The Cedar Post

February 1992 No. 15

Global Change: Upper Atmospheric Research and the Role of the NSF CEDAR Program

The effects of Global Change on the biosphere and on human endeavors, in particular, are of great interest and concern as we enter the next century. The question is not so much if the atmosphere is changing but how fast and to what extent. The US Global Change Program is a national effort to attack this problem in all of its complexity. In this short note we outline the role that the upper atmosphere research community is playing in the program. This effort is organized under the banner of the NSF CEDAR (Coupling Energetics and Dynamics of Atmospheric Regions) Initiative and is primarily funded by the NSF Aeronomy Program. In the paragraphs below we identify and discuss several upper atmosphere phenomena which seem quite sensitive to changes in the earth's lower atmosphere. Although interesting and worthy of study in their own right, these phenomena may, in addition, provide a crucial measure of the rate at which global change is affecting the atmosphere. This holds since the upper regions are so tenuous that lower atmospheric processes are amplified.

As a specific example, we note that noctilucent cloud formation in the upper mesosphere has monotonically increased during this century, an increase that is believed to be related to decreasing temperatures and increasing water vapor in this region. Since these clouds are optically thin, they do not directly affect the radiation balance of the atmosphere. But if we can understand these clouds and successfully monitor their occurrence, we may be able to quantify an important consequence of increasing greenhouse gases in the atmosphere. Since the economic costs to reduce greenhouse gases are enormous, it seems crucial to provide as many measures of global change as possible, particularly those which change most rapidly. CEDAR and upper atmosphere research in general can help provide the understanding and the observational capabilities to study several phenomena of this type.

Temperature Changes in the Upper Atmosphere

Releases of trace gases from human activity have the potential for causing major change in the climate of the Earth. At the current rates of increase, tropospheric CO_2 and CH_4 concentrations are predicted to double within the next century. Most studies suggest that the troposphere will warm by several K while the stratosphere will cool in response to the increase in these important greenhouse gases. Recently published global circulation model studies suggest that this same increase in CO_2 and CH_4 will cool parts of the mesosphere by 10-20 K in the global mean while the thermosphere may cool by as much as 50 K [e.g., Roble and Dickinson, 1989; Brasseur and Hitchman, 1988; Rind et al., 1990]. Figure 1, taken from Roble and Dickinson [1989], illustrates the

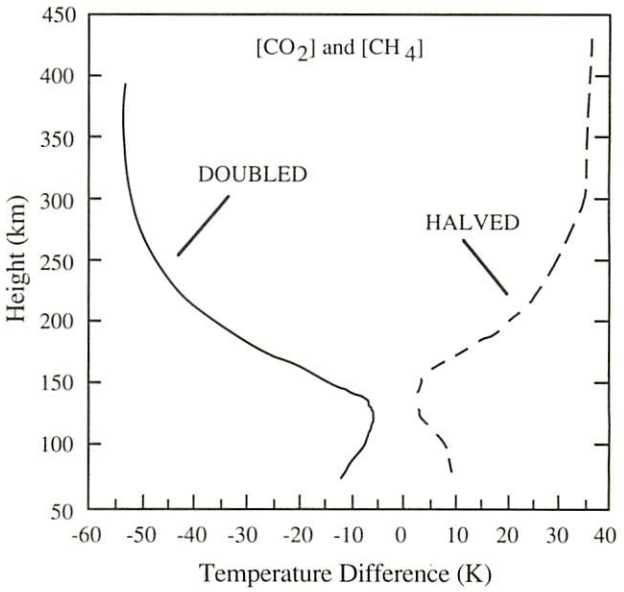

Fig. 1 At the current rates of increase, atmospheric CO_2 and CH_4 concentrations are predicted to double within the next century. Plotted here are calculated temperature changes in the mesosphere and stratosphere for the case in which CO_2 and CH_4 concentrations at 60 km are doubled (solid curve) and halved (dashed curve) (from Roble and Dickinson [1989]).

predicted globally averaged temperature changes in the mesosphere and thermosphere in response to a doubling and halving of CO_2 and CH_4 concentrations near the stratopause. Accompanying these large temperature changes will be a redistribution of both major and minor constituents as well as substantial changes in atmospheric densities and scale heights. It is not yet clear how the basic structure and dynamics of the middle and upper atmospheres will change but there is little doubt the predicted temperature changes will affect the propagation and dissipation of gravity waves, planetary waves and tides. These waves have a substantial influence on the thermal and wind structure of this region.

In the thermosphere, the atmospheric density at a given altitude should decrease up to 40% in response to the predicted cooling, and the atmospheric scale heights that govern thermospheric and ionospheric properties should also decrease. Risbeth [1990] has examined greenhouse effects on ionospheric densities and his model predicts a lowering of the F2 region peak by about 20 km. Carbon dioxide cooling, which is the dominant cooling mechanism throughout the mesosphere and lower thermospheres, will also be effective in damping the present day thermospheric and ionospheric responses to solar and auroral variability. Unfortunately, it is not clear how these changes will affect the present day ionospheric wind dynamo and the coupling of the ionosphere and magnetosphere with the solar wind. However, changes in the thermospheric circulation will result in a changed electrodynamic structure of the upper atmosphere and, through dynamo action, alter magnetospheric/ionospheric coupling processes.

