NARSTO News

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

Volume 9, Number 2;
Summer/Fall 2005

http://www.cgenv.com/Narsto

Executive Assembly Considers NARSTO's Future Agenda

Over 45 NARSTO members and guests gathered at Las Vegas' Sahara Hotel on April 11 and 12 for the NARSTO Executive Assembly. This year's assembly featured a panel discussion of actions the scientific community and funding agencies could take to strengthen collaboration between air quality and health sciences researchers. A summary of the conclusions and recommendations of the panel is presented elsewhere in this issue of NARSTO News. More information on the Assembly, including copies of the presentations and a list of attendees, can be found on the NARSTO website at www.cgenv.com/Narsto.

The first day of the assembly focused on the panel discussion. The second day was dedicated to a discussion of future NARSTO activities. These activities include a) communicating the conclusions of the Emission Inventory Assessment to the emission inventory community, b) actions NARSTO should take to help implement the recommendations of the air-quality/health-sciences panel, c) the role of NARSTO in promoting research in air quality and climate, and d) how NARSTO might assist in facilitating a multi-pollutant or "one-atmosphere" approach to air-quality management. The Executive Assembly recommended the following actions to the Management Coordinator and the Executive Steering Committee:

Emission Inventory Assessment

Prepare and execute a strategy for communication the findings and conclusions to key decision-makers and stakeholders in the three NARSTO countries.

Strengthening Connections between the Air-Quality and Health-Science Communities

Take various actions to implement the recommendations of the Executive Assembly panel discussion including:

a) Brief the U.S. Air Quality Research Subcommittee on recommendations to funding agencies for improving collaboration between these communities.

b) Consider preparation of a summary paper on enhancing collaboration for presentation at health science research meetings.

c) Consider preparation of a critical review paper on source apportionment methods for publication or presentation in appropriate health science research venues.

d) Consider collaboration with appropriate health science organizations in developing recommended research strategies.

e) Consider joint sponsorship, with an appropriate health sciences research organization, of a periodic conference on air-quality and health-effects research.

Climate and Air Quality

Two immediate actions were recommended: First, the Management Coordinator should investigate interest in a regional aerosol modeling workshop and assessment. The workshop would consider the current state-of-the-art in modeling regional aerosol processes important to understanding their effects on climate and air quality. Initial contacts with the aerosol modeling community indicate significant interest in such a workshop. Second, the Management Coordinator should conduct an analysis of air-quality and climate research activities and plans in the three NARSTO countries. The Management Coordinator will look for opportunities where NARSTO could contribute to furthering research in these areas or could assist in meeting assessment goals.

One-Atmosphere Approach to Air-Quality Management

The Management Coordinator should establish a small working group to define the level of interest, a scope, charge, and plan of attack for a NARSTO activity in this area. This committee will take a long-term view of this issue considering the scientific challenges of implementing this approach not only in terms of traditional air pollutants, but also with respect to developing issues such as climate change and the long-range transport of air pollutants.

In this edition...

NARSTO Emission Inventory Assessment Goes to Press

NARSTO's much awaited Emission Inventory Assessment is scheduled to be printed by late September, 2005. After considerable discussion, editing, peer review and formatting the final version will soon be posted on the NARSTO website for downloading and approximately 500 color copies will be printed. The report has nine chapters, several appendixes and a executive summary that has been translated into French, English, and Spanish in a manor consistent with other NARSTO assessments.

NARSTO would like to thank and acknowledge the many people and agencies who made this report possible including NARSTO leadership, Steering Committee, and co-chairs, chapter authors and contributors, and funding organizations. We would also like to thank all the authors and reviewers whose generous contribution of time and effort in reviewing this assessment have made its completion possible.

For more information or to see the document in PDF format see NARSTO's website at www.cgenv.com/Narsto.

