

FINAL REPORT
ASSISTANCE FOR VISIBILITY DATA ANALYSIS & IMAGE DISPLAY
TECHNIQUES
CSU/CIRA/NPS Research Activities & Accomplishments:
Task #05-60 from Sep. 2005 – Jan. 2007

1. Major activities and accomplishments by CIRA Sept 2005-Dec. 2006

A. IMPROVE Support

- We continue with on-going work on the QA/QC and data management for the Interagency Monitoring of Protected Visual Environments (IMPROVE) program and its vast data resources. Accomplishments this task period include the following:
 1. September–December 2004 data was received and ingested into the VIEWS (Visibility Information Exchange Web System)/IMPROVE database and made available as preliminary data via the IMPROVE and VIEWS query wizard.
 2. The resubmission of 2000-2004 IMPROVE data was reviewed at the Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University (CSU) and problems reported back to the University of California, Davis, for further review.
 3. The Regional Haze Rule (RHR) data set was produced and made available from the VIEWS/IMPROVE database.
 4. A rough draft of a document describing the CIRA data validation procedures was produced for future publication on the IMPROVE web page.
 5. IMPROVE 2004 data was subjected to a thorough QA/QC process, culminating in the completion of a data validation report to be distributed internally and, after proper review, externally via the IMPROVE web page.
 6. Work on QA/QC and data management for IMPROVE data has been moved over to UC Davis giving them primary responsibility for this activity.

- Shawn McClure worked with UC Davis to develop a better IMPROVE data archive architecture that is more compatible with VIEWS/CIRA systems designs.
- IMPROVE report
 1. An outline was developed and work commenced on the data analysis in September 2005.
 2. Maps and various plots of IMPROVE data have been generated for the 2006 IMPROVE Summary Report.
 3. A first draft of the IMPROVE report was completed in June 2006 and sent for review to Bill Malm, Kristi Gebhart, and Bret Schichtel.
 4. The IMPROVE report was completed in November 2006, having been thoroughly reviewed internally and externally. It was posted on the IMPROVE web site in December 2006
- Implementation of the new IMPROVE extinction algorithm has been accomplished, with results posted on the VIEWS and IMPROVE web sites.

- Work is continuing on aspects of applying the new IMPROVE equation to the RHR, including, for example, determining natural background values for all Class I areas.
- Natural condition dv estimates have been developed and made available through links from the VIEWS home page.
- Developed, distributed, and refined a draft document for reducing the IMPROVE network size in the face of anticipated budget cuts. Based on comments received from States and other interested parties, a final draft was sent to the Environmental Protection Agency (EPA) in November.
- Linsey DeBell resigned and her duties were distributed to other members of the CIRA team.
- UC Davis has assumed primary responsibility for QA/QC and data management of the IMPROVE data. Shawn McClure continues to work closely with them on this transition and implementation of new data management systems.
- Work is continuing on aspects of applying the new IMPROVE equation to the RHR, including, for example, determining natural background values for all Class I areas.
- A final draft was sent to the EPA in November of a document addressing the implications of reducing the IMPROVE network size in the face of anticipated budget cuts.

B. Aerosol Research

- We continue to support a number of research activities associated with the understanding of aerosols and their impact on visibility. All of this research is collaborative with the research teams at Colorado State University, Atmospheric Sciences Department, under the direction of Professor Collett and Professor Kreidenweis. Specifically, this year some of our accomplishments were the following:
 1. The continued analysis of field data collected with the Collett & Kreidenweis teams as part of the Yosemite study. CIRA completed a draft final report on the analysis of data from the Yosemite study in February 2006.
 2. Along with the Collett & Kreidenweis teams, we continued to work with UC Davis on the development of a mobile aerosol measurement laboratory. The mobile aerosol laboratory was delivered to CSU in December 2005 and CIRA continued assisting in its testing through February, 2006.
 3. Along with the Collett & Kreidenweis teams, we continued to work on analyses of data from the Grand Canyon Aerosol Study.
 4. We are working on analysis and publication of data from the Missoula smoke study (f(RH) measurements, seven wavelength b_{abs} measurements, chemical composition, and particle morphology) from various forest fire fuels.
- Jenny Hand acted as science mentor for MS Student Nancy Rivera Rivera from the National Center for Atmospheric Research (NCAR) Significant Opportunities in Atmospheric Research and Science (SOARS) program during the summer 2006 on the project titled "Meteorological conditions of extreme dust events in the Chihuahuan desert region of the United States and Mexico."

