NARSTO News

A North American Consortium for Atmospheric Research in Support of Air-Quality Management

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2007 Executive Assembly Meets in Washington, D.C.

NARSTO's Executive Assembly met March 27-28, 2007, at the Hyatt Regency in Crystal City, Virginia, to review progress over the past year and to set objectives for 2007-2008. In addition to a review of NARSTO's activities since the last Executive Assembly meeting, the assembly heard reports on the activities of the Quality Systems Science Center (QSSC) and the NARSTO data archive, a review of NARSTO's infrastructure budget and of the support provided to NARSTO by the Oak Ridge Institute for Science and Education (ORISE), reviews of NARSTO-related field research in Texas and Mexico, and a summary of results from NARSTO's Reactivity Research Working Group (RRWG). Summaries of field research and results of the RRWG activities are included in this issue of NARSTO News. Materials from the meeting, including copies of all presentations, are available on NARSTO's website: http://www.narsto.org/section.src?SID=56.

Progress Over the Past Year

During the period of May 2006 to March 2007, NARSTO's principal focus was on conducting two workshops on the modeling of atmospheric aerosols (held June 2006 in Boulder, CO), reporting the results of these workshops, and on organizing and initiating a new NARSTO assessment of the technical/scientific challenges of implementing results-oriented, accountability-based air quality management within a multi-pollutant framework. Information on the aerosol workshops was provided in the Summer/Fall 2006 issue of NARSTO News (Volume 10, Number 2). An update on the multi-pollutant assessment can be found in this issue.

In addition to these major activities, a paper summarizing the NARSTO emission inventory assessment was published in the Journal of the Air and Waste Management Association (Miller et al., vol 56, pp 1115-1129), and presentations on the assessment were given at the NERAM Colloquium on Air Quality Risk Management in Vancouver, B.C. and at the GEIA 2006 Open Meeting in Paris. Additional work to promote emission inventory improvement is also being contemplated (see below).

In the area of health effects, EPRI and NARSTO cosponsored a workshop on the health effects of organic aerosols, and a paper on air pollution and human health was published in EM magazine (Pennell et al., September, pp 8-14).

Within the QSSC, a new set of Google Earth products have been created to provide visual information on the location and physical surroundings of major air quality monitoring sites. In addition, a new report on minimum detection limits for the measurement of various air contaminants is in preparation. When completed, this report will be posted on the NARSTO website.

In this edition...

Executive Assembly Directives

The second day of the Executive Assembly was dedicated to a discussion of NARSTO's agenda for the coming year. This discussion led to the following directives to the Management Coordinator and the Executive Steering Committee (ESC):

Multi-Pollutant Accountability Assessment

1. Proceed with plans to complete this assessment by the end of CY 2008.

2. Plan for meetings in Canada, the United States, and Mexico to roll out assessment findings to key decision-makers.

Aerosol Workshops

1. Place immediate priority on publication of two papers summarizing the findings and recommendations of the workshop on applications of chemical transport and receptor models. The first paper should be written for the health research community and published in an appropriate journal. The second paper will be prepared for EM, and written for the air quality management community.

2. Complete final reports on the two aerosol workshops (model applications and aerosol processes) and post them on the NARSTO website. If funding allows, print a small number of copies (about 100) to be distributed to NARSTO members and selected decision-makers.

Regional Emission Inventory Workshop

NYSERDA and MARAMA are planning a workshop on emission inventory gaps in the northeastern United States. The focus of the workshops will be on improving the spatial and temporal scale of the inventories and on improving the accuracy for area and small, distributed point sources. Areas of concern include 1) criteria pollutants, 2) air toxics, and 3) greenhouse gases.

To obtain NARSTO assistance, representatives of MARAMA and NYSERDA were asked to prepare a proposal specifying the assistance desired for consideration by the ESC.

NARSTO and GEOSS (see http://www.epa.gov/geoss/)

NARSTO should hold a workshop to discuss an appropriate role for NARSTO within the Global Earth Observation System of Systems (GEOSS). The Management Coordinator was charged with convening an organizing committee to discuss the focus of the workshop and draw up a list of invitees. Once the workshop has been organized, information will be posted on the NARSTO website.