A recent analysis of satellite and Rayleigh lidar observations from 44°N have shown a cooling trend in the stratopause region of approximately -0.3 K/year during the past decade (Fig. 2), which may be related to the increase in tropospheric temperatures during this same period [Aikin et al., 1991]. Analysis of Rayleigh lidar data collected since 1979 in southern France suggests that parts of the mesosphere may be cooling at remarkably fast rates, perhaps as high as -0.4 K/year between 60 and 70 km altitude (Fig. 3) [Hauchecorne et al., 1991]. While both of these studies were conducted over time periods that are far too short to definitively attribute the observed temperature variations to global change and greenhouse gas increases, the studies do illustrate the extreme sensitivity of this region of the atmosphere. They also illustrate the importance of accurate long-term observations, preferably from multiple locations. It seems likely that the first conclusive evidence that effects predicted by the greenhouse theory are also occurring in the upper atmosphere may be obtained by observing long-term changes in stratospheric and mesospheric temperatures.

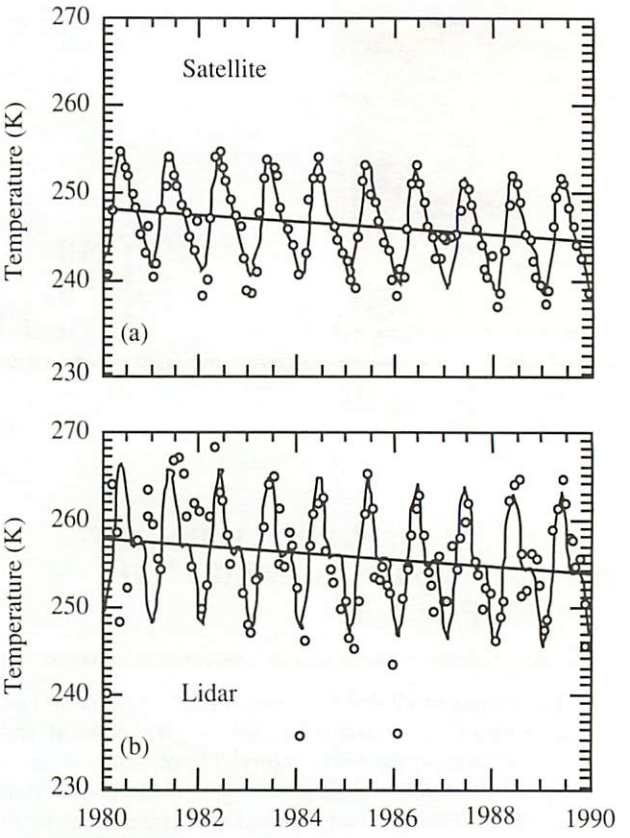

Fig. 2 Satellite (top figure) and Rayleigh lidar (bottom figure) measurements of stratopause temperatures during the past decade show a cooling trend of approximately -0.3 K/year at 44°N latitude (from Aikin et al. [1991]).

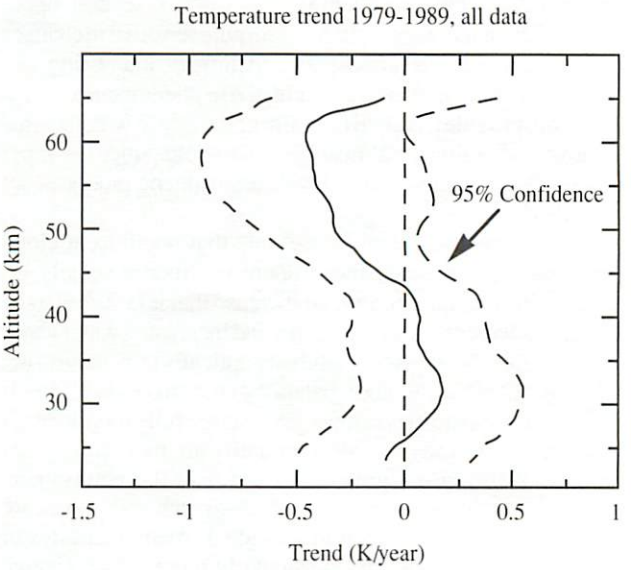

Fig. 3 During the past decade, Rayleigh lidar measurements of stratospheric and mesospheric temperatures above southern France have exhibited cooling trends approaching -0.4 K/year between 60 and 70 km altitude (from Hauchecorne et al. [1991]).

Increasing Cloudiness in the Upper Atmosphere

Increasing concentrations of the greenhouse gas methane, coupled with decreasing mesospheric temperatures, may also be related to the increased formation of noctilucent clouds (NLC) near 82 km (the highest clouds on earth) over the cold summertime polar caps. Noctilucent cloud displays are an ubiquitous feature of the summer polar regions and have been observed in the twilight sky for about 100 years. These clouds are comprised of submicron-size ice crystals. They

form and grow in summer when mesopause temperatures reach incredibly low values (~120-140 K) over the polar caps. Observations of NLCs have been reported at latitudes as low as 50-60°. It is now believed that methane may facilitate NLC formation because of its ability to transport hydrogen through the stratosphere. Once methane reaches the mesosphere, photo-chemical reactions in the presence of atomic oxygen produce water vapor that is essential for NLC formation.

Recently Thomas et al. [1989] discovered that the historical record contains no reports of NLC sightings before 1885 even though skilled observers were monitoring auroral and twilight phenomena at high latitudes for many decades by then. Thomas et al. suggested that the eruption of Krakatoa in 1883 may have precipitated the discovery of NLCs two years later. Since their discovery more than 100 years ago, the brightness and frequency of NLC displays have been increasing. Thomas et al. attribute the increasing cloudiness to increasing methane and, hence, increasing mesospheric water vapor levels, while Gadsen [1990] attributes the cloudiness to decreasing temperatures at the mesopause. The work of both groups suggests that the brightness and geographic extent of these displays may be further enhanced if the mesopause region cools appreciably during the next century and the atmospheric methane levels continue to increase.

