +/- 1 count (+/- 0.001 km^{-1})
Accuracy Near Rayleigh: +/1 10% (+/- 0.001 km^{-1})
Computer Control: An internal CMOS computer controls all operating functions and outputs data in either digital or analog format.
Power Requirements: 13.8 VDC, 5-amp power supply.
Normal operating power consumption: approximately 45 watts.
Operating Temperature Range: -20 degrees C to 45 Degrees C.
Operating Humidity Range: 0% to 100% RH
Sample Chamber Temperature: Laboratory and operational field tests of the NGN-2 indicate t hat the average sample chamber is within than 0.5 degrees C of ambient under a variety of operational conditions.
Data Output: Both serial RS-232 and analog (two-channel D/A) outputs are available.
Analog output ranges: 0 to 5 volts, or 0 to 10 volts.
Serial baud rates: 300 to 9600 with eight data bits, no parity, and one-stop bit.

Limitations of Older Generation Nephelometers

Integrating nephelometers estimate b_{scat} by directly measuring the light scattered by aerosols and gases in a sampled air volume. While nephelometers (MRI/Belfort 1550, 1560, and 1590 series) have been used for nearly twenty years, the following limitations associated with b_{scat} measurements made by these instruments have been documented by a number of researchers:

- Ambient aerosols are modified by heating within the sample chamber. This is especially significant at high relative humidities when a large fraction of the ambient aerosol is composed of hygroscopic particles. Chamber heating of hygroscopic or volatile aerosols can cause an underestimation of ambient b_{scat}.
- Inlet, sampling train, and optical chamber design can cause an ill-defined particle size cut. An inherent design restriction of all integrating nephelometers prevents the measurement of light scattered in the extreme forward and backward directions. This limitation, known as truncation error, has its most severe effect on the measurement of scattering due to particles larger than a few microns in diameter.
- The wavelength response of the instruments' lamps, filters, detectors, and electronics have at times been poorly defined, introducing uncertainties into scattering intercomparisons.
- Outdated electronics that display large non-linear drifts in zero and span values when systems are operated at ambient temperatures dramatically increase the uncertainty of measured b_{scat}.

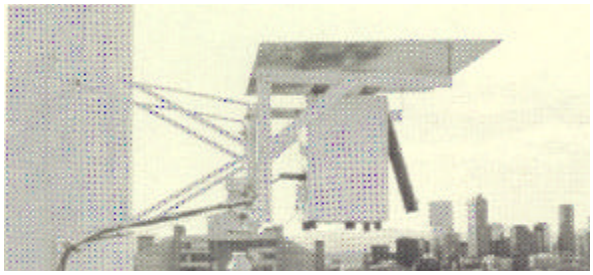
Data are output from either the Serial RS-232 or two-channel analog interfaces.

Operational field trials and laboratory tests of the Optec NGN-2 have been conducted for more than a year at the manufacturer's facilities in Lowell, Michigan; in Shenandoah National Park in the Mohave Desert; in Denver, Colorado; and at Air Resource Specialists, Inc. in Fort Collins, Colorado. These tests have included side-by-side comparisons with Belfort-type nephelometers and Optec transmissometers. The results of these evaluations verify that:

- The air sampled by the NGN-2 remains at ambient temperature.
- The open-air design allows laminar entry of ambient air directly into the sample chamber. Residence time of the sampled air is less than one half second.
- Absolute calibration of the system to known standards is easily performed. The instrument yields very stable zero air and span gas calibration values over a broad range of ambient temperatures and environmental conditions.
- The system has proven to be rugged and reliable. The only regular maintenance required is a lamp change at 750-hour intervals. Calibrations can be automatically performed. Annual preventive service and maintenance is suggested.
- System electronics remain stable over a broad range of environmental conditions.
- The instrument effectively tracks the dynamics of visibility when compared to collocated transmissometers and Belfort-type nephelometers.
- The NGN-2 yields reliable results regardless of relative humidity. At high relative humidity, the NGN-2 consistently yields higher b_{scat} estimates than Belfort-type systems which are known to underestimate b_{scat}.
- The system is easily installed and has operated effectively at both line-powered and solar-powered sites.

