U.S. Fish and Wildlife Service
Air Quality Branch

Sandra Silva
MANE-VU Monitoring Meeting
October 20, 2004
Mission

- “…working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.”

Programs

- Endangered Species, Migratory Birds, Law Enforcement, Fish Hatcheries, National Wildlife Refuge System
National Wildlife Refuge System

- Over 100 million acres
- 542 National Wildlife Refuges
- 20 million acres of wilderness
Air Quality Branch Mission

“...is to protect and enhance air quality in support of ecosystem management in the National Wildlife Refuge System.”
Class I Areas

- Special protection from air pollution
- National parks > 6,000 acres
- Wilderness areas > 5,000 acres
- In existence on August 7, 1977
# Sources of Air Pollution

<table>
<thead>
<tr>
<th>Source</th>
<th>Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power plants</td>
<td>SOx, NOx, metals</td>
</tr>
<tr>
<td>Industry</td>
<td>NOx, SOx, organics, metals</td>
</tr>
<tr>
<td>Incinerators</td>
<td>NOx, organics, metals</td>
</tr>
<tr>
<td>Mobile sources</td>
<td>NOx, organics</td>
</tr>
</tbody>
</table>
Geographic Distribution of Emissions
Air Pollution Effects

- Visibility impairment by particles
- Eutrophication of coastal areas
- Bioaccumulation of mercury
- Ozone injury to plants
- Acidification of lakes and streams
Air Quality Monitoring

Why?

- establish current conditions
- determine trends over time
- assess the impacts of air pollution on natural resources
- identify sources/source areas of air pollution that affect natural resources in your refuge
What do we Monitor?

- Interagency Monitoring of Protected Visual Environments (IMPROVE) Network
  - Scene
  - Particles
- National Atmospheric Deposition Program (NADP)
  - Atmospheric Deposition
  - Mercury Deposition
IMPROVE Network
Interagency Monitoring of Protected Visual Environments

- Identify the types and amounts of particles responsible for visibility impairment
- IMPROVE began in 1988 and grew to approximately 30 sites.
- Cooperative effort between EPA, FLMs, and state air agencies.
- In 1999, the Regional Haze Rule called for an expansion of visibility monitoring to all Class I areas.
<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPROVE Steering Committee</td>
<td>Marc Pitchford</td>
<td>Desert Research Institute, 755 East Flamingo Road, Las Vegas, NV 89119</td>
</tr>
<tr>
<td>National Park Service</td>
<td>William Malm</td>
<td>Colorado State University, CIRA - Foothills Campus, Ft. Collins, CO 80523</td>
</tr>
<tr>
<td>US Environmental Protection Agency</td>
<td>Neil Frank</td>
<td>EPA-OAQS, MRB/MD-14, Research Triangle Park, NC 27711</td>
</tr>
<tr>
<td>Mid-Atlantic Regional Air Management Association</td>
<td>David Krask</td>
<td>DC Department of Health, 51 N Street, NE, Washington, DC 20002, 202-535-2250 (fax 1371)</td>
</tr>
<tr>
<td>Forest Service</td>
<td>Rich Fisher</td>
<td>Air Specialist, Wash. Office, Central Administrative Zone, 2150 Center Avenue, Building A, Ft. Collins, CO 80526</td>
</tr>
<tr>
<td>State Air Pollution Program Administrators</td>
<td>Rich Poirot</td>
<td>VT Agency of Natural Res., 103 S. Main St., Building 3 South, Waterbury, VT 05676</td>
</tr>
<tr>
<td>Western States Air Resources Council</td>
<td>Robert Lebens</td>
<td>9 Monroe Parkway, Suite 250, Lake Oswego, OR 97035</td>
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<tr>
<td>National Oceanic and Atmospheric Administration</td>
<td>Sandra Silva</td>
<td>Fish and Wildlife Service, P.O. Box 25287, 12795 W. Alameda, Denver, CO 80225</td>
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<tr>
<td>Forest Service</td>
<td>Scott Archer</td>
<td>Science Center (RS-140), PO Box 25047, Denver, CO 80225-0047</td>
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<tr>
<td>Bureau of Land Management</td>
<td>Ray Bishop</td>
<td>Dept. of Environmental Quality, Air Quality Division, 707 North Robinson, PO Box 1677, Oklahoma City, OK 73101-1677</td>
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<tr>
<td>N.E. States for Coordinated Air Use Management</td>
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To monitor the visibility conditions in all Class I areas, the IMPROVE network was expanded from 30 to 110 sites. In addition, 33 sites in rural but non Class I areas following the IMPROVE protocol exist.
IMPROVE Protocol Network in year 2002

IMPROVE Sites (1-110)

Protocol Sites (111-163)

QA Sites (201-202)
Every IMPROVE site deploys an aerosol sampler to measure speciated fine aerosols and PM10 mass. Select sites also deploy Transmissometer and Nephelometers to measure light extinction and scattering respectively, as well as automatic camera systems to measure the “scene”.

The IMPROVE Modular Aerosol Sampler which, measure fine and total aerosol mass. The sampler was developed and refined by the IMPROVE program, and has been in operated since 1987. The receiver for an Optec LPV-2 transmissometer, which measures the light extinction coefficient by measuring the attenuation of light from a light source. The Optec NGN-2 integrating nephelometer, which estimates the atm. scattering coefficient by directly measuring light scattered by aerosols and gasses in a sampled air volume.
Interagency Monitoring of Protected Visual Environments

Scene Monitoring

Cape Romain NWR

Great Smoky Mountains NP
IMPROVE Particle Sampler
The standard IMPROVE sampler consists of four independent sampling modules. Prior to 2000, two 24 hour samples were collected twice a week, on Wednesday and Saturday. After 2000, 24 hour samples were collected every three days. The IMPROVE data guide provides a more detailed overview of the IMPROVE samplers and analysis. See IMPROVE Standard Operating Procedures for full details.