Much of the existing information on NLCs are qualitative parameters such as relative brightness and sky coverage obtained from human observers and photographic records. Quantitative data such as absolute brightness, frequency of occurrence and geographic extent of the related phenomenon,

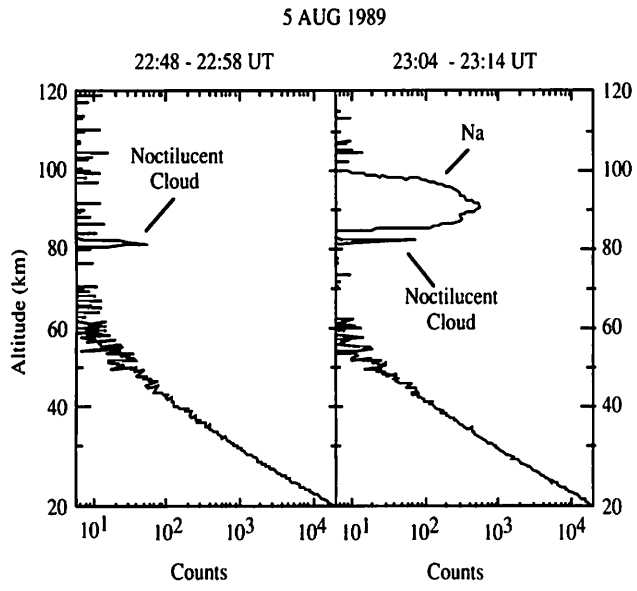

Fig. 4 The brightness and frequency of noctilucent cloud displays over the summer polar regions have increased during the past century, perhaps reflecting changes in the water vapor content and temperature of the mesopause region. Lidar and radar systems are now being used to study noctilucent clouds. This lidar profile obtained in early August 1989 at Andoya, Norway (69°N), shows strong scattering from a noctilucent cloud and the Na layer. The data on the left were obtained by tuning the laser off the Na resonance line (from Hansen et al. [1989]).

Polar Mesospheric Clouds (PMC), have only recently been reported by Olivero and Thomas [1986]. These statistics were obtained by analyzing the UV scattered light measured by the SME satellite. Data on the height and thickness of NLCs and PMCs are rare. Lidar observations at Andoya, Norway, (69°N) in 1989, were the first to reveal the vertical structure of these very thin clouds (Fig. 4). Radar observations at high latitudes have frequently exhibited enhanced scattering during summer that is now believed to be related to NLCs. These polar summer mesospheric echos occur over a narrow height range near 85 km and are accompanied by sharp notches or bite-outs in the electron density profile (Fig. 5). One theory is that the enhanced radar echos are caused by positively charged aerosols or ice particles, perhaps NLC particles. Lidar and radar techniques are now capable of observing temperatures, NLCs and related phenomena in the polar mesosphere on a routine basis. These measurements are important for quantifying changes in the mesopause region that may be related to Global Change.

Conclusions

While the global tropospheric temperature record extends back almost 150 years and proxy data such as ice cores, pollen remains, ocean sediments and tree ring data have provided useful information on climate changes extending back almost 5,000,000 years, we have only a crude record of the seasonal variability of temperatures in the stratosphere, mesosphere and thermosphere and virtually no information on variability at time scales of several decades or longer. There is a crucial need to establish the present day structure

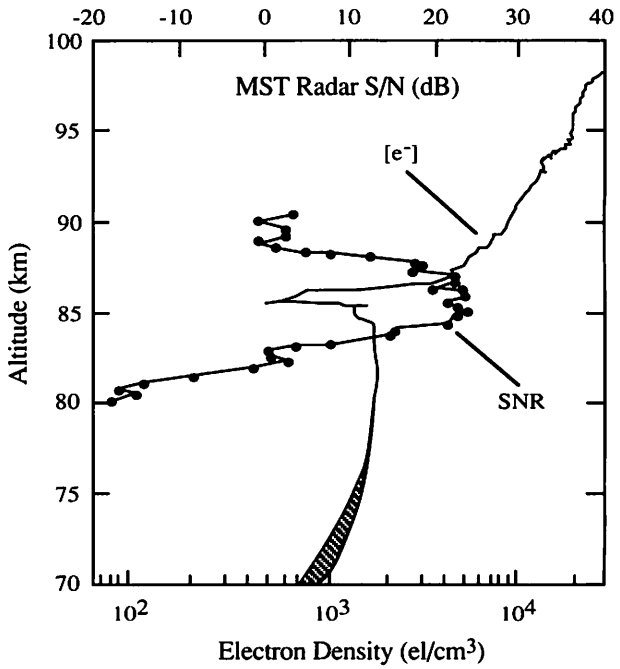

Fig. 5 Simultaneous rocket measurements of electron density and radar backscatter profiles over Alaska in summer sometimes exhibit enhanced scattering and electron density perturbations near 85 km that may be related to noctilucent clouds (from Ulwick et al. [1988]).

and circulation of the neutral upper atmosphere and ionosphere and to characterize the key physical and chemical processes that control these regions. These measurements will provide the background properties so that future trends in upper atmosphere structure and dynamics can be identified and related to global atmospheric change. Of particular importance are quantitative observations of NLC properties and long-term observations of temperatures, winds and densities throughout the stratosphere, mesosphere and thermosphere.