2008 Executive Assembly Meeting

The Executive Assembly recommended that the 2008 Executive Assembly Meeting be held in Mexico, followed by a technical symposium on some aspect of multi-pollutant accountability of particular relevance to Mexico. The 2008 Executive Assembly will address progress on the multi-pollutant accountability assessment, and it will feature discussions of the links between climate change and air quality. The ESC will work with the Management Coordinator to identify an appropriate theme for the climate/air quality discussions. The subject of the technical symposium will be determined by the assessment co-chairs and submitted to the ESC for advice and consent.

The NARSTO News is published biannually for the purpose of communicating NARSTO activities and progress to members of the extended NARSTO community. Persons wishing to comment on the newsletter or submit material for publication are invited to do so by contacting either Diane Fleshman at 509-375-5694 or Bill Pennell in the NARSTO Management Coordinator's office, at the following address:

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NARSTO Assessment Update

As reported in the last issue of NARSTO News (Volume 10, Number 2), NARSTO is conducting an assessment of the technical challenges of implementing accountability within a multi-pollutant air-quality management framework. Accountability is a process for evaluating the effectiveness of an air-quality management action or actions, and it is intended to provide feedback for modifying or improving air-quality management actions as they are implemented. As generally conceived, accountability is implemented by addressing a set of questions that make up the so-called "accountability chain":

1. Was the air-quality action implemented?
2. Were the expected emission reductions achieved?
3. Did the expected reductions in ambient con centrations occur?
4. Was exposure reduced?
5. Were the expected health and ecosystem benefits realized?

The plan for implementing the assessment is to meet with expert panels from the health and ecosystem research communities, assess the state of the science in terms of answering the accountability questions, and determine the information that would be needed in order to address them. NARSTO atmospheric and exposure science experts would then assess the capabilities for providing this information both currently and in the near future.

Lead authors for the various chapters of the assessment have been selected, and a lead-author meeting was held January 2007 in Research Triangle Park, N.C. The health and ecosystem expert panel meetings were held in April 2007. The assessment co-chairs as well as atmospheric science, exposure science, and risk assessment experts will be conferring in July to discuss the implications of the expert panel meetings for the assessment process. The assessment implementation plan calls for a final draft assessment report by spring 2008. Completion of the assessment is scheduled for December 2008.

Additional information on the NARSTO assessment and on multi-pollutant air-quality management can be found in a series of review articles published in the May 2007 issue of EM magazine.

Recent NARSTO-Related Field Research

The March 2007 Executive Assembly meeting featured presentations on three recent NARSTO-related field research activities: the second Texas Air Quality Study and two studies from Mexico – MILAGRO, and MAXMex. Early results from this work epitomize the breadth of NARSTO's research agenda. The Texas Air Quality Study is part of a continuing effort to understand the ozone problem by conducting basic research in a variety of chemical and meteorological environments. These studies have also contributed practical guidance for the development of ozone control strategies, as can be seen below. In Mexico, past field research has focused on urban air pollution in Mexico City. More recently, the focus has expanded to include the effects of Mexico City on regional climate.

Texas Air Quality Study

Professor Ellis Cowling (North Carolina State University) summarized preliminary findings from the second Texas Air Quality Study (TexAQS II). These results have been generated through the Rapid Science Synthesis (RSS) project of the Texas Commission on Environmental Quality (TCEQ). The RSS was designed to provide early answers to high-priority questions from the TCEQ regarding development of ozone and particulate matter (PM) State Implementation Plans for Houston and Dallas. The questions are

- Which local emissions are responsible for high transient ozone concentrations and for potential exceedences of the eight-hour standard?
- How have emissions of volatile organic compounds (VOCs) and NO_x changed since the first Texas Air Quality Study in 2000?
- What conclusions can be drawn from the observations regarding the validity of emission inventories and relative importance of anthropogenic and natural emissions?
- What is the relative importance of local versus distant sources, and where are these sources are located?
- What meteorological conditions are associated with significant long-range transport of pollutants or precursors?
- What typical background PM and ozone concentrations exist during poor air-quality events?
- Which chemical kinetic models best represent conditions in Texas?
- How might models and measurements be combined to address critical issues in air quality management such as NO_x versus VOC sensitivity in reducing ozone?

