The Cedar Post

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The CRRES *El Coqui* Caribbean Campaign

The NASA Combined Release and Radiation Effects Satellite (CRRES) *El Coqui* rocket campaign was successfully carried out in Puerto Rico during the period of May 18 through July 12, 1992. This campaign was the last component of the larger CRRES program, which consisted of a primary CRRES spacecraft launched with an Atlas/Centaur vehicle, a Pegasus-borne small satellite, and two rocket campaigns performed from Kwajalein Atoll and Puerto Rico. The *El Coqui* campaign was conducted from Puerto Rico to take advantage of the large incoherent scatter radar at Arecibo Observatory, Puerto Rico and the Arecibo high-power, high-frequency (HF) facility. A total of eight rockets were launched into the ionosphere above Arecibo Observatory. Six of the rockets carried chemical release payloads that were used to actively modify the ionosphere and to examine physical processes in the laboratory-without-walls environment of space. The remaining two rockets were used to probe natural sporadic-E instabilities and to make in situ measurements of ionospheric modifications produced by the Arecibo HF facility.

Arecibo Observatory, operated by Cornell University under a cooperative agreement with the National Science Foundation, hosted many of the experimenters and served as a control center for most of the chemical releases. Numerous groups established field sites throughout the Caribbean basin to support various aspects of the *El Coqui* project. Optical diagnostics were contributed by Arecibo Observatory, Los Alamos National Laboratory (LANL), the Naval Research Laboratory (NRL), and the Air Force Phillips Laboratory (PL). PL also supplied a KC-135 aircraft that was manned with personnel from PL and SRI, International (SRII). The airplane was used to map out irregularities in chemical release clouds with the aid of signals from satellite beacons. In addition, the PL aircraft served as a platform for optics and radio wave sounding of the ionosphere. Radars operating from HF to VHF were deployed and operated by Cornell University, Geospace Research, Inc. (GRI), LANL, PL, and SRII. Finally, supplemental radar processors were supplied by GRI and SRII to capture the full information content of the Arecibo incoherent scatter radar and to furnish real-time data during several of the chemical releases.

The first launch of the campaign (rocket 18-224, L. M. Duncan/University of Tulsa, P.I.) occurred at dusk on May 25. Two small canisters of Ba were explosively released within the beam of the Arecibo HF facility at 251 and 271 km altitude. Each canister contained 1.1 kg of Ba. The two Ba clouds were viewed optically, and the lower of the two ion clouds was examined with the Arecibo incoherent scatter radar. This experiment was designed to map out large-scale ionospheric structures produced by the HF beam and provided the first glimpse of HF-induced Langmuir turbulence in a Ba^+ plasma. The studies of induced plasma turbulence proved to be rather intriguing. Initially, very strong Langmuir and ion oscillations were detected in the Ba^+ cloud. However, after a short period of time (~15 s) these waves disappeared and the Ba^+ cloud effectively blocked the excitation of all HF-induced turbulence in the volume viewed by the radar. After several minutes, a normal pattern of HF-excited waves was established in the ionosphere. The total disappearance of the turbulence was completely unexpected and is currently the subject of a highly focussed study.

On May 30, the second rocket of the campaign was launched (rocket 36-065, P. A. Bernhardt/NRL, P.I.). The payload consisted of a chemical canister and diagnostic instrumentation used to measure the properties of the modified ionospheric plasma. Approximately 30 kg of gaseous CF3Br were vented at 284 km altitude near the center of the Arecibo HF beam. The purpose of the CF3Br was to generate an electron density cavity in the ionosphere through dissociative attachment of free electrons. Once formed, the ionospheric cavity was used as a refractive lens to focus the HF beam. This greatly increased the power density of the beam near the point of HF reflection. Observations made with the incoherent scatter radar clearly showed the development of

the ionospheric hole and the subsequent intensification of HF-induced turbulence as the HF beam was focused. Radar backscatter from the turbulence increased by two orders of magnitude once the hole developed. An additional unanticipated discovery was made when in situ measurements of electron density were examined. Shortly after the release, small-scale (~2 m) electron density depletions developed in the plasma. The depth of some of the depletions relative to the background was very large (>90%). The source of these irregularities is currently unknown, but the mystery is likely to unravel as more data are examined.

On June 6, rocket 36-064 (E. P. Szuszczewicz/SAIC, P.I.) was launched under dawn moon-down conditions to study multi-ion expansion processes and their coupling to the background ionosphere. Expanding clouds of Ba^+ and Li^+ with a mass ratio similar to that found in the high-latitude polar wind were diagnosed by a suite of in situ particle and field detectors and supporting radar/optical systems on the ground. Four canisters of chemicals were ejected from the mother payload, two parallel to the geomagnetic field and two perpendicular to the field. In the first release event, 712 gm of Ba and 38 gm of Li were discharged in the middle of the Arecibo radar beam at 290 km altitude. This release provided cross-field diagnostics of ion expansion along the geomagnetic field and surprisingly produced a decrease in radar backscatter rather than an increase expected because of the rapid ionization of neutral Ba. The second release occurred near ~350 km altitude where ion expansion parallel to the geomagnetic field could be viewed along field lines; the chemical mixture was the same as the first. The third release occurred on the downleg of the flight and involved the simultaneous discharge of two canisters, each containing 1.5 kg of Ba and 19 gm of Sr. The instrument package viewed the ionizing cloud as it expanded across the geomagnetic field. Preliminary examinations of the in situ data indicate that "snowplowing" of O^+ ions and forerunning Li^+ ions may have been detected. In addition, there is clear evidence of gyro-kinetic effects on a Saha-like ionization source (i.e., an "instantaneous" ionization process that operates at the very earliest phases in the cloud's evolution).

