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# Volume 31

# **MR. KELLEY GOES TO CONGRESS!**

Editor's note: As part of the congressional review and approval process for the National Science Foundation's FY'98 budget, Professor Michael Kelley appeared as an expert witness on behalf of the proposed Polar Cap Observatory (PCO). While his formal prepared text was submitted in advance, we reproduce here a transcript of the more informal oral statement delivered on April 9, 1997. It captures the more animated, enthusiastic and spirited style we associate with any interaction with Mike Kelley, whether scientific or athletic!

### Statement of Dr. Michael Kelley, Professor of Electrical Engineering Cornell University, Ithaca, New York

Dr. Kelley: Thank you very much.

I'm pleased to make this testimony on behalf of the so-called Polar Cap Observatory. This program evolved out of very much a grassroots effort which began at the peak of the last solar cycle. A group of scientists, close to a hundred, got together and wrote a document which I've entered as part of my testimony, concerning what scientific advantages there would be to the U.S. and international partners if we had an observatory deep in the earth's polar region.

There are four facilities now in the so-called upper atmosphere facility chain by the National Science Foundation. There's one near Lima, Peru; one in Arecibo, Puerto Rico; one near Boston, Massachusetts; and one in Greenland. These stretch roughly along the 75th meridian, and it's clear that as we went through the last solar maximum, that we really deeply need an observatory right in the earth's polar cap.

These observatories are what I call portholes on spaceship earth. They have instruments that can do remote sensing upside down; that can look from the earth out into space. The way we do it primarily is to send up a signal, or different types of signals, and then wait for them to come back, scattered off the medium. Particularly high power radars that grew out of radar research in World War II have been built at every one of these facilities. These allow us to probe deep into space, thousand of kilometers out into the near-space regions of the earth.

The reasons we need to go into the polar cap are many, and they're outlined here. One thing is, as I look to my right, this picture

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of the sun exploding a tremendous solar flare. We live close to a very dangerous stellar body, and as we approach the next solar maximum we're going to find out in reality how dangerous it is, with the amount of space assets we'll have this time around.

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The earth is really embedded in the sun's upper atmosphere. It blows by the earth at hundreds of miles per second, carrying tremendous energy. And we have a magnetic shield, fortunately for life on earth. But this is not perfect. About 1 percent of the energy that hits the front of the earth's magnetosphere actually gets into the atmosphere, focused in the polar regions.

It first comes in right over the polar caps, both north and south. It's almost like a hurricane in the thermosphere and ionosphere. And Resolute Bay, which is our location of greatest interest for this observatory, is right in the center of it. This energy that's poured into our atmosphere and sets it in motion, and creates magnificent auroras in the polar cap, structures that affect communications, many very interesting phenomena. So our main interest has been the very upper atmosphere, and how we can look deep into space from such an observatory.

There are other aspects of the polar Arctic. The highest clouds on earth form in the summer in the polar mesosphere. These clouds form at the coldest part of the earth's atmosphere, 180 degrees below zero centigrade, 100 degrees Kelvin.

It seems that these clouds were not here prior to this century. They could be an incredibly accurate marker for global change. As the earth's lower atmosphere warms up, the upper atmosphere cools, and you can form these clouds when there should be no clouds at all. These clouds exist fifty miles high, and they're getting more common all through this century.

This observatory would sit right in the middle of this region and give us a chance over many, possibly even several, decades of observing the development and possible mitigation of such clouds.

The polar vortex, the ozone hole in terms of the northern hemisphere--this is a very important aspect of the research we'd like to carry out there. This also is a unique place where one can do the science.

The more practical side of what we might do at the polar cap involves the national space weather program, something you may have heard about or maybe you will hear about. It's a partnership between NSF and the DoD to try and give us some predictive capability about space weather.

This January, we had a tremendous solar event that even got on CBS News with Dan Rather. Within a day, the Telstar 401 spacecraft winked out. That's a hundreds of million dollar spacecraft, no longer to be heard from.

A lot of us think that the so-called killer electrons caused this outage. The whole province of Quebec went out for 16 hours in the last solar maximum. So we're looking at major impacts on humanity, and the polar cap observatory sits right where the action is, so to speak. The first action occurs where this energy gets focused. It's sort of a bullseye in the center of the polar cap.

From the scientific aspects, I'd like to turn to educational. I'm a full professor at Cornell, and yet I teach freshman calculus, and I have freshman advisees who are, this very day, using instruments at one of these NSF chains, particularly the one at Arecibo that's operated by Cornell University. They're able, on the Internet, to actually control and operate a camera, a very expensive camera, and bring the data, downlink the data, analyze the data. These are freshman, and they're really doing a terrific job.

And that's what we want to build here. We want to make this virtual observatory. It's in Cornwallis Island, Resolute Bay. There's not much population up there, although there are two flights a week. That's one reason we chose it.

But we'll be able to tune in to this station as if it was next door, and that's the way we want to do. We want to start a new type of way of doing business with this observatory as the first.

We have partnerships I want to talk about with NASA. NASA has a fleet of spacecraft call ISTP that we certainly hope this committee recognizes as being important for the solar maximum, to keep this billion-dollar asset functioning.

NASA's launching TIMED in the year 2000. That's an important spacecraft for studying the near-earth space, upper atmosphere, thermosphere, ionosphere, mesosphere, and electrodynamics. We want to be up when TIMED is up, and vice versa.

In terms of international aspects, we certainly have very strong partnerships with Canadian scientists. Nine Canadian scientists contributed to this report. We've got letters from the Canadian Network for Space Research. The Canadian Space Agency is helping us very much. Canada has already invested scientific instruments in Resolute Bay. I believe this will be the beginning of a tremendous partnership in space science.

We think we can essentially be a low-earth orbiting spacecraft, say 20 feet above the ground. We can be there for 20 years. We can be serviced by commercial aircraft. We can have students--hundreds, maybe thousands of people involved in using this facility over its lifetime. Arecibo is still a state-of-the-art observatory run by Cornell 40 years after it was built.

It's a tremendous chance, for less than the cost of a modest spacecraft mission, and we sure hope we can do it. Thank you.

