

# **1988 CEDAR Workshop Report**

Our annual summer meeting was a great success again with a total of 155 participants including 36 students in attendance! The facilities were excellent and a vote of thanks is due the local organizer, Dr. Barbara Emery. The week was a busy one, with 5 excellent tutorials covering much of our field of solar terrestrial relations from the magnetosphere to solar/weather relations and including experimental technique reviews. There were also 14 successful workshops covering the results from ongoing CEDAR campaigns as well as planning for new ventures.

### Individual Workshop Reports

The following notes have been abstracted from the more complete workshop reports submitted to the steering committee by the individual workshop convenors. A full set of reports can be obtained from Tim Killeen on request.

### 1. Sun/Weather workshop.

The co-convenors of this group are Brian Tinsley and Susan Avery. The group's main purpose was to form a community of interest to search for and evaluate hypotheses for the mechanism(s) for the solar variability - quasibiennial oscillation - weather linkages (SV-QBO-W) that have been brought to light by recent research due to Karen Labitske and Harry Van Loon.

Presentations by Van Loon and Tinsley made it clear that the SV-QBO-W effects extend throughout the height range from the surface to the mesosphere and from the equator to the poles - a truly global effect. The location and nature of the solar driver is not known, although several possible mechanisms were discussed. The group has decided to hold a workshop (tentatively scheduled for 20-21 June 1989 in Boulder prior to the next annual meeting) to discuss campaign activities and progress made in identifying the mechanism(s). They will also circulate a newsletter to interested participants. The group is seeking the involvement of meteorologists as well as aeronomers and student participation is encouraged. The principal contact person is Brian Tinsley whose address is Mail Stop Fo22, University of Texas at Dallas, Box 688, Richardson, TX 75080. A great acronym (for those into such things) for this effort has been suggested by Brian Tinsley and Colin Hines -QWEST - QBO/Weather/Sun Teleconnections.

### 2. Equatorial Dynamics.

The first meeting of this new CEDAR project took place on June 7, 1988 with Brian Tinsley and Michael Mendillo as the coconvenors. About 60 people attended. The initial objectives are to facilitate coordination among a number of groups planning to make measurements at equatorial latitudes. Scientific topics to be studied include low latitude F-layer plasma dynamics; transequatorial plasma bubble development; equatorial mesosphere dynamics; effects of gravity waves on plasma bubble dynamics, etc. Observations are planned in at least three longitude regions: 1) Kwajalein/Wake Island; 2) Hawaii/Christmas Island/Palmerston Island; 3) Jicamarca/Arequipa/N.Peru/Brasil. Plans are well underway for three major campaign periods spread over four years from 1988 to 1991. Scientists from at least 14 institutions are participating, with a wide variety of experimental techniques. The aim is to present first results at the CEDAR 1989 meeting. The principal contact person for this group is Brian Tinsley (address given above), with David Anderson of AFGL coordinating the modeling aspects of the effort.

#### 3. CEDAR/WITS - High latitude.

A workshop was held on the results of the February campaign on 1) High Latitude Plasma Structure, HLPS, 2) Sun-Aligned Arcs, 3) Polar-Thermosphere weather. The central purpose of this group's efforts is to study high latitude convection and plasma structures at hundreds of km to meter scales for IMF Bz positive and negative. The convenor for the group is Sunanda Basu, Emmanuel College, 400 The Fenway, Boston, MA 02115. There were about 50 participants in the workshop from 10 U.S. institutions and 2 in Europe. The February 1988 campaign was judged a great success, with most of the initial objectives met. A second campaign is being planned for December 1988 (tentative dates Dec 3-14) and a special session at the Spring AGU meeting in May 1989 was proposed. One of the highlights of the first HLPS campaign were measurements that made it possible, for the first time, to follow plasma structuring in the ionosphere at hundreds of km scales, controlled by the interplanetary magnetic field, down to m-scale structuring caused by

plasma instabilities generated in the neutral rest frame.