Rocket 36-071 (M. C. Kelley/Cornell University, P.I.) was launched on June 9 at 01:39 AST. The payload contained a group of sensors specially designed to diagnose modifications to the natural ionosphere by the Arecibo high-power HF beam. The focus of the observations was on Langmuir turbulence excited near the reflection point of the HF radio wave. The rocket instrumentation detected packets of HF-induced ionospheric depletions both below and above the nominal height of HF wave reflection. Individual irregularities had scale sizes in the range of 12 to 18 m and averaged 6% in depth. Such medium-scale irregularities are not readily measured with ground-based radar systems. The newly detected irregularities are believed to play a central role in the evolution of HF-induced Langmuir turbulence, and the experiment as a whole is expected to provide much needed guidance for ongoing theoretical studies.

Rocket 21-105, (R. F. Pfaff/Goddard Space Flight Center, P.I.) was launched on the evening of June 22. It contained a heavily instrumented payload that was used to investigate sporadic-E plasma instabilities near 110 km altitude. The CUPRI radar provided the launch criterion from its location in southern Puerto Rico. Key in situ detectors included electron density and electric field sensors and an ion mass spectrometer. In addition to providing a detailed view of sporadic-E processes, the rocket payload also measured an intriguing wave structure at higher altitudes near 130 km. Continuing studies of this kilometer-size structure are likely to shed light on electrodynamic processes in the midlatitude ionosphere.

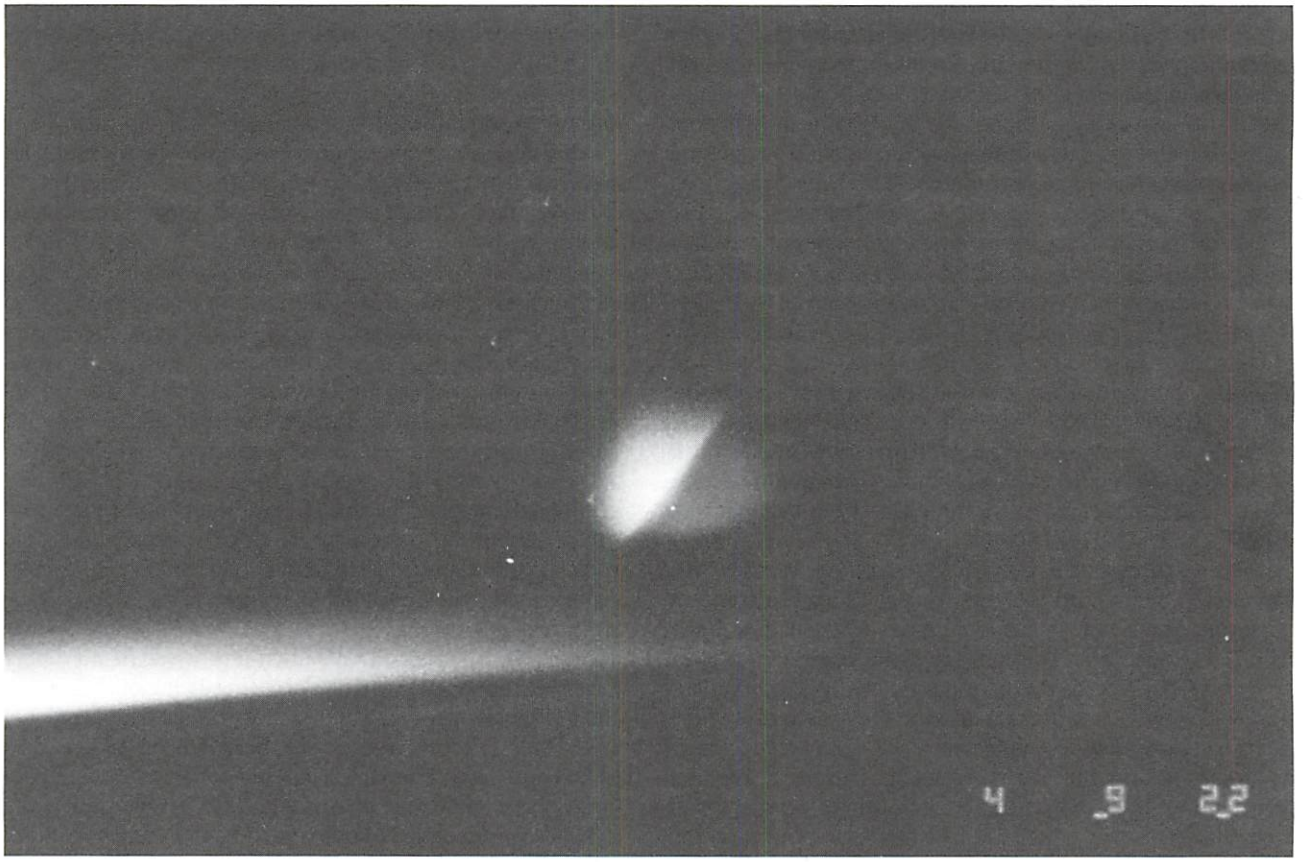
The chemical canisters onboard rockets 36-082 and 36-083 (E. J. Weber/PL, P.I.) were discharged at dawn near 255 km altitude on July 2 and 4. Optical observations made from the Space Shuttle on July 4 yielded the first space-based images of a high-altitude chemical release (see page 3). Each release consisted of ~22 kg of Ba and 276 gm of Sr with the Sr serving as a dopant for diagnostic purposes. As expected, the two Ba releases produced large clouds of Ba^+ plasma that were readily detected with the Arecibo incoherent scatter radar. However, prior to the arrival of the Ba^+ ions in the radar beam, a large (1400 K) enhancement in the temperature of the background electron gas was observed. At late times following each release, enhanced electron temperatures were also measured above the Ba^+ cloud along with an electron density depression. The observed electron temperature enhancements were not anticipated, and their cause is currently under study.