- Initial analysis of smoke f(RH) factors from the second Missoula study was completed by Derek Day.

ROMANS Study

- We helped in the planning for the Rocky Mountain Atmospheric Nitrogen and Sulfur (ROMANS) field study focused on Rocky Mountain National Park, with an initial field campaign in March 2006.
- We prepared a summary of historical IMPROVE data for Rocky Mountain National Park in support of the ROMANS Pilot Study.
- The first phase of the ROMANS study focused on Rocky Mountain National Park was completed successfully in March 2006. Derek Day spent five weeks in Dinosaur National Park taking measurements in support of the Rocky Mountain NP study.
- The summer phase of ROMANS began in July and was successfully completed.
- CIRA contributed to ROMANS progress reports for Susan Johnson of NPS Air Resources Division, who is compiling a report for the state of Colorado. Our contributions can be found at <ftp://ftp.cira.colostate.edu/susan>.
- Analyses of nephelometer data (stationary and mobile nephs) is in progress from the ROMANS study by Derek Day.

C. Modeling

- We are evaluating the CAMx model results of various simulations that involve the installation of a proposed power plant in the Four Corners region. A report is being prepared to document our results.
- We have extended our model performance evaluation to include PM species of interest (sulfate, nitrate, ammonium, soil, etc.) using available data from different networks (IMPROVE, CASTNET, NADP). We are comparing our results with the Western Regional Air Partnership's (WRAP) modeling efforts.
- We have started the necessary planning to acquire the hardware, build, and set up an NPS exclusive Linux computing system for our future modeling projects.
- We have installed the Sparse Matrix Operator Kernel Emissions (SMOKE) emissions processing system in our Linux computers and have run the test case.
- A draft report has been prepared documenting our results in applying the Comprehensive Air Quality Model with Extensions (CAMx) and the Regional Modeling System for Aerosols and Deposition (REMSAD) regional air quality models for various simulations that involve the installation of a proposed power plant in the Four Corners region.
- We have extended our model performance evaluation to include comparing our results with WRAP's modeling efforts.
- We have purchased six additional dual-core Opteron servers for use as modeling hardware, and set up an NPS exclusive Linux computing system for our future modeling projects. Storage has also grown by 2.5 TB for a total of 6.5 TB.

- Marco has participated in SMOKE emissions processor training and he is operating the SMOKE processor on our Linux computers and has been developing emissions files for various test cases. A draft report has been prepared documenting our results in applying the CAMx and REMSAD regional air quality models for various simulations that involve the installation of a proposed power plant in the Four Corners region.
- We have extended our model performance evaluation to include comparing our results with WRAP's modeling efforts.
- We have purchased six additional dual-core Opteron servers for use as modeling hardware, and set up an NPS exclusive Linux computing system for our future modeling projects. Storage has also grown by 2.5 TB for a total of 6.5 TB.
- We have created our own set of emissions inventory (cira02) for the year 2002 based on the efforts of RMC. We have changed and implemented our own SMOKE scripts and compared our results with RMC base02b emissions inventory using PAVE and other diagnostic tools.
- We have performed CAMx simulations for the year 2002 with the cira02 emissions inventory. These simulations are the base case that will allow comparisons with emission scenarios of interest such as the impacts of oil and gas development on the western United States.
- We are currently updating and extending our model performance evaluation tool (camxmpe) to obtain various types of isopleth plots of modeled and observational annual average concentrations. This tool is written in Perl and IDL programming languages.
- We looked at CAMx performance evaluation results for 2002 using the cira02 emissions inventory. In particular we have compared CAMx with RMC's CMAQ wet deposition. CAMx consistently shows larger negative biases that are at least twice as large as RMC's for the WRAP states. We have contacted ENVIRON to find the source of these differences.
- As part of various pre-ROMANS modeling evaluations, we have simulated a two-week period tracer run to coincide with ROMANS spring campaign (April 2006). We have used in-house MM5 meteorology and 2002 emissions inventories for NO_x and NH₃. These tracer simulations are a first attempt to distinguish the contribution of Colorado vs. the rest of the U.S. emission sources.
- We are currently working on the analysis and write-up of a paper on the effects of oil and gas installations on the air quality of Class I areas in the western U.S. Our main focus is on ozone and particulate nitrate impacts.
- We have updated our model performance evaluation tool (camxmpe) to obtain various types of isopleth plots of modeled and observational annual average concentrations. This tool is written in Perl and IDL programming languages.
- We have setup a new RAID in a Linux system that will be dedicated exclusively to emissions processing.
- An analysis and write-up of a paper on the effects of oil and gas installations on the air quality of Class I areas in the western United States with the main focus on ozone and particulate nitrate impacts is under development (Marco).