4. Lower Thermosphere Coupling Study (LTCS)

LTCS workshop sessions were held between 2:00 and 5:30 pm on Wednesday, June 8, and 3:00 and 5:30 pm on Thursday. June 9. The attendance at both sessions was in the range 25-35 and the discussion was led by the convenor, Jeff Forbes, whose address is Department of Electrical, Computer and System Engineering, Boston University, 110 Cummington St., Boston, MA 02215. The purpose of the LTCS workshop was to examine and assess data acquired during the very successful LTCS-1 campaign, held during 21-25 September 1987, in light of the stated goals of the LTCS: to better understand the processes which dynamically and electrodynamically couple the mesosphere and thermosphere. The incoherent scatter radar results were reported available from Millstone Hill, Arecibo, St. Santin, Sondrestrom, and EISCAT. Data from the NSF facilities were presented. Alan Manson reported that virtually all the mesosphere/lower thermosphere radars from the global network collected usable data during LTCS-1. Some optical (green line) data was presented from Thule, Arecibo and Poker Flat, but additional efforts are required to collect and analyze the optical measurements (green line Doppler winds and OH rotational temperatures) made during LTCS-1.

The LTCS-1 period was characterized by variable magnetic activity, ranging from very quiet to very disturbed levels. Preliminary evidence from Millstone Hill and Sondrestrom indicated evidence of geomagnetic activity effects in the neutral circulation down to about 130 km. The incoherent scatter radar data clearly showed the semi-diurnal tides in at least two out of the four days and the MS radars reported tidal phases and amplitudes in line with expected climatology for September conditions. It was decided to concentrate on analysis of observations relating to the exciting new measurements in the 80-140 km region, and in particular the dynamical variations seen above 100 km by incoherent scatter and those below 100 km by the MS radars. Additional campaigns were scheduled for late 1988 and June 1989, though these dates are subject to revision. It was universally agreed that an improved understanding of the lower

thermosphere requires the accumulation of a multi-instrument E-region archival data base providing good seasonal and even solar cycle coverage. A further LTCS workshop was held at the recent COSPAR meeting in Helsinki, where significant international interest was evident.

## 5. AIDA Act'89

The AIDA (Arecibo Initiative in the Dynamics of the Atmosphere) group's main purpose is to compare measurements of winds and "alleged" winds throughout the height range covered by the Spaced Antenna Drift (SAD) and Imaging Doppler Interferometer (IDI) partial reflection radars over the Arecibo incoherent scatter radar. A set of simultaneous measurements will be taken that will allow the level of agreement between them (as well as the implications of any serious disagreement) to be established. The instrumentation which will be brought to bear on a study of the dynamics of the atmosphere over Arecibo includes: 430 Mhz scatter radar (65-120 km by day; 15-25 km by night); 46.8 MHz radar (8-20 km, day and night); 1.95 MHz Vincent-type SAD system (75-105 km approx, day and night); Rayleigh and resonance scattering Lidar from the University of Illinois; Fabry-Perot interferometer ( $O(^{1}S)$ ) and possibly OH or Na); OH and O2 spectrometer;  $O(^{1}S)$  and Na photometers; Utah State University's IDI system (~10-100 km by day 10-150 km by night) and 50 MHz meteor radar; possibly a field-widened Doppler imaging Michelson from York University; all sky imaging airglow cameras from Aerospace Corporation and Whitworth College; University of Colorado's meteor system "black box" to piggyback on the 46.8 MHz radar.

At present the core periods for the AIDA study have been chosen tentatively and these are:

| "Tune up": | March 8-15 1989        |
|------------|------------------------|
| "Act '89": | March 28-April 10 1989 |
| "Reprise": | April 30 - May 7 1989  |

The central core period Act'89 has been timed to maximize the scientific return and incorporates a new moon period (April 5/6). The Tune up and Reprise periods are designed in support of the main Act'89 effort. The SAD system is expected to remain in operation routinely and indefinitely, while the IDI system will remain at Arecibo for 1-3 months. For further information on the AIDA program, potential participants are encouraged to contact the lead organizer: Dr. Colin Hines, Arecibo Observatory, Arecibo, PR 00613-0995.

#### 6. Exospheric studies (CHARM)

The purpose of the CHARM (Collaborative H-alpha and Radar Measurements) program is to enhance our knowledge of the coupled thermosphere, exosphere, ionosphere and protonosphere with comprehensive experimental evidence. The program will produce composition measurements of H, H<sup>+</sup>, O<sup>+</sup>, and perhaps O as a function of altitude (300 - 2000 km), latitude (10°S-78°N), and local time (nighttime, and H<sup>+</sup> full diurnal). As functions of the same variables, CHARM will also produce T<sub>i</sub>, T<sub>e</sub>, T<sub>H</sub>, atomic hydrogen escape flux, proton flux, and the exosphere atomic hydrogen velocity distribution.