- Module A: PM2.5 particles on Teflon. These are analyzed by five methods at UC Davis for:
  - gravimetric mass for PM2.5
  - optical absorption
  - hydrogen by PESA
  - Elements Na-Mn by PIXE
  - Elements Fe-Pb by XRF

- Module B: PM2.5 particles on nylon. A denuder before the nylon filter removes nitric acid vapors. These are analyzed by ion chromatography for nitrate, chloride, sulfate and nitrite.

- Module C: PM2.5 particles on quartz. These are analyzed at DRI for carbon using the Thermal Optical Reflectance (TOR). A secondary filter at is used to determine artifact.

- Module D: PM10 particles on Teflon.

Schematic of the IMPROVE sampler showing the four modules with separate inlets and pumps.
2001 Annual Sulfate Extinction
2001 Annual Nitrate Extinction
2001 Annual Organic Carbon Extinction
2001 Annual Course Particle Extinction
### BRIG1 2001 Annual Aerosol bext Composition

<table>
<thead>
<tr>
<th>Component</th>
<th>Mass (Mm⁻¹)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH₄NO₃ bext</td>
<td>10.9</td>
<td>12.5 %</td>
</tr>
<tr>
<td>(NH₄)₂SO₄ bext</td>
<td>55.6</td>
<td>64.1 %</td>
</tr>
<tr>
<td>CM bext</td>
<td>5.74</td>
<td>6.6 %</td>
</tr>
<tr>
<td>EC bext</td>
<td>4.42</td>
<td>5.1 %</td>
</tr>
<tr>
<td>OMC bext</td>
<td>9.88</td>
<td>11.1 %</td>
</tr>
<tr>
<td>SOIL bext</td>
<td>0.53</td>
<td>0.6 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>86.9</strong></td>
<td></td>
</tr>
</tbody>
</table>
1999 Regional Haze Rule

- Goal is to remedy existing and prevent any future man-made visibility impairment in Class I Areas
- The rule requires
  - visibility to improve on the 20% haziest days
  - no degradation will occur on the 20% clearest days
- Five multi-state Regional Planning Organizations (RPOs)
Timeline for States to Implement Haze Rule

Adapted from US EPA’s Regional Haze State Implementation Milestones

Control strategies are to cover an initial implementation period extending to 2018 with reassessment and revisions every 10 years thereafter.
The tracking of progress towards the goal of reaching natural background condition in 60 years requires calculation of three visibility metrics.

- **Natural Conditions** (ultimate goal of haze regulations)
  - Level of visibility (in deciviews) for the 20% most-impaired and 20% least-impaired days that would exist if there were no human emissions

- **Baseline Conditions** (reference point to measure progress against)
  - Visibility (in deciviews) for the 20% most-impaired and 20% least-impaired days for the years 2000-2004

- **Current Conditions** (used to determine progress made)
  - Visibility (in deciview) for the 20% most-impaired and 20% least-impaired days for the most recent 5 year period.
Reconstructed Extinction on All Available Sample Days

Brigantine: 2001 Mean = 77.9 Mm-1

Brigantine: 2002 Mean = 81.6 Mm-1

Brigantine: 2003 Mean = 80.5 Mm-1
Reconstructed Extinction on Best Days

Brigantine: 1993 Mean = 44.2 Mm-1

Brigantine: 1994 Mean = 38.8 Mm-1

Brigantine: 1995 Mean = 33.9 Mm-1

Legend:
- Coarse Mass
- Nitrate
- Organics
- Sulfate
- Soil
- Soot (AC)
- Data Missing
- Day Missing
Reconstructed Extinction on Best Days

Brigantine: 2001 Mean = 29.8 Mm⁻¹

Brigantine: 2002 Mean = 32.4 Mm⁻¹

Brigantine: 2003 Mean = 28.7 Mm⁻¹

Data Missing: Day Missing
Reconstructed Extinction on Worst Days

Brigantine: 1997 Mean = 152.4 Mm⁻¹

Brigantine: 1999 Mean = 142.5 Mm⁻¹

Brigantine: 2000 Mean = 152 Mm⁻¹
National Atmospheric Deposition Program (NADP)

- Established in 1977 to measure atmospheric deposition and its effects on the environment.
- The network has grown from an original 22 sites to 240 sites across the U.S, extending from Alaska to the Virgin Islands.
- Cooperatively funded by federal, state, and local government, State Agricultural Experiment Stations, universities, and private organizations.
NADP Equipment

Aerochem Precipitation Collector and Belfort Rain Gage
Sample Collection and Analysis

- Site Operators collect the precipitation sample every Tuesday, measure pH and conductivity and send the sample to the Central Analytical Laboratory (CAL).
- The CAL analyzes the samples for hydrogen ion (pH), sulfate, nitrate, chloride, ammonium, calcium, magnesium, potassium, and sodium.
- Data are posted to the NADP web site: http://nadp.sws.uiuc.edu and in annual publications.
Nitrate ion wet deposition, 2003

Sites not pictured:
AK01  1 kg/ha
AK03  1 kg/ha
HI99  2 kg/ha
PR20  10 kg/ha
VI01  3 kg/ha

National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu
The Mercury Deposition Network, was formed in 1995 to monitor mercury in precipitation on a regional basis.

The Network grew from an original 13 sites to almost 70 sites in 2003.

Samples of precipitation are collected every Tuesday and sent to Frontier Geosciences to be analyzed to for total mercury and sometimes methylmercury.
NADP/MDN Equipment

Modified Aerochem Precipitation Collector for Hg Sampling at Chassahowitzka NWR