- We have initiated migration of selected desktop computers in the CIRA/NPS group (4 in total) from Windows to Gentoo Linux (Marco).
- Our Linux computer systems are having upgraded security protection using a built-in firewall (Marco).

D. Media Center

- Layout and publication of the 2006 IMPROVE calendar started before September, 2005, including
 - Operator bios were written, reviewed, and revised for the 2006 IMPROVE calendar.
 - Improve related articles and research articles for the upper calendar pages were compiled.
- The calendar went into layout September 17, 2005.
- The 2006 IMPROVE calendar was delivered in late December, 2005.
- An air quality program multimedia presentation for Sequoia NP was developed:
 - These modules were completed in Nov:
 - Geography of the area with digital fly over
 - Animated flows illustrating the Fresno eddy
 - Other modules were started in December:
 - Ozone and its effects,
 - Acid Rain and why it matters
 - Finalization of the Sequoia / Kings Canyon Visitor Center interactive CD-ROM program resumed in January.
- The draft air quality program for Sequoia is in the review stage.
 - These modules were completed in January:
 - Ozone and Its Effects
 - Acid Rain and Why It Matters
 - Finalization of the Sequoia / Kings Canyon Visitor Center interactive CD-ROM program is progressing.
- Work was completed on the 2007 IMPROVE calendar.
- A brochure was completed that details the problem, goals, and objectives of the ROMANS study. ROMANS brochure has been assembled, printed, and distributed.
- Sequoia / Kings Canyon Visitor Center interactive display and CD-ROM program were installed at Grants Grove April 27, 2006, for the grand opening of the center. We met with park interpreters and resource managers to finalize changes in the English version and are in the processes of incorporating their final changes. The program is currently up and running and after the final changes are accepted we will proceed with the translation to Spanish.
- Additional report graphics completed for Bill Malm.
- Optimization of 3600 archived images taken from 50 monitoring sites is nearly complete. The enhanced and corrected images will be available on the web.
- Adjustments and enhancements on 3700 park photos nearly completed and ready to resize for the web.

- Sequoia and Kings Canyon National Park Visitor Center display has been completed with a very complimentary letter of thanks from the Park Superintendent.
- A presentation of the Sequoia and Kings Canyon project was made to the IMPROVE steering committee in September 2006.
- A flyer was designed for the Aerosols & Atmospheric Optics 9th A&WMA Visibility Specialty Conference.
- Graphics were assembled and edited for the IMPROVE Report and for Bill Malm's paper "Coarse Particle Speciation at Selected Locations in the Rural Continental U.S."
- New web page buttons and links were created for 64 web cam sites for an update to the webcam page of the VIEWS web site.
- The final segment of the Sequoia-Kings Canyon National Park visitor center informational kiosk program – which was the Spanish version – was completed, and other final changes were made. The program is now in final assembly and review, in preparation for shipment to Sequoia-Kings Canyon.

E. Web Development

- We continued to work on the VIEWS, IMPROVE, and Air Toxics web sites.
- Initiated work on the Technical Support System (TSS) for the WRAP.
 - Work on the Technical Support System (TSS) for the WRAP has been progressing with a major demonstration of initial system design and capabilities conducted in late January for the WRAP Attribution of Haze Working Group in San Diego.
 - Innovative progress on integration of alternative Web mapping Services into the TSS is progressing.
 - Rodger & Shawn participated in a workshop and training experience for the WRAP Attribution of Haze Working Group in Seattle on 26 and 27 April 2006.
- We continued to work on the VIEWS, IMPROVE, and Air Toxics web sites, adding access to "substituted" data sets for sites that did not meet the RHR completeness requirement. One site (BOWA1) is online now, and several others may be added in the near future.
- Rodger Ames worked with the Monitoring and Data Analysis working group to develop and finalize a methodology that incorporates the new IMPROVE algorithm into natural conditions estimates for the RHR. The new methodology was approved by a scientific review subcommittee of the working group and results made available on VIEWS.
- Added a 'Substitute Data' section to VIEWS, providing access to alternate data sets for IMPROVE monitoring sites with insufficient (less than two complete years) of baseline data. These data sets are being incorporated into VIEWS Regional Haze data as they become available from outside providers.
- Work on the Technical Support System (TSS) for the WRAP has progressed and a preliminary draft version was released to the client community in October. This includes innovative work on integrating Web Mapping Services, allowing different GIS functionality.