The planning workshop was attended by about 25 representatives of both the optical and radar communities, and a few members of the modeling community. Progress in the program to date has met and exceeded proposal expectations. Feasibility or proof-of-concept experiments have been completed with optical studies at Haleakala HI, Arecibo PR, and Sondrestrom, Greenland. The Aerospace Corporations 3" aperture FPI at Sondrestrom produced excellent H-alpha intensity and profile measurements in February. 1988. The radar has been upgraded and data showing detection of H+ in the Sondrestrom ACF's were presented at the workshop. The FPI at Laurel Ridge and the radar at Jicamarca have been added to the number of participating instruments and plans for intercalibration of optical sensors have been made. The optimum FPI parameters for the CHARM exospheric measurements have been established through community interaction.

CHARM observations will begin in October 1988 and a global campaign will take place on February 1-8, 1989. A second global campaign is tentatively scheduled for February, 1990. A further meeting of the group is planned to occur at the upcoming Fall AGU meeting in San Francisco. Interested potential participants are encouraged to contact one of the lead organizers Dr. R. Kerr (Boston University), Dr. F. L. Roesler (University of Wisconsin, and Dr. C. A. Tepley (Arecibo Observatory).

### 7. Equinox Transition Study (ETS)

The purpose of the ETS study is to understand the global response of the thermosphere to magnetospheric forcing through the period of changes thought to occur during the transition from one solstice (June) to another (December). To this end, a comprehensive data base was obtained during an 8-day period in September 1984. The data were provided by eight polar orbiting satellites, five incoherent scatter radars, and a large supporting cast of diagnostics, covering neutral and charged particle densities, temperatures, winds, and electric fields. A broad range of scientific problems are being studied, ranging from lower thermospheric composition to the energization of SAR arcs in the inner magnetosphere. The study relies heavily on interactive and iterative use of the NCAR TGCM to understand features in the data and to develop more appropriate inputs to the model.

The number of participants in attendance at the workshop was ~15-20, and the efforts extended over a three day period. Reports were given on progress made on certain problems identified at the previous ETS workshop held at AFGL in January 1988. Preparations were also made for the ETS presentations to be given at a planned special session of the Fall AGU meeting. Future plans include the publication of a set of papers in a special section of JGR. In general, the ETS program is in a state of maturity in that much of the experimental data has been processed and analyzed. TGCM simulations of the entire 8-day period are planned, though significant attention has focused on the modeling and experimental comparison for the 19 September (the half amplitude storm day) and the preceding quiet day. There will be a logical progression in the modeling effort towards the simulation of the events of the 23 September (largest storm of the year). Interested scientists are encouraged to contact one of the two coconvenors: Dr. G. Crowley, HAO/NCAR, P.O. Box 3000, Boulder, CO 80307-3000 and Dr. H. C. Carlson, Chief Scientist, AFGL, Hanscom AFB, Bedford, MA 01731.

#### 8. Sondre Stromfjord Radar/Optical 1986-88

This study involves making optical observations of auroral emissions simultaneously with incoherent scatter measurements made up

the field line at Sondrestrom. The radar observations will be analyzed with the Strickland electron transport code to determine the following: total energy flux of the precipitating particles, the average or characteristic particle energy, the type of particle distribution (Gaussian or Maxwellian), and the thermospheric atomic and molecular oxygen density compared to that given in a model atmosphere. The radar modeldependent results will be compared with new optical techniques to determine the same parameters to determine the utility and generality of the optical methods. For example, the intensity of the  $N_2^+$  first negative emission will give total energy flux, and the rotational temperature of that emission will determine the average particle energy.

The program started in 1986, with optical equipment supported by Aerospace Corporation, University of Michigan, National Research Council of Canada used in conjunction with the SRI-supported radar. Modeling involvement is by scientists at the Naval Research Laboratory and Computational Physics Inc. The workshop at the annual CEDAR meeting was attended by ~30-40 scientists, with an active core of ~5-10 experimentalists and theoreticians. Reports of the results obtained to date occupied much of the time. Jim Hecht described how selected auroral optical measurements when coupled with the Strickland code could produce lower thermosphere atomic oxygen densities. For the quiet periods analyzed to date the opticallyderived densities were ~50% of the equivalent MSIS model predictions, dropping to lower values yet during active periods. Unique observations of a sun-aligned arc observed over Sondrestrom during February 1987 were reported by Rick Niciejewski. Much discussion centered on the relative merits of the Strickland and Rees/Lummerzheim electron transport codes for use in this program and continuing efforts to compare and contrast the techniques will be undertaken. This workshop had a spirited, but inconclusive discussion on the issues involved with the archiving of CEDAR data.

