# ON THE AIR!

NOAA CIRES

AERONOMY LABORATORY

**A Quarterly Newsletter of the NOAA Aeronomy Laboratory**

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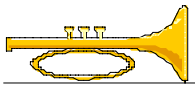
## WELCOME

Welcome to the inaugural edition of the Aeronomy Laboratory newsletter, *On the Air!*

The Aeronomy Laboratory has never had its own newsletter... but then again, the Aeronomy Lab is now bigger, its research interests more numerous, and it's never been more of a challenge for each of us to "keep up" with what our colleagues are doing. Hence, this quarterly newsletter.

We hope that you will enjoy reading about what's going on in the Lab. It's a busy place, and we won't pretend that we will include everything. But we hope to highlight some of the many activities that are occurring, both here at home and in far-flung reaches of the globe. Don't be shy about walking up to our roving reporter (C.E.) and giving her a "scoop." We're hoping for (and, in fact, counting on) *your* involvement in *your* newsletter. Story ideas, photos, and the like are welcome.



## ANNOUNCEMENTS

### *The Envelope Please...*

**David Fahey** received the American Meteorological Society's Henry G. Houghton award on January 31 in Atlanta. The award citation reads "*For outstanding contribution to our understanding of the ozone layer through airborne observations and theoretical analyses.*"

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**David Hanson** will receive the American Geophysical Union's James B. Macelwane Medal for 1996. The award honors David for his many contributions to the study of the heterogeneous chemistry of the atmosphere.

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### *Ozone Video Available*

We have some copies of a new video (*Our Ozone Layer: Its Science and Its Protection)* that was prepared last fall to commemorate the Tenth Anniversary of the signing of the Vienna Convention for Protection of the Ozone Layer. It gives an overview of how science and policy have evolved on the issue of stratospheric ozone. Dan Albritton is interviewed extensively in the video, which runs 38 minutes and is suitable for a general audience. Contact Chris Ennis if you'd like a copy.

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## THE FISCAL  OUTLOOK: DOLLARS AND SENSE

"*It was the best of times, it was the worst of times.*" Charles Dickens, 19th Century English social "climatologist."

Global temperature data show that 1995 was the warmest year on record. "Fiscal temperatures" in the District of Columbia showed that the same was true in Washington, DC. Now as we enter 1996, the fiscal *variance* has somewhat decreased, revealing a little more clearly what the rest of Fiscal Year 1996 could look like for the Aeronomy Lab.

The Continuing Resolution (CR) under which we are currently operating (until 15 March) is fiscally more favorable for us than earlier ones. The CR places NOAA at the levels stated in the House-Senate Conference, in contrast, for example, to the lower levels in the House version. Further, the budget line item of the Office of Oceanic and Atmospheric Research under which we operate is essentially "level funded" from FY 1995, in contrast to the 75% level that was stated in earlier CRs. However, the NOAA Climate and Global Change Program, from which about a third of the Lab's support comes, is funded at ~25% below its FY 1995 level, which will likely imply about the same percentage reduction in the support for the trace-gas research of the Aeronomy Laboratory.

What will happen on March 15? Another CR? A final budget signed? Likely, no one currently knows the exact answer to that question. "Conventional wisdom" would say that the budget levels of the post-15 March period in 1996 are somewhat likely to resemble those of the current CR.

In climate (in contrast to weather), one looks over somewhat longer time scales for an outlook of the future. Despite our seasonal fiscal "snowstorms" of the present, my picture of the future remains fundamentally unaltered. Namely, research that clarifies the basic understanding of our regional and global environment will remain an important endeavor (and recognized as such). My reasoning goes like this: There is one planet. It will contain more and more people. They will all want a reasonable lifestyle, which will be sought by technology, chemistry, improved habitation, extended transportation, etc. Therefore, *knowledge as to how best to accomplish this without it being at the expense of the environment will be information of higher and higher value.* Providing that information is our line of business. *-Dan Albritton*

## THE SEARCH FOR "OZONE FRIENDLY" CFC SUBSTITUTES

This past January 1 marked the beginning of a global "New Year's Resolution": much of the world discontinued nearly all production of the ozone-damaging chlorofluorocarbons (CFCs), in accordance with the United Nations Montreal Protocol on Substances that Deplete the Ozone Layer. The question "What do we substitute for the CFCs?" arose even before the 1987 signing of the Protocol. The search for environmentally acceptable substitutes had begun and with it, a major research effort of the Aeronomy Laboratory.

