

### ANNOUNCEMENTS

#### *Fall Seminar Lineup Takes Shape*

Here's the first of the lineup for the Aeronomy Lab's fall seminar series, arranged by our new Seminar Coordinator, John Daniel:

- Sept. 25 - George Reid
  - Oct. 9 - V. Ramanathan
  - Oct. 23 - Greg Frost
  - Nov. 6 - Karen Rosenlof
- (other dates to be determined)

All talks are on Wednesdays at 3:30 p.m. in Room 0113, Bldg. 2, unless otherwise noted. Please see the Aeronomy Laboratory Web Page for updates of the schedule and titles of the talks (<http://www.al.noaa.gov>).

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#### *Bits On Computing*

The Computing and Networking Resources Group needs your help in keeping the network running smoothly! Please notify us via email (address: [cnrg@al.noaa.gov](mailto:cnrg@al.noaa.gov)) when any of the following events occur:

1. A hardware device will be added to the network.
2. A hardware device will be removed from the network for more than a short time, or temporarily used on a field trip.
3. A network device is repaired, resulting in a new motherboard, a new ethernet interface, or a new operating system.
4. An existing network device will be transferred to a different location or employee.
5. Any ethernet connection device (card, adapter, PCMCIA card, motherboard, etc.) is changed or moved to a different machine.
6. An employee with network accounts leaves the lab.
7. A new employee will need network accounts.
8. A new or different computer will be added.
9. New operating systems or operating system versions are installed on a networked computer.

10. You add or change an account on a UNIX machine that is connected to the network.

Thanks for your cooperation!

—Walt, Cathy, and Jenny

#### *Climate Assessment Available*



Personal copies of the latest scientific assessment of climate change are available for any interested Aeronomy Laboratory staff member. The Intergovernmental Panel on Climate Change (IPCC) report, *Climate Change 1995: The Science of Climate Change*, is located outside of Jeanne Waters' office in Building 24. This document forms the scientific basis for international decisions related to climate; it was a centerpiece of the July meeting of the Parties to the Framework Convention on Climate Change, held in Geneva. Of particular note is the update of scientific research on the attribution of observed climate change to human influence.

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#### THE FISCAL OUTLOOK: FY 1996 — FY 1997 — FY 1998

August and September are months in which the budgets of *three* different fiscal years must be "worked" simultaneously. First, Deb Wilson's office is busy making sure that *FY 1996* ends up in balance on September 30 (within the  $\pm 1\%$  required of us). Second, on Capitol Hill, the Congress continues its deliberations on the Federal budget for *FY 1997*, with the goal of sending an appropriations bill to the President before 1 October. Currently, there are separate House and Senate versions, awaiting reconciliation by a Joint Committee after Labor Day. The two versions look better for us, particularly the Senate's, than our current year's allocation. Third, most of the hurdles of the *FY 1998* budget still lie ahead, with the current discussions being within the Commerce Department. "Conventional wisdom" points to the fact that it may indeed be the post - 5 November time period before the picture of the fiscal future sharpens up.

—Dan Albritton

## The Airborne Chromatograph for Atmospheric Trace Species

The word "collaboration" hardly seems adequate to describe the intense Aeronomy Laboratory/Climate Monitoring and Diagnostics Laboratory partnership that has given birth to a powerful new instrument for atmospheric science, the Airborne Chromatograph for Atmospheric Trace Species (ACATS). Not only have the AL/CMDL *scientists* joined forces to create the instrument; the two labs' *hardware* is, quite literally, joined in the effort.

In the early 1990s, lead scientists Dave Fahey (AL) and Jim Elkins (CMDL) realized that, together, they might just be able to fill a research gap that neither could address individually. The scientific need was to increase the number of stratospheric measurements of long-lived atmospheric species obtained by the NASA ER-2 high-altitude research aircraft. The targets: halocarbons (used to determine the chlorine/bromine budget of the stratosphere and subsequent implications for the ozone layer); tracer molecules, such as sulfur hexafluoride (SF<sub>6</sub>) and nitrous oxide (N<sub>2</sub>O), that are diagnostic of atmospheric transport; and molecules that can be used to constrain the hydrogen budget of the lower stratosphere (methane and hydrogen).

Jim and his colleagues at CMDL knew that gas chromatography/electron capture detection methods (GC/ECD) could do the job admirably in the laboratory; in fact, GC approaches have been used by the atmospheric chemistry community for years to analyze "grab samples" brought back to the laboratory for post-mission analysis. The challenge was to improve on the sampling frequency by making a "real-time" instrument that would actually operate in the stratosphere ("in situ").