Future plans include a campaign in February 1989 to achieve the following: 1) continue to monitor O composition to see how this changes with the solar cycle, 2) make observations of several auroral emissions to see whether, when combined with radar observations and the Strickland code, their excitation mechanisms can be determined, 3) make use of the much improved height resolution of the radar in the region below 120 km. The campaign period 1/28-2/10 coincides with CHARM but should not be problematical since both efforts require the radar to point along B and the optical instruments can be rapidly reconfigured between auroral and exospheric modes. Interested scientists can contact Dr. Jim Hecht, Aerospace

### 9. Twilight Airglow

Approximately 20 people attended the workshop on Twilight Airglow that was chaired by Dr. W. E. Sharp, Space Physics Research Laboratory, University of Michigan, 2455 Hayward, Ann Arbor MI 48109. The purpose of this group is to develop optical and modeling techniques that will allow for thermospheric composition to be measured from the ground during twilight hours.

Corporation for additional information.

Considerable progress was reported by Douglas Torr and Phil Richards in developing the algorithms necessary for inverting the twilight decay optical profiles. Good fits to 7320Å observations were presented, although the considerable uncertainty in exospheric temperature meant that the uncertainty in the deduced atomic oxygen density was unacceptably large. The ISO instrument has been located at McDonald Observatory for the past 12 months, making twilight observations at 7320Å, 6300Å, and the N2<sup>+</sup>  $\Delta$ v=-1,0,1 sequences. It is recommended that these observations be supplemented by direct measurements of exospheric temperature.

Two observational campaigns are planned, using the Torr spectrograph, the Broadfoot spectrograph, and the Sivjee scanning spectrometer at McDonald Observatory in August 1988 and at Tuscon in the Fall. The Torr/Richards algorithms will be used to analyze the results. There is a need for wider participation in this important CEDAR program and interested scientists are encouraged to contact the workshop organizer.

# **10 MAPSTAR**

The acronym MAPSTAR stands for Middle Atmosphere Periodic Structure Associated Radiance. The purpose of this program is to study the wavelike patterns seen in the IR emissions of the OH airglow from 85 km altitude. During the workshop the goals and experimental techniques of the program were reviewed. Primary interest centers on the gravity wave sources producing the patterns and the mechanism of the emissions.

Progress to date includes the campaign efforts of May-July 1988, the design and construction of an IR interferometer with on-line spectral and temperature measurement capability, and the development and use of the IDI (Imaging Doppler Interferometer) MAPSTAR radar. Additional campaigns are being planned and the next MAPSTAR workshop will be in September at which time the May-July data will be discussed. This is a relatively mature program that has led to ~12 publications already. Interested potential participants should contact Dr. Edmond M. Dewan, Infrared Dynamics Branch, Infrared Technology Division, Air Force Geophysics Laboratory, Hanscom AFB, MA 01731-5000.

### 11. GISMOS

The GISMOS (Global Ionospheric Simultaneous Measurements of Substorms) campaigns are coordinated observations aimed at studying the coupling between the magnetosphere and the ionosphere. A GISMOS workshop took place during the past two CEDAR annual meetings. A further workshop is planned in the Exeter, United Kingdom during the summer of 1989.

The principal goals of GISMOS are: 1) to obtain simultaneous measurements of the ionosphere and magnetosphere, 2) analyze individual events in detail to understand the timevarying aspects of the ionosphere-magnetosphere coupling, 3) provide realistic inputs and boundary conditions for theoretical models, as well as observations against which the model predictions can be tested, 4) foster integration of the models through comparisons with this global and relatively complete set of observations of specific events. Six campaigns have already taken place, including one September 23-26, 1986, during a SUNDIAL period, one April 1-4, 1986, during Promis, and one during January 12-16 1988, during a large storm. A special session of the Fall AGU is planned to highlight the results from these and earlier GISMOS campaigns.