- Incorporated the following data sets and related visualization tools into the TSS:
 - VIEWS trends & composition tools
 - CMAQ daily air quality modeling results for three emissions scenarios (two base cases, one planning) at various time aggregations (daily, monthly, annual, all calendar days, sampled IMPROVE days, best and worst 20% sampled IMPROVE days)
 - CAMx source apportionment results (aggregations and scenarios listed above)
 - Organic carbon tracer results
 - Weighted Emissions Potential results
 - Natural conditions calculator – provides aerosol b_{ext} , dv , and aerosol species baseline values, natural condition estimates, and incremental attainment values based on URP glide slopes
 - Weight of Evidence checklist
 - Area of interest Class I area and IMPROVE monitoring site selection tool – Web-based GIS application to visualize and select CIA's and representative IMPROVE monitoring data
- Migration of GIS-based AOI site selection and general data browser to Air Toxics web site. These tools share underlying code base with similar tools developed for the TSS.
- Work included adding access to “substituted” data sets for sites that did not meet the RHR completeness requirement.
- Rodger Ames continued to work with the RPO Monitoring and Data Analysis working group to develop and finalize a methodology that incorporates the new IMPROVE algorithm into natural conditions estimates for the Regional Haze Rule.
- ‘Substitute Data’ section on VIEWS provides access to alternate data sets for IMPROVE monitoring sites with insufficient (less than two complete years) of baseline data. These data sets are incorporated into VIEWS Regional Haze data as they become available from outside providers.
- Work on the Technical Support System (TSS) for the WRAP has progressed following the release of v1 to the client community in October 2006. This includes innovative work on integrating Web Mapping Services, allowing different GIS functionality.
- Incorporated the following data sets and related visualization tools into the TSS:
- **Under TSS Resources – Area of Interest section:**
 - CAMx source apportionment results at IMPROVE sites in the WRAP. Results for all modeling days, IMPROVE sampled, and best and worst 20% sampled IMPROVE visibility days, as well as annual and monthly aggregations available through the PSAT time series, source category, and source region viewers.
 - CMAQ modeling results at all IMPROVE sites. Results for all modeling days, IMPROVE sampled, best and worst 20%, as well as annual, monthly and daily aggregations available through the Visibility Modeling tool.

- IMPROVE monitoring data. Results for IMPROVE sampled, best and worst 20%, as well as annual, monthly and daily aggregations available through the Monitoring Data tool.
- Model Performance Evaluation (MPE) tool. Allows for comparison of CMAQ modeling results with IMPROVE monitoring data
- Weighted Emissions Potential (WEP) tool. Allows for display and access to WEP results generated by ENVIRON using DRI-generated residence time analyses.
- Organic Aerosol Tracer. Provides results at various aggregations for speciated organic aerosol attribution at IMPROVE sites. Results generated by the Regional Modeling Center (RMC).
- **Under TSS Area of Interest link from TSS home page:**
 - Area of Interest (AOI) site selection tool. Allows map-based selection of IMPROVE sites and/or IMPROVE sites representative of selected Class I areas or tribal lands. Map-based metadata are available as mouse-over tips for displayed polygon features. Site selections can be viewed in web-based Google Earth or Microsoft Virtual Earth displays, as well as in tabular display. Site selections and map extent propagate to AOI results tool in the TSS Resources section
- **Weight of Evidence Checklist;**
 - Expanded to include specific checklists relating to class I area, site, tribal, and additional technical support.
 - Incorporated under the tools section a natural conditions viewer to support natural conditions estimates based on the new IMPROVE algorithm. Features include; annual data, 5-yr baseline data, glide slopes to estimated natural conditions, and natural condition values. Visibility metrics and aerosol species mass and light extinction are available for annual and best and worst 20% IMPROVE sampled days.