The CEDAR Initiative is a comprehensive, balanced program designed to address fundamental research issues involving the physics and chemistry of the upper atmosphere. While many of the CEDAR goals and projects are directly related to Global Change, many others are concerned primarily with increasing our basic understanding of the atmosphere and are equally compelling. In the future the CEDAR contributions to Global Change and to fundamental atmospheric science will become even more important as the program continues to facilitate the development of critical observational capabilities, such as lidar and radar, extends our research capabilities into the deep Arctic polar cap, and continues to support improvements in theoretical models of the middle and upper atmospheres.

References

Aikin, A. C., M. L. Chanin, J. Nash and D. J. Kendig, Temperature trends in the lower mesosphere, *Geophys. Res. Lett., 18*, 416-419, 1991.

Brasseur, G., and M. H. Hitchman, Stratospheric response to trace gas perturbations: Changes in ozone and temperature distributions, *Science, 240*, 634-637, 1988.

Gadsen, M., A secular change in noctilucent cloud occurrence, *J. Atmos. Terr. Phys., 52*, 247-251, 1990.

Hansen, G., M. Serwazi and U. vonZahn, First detection of a noctilucent cloud by lidar, *Geophys. Res. Lett., 16*, 1445-1448, 1989.

Hauchecorne, A., M. L. Chanin and P. Keckhut, Climatology and trends of the middle atmospheric temperature (33-87 km) as seen by Rayleigh lidar over the south of France, *J. Geophys. Res., 96*, 15297-15309, 1991.

Olivero, J. J., and G. E. Thomas, Climatology of polar mesospheric clouds, *J. Atmos. Sci., 43*, 1263-1274, 1986.

Rind, D., R. Suozzo, N. K. Balachandran and M. J. Prather, Climate change and the middle atmosphere: The doubled CO_2 climate, *J. Atmos. Sci., 47*, 475-494, 1990.

Rishbeth, H., A greenhouse effect in the ionosphere?, *Planet. Space Sci., 38*, 945-948, 1990.

Roble, R. G., and R. E. Dickinson, How will changes in carbon dioxide and methane modify the mean structure of the mesosphere and thermosphere?, *Geophys. Res. Lett., 16*, 1441, 1989.

Thomas, G. E., J. J. Olivero, E. J. Jensen, W. Schroeder and O. B. Toon, Relation between increasing methane and the presence of ice clouds at the mesopause, *Nature, 338*, 490-492, 1989.

Ulwick, J. C., K. D. Baker, M. C. Kelley, B. B. Balsley and W. L. Ecklund, Comparison of simultaneous MST radar and electron density probe measurements during STATE, *J. Geophys. Res., 93*, 6989-7000, 1988.

Ray Roble, NCAR
Mike Kelley, Cornell
Chet Gardner, U. Illinois

The Airborne Optic and Magnetic Observatory (ABOMO Project)

The St. Petersburg Division of the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Sciences (S.P.F. IZMIRAN) has recently initiated a major new research project involving the Airborne Complex Optic and Magnetic Observatory (ABOMO Project). ABOMO is designed specifically for studies of auroral, magnetic, ionospheric and atmospheric phenomena including measurements of ozone and other important atmospheric constituents. The Observatory is constructed aboard a modified four-engine turboprop Russian military aircraft (AN-12). Researchers at S.P.F. IZMIRAN have recently installed instruments on the aircraft for measuring the geomagnetic field components (X, Y, Z and T). Installation of several optical instruments including imagers, photometers and spectrometers will be completed in March 1992. The optical instruments will make observations through several quartz windows at the top of the plane. S.P.F. IZMIRAN has received special permission from Russian authorities to operate the observatory outside Russia including Alaska, Canada, USA and Scandinavia. The first measurement campaign will be conducted near Svalbard to study the cusp region.

S.P.F. IZMIRAN invites other scientists and organizations to consider collaborative research projects involving ABOMO. If necessary, the aircraft can be modified to accommodate other instruments. If you would like to receive additional information about ABOMO the contact person and ABOMO Project Coordinator is Professor Oleg M. Raspopov, Deputy Director, S.P.F. IZMIRAN, 2 Linija, 23, 199053 S. Petersburg, Russia, e-mail (Internet): sedom@loizmiran.spb.su

Nominations Requested for the 1992 CEDAR Prize Lecture

The CEDAR Lecture Prize was established in 1989 to recognize outstanding scientific contributions to the CEDAR Program. Selection is based upon a research paper either presented at a scientific meeting or submitted for publication during the past year. This year's nominations should be submitted to Chet Gardner, no later than May 1. The winner will present a special 30-min lecture at the 1992 CEDAR Meeting. Previous CEDAR prize lecturers and the titles of their talks are:

1989 **Art Richmond**, *Assimilative Mapping of Ionospheric Electrodynamics*
1990 **Mike Mendillo**, *The Discovery of a Sodium Magneto-Nebula Around Jupiter*
1991 **Craig Heinselman**, *Sondrestrom MUSCOX – Capabilities and New Results*

1992 Annual CEDAR Meeting Plans
Sunday, June 21 to Friday, June 26, Boulder, CO

A preliminary agenda for the CEDAR meeting is included. This year, there will be a radar school organized by B. Fejer and J. Vickrey on Sunday, June 21, on incoherent scatter radar observations. The tentatively scheduled tutorial lectures cover a wide range of subjects, with particular emphasis on global change. At this time, the workshop is scheduled to end Friday afternoon at 3:00 PM. There will be no planned extra-curricular activities due to the short course on Sunday. There will be a reception Monday evening, and a barbecue Wednesday evening at the National Center for Atmospheric Research (NCAR) on the mesa at 1850 Table Mesa Drive. The morning sessions will be held at the National Institute of Standards and Technology (NIST) at 325 Broadway. NCAR has a second facility, Foothills Laboratory, at 3450 Mitchell Lane in NE Boulder, which may or may not be used.