Enter the Aeronomy Laboratory and Dave's NO<sub>y</sub> group of the Meteorological Chemistry Program. Since 1986, the NO<sub>y</sub> instrument has had a first-class seat in the so-called "Q-bay" of the ER-2, contributing to state-of-the-art research in stratospheric chemistry. With real estate at a premium on the

ER-2, Dave offered to incorporate the GC *inside* of his group's new multi-channel NO<sub>y</sub> instrument.

A team of NOAA scientists undertook the challenges of not only minimizing the size and weight of the GC instrument, but configuring it for the autonomous operation that is demanded by the pilot-only ER-2 platform. Bolted upside-down in a corner of the Aeronomy Lab instrument, ACATS-II (the first ACATS configuration, with "II" denoting the two channels of the instrument) shared power and control hardware, data acquisition systems, and a specially-designed pump with the NO<sub>y</sub> instrument. The technical feats were numerous and called upon the combined expertise of CMDL and AL, including remarkable software, hardware, and mechanical engineering innovations from Dick Winkler, Tommy Thompson, and Rich McLaughlin of AL.

Owing to the chromatographic wizardry of Jim and his group, today ACATS-II has evolved to become ACATS-IV, a 4-channel instrument that can measure six key halocarbons, plus SF<sub>6</sub>, N<sub>2</sub>O, methane, and hydrogen. The in-situ sample processing occurs on a 3-minute cycle for most of the gases. Though ACATS-IV is now housed outside of the NO<sub>y</sub> instrument, the two instruments still share a specially designed pump.

ACATS has already flown on several ER-2 missions and is presently deployed in STRAT (Stratospheric Tracers of Atmospheric Transport). The scientific interpretation of ACATS data has addressed the time scale for entrainment of mid-latitude air into the tropical lower stratosphere (found to be ~13.5 months) and the chlorine budget of the lower stratosphere. Future work will address the bromine budget and atmospheric tracer lifetimes. A third ACATS configuration, a two-channel ACATS, went aloft on a balloon platform earlier this summer as part of the Observations of the Middle Stratosphere campaign. Clearly, the sky is no longer the limit.



### HOME and AWAY

#### *The WB57 Aircraft: Gearing Up*

This summer, it became apparent that the WB-57 research aircraft, owned and operated by NCAR and a prominent part of future Aeronomy Laboratory research plans, would have to find a new home. Its size proved to be incompatible with the Jefferson County Airport west of Broomfield. It appears now that Denver International Airport will be the WB-57's new location. Agreements with Continental Airlines and city/county officials to use a portion of a hangar are finalized. Tuesday, August 20, the aircraft flies from Jeffco to Pueblo, Colorado, for some pilot-

training practice, followed by a journey back north for its first touch-down at DIA later in the day.

If all goes well, the first engineering and test flights will occur in the latter half of August. Several members of the Meteorological Chemistry Program are developing or adapting instrumentation for the platform, including Ken Kelly and Erik Richard (water vapor and methane), Dan Murphy and Mike Schein (particle analysis by laser mass spectroscopy), and Mike Proffitt and Ken Aiken (ozone). The WB-57 will allow researchers to get detailed measurements of the critical region of the upper troposphere and lower stratosphere, an area that is difficult to access over extended time periods using other platforms.





## STERAO UPDATE



The first Stratosphere-Troposphere Experiments: Radiation, Aerosols, and Ozone mission (STERAO-A) is underway, with a major phase involving flights of the WP-3D completed on July 16. About a dozen flights took Aeronomy Laboratory researchers and their collaborators into the heart of thunderstorm country in northeastern Colorado, southern Wyoming, and western Nebraska. Most of the flights resulted in successful encounters with storm activity, enabling the investigators to make measurements of the chemistry and meteorology associated with deep convection and lightning in and around those systems. STERAO-A activity is continuing until early September, with plans calling for flights of the higher-altitude WB-57 aircraft to commence in late August (see related story on page 2). Ground-based meteorological measurements involving radar facilities of Colorado State University and the Denver NEXRAD will continue to provide storm forecasting for the campaign.

