



ANNOUNCEMENTS

CIRES Review Outcome - It's "☆☆☆☆☆"

The CIRES Review was completed on April 16-17. To say it was a "success" would be an understatement. The reviewers were extremely complimentary of the scientific achievements of CIRES and of the workings of the CIRES/NOAA partnership. One reviewer's way of putting it will surely be recalled for years: "CIRES is a jewel in CU's crown." The reviewers offered several very helpful suggestions on how CIRES can continue to live up to those very motivating words. Included were ideas on how to cultivate and maintain a high-quality research staff, suggestions for the planning of the CIRES "Water in the West" initiative, encouragement for incorporating remote sensing more strongly in CIRES research, and suggestions related to administration and funding of the Institute. Director Susan Avery encourages your suggestions on how to implement the reviewers' recommendations.

Overview Paper Published in Science

Ravi has authored one of the seven invited overview papers in the special section on Tropospheric Processes in the 16 May 1997 issue of *Science*. His

article, "Heterogeneous and Multiphase Chemistry in the Troposphere," gives an overview of reactions on solid particles ("heterogeneous" reactions) and in liquid droplets ("multiphase" reactions). Such reactions play a defining role in the lower atmosphere by oxidizing sulfur dioxide to form sulfuric acid (the "acid" in acid rain), by removing oxidants from the troposphere, and by the effects of cirrus clouds on atmospheric composition. Ravi also points out that a better understanding of this aspect of the chemistry of the lower atmosphere will be crucial for improving our ability to "predict" the future state of the troposphere in the face of anthropogenic activities, such as aviation. [Jerry Mahlman, Director of NOAA's Geophysical Fluid Dynamics Laboratory, also authored a paper in the special section, on "Dynamics of Transport Processes in the Upper Troposphere."]

An Aeronomy Lab Tradition - The Coffee Fund

A big THANK YOU goes to **Jeanne Waters**, who has managed the Aeronomy Laboratory's coffee fund for years (or is it decades?). By selling the soda pop and recycling the empty cans, Jeanne earns money that is used to buy coffee and goodies for Lab-sponsored meetings (a "soda-to-coffee" transform function). So when you see Jeanne carrying in loads of soda pop, it's "official business"!

The Role of Scientific "State-of-Understanding" Assessments: Stratospheric Ozone and the Montreal Protocol

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

Scientific "state-of-understanding" assessments have been the bridge between the scientific community and decisionmakers. By summarizing scientific findings in policy-relevant terms, the assessment reports play a unique role in society. The longest-running of these scientific assessments concerns the stratospheric ozone layer. The 1985 report formed the scientific basis for the 1987 United Nations Montreal Protocol on Substances That Deplete the Ozone Layer. Amendments and adjustments to that historic international agreement have occurred in lock-step with the subsequent scientific assessments in 1989, 1991, and 1994.

The Aeronomy Laboratory has played a leading role in these international, United Nations-sponsored assessments. Dan Albritton continues to co-chair the reports, and others in the Lab (and elsewhere in NOAA) have been chapter lead authors, coauthors, reviewers, contributors, coordinating editor, and edi-

torial assistants. That NOAA contribution continues with the 1998 assessment, currently in preparation.

The *Scientific Assessment of the Ozone Layer: 1998* will have four major sections. The opening section sets the scene by describing "what is happening" with respect to trends in ozone and things that influence or are influenced by stratospheric ozone (halocarbons, aerosols, temperature). The next section addresses the "why" types of questions by summarizing advances in understanding the processes that affect stratospheric ozone. The third section covers the "so what" issues, relating ozone changes to effects on ultraviolet radiation and exploring the coupling of ozone changes to climate and pollution issues. The final section looks ahead to "what's next" by examining the ozone layer response to a range of possible future scenarios for halocarbon use and giving the scientific prognosis for the future health and recovery of the ozone layer. [Aeronomy Lab participants include Ravi and Claire Granier as chapter lead authors, John Daniel and Bob Portmann as coauthors, Chris Ennis as coordinating editor, and Jeanne Waters as editorial assistant.]

The Trans-Pacific Profiler Network

The Trans-Pacific Profiler Network (TPPN) is a series of wind observing stations that dot the equatorial Pacific Ocean, stretching over 9000 miles from Peru to Indonesia. The Aeronomy Lab is the "home base" of the TPPN and also the birthplace of the wind profiling measurement technique that is used at its stations.

The "seed" that would grow to be the TPPN was first cultivated in the 1980s during many discussions among Aeronomy Lab researchers Ken Gage, George Reid, and Ben Balsley (now with CIRES). Those talks focussed on how the tropical Pacific Ocean plays a key role in the Earth's climate. The tropical Pacific is the site of large-scale atmospheric circulation systems associated with the El Niño-Southern Oscillation phenomenon. The coupled ocean-atmosphere dynamics of the region and the patterns of tropical heating and convection create global "teleconnections" that influence weather and climate around the world. A better understanding of these large-scale interactions will help to improve seasonal climate predictions. Despite the region's importance, atmospheric observations in the area were very sparse — until the TPPN came along.