# New CEDAR Science Steering Committee (CSSC)

At the conclusion of this year's meeting, Cassandra Fesen, John Holt, Robert Kerr, Gary Swenson and Paul Castleberg completed their terms on the committee. We are indebted to them for their leadership, service and commitment during the past three years.

We welcome Maura Hagan, Michael Hickey, Chiao-Yao (Joe) She and Michael Sulzer as new members of the committee. Julie Chang (Colorado) replaces Paul Castleberg (Cornell) as student representative. As our second international member, we welcome Anthony Van Eyken.

Listed below are the names and addresses of the current CSSC members for the 1997-98. You are invited to contact any of these individuals as a means of bringing matters to the attention of the CSSC committee.

#### **Professor Roderick Heelis**

Center for Space Physics University of Texas at Dallas Richardson, TX 75083 (214)690-2851 heelis@utdallas.edu

#### Dr. Maura Hagan

NCAR High Altitude Observatory PO BOX 3000 Boulder, CO 80307-3000 (303)497-1537 hagan@ucar.edu

#### Dr. Michael P. Hickey

University of Alabama, Huntsville OB 344/OAL 301 Sparkman Drive Hunstville, AL 35899 (205)890-6238 x344 hickeym@cspar.uah.edu

#### Professor David Hysell

Department of Physics Clemson University 205 Kinard Laboratory Clemson, SC 29634 (864)656-4349 daveh@vlasov.phys.clemson.edu

#### **Professor Michael Mendillo**

Boston University Center for Space Physics 725 Commonwealth Avenue Boston, MA 02215 (617)353-2629 mendillo@buasta.bu.edu

#### Dr. Joseph Salah CSSC Chairman MIT/Haystack Observatory Off Route 40 Westford, MA 01886 (617)981-5411 jes@wells.haystack.edu

#### Professor Gordon Shephard

Department of Physics York University 4700 Keele Street Downsview, Ontario Canada, M3J 1P3 (416)736-5247 gordon@windii.yorku.ca

#### Dr. Chiao-Yao (Joe) She

Colorado State University Physics Department Fort Collins, CO 80523 (970)491-6261 joeshe@lamar.colorado.edu

#### Dr. Michael Sulzer

NAIC/Arecibo Observatory PO BOX 995 Arecibo, PR 00613-0995 (787)8782612 msulzer@naic.edu

#### Dr. Michael Taylor

Space Dynamics Laboratory Utah State University Logan, UT 83422 taylor@psi.sci.sdl.usu.edu

#### Dr. Anthony Van Eyken

EISCAT Scientific Association Ramfjordmoen N-9027 Ramfjordbotn ,Norway 47-77692166 tony@eiscat.uit.no

#### Ms. Julie Chang

University of Colorado CIRES Campus Box 216 Boulder, CO 80309-0216 (303)492-4290 changJ@boulder.colorado.edu

#### Dr. Sunanda Basu ex officio

Program Director: Aeronomy National Science Foundation GEO/ATM Room 790 4201 Wilson Boulevard Arlington, VA 22230 (703)306-1529 sbasu@nsf.gov

#### Dr. Robert Robinson ex officio

Program Director Upper Atmospheric Facilities National Science Foundation GEO/ATM Room 790 4201 Wilson Boulevard Arlington, VA 22230 (703)306-1531 rmrobins@nsf.gov

### 1997 CEDAR Workshop

### University of Colorado June 8-13, 1997 Barbara Emery, HAO/NCAR

The 1997 CEDAR Workshop was held between Sunday, June 8, and Friday, June 13, at the University of Colorado in Boulder. A total of 300 persons from 75 institutions, 14 outside the United States and Puerto Rico, attended the CEDAR Workshop. This is an increase of 11% in participants and 17% in institutions over last year. The increase was about the same for both students and non-students. This year, 118 students came from 31 universities and 5 research labs, including one student each from Canada, Spain, Argentina and the United Kingdom, and 3 students from Taiwan. There were a total of 45 universities represented at the Workshop and 30 research laboratories, including 9 small businesses, which was a 50% increase in attendance over last year.

The CEDAR Prize lecture was given by Bela Fejer of Utah State University on "Multi-Instrument Studies of lonospheric Electrodynamics" using incoherent scatter radar ion drift data from Jicamarca and Arecibo. Henry Rishbeth of the University of Southampton gave a tutorial on "Winds and Composition in the Thermosphere", while Supriya Chakrabarti of Boston University gave a tutorial on "Daytime Optical Aeronomy". Two tutorials were followed by panel discussions. The most animated discussion occurred with the panel on parameterization of gravity wave theories that followed the tutorial by Charles McLandress of the University of Washington on "Gravity Waves: Their Importance in the Middle Atmosphere and their Parameterization in General Circulation Models." The other panel discussion followed the tutorial by Roger Smith of the University of Alaska on "The Observation and Interpretation of Vertical Winds in the Mesosphere and Thermosphere." Hard copies of the transparencies are available, as are video tapes of these talks. Please contact Barbara Emery (emery@ncar.ucar.edu, HAO/NCAR, PO Box 3000, Boulder CO 80307) if interested in obtaining copies.

This year, there were 7 science highlight talks by members of the community, and 10 briefings on various programs. There were 18 workshops, which are reviewed elsewhere in this issue. The fourth annual student workshop was all day on Sunday and was organized by Bob Henson, a science writer at the National Center for Atmospheric Research (NCAR), and Paul Castleberg, the CEDAR Student Representative. The workshop addressed communicating science better to the public. About 90 came, of which about 80% were students. A follow-on to this workshop was the compilation and judging of press releases of student posters. Ten students wrote press releases which were judged by 3 science writers from NCAR. Two press releases, the grand prize by Andrew Stephan of Boston University, and the first prize by Onder Kivanc of the University of Texas at Dallas, were judged to be good enough to be released to the public with no changes. The second and third prizes went to Rosemary Rollason of the University of East Anglia and Karen Remick of the University of Alaska, respectively.

The annual poster session was held in 3 rooms of the Coors Events Center at the University of Colorado. The posters were arranged in 5 topics, and judged by 10 judges, 2 in each topic. There were 16 more posters than last year, 2 by students, and 14 by non-students.