### *The Particle Flow Tube*

It seems that particles have a front-row seat at the frontier of most of the atmospheric issues of today: ozone-layer depletion, climate change, and acid generation in the lower atmosphere, to name the foremost examples. But how can scientists, familiar with techniques for studying reactions between gases, switch gears to study the chemistry of particles in the laboratory? For Dave Hanson and Ned Lovejoy of the Atmospheric Chemical Kinetics Program, the answer was to extend the capabilities of bulk studies used by Dave and others and build upon the heritage of gas-phase research to devise a way to characterize gas-particle ("heterogeneous") chemistry.

Over the last 2-3 years, Dave and Ned have developed the "particle flow tube" technique for studying the rates of reaction ("kinetics") between particles and gases. It works on the same principle as the gas-phase flow tube. The gas and the particles react together while flowing down a (usually glass) tube and enter a detection region, where the extent of their reaction is measured. By putting the gas down a small, moveable "injector" tube in the middle of the larger flow tube, and the particles down the large tube, the point of mixing of the two species can be varied and therefore the extent of the reaction can be changed. One approach to measuring the reaction rate is to measure the extent of reaction for several different injector positions. In the particle flow tube, the pressures used are higher (ranging up to about an atmosphere) than what is used in gas-phase flow tube studies, so as to decrease diffusion effects. Chemical ionization mass spectrometry is used as the detection method.

Dave and Ned came up with a novel way to make sulfuric acid/water particles that are similar in size

and water content to actual atmospheric particles. The "hot acid generator" works by flowing a carrier gas over heated concentrated liquid sulfuric acid, and then cooling down the saturated vapor and flowing it over an aqueous sulfuric acid solution to "pick up" water vapor. Ned and Dave devised ways to vary and also to measure the size of the aerosol, innovations that enabled them to make the first-ever measurements of how aerosol size influences gas-particle kinetics.

Thus far, Ned and Dave have focused on projects relevant to the stratosphere, including studying the reaction of chlorine nitrate with sulfuric acid aerosol and investigating the hydrolysis reactions of several gases in the presence of aerosol. Future research will explore other types of particles, including tropospheric "wet fog" types of aerosols that likely play a role in the free radical chemistry of the lower atmosphere. ♣

### *Studying the Ups and Downs of the Atmosphere: The Flatland96 Campaign*

"Flat" is definitely beautiful if you're in the business of measuring boundary layer properties, so it's no surprise that the uniform expanses of cornfields of the Champaign-Urbana, Illinois, region provide the ideal site for the Atmospheric Dynamics Program's long-term research at Flatland Atmospheric Observatory (FAO) and their "Flatland96" campaign this summer.

After a successful 2-month run, Flatland96 is drawing to a close on August 23. It's the second of two field campaigns (the first being Flatland95 last summer) to improve understanding of boundary layer structure and characterize the process known as boundary layer "entrainment" (the drawing in of materials from above). The measurements use the FAO's 915 MHz wind profiler and two Integrated Sounding Systems, as well as surface-flux measuring instruments. The heart of the dataset is comprised of wind velocities, measured from the surface up to about 5 kilometers in height.

Lead investigator Wayne Angevine and his Aeronomy Laboratory colleagues Allison Grimsdell and Jim Warnock report that all went smoothly with the observations. They'll be busy now with processing the data, which should improve understanding of the vertical velocities in the boundary layer and yield insights into the transport of chemical constituents in the atmosphere. The findings could prove useful in research efforts to understand how the upward and downward transport of precursor compounds affects oxidant production in the troposphere, for example. ♣

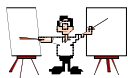


## WHAT'S UP WITH PEOPLE

**Nanette Plock** has taken a new secretarial position with the U.S. Department of Agriculture in Boulder, after nearly seven years with the Aeronomy Lab-