The GISMOS campaigns have used the two chains of incoherent scatter radars and have taken advantage of a variety of ground-based instruments (e.g. radars, magnetometers, photometers, riometers) and several satellite programs (e.g., DMSP, NOAA, HILAT, Polar Bear, DE 1, VIKING, ISEE, AMPTE, and IMP-8). Various modeling groups have participated in GISMOS from the planning stages. Four subgroups have been established. Subgroup 1 is led by David Evans and has the task of studying the large-scale convection and precipitation. Subgroup 2 (leaders G. Rostoker and L. Lyons) is concerned with substorm morphology and subgroup 3 (leader C. Rasmussen) is concerned with global ionospheric modeling. Subgroup 4 has the task of studying the penetration of electric fields to lower latitudes and is led by B. Fejer. The GISMOS organizer is Dr. O. de la Beaujardiere, SRI International, 333 Ravenswood Ave., Menlo Park, CA 94025.

### 12. Global Thermospheric Dynamics (GITCAD)

The GITCAD (Global Ionospheric Thermospheric Coupled Atmospheric Dynamics) study continues a series of global campaign efforts initiated by the GTMS, GISMOS, and ETS studies with emphasis placed on the coupling between high and low latitudes. It differs from GISMOS in that the radar observing modes used emphasize the acquisition of thermospheric winds and temperatures rather than ion drifts. Since the original organization of GITCAD by Dr. M. A. Biondi, several campaigns have been held (January 1987, March 1987, March 1988).

The workshop was convened by Dr. J. W. Meriwether (Space Physics Research Laboratory, University of Michigan, Ann Arbor, MI 48109) and Dr. V. Wickwar (Utah State University) and there were about 40 attendees. The workshop discussion centered on the results of the January 1987 campaign for the Fabry-Perot observations and on the modeling work summarized by Drs. G. Crowley, B. Emery, C. Fesen. The January campaign was successful in that the weather conditions were good (as opposed to the bad weather of March 1987) and the combined radar (Arecibo, Millstone Hill, and Sondrestrom) and Fabry-Perot data made for a comprehensive data resource.

Since it is apparent that the other CEDAR efforts have almost completely absorbed the

energies of the modeling community for the present, GITCAD analysis will concentrate on the accumulation of a data base. Dr. K. Miller will supplement the Fabry-Perot wind observations with wind determinations from the network of ionosondes. The combined data sets will be entered into the CEDAR data base. Dr. Wickwar will lead the GITCAD effort for 1989, with a steering committee composed of Drs. M. A. Biondi, D. Sipler, R. Niciejewski, C. Tepley, R. Smith and K. Miller.

### 13. ARIA

Approximately two dozen researchers attended the ARIA (Atmospheric Response in Aurora) workshop, together with a herd of deer. The purpose of this newly-formed group is to measure the localized atmospheric response to auroral particle and energy inputs. In particular, the theoretical predictions of large E-region neutral wind jets in association with the diffuse aurora by Lyons and Walterscheid are to be examined experimentally using rocket-borne instrumentation. The group's organizers are Drs. A. F. Christensen and D. C. Kayser of the Aerospace Corporation, Space Sciences Laboratory, P. O. Box 92957, Los Angeles, CA 90009-2957.

The ARIA investigation will use sounding rockets and ground-based techniques to specify energy inputs responsible for heating the thermosphere and to measure the response of the atmosphere in terms of winds and compositional changes. The interpretation of the results will use new dynamical models and auroral codes. At the workshop, the campaign definition was discussed, including the type and number of rocket launches, range availability, instrumental payloads, ground-based support, etc. Letters of interest were solicited from experimentalists and theoreticians and a strawman payload identified. The rocket campaign is tentatively scheduled for late 1990 or early 1991 at Poker Flat range near Fairbanks, Alaska. There will be a further team meeting at the upcoming Fall AGU in San Francisco.

# 14. San Marco

The San Marco studies project was initiated at the CEDAR summer workshop of 1986, but remained dormant until the launch of San Marco in March 1988. Various CEDAR

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activities have been planned to take advantage of the unique equatorial measurement capability of the San Marco spacecraft. This group intends to use San Marco data in conjunction with groundbased experiments at Jicamarca and Arequipa in Peru, the airglow observatories in Brasil, radar facilities at Kwajalein and airglow instrumentation in Hawaii. Two new investigations were proposed using groundbased measurements of Hydrogen Lyman  $\beta$  at Arecibo and EUV emissions from McDonald Observatory in Texas.