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 509-546-9541 or Bill Pennell in the NARSTO Management Coordinator's office, at the following address:

NARSTO Management Coordinator's Office
7420 Ricky Rd.
Pasco, WA 99301

Phone: 509/542-0644
e-mail: bill@craea.com

Strengthening the Connection between Air Quality and Health Effects Science

Ten leading air quality and health sciences researchers from Canada, the United States and Mexico joined NARSTO members in a lively discussion of the future of collaborative research into the health effects of air pollutants. The members of the panel were:

Joe Mauderly (Director, National Environmental Respiratory Center, Lovelace Respiratory Research Institute)

Ron Wyzga (Technical Executive, Air Quality, EPRI)

Constantinos Sioutas (Professor of Civil and Environmental Engineering, Southern California PM Center and Supersite, University of Southern California)

Ted Russell (Georgia Power Distinguished Professor, Department of Civil and Environmental Engineering, Georgia Institute of Technology)

Jeff Brook (Senior Research Scientist, Environment Canada and Adjunct Professor, Department of Public Heath Sciences and Department of Chemical Engineering, University of Toronto)

Pat Mastin (Chief, Cellular, Organs and Systems Pathobiology Branch, Division of Environmental Research and Training, NIEHS)

Andy Miller (Senior Research Engineer, Office of Research and Development, U.S. Environmental Protection Agency)

Mark Raizenne (Associate Director General, Safe Environments Program, Health Canada)

Carlos Santos-Burgoa (Director General de Promoción de la Salud)

Dan Greenbaum (Director, Health Effects Institute)

The panel members expressed a strong opinion that continued progress in understanding the health effects of air pollutants requires innovative research designs that employ multi-disciplinary research teams. These teams must include air-quality scientists in addition to other disciplines. There was also consensus that the design of health-effects research studies has not kept pace with the advances in scientific knowledge. Although PM is frequently shown to have the strongest association with health effects among the few pollutants measured routinely, individuals in the real world are exposed to multiple pollutants – both particles and gases. Agencies must adopt a "one-atmosphere" approach for research and regulation. Experiments need to identify what chemical components and what types of exposures are most important in initiating adverse health effects in sensitive populations.

Traditional epidemiological studies have focused on identifying associations among air-quality metrics (both chemical and meteorological) and health endpoints. Some studies have begun to focus on associating specific sources of air pollutants with health effects. Continuing research using both approaches is needed. Exposure of sensitive populations to specific chemical components or combinations of components (both PM and gases) – along with coincident environmental conditions including each individual's current health status – is what exacerbates or possibly initiates disease. The panel concluded that if we are to understand the mechanisms of environmentally induced disease, we must understand to what, how much, and under what conditions people are exposed, as well as how such exposures interact with medical/public health and socioeconomic factors.

In light of these observations and findings, panel members offered a number of suggestions for improving the state-of-the-science in health effects research. Improved health effects research studies will require

- Better characterization of the surface chemistry of PM, and better tools for speciation, especially for semivolatile components.
- Better methods for characterizing complex exposures.
- Funding support for interdisciplinary "resource centers" that house multi-disciplinary teams and research facilities, develop new analysis and measurement methods, and make these capabilities available to a broad spectrum of researchers.
- Improved "cross-over training" for graduates and postgraduates: true multi-disciplinary research teams must be composed of scientists who understand the science and the cultures of the key disciplines that make up the team.
- Removal of disincentives, especially within academic institutions, to the pursuit of careers in multi-disciplinary team research, and perhaps even positive incentives for pursuing these lines of research.
- Better designed monitoring programs: Monitoring networks need sufficient longevity to enable complex relationships between exposure and effect to be teased from the data, they need to measure the right chemical components, and they need to document spatial and temporal variability. Monitoring programs need to be better coordinated among sites with different or unique chemical and meteorological climatologies.
- Better measurements of gas-phase and PM-surface organics – bulk chemistry is not sufficient. These technologies will be most useful if they are developed to fill specific needs as identified by better designed or more innovative health studies.
- Better personal exposure monitors, and continuous samplers that provide accurate speciation.
- Proteomic and metabolomic markers of exposure and dose.
- An organization within the health effects research community that could parallel NARSTO.

Six-State Air Emission Data puts Mexico's National Inventory in Sight

By Paul J. Miller, Commission for Environmental Cooperation

One way to cross the border between Texas and Mexico is to simply walk across the Paso del Norte Bridge linking El Paso, Texas and Ciudad Juárez, Chihuahua. After dodging sidewalk vendors at either end, one can leisurely stroll and look down upon what was once the natural riverbed of the Rio Grande. There's still a trickle of water, but much of the bed is dry with a few reeds sprouting here and there. Running parallel to the former river bed is its modern version where most of the water now flows – a concrete channel more akin to an irrigation canal than a free-flowing river. The reason for this is that the Rio Grande makes a lousy border. It meanders and bends and loops around, and every once in a while, a flood makes a new path, cutting off a piece of one country and placing it on the other side. Today's concrete channel is the modern fix to the political boundary problem posed by a river that won't respect its own banks.