Wind profilers are Doppler radars that use radar "echoes" to measure horizontal and vertical wind motions in the troposphere and lower stratosphere. Turbulence in the atmosphere scatters the profiler's outgoing radar beam, and a Doppler shift in the return signal is a measure of the wind in which the turbulence resides. Developed in the 1970s by the Aeronomy Lab, the wind profiler measurement technique went through several stages of scientific discovery and development at Jicamarca (Peru), Sunset (Colorado), Platteville (Colorado), and Poker Flat (Alaska). In the late 1970s Ken Gage joined that effort, which was headed by Tom Van Zandt. In the 1980s the group branched to pursue different scientific applications of the profilers — Tom starting the Flatland Atmospheric Observatory in Illinois within the Lab's current Atmospheric Dynamics Program, and Ben Balsley starting the TPPN within the current Tropical Dynamics and Climate Program. (Ken took over the reigns of the TDC Program when Ben joined CIRES in 1990.)

The first TPPN site was installed in 1984 at Pohnpei (Indonesia). In the 1980s, the international Tropical Ocean-Global Atmosphere (TOGA) experiment focussed attention on the tropical Pacific and sparked the interest of NOAA's Office of Global Programs in the TPPN. The Christmas Island site (in the mid-Pacific) began operations in 1986 with OGP support. The National Science Foundation has also backed the wind profiler effort and today supports some TPPN sites. There are about a half-dozen sites in all, two on land sites in Peru and Australia and others on islands in Indonesia and the remote Pacific. The data are relayed by the GOES satellite and input to the Global Telecommunications System for worldwide use.

As the TPPN has grown, so has the wind profiler measurement technique. The original 50-MHz profilers can observe from about 2 kilometers up to the lower stratosphere. But they are expensive and each radar requires several acres. Warner Ecklund and Dave Carter have led the development of 915-MHz profilers that now enable researchers to observe winds from the surface to the lower troposphere. They are relatively inexpensive and small enough to deploy even on a ship (a feat accomplished last year by the TDC group). An added bonus: the 915-MHz profilers are sensitive to precipitation, so that the "wind" profilers are also used to reveal details about the vertical structure of precipitating cloud systems. Christopher Williams, Warner, and Ken have recently used the technology to come up with a new way of classifying precipitating clouds that will improve parameterization of such systems in numerical atmospheric models.

There's no end in sight to the versatility of the profilers and the ingenuity of the scientists who've developed them. NOAA's Environmental Technology Lab and the Aeronomy Lab have had a cooperative research and development agreement (CRADA) with a local company since 1991, and other NOAA scientists are using profilers in meteorological research. An even smaller "S-band" radar recently developed by Warner can be used to study cloud structure and will be applied in investigations about the effect of clouds on the radiative balance of the atmosphere.



HOME and AWAY

POLARIS: The Early Bird Got the Data

The first deployment of the Photochemistry of Ozone Loss in the Arctic Region In Summer (POLARIS) mission resulted in 11 successful flights of the NASA ER-2 in a 27-day period from late April to mid-May. Adding to that challenging schedule was the fact that the mission start-date was moved forward by about a week. The early start was an effort to get a glimpse inside the Arctic polar vortex before breakup. The vortex lasted well into

spring, and there was lower overhead ozone inside the vortex this season. This occurrence will certainly be a subject of considerable follow-up study, to sort out various possible causes. The earlier POLARIS start-up paid off, in that the first of the flights from Fairbanks, Alaska, reached the area inside the vortex boundary (and the North Pole) and sampled air containing significantly lower ozone.

POLARIS is designed to understand the behavior of Arctic stratospheric ozone as it changes from very high concentrations in spring down to very low concentrations in autumn. The second deployment runs from June 23-July 13, and the final flights will occur in September. ♣

Illinois Study: What Goes Down... Comes Up?

Researchers from the Tropospheric Chemistry Program and the Atmospheric Dynamics Program are literally "in the field" this summer — an Illinois cornfield, that is. The site is near the Flatland Atmospheric Observatory outside of Champaign-Urbana, an area in which the Atmospheric Dynamics Program has a long history of studying atmospheric waves in the lower atmosphere. This time, chemistry measurements and meteorological measurements will be combined in the Flatland '97 Flux Study.