The 1998 CEDAR Workshop will be held at the University of Colorado between Sunday, June 7, and Saturday, June 13, 1998. This precedes the GEM Workshop to be held at Snowmass June 15-19. The weekend in-between (June 13-14), will be explored as a time to have a joint CEDAR/GEM/SHINE space weather meeting. A joint meeting was not held this year because of various special space weather sessions at other meetings just before the CEDAR Workshop.



#### Title: 1997 CEDAR Poster Session

Date: Wednesday, June 11 Convener: D. Hysell Attendance: Plenary Session

A familiar component of the annual CEDAR workshop is the poster session, a venue allowing students and non-students alike to present their latest research results in a setting somewhat more structured than the usual workshops. Being scheduled so as not to conflict with other sessions (and being collocated with the annual buffet), the poster session is one of the best attended at CEDAR. This promotes interaction and collaboration between participants and passers-by and gives many students their first exposure to the community they have chosen to join.

Sixty-seven posters from thirty-two institutions were presented at this year's session, of which fortyfour were presented by students (including two by undergraduates). Participation was international, with contributors from Canada, England, Japan, Peru, Russia, Spain, and Taiwan. Among the topics addressed were ground-based remote sensing of processes in the atmosphere and ionosphere (using coherent and incoherent scatter radar, all sky imagers and spectrometers, optical interferometers, and lidar). along with remote sensing and in-situ measurements made from spacecraft. The plurality of the posters fell into the area of theory and modeling and included geomagnetic model-data comparisons. storm modeling, models of ionospheric irregularities and electrodynamics, gravity wave and tidal models, and laboratory studies. All latitude regimes were addressed, as were all altitude regimes between the middle atmosphere and the magnetosphere.

Prizes were awarded for the best student poster presentation on the basis of scientific content, presenter's knowledge, relevance to CEDAR themes, and overall presentation. First prize went to Farzad Kamalabadi from Boston University for his poster entitled "Space-based ionospheric remote sensing using tomographic inversion of radiative recombinative EUV sources." Second prize went to Ligun Zhou from Utah State University for "Modeling and model-data comparisons of the evening peak of the ionospheric F region electron density over Millstone Hill Observatory." Third prize was awarded to Gregory Fall from the University of Michigan for "Relating HRDI airglow imagery to critical level filtering of internal gravity waves." Honorable mention was given to Rosemary Rollason from the University of East Anglia for "Laboratory studies of the mesospheric chemistry of iron" and to Laura Peticolas from The University of Alaska-Fairbanks for "Thin auroral arcs: Their formation and signatures in the ionosphere."

#### Title: CEDAR Storm Study Workshop

Date: Friday, June 13 Convener: M. Buonsanto Attendance: ~40

This was the 15th in a series of CEDAR Storm Workshops/Sessions held since 1990. Speakers described progress on projects dealing with all 5 CEDAR Storm Study intervals: (1) March 16-23, 1990 (2) June 5-14, 1991 (3) November 3-11, 1993 (4) May 1-5, 1995 (5) January 6-11, 1997

The project reports dealt with the following topics including: importance of taking into account small scale variability of electric fields in first-principle modeling; the value of TEC maps from TOPEX/Poseidon and GPS in following the changes in ionospheric electron density as well as irregularities during storms; how the FLIP model can be constrained using the observed hmF2, NmF2, and Te at 600 km to better reproduce the observed electron density profiles; the continuing controversy over the possible importance of vibrationally excited species: AMIE analyses and attempts to validate the TIEGCM: positive and negative storm effects as seen in ionosonde data from the Australian sector: simulations of high latitude storm effects from the Univ. of Alaska Fairbanks ionospheric model; radar chain studies of storm intervals which help explain storm-time wind and electric field effects which penetrate from the auroral zone to the equator; optical tomographic imaging; particle heating as a possible source for elevated electron temperature at mid-latitude; and POLAR UVI images which showed the auroral response major events.

Future plans for the CEDAR Storm Study were then discussed. First, special sections of major journals were brought to the attention of the participants:

- 1. November 1993 Event, JGR, deadline June 30, 1997.
- 2. January 1997 ISTP Sun-Earth Connections Event GRL, deadline Sept. 15, 1997.
- 3. Thermosphere/Ionosphere Storms (emphasis on Jan. 1997 event) JASTP, deadline Jan. 10, 1998.

We confirmed the decision made at the March 1997 workshop at Millstone Hill to request a special session on ionosphere/thermosphere storms to be held at the Fall AGU meeting Dec. 8-12, 1997, in San Francisco. This will be an SA session, joint with SM. This special session has been approved by AGU and designated SA-01. We also decided to hold an informal (2-hr session) at the Fall AGU to enable substantive discussions which will supplement the formal presentations at the meeting.

John Foster, as coordinator of the WLS (Wide Area Substorm) campaign, presented his suggestion

that the April 10-11,1997, WLS/UARC/ISTP event be designated as a CEDAR Storm Study period. While WLS (Workshop Report, this issue) focuses on coordinated data acquisition and small-scale responses of the ionosphere to substorms, John felt that the major event which occurred on April 10-11, 1997, would be an excellent event for the CEDAR Storm Study to take on, as the focus of our group is on retrospective analysis of storm intervals. John briefly summarized some of the excellent data taken during this campaign. Participants at the workshop then agreed to adopt this period as a CEDAR Storm Study interval. The first step in the study of this event will be for participants to examine their data and be prepared to report on it at the informal meeting in San Francisco. At that time specific projects dealing with this event will be identified.

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#### Title: Incoherent Scatter Radars Workshop

Convener: D. T. Farley Date: Monday, June 9

Attendance: Several hundred (Plenary Session)

This year we did not have separate workshops for each IS radar facility. Instead, this 4-hour "workshop" was more of a tutorial session for the entire CEDAR community. The aim was to describe, to non-radar specialists, what the observatories can do and how they do it, and further, what the trade-offs and limitations of the various modes of operation are. The radars differ from one another in size, operational modes, sensitivity, frequency, and latitude. The Workshop began with a general overview of incoherent scatter probing, followed by presentations on five ISR observatories: Millstone Hill, Sondre Stromfjord, EISCAT, Arecibo, and Jicamarca. We concluded the workshop with a panel discussion dealing with comparisons between neutral F-region temperatures determined by Fabry-Perot interferometer airglow measurements and plasma temperatures measured by radar. Some comparisons seem to agree pretty well and others do not, with differences of as much as one hundred degrees. Calibrating the FPI data is far from simple, it turns out, and more work on this is planned for the near future. Overall, I think this Workshop achieved its goals pretty well. It probably does not make sense to keep this same format every year, however.