Graduate Students and Research Advisors

All students from US or foreign institutions who attend the CEDAR meeting will have their registration fees waived. A list of students, their interests and graduation dates will be distributed at the meeting. Space on a bulletin board will be provided for resumes and job announcements. Students will introduce themselves to the community in the first session on Monday morning.

NSF has provided money for travel and per diem for students from US institutions or students from foreign universities who are visiting US institutions and have a US sponsor. Preference will be given to graduate students, but some undergraduates will also benefit. Students will receive their per diem payment after the meeting and must make their own lodging arrangements.

This year, air flight reservations will be made through NCAR in order to obtain discounted rates. **This means that it is no longer necessary to stay over on a Saturday night** to have the discounted fare. However, attendance at the radar school will probably require staying over on Saturday night. Students should contact NCAR about their plans and they will receive their plane tickets in the mail. Any further changes must also be made through NCAR. Students who drive will receive $0.28/mile or the equivalent air fare, whichever is smaller. The per diem (which includes meals, lodging and miscellaneous) is currently set at $20 per day, or $120 from Sunday, June 21, to Friday, June 26. The next *CEDAR Post* will indicate the per diem which will be used for the meeting.

Last year, 117 students had their registration fees waived and 94 received travel assistance. The "Application for Student Financial Support" on the back of the registration form requires the signature of the research advisor, thus vouching for the student's status. The form also requires travel plans. This form should be received by April 30 to be considered for support and to allow time to arrange for airline tickets. Please apply to Dr. Barbara Emery, at the address shown on the registration form.

Call for Poster Papers

Last year, there were 32 posters, most of which were presented by students. There will be prizes for the best student posters. Last year, the winners were: K. Groves of the Massachusetts Institute of Technology, J. Minow of the University of Alaska, and T. Stevens and P. Haris (not Y.-C. Rau as stated in the September 1991 *CEDAR Post*) of Pennsylvania State University. There was also an honorable mention for D. Knutson of Whitworth College for the best undergraduate poster.

Poster space is 4 feet tall by 3.5 feet wide. Since there were so many posters last year, it was decided to split the poster session in two this year, and show half Tuesday morning and half Wednesday morning. There will be no preview poster sessions. We encourage posters from all participants. Indicate on the registration form if you plan to submit a poster, and send a title and list of authors by May 29 to: Dr. James Hecht, Aerospace Corporation, M2-256, P. O. Box 92957, Los Angeles, CA 90009. Phone: (310) 336-7017, FAX: (310) 336-1636. e-mail: dirac2::hecht (SPAN).

Workshops

The deadline for workshop leaders to reserve time and meeting rooms is **APRIL 30**. If necessary, related workshops will be grouped together to minimize duplication of subjects. Please submit your workshop requests and an estimate of the time needed to: Dr. Odile de la Beaujardiere, SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025. Phone: (415) 859-2093, FAX: (415) 322-2318, e-mail; odile@sri.com.

Video Tapes from the 1991 CEDAR Workshop

The 1991 CEDAR tutorials and short courses have been edited and prepared for copying. There were 11 hours total, and for the first time the CEDAR Prize Lecture was added to the video. There are 6 tapes total. These are:

1) David Fritts, "Atmospheric Dynamics"
   Guy Brasseur, "Atmospheric Chemistry"
2) Gerhard Haerendal, "Physics of Auroral Arcs"
   Rod Heelis, "High Latitude Convection"
3) Russ Philbrick, "LIDAR Short Course," Part 1 of 2
4) Russ Philbrick, "LIDAR Short Course," Part 2 of 2
5) Roger Smith, "Airglow Instruments Short Course," Part 1 of 2
6) Roger Smith, "Airglow Instruments Short Course," Part 2 of 2
   Craig Heinselmann, "Sondrestrom MUSCOX" – Prize Lecture

The lecture notes for both Short Courses will be included with the tapes, and some of the lecture notes for some of the tutorials. The tapes come as a set of all six. The cost for NTSC (regular VHS) copies is $100 total, while the cost for PAL or SECAM is $300. All the speakers will receive complimentary copies. If you wish to get a copy of the tapes, please contact *(continued on p. 11)*

1992 Annual CEDAR Meeting Agenda
Sponsored by NSF, HAO/NCAR, and U of CO

Sunday, June 21, 1992 – Radar School

10:00–4:30	Incoherent Scatter Measurements Technique and Applications Bela Fejer, Utah State Jim Vickrey, SRI

Monday, June 22, 1992 – NIST Auditorium

8:30–9:30	Introductions and Welcome (NCAR, HAO, Kelley, students, postdocs)
9:30–10:15	Tutorial Lecture – Metallic Layers in the Mesosphere John Plane, Univ. East Anglia, UK
10:15–10:45	BREAK
10:45–11:30	Large Atmospheric Observatory Initiative Chet Gardner, Univ. Illinois
11:30–12:00	UARS Results Gordon Shepherd, York Univ. John Gille, NCAR
12:00–2:00	LUNCH
2:00–5:30	Workshops
5:30–7:00	Reception at NCAR