It's a classic story of research at the Aeronomy Lab, with several Programs (nearly everyone in Atmospheric Chemical Kinetics, plus members of Middle Atmosphere and Theoretical Aeronomy) working together to carry out laboratory and theoretical studies that range the full gamut from homogeneous reactions to photochemistry to heterogeneous reactions to modeling. Nearly 20 papers later, the path to a CFC-free world is becoming decidedly clearer.

One major aspect of the work has been to quantify the atmosphere's "first line of defense" against proposed CFC substitutes: reactions with OH radicals and excited-state oxygen atoms; and ultraviolet photolysis. The laboratory work has been very challenging because the rate constants are extremely small—"tricky business," as Ravi describes it. Those parameters are input to models, leading to the calculation of the atmospheric lifetime of the substitute and its Ozone Depletion Potential (ODP).

The answers have a waiting audience in those industries that are gearing up to manufacture new compounds to replace the CFCs. In some cases, a proposed substitute has gotten the "green light" and production has proceeded. Many automobile air conditioners now use one of those "success" stories, HFC-134a. That outcome hinged on the Aeronomy Lab's finding that degradation products of the HFCs [oxygenated carbon trifluoride ($CF_3O_x$) species] were not ozone destroyers.

In other cases, the results have spared industry needless expense to produce what would have been an unacceptable alternative. Such was the case with HCFC-141b, a substance that industry was poised to manufacture for use as a solvent and foam-blowing agent. The work resulted in what, at the time, was a surprising conclusion: it may not meet the U.S. Clean Air Act's ODP limit of 0.2.

The research has taken some interesting twists and turns, illustrating both the ingenuity of the investigators and the intricacy of our atmosphere. The case of the perfluorocarbons (PFCs) has illustrated the point. Lab and modeling work showed that they are harmless to the ozone layer, but the story does not end there. It pointed to the PFCs' role as potent greenhouse gases, and consideration of climate issues has arisen.

The search for safe substitutes continues and many new candidates are proposed each year. What will be the effects of this "halocarbon zoo" on our atmosphere? Are the substitutes ozone friendly? Climate friendly? What about their degradation products? In short: do any represent a leap from the frying pan into the fire? Those are the questions of the future— and the work of Aeronomy Lab scientists today.

## IN THE FIELD

### *ACE-1: Mission Accomplished*

How do aerosol particles form in the atmosphere? What are they made of, and how do they affect the Earth's radiation balance? These questions and more were the target of the Southern Hemisphere Marine Aerosol Characterization Experiment (ACE-1), an interagency-sponsored investigation whose shipboard, airborne, and ground-based studies addressed the sulfur budget, aerosols, and the radiation balance in the clean, remote Southern Hemisphere.

The questions propelled an international team of researchers into the field in the region of the Southern Ocean, south of Australia. Among them were Dan Murphy, David Thomson, Ann Middlebrook, and Mike Schein of the Aeronomy Lab. The Aeronomy Lab group recently returned (with gigabytes of data in hand) from Cape Grim, Australia. There, for much of November and December, they measured the chemical composition of aerosols using the Aeronomy Lab instrument they have developed (particle analysis by laser mass spectroscopy, or PALMS). Housed in a trailer that was perched (very scenically) on a high cliff overlooking the ocean, the instrument sampled the mostly clean "background" marine air characteristic of the site. PALMS received high marks from the group for its first international outing.

As David says, "The easy part is done." Now comes the difficult but very interesting analysis of the PALMS data, and (later this summer) the first workshop to compare notes with the other investigators. Upwards of 30,000 spectra were obtained, making the post-mission analysis a rather daunting project. Dan has developed some software to "sift" the data, so that they can focus on particles other than the (very expected) sea salt aerosols. The group already has tentatively identified a very interesting subset of the observations, comprised of particles that contain halo-alkanes.

## *STRAT: We've Only Just Begun...*

If we put more supersonic aircraft into operation, it's certain that transcontinental air transit times would plummet. Imagine flying to New Zealand in 8 hours! But the supersonic planes fly in the lower stratosphere — what might happen to the ozone layer?

The answers will come, in part, from the results of a study now in progress. Several Aeronomy Lab staff from the Meteorological Chemistry Program departed recently for another installment in the series of field campaigns associated with the STRAT experiment (Stratospheric Tracers of Atmospheric Transport). The Aeronomy Lab researchers are part of a team of researchers from NASA, NOAA, other agencies, and universities that are using instruments aboard the NASA ER-2 high-flying aircraft to investigate how gases and particles are transported in the stratosphere. Aeronomy Lab instruments will measure nitrogen oxides and ozone.