For more information on the Optec NGN-2 contact:

Optec, Inc. 616-897-9351
ARS Technologies, Inc. 800-346-5845



Urban Installation, Denver Visibility Monitoring Instrument Intercomparison Tests

Solar-Powered Installation at Joshua Tree National Monument

Six NGN-2 nephelometers are currently operating in the Project MOHAVE summer intensive. By spring of 1993, twelve systems will be operating at IMPROVE sites where transmissometer installations are not practical.

PROJECT MOHAVE UPDATE *(Continued from page 1)*

Data Analysis Meeting

A meeting among approximately 25 scientists was held on May 27 and 28 to discuss the data analysis and modeling strategies for Project MOHAVE. Presentations and discussions during the two-day meeting focused on coordination among monitoring, data analysis, and modeling teams participating in the project. Meeting highlights included discussions of:

- advantages and disadvantages of complex diagnostic models and receptor models
- model parameterization and sensitivity analyses
- tracer release options
- methods for determining "influence functions" for source areas
- review of the data analysis plan and supplemental data sources

Data analysis and modeling for the winter intensive period is underway.

For more information on Project MOHAVE contact:

Bob Bauman 919-541-5629
Marc Pitchford 702-895-0432

IMPROVE STEERING COMMITTEE

IMPROVE Steering Committee members represent their respective agencies and meet periodically to establish and evaluate program goals and actions. IMPROVE-related questions within agencies should be directed to the agency's Steering Committee representative. Steering Committee representatives are:

U.S. EPA
Marc Pitchford
Environmental Monitoring Systems Lab
P.O. Box 93478
Las Vegas, NV 89193-3478
702/895-0432 (Phone)
702/736-7729 (Fax)

U.S. EPA
Joe Elkins
MD-14
OAQPS
Research Triangle Park, NC 27711
919/541-5653 (Phone)
919/541-2357 (Fax)

NPS
William Malm
NPS-AIR
Colorado State University
CIRA - Foothills Campus
Fort Collins, CO 80523
303/491-8292 (Phone)
303/491-8598 (Fax)

BLM
Scott Archer
Colorado State Office
2850 Youngfield
Lakewood, CO 80215
303/239-3726 (Phone)
303/239-3933 (Fax)

USFS
Rich Fisher
Air Specialist, Wash. Office
Rocky Mtn. Experiment Sta.
240 W. Prospect
Fort Collins, CO 80526
303/498-1232 (Phone)
303/323-1010 (Fax)

FWS
Sandra Silva
Fish and Wildlife Service
P.O. Box 25287
Denver, CO 80225
303/969-2822 (Phone)
303/969-2814 (Fax)

NESCAUM
Rich Poirot
VT Agency of Nat. Res.
103 South Main Street
Building 3 South
Waterbury, VT 05676
802/244-8731 (Phone)
802/244-5141 (Fax)

STAPPA
Dan Ely
Colorado Dept. of Health
Air Pollution Control Div.
4210 East 11th Avenue
Denver, CO 80220
303/331-8529 (Phone)
303/320-4079 (Fax)

WESTAR
John Core
Executive Director
1001 S.W. 5th Ave.,
Suite 1000
Portland, OR 97204
503/220-1660 (Phone)
503/220-1651 (Fax)

PREVIEW OF UPCOMING ISSUE . . . .

The next IMPROVE Newsletter will be published on October 15, 1992, and will include:

- Network Status for the Summer 1992 Season
- ***FEATURE ARTICLE:*** Grand Canyon Transport Commission

PUBLISHED BY:

Air Resource Specialists, Inc.

1901 Sharp Point Drive
Suite E
Fort Collins, CO 80525

The IMPROVE Newsleter is published four times a year (April, July, October, & January) under NPS Contract CX-0001-1-0025.

Your input to the IMPROVE Newsletter is always welcome. For more information, address corrections, or to receive the IMPROVE Newsletter, contact:

Air Resource Specialists, Inc.
303/484-7941 Phone
303/484-3423 Fax

IMPROVE Newsletter text is also available on the **EPA's AMTIC Electronic Bulletin Board.:**

919-541-5742
(1200 or 2400 baud)

919-541-1447
(9600 baud)

Air Resource Specialists, Inc.
1901 Sharp Point Drive, Suite E
Fort Collins, CO 80525

TO:

First Class Mail