Tuesday, June 23, 1992 – NIST Auditorium

8:30–9:00	NSF-CEDAR Issues Rich Behnke and Fred Roesler, NSF
9:00–9:45	Tutorial Lecture – Global Change Effects on Upper Atmosphere Bob Dickinson, Univ. Arizona
9:45–10:15	BREAK
10:30–12:00	Posters – Session A
12:00–2:00	LUNCH
2:00–5:30	Workshops

Wednesday, June 24, 1992 – NIST Auditorium

8:30–9:00	CEDAR Prize Lecture
9:00–9:15	TIMED Tim Killeen, Univ. Michigan
9:15–10:00	Tutorial Lecture – The Effect of Solar Variability on Global Change Judith Lean, NRL
10:00–10:30	BREAK
10:30–12:15	Posters – Session B
12:15–2:00	LUNCH
2:00–5:30	Workshops
6:00–8:30	BBQ at NCAR

Thursday, June 25, 1992 – The Polar Cap Observatory: Scientific and Technical Issues

8:30–9:00	PCO Engineering Studies
9:00–9:45	Tutorial Lecture – Global Change and Polar Mesospheric Clouds Gary Thomas, Univ. Colorado
9:45–10:00	Polar Summer Mesospheric Radar Echoes Mike Kelley, Cornell Univ.
10:00–10:15	Polar Stratospheric Clouds John Meriwether, Clemson Univ.
10:15–10:45	BREAK
10:45–11:00	Goose Bay/Shefferville Observation Catherine Senior, CRPE–Paris
11:00 – 11:15	Convection Pattern for Northward IMF Dolores Knipp, Air Force Academy
11:15–12:00	Tutorial Lecture – Time-Varying Convection Michael Lockwood, RAL-UK
12:00–12:15	Status of NSF Long-Range Strategic Planning Rich Behnke, NSF
12:15–12:30	Concluding Remarks Mike Kelley, Cornell Univ.
12:30–2:00	LUNCH
2:00–5:30	Workshops

Friday, June 26, 1992 – NIST/NCAR

8:30–8:45	Status of GEM Bill Lotko, Dartmouth
8:45–9:30	Tutorial Lecture – Substorms TBD
9:30–10:00	CEDAR-Related Work in Russia Yuri Galperin, SRI–Moscow
10:00–10:30	BREAK
10:30–10:45	Air Force Efforts in Global Models Dave Anderson, Phillips Laboratory
10:45–11:00	Radars in Japan and Indonesia Shoichiro Fukao, Kyoto Univ.
11:00–11:30	Poster Prize Awards, Future Plans for CEDAR, Concluding Remarks
11:30–1:30	LUNCH
1:30–3:00	Workshops (if deemed necessary)

Registration Form
1992 Seventh Summer NSF CEDAR Workshop
June 21–26, 1992

National Institute of Standards and Technology – NIST
National Center for Atmospheric Research –NCAR

1. PLEASE PRINT

   Name: _____

   Institution: _____

   Address: _____

   _____

   Telephone: (___) _____ FAX: (___) _____

   E-mail: _____ Citizenship: _____

   Are you a student: ( ) Tutorial Speaker: ( )

   NOTE: Students must register and apply for travel funds by APRIL 30 in order to be considered for funding.

2. I plan to attend the radar school on Sunday, June 21 _____.

3. I plan to present a poster at the meeting _____.
   NOTE: Students will be given preference if there are space limitations.

4. (a) Enclosed is my registration fee of $55.00 _____.
   (Fee includes reception and barbecue. Due May 31 for $15.00 discount.)
   NOTE: FEE WAIVED FOR STUDENTS AND TUTORIAL SPEAKERS.

   (b) Enclosed is my late registration fee of $70.00 _____.
   (Due after May 31)

5. (a) I plan to attend the barbecue at NCAR on Wednesday, June 24 _____.

   (b) I am bringing _____ guest(s) to the barbecue at NCAR Wednesday, June 24,
   and enclose $15.00/guest (indicate amount enclosed) _____.

6. I would like to be (removed _____/included _____) in the mailing list for the CEDAR Data Base Catalogue.

NOTE: If registration payment is not enclosed with this form, please be certain that checks sent separately identify you and the workshop. Checks for workshop (and guests for the barbecue) should be made payable to NCAR. Please send correspondence to:

Barbara Emery
HAO/NCAR
P. O. Box 3000
Boulder, CO 80307-3000
(303) 497-1596
FAX Number: (303) 497-1137
Internet: emery@ncar.ucar.edu
SPAN: 9580::"emery@ncar.ucar.edu"

****STUDENTS** Please complete BOTH sides of this registration form.**

Application for Student Financial Support to Attend the Annual CEDAR Meeting

All students are eligible to receive a registration fee waiver, including those from non-US institutions. Travel funds and per diem funds are also available for students from US institutions. All students must fill out this application form. Application deadline is **April 30, 1992**. Apply early so airline reservations can be made through NCAR and tickets can be mailed.

Name _____

University address _____

_____

_____

Phone: _____ FAX: _____ e-mail: _____

Mailing address (if different) _____

_____

Expected degree and date of graduation _____

Advisor(s) and phone number _____

Traveling by air? _____ If "yes," contact NCAR to arrange tickets. (Need carrier and desired flight numbers and times.

Can mark them here if known.) _____

Research interests _____

_____

_____

_____

Instruments, models or data used _____

_____

_____

_____

Advisor's signature of student status

I confirm that the applicant is a ( ) graduate ( ) undergraduate student at my university or research laboratory who is working on a research project related to the CEDAR Program.

Research Advisor's signature _____

University of Colorado Summer Conference Housing Application
Main Campus

COMPLETE THE INFORMATION REQUESTED BELOW AND SEND TO THE ADDRESS INDICATED AT THE BOTTOM OF THE FORM.