Work under RSS is continuing, but some representative conclusions include:

a) The highest transient concentrations of ozone in the Houston region occur in narrow, intense plumes of NO_x and highly reactive VOCs co-emitted from petrochemical facilities. There is some evidence that emissions of these VOCs may have declined by a factor of two between 2000 and 2006, but existing inventories appear to underestimate the emissions of highly reactive VOCs from industrial sources by an order of magnitude.

b) On-road mobile emissions developed from MOBILE-6 appear to over estimate CO emissions by a factor of two, and NO_x emissions are likely underestimated.

c) Average background concentrations of ozone in eastern Texas range from 50-60 ppb. Also, ozone can be transported from Houston to Dallas on an episodic basis. Both observations indicate that it will be difficult to attain ozone standards solely via local controls.

MILAGRO

Professor Luisa Molina (MIT) reviewed the MILAGRO (Megacity Initiative: Local and Global Research Observations) experiment, which is examining the effects of megacities on air quality. Defined as urban areas with populations greater than 10 million, the number of megacities has expanded from three in 1975 to twenty in 2005. Of these twenty megacities, fifteen are in developing countries. Each of these cities cause environmental impacts on the local (e.g., air quality and health) to global scale (e.g., climate change), and in most megacities in the developing world, authorities are just beginning to deal with these issues. MILAGRO is addressing three primary scientific questions:

1) What is the spatial and temporal extent of pollution plumes from megacities,

2) How and where are urban pollutants removed from the atmosphere, and

3) What are the regional and global impacts of these plumes?

As a megacity case study, MILAGRO is focusing on Mexico City. Mexico City is a representative tropical megacity with

- an extensive air-quality monitoring network,
- good meteorological support, emission inventories, and infrastructure,
- opportunities for excellent scientific collaborations, and
- a history of previous scientific investigations on which to build.

The initial MILAGRO field experiment was conducted in the spring of 2006. It consisted of four coordinated components – the Mexico City Metropolitan Area – 2006 (MCMA-2006) experiment, which focused on urban air quality and air quality effects; the Megacity Aerosol Experiment – Mexico (MAXMex), which examined the evolution of aerosol properties and aerosol-gas interactions in the immediate urban outflow; the Megacity Impacts on Regional and Global Environments – Mexico (MIRAGE-Mexico), which examined the evolution of the Mexico City plume on a larger regional scale; and the

Intercontinental Chemical Transport Experiment – Phase B (INTEX-B) collaboration, which is studying the transport and evolution of pollution on the global scale.

Results from MILAGRO are just beginning to emerge, and they are building on the observations from previous Mexico City air quality experiments (e.g., MCMA-2003). From an atmospheric chemistry point of view, Mexico City's physical location (low latitude, high altitude, and topography), coupled with its mix of emissions, provides a good test bed for examining our understanding of urban and regional-scale chemistry. Criteria pollutant concentrations within the MCMA are declining as a result of ongoing control activities. Ozone chemistry is VOC-limited, but the trend is towards higher NO_x and lower reactivity. Particulate matter appears to have a higher organic fraction than most other cities worldwide, and Mexico City is a very rich environment in which to study secondary organic aerosol formation – both within and downwind of the city. In summary, MILAGRO will provide the first assessment of the regional air-quality impacts of a mega city, it provides an opportunity to examine poorly understood, but very important, air quality and climate-related processes in urban air, and it will provide better understanding of the relative importance of various emission sources – urban, biomass burning, and natural – in a tropical city. From a global perspective, MILAGRO will give insights into the regional and global impact of growing urbanization. The number of megacities is expected to grow to twenty-two by the year 2015, and the number of mini-megacities – cities with population between five and ten million – is expected to reach 40 by that time. Finally, by providing Mexican students and professionals the opportunity to conduct cutting-edge science in collaboration with an outstanding contingent of international experts, MILAGRO is enabling Mexico to build its human capital in the area of atmospheric and health science.