In contrast to the concrete river, no one yet has figured out a way to keep air from spilling over the border. Air pollution freely travels in both directions – a common problem that requires a collaborative, bilateral approach by Mexico and the United States. To this end it was a major step forward when, on June 9, 2005, Mexico's environment secretary Alberto Cárdenas Jiménez headlined an event in Ciudad Juárez to mark the public release of a new regional air emissions inventory spanning the six northern Mexican states that lie along the border with the United States. This has significant bilateral importance because it provides a better understanding of Mexico's air pollution sources for air quality planning purposes, helping inform air quality management decisions on both sides of the border. On the U.S. side, for example, it will provide fundamental inputs into the western U.S. regional visibility modeling and planning efforts.

The completion of this air emissions inventory for Mexico's northern states is also a major milestone on the way towards Mexico's first-ever national air emissions inventory, which will be completed later this year. The completed inventory will be the foundation for Mexico's planning efforts to continue addressing air pollution sources in Mexico's major cities and along the Mexico-U.S. border region.

Overview of Mexico's Air Inventory Initiative

The Mexican federal agencies Instituto Nacional de Ecología (INE) and the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) have jointly coordinated and led the national air inventory initiative. Key collaborative support in planning, technical work, and funding has come from the Western Governors' Association (WGA), the US EPA, and the Commission for Environmental Cooperation (CEC).

From the start, Mexico's air inventory initiative adhered to four principal objectives:

1. Create Mexico's first national air emissions inventory (base year 1999).

2. Further the technical capacity at the national level in Mexico to develop air emissions information.

3. Support air quality studies along the Mexico-US border.

4. Help the CEC's efforts to improve the availability and comparability of air emissions data on a trinational level.

The national inventory includes emissions of nitrogen oxides, sulfur oxides, volatile organic compounds, carbon monoxide, particulate matter and ammonia from point, area and mobile sources. It also includes estimates of emissions from natural sources, such as vegetation and soils.

In Mexico, air pollution sources typically fall under either federal or state and municipal jurisdiction, depending upon the source category. It is thus important to involve federal, state and local agencies throughout the inventory development process to ensure the inventory reflects the best currently available information, as well as identify important gaps where data are lacking. To help do this, the inventory project has two committees that bring together the key agencies and other participants to integrate air emissions information into the inventory. The committees also serve as venues for informing the various agencies and stakeholders of the methodologies developed and applied in Mexico to estimate emissions from important source categories. A notable example is the modification of the mobile source emissions model MOBILE6 by the project contractor Eastern Research Group (ERG) to better reflect motor vehicle emission characteristics in Mexico.

The first committee, known as the Binational Advisory Committee, has members from INE, SEMARNAT, US EPA and the WGA and provides overall project planning and coordination. The second committee is the Technical Advisory Committee (TAC), which performs technical oversight of the inventory development process. The TAC members come from INE, SEMARNAT, Mexico's federal energy agency, WGA, US EPA, the 10 Mexico and US border states, industry, academia, and environmental groups.

With the June 2005 release of the six-state northern Mexico air emissions inventory, the completion of Mexico's national air emissions inventory is now within sight. It has been a collective effort of the two committees along with many agencies, organizations, and individuals. It is a good example of cooperative exchanges and working partnerships among the Mexico and U.S. participants. But it is also just one more step along a longer road, albeit a major advance. Air pollution is not static, and emission sources change over time, as do the methods to estimate and measure the amount of pollution emitted. The next step therefore will be to create the institutional framework and momentum in Mexico to refine and update its national air emissions inventory in future years to continue addressing existing and emerging challenges. As most inventory developers are well aware, air emission inventories are never finished, only revised.