F. Other activities

- Bill Malm attended the Joint Fire Science Program principal investigator workshop in San Diego in November 2005.
- Bret Schichtel attended a DataFed training session at the EPA training center in Research Triangle Park in November 2005.
- J.L. Hand, Peer-review of journal articles for Atmospheric Environment, Geophysical Research Letters.
- Reviewed technical aspects of North Carolina RAVI BART analysis protocols.

2. Student Participation, Outreach, Awards and Honors, and Collaborations (list student presentations, conferences attended with NPS funds, and faculty presentations).

- There is no student participation under the CIRA agreement. We do work with, really support, students who are supported under the NPS cooperative agreements with

Colorado State University faculty, specifically, Professors Collett, Kreidenweis, & Iyer.

- Jenny Hand acted as science mentor for MS Student Nancy Rivera Rivera from the NCAR SOARS program during the summer 2006 on the project titled “Meteorological conditions of extreme dust events in the Chihuahuan desert region of the United States and Mexico.”
- Presentations are listed below .
- Project travel included:
 - Scott Copeland travel to CIRA every 6-8 weeks.
 - ROMANS study site visits to Rocky Mountain National Park, February, April 2006: Jenny Hand.
 - IMPROVE calendar research, Reno, February 2006, Missoula, May 2006: Julie Winchester.
 - WRAP TSS training session, Seattle, April 2006: Rodger Ames, Shawn McClure.
 - Sequoia Kings Canyon outreach kiosk setup, April 2006: Julie Winchester.
 - SOARS meetings, Boulder, May, June, August 2006: Jenny Hand.
 - Joint Fire Science Project field study, Missoula, May-June 2006: Derek Day.
 - Air & Waste Management Association Annual Conference, New Orleans, June 2006: Rodger Ames.
 - WRAP TSS technical meeting, Denver, July 2006: Rodger Ames, Doug Fox, Shawn McClure.
 - ROMANS field study, Rocky Mountain National Park, July-August 2006: Derek Day.
 - American Association for Aerosol Research, St. Paul, September 2006: Marco Rodriguez.
 - IMPROVE Steering Committee meeting, September 2006: Julie Winchester.

3. Journal Manuscripts Published, Submitted, and Under Review (full reference documentation).

1. Ames, Rodger, and Marc Pitchford drafting journal article on natural condition estimation approach based on new IMPROVE algorithm.
2. Barna, M. G., and E.M. Knipping, 2006, Using Sulfur Predictions from a Global Model to Specify Boundary Conditions in a Regional Air Quality Model, (submitted as part of the AAAR 2005 Supersites Supplement) has been accepted for publication in Atmospheric Environment,.
3. Barna, M.G., K.A. Gebhart, B.A. Schichtel, and W.C. Malm, 2005, Modeling Regional Sulfate during the BRAVO Study: 1. Base Emissions Simulation and Performance Evaluation, Atmospheric Environment, accepted for publication.
4. Barna, M.G., B.A. Schichtel, K.A. Gebhart, and W.C. Malm, 2005, Modeling Regional Sulfate during the BRAVO Study: 2. Emission Sensitivity Simulations and Source Apportionment, Atmospheric Environment, accepted for publication.