The STRAT research will help to clarify how the exhaust of potential future fleets of supersonic airplanes would be distributed around the globe and might influence the ozone layer. In addition, says principal investigator David Fahey, the flights will give scientists their first extensive look at the upper troposphere. The flights began last year and will continue regularly during the coming year, taking the instruments from the tropics to 60°N to observe the latitudinal and seasonal characteristics of atmospheric transport. Additional measurements will come from instruments carried aloft by balloons in the summer of 1996 and from satellite instruments.

The work is of great interest because the U.S. and several other nations of the world are considering expanding the use of supersonic aircraft for commercial travel. The only such aircraft presently in operation is the Concorde, which flies out of Europe. Decisions on expansion will consider the results of scientific research, such as the STRAT experiment. (Field investigators for this STRAT mission are: David Fahey, Ken Aikin, Stephen Donnelly, Ru-Shan Gao, Eric Keim, Mike Proffitt, Elena Teverovski, Tommy Thompson, Robert Wamsley, and Wink Winkler. See "Down the Road" section on page 4 for related information about a symposium this spring).

## *Wind Profiler Takes to the High Seas*

One could be a little envious of the wind profilers of the Trans-Pacific Profiler Network. Located on several remote islands in the tropical Pacific Ocean, they seem to have the perfect working environment for their mission, which is to measure the winds in the lower ~5 kilometers of the atmosphere. But a milestone will occur early in 1996 as one profiler goes "out to sea" for a first-time permanent assignment aboard a NOAA research vessel.

In February, sea trials begin for the "rover" wind profiler. The idea takes advantage of a natural opportunity by deploying the profiler on the NOAA ship that regularly visits buoys, moored in the equatorial Pacific, known as the Tropical Atmosphere Ocean (TAO) array. Paul Johnston, John Wilson, David Carter, Mark Haeg, and Al Gray of the Tropical Dynamics and Climate Program will oversee the tests of the profiler.

The shipboard profiler will provide wind measurements in previously uncharted territory of the Pacific. It's all in the interest of gaining a better understanding of El Niño, a major climatic phenomenon that is responsible for much of the multi-year climate variability that leads to floods and droughts in parts of the world (in the U.S., flooding in the Gulf States could be one manifestation). The El Niño originates in the tropical Pacific Ocean when the easterly winds weaken, leading to changes in ocean circulation. In a cascade of effects, the eastern Pacific Ocean warms, upwelling of nutrient-rich cold water from the deeper oceans is reduced, and marine life suffers (particularly in one of the world's richest fisheries, off the coast of Equador and Peru).

El Niño happens at irregular intervals, usually every 2-10 years, starting around Christmas time and normally lasting for several months. The wind profilers of the TPPN are helping scientists to better understand the phenomenon, with the ultimate aim of being able to "forecast" an impending El Niño. On the island stations and soon also onboard the NOAA ship, the wind profilers are poised perfectly to help make that goal a reality.

## WHAT'S UP WITH PEOPLE

**Shaw Liu** will be leaving the Aeronomy Lab in March. He'll be with the Georgia Institute of Technology in Atlanta... **George Kiladis** has recently joined the Tropical Dynamics and Climate Program. Formerly with CIRES and the NOAA Climate Diagnostics Center, George will be studying tropical dynamics, waves, and tropical-extratropical interactions... Working with George is **Matt Wheeler**, a CU graduate student who is studying intraseasonal variability in the tropical atmosphere... **Jeff Hicke** is a CU graduate student working in the Meteorological Chemistry Program; he'll be applying his expertise in radiative transfer to analyses of the ER-2 datasets from missions such as the Airborne Southern Hemisphere Ozone Expedition... **Jeremy Zucker** recently joined the Middle Atmosphere Program, where is doing computer systems work and other projects... **Stephane Bauguitte** is visiting from the University of East Anglia. Until the end of January, he'll be working with the Tropospheric Chemistry Program to develop a new instrument for measuring $NO_X$... **Travis Nelson** is leaving the Tropospheric Chemistry group this spring to continue his studies at the University of Colorado... **Peter Villalta, Jurg Eberhard,** and **Andrew Turnipseed**, all of the