The final release of the *El Coqui* campaign (rocket 36-081, F. T. Djuth/GRI, P.I.) occurred at dawn on July 12. Approximately 35 kg of Ba doped with 148 gm of Sr, 260 gm of Eu, and 24 gm of Li were released near 252 km altitude. This Ba release, which was the largest of the CRRES program, occurred near the center of the Arecibo HF beam. It produced a distinctive ionospheric layer having a maximum plasma frequency of 11 MHz. An extremely rich data set was obtained with the Arecibo incoherent scatter radar. During the first two minutes after the release, the strongest ionospheric Langmuir turbulence ever measured at Arecibo was detected in the Ba^+ cloud. Moreover, the underlying symmetry of the basic wave-plasma interaction disappeared. Asymmetries between upgoing and downcoming plasma waves greater than 10^7 in power were encountered in a process that theoretically should be symmetric. With the appearance of short-scale field-aligned irregularities monitored with a mobile VHF radar, wave symmetry was once again restored to the instability process. This experiment is expected to foster new theoretical efforts in an area that was once considered to be well-understood.

In summary, all rockets launched during the CRRES *El Coqui* campaign produced interesting scientific results, and many of the experiments led to unanticipated discoveries. The strength of the observations lies in the diversity of diagnostics brought to bear on each investigation. Ultimately, the combination of radar/radio observations, optical measurements, and in certain cases, in situ data will provide an unusually complete physical description of eight unique space plasma experiments.

F. T. Djuth, Geospace Research, Inc.

Photo of CRRES/COQUI Barium Release Taken From STS-50 on July 4, 1992



This photo was taken by STS-50 crew at 0522 EDT on July 4, 1992 of the barium cloud produced by one of the Combined Release and Radiation Effects (CRRES) sounding rockets launched during the Puerto Rican COQUI Campaign last summer. The two stage Terrier-Black Brant rocket was launched from a site on the north coast of Puerto Rico. The rocket released the 22 kg of vaporized barium at an altitude of about 250 km at 0500 EDT (about 22 minutes before this picture was taken). The Shuttle was traveling eastward from darkness into daylight at an altitude of about 300 km at the time that this photo was taken. The light from the barium cloud is produced when sunlight hits the barium atoms, causing them to emit light at specific frequencies. The diagonal line in the center of the barium cloud is produced by barium ions becoming aligned with the earth's magnetic field. The photograph was taken using a standard, unfiltered 35 mm camera carried aboard the Shuttle.

The 8th CEDAR Meeting: Morning Sessions

The CEDAR annual meeting began at 8:30 am on Monday, June 21, 1993 with the usual NCAR welcome from the acting Director of NCAR, Guy Brasseur, and the Director of the High Altitude Observatory, Tom Holzer. In addition to the welcome, Guy Brasseur also presented a report on the present status of the Middle Atmosphere Research Initiative (MARI) and Tom Holzer summarized the current status of HAO solar-terrestrial research and HAO activities within the CEDAR program.

George Withbroe then gave a summary of activities within the NASA Space Physics Division as they relate to CEDAR activities. In particular he summarized the NASA support for the TIMED satellite mission and indicated that a unique opportunity exists for studying the mesosphere and thermosphere using combined TIMED and CEDAR measurements. He also reviewed the status of the TIMED team selection, indicating that the delay in the announcement was due to a NASA reorganizational procedure. The TIMED selections were announced shortly after the CEDAR meeting.

Jeffrey Forbes then gave the first of the series of excellent CEDAR tutorial lectures on *Tides and Global Oscillations*. The second tutorial lecture on Tuesday was given by Robert Meier on *UV Spectroscopy*, the third on Wednesday by Richard Walterschied on *Gravity Waves*, the fourth on Thursday by Gordon Rostoker on *Geomagnetic Substorms* and the last on Friday by Douglas Torr on *The Photochemistry of the Lower Thermosphere and Mesosphere: What has Been Achieved and What Remains to be Done*. These tutorials were all video taped and copies of the tutorials can be obtained from Barbara Emery at HAO/NCAR.