#### Title: MSX 1997 CEDAR Workshop Review

Date: Monday,June 9 Convener: Jerry Romick Attendance: ~ 50

The DoD-BMDO sponsored Midcourse Space Experiment (MSX) satellite was launched in April, 1996. Phase I operation through the end of the cryogen life ended at the end of Feb. 1997. During Phase I over 2 Tbytes of data were collected. About half of the data was collected on earth backgrounds with the SPIRIT III infrared instrument and the UVISI visible and ultraviolet instrument.

Jerry Romick started the workshop with a brief overview of the program and a report on the healthy status of the spacecraft and Phase 2 current UV Visible operation. He reported that additional PMC, day and night limb, nadir airglow observations, observations over the Antarctic Superdarn Radar sites and continued stellar observations are planned for this summer through the end of this fiscal year.

Sam Yee presented some of the data taken during a Stellar occultation event and showed retrieval of molecular oxygen and ozone densities, and various airglow and auroral emissions that were seen in the background. As an example, he discussed briefly the capabilities of measuring all the components necessary in order to unambiguously determine the branching ratio in the O(1D) + O<sub>2</sub> reaction.

Doug Strickland described the auroral data in the UV and Visible for a data collection event that occurred on 10 Nov 96. He showed various emissions associated with the particle precipitation and the initial deduction of the characteristic particle energy and flux for both electrons and protons whose characteristic signatures were observed. Infrared data was also obtained on this event and a number of talks at the Spring AGU reported on these data.

Jerry Romick showed Polar Mesospheric cloud data obtained in July 1996 in the 70 to 84 N latitude region. He showed both UV images and some spectra as well as some of the Infrared data taken and showed that they occurred in the same region. The IR analysts feel confident that they can come up with a temperature associated with these cloud observations. He also showed a video of the UV PMC images and another video of auroral images

Bob Sears presented some of the early results on structure in the airglow and some of the Infrared 4.3 micron observations of waves coming from the 40 km region.

Ed Dewan followed this with a brief discussion of how the circular wave structure that was observed can be shown to originate from weather systems in the Troposphere.

Mike Taylor showed some of the different types of Infrared data that were taken on MSX and then presented a review of some of the ground data taken

at Poker Flat and Bear Lake during MSX data collection events. There were all sky images of aurora, sodium lidar, as well as airglow wave structures. FPI wind observation also exist at Poker Flat and Bear Lake Observatory for some dates.

Mike Kendra prepared a poster showing MSX target point tracks over the various ground sites and set this up in the front of the room. He also distributed handouts about the MSX program and instruments.

After these presentations there was a general discussion of how to proceed with arranging coordinated analyses between people that have ground or satellite data during MSX data collection events. The consensus was that a list of events, times and locations for the different MSX data collection events be accessible through the CEDAR Data base system for people to reference. Those events known to be coordinated with specific ground station or satellite operation should be noted. Anyone that has data was encouraged to contact any of the MSX participants (Romick and O'Neil for general MSX involvement and specifically Romick for PMC's, Yee for Stellar Occultation & airglow emissions, Strickland UV/Visible Aurora, O'Neil for IR data in general, Sears and Dewan for Clutter and Structure, Taylor for ground coordination and Kendra for event geometry). Initial periods of high auroral interest were Nov. 10,1996, Jan. 6-14,1997, and Feb. 6-14, 1996.

All those planning future campaigns that have an interest in MSX observations please contact Jerry Romick. At this time there is nothing definite about funding for the continued operation of the spacecraft after this fiscal year. However, if it is continued then there will be some opportunities for coordinated observations, especially if they are planned well ahead of time.

We need to concentrate on specific time intervals and events because of limited funding for the analysis of the satellite data, so all those with data that want to become involved in the coordinated analyses please get in touch with any of the above mentioned people. The plan will be to devote the next MSX CEDAR workshop to detailed discussion of the coordinated data and planning for publication, etc. Hopefully by the publication of this report the MSX event list will be available through the CEDAR web site either directly or as a link to another URL.

#### Title: TIMED 1997 CEDAR Workshop

Conveners: Sam Yee, Geoff Crowley, Miquel Larson, and Mike Hickey

Date: Tuesday, June 10

Attendance: 100

A TIMED workshop was conducted at CEDAR 1997 to provide a forum for discussion of the most effective ways in which the TIMED and CEDAR programs can support each other. Sam Yee started the workshop with a brief overview of the TIMED mission and its synergy with the CEDAR science goals. The workshop built on the previous workshop held April 1-2 in Ellicott City, MD. Summaries of the findings from the four subgroups formed in the April workshops were given by each of the subgroup leaders: (1) intercomparisons of measurements of geophysical parameters (Steve Franke); (2) largescale waves and dynamics (Miquel Larson); (3) small scale waves and dynamics (Mike Hickey); (4) ionneutral coupling processes (Geoff Crowley).

Summary reports of each subgroup efforts and information regarding TIMED mission, instrumentation, and interdisciplinary investigations were distributed at the workshop. Sam Yee also gave the WWW cite address (http://sd-www.jhuapl.edu/ TIMED/news.html) from which people can obtain additional information regarding TIMED.

After the subgroup reports, the workshop was divided into three subgroup meetings concentrating on the large-scale dynamics, small-scale dynamics, and ionneutral interactions. The reports from each of the subgroups contained a large amount of detailed information too extensive for this report, but they can be found in full text at the TIMED WEB site. At the plenary session after the subgroup meetings, Sam Yee suggested that the next joint TIMED/CEDAR workshop to be conducted in October 14-16, 1997, at APL. He also announced that an open meeting on TIMED was scheduled during the IAGA meeting at 8 p.m. on Aug. 11 in HSC 2.

