



ANNOUNCEMENTS

The Department of Commerce awarded the Bronze Medal to several organizations that have been involved in the scientific development of the NOAA research vessel KA'IMIMOANA, which services the Tropical Atmosphere-Ocean (TAO) array in the eastern and central Pacific. The Aeronomy Lab's Tropical Dynamics and Climate group were among those honored; the group was responsible for the installation of a wind profiler (the first of its type ever to be permanently installed on a NOAA ship) and the design and construction of a balloon launcher for the ship. **Ken Gage, John Wilson, Paul Johnston, and Dave Carter** are being recognized. Ken accepted the award at a ceremony on December 12 in Silver Spring, MD.



Aeronomy Lab publications have won two of the five "research category" awards in the NOAA Environmental Research Laboratories 1996 "Outstanding Scientific Paper" awards competition:

Murphy, D.M., and D.S. Thomson, Laser ionization mass spectroscopy of single aerosol particles, *Aerosol Science and Technology*, 22, 237-249 (1995).

Fahey, D.W., et al., Emission measurements of the Concorde supersonic aircraft in the lower stratosphere, *Science*, 270, 70-74 (1995). [Aeronomy Lab coauthors: **E.R. Keim, E.L. Woodbridge, R.S. Gao, S.G. Donnelly, R.C. Wamsley, L.A. Del Negro, S. Solomon, and K.K. Kelly**]



Dan Albritton has been honored with a Distinguished Presidential Rank Award for 1997. The award cites Dan's leadership of the Aeronomy Laboratory; his many contributions to advancing the scientific understanding of climate change, air quality, and ozone depletion; and his communicating that understanding to decisionmakers and the public. He will accept the award in a ceremony in Silver Spring, MD, next summer. [A.E. MacDonald, Director of the NOAA Forecast Systems Laboratory in Boulder, also won a Distinguished Presidential Rank Award.]



The Role of Scientific "State-of-Understanding" Assessments: Breaking New Ground on the Topic of Air Quality

[Note: This is the second in a series of articles summarizing the Aeronomy Lab's current participation in science assessments.]

Scientific "state-of-understanding" assessments have been a key communications link between the scientific community and decisionmakers. Assessment reports are unique among scientific documents, in that they specifically set out to summarize scientific findings in policy-relevant terms. In our first article (Vol. 2 Issue 2), we reported on the longest-running of these scientific assessments, concerning the stratospheric ozone layer. In this issue we examine the "newcomer": the scientific assessment of air quality issues related to the lower atmosphere. The first-ever international assessment on this topic is currently in preparation, with expected completion in late 1998.

With decisions on air quality regulations on the front burner in the U.S., the assessment will be particularly timely. Changes to clean air regulations are being proposed by the Environmental Protection Agency and will be considered by Congress. The assessment's compilation and update of air quality science, documented from an ozone-management perspective, will provide a sound scientific basis for future policy analysis and also will be a valuable reference for the air quality research community.

The assessment is being prepared as one of the key activities of the organization known as the North American Research Strategy for Tropospheric Ozone (NARSTO). NARSTO is a public/private partnership of government, utilities, industry, and academia throughout Mexico, Canada, and the U.S. with the primary mission of coordinating and enhancing policy-relevant scientific research and assessment of tropospheric ozone behavior. The U.S. Administration has identified NARSTO as one of the top interagency research priorities of the Nation.

Aeronomy Lab scientists are playing key roles in NARSTO and, specifically, the assessment. Fred Fehsenfeld and Dan Albritton were closely involved in the "launching" of NARSTO in 1995, and several members of the Tropospheric Chemistry Program have given invited scientific talks at NARSTO symposia during the past few years. In the case of the assessment, Tropospheric Chemistry group members are serving as Coauthors of Critical Review Papers that will be among 30 such papers published as a special issue of *Atmospheric Environment*. Dan is on a "synthesis team" that will use those papers to prepare the corresponding assessment document.

[Fred Fehsenfeld, Michael Trainer, Dave Parrish, Jim Roberts, and Paul Goldan are Coauthors of Critical Review Papers.]

Another Chapter in the North Atlantic Regional Experiment

The relaxed pace of life in St. John's, Newfoundland, provided a stark contrast for the research activities associated with the Fall 1997 mission of the North Atlantic Regional Experiment (NARE). In a busy month of activities this September, Aeronomy Lab scientists from the Tropospheric Chemistry, Theoretical Aeronomy, and Meteorological Chemistry groups made 11 flights of the NOAA WP-3D research aircraft based out of St. John's, logging nearly 100 hours of flight time.