MAXMex

Professor Jeff Gaffney (University of Arkansas at Little Rock) summarized preliminary accomplishments of MAXMex. MAXMex is a field research component of the Department of Energy's Atmospheric Science Program (ASP), and, as described above, it is one of the four components of MILAGRO. ASP is part of the DOE Office of Science's program of research into the physics and chemistry of climate change. ASP's focus is on understanding the effects of atmospheric aerosols on the Earth's radiation budget and on transferring this understanding into improved representations of aerosol effects in climate models. Within this overall objective, MAXMex was designed to examine

1. aerosol size-dependent composition,
2. aerosol optical properties and their dependence upon controlling variables,
3. aerosol "aging" and transformations during transport,
4. secondary aerosol formation and evolution, and
5. the differences between urban, regional, and global aerosol radiative forcing.

Mexico City was chosen as a research venue because it is a strong source of aerosols, particularly secondary organic aerosols, that contrasts with the sulfate-dominated aerosols typical of the eastern U.S.

Previous air quality studies in Mexico City had suggested that on fairly frequent occasions boundary layer air is transported out of the Mexico City basin to the northeast. In addition, the topography of the Mexico City basin is such that polluted air is frequently vented by dry convection and slope-driven convergence zones that transport material above the height of the surrounding terrain and into the synoptic-scale flow. These phenomena provide opportunities to study aerosol evolution via surface measurements and aircraft. The surface networks consisted of three well-instrumented "super sites" located within the city and at two locations in the northeast downwind direction. The distance encompassed by the three sites

was 70 km or several hours of transit time – depending upon wind speed. During transport episodes, measurements from aircraft were coordinated with the surface sampling. Two aircraft were employed: the DOE G-1, which was equipped with a suite of instrumentation for obtaining meteorological parameters, gas phase chemistry, and aerosol composition, and the NASA King Air, which was equipped with a downward-pointing lidar for vertical profiles of aerosol properties.

As with MILAGRO, results from MAXMex are just emerging. Preliminary analysis of the data confirmed that aerosols downwind of Mexico City are typically absorbing and are predominately composed of organic material and nitrates. Aerosol profiles obtained from the NASA King Air confirmed venting from the Mexico City basin as predicted by the models. Numerous new particle formation events were observed. The hygroscopicity of these new particles was variable, indicating that they are probably externally mixed. As the data are more thoroughly analyzed, MAXMex is expected to yield new information, for example, on size-dependent aerosol composition and processing, dependence of these properties on sources and subsequent atmospheric processing, secondary aerosol formation and processing, on the performance of aerosol models, and on how to improve the representation of aerosol properties and effects in these models.

NARSTO Finalizes Review of RRWG Scientific Effort

Contributed by Jeremy Hales

NARSTO is completing a summary report documenting progress of the Reactivity Research Working Group (RRWG), and expects to have the final version available on its Web site shortly.

Formed in late 1998, the RRWG operates as a NARSTO adjunct, and is a consortium of individuals from government, industry and academe addressing the potential for managing organic pollutant emissions on the basis of their individual ozone-generation potentials, or "reactivities." Early in its history the RRWG anticipated that EPA would publish a rulemaking on US Federal reactivity policy, and designed its program to provide research support for this action. Although the Rulemaking did not materialize, the EPA did publish, in September 2005, an Interim Guidance on Control of Volatile Organic Compounds in Ozone State Implementation Plans, which encourages the states to incorporate reactivity features into their individual State Implementation Plans.

The EPA Guidance provides at least an interim breakpoint in the RRWG effort, and the NARSTO report summarizes and compiles RRWG progress by providing a critical scientific review of the work and a collection of the major RRWG products. These products are documented in a set of appendices that include:

- An early "Assessment" of scientific and policy-analysis aspects of reactivity, which documents the current state of knowledge and establishes a background for additional RRWG research.
- An evaluation, using an observation-based model approach, of geographical areas within the US where O_3 formation is limited by VOCs or, alternatively, by NO_x.
- Several evaluations, using Eulerian grid models, of VOC/NO_x limitation as well as of alternative reactivity scales. These modeling studies emphasize regions of the Eastern US, but provide a more limited characterization of Southern California as well.