5. Day, D. E., J. L. Hand, C. M. Carrico, Guenter Engling, and W. C. Malm, Humidification factors from laboratory studies of fresh smoke from biomass fuels, *Journal of Geophysical Research*, 2006.
6. Day, D., Hand, J. L., Carrico, C. M., Engling, G., and Malm, W. C., Hygroscopic growth factors from laboratory studies of fresh smoke from biomass fuels, *Journal of Geophysical Research-Atmospheres*, 2006.
7. Gebhart, K.A., Schichtel, B.A., Barna, M.G., Malm, W.C., 2006, Quantitative Back-Trajectory Apportionment of sources of particulate sulfate at Big Bend National Park, TX, *Atmospheric Environment*, 40, 2823-2834.
8. Geiser, L., A. Bytnerowicz, J. Ingersoll, and S. Copeland, 2006, Evidence of atmospheric ammoniacal nitrogen deposition in Hells Canyon: Implications for natural and cultural resources,” in review for *Environmental Pollution*.
9. Hand J. L., and W. C. Malm, Review of aerosol mass scattering efficiencies from ground-based measurements since 1990, In preparation for submission to *Journal of Geophysical Research-Atmospheres*.
10. Malm, W. C., M. L. Pitchford, C. McDade, and L. L. Ashbaugh, 2006, Coarse particle speciation at selected locations in the rural continental United States, Accepted for publication, *Atmospheric Environment*.
11. Malm, W. C., and Hand, J. L., 2006, An examination of aerosol physical and optical properties of aerosols collected in the IMPROVE program, accepted by *Atmospheric Environment*.
12. Malm, W. C., and J. L. Hand, Mass scattering and extinction efficiencies derived from aerosol composition data using linear regression techniques, Accepted for publication, *Atmospheric Environment*.
13. Malm, W. C., J. L. Hand, and M.L. Pitchford, A statistical exploration of coarse and fine particle mass scattering efficiencies functional dependence on ambient mass concentration at 35 monitoring sites, in preparation.
14. McMeeking, G. R., S. M. Kreidenweis, M. Lunden, J. Carrillo, C. M. Carrico, T. Lee, P. Herckes, G. Engling, D. E. Day, J. Hand, N. Brown, W. C. Malm, and J. L. Collett, Jr., 2006, Smoke-impacted regional haze in California during the summer of 2002, *Agricultural and Forest Meteorology*, 137, 25-42.
15. Rodriguez, M. A., J. Brouwer, G.S. Samuelson, and D. Dabdub, 2006, Air Quality Impacts of Distributed Power Generation in the South Coast Air Basin of California 2: Model Uncertainty and Sensitivity Analysis, accepted for publication in *Atmospheric Environment*.

16. Rodriguez, M. A., M. Carreras, M. Medrano, J. Brouwer, G.S. Samuelsen, and D. Dabdub, 2006, Air Quality Impacts of Distributed Power Generation in the South Coast Air Basin of California 1: Scenario Development and Modeling Analysis, accepted for publication in Atmospheric Environment.
17. Wang, J., S. A. Christopher, U. S. Nair, J. S. Reid, E. M. Prins, J. Szykman, J. L. Hand, 2006, Mesoscale modeling of Central American smoke transport to the United States, Part I: "Top-down" assessment of emission strength and diurnal variation impacts, J. Geophysical Res., accepted.

Technical reports:

1. Carrico, C.M., Malm, W.C., Kreidenweis, S.M., Collett, J.L. Jr., Day, D.E., McMeeking, G.R., Hand, J.L., Herckes, P., Engling, G., Lee, T., and Carrillo, J., 2005. The Yosemite Aerosol Characterization Study of 2002 (YACS), ISSN 0737-5352-65.
2. Hand, J. L., and Malm, W. C., 2005. Review of the IMPROVE equation for estimating ambient light extinction coefficients," available at: [http://vista.cira.colostate.edu/improve/Publications/GrayLit/016 IMPROVEEqReview/IMPROVEEqReview.htm](http://vista.cira.colostate.edu/improve/Publications/GrayLit/016_IMPROVEEqReview/IMPROVEEqReview.htm).
3. Jeffrey Collett Jr., Suresh Raja, Taehyoung Lee, Xiao-Ying Yu, Kip Carrico, Sonia Kreidenweis, Jenny Hand, Bret Schichtel, Derek Day, Kristi Gebhart, and William Malm. 2006. Preliminary Report of Findings from the 2005 Rocky Mountain National Park Pilot Study. Report of the Colorado State University and National Park Service Scientists involved in the study, 4 Jan 2006, 34 pp.
4. DeBell, L.J., Gebhart, K.A., Hand, J.L., Malm, W.C., Pitchford, M.L., Schichtel, B.A., and White, W.H., 2006. Spatial and Seasonal Patterns and Temporal Variability of Haze and Its Constituents in the United States, IMPROVE Report IV, ISSN 0737-5352-74, CIRA, Colorado State University, Fort Collins.

4. Presentations (full reference documentation).

November/December 2005 presentations:

R. Ames, S. McClure, B. Schichtel, D. Fox. The Visibility Information Exchange Web System (VIEWS), Air Toxics, and IMPROVE Web Sites: database driven internet sites for access, inter-comparison, and on-line analysis of air quality data, AWMA 2005, Oak Brook, IL.