The remainder of the morning session on Monday was devoted to various project reports with Herb Carlson first reporting on the research opportunities associated with the HAARP Radar near Fairbanks, Alaska and Mike Kelley reviewing the current status of the Polar Cap Observatory. Leroy Cogger then summarized some of the activities of the Canadian Network for Space Research, a collaborative science/technology transfer effort between various Canadian Universities involved in upper atmosphere research and Canadian industry. There are five projects involved in the effort and Robert Lowe summarized the activities of Project 1 - Middle Atmosphere Study (30-100 km) that involves optical instrumentation complimentary to similar developments in the CEDAR program. In fact, there are various collaborative efforts between CEDAR and the Canadian Network for Space Research that mutually benefit each program as well as enhancing the scientific effort through the pooling of resources.

Tuesday started with a summary of the status of CEDAR by Richard Behnke of NSF. He presented a list of the current awardees of CEDAR grants and discussed future plans for current and future research in the program.

Tuesday was also a day of celebration and reminiscence for the 10th, 9th, or 8th (?) anniversary of the beginning of CEDAR. Various "old crows" tried to reconstruct the beginning days of CEDAR, relate their experiences, and offer advice to the "young crows" in the audience. An accurate account of the early days of CEDAR may be lost forever since there appeared to be much confusion on the chronological sequence of events. Nevertheless, the growth of the program, its successes and achievements were adeptly summarized by the various speakers and certainly all participants must be congratulated on an entertaining, humorous and enjoyable morning of celebration at the 10th, 9th, or 8th (?) CEDAR anniversary.

On Wednesday morning, after John Sahr presented the CEDAR prize lecture and following the tutorial talk, the second CEDAR poster session was held at NIST. The first CEDAR poster session was held before and during the opening day reception. Throughout the entire workshop there were numerous excellent poster papers on nearly all aspects of CEDAR and related research. As usual the poster papers were a highlight of the meeting and stimulated considerable discussion and information exchange.

On Thursday after various reports from CEDAR post docs and a report by Chet Gardner on the status of the Large Optical Observatory, a series of reports on recent data from the UARS satellite were presented. The principal investigators of instruments most relevant to CEDAR summarized the results of their measurements. Gary Rottman illustrated variations of solar UV spectral irradiance from Lyman-alpha to about 400 nm with the solar 27-day rotation period and also showed variations over other time periods. David Winningham presented results from the Particle Environment Monitor that not only measures energetic electron and proton fluxes in-situ but also remotely through an x-ray imager. He showed significant energetic particle fluxes bombarding the atmosphere during the November 9, 1991 geomagnetic storm. Paul Hays summarized HRDI wind and temperature measurements showing considerable dynamic variability in the upper mesosphere. He also reviewed the observed characteristics of the diurnal tide and two-day wave in the upper mesosphere and presented data showing their global structure and a comparison of data with winds predicted by the global model of Jeff Forbes. Gordon Shepherd showed WINDII data of OH and green line winds and temperatures in the upper mesosphere and lower thermosphere. The green line data showed considerable latitudinal and longitudinal variability that was probably associated with atomic oxygen variations and the interaction of dynamics with composition on a global scale. The UARS measurements gave a good global picture of dynamics, temperature and compositional structure and offer an excellent opportunity for collaborative research with the CEDAR program where ground-based measurements of temporal variations combined with satellite measurements of global structure offer a unique insight into global, time-dependent upper atmosphere phenomena.

On Friday, reports on various programs such as ADS, RAIDS, TIMED, FREJA, and a host of others were presented and together summarized significant opportunities for joint CEDAR program research. There was also a report on GEM activities and plans for the workshop taking place at Snowmass, CO the week following the CEDAR workshop. Gonzalo Hernandez summarized results from a unique southern hemisphere measurement program, including the south pole. The south pole data provided a unique view of dynamics in the

polar mesosphere and thermosphere. This program, supported mainly by the NSF Polar Programs Office, can provide important measurements for collaborative research with the CEDAR program.

Finally, the meeting came to an end with the announcement of the annual CEDAR Poster Prize Awards and a discussion of future plans for CEDAR. Overall, it was an excellent workshop with a record number of participants and students and provided a good forum for scientific exchange and planning within the CEDAR program.

Ray Roble, HAO/NCAR

Notes on the CEDAR-93 Workshops

For the 1993 CEDAR meeting we had a record 26 afternoon workshops, up 73% from last year. This was an excellent tribute to a more extensive community involvement in CEDAR-related activities, although it did create some major scheduling anxieties. Overall, many of the workshops featured an informal structure and a lively interaction among its participants, an original theme that we had wanted to return to as in earlier CEDAR workshops.

Among others, the workshops included a new style of CEDAR Database participation, taking place on four of the five afternoons, where users would walk in for personalized hands-on instruction. Other workshop themes included looking at two of the wintertime LTCS periods from three different perspectives, and high latitude studies of auroral arcs, joule heating, substorm phenomena, modelling, and noctilucent clouds. Analysis of recent results included workshops on the 10-day World Week-1/2 experiment that took place in January 1993, the STS-53 Airglow studies, and ATLAS, CADRE, CORN, and MISETA, to name a few acronyms. Planning meetings for the next year's series of World Day experiments, applications of new techniques for resonance lidar and incoherent scatter radar, the Turbopause Transition and the AIRA II rocket investigations, new studies of planetary atmospheres, and opportunities for future collaborations with Russian colleagues were also featured. As always, there were simply too many interesting workshops for adequate attention, which has become a notable trait of the diversified profile of the CEDAR program.