- An evaluation of VOC deposition and re-emission behavior using a multimedium transport model.
- An enhancement of the SMOKE emission processor for use with EPA's Models-3/CMAQ modeling system to produce reactivity-relevant computations.

Primary conclusions derived from these studies include the following:

1. Although significant US regions exist where VOC emissions have appreciable influence on summertime O_3 formation, there are major areas where NO_x limitation prevails.
2. During summertime, natural emissions contribute roughly 80 percent of the total VOC burden in the Eastern US, limiting the fraction of VOC emissions amenable to direct control.
3. Because of 1 and 2 above, area-average O_3 concentrations will respond only marginally to additional anthropogenic VOC control. Model calculations indicate that total curtailment of anthropogenic VOC emissions will result in a roughly 5 percent reduction in area-average O_3 concentrations. While O_3 reductions approaching 70 percent are expected at some, highly VOC-limited, locations, these locations represent only minor portions of the total modeled areas.
4. Of the reactivity scales evaluated by RRWG modeling analyses, several were judged suitable for regulatory application, noting that choice of scale will depend on the goals of the regulatory system. To this point it is noted that a complete evaluation of scales necessarily involves consideration of the following questions:

   Question 1. What, precisely, are the objectives to be attained by the regulatory application?

   Question 2. How, precisely, will the regulation be applied?

   Because these questions remain largely unanswered at present, a totally comprehensive evaluation of the scales was somewhat beyond the scope of the RRWG modeling studies.
5. Substitution of a low-reactivity VOC, such as ethane, for anthropogenic VOC emissions has much the same effect on O_3 production as VOC elimination. This supports the concept of using ethane as a "bright-band" cutoff if such a VOC-control strategy is imposed.

The NARSTO report concludes that the RRWG activity has been commendably productive, owing both to the initiative of its participants and to the effective and productive interaction between its policy analysts and scientists. Because of conclusions 1 through 3 above, the Interim Guidance approach adopted by the EPA seems appropriate at this development stage.

The report suggests that further efforts by the RRWG or its successors should maintain and augment the strong science/policy structure and should broaden the scope to address more squarely Questions 1 and 2 above, with the policy sector taking a lead role in this process. Primary issues to be addressed are in this regard are

- O_3 management by coordinated, optimized VOC and NO_x control;
- Definitive criteria for O_3 management; and
- Multi-pollutant management.

These complex issues demand an effective interaction between scientists and policy analysts. To enhance and systematize this interaction, the NARSTO report recommends that a formal interactive construct, termed the "Policy Testbed," be applied in future programs of this type. Prepared by the policy-analysis sector, Testbeds are formal statements describing hypothetical regulatory systems addressing Question 1 (and portions of Question 2) above, and serve as frameworks for defining key issues, prioritizing research, and communicating results.

In conclusion, the RRWG served a valuable role in developing the air-pollution community's information base, demonstrating effective methods for operations between the science and policy sectors, and setting the stage for future developments in the field of reactivity-based air quality management. It is likely that future efforts along these lines can achieve considerable success if they build upon the RRWG results reviewed and documented in this report.

Quality Systems Science Center Update

Contributed by Les Hook

Data Sets Available to the Public: Recent Additions to the NARSTO Permanent Data Archive at the Langley Atmospheric Science Data Center.

New York EPA Supersites Data

- **NARSTO EPA_SS_NY Air Chemistry, Particulate Matter, and Met Data**

A second increment of 48 files has been added to this data set for a total of 156 files. **This completes archiving of NY data.**

Data files from all components of the **$PM_{2.5}$ Technology Assessment and Characterization Study in New York State (PMTACS-NY) Supersite** program are archived in this single data set. Time-series plots are included for all of the numeric variables in each of the data files. These plots are useful for screening for outliers and visualization of values less than the detection limit and values with other quality flags. QA plans and the final PMTACS-NY Supersite report are included as documentation.