# Title: Advanced Research Global Observing Satellite (ARGOS)

Conveners: A. Nicholas (NRL) and R. McCoy (ONR) Date: Friday, June 13 Attendance: 25-30

The intent of the ARGOS workshop was to familiarize the CEDAR community with the types of observations which the instrumentation onboard ARGOS will be making next year, and to address the CEDAR related science goals of the mission. A thorough yet concise overview of the instrumentation was presented followed by a presentation of the aeronomy science goals. Discussion topics and questions from the participants during the session were well thought and numerous. There was interest in: collaboration of different ground receiver chains for the Beacon experiment (radio ionospheric tomography), using the imagers (GIMI, EUVIP) to observe gravity waves methods of retrieving ionospheric densities from limb profile intensities. validation of these methods, including the use of other models observing the NO nightglow (overlapping groundbased and ARGOS measurements), emphasis on the need for more results on neutral densities for space weather simulations

Several participants requested copies of the material presented at the workshop. In my opinion the workshop was very successful.

Questions and/or comments are welcome. <nicholas@uap.nrl.navy.mil>

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Title: ARECIBO HIGH ALTITUDE Workshop

Conveners: S A Gonza'lez and M P Sulzer Date: Tuesday, June 10 Attendance: ~ 50

Some highlights of the Arecibo High Altitude (AHA!) Workshop were Rod Heelis' clear presentation of how an RPA functions and Mike Sulzer's description of a novel way of transforming ISR line of sight velocities into vector velocities; the later stirred up heated discussion amongst the audience. Another good discussion focussed on the combination of ISR and GPS TEC measurements for space weather purposes. Finally, the "refreshments" after the workshop were well received by the attendees.

# Title: Lower Thermosphere Coupling Study (LTCS) Workshop

Conveners: C G Fesen and R M Johnson Date: Friday, 13 June Attendance: ~ 40

LTCS was the last workshop of the 1997 CEDAR meeting. In spite of this, attendance was surprisingly strong. Because of time constraints, the topics were limited to two: (1) What projects and studies should be pursued in the short term? (2) Should LTCS modify its goals and mission in the longer term, consistent with the CEDAR Phase III program and new opportunities?

After general discussion, the consensus seemed to be to focus on two campaigns as possible projects in the next year. These are LTCS 10, from August 9-18, 1994, and LTCS 15, from January 6-10, 1997. Contact is being made with the optical, lidar, and UARS community to ascertain the degree of overlap between the various datasets.

In regards to the longer term plans for LTCS (including potentially changing the project name), no firm decisions were made. Sentiment was running towards redirecting efforts beyond defining the climatology of the mesosphere-lower thermosphere region, since a large data set has been collected for that purpose over the last ten years. Suggestions included (a) studies of the causes of the observed tidal variability, (b) preparations for coupling with the TIMED mission, such as developing assimilation models and performing consistency tests between ground-based instruments, (c) investigation of geomagnetic effects in the increasing phase of the solar cycle, (d) collection of long term (low resolution) data sets to study planetary waves and lunar tides, and (e) electrodynamics studies.

Comments and suggestions on new directions for LTCS are sought, especially ideas for a new name for the project! Some ideas appear at the LTCS website (address below). We would like to finalize the new goals and new name for LTCS prior to the next CEDAR meeting where they would be presented to the community. This requires interaction through the LTCS mailing list and the website. A list of participants is posted at the website along with email addresses.

Please contact the conveners for more information; again, ideas and comments are welcome and encouraged!

Cassandra Fesen fesen@tides.utdallas.edu Roberta Johnson rmjohnsn@umich.edu

LTCS website: http://www.dartmouth.edu/~cfesen/ltcs

## Title: Multi-Instrument Studies of the Thermosphere Equatorial Aeronomy

Convener: John W. Meriwether Date: Friday, June 13 Attendance: 35

One of the goals of the session was to develop a plan for the initiation of a series of regular campaigns designed to combine ISR horizontal and vertical drift measurements for the study of ion-neutral coupling with Faraday rotation measurements intended to study the large scale structure of the midnight temperature maximum. Some consensus was developed that such measurements would be desirable to have, especially in light of the transition of the solar flux from minimum levels to maximum levels over the next three years. An effort will be made to combine measurements in this program with World Day measurements scheduled as part of other Otherwise, the measurement periods programs. would extend from 3 pm to 3 am for three to four runs in each season. In the following week, the emphasis would be switched to the Faraday mode. Since then, the question has come up as to whether JULIA might provide the vertical and horizontal drift measurements. We are looking into this guestion, and it seems likely that this will be the ideal means for collecting the desired drift measurements even during the prereversal enhancement periods.

A second topic was a discussion about how to improve the distribution and access to MISETA data. Cassandra Fesen has been developing a MISETA Web page that would have links to the MISETA PIs with results relating to the individual campaigns. It was agreed that this line of development should be pursued more vigorously as such access will speed up the process of producing science analysis and producing publications.

Further discussions focused upon how the expected instrumental improvements for the MISETA instruments can produce better MISETA science. Areas of expected improvements were 1) increased sensitivity for the Arequipa FPI gained through the incorporation of the CCD detector, 2) improved imaging for the Areguipa BU imager achieved through the replacement of the image intensifier with a bare CCD camera, 3) the introduction of GPS receivers into the Ancon spaced scintillation beacon receiver system to observe high frequency scintillations, 4) the introduction of oblique ionosonde reception at Jicamarca to observe the total electron content of both Appleton anomalies to monitor asymmetries caused by trans-hemispheric winds, and 5) the utilization of the greater Arequipa imager sensitivity to deduce (using the ratio of 7774 to 6300 airglow signals) the height of the "brightness wave" region.

e-mail john.meriwether@ces.clemson.edu

#### Title: Science Communication and Community Outreach

Conveners: Bob Henson, UCAR Communications Paul Castleberg, Toyon Research (CEDAR Student Representative)

Date: Sunday, June 8

Attendance: ~ 90, roughly 80% CEDAR students

How can atmospheric scientists get their research communicated to the world at large? This was the question at hand in the 1997 CEDAR student workshop. The day's events were largely interactive, designed to get participants thinking about the challenges in taking science beyond their "in group" of fellow specialists.

One of the main themes was audience: whom are you trying to reach, and what are you trying to tell them? Small groups formed to discuss research topics from their own experience and characterize them in lay terms. In one session, the group explored how the concept of air motion and wind speed might be explained to, and explored by, elementary school students.