Atmospheric Chemical Kinetics Program, have recently embarked on new endeavors. Peter began a new position doing laboratory kinetics at Aerodyne Research, Inc., in Massachusetts; Jurg is doing kinetics at the National Tsing Hua University in Taiwan with Y.P. Lee (a former Aeronomy Lab post-doc with Carl Howard); Andrew began a CIRES/ University of Colorado position in Russ Monson's group, studying biogenic trace gas emissions... There are also several new folks in the Atmospheric Chemical Kinetics Program who will be carrying out laboratory studies of atmospheric processes. **Takashi Imamura** is here from the Tsukuba, Japan, on an appointment as a Senior Research Associate of the National Research Council. **Matt Harwood** (from Cambridge University), **Stefan Bauerle** (Institute for Physical Chemistry, Göttingen, Germany), **Frederiqué Battin-LeClerc**, (CNRS, France), and **Ed Dunlea** (a graduate student at CU) have also joined ACK... **John McAfee** recently retired. He was with the Aeronomy Lab for 30 years, most recently with the Tropical Dynamics and Climate Program. We wish John all the best...

## COMMUNICATING OUR SCIENCE

***To Policymakers:*** The Fall Meeting of the North American Research Strategy for Tropospheric Ozone (NARSTO) was held November 14-17 in San Antonio, Texas. Government agencies, utilities, industry, and academia in the U.S., Mexico, and Canada are members of NARSTO, whose mission is to coordinate and enhance scientific research and assessment of surface-level ozone so that the strategies developed by policymakers to control ozone will be effective and workable. Plans for the initial assessment document, scheduled for completion in 1998, were made at the meeting. The Aeronomy Lab is taking a leading role in helping to launch NARSTO, through the efforts of Fred Fehsenfeld and Dan Albritton. Members of the Tropospheric Chemistry, Theoretical Aeronomy, and Atmospheric Chemical Kinetics Programs are conducting scientific research in support of NARSTO's objectives... The Executive Summary of the 1994 WMO/UNEP *Scientific Assessment of Ozone Depletion* has undergone a second printing. This is largely the result of the huge demand for the section called "Common Questions About Ozone," developed under the leadership of Susan Solomon. (Copies of the Executive Summary and full report are still available. See Jeanne Waters or Chris Ennis.)

***To the Scientific Community:*** January's issue of the *Journal of Geophysical Research* is a special issue featuring papers from the Pacific Exploratory Mission-West-A experiment, which was conducted in 1991 and which involves the efforts of Shaw Liu as Mission Scientist and other members of the Theoretical Aeronomy Program doing analysis of the data. The study used airborne and ground-based instruments to examine natural and human-caused influences on tropospheric "greenhouse" ozone over the Western Pacific. Other observations were made to investigate the sources of sulfur compounds in the region. NASA sponsors PEM, and NOAA and university scientists are involved in its highly collaborative activities. About a third of the *JGR* special issue papers involve Aeronomy Lab scientists.

***To Kids:*** Sherry Stephens is working on a project to construct a Web Page for kids, on the topic of the ozone layer... Also, a local middle school teacher, Louise Belnay, has been working with Aeronomy Lab to develop teaching materials on the same topic for inner-city middle schools... 'Tis the season to do science fair projects, and several of you volunteer as judges or help out in other ways at the local science fairs. Thanks to all of you for your good efforts!

## DOWN THE ROAD

*March 16-April 30:* Members of the Tropospheric Chemistry Program will embark on a field mission of the North Atlantic Regional Experiment (NARE). For the first time, the NOAA WP-3D aircraft will be used in NARE. Based out of Providence, RI, the P-3 flights will enable the scientists to study how the chemical composition of air changes as it is carried across the north Atlantic Ocean. This and previous field missions of NARE aim to learn how emissions from the North American continent affect the chemical make-up of the lower atmosphere on a hemispheric scale. Other organizations are involved in making measurements from the ground, balloons, and other aircraft.

*March:* Members of the Tropical Dynamics and Climate Program will participate in a field study to compare shipboard wind profiler measurements with those obtained on nearby Manus Island, in Papau New Guinea. The idea is to study the island influence on cloud systems and assess the representativeness of island-based observations.

*April 15-19:* Symposium on the Global Atmospheric Effects of Aviation; Virginia Beach, VA. This symposium will bring together scientists, technologists, economists, and policymakers to examine the potential impacts of aviation on the global atmosphere and discuss the environmental issues raised. The aim is to enhance the dialogue between experts researching the phenomena and those who need the information. Ravi is co-chairing the symposium (with David Lister of the Defence Research Agency, UK), and other Aeronomy Lab scientists will participate. NASA, NOAA, the United Nations, and other research agencies worldwide are sponsoring the symposium.

*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).