Pittsburgh EPA Supersites Data

- **NARSTO EPA_SS_PITTSBURGH Gas Conc and PM Physical Properties Data (26 data files with plots)**
- **NARSTO EPA_SS_PITTSBURGH Particulate Matter Composition Data (29 data files with plots)**

These two data sets provide Gas Concentration and Particulate Matter Physical Properties and Composition Data from the **Pittsburgh Air Quality Study (PAQS)**.

The **PAQS** was a comprehensive, multi-disciplinary investigation to characterize the ambient PM in the Pittsburgh region. The measurement campaign lasted for 14 months (July 2001-September 2002). Baseline measurements included daily filter samples for fine particle mass and composition (OC/EC, major ions, elemental composition). QA plans and the final PAQS Supersite report are included as documentation. These data sets join the previously archived **Meteorological Data and Single-Particle Mass Spectrometer Data**

Los Angeles EPA Supersites Data

- **NARSTO EPA_SS_LOS_ANGELES Aethalometer Elemental Carbon Data (6 data files with plots)**

A dual beam aethalometer was used in a mobile trailer to collect mass concentrations of optically absorbing black carbon particles in the submicron size range during the period of September 15, 2000 to October 16, 2003 at several Los Angeles locations. The final LA Supersite report is included in the archive as documentation.

The overall objective of the **Los Angeles EPA Supersite** project was to conduct monitoring and research that contributes to a better understanding of the measurement, sources, size distribution, chemical composition and physical state, spatial and temporal variability, and linkages to health effects of airborne particulate matter in the Los Angeles Basin.

We expect to add additional LA data sets in coming months.

Data Archive Link: http://eosweb.larc.nasa.gov/PRODOCS/narsto/table_narsto.html

Published on QSSC FTP Site and Available to the Public for Downloading

MILAGRO MAX-Mex 2006 DOE G-1 Data

- **NARSTO MILAGRO MAX-Mex 2006 DOE G-1 Aerosol, Air Chem, Radiometric, and Met Data**

The DOE Gulfstream G-1 aircraft participated in the Megacity Initiative: Local And Global Research Observations (MILAGRO), Megacities

Aerosol eXperiment-Mexico (MAX-Mex) during March, 2006. Thirty (30) data files with time series plots have been published on QSSC FTP Site (ftp://narsto.esd.ornl.gov/pub/MILAGRO/) in the NARSTO DES format.

The G-1 operated out of Veracruz, MX and flew research flights in and around the Mexico City airspace during the month of March 2006. There were a total of 15 research flights on eleven different days. Data are reported for both 1 second and averaged 10 second sampling intervals.

Measurements were obtained to characterize regional differences in aerosol distribution, composition, and microphysics in relation to aerosol sources and processing history and to characterize the contribution of urban sources of aerosols and their precursors to aerosol burdens downwind of Mexico City.

New on the QSSC Web Site

A new data file search application (in test mode) will identify data files containing data for the parameters that you select. The search returns the names of the data files, data set names, and links to their locations on the Permanent Data Archive and the QSSC FTP Site.

All of these resources are found on the NARSTO Quality Systems Science Center (QSSC) web site at http://cdiac.ornl.gov/programs/NARSTO/.

More Resources for Managing and Archiving Your Data

Guidelines for Archiving Data in the NARSTO Permanent Data Archive

- Outlines how data are selected for archiving; identifies ways that projects can foster archiving; lists items to consider when preparing data for archiving; and describes the archiving process.

Data Management Planning Guide

- A compilation of data management policy and guidance modules for program, project, and investigator use in developing and implementing data management plans.

Archive Data File Format Template

- Data Exchange Standard (DES) format and Site Information templates with picklists for standardized metadata fields.

Standardized Variable Names and Metadata Values for both NARTSO and ICARTT Data File Formats

- Find consistent values for names and units that can be used to report measurements and metadata for various data types across multiple platforms. ICARTT values have been specifically constructed to be friendly to most data user software and data systems.

Need Additional Information?

Please contact Les Hook at the QSSC, Oak Ridge National Laboratory, by either e-mail (hookla@ornl.gov) or phone (865-241-4846).

In the **last** edition...

NARSTO Launches New Assessment

Aerosol Modeling Workshop

EPRI/NARSTO Organics Workshop

What's New at QSSC

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