Craig Tepley, Arecibo Observatory

1993 CEDAR Workshop Participants and Poster Prizes

There were 397 participants at the 1993 CEDAR Workshop, 174 of them students. Approximately 70 posters were shown during the two poster sessions, 75% of which were shown by students. Monica Coakley of the University of Wisconsin received the poster prize book of J. Hargreaves (*The Solar Terrestrial Environment*) for the best student poster in the Monday session. Her poster was "Application of CCD Fabry-Perot Ring Imaging to Daysky Emission Line Measurements." Two other prize books by M.C. Kelley (*The Earth's Ionosphere*) were awarded to the best student poster in the Wednesday session and to the best runner-up. Denise Thorsen of the University of Illinois had the best student poster on Wednesday. Her poster was entitled "Radar Observations of Mesospheric Mean Winds and Gravity Waves at Urbana." Redgie Lancaster of Boston University had the best runner-up poster on "Recent Observations of the O(I) 8446 Angstrom Triplet Emission Over Millstone Hill."

Notes from the tutorials, the CEDAR Prize Lecture, and the Saturday Data Analysis School are available. Please contact Barbara Emery (HAO/NCAR, P.O. Box 3000, Boulder, CO 80307, USA; e-mail: emery@ncar.ucar.edu) if interested in these notes or in the videos, which will be available in November.

Barbara Emery, NCAR

9th Annual CEDAR Workshop Scheduled for June 20-24, 1994

The 9th annual CEDAR Workshop will be held at the National Institute of Standards and Technology (NIST) and at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, from Monday, June 20 through Friday, June 24, 1994. It will again be followed by the GEM Workshop in Snowmass, which is tentatively scheduled for June 27-July 1, 1994. The CEDAR Workshop committee will be chaired by Tim Killeen and includes Miguel Larsen, John Sahr, and Barbara Emery. The format will be similar to previous meetings with tutorials, a poster session, and workshops. Specific information about the 9th CEDAR Workshop, including tentative agenda and housing information, will be included in the February issue of the *Cedar Post*.

New CEDAR Science Steering Committee Members Begin Three-Year Terms

Coordination of the CEDAR Program and the organization of the annual workshop are the responsibilities of the CEDAR Science Steering Committee. The CSSC includes nine scientists who serve staggered three-year terms. The NSF program directors for Aeronomy and for Upper Atmospheric Facilities serve as ex officio members. At the conclusion of this year's workshop, Odile de la Beaujardiére and Roger Smith completed their terms on the committee. Both members provided exceptional leadership, which has been greatly appreciated. Their collective insight, wisdom, and experience have been very important in helping to shape the CEDAR Program during the past three years.

The CEDAR Program is fortunate to have well-qualified replacements for Odile and Roger. John Sahr from the University of Washington and Jeff Thayer from SRI International are the new CSSC members and began their terms in June at the annual workshop.

Listed below are the names and addresses of the current CSSC members for 1993-94:

Dr. Jeffrey Forbes
CSSC Chair Elect
Department of Aerospace Engineering and Sciences
University of Colorado
Boulder, CO 80309
(303) 492-4359

Dr. James H. Hecht
The Aerospace Corporation
MS M2-255
P.O. Box 92957
Los Angeles, CA 90009
(310) 336-7017

Dr. Michael C. Kelley
CSSC Chair
318 E&TC
Cornell University
Ithaca, NY 14853-5401
(607) 255-7425

Dr. Timothy L. Killeen
Space Physics Research Lab.
University of Michigan
Ann Arbor, MI 48109
(313) 747-3435

Dr. Miguel F. Larsen
Department of Physics and Astronomy
College of Sciences
Clemson University
Clemson, SC 29631
(803) 656-5309

Dr. Raymond Roble
HAO/NCAR
P.O. Box 3000
Boulder, CO 80307-3000
(303) 497-1562

Dr. John Sahr
404 Electrical Engineering Building, FT10
University of Washington
Seattle, WA 98195
(206) 685-4816

Dr. Craig A. Tepley
Arecibo Observatory
P.O. Box 995
Arecibo, PR 00613
(809) 878-2612

Dr. Jeffrey Thayer
Geoscience and Engineering Center
SRI International
Building G, Room 284
333 Ravenswood Avenue
Menlo Park, CA 94025
(415) 859-3557

Dr. Sunanda Basu
ex officio
Program Director, Aeronomy
National Science Foundation
Room 644
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Washington, DC 20550
(202) 357-7619

Dr. Robert Robinson
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Upper Atmospheric Facilities
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Status of CEDAR Review

The CEDAR Review is proceeding according to schedule. We still plan to distribute the report before December. I would like to thank everyone who responded to the requests for information on CEDAR accomplishments. It is not too late to submit additional material. In particular, I am still interested in receiving figures that can be used in the text and on the cover of the report. Please mail publication-quality figures to me at the address below.