Name of Conference: NSF CEDAR Meeting, Summer 1992

Participant's Name: _____ Sex _____
(last) (first)

First Night's Lodging _____ Last Night's Lodging _____
(date) (date)

Address: _____ City: _____ State:____ Zip: _____

Telephone: (Home) _____ (Business) _____

Please request one of the following:

*Single Room _____ Double Room _____ (Roommate Preference if Any)_____

Special Requests (Smoker/Nonsmoker, etc.) _____

*There are a limited number of single rooms. If a single room is unavailable, you will share a double room with another conference participant.

Complete if Accompanied by Spouse and/or Family:

Spouse's Name _____ First Night's Lodging _____ Last Night's Lodging_____

Child's Name _____ Age ____ Sex____ Dbl ____ Sngl ____ 1st Night____ Last Night_____

" Name _____ Age ____ Sex____ Dbl ____ Sngl ____ 1st Night____ Last Night_____

" Name_____ Age ____ Sex____ Dbl ____ Sngl ____ 1st Night____ Last Night_____

Will a rollaway bed be needed? _____ Crib? _____ **Total Number in Party** _____

PAYMENT IS DUE AT CHECK-IN. Cash, traveler's checks, personal checks, VISA and MasterCard will be accepted. DO NOT SEND MONEY IN ADVANCE. PHONE-IN REGISTRATIONS ARE NOT BEING ACCEPTED BUT, IN CASE OF ANY QUESTIONS OR EMERGENCIES, THE AREA MANAGER'S TELEPHONE NUMBER IS (303) 492-6885.

MAIL TO: Main Campus Conference Housing Area
142 Cheyenne-Arapaho Hall
Boulder, CO 80310

Boulder Lodging and Local Transportation Information

1992 Seventh Summer CEDAR Workshop
June 21–26, 1992

The facilities listed below have blocked rooms for workshop participants for the nights of June 21-June 25 (with arrival on June 20-21 and checkout on June 26-28), 1992. Reservations must be accompanied by a credit card charge number or a deposit for the first night's lodging; Visa, Mastercharge, American Express, and Discover credit cards are accepted at most of the hotels. Cancellations must be made before 4:00 PM on the arrival day to avoid being charged for the first night's lodging. The blocks of rooms at special workshop rates are only being held until the dates indicated below and they may fill up early. MAKE ALL RESERVATIONS AS SOON AS POSSIBLE AND SPECIFICALLY MENTION THE CEDAR WORKSHOP HOSTED BY NCAR (if using a Travel Agent, have them identify you in the same manner). Participating hotels and rates for June 21-June 25, 1992, are:

Hotel	Single*	Double*	Deadline	No. of Rooms
Days Inn 5397 S. Boulder Road Boulder, CO 80303 (303) 499-4422; FAX: (303) 494-0269	$41	$41 (Up to 4 People)	June 7	50
Holiday Inn of Boulder 800 - 28th Street Boulder, CO 80303 (303) 443-3322 or 1-800-542-0304	$62	$62	May 20	25
Homewood Suites Hotel 4950 Baseline Road Boulder, CO 80303 (303) 499-9922 or 1-800-225-5466; FAX: (303) 499-6702	$56 for a Suite w/ Kitchen (will accommodate 3-4 people; 1 bed is a sofa sleeper)		May 14	25
Courtyard By Marriott 4710 Pearl East Circle Boulder, CO 80301 (303) 440-4700 or 1-800-321-2211; FAX: (303) 440-8975	$66	$66	June 5	20

RESERVE ROOMS BEFORE DEADLINES TO ASSURE LOWER RATES

All hotels have comfortable accommodations and all of them, except the Courtyard, can provide shuttle service to local meetings if requested by individuals *in advance* (based on availability). The Days Inn and Homewood Suites provide free continental breakfasts with lodging. Homewood Suites also has a free social hour Monday through Thursday. Checkout times are 12:00 noon. All hotels have swimming pools. We were unable to book blocks of rooms at the Broker Inn or the Clarion due to a medical convention, but some individual rooms may be available.

*Hotel rates do not include 9.5% sales tax.

University of Colorado Dormitory Rooms & Meals:

	Single	Double	No. of Rooms
Main Campus Conf. Housing Area 142 Cheyenne-Arapaho Hall Boulder, CO 80310	$126	$112 (per person)	30(S), 45(D)

NOTE: FOR EMERGENCIES ONLY: (303) 492-6885 (Suzy Campbell or her secretary)

Rates include a Dorm Room from 6/21 to 6/25 and breakfast every day from 6/22 to 6/26. Lunches at $6 and dinners for $7.75 are available to anyone on an a-la-carte basis. Early arrivals (6/20) and late departures (6/27-28) will pay extra for those nights. NO PHONE-IN RESERVATIONS ARE ACCEPTED. PLEASE SEND REGISTRATION FORM PROVIDED HEREIN. Also, have only ONE individual in charge of each group from each university. CU accepts VISA and Mastercard. The above prices are maximum amounts that do not include the 9.5% sales tax.

GROUND TRANSPORTATION (Airport)

The Boulder Airporter Limousine Service (303/321-3222) and the Stapleton Supercoach (303/499-1951) will take reservations for direct transportation between the hotels, University and Denver's Stapleton Airport. Their schedules are staggered so you may find one more convenient for your arrival/departure.