The final report on Mexico's six northern states' air emissions inventory is available from the Instituto Nacional de Ecología, http://www.ine.gob.mx/ (in Spanish) and from the Commission for Environmental Cooperation, http://www.cec.org/pubs_info_resources/, under the "Pollutants and Health" title (English and Spanish versions available).

Desktop Air-Chemistry and Reactivity Simulation

Did you ever wish you had a quick, convenient way of examining tropospheric air-chemistry interactions on your desktop? NARSTO has taken a significant step in this direction by creating the User's Reactivity Analysis Code (URAC), a software package that is intended for use on laptop or desktop computers. URAC is based on a box-model description of a pollutant-containing air parcel, as shown schematically in Figure 1. The parcel's contents are presumed to be well mixed and subjected to solar insolation, which varies with geographical location, date, and time of day. Based on this conceptual framework, the code simulates chemical reaction, inflow, outflow, emissions, deposition, and ventilation, calculating chemical-species concentrations and associated sensitivity coefficients as functions of elapsed time.

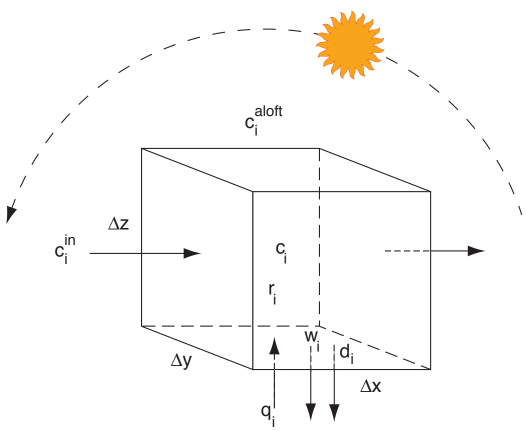

Figure 1: Schematic of Computational Domain

The software associated with this code is written for Unix operating systems and allows execution in batch mode as well as through a graphical user interface (GUI). As such it provides a convenient facility for executing the reaction codes, which requires little prior knowledge of atmospheric chemistry or the intricacies of formulating and solving the associated equations. On-screen plotting of computed output occurs automatically as the GUI-based simulation proceeds. These features reflect the primary intent of this software, which is to serve the following two groups of users:

1. Persons wishing to increase their understanding of tropospheric chemistry in a straightforward and convenient manner, without the burden of acquiring prior knowledge of the computational basis. A primary target audience for this application consists of college-level students of atmospheric chemistry; but it should useful as an instructional tool to a variety of other interested persons as well.

2. Persons involved with policy analysis and air-quality management decision processes. While the limitations of this simple box-model approach are obvious, it is nevertheless valuable as a scoping tool for evaluating alternative control scenarios prior to selection, implementation, and/or more detailed modeling analysis.

In addition to computing time-series of pollutant concentrations for user-specified locations, dates, and start times, the code provides the means to calculate reactivities for selected chemical species. Figure 2 provides examples of these two functions.[1] Here the top plot shows computed mixing ratios for several pollutants corresponding to a particular latitude/longitude position and a particular day for assumed pollutant initial conditions, with the simulation begining at 6:00 AM.

The bottom plot shows sensitivity coefficients, or "sensitivities" of the indicated species to the initial nitric oxide concentration, in terms of the parts-per-million change in the indicated species that would result from a unit change in initial nitric oxide. "Reactivities" of various definitions are derived directly from sensitivity