Robert Robinson
National Science Foundation
1800 G Street N. W.
Washington, D. C. 20550

AGU Union Session for the Fall 1993 Meeting:
CEDAR: Past, Present, and Future

At the last CEDAR Workshop in Boulder, we celebrated the tenth anniversary of the combined GBOA/CEDAR Programs. At that time it was also pointed out that CEDAR awards had been made by the National Science Foundation for five consecutive years. To share the results and accomplishments of the CEDAR Program with the community at large, Andrew B. Christensen, Secretary, SPA: Aeronomy Section of AGU was able to arrange a Union session with the above title at the fall meeting in December, 1993. We have organized one invited session to highlight some of the scientific accomplishments and history of CEDAR, elucidate current scientific issues and problems, and describe plans for the future. The program for the invited session is given below. A solicitation for contributed papers has appeared in a recent issue of *Eos*. It is hoped that there will be an enthusiastic response from the community so that there can be additional oral/poster sessions at the AGU fall meeting on this topic, in addition to the invited session. Also of interest to the CEDAR community will be a special session on LTCS/CAT/PRIMO organized jointly by Jeff Forbes, Maura Hagan and Dave Anderson.

AGU Invited CEDAR Session Program

CEDAR: A Success Story	Richard Behnke
CEDAR Studies of Magnetosphere/Ionosphere Coupling	Odile de la Beaujardiére
Imaging Science Contributions to the CEDAR Program	Michael Mendillo
CEDAR Contributions to Resonance Fluorescence Lidar Studies of the Chemistry and Dynamics of the Mesopause Region	Chester Gardner
The Earth's Summer Polar Mesosphere: An Icy Space Plasma and/or a Marker for Global Change	Michael Kelley
Break	
The Lower Thermosphere and Coupling with Other Atmospheric Regions	Jeff Forbes
The Quasi Two-Day Wave: Impacts on the Global Circulation in the Upper Atmosphere	Susan Avery
Global Change Influences on the Upper Atmosphere	Ray Roble
Interactions Between Chemical, Dynamical, and Radiative Processes in the Middle Atmosphere	Guy Brasseur and A. K. Smith
Remote Sensing of the Upper Atmosphere from Ground and Space: CEDAR and TIMED	Timothy Killeen

We understand from Andy Christensen that this is the first Union session for the SPA: Aeronomy Section. We hope participation by our large community of CEDAR scientists and students will make it very successful, indeed.

Sunanda Basu, NSF

FY 1993 CEDAR Awards

In FY 1993, NSF received 47 CEDAR proposals requesting over $4M. The amount of funding available was about $1.3M. As in past years, the FY 1993 CEDAR proposals were first reviewed by mail, then discussed and ranked by a panel of experts. The panel met on February 16 and 17, 1993, and consisted of 11 senior scientists, all with a deep understanding of the CEDAR program. Robert Robinson and Sunanda Basu, Program Directors for Upper Atmosphere Facilities and Aeronomy, respectively, were present, as was Richard Behnke. They provided program information as requested by the panel throughout the discussions.

Each proposal was discussed at length on Tuesday. On Wednesday each proposal was briefly reviewed and where appropriate, suggestions were made for narrowing objectives and adjusting budgets to better meet program goals and budget constraints. A ranked list was prepared and adjusted for consistency and balance relative to CEDAR goals.

In the final analysis, 21 proposals were funded. These are listed in the accompanying chart on page 9. Almost all of these proposals were reduced from the original request. A histogram of the size of the awards is shown in Figure 1. The peak (11 awards) was once again in the $25,000 to $50,000 range as it was for FY 1992.