If the acronym "NARE" seems familiar, there's good reason; the 1997 campaign was the fourth in a series of missions that began in 1991 as part of the International Global Atmospheric Chemistry (IGAC) research of the International Geosphere-Biosphere Programme (IGBP). The scientific aim of NARE is to understand how North American continental areas are influencing atmospheric composition (especially ozone) of the troposphere in the broad North Atlantic region. Traditionally thought of as a regional issue, tropospheric ozone is now recognized as a more "hemispheric" issue in the North Atlantic — a realization that emerged in the first NARE experiment and has been strengthened and refined in the 1993, 1996, and 1997 campaigns.

Each of those campaigns has differed in the approach and the specific emphasis it has had in addressing the basic scientific aim of NARE. In 1991, summertime measurements of ozone and carbon monoxide (CO, a tracer of human-made pollution) were made at three island sites spaced at approximately 500-km intervals on the Atlantic coast of Canada, giving researchers three "glimpses" of the boundary layer air as it moved from the polluted northeastern U.S. corridor eastward toward Europe. Various studies in the previous decade had given examples of anthropogenic influence, but after the 1991 NARE experiment, scientists could for the first time *quantify* that influence. By considering the measured correlation of CO and ozone, coupled with inventoried emissions of CO from the

continent, it was determined that approximately 50 million kilograms of ozone, or about 1 of every 6 ozone molecules produced in northeastern North America, gets transported out over the North Atlantic, and thus becomes "international" ozone.

Subsequent NARE campaigns have added airborne measurements to the ground data, enabling scientists to do a more detailed tracking of the air masses across the North Atlantic. In the 6-week summer campaign of 1993, there were 5 different aircraft platforms (with AL scientists aboard the NCAR King Air) and 10 ground stations spanning from the North American coast to the Azores. The expansion gave researchers more information about the temporal cycles of important processes and also initiated exploratory studies in the more remote Atlantic. The 1996 campaign was the first to examine springtime meteorological influences during the breakup and outflow of Arctic air masses; it was also the first NARE mission to use the WP-3D aircraft.

With the 1997 intensive, NARE scientists now have their first look at the influence of fall weather fronts on atmospheric chemistry and transport. It was sometimes a game of scientific "tag team" racing, with the P-3 tracking air masses eastward from North America, and German and British aircraft "picking up" on those air masses as they approached Europe. And AL scientists had new "eyes" for this mission: the real-time mass spectrometric nitric acid instrument developed by Greg Huey, and the faster, more sensitive UV fluorescence CO instrument developed by Dave Parrish, John Holloway, and Roger Jakoubek.

Early probing of the dataset has revealed interesting mysteries related to processes occurring within or just above clouds, and some evidence of a "layering" of the chemistry. The 1997 mission's long-range tracking made it clear that the North American plume gets lofted into a fairly well-defined layer for extremely long distances. Scientists will examine the dataset further to see what other new discoveries can be credited to the NARE ledger.



HOME and AWAY

PALMS Goes Up, Up, and... WAM

Members of the Meteorological Chemistry group are getting ready for a "first" — the first fully operational flights of the Particle Analysis by Laser Mass Spectrometry (PALMS) instrument. The flights are due to take place in the January-April time frame as part of the WB57F Aerosol Mission (WAM). PALMS is a key component of the mission. Never before has the chemical composition of individual aerosol particles been characterized "on the fly" in the upper troposphere and lower stratosphere. With the Aeronomy Lab's development of PALMS over the last 5-6 years, that capability is now available — and in

early 1998, the feat will be accomplished in flights of the NASA/U.S. Air Force WB57F aircraft based at the Johnson Space Flight Center in Houston. Six science flights will range to 9°N and 49°N from Houston (29°N, 95°W).

A suite of other instruments are needed to set the full scientific context for the particle information. The Meteorological Chemistry program is flying its instruments for measuring water, methane, and ozone; collaborators from several other organizations will gather information on meteorology, particle sizing, tracers, and radiative fluxes. The combined dataset from WAM will lead to a better understanding of the role of aerosols in climate and stratospheric ozone depletion and will be especially valuable for current efforts to assess the effects of aviation on the earth's atmosphere. ♣

Illuminating the "Bridge" between Atmospheric Gases and Particles

Atmospheric scientists have long suspected that the formation of sulfur trioxide (SO_3) is tantamount to the formation of gas-phase sulfuric acid in the atmosphere, and that sulfuric acid (H_2SO_4) particles are subsequently formed. What has not been understood is just *how* those chemical dominoes fall – in other words, the "mechanism" of each step in the chain. Ned Lovejoy, Dave Hanson, and Greg Huey found the mystery of one step, the gas-phase conversion of SO_3 to sulfuric acid, irresistible. In an elegant and exhaustive set of experiments, they've now shed some light on just how this key reaction occurs.