oratory... **Cheryl Longfellow** will be joining the Atmospheric Chemical Kinetics Program in early September to do laboratory studies of reactions. She has just completed her graduate work with Prof. Y.T. Lee at the University of California at Berkeley... Three other members of ACK will be returning to their home institutions in August-September: **Jamie Donaldson** (University of Toronto); **Takashi Imamura** (National Institute for Environmental Studies, Japan); and **Tomasz Gierczak** (University of Warsaw, Poland)... **Roger Dennett** left the Aeronomy Laboratory at the end of July. He worked in the Atmospheric Dynamics Program for about three years, analyzing data from the Flatland Atmospheric Observatory in Illinois... **Irene DeDe** will be retiring at the end of September after 20 years of federal service. She was a secretary with the Aeronomy Lab in the 1980s and again most recently this year... **Klaus Jänner** is an electronics technician from the Max Planck Institute in Heidelberg. He is working with Dan Murphy on the particle mass spectrometer for three months... **Stephen Reid** will arrive in September from the University of Wales. He was awarded a National Research Council postdoctoral fellowship to work with the Meteorological Chemistry Program; he will be analyzing ER-2 aircraft data and the long-term ozone lidar observations from Fritz Peak... **Robert Wamsley** has left the NO<sub>y</sub> group of the Meteorological Chemistry Program. He did field work and data interpretation studies with the group... **Marty Buhr** will be leaving at the end of August to take a position as Air Quality Scientist with the Regional Air Quality Council in Denver. He'll work on developing a comprehensive air quality plan for the Denver metro area... **Adrian Matthews** arrived in early August from the University of Reading. He'll be here for two years doing modeling studies of tropical dynamics with the Tropical Dynamics and Climate Program... After 19 years with the Aeronomy Laboratory's Fritz Peak Observatory, **Betsy Burnett** has left to begin studies at the University of Colorado. We wish her and other departing staff members well...

## COMMUNICATING OUR SCIENCE



**To Decisionmakers:** On 10 July, Dan Albritton was one of three scientists who gave a special briefing on climate change to members of the U.S. House of Representatives. The opportunity followed closely on the heels of Dan's participation in Senate climate "roundtable" discussion in June...

**To the Scientific Community:** In June, Dan Murphy and Ann Middlebrook participated in the first data workshop of the Aerosol Characterization Experiment. They and 70-plus other scientists discussed the findings of last December's experiments to characterize Southern-Hemisphere marine aerosols.

**To Media and the Public:** Gerd Hübler coordinated the visit of Denver TV station Channel 4 to the Aeronomy Lab and the P3 aircraft during the STERAO field campaign this summer. Gerd was the lead

interviewee and several other researchers were shown during the ~2-minute spot, which aired on the evening news on 16 July... Donna Sueper and Fred Fehsenfeld's poster, "Clearing the Air About Ozone," was displayed in the NOAA booth at the 1996 Olympics in Atlanta. The video filmed at the Aeronomy Laboratory last October ("Our Ozone Layer: Its Science and Its Protection") was also shown in the booth... Dan Albritton gave the keynote address at the AMS annual meeting of broadcast meteorologists in Boston on June 22.

**To Kids and Teachers:** Alex Weaver, Susan Buhr, and Donna Sueper conducted an all-day workshop on atmospheric science for Denver public school-teachers. It was part of a 2-week series of activities put on by the Colorado Alliance for Science... Alex Weaver gave a talk and demonstrations about stratospheric ozone to a group of 15 teachers in the AMS "Project Atmosphere" workshop in July.

**To Constituents:** In May, Dan Albritton briefed members of the National Association of State Universities and Land Grant Colleges on the NOAA Health of the Atmosphere research. Scott Rayder of NOAA headquarters set up the briefing.

**To Our Visitors:** In July, visitors from the Office of the Federal Coordinator for Meteorology were briefed by Wayne Angevine on the Aeronomy Laboratory's research using wind profilers.

## DOWN THE ROAD



**Aug. 22:** 10th Anniversary National Ozone Expedition (NOZE) Symposium, NCAR Mesa Lab (organized by Susan Solomon; several AL and CMDL scientists are invited speakers).

**Sept. 12-21:** XVIII Quadrennial Ozone Symposium 96, L'Aquila, Italy (several AL scientists attending).

**Sept. 17-25:** Ryan Sanders and Roy Miller will visit Kangerlussuaq, Greenland, to make some last hands-on calibrations of the NO<sub>2</sub>/OCIO/ozone spectrograph, then bring it home. For the last two years, Roy, Ryan, and Alex Weaver have operated the instrument remotely from Boulder via the Internet.

**Oct. 15-18:** Impact of Aircraft Emissions upon the Atmosphere - Association of European Research Establishment in Aeronautics Meeting, Paris, France. (David Fahey, Adrian Tuck, and Ravi are 3 of the 4 U.S. scientists on the organizing committee; several AL scientists will contribute).

**Oct. 21-23:** International Workshop on Modeling Heterogeneous Chemistry of the Lower Stratosphere/Upper Troposphere, Strasbourg, France (Ravi is co-chair; several AL scientists will participate).

*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](mailto:cennis@al.noaa.gov)).