Nancy I. Rivera, T. E. Gill, M. P. Bleiweiss, J. L. Hand, M. Dominguez A., A. Ruiz, A. E. Perez, S. P. Emmert, J. A. Lee, and K. R. Mulligan, "Detection and preliminary assessment of source areas of the 15 December 2003 dust storm in the Chihuahuan desert, southwestern North America", Paper H51C-0389, AGU Fall Annual Meeting, San Francisco, December 2005.

J. L. Hand, "Characterization of aerosol physical, chemical, and optical properties at national parks: Implications for visibility estimates", Invited seminar to the Environmental Science and Engineering Program, University of Texas, El Paso, November 2, 2005.

J.L. Hand, "Visibility in National Parks", presented to the CIRA research coordinators.

January/February 2005 presentations:

R. Ames, S. McClure, T. Moore, D. Fox, "WRAP TSS Capabilities," WRAP AoH Working Group meeting, January 24, 2006, San Diego.

March/April 2006 presentations:

R. Ames, S. McClure, T. Moore, D. Fox, "Demonstration of WRAP TSS Capabilities," WRAP AoH Working Group meeting, April 26-27, 2006, Seattle.

R. Ames, "Alternative methods for calculating natural background with the revised IMPROVE equation," presented to the RPO Monitoring and Data Analysis Working Group conference call April 26, 2006.

S. Copeland, "A patched Boundary Waters Wilderness Area data set," presented to the RPO Monitoring and Data Analysis Working Group conference call April 17.

May/June 2006 presentations:

Rodriguez, M. A., Barna, M. G., Schichtel, B. A., and Gebhart, K. A. 5-16-2006. Poster: Regional modeling using CAMx: Evaluation of the air quality in the western national parks, CIRA Science Symposium, Fort Collins.

Rodriguez, M. A., Barna M. G., Schichtel B. A., "Using CAMx to Model the Potential Impacts of a Proposed Power Plant in the Four Corners Region", Presented at the 99th AWMA Annual Conference and Exhibition, New Orleans, LA, 2006.

Schichtel, B. A., Barna, M. G., Gebhart, K. A., and Rodriguez, M. A. 5-16-2006. Poster: Integrating air quality data and modeling results to refine source apportionment estimates, CIRA Science Symposium, Fort Collins.

July-October 2006 presentations & training activities:

Rodger Ames co-led the July 27, 2006, TSS Attribution of Haze working group training session in Seattle, WA.

Mike Barna gave a presentation to the WRAP Modeling Forum titled “CAMx-simulated ozone impacts from oil and gas development in the western U.S.,” San Diego, Nov. 2-3, 2006.

Rodger B. Ames, S. E. McClure, B. A. Schichtel, D. G. Fox, and T. Moore, “Examples of web-based reporting and analysis products from VIEWS and the WRAP TSS,” presented at the 99th A&WMA Annual Conference, New Orleans, LA, June 2006.

Kristi A. Gebhart, “Early indications of nitrogen and sulfur sources at Rocky Mountain National Park”, Proceedings of the American Association for Aerosol Research (AAAR) 7th International Aerosol Conference, p. 1217, St. Paul, MN, Sept. 10-15, 2006.

Michael G. Barna, Marco A. Rodriguez, Kristi A. Gebhart, Bret A. Schichtel, “CAMx simulations of nitrogen and sulfur deposition along Colorado’s Front Range,” Proceedings of the American Association for Aerosol Research (AAAR) 7th International Aerosol Conference, p. 1716, St. Paul, MN, Sept. 10-15, 2006.

Rodriguez, M. A., M. G. Barna, and B. Schichtel, “Assessment of the air quality in the Western U.S. National Parks: Model Performance Evaluation,” presented at American Association for Aerosol Research (AAAR) 7th International Aerosol Conference, St. Paul, MN, Sept. 10-15, 2006.

November - December 2006 presentations & training activities:

B. A. Schichtel, W. C. Malm, G. Bench, C. E. McDade, and J. C. Chow, Fossil vs. contemporary carbon at 12 rural and urban sites in the United States, presented at the American Geophysical Union fall meeting, San Francisco, December 2006.