Richard Behnke, NSF
Michael C. Kelley, Cornell University

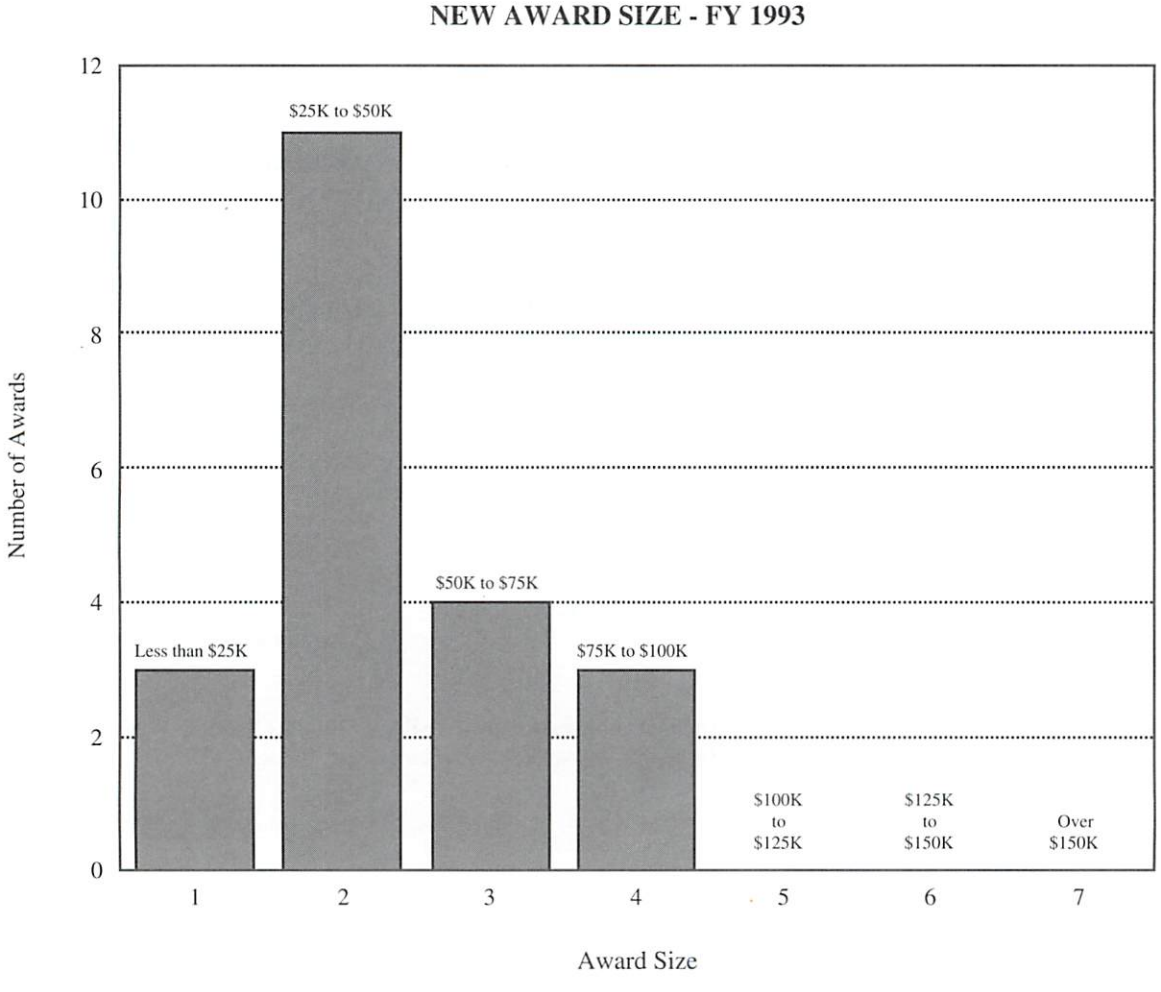

Figure 1

List of New FY 93 CEDAR Awards

Patrick J. Espy
Utah State University
ANLC-93: Aircraft-Borne and Ground-Based Hydroxyl and NLC Measurements of Small and Large-Scale Dynamics in the Polar Summer Mesosphere

John C. Foster
Massachusetts Institute of Technology
Former Soviet Union Visiting Scientist Program at Millstone Hill

David C. Fritts
University of Colorado
Dynamic Studies in Support of CADRE and ALOHA-93 with an MF Radar in Hawaii

Joseph R. Isler
University of Colorado
Three Dimensional Modeling of Gravity Waves and Airglow

J. D. Kelly
SRI International
Early Polar Cap Observatory

Robert B. Kerr
Boston University
Broad-Band, High Spectral Resolution Spectrometers for CEDAR Facilities

Timothy L. Killeen
University of Michigan
Mid-Latitude Long-Term Mesospheric and Lower Thermospheric Dynamics Measurements from a Mid-Latitude Site at Peach Mountain

Delores J. Knipp
US Air Force Academy
Mapping Conjugate and Non-Conjugate Convection Response Dating Equinox Intervals

Stephen B. Mende
Lockheed Missile Corporation
Auroral and Atmospheric Dynamics in the Polar Cap

Robert D. Palmer
University of Nebraska, Lincoln
Vertical Velocity Measurements in the Mesosphere: Biases and Possible Solutions Using Spatial Interferometry

Helen Parish
Boston University
Effects of Penetrating Electric Fields and Planetary Waves on the Equatorial Ionosphere

Chiao-Yao She
Colorado State University
Vapor Filters: Developing New Measurement Capabilities for Narrowband Na Lidar

Roger W. Smith
University of Alaska
The Longyearbyen Optical Station

Jan J. Sojka
Utah State University
Analysis of CEDAR-HLPS Polar Cap Arc Observations Using Model Observation Comparison Techniques

Gary R. Swenson
Lockheed Missile Corporation
ALOHA/ANLC-93; Airglow Imaging Studies

M. J. Taylor
Utah State University
An Investigation of the Properties and Sources of Small-Scale Gravity Waves at Low Latitudes as Part of the ALOHA-93/ CADRE Campaigns

Douglas G. Torr
University of Alabama
A Program to Fabricate a Phase III Class I Spectrometric Facility for a CEDAR Observatory

Brenton J. Watkins
University of Alaska
Student Lab Access to Experiments at Sondrestrom, Greenland

Vincent B. Wickwar
Utah State University
Bear Lake Observatory: A Mid-Latitude CEDAR Facility for Middle and Upper Atmosphere Studies

Thomas D. Wilkerson
University of Maryland
Vincent B. Wickwar
Utah State University
John W. Meriwether
Clemson University
Lidar Studies of Middle Atmosphere Dynamics

Jeng-Hwa Yee
Johns Hopkins University
Airglow Temperature/Brightness Observations for the ALOHA/ ANLC 1993 Campaign

CEDAR Post-Doctoral Awards

The Aeronomy and Upper Atmospheric Facilities Program of the Division of Atmospheric Sciences of the National Science Foundation plans to make two or more post-doctoral awards within the Coupling Energetics and Dynamics of Atmospheric Regions (CEDAR) initiative. The types of studies the successful candidates will be expected to perform include: analyzing existing CEDAR campaign data, taking an active role in an ongoing CEDAR campaign, coordinating the community in helping develop a new CEDAR campaign, developing hardware/software of interest to the CEDAR community of scientists, and developing instrumentation pertinent to CEDAR. The demonstrated abilities to be self-starting and to work independently will be important selection criteria.