The investigation is aimed at answering an intriguing question: Do the agricultural fertilizers applied to the cornfields have an effect on the local, or even regional, atmosphere? The nitrogen in the fertilizers is consumed and transformed by soil bacteria, ultimately forming nitrogen oxides (NO_x). If the NO_x stays close to the ground (within the "canopy" of the corn), the atmospheric NO_x concentration could build up so high that it triggers a reaction with ozone. This scenario would consume ozone and thereby reduce the local ozone levels. But if the NO_x is dispersed beyond the canopy, the more moderate but more widespread increase in NO_x could affect the regional oxidant chemistry in such a way as to make more ozone.

Eric Williams, Jerry Harder, and Chuck Eubank will be making measurements of NO , NO_2 , and O_3 fluxes to try to determine which way that "switch" is toggled. They'll use two methods to measure the fluxes: their time-tested enclosure method (in which containers are placed over the soil and the interior air is sampled over time); and a new configuration of existing equipment that will provide eddy correlation measurements of the fluxes. Two CU students will be making leaf-level measurements. From June 8-July 2, the scientists will be making observations while the corn is just getting a start on growing. Then during the July 23-August 15 phase of the study, the canopy will be at its maximum. Wayne Angevine and Alison Grimsdell will be looking at dynamics on a broader scale using wind profilers and balloon soundings, and NOAA's Air Resources Laboratory will make meteorological and chemical measurements from NOAA's Twin Otter aircraft. The combination will be used to initialize, verify, and improve the Aeronomy Laboratory's models that will attempt to "scale up" the surface flux measurements of Eric's group.

At the end of the study, the scientists believe they will know "how much of what goes down must come up" — and where. ♣



WHAT'S UP WITH PEOPLE

Murari Lal is visiting the Aeronomy Laboratory for 10 weeks from the Indian Institute of Technology. He is working with scientists in the Middle Atmosphere Program on CFC, Halon, and methyl bromide emission scenario calculations, bromine/chlorine

loading, and other stratospheric ozone issues for the 1998 ozone scientific assessment. He'll be here until mid-July... **George Mount** starts a new position in mid-June as a professor in the Civil and Environmental Engineering Department of Washington State University. He has been with the Aeronomy Laboratory for 12 years... **Sarah Thompson** has joined the Computing and Networking Resources Group. She was most recently with TCI in Denver.. **Jim Warnock** is retiring in June. He has been with the NOAA for over 30 years and was with the Aeronomy Lab since its beginning. He was most recently involved with analyzing data from the Flatland Atmospheric Observatory... **Ann Middlebrook** has moved from the Meteorological Chemistry Program to the Tropospheric Chemistry Program, where she will be involved with studies of tropospheric aerosol particles... **Matt Warshawsky** has begun his graduate analytical chemistry research in Maggie Tolbert's group at CU. He'll continue to do some occasional consulting work with the Tropospheric Chemistry Program... In the Atmospheric Chemical Kinetics group: **Leah Goldfarb** has completed her Ph.D. in Chemistry at CU, and recently began postdoctoral research at the Laboratory for Atmospheric and Space Physics at CU, working with Linnea Avallone. **Tomasz Gierczak**, of the University of Warsaw, has returned for a 3-month visit. **Carla Kegley-Owen** has also been visiting the group to carry out experiments for her thesis at CU. **Frank Sauer** will soon arrive to begin a postdoc. He did his graduate work with Gert Moortgat and Paul Crutzen at Max Planck Institute in Germany... **J. Andrew Neuman** has joined the Meteorological Chemistry Program. He'll be working with Dave Fahey's group doing stratospheric measurements using the ER-2 platform... **Michael Mills** recently began a postdoctoral appointment at CU, working with Brian Toon. He'll continue to collaborate with the Middle Atmosphere Program on a variety of stratospheric aerosol topics... In the Tropical Dynamics and Climate Program: **Mark Haeg** is on leave this summer from CIRES, pursuing an internship in Germany as part of his MBA work at CU. **Zachary Wilson**, a senior Aeronautical Engineering student at CU, is assisting the group with field work this summer. **Demetry Gemolas**, also a senior at CU, will be working with Dave Carter on data analysis for the Pacific wind profilers. **Jason Hoskins** recently completed his data analysis work with the group... **Jim Cannon** has left the MASC Custodial Staff to take a new job with Boulder Toyota. The new custodian helping us "clean up our act" in the Building 24 complex is **Mauri Mousovich**... We wish everyone the best in their new endeavors, whether here or elsewhere!

COMMUNICATING OUR SCIENCE



To Decisionmakers: On April 24, Dan Albritton briefed Secretary of State Madeline Albright on the scientific understanding of climate change. He briefed Attorney General Janet Reno and Commerce Secretary William Daley on the same topic on June

13, with Rosina Bierbaum of the White House Office of Science and Technology Policy summarizing research on the impacts of climate change... At the invitation of NOAA Deputy Under Secretary Diana Josephson, Dan and Rosina gave climate science and impacts briefings on June 11 to the Interagency Working Group on Food Security.