Throughout the day, there were presentations and lively discussions on the merits of communicating science to larger audiences, whether it be through the mass media (where a scientist's control of the informational context is limited) or through the World Wide Web (where a scientist can put up a home page as detailed or as informal as one likes).

It was a full day of material with much food for thought. To keep as much time as possible for discussion and interactive exercises, some material was distributed for later reference, such as "Communicating Science News," a guidebook produced for scientists and reporters by the National Association of Science Writers. The students also got a chance to apply their newfound knowledge in the press-release competition held in conjunction with the CEDAR poster competition (see the workshop summary by Barb Emery).

While a few of the student participants expressed skepticism about the importance of broad-based science communication, many (if not most) were enthusiastic participants in the workshop. Our hope as conveners was to get the students thinking about these issues so that they will be better prepared to deal with reporters, visit schools, meet with legislators, or design Web pages once they are working scientists. Judging from the animated discussions and thoughtful questions that surfaced during the workshop, and from the very positive written evaluations they submitted, these participants are well on their way.

# Title: Horizontal Wind Model (HWM) Workshop Summary

Conveners: Douglas P. Drob and J. Michael Picone Date: Thursday, June 12 Attendance: ~35

The Horizontal Wind Model (HWM) is a comprehensive empirical model for horizontal winds in the thermosphere and middle atmosphere based on a number of measurements from a variety of techniques including ground based optical, radar, and satellite measurements (Hedin et al, JATP 58, 13, 1421-1447, 1996). The Naval Research Laboratory (NRL) is currently planning to update the model though ingestion of new and existing data sets, as well as by enhancing model capabilities and parameterizations. The purpose of this CEDAR workshop was to get the community's input on how to best improve the model.

Several suggestions were made by members of the CEDAR community. These dealt with the inclusion of error estimates in the model output and the removal or replacement of problematic data sets. Inclusion of additional parameterizations, such as the semi-annual variation of the diurnal tide, and interannual effects such as the Quasi-Biennial oscillation, were also thought to be important. Among the wealth of available data sets, several sets were identified as significant to the next generation of the model. These comprehensive data sets include: The UARS WINDII and HRDI wind measurements, EISCAT and Millstone Hill ISR measurements, hmF2 derived winds, and a database of MF and Meteor radar measurements. Other data sets include LIDAR and long term FPI measurements.

One stumbling block that still remains is the discrepancy between UARS and ground-based climatologies of the MLT region. Resolution of this issue is vital to the TIMED/CEDAR effort which plans to combine ground-based and satellite measurements into a comprehensive climatology. A recent paper by Wang et al. (JGR 102, 6729-6745, 1997) indicates that reduction of WINDII data by ingestion of raw data into a comprehensive atmospheric parameterization such as HWM significantly reduces the magnitude of derived mean winds and tidal amplitudes. This is more in line with ground-based climatologies. Conversely, FPI wind measurement of the Hydroxly emission at 89 km and LIDAR observations may bring the current ground-based wind climatologies into better agreement with UARS. It is hoped that a careful statistical combination of UARS and groundbased measurements into HWM will lay the foundation for TIMED/CEDAR efforts to develop a comprehensive wind climatology of the MLT.

NRL would also like to thanks the participants of the workshop for their suggestions and willingness to provide data sets. Any contributions are welcome. For more information please contact Dr. Douglas P. Drob (email: drob@uap.nrl.navy.mil, voice: (202) 404-1292)

#### Title: Towards TIMED: The CEDAR Lidar Community Workshop

Date: Wednesday, June 11 Conveners: Jonathan Friedman and Richard Collins Attendance: 50+

The goal of the workshop was to discuss the coordinated science that the CEDAR lidar community can achieve during the TIMED mission. The lidar community has grown significantly since the UARS launch with several new lidar sites having been established, and new lidar techniques having been developed. The TIMED mission provides the opportunity to carry out both single-site studies and coordinated multi-site studies.

The workshop began with student introductions and an overview of workshop goals. There were three initial presentations: (1) a review of the current CEDAR lidar instruments and distribution of sites and discussion of how the community might interact as a chain of lidar observatories distributed over the Americas and Greenland, (2) a review of aeronomy topics that are addressed by lidar and discussion of the role of a community mobile Na temperature lidar system, and (3) a presentation of the unique capabilities of large aperture telescopes for measuring wave-induced momentum and heat fluxes in the mesopause region. The discussion was then opened to the floor. A variety of recent observations were presented and the capabilities of several new lidar systems were discussed in terms of the science goals of the TIMED mission.

#### \*\*\*\*\*

# Title: Accessing the CEDAR Data Base (Hands-On Sessions)

Convener: Roy Barnes (SCD/NCAR) Dates: June 10, 11 and 12 Attendance: 30+

During the conference there were three afternoon workshops. Eight workstations were available at which individual instruction was provided. Handouts described how to start exploring capabilities independently. However, usually the interactive access utility (cmenu) was demonstrated. The cmenu utility produced a summary of available data for campaigns or instruments of interest and a sample data subset was obtained. Some users were strictly interested in model source codes also available via cmenu. Caveats and nuances of data organization were discussed. Occasionally plot utilities were demonstrated. Eight requested logins to further pursue independent data access. Note that (for locations without good internet connectivity) it is still possible to request data subsets to be prepared and mailed. A demo of UARC capabilities was given by Peter Knoop of the University of Michigan on Thursday PM on June 12.

#### Title: SWIFT, Space Weather Ionospheric Forecasting Techniques

Conveners: T. Fuller-Rowell, J. Soika, D. Anderson Date: Thursday, June 12 Attendance: 50 +

SWIFT's forerunner PRIMO (Problems Related to lonospheric Modeling and Observations) was mainly concerned with theoretical modeling of ionospheric climatology. The SWIFT workshop was proposed to move on from this objective and begin to address our understanding of ionospheric "weather." The goal is to determine the research that needs to be done to address issues of "Space Weather" from the perspective of the CEDAR community. Since this was our first meeting it was very much a planning session to discuss the topics which should come under this workshop's umbrella.