H_2SO_4 is formed when SO_3 reacts with water. Previous research had hinted that it's not a simple one-step process, but the details of the SO_3 conversion were not firmly understood. That's partly because of the multiple experimental challenges posed by the gas-phase $\text{SO}_3 + \text{H}_2\text{O}$ reaction, such as designing a SO_3 source, choosing a good detection method, and confirming that heterogeneous side reactions do not interfere. Those challenges seemed tailor-made for Ned, Dave, and Greg. Ned had designed a source that he could show did not produce aerosols, Greg's chemical ionization mass spectrometer could "see" the SO_3 very sensitively and in several different ways that permitted cross-checking against potential experimental pitfalls, and the trio had the combined expertise in reaction kinetics and thermodynamics to design a powerful suite of measurements.

By studying the reaction at different pressures and temperatures and by looking at the effects of H_2O versus "heavy" (isotopically-labelled) water, the scientists showed that the SO_3 and H_2O first form an adduct (a loosely bound association) and that this adduct then reacts with a second water molecule to form H_2SO_4 (with a water molecule being "kicked out" in the process). This was a change to the previous picture that the reaction could go via a simple one-step bimolecular reaction or a perhaps involves clusters of 2 water molecules. The Aeronomy Lab experiments showed that the reaction is quite fast.

In the troposphere, the results confirm the picture that SO_3 's fate is sealed; it is converted to H_2SO_4 and has a lifetime of less than a millisecond. But the findings have other AL researchers rethinking the chemistry of SO_3 in the upper stratosphere. There, where water is less abundant, the $\text{SO}_3 + \text{H}_2\text{O}$ reaction is not as dominant and photolysis can be a significant SO_3 loss process. Jim Burkholder and Stu McKeen are now investigating the implications this may have for the extent of the stratospheric aerosol layer, and we'll soon know even more about the key reactions that comprise the "bridge" between gases and particles in the atmosphere. ♣



WHAT'S UP WITH PEOPLE

Jim Meagher will be arriving in late January to work with Dan Albritton, Fred Fehsenfeld, and others on the Health of the Atmosphere Program in air quality research. He has been a scientist and research leader with the Tennessee Valley Authority since 1976... In September, **Jerry Harder** began a new position with the Laboratory for Atmospheric and Space Physics in Boulder. He was with the Aeronomy Lab for 10 years, designing instruments and working on both tropospheric and stratospheric chemistry projects... **John Wilson** left in early November to take a position with Baker Instruments in Fort Collins. He was with the Tropical Dynamics and Climate group for about eight years, working on antenna systems and other hardware for shipboard wind profiling measurements... **Jonathan Williams** was a visitor in the Tropospheric Chemistry Program for a few weeks this fall to participate in the North Atlantic Regional Experiment mission. He returned to the University of East Anglia in November... **Debe Fisher-Daley** will be working part-time for the next year, assisting secretarial and administrative staff and filling in where needed... We wish everyone the best in their new endeavors, whether here or elsewhere!

COMMUNICATING OUR SCIENCE



To Decisionmakers: Dan Albritton was asked by the White House to be the Science Advisor to the U.S. delegation for the Third Conference of Parties to the United Nations Framework Convention on Climate Change, which took place December 1-10 in Kyoto, Japan... Fred Fehsenfeld, Michael Trainer, and Dave Parrish gave presentations at the Science Symposium of the North American Research Strategy for Tropospheric Ozone (NARSTO), held November 16-20 in West Palm Beach, Florida... Carl Howard made a presentation to the Colorado State Legislature Interim Committee on Air Quality Control Issues on October 17 regarding the effects of the winter oxy-fuel program on air quality.

To the Scientific Community: Several AL scientists gave talks and posters at the Fall Meeting of the AGU in San Francisco, December 8-12. Among them were talks at a special session on the first Stratosphere-Troposphere Exchange - Radiation, Aerosols, and Ozone mission (STRAO-a), a poster on the Flatland 95-96-97 experiments, and a poster on the observations of ozone at Fritz Peak Observatory... Dave Parrish, John Daniel, and Claire Granier gave talks at the International Conference on Atmospheric Carbon Monoxide and Its Environmental Effects, held December 3-6 in Portland, Oregon... George Kiladis gave invited seminars on tropical convection and equatorial waves at New York University and LaMont-Doherty Institute of Columbia University on December 4-5... On November 24, Susan Solomon gave an invited plenary lecture to the American Physical Society in San Francisco. Jerry Weinstock gave a talk at the meeting... On November 15, John Daniel was an invited speaker at a meeting on halon replacements at NIST in Gaithersburg, MD... Ken Gage gave an