Since the launch of the satellite, two campaigns have been completed and data analysis is underway. The first campaign, during April 25-27, used Jicamarca radar operating in the vertical and east-west drift mode. The Arequipa airglow Fabry-Perot also provided data. The neutral wind and temperature spectrometer on San Marco operated during this period but unfortunately failed towards the end of April. The second campaign during June 15-16 gave Jicamarca and Arequipa data of good quality. Some early San Marco results will be presented at the Fall AGU meeting.

Future plans include a Kwajalein campaign coordinated by Dr. T. Aggson and an equatorial spread-F campaign in September 1988. Interested scientists should contact Dr. F. A. Herrero, NASA Goddard Space Flight Center, Greenbelt, MD 20771, for further information.

#### Video tapes of tutorials

Video tapes of the four hour-long tutorials given at the 1988 CEDAR summer workshop are available for \$30 a copy. Please contact Dr. Barbara Emery at HAO/NCAR, P.O. Box 3000, Boulder, CO 80307 tel (303-497-1596) as soon as possible if you have an interest in purchasing a copy since supplies are likely to be limited

# LOGO Contest

Yes, folks, it's **CEDAR LOGO** time again! The new steering committee discussed the pressing issue of the design of a CEDAR LOGO, censured the previous steering committee for not making a decision, and decided that the community should be asked again to develop ideas (or resubmit old ideas) for a CEDAR LOGO. A prize of a free banquet ticket plus a moment of glory awaits the winner. Please send your ideas to the editor by **January 1 1989**. If no winner appears from the community, the committee will consider having a professional graphic artist design one for us.

# **CEDAR Promotion Activities**

The steering committee will be preparing a **CEDAR handbook** of accomplishments for 1988 for submission to NSF. We are interested in highlights (e.g. a figure with explanatory caption) that highlights a significant recent accomplishment of the CEDAR program. Ideas and/or material for the handbook are solicited. The committee also intends to institute a **CEDAR Lecture** to be given by an individual responsible for a significant scientific effort. Please send in highlights and/or nominations or suggestions for the CEDAR lecturer. The lecture will be a 30 minute presentation at a plenary session of our annual meeting.

# **Proposal Deadline**

We remind readers of the 1 October 1988 deadline for the submission of CEDAR proposals for the upcoming fiscal years. Submit early and submit often for best results (Quality proposals are the lifeblood of this program)!

#### Steering Committee membership

The new steering committee membership is as follows:

T. L. Killeen (U. of Michigan) chair

W. E. Sharp (U. of Michigan) v chair

C. S. Gardner (U. of Illinois)

M. J. Mendillo (Boston U.)

J. E. Salah (MIT/Haystack)

J. W. Meriwether (AFGL)

C. Hines (Arecibo)

G. G. Sivjee (Embry-Riddle U)

G. J. Romick (NSF)

R. Behnke (NSF)

B. A. Emery (HAO/NCAR)

ex officio:

There will be a steering committee meeting at NSF in mid-October. Please contact your local committee member if you have any pressing issues to raise.

# **CEDAR** Postdoctoral Scholar - status

Currently Stan Solomon and Julie Moses at HAO/NCAR share the first CEDAR postdoctoral scholar position. Julie is working closely with Art Richmond on tasks related to electrodynamical modeling, while Stan is primed to interface TGCM calculations of optical emissions with the experimental community. A second postdoctoral position is planned that need not be located at NCAR. Look out for a forthcoming position announcement.

#### CEDAR Annual summer meeting 1989

The 1989 CEDAR annual workshop will be held in Boulder, Colorado in June 1989, between the 22nd and the 27th of the month. It is intended that Saturday afternoon and all day Sunday will not be scheduled for any formal CEDAR activity. Participants might plan to confer informally and to enjoy the hiking trails outside Boulder. The first meeting announcement with details of the program will be sent out to the CEDAR mailing list in March 1989. Dr. John Meriwether, Air Force Geophysics Laboratories, is the chairman of the program committee this time and any comments, suggestions should be directed his way.

> Dr. John Meriwether Space Physics Lab University of Michigan Ann Arbor, MI 48103