To the Scientific Community: On April 16, Carl Howard gave an invited presentation on the air quality effects of the winter oxyfuel program at the American Chemical Society National meeting... In March, Susan Solomon gave a series of invited lectures on stratospheric science at the University of Connecticut... Greg Huey gave invited talks at the Ion-Molecule Gordon Conference in Ventura, CA, on February 23-27 and at the American Society of Mass Spectrometry's annual meeting on June 5... In May, Fred Fehsenfeld and Susan Solomon gave invited seminars at UC-Riverside in California.

To Media: Dave Fahey participated in a press conference about POLARIS and gave interviews to print media in Fairbanks this spring. Closer to home, he and Jim Elkins were interviewed by Channel 7-KMGH for an item that is expected to air in June on the 10 p.m. news report.

To the Public: Alex Weaver organized the Aeronomy Lab's participation in the Earth Day fair at Evergreen, Colorado, on April 19. The booth was designed and staffed by Alex, Ned Lovejoy, Donna Sueper, Christopher Williams, Ann Middlebrook, Joe Pettit, Cheryl Longfellow, and Terry Cookro. About 300-500 people visited the booth that day... Wally Clark gave an invited talk on El Niño to the Rocky Mountain Climbers Club on March 29.

To Students and Teachers: Leslie Hartten served as an on-line mentor for students at a number of schools as part of a program called "Kids as Global Scientists"... Leslie and Matt Nowick were science fair judges at Horizons Elementary this spring; Karen Rosenlof did likewise at Bear Creek Elementary... In March, Paul Golden gave a science presentation to 4th graders at Martin Park Elementary School... On 3 April, Susan Solomon gave a presentation on ozone depletion that was sponsored by mathematics students at CU. Jenny Fox of the Aeronomy Lab was on the organizing committee.

To the Business Community: Dan Albritton gave the opening invited talk at the International Climate Change Conference and Technologies Exhibition in Baltimore on 12 June. Dan's address on the science of climate change was heard by hundreds of the national and international business leaders, who are looking to integrate climate change in their corporate business strategies... Carl Howard gave an invited talk on the air quality effects of the winter oxyfuels program at the Air and Waste Management Association Meeting on April 25 in Denver... Dan Albritton gave an invited talk to the Boulder Rotary Club on 30 May, describing the scientific knowns and unknowns on the topic of climate change.

To Our Visitors: Michelle Fox, the new Legislative Affairs specialist for NOAA/OAR, visited the NOAA-

Boulder Labs on May 27 and talked with Dan Albritton, Fred Fehsenfeld, Ravi, and Chris Ennis at the Aeronomy Laboratory. Michelle will be setting up briefings for Members of Congress and their staff, at which Dan and others will provide scientific information on topics related to the Aeronomy Lab's research. Mary Anne Whitcomb (OAR Resource Management) and Carol Knight (Outreach Coordinator for ERL-Boulder) arranged the visit and participated in the discussions that gave Michelle an overview of the Boulder labs.

DOWN THE ROAD



June 8-July 2: Flatland '97 Flux Study, Champaign, Illinois, first campaign (see p. 3 of this newsletter).

June 16-20: Gordon Research Conference on Atmospheric Chemistry, Newport, Rhode Island. Several Aeronomy Lab scientists are presenting papers and participating in the meeting.

June 23-July 13: Photochemistry of Ozone Loss in the Arctic Region in Summer (POLARIS) second field campaign, NASA Ames Air Force Base, California, and Fairbanks, Alaska. Several members of the Meteorological Chemistry Program and the Middle Atmosphere Program are participating in the campaign, as are scientists of the Climate Monitoring and Diagnostics Laboratory.

June 23-27: 11th Conference on Fluid Dynamics, and Middle Atmosphere Conference, Tacoma, Washington. Members of the Tropical Dynamics and Climate Program and the Meteorological Chemistry Program are presenting papers.

July 22-August 15: Flatland '97 Flux Study, Champaign, Illinois, second campaign (see p. 3).

July-August: East-central Pacific campaign of the Pan American Climate Study, to investigate the structure of precipitating cloud systems in the northern hemisphere tropics. Members of the Tropical Dynamics and Climate Program will contribute wind and precipitation measurements using the group's wind profilers, which will operate onboard the inaugural cruise of the NOAA ship *Ronald H. Brown*.

July 28-August 1: 12th Symposium on Boundary Layers and Turbulence, Vancouver, BC. Scientists in the Atmospheric Dynamics Program will present a set of papers and posters during a special session on the Flatland96 meteorological experiment.

August 4-14: Meeting of the International Association of Geomagnetism and Aeronomy (IAGA) in Uppsala, Sweden. George Reid and Susan Solomon will be presenting invited tutorial lectures.

Seminar Series: Resumes in the fall.

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).