About half the time was used for a few speakers to set the stage in terms of "operational needs" and introduce topics to promote discussion. It was clear that there is a strong latitude dependence in the problems or questions to be addressed. For instance, equatorial irregularities pose different problems from mid-latitude variability, that are different again from the high-latitude response to changes in the interplanetary magnetic field (IMF).

The remaining time was devoted to an active and lively discussion by all on the direction in which SWIFT should proceed. We highlighted five possible focus areas. These were:

- 1. To determine the degree and sources of variability of the mid-latitude ionosphere.
- 2. To determine the quality of the modeled response to magnetospheric forcing of the high latitude ionosphere.
- 3. To determine if measurements made at an earlier local time or another longitude can provide a useful forecast for the equatorial ionosphere.
- To determine from satellite drag data, or other sources of neutral atmosphere data, the sensitivity of the thermosphere to weather inputs, and determine the impact for understanding ionospheric variability.
- 5. To determine the temporal and spatial coherence scales in the various regions of the ionosphere.

We propose to circulate to those present a more detailed report of these five focus areas and, based on their response, define maybe two or three research topics to investigate for presentation at SWIFT-2 at CEDAR 1998.

### Title: Wide Latitude Substorm (WLS) Study

Conveners: J C Foster & A van Eyken Date: Wednesday, June 11 Attendees: ~35

The first purpose of the WLS workshop was to review the issues surrounding the use of floatingschedule experiments at the major (ISR) facilities to perform detailed diagnostics of temporally and spatially discrete phenomena, such as substorm characteristics. An initial floating World Day experiment was run on April 8-11, 1997, and the consensus was that this mode of operation did not impose any undue hardship on the scheduling or operations at the facilities. ISR facilities at Sondrestrom, Millstone Hill, Jicamarca, EISCAT, EISCAT/Svalbaard, and Irkutsk ran during the 2-day window and data from all sites have been made available for analysis. Better coordination of the CEDAR optical facilities was requested for future experiments.

The second objective was to provide an overview of the storm-time observations made during the April, '97 WLS experiment with the purpose of interesting further involvement by the CEDAR research community in this interesting, well-documented event. ISTP and UARC campaigns coincided with the WLS experiment and real-time data were monitored by an extensive research community. These data were used to make real-time decisions concerning the continuing of operations through the solar-induced disturbance on April 10-11, 1997. Extensive satellite and groundbased data are available and modeling has begun in the GEM and other communities. The April '97 WLS event was proposed for inclusion in the CEDAR/STORM initiative, as a study interval, and this recommendation was ratified at the subsequent STORM Workshop. This event was presented at the GEM Workshop and has been adopted there for extensive modeling and analysis and as a prime candidate for CEDAR/GEM collaboration.

The third topic of the WLS Workshop consisted of future plans. It was recommended that two 2-day intervals be proposed for the 1998 ISR World Day calendar as 'floating-window' experiments. These are to be run in April and October, 1998. This proposal was ratified by the URSI/ISR scheduling session and these experiments will be included on the 1998 World Day schedule. A further discussion point concerned the need to have a single focal point (coordinator) for such experiments who can keep abreast of the status of instruments and activity and can coordinate the WLS operations. This was felt to be important to avoid confusion and crossed signals as numerous participants might to monitor conditions try independently during future experiments. A follow-on WLS workshop will be requested at the June 1998 CEDAR Workshop.

#### Title: Daytime Optical Aeronomy Workshop Report

Co-conveners: Roger Smith and Jeffrey Baumgardner Date: Thursday, 12 June

Attendance: ~40

This was the first "techniques workshop" on this topic for CEDAR. In the morning tutorial by S. Chakrabarti, science issues and the nature of the observational problems were presented. In the afternoon workshop, the presentations fell into three major categories: Fabry-Perot interferometers; grating spectrographs; and Lidars.

The Lidar presenters were: Joe She (Colorado State); Monica Coakley (Millstone Hill); and Bob States (Univ. of Illinois). Joe She also presented material from Ulf vonZhan (Rostock Univ.) describing daytime measurements from Alomar. Daytime sodium density and temperature data were shown from three operational Lidars, and Monica Coakley described the plans to upgrade the Fire Pond Lidar at Millstone Hill. Questions from the audience were concerned with the frequency stability of the lasers and the type of narrow band filters used on the detectors for daytime measurements.

Speakers describing FPI instruments and observations were: Mark Conde (Univ. of Alaska); Monica Coakley (Millstone Hill), John Noto (Scientific Solutions Inc.), Pallam Raju (Boston University), and Roger Smith (Univ. of Alaska). 6300Å data was shown from instruments located in Antarctica, Millstone Hill, and India. Plans for an all-sky daytime auroral FPI were presented. A new etalon technology using liquid crystals was also described. Questions from the floor concentrated on the issue of the performance of a relatively large bandpass(0.7A) FPI and its ability to measure dayglow intensities against the huge sky background. This was a lively topic during the discussions held at the end of all of the formal presentations.

The last two papers were concerned with how grating spectrographs could be used to measure the intensity of the 6300A dayglow. The speakers were: Wesley Swift (Univ. of Alabama), and Jeff Baumgardner (Boston Univ.). After these presentations, the discussion centered on the ability to measure small signals against verv large backgrounds. The statement was made that in the case of the 6300Å line, no improvement in the signal to noise was likely to be gained by narrowing the bandpass to much less than 0.05A...the width of the line. A statistical argument was presented that showed that if one only considers photon statistics, the SNR is a function of the number of photons measured and not dependent on the bandpass used. Those who have actually measured daytime 6300A made a case for the fact that one has to measure the underlying scattered solar spectrum very accurately in order to subtract the right amount from the total signal. It was pointed out that this scattered solar

spectrum was slightly different from a scaled direct solar spectrum, and that this is where the higher resolution instruments will have an advantage.

No definite plans were made at the end of the discussion period to re-convene this workshop at the next CEDAR meeting. Given the unique set of issues facing both active (i.e., Lidar) techniques and passive techniques, it probably would be more productive to convene separate workshops if only technical rather than science issues are to be addressed.