DAY CARE

For child care while you attend the workshop, Children's World at 5377 Manhattan Circle in Boulder will accept children on a drop-in basis (based on availability). Children's World also offers summer field-trip programs. If you're interested, please call Shaun Barnes at (303) 494-3694. Many other day-care facilities are listed in the Boulder telephone directory under "Child Care."

HLPS/GAPS Workshop To Be Held Near Boulder, Colorado

The HLPS (High Latitude Plasma Structures) Group of CEDAR with its Solar-Terrestrial Energy Program (STEP) Working Group 3 counterpart GAPS (Global Aspects of Plasma Structures) will hold a joint three-day Workshop on June 18-20, 1992, at the Peaceful Valley Lodge and Conference Center, Lyons, Colorado, located about 30 miles from Boulder (60 miles NW of Denver) in a pleasant mountain environment.

The primary objectives will be the discussion of the results obtained during the HLPS/GAPS experimental campaigns of February 1990, January 1991, the conjugate mid-latitude campaign of July 1991, and the earlier HLPS campaigns conducted in 1988/89. This Workshop will precede the Annual CEDAR Workshop to be held in Boulder, June 21-26, 1992. It is possible that some funds may be available for partial travel support. Interested participants should contact Sunanda Basu, Institute for Space Research, Boston College, Newton, MA 02159 USA. FAX: (617) 552-8778; (617) 377-2770. E-Mail: BASUS@BCVMS (BITNET), AFGL::BASUS (SPAN). The specific topics for discussion are as follows:

1. Polar Cap "Patch" and Auroral "Blob" Observations: formation, entry and exit mechanisms, large- and small-scale plasma structuring, IMF controlled dynamics and conjugacy.

   Coordinators:

   E. Weber, PL — **FAX:** (617) 377-3550
   J. Dudeney, BAS, UK — **FAX:** (0223) 62616

2. Modeling Studies of Patches and Blobs: effects of dayside cusp precipitation, sensitivity to different convection models.

   Coordinators:

   D. Anderson, PL — **FAX:** (617) 377-2770
   R. Heelis, UTD — **FAX:** (214) 690-2848

3. Observations of Sun-Aligned Polar Cap and Auroral Oval Arcs: their morphology, plasma and neutral dynamics, large- and small-scale plasma structuring in sheared flow regions, effects of conducting E-region on structure and anisotropy of F-region irregularities.

   Coordinators:

   J. Vickrey, SRI — **FAX:** (415) 322-2318
   C. Valladares, BC — **FAX:** (617) 552-8778

4. Modeling of Polar Cap Arcs: mesoscale magnetosphere-ionosphere-thermosphere coupled models, time-dependent behavior.

   Coordinators:

   J. Sojka, USU — **FAX:** (801) 750-2992
   M. Keskinen, NRL — **FAX:** (202) 767-3142

5. Mid-Latitude Structuring: their morphology, inverse correlation with sunspot cycle, winds and waves, E- and F-region couplings, conjugate studies.

   Coordinators:

   M. Kelley, Cornell — **FAX:** (706) 255-6236
   S. Fukao, RASC, Japan — **FAX:** (81) 774-31-8463

6. Collaborative Paper Topics and Future Plans.

   Coordinator:

   Su. Basu, BC — **FAX:** (617) 552-8778

Individual announcements and an early registration form have been sent at the end of September 1991 to the approximately 100 scientists on the HLPS/GAPS list. Positive responses have been received from 40 U.S. and foreign participants. These people are urged to contact one of the relevant coordinators to discuss their presentations at the workshop.

Sunanda Basu, Boston College

(continued from p. 5)

Dr. Barbara Emery at the address in the registration form. For future videos, we will try to provide notes from all of the speakers, so speakers will have to provide a monochrome copy of their slides or transparencies at the meeting.

The 1992 CEDAR Catalogue

The 1992 CEDAR Data Base catalogue is scheduled to be sent out in April 1992. In the past, the catalogue has been sent to everyone on the *CEDAR Post* mailing list. Since this list now exceeds 1000 names, the mailing list of those who receive the data catalogue is being shortened. Those who attended the 1991 CEDAR meeting and those who have requested data in the past will automatically be put on the mailing list to receive a catalogue. If you are not in either group and wish to receive the 1992 catalogue, please contact: Dr. Barbara Emery, HAO/NCAR, P. O. Box 3000, Boulder, CO 80307. Phone: (303) 497-1596. FAX: (303) 497-1137. e-mail: emery@ncar.ucar.edu INTERNET or 9580::"emery@ncar. ucar.edu" SPAN. If you are attending the 1992 CEDAR meeting and do not want to receive the catalogue, please indicate so on the registration form.

FIRST CLASS

The Cedar Post

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The Cedar Post is published quarterly and mailed to more than 800 scientists worldwide.
C. S. Gardner, Editor.

The Sondrestrom radar facility located on the southwest coast of Greenland is operated by SRI International with funding from the National Science Foundation. The radar, with its 33-m diameter parabolic antenna shown above, is capable of measuring electron densities, electron and ion temperatures and Doppler velocities over a large field-of-view at all ionospheric heights. From these basic quantities, several other important parameters are derived, including winds, neutral temperatures, electric fields and currents. The domes in the foreground are used for airglow and auroral observations with various spectrometers, imagers and interferometers. The facility instrumentation also includes magnetometers, ionosondes and riometers. SRI is currently developing a Rayleigh/aerosol lidar for Sondrestrom which will permit observations of stratospheric aerosols (including polar stratospheric clouds), middle atmospheric densities and temperatures and polar mesospheric clouds. The lidar will have a range resolution of 1 m, a power aperture product of 13 Wm^2 and will become operational in early 1993.