invited seminar at Texas A&M University on 11 November on the topic of tropical wind profiler observations of precipitation... David Fahey gave an invited talk at the California Institute of Technology in October and at the International Global Atmospheric Chemistry (IGAC) International Symposium on Atmospheric Chemistry and the Future Global Environment in Nagoya, Japan, in November... Talks and posters were given by members of the Tropical Dynamics and Climate group at the 22nd Annual Climate Diagnostics and Prediction Workshop in October and at the AMS 25th Conference on Radar Meteorology in September... Tom Jobson and Greg Frost gave invited presentations at the Workshop on Volatile Organic Compounds in the Atmosphere held in Jülich, Germany in October... Lori Del Negro gave an invited talk on Antarctic heterogeneous chemistry at the Conference of the Federation of Analytical Chemistry and Spectroscopy Societies in Providence in late October... On October 2, Wayne Angevine gave an invited talk at the European Association for the Science of Air Pollution (EURASAP) Workshop at the Risoe National Laboratory in Denmark on the determination of mixing height in the lower atmosphere... David Hanson gave an invited seminar at the University of Minnesota in September on polar heterogeneous chemistry... Dan Murphy gave a talk about Cape Grim observations of marine aerosols at the Conference on Visual Air Quality, Aerosols, and Global Radiation Balance in September... Ken Gage, Chris Ennis, and Cathy Burgdorf have redesigned the Aeronomy Lab Web page on the Trans-Pacific Profiler Network. It is now linked to a new NOAA page highlighting El Niño research (<http://www.elnino.noaa.gov>).

To Media: Dan Albritton was interviewed by *USA Today* and *The Washington Post* for feature articles on the topic of climate change. The articles ran in November as a prelude to the climate negotiations that occurred December 1-10 in Kyoto, Japan.

To Industry: Dan Albritton gave an invited plenary presentation on October 6 at the annual conference of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). His talk described what we have learned from efforts to address the ozone-layer issue and how those lessons can be applied to the topic of global warming. Conference participants will likely prove to be key players in arriving at engineering solutions that bring about greater efficiencies and alternative approaches to energy demands in buildings, just as they were critical to the successful application during the last two decades of suitable "ozone friendly" replacements in appliances and industry.

To the Public: Dave Fahey spoke to about 150 members of the Rotary Club in Fairbanks, Alaska, on September 18. The topic was Arctic ozone and the role of the Photochemistry of Ozone Loss in the Arctic Region in Summer (POLARIS) mission that was based out of Fairbanks.

To Students and Teachers: In July, Leslie Hartten participated in on-line "chat" sessions with 6th

through 9th graders who were part of a week-long program designed to teach students about the scientific resources available over the Internet and to expose them to people who use the Internet for their scientific and computational work... Gregory Frost was an invited informal speaker to the Significant Opportunities in Atmospheric Research and Science (SOARS) Program, NCAR/UCAR and CIRES, in July. The program fosters the careers of undergraduates interested in science by providing summer research opportunities.

To Our Visitors: Chris Ennis described Aeronomy Lab research and the Health of the Atmosphere Program to Sarah Laskin (Office of Management and Budget), Sue Fruchter (NOAA Headquarters), John Calder (ERL Deputy Director), and Mary Anne Whitcomb (NOAA/OAR Resource Management) on September 16.

Through Service on Scientific Panels: Dave Fahey has agreed to be a member of the National Research Council/Polar Research Board's Committee on Arctic Natural Sciences for the next year... George Reid has been appointed to a 3-year term on the National Academy's Committee on Solar-Terrestrial Relations, which advises the National Science Foundation on programs related to solar physics and the middle and upper atmosphere.

DOWN THE ROAD



December 15-20: Eighth International Workshop on Technical and Scientific Aspects of Mesosphere-Stratosphere-Troposphere Radar, Bangalore, India. Ken Gage is a session organizer, and members of the Tropical Dynamics and Climate Program and the Atmospheric Dynamics Program will present papers.

January 5: Union of Radio Scientists International (URSI) National Radio Science meeting, Boulder, CO. Wally Clark will present a description of the October 1-18 TRIFLEX97 campaign at Flatland Atmospheric Observatory, which tested the ability of a prototype "multistatic" Doppler radar system to obtain more accurate wind profiles and momentum flux measurements.

January 11-16: Annual Meeting of the American Meteorological Society, Phoenix, Arizona. Dan Albritton will give the keynote address to open the meeting, "The Kyoto Climate Conference from a Scientific Perspective," and Wayne Angevine will give two talks on boundary layer dynamics.

January 14-20: Trombay Symposium on Radiation and Photochemistry, Mumbai, India. Ravi and Ranajit Talukdar will be giving presentations.

Upcoming AL Seminar Speakers: S. Solomon, M. Prather, L. Harten, M. Mills, A. Matthews, A. Smith.

On the Air! is a quarterly publication of the NOAA Aeronomy Laboratory. Please send any comments, questions, and suggestions to: Chris Ennis (phone 303-497-7538; email cennis@al.noaa.gov).