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### Title: Sporadic-E Workshop

Convenor: Robert Pfaff Date: Thursday, 12 June Attendance: ~30

The Sporadic-E workshop brought together discussions and informal presentations on neutralplasma coupling associated with intense ionization layers at E-region altitudes at mid-latitudes. Plasma irregularities associated with such layers were featured in many of the science discussions.

The majority of the meeting consisted of presentations of recent results from the SEEK rocket campaign which took place in August, 1996. This campaign consisted of two rockets launched into active sporadic-E conditions from Kagoshima, Japan. (The P.I. was Shoichiro Fukao of Kyoto University.) These new data present a fresh look at some longstanding mysteries and triggered new thinking of our understanding of sporadic-E layers. In particular, the data show neutral winds associated with the layer that are considerably larger than previously believed and a rich assortment of electric fields structures that covered a wide range of time and distance scales. SEEK presentations were provided by Roland Tsunoda (radar results), Miguel Larsen (neutral wind results), and Rob Pfaff (electric field results). Theoretical ideas were also discussed, in light of the new data. In addition to the SEEK data, some additional new ionosonde data were also shown (J. Scali).

After the SEEK discussion, plans for several new NASA rockets to be launched from Puerto Rico in 1998 were presented. These include dedicated sporadic-E layer rockets (R. Pfaff) and a rocket to study descending layers (G. Earle). These experiments will be conducted in conjunction with Arecibo incoherent scatter measurements as well as VHF backscatter measurements to be carried out by the Univ. of Illinois (E. Kudeki and S. Franke). Unfortunately, there was not enough time to cover all aspects of the new campaign, although the workshop attendees did receive a good overview of what new measurements to expect in the coming year.

#### Title: POLITE Campaign Workshop

Thursday, June 10 Convener: Philip Erickson Attendance: ~18

For the second year in a row, the POLITE campaign workshop was successfully convened at the CEDAR meeting to discuss the ongoing Plasmaspheric Observations of Light lons in the Topside and Exosphere campaign effort, organized around the ISR world day schedule. Rather than being a series of isolated presentations, the workshop encouraged participation and feedback from the audience throughout a series of talks emphasizing important topside physics issues.

Full details of the workshop are being assembled on the POLITE web pages at http://www.havstack. edu/polite, but in summary, we discovered during the meeting that very good data coverage from IS radars. ground-based optical instruments, and satellites exists for the first two POLITE campaign periods. Reports from Jicamarca (Wes Swartz), Arecibo (Sixto Gonzalez), Millstone Hill (Phil Erickson), Sondrestrom (John Kelly), EISCAT (Tony van Eyken), and the Kharkov radars (P. Erickson for V. I. Taran) indicate topside light ions were successfully observed all along the ISR latitudinal chain, as well as valuable longitude variations provided by Kharkov and EISCAT. Neutral species (8446 OI, H-alpha, 10830 He) were imaged successfully during campaign periods by the Boston University group headed by Bob Kerr, and these efforts will shed important light on the lower topside charge exchange process, global hydrogen abundance, and escape flux variation. Some multiinstrument studies are already underway, such as the one Sixto Gonzalez described which compares SUPIM modeling results to Arecibo topside data and DMSP satellite overpasses. Neutral hydrogen was identified by several people as a current "hot topic". For example, Susan Nossal of the University of Wisconsin pointed out that the WHAM instrument can be configured to look at the neutral hydrogen Lymanalpha nightglow and add longitudinal information. Phil Erickson showed Millstone Hill results on neutral hydrogen which infer that  $O^+ - H^+$  charge exchange cannot explain features in the lower topside.

At the close of the workshop, plans were discussed for a fall 1997 AGU special session on topside issues (Phil Erickson volunteered to pursue this), and a list of current projects using POLITE campaign periods was assembled, for placement on the POLITE web site and for future reference. Efforts were initiated as well to combine several radars' data sets for a topside chain study. Finally, 1998 will see two more POLITE world day runs to add to the 4 already available in 1996 and 1997.

In the future, we plan to hold another POLITE workshop at the next CEDAR meeting, and the aforementioned fall AGU special session will focus on the topside. In the meantime, however, anyone desiring more information on POLITE or the workshop can visit the POLITE web site at http://www.haystack.edu/polite or contact the POLITE coordinator, Phil Erickson, at pje@hyperion.haystack.edu.

# **CEDAR Baked Beans**

Six-way Ambiguity?

Looking at the variety of interesting results displayed at the CEDAR Workshop, it occurred to me that the wellknown ambiguity in dates will get much worse before many years are out. We'll be faced with dates like 01/02/03 which might mean any of:

> [a] 2001 Feb 3 [b] 2001 Mar 2

Mar 2 [d] 2002 Mar 1

[c] 2002 Jan 3

[e] 2003 Jan 2 [f] 2003 Fe 1

Most readers of CEDAR Post are of course from the USA and would plump for [e], but I and anyone else from almost any other country would go for [f], though several countries now use the convention [a], as do the more logically-minded scientists, notably astronomers. The other three options are unlikely to be chosen by anyone with any sense. But three possible interpretations are two too many.

We're not going to agree on this, but I'd suggest that the following will help:

1. YYYY MM DD really seems best;

2. One can skip the "month" problem by using "day of year", i.e.. YY DDD or better still YYYY DDD - but even that's a bit ambiguous because, although most people take DDD as 001-365 (or 001-366), some take it to be 000-364 (or 000-365)\*;

3. If you don't like either of these, then may I suggest "Year in full, month in letters"?

\* And of course we all know better (don't we?) than to use the misnomer "Julian Day" for "day of year"? The REAL 7digit Julian days started in 4713 BC (for a quite abstruse reason), the 5-digit "modified Julian days" started in 1858 AD.

Henry Rishbeth (written 30/6/97 ... or I'd better say 1997/06/30, 1997-181, JD 2450449/50 [I think] or MJD 50449)



# CEDAR Phase III Report Available

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M. Mendillo, Editor (mendillo@bu.edu) K. Nottingham, Assistant Editor (kathynot@bu.edu)

# CEDAR Baked Beans

The Editor invites submission to the CEDAR Baked Beans section of the Post. The purpose is to provide an informal forum for anyone to briefly address issues, controversial subjects, etc. Limited to 250 words. Replies to such commentaries are also welcome. Final selection for publication rests with the Editor and his CEDAR lawyers.