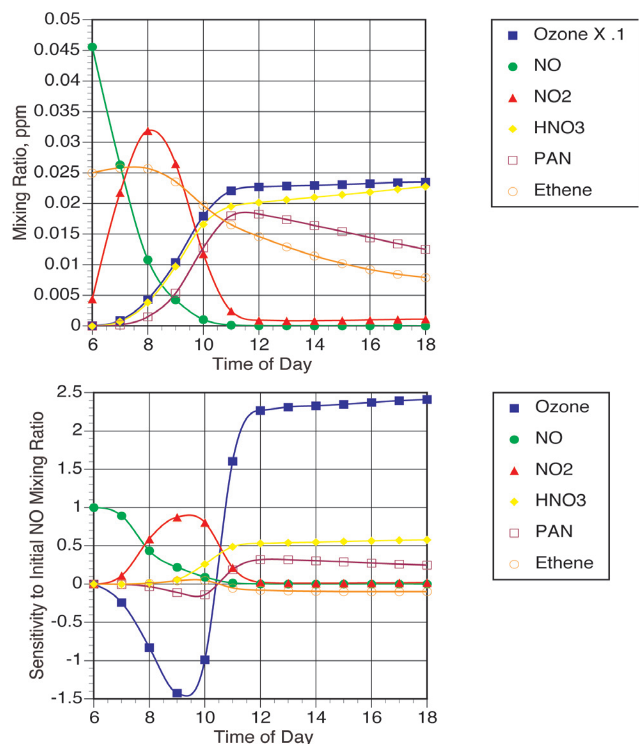

Figure 2: Selected Output from Default-Mode Execution of Code Using CB-4 Parameterization. Top: Computed Mixing Ratios. Bottom: Computed Mixing-Ratio Sensitivities to Initial NO Mixing Ratio.

information; thus the user can apply URAC sensitivity output to generate a variety of reactivities, depending on his or her needs.

URAC's source code is written in Fortran and C, and its GUI is based on the X-Windows application as well as other public-domain utilities. Thus far it has been operated on Sun and MacIntosh platforms, but should be extendable to other Unix and Linux platforms in a relatively straightforward fashion. Although a novice can operate the code easily once it's installed, installation requires some Unix experience. Source code and a user's manual for URAC are available on the VOC Reactivity section of the NARSTO Web site.

Reference

Busness, K. M. and J. M. Hales (2005) USER's Guide to URAC Calculations. Envair Report to Argonne National Laboratory, Contract No. 2F-00871. ENV 05-001. (Available for download on the NARSTO Web site.)

[1]Calculations for these plots were performed using the Carbon-Bond 4 (CB-4) reaction parameterization. Currently URAC supports CB-4, SAPRC-90 and SAPRC 97 parameterizations.

RRWG Meeting Held in May 2005

The Reactivity Research Working Group ("RRWG" -- a NARSTO functional unit) held its first meeting of 2005 on May 25-26, at U.S. EPA's new facility in Research Triangle Park, North Carolina. The meeting was well-attended by industry, academic, and air quality agency representatives, who were keenly interested in hearing a progress report on U.S. EPA's draft Advance Notice of Policy Review ("ANPR") on using VOC reactivity criteria in ozone regulatory policy. After opening the meeting with a welcome and introductions, RRWG Chairman Don Fox moved directly to the progress report as the first item of business.

Tom Helms, of U.S. EPA's Office of Air Quality Planning and Standards, presented the report on the draft ANPR, beginning with a review of EPA's historical development of its VOC control policy, issues and concerns that had emerged over the years, formation of the RRWG, and the progress of policy-relevant scientific research under the RRWG. A number of issues related to translating the research results into control policy applications remain under EPA's review. Accordingly, Mr. Helms could not say what specific conclusions or recommendations might be contained in the ANPR when published, but was optimistic that the long-awaited document would be published sometime this summer. He stressed that the ANPR would serve primarily to define issues of concern and to seek public comment on those issues.

[Note: On August 26, 2005, U.S. EPA published in the Federal Register a Notice of Interim Guidance on SIP Development, in lieu of the more formal ANPR. The interim guidance "encourages States to consider recent scientific information on the photochemical reactivity of volatile organic compounds" and "summarizes recent scientific findings" but "does not change any existing rules." The interim guidance document is available on EPA's website at: http://www.epa.gov/ttn/oarpg/t1/memoranda/27601interimguidvoc.pdf]

Among the other reports presented at the RRWG meeting were: Regional Photochemical Reactivity Modeling By U.S. EPA, from Deborah Luecken of U.S. EPA's Office of Research and Development; Calculation of Reactivity Scales Using Regional Models, from Bill Carter of the University of California, Riverside; and SMOKE – Final Report Presentation, from Zak Adelman of the UNC-Carolina Environmental Program. Future activities of the RRWG are to include preparation of a "progress-to-date" summary geared to explaining the policy-relevant research results of interest to air quality regulators and other policymakers.

PRSRT STD
AUTO
USPOSTAGE PAID
PASCO, WA
PERMIT NO. 200

NARSTO Management Coordinator's Office
7420 Ricky Rd.
Pasco, WA 99301