Progress of Deliverables

To be completed by October 31, 2006

1. Complete revised Natural Conditions estimates using the New IMPROVE algorithm for Regional Haze Rule Guidance – collaboration with Marc Pitchford. *Accomplished.*
2. Completed draft IMPROVE Report. *Accomplished*
3. Completed NPS/CIRA QA webpage section for IMPROVE web site updated with data validation results and an overview document. *Accomplished;*
available at:
http://vista.cira.colostate.edu/improve/Data/QA_QC/qa_qc_Branch.htm
4. Completed presentations at Vienna Visibility conference. *Accomplished.*
5. Presentation at the AAAR International Aerosol Conference, Assessment of the Air Quality in the Western U.S. National Parks: Model Performance Evaluation. *Accomplished.*
6. Completion of RoMANS brochure. *Accomplished.*

7. Completion of Sequoia NP Visitor Center kiosk program. *Accomplished.*

To be completed by December 31, 2006

1. Ingest and validation of 2005 IMPROVE network data (dependent on delivery from UC Davis). *Accomplished.*
2. AGU presentations on IMPROVE report results. *Accomplished.*
3. Completion of IMPROVE 2007 Calendar. *Accomplished.*
4. Completion of preliminary analysis of data collected from 6 nephelometers, including a mobile instrument from the RoMANS summer field study conducted from 7/6/06 through 8/11/06. *Accomplished.*
5. Completion of preliminary analysis of data collected during the laboratory experiments conducted (5-23-06 through 6-9-06) in conjunction with the Forest Service Fire Sciences Lab at Missoula, Montana. *Accomplished.*
6. Release of TSS Ver 1.0 (implying limited similar functionality for VIEWS & IMPROVE web sites) including:
 - a. Weight of Evidence Checklist page; *Accomplished.*
 - b. Trends page; *Accomplished.*
 - c. Composition page. *Accomplished.*

Details of accomplishments on TSS:

- Under TSS Resources – Area of Interest section; *Accomplished*
 - CAMx (PSAT) source apportionment results at IMPROVE sites in the WRAP. Results for all modeling days, IMPROVE sampled and best and worst 20% sampled IMPROVE visibility days, as well as annual and monthly aggregations available through the PSAT time series, source category, and source region viewers.
 - CMAQ modeling results at all IMPROVE sites. Results for all modeling days, IMPROVE sampled, best and worst 20%, as well as annual, monthly and daily aggregations available through the Visibility Modeling tool.
 - IMPROVE monitoring data. Results for IMPROVE sampled, best and worst 20%, as well as annual, monthly and daily aggregations available through the Monitoring Data tool.
 - Model Performance Evaluation (MPE) tool. Allows for comparison of CMAQ modeling results with IMPROVE monitoring data
 - Weighted Emissions Potential (WEP) tool. Allows for display and access to WEP results generated by ENVIRON using DRI generated residence time analyses.
 - Organic Aerosol Tracer. Provides results at various aggregations for speciated organic aerosol attribution at IMPROVE sites. Results generated by the RMC.
- Under TSS Area of Interest link from TSS home page; *Accomplished*

1. Area of Interest (AOI) site selection tool. Allows map based selection of IMPROVE sites and/or IMPROVE sites representative of selected class I areas or Tribal lands. Map based metadata are available as mouse over tips for displayed polygon features. Site selections can be viewed in web-based Google Earth or Microsoft Virtual Earth displays, as well as in tabular display. Site selections and map extent propagate to AOI results tool in the TSS Resources section
- Weight of Evidence Checklist; ***Accomplished***
 1. Expanded to include specific checklists relating to class I Area, site, tribal, and additional technical support.
 2. Incorporated under the tools section a natural conditions viewer to support natural conditions estimates based on the new IMPROVE algorithm. Features include; annual data, 5-yr baseline data, glide slopes to estimated natural conditions, and natural condition values. Visibility metrics and aerosol species mass and light extinction are available for annual, best and worst 20% IMPROVE sampled days.)
7. Ongoing VIEWS/TSS work including:
 - a. Updates to Regional Haze and IMPROVE data sets; ***Accomplished***
 - b. Response to user feedback and questions. ***Accomplished.***
8. Completion of CAMx model performance evaluation and results comparison with WRAP RMC results for the simulation of year 2002. ***Accomplished.***
9. Report on the effects of oil and gas development during 2002 in the WRAP region. ***Accomplished.***
10. Meteorology and emissions assessment of the 2006 ROMANS field study through various inert tracer runs with CAMx. ***Accomplished.***