The tenure of these awards may be at the institution or facility of the applicant's choice. The candidates will be expected to provide a short proposal including a brief (3 pages or less) description of the type of CEDAR-related research to be carried out. In addition to the standard NSF proposal forms, a letter indicating the host institution or facility's interest and commitment to this CEDAR award must be included, along with two letters of recommendation, an abstract of the candidate's doctoral thesis, and a transcript of course work. Applications will be reviewed by the CEDAR Science Steering Committee with a final selection made by the AER and UAF program officers.

The awards will be for **two** years at a stipend level of $36,000. per year. An additional amount of approximately $9,000. will be provided toward employee benefits and institutional overhead. If cost sharing possibilities exist at the host institution, through an existing NSF grant, for example, this should be mentioned in a cover letter accompanying the proposal. Such possibilities will not be taken into account in ranking the proposals but may be considered in maximizing the effect of the available resources. All proposals should be sent to either the Aeronomy or Upper Atmospheric Facilities programs by **January 14, 1994**. Questions regarding these awards can be addressed to:

Dr. Sunanda Basu
Division of Atmospheric Sciences
Aeronomy Program
National Science Foundation
1800 G Street, NW
Washington, DC 20550
(202) 357-7619

Dr. Robert Robinson
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In contrast to previous years, there will be no separate award for an NCAR CEDAR post-doctoral position. However, candidates may still designate NCAR as the institution at which the research is to be conducted.

Arecibo ATM Group Staffing

Dr. John Cho joined the Arecibo Atmospheric Science Group in the spring of 1993. His thesis work at Cornell dealt with radar observations of the Polar Summer Mesosphere. At Arecibo he will turn to the study of the stratosphere using the unique capabilities of the radar system at Arecibo. Sixto Gonzales has accepted an offer at Arecibo and will join the group this fall after completing his thesis at Utah State. Sixto will emphasize radar studies of the protonosphere at Arecibo.

A post-doctoral position is under advertisement (see page 11).

Post-Doctoral Fellow Position
Arecibo Observatory

A post-doctoral position in the area of atmospheric science is currently open at the Arecibo Observatory in Puerto Rico. This would be a two-year appointment with a possible renewal for a third year. The flexible start date for this position can be as early as the beginning of 1994 or as late as the summer of that year. Applicants should have a recent doctoral degree in atmospheric science or in a related engineering field and have the ability to pursue independent research. As a member of the Atmospheric Sciences Group at Arecibo, the successful candidate would also be expected to occasionally aid visiting observers in his or her area of specialty, and to help define and implement improvements in instrumentation and procedures.

We will consider applications in all specialized areas of atmospheric research. However, specific areas in which we are most interested in reinforcing our capabilities at Arecibo are: studies of the F- and E-region ionosphere and thermosphere utilizing combined incoherent scatter radar and passive optical sensors, active experiments employing the HF facility for ionospheric modification, and high altitude protonospheric investigations using UHF and VHF radars. An experimental background in multiple remote sensing techniques, such as radar and optics, would be advantageous.

Applicants should send a resume including a list of publications, the names of three references, and a summary of the type of research activity that would be conducted at Arecibo. The application deadline is **December 15, 1993**. Send your material to:

Office of the Director
NAIC Space Sciences Building
Cornell University
Ithaca, NY 14853-6801

NAIC is operated by Cornell University under a cooperative agreement with the National Science Foundation. EOE/AAF.

Post-Doctoral Fellow Position
Utah State University

The Center for Atmospheric and Space Sciences of Utah State University has a post-doctoral position open for a recent Ph.D. with a strong background in aeronomy, particularly pertaining to the E and F regions, and to the thermosphere. The position involves a range of activities, including the analysis of incoherent-scatter radar data for geophysical parameters, comparisons of observations and model calculations, and radar experiments. Familiarity with incoherent-scatter radars and the analysis of their data would be advantageous. Please send a letter stating interest and pertinent background, a resume, and the names, addresses, and telephone numbers of three references to:

Vincent B. Wickwar
Center for Atmospheric and Space Sciences
Utah State University
Logan, UT 84322-4405

Phone: (801) 750-2962
Fax: (801) 750-2992
e-mail: shawna@logan.cass.usu.edu

Review of applications began August 6, 1993. Position open until filled. The salary is commensurate with qualifications.

Utah State University is an Affirmative Action/Equal Opportunity employer.

The Cedar Post

Dr. Michael C. Kelley
School of Electrical Engineering
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Ithaca, NY 14853

Address correction requested.

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