



The Earth Observer

An Eos Periodical of Timely News and Events

Vol. 1, No. 5

Message from HQ

Eos On Target for an FY 1991 New Start

The Non-Advocate Review (NAR) of Eos has been conducted, and NAR Committee Chairman, Dr. Paul Holloway, reported the Committee's recommendations to Dr. Fisk on July 11. In response to the recommendations of the NAR Committee and the underlying reasons for their recommendations, the plans for Eos are being modified. This status update is provided so that the Eos community can have a complete and accurate understanding of what is happening.

The first change is that project management of the Eos mission is now centralized at Goddard, with Headquarters continuing to provide program management. Some restructuring of Goddard is anticipated in response to this major assignment. This arrangement is generally similar to that for other flight missions, but with one key exception: overall responsibility for the management of the Interdisciplinary Investigators will reside with the Eos Program Scientist at Headquarters, and their execution-phase activities (beginning in FY 1991) will be funded directly from NASA Headquarters. This arrangement maximizes the opportunity to integrate the Interdisciplinary Investigations with those of the on-going Headquarters program, so that the overall effort will be as supportive of the integrated Eos objectives as possible. Even so, all investigators should remember that their primary, day-to-day interface with Eos will be through the Eos Project Scientist and his staff. In order to facilitate the full involvement of all investigators, the Eos Program Scientist and the Eos Project Scientist will co-chair the Eos Investigator Working Group and its Science Executive Committee. In addition to advising the EosDIS managers within the Eos Project Office at Goddard, the EosDIS Advisory Committee will report to the Earth Science Data System Coordinator at NASA Headquarters.

The second change relates to the polar platform. There is a clear recognition that the only mission for the Space
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Science Focus

Eos Science Priorities and Science Requirements

As a result of the Eos Non-Advocate Review (NAR) that was held in June, the Project and Program Offices have been requested to consider the science priorities for the mission. This topic was discussed at the Science Executive Committee (SEC) meeting on July 21, but no conclusions were reached. Members of the SEC elected to hold another meeting on September 14 to deal with Eos priorities as well as the IWG charter and the agenda for the next IWG meeting. Obviously for missions as multi-disciplinary as Eos, it is not possible to arrive at a single
(Continued on page 2)

EDITOR'S CORNER

The decision by NASA Headquarters to assign Eos management solely to GSFC, not shared between JPL and GSFC, results in Eos Project activity being focussed at GSFC. For this reason *The Earth Observer* editorship will be performed by the Goddard Project Science Office. (A chief editor will be selected in the future.)

The new masthead reflects this change. We thank Dr. Cimino and Ms. Marguerite Schier for their help in the production of Vol. 1, Nos. 1-4 and hope they will continue to be contributors to this publication. We regret that the August edition was not issued, and we ask our readership's forbearance as we deal with our reorganizing. This issue combines August and September.

In the future our publishing schedule will be based on Project events and milestones rather than on the calendar. Phase B is a critically important period in determining the character and the details of the Eos missions. It is imperative that the scientists are kept informed. *The Earth Observer* is a major source of that information.

*Message...**(Continued from page 1)*

Station platform(s) which is on the horizon is Eos. Individuals from the Office of Space Science and Applications at NASA Headquarters will become involved in the day-to-day management of the polar platform at Reston. Their objective will be to assure increased harmony between Eos requirements and Space Station platform designs and to provide needed focus on platform requirements so that launch can remain on schedule. Polar platform development remains a part of the Space Station and will be funded under the auspices of the Space Station program.

The third change concerns the Eos SAR. In working with Dr. Fisk to shape the FY 1991 Eos initiative in light of the NAR, it became clear that some part of the program would have to be delayed for the present in order to meet annual spending targets which Dr. Fisk thinks he can sell. Significant cost savings can be realized in Eos by using six identical polar platforms to fly our two payload sets for 15 years. (Each platform and payload will be designed for 5 year life.) There is also less risk in Eos development if we are not pressing the envelope of launch vehicle performance. The approach we are currently following is based on providing support for a payload mass of about 3000 kg on each platform. As a result of all these considerations, the Eos SAR is not included as part of the payload for the Eos-A or -B series.

The Eos SAR is still viewed as providing critical data for the study of global change. Specifically, multiparameter SAR data is not being provided by the European Space Agency SAR nor the SAR instruments being developed by Japan and Canada. This multiparameter data is an unproven commodity, but there is considerable opinion in the community that it will be crucial in the characterization of land biota. The Eos SAR offers the ability to observe through clouds and to penetrate dense plant canopies. Both of these capabilities are particularly germane to the study of rain forests. Because the scientific requirements for the Eos SAR are recognized, the omission of the Eos SAR from the FY 1991 initiative is not viewed as a permanent deletion from the program. A subsequent fiscal year initiative may be required to provide for it. The SAR science team selected through the Eos AO will continue to be supported. The SAR-related aspects of the Eos Data and Information System (EosDIS) will be included in the system architecture and design studies. The accommodation of SAR on additional copies of the polar platform will be studied along with the flight of the SAR on a custom spacecraft. In other words, every step will be taken to prepare for an initiative to add the SAR capability to Eos in a scientifically and programmatically unified manner.

The fourth change regards the selection of attached payloads. Dr. Fisk made the attached payload selections on June 29. As part of Eos, three instruments were selected for definition leading to possible deployment during the assembly phase of Space Station Freedom.

The other six instruments which were recommended for selection have been selected for concept definition. This form of selection implies that concept studies of the instruments will be conducted over the next three years and that eventual selection will be for deployment during the operational phase of Freedom. All of the plans for integration of the attached payload investigations into the overall Eos mission will proceed. Dr. Gerald North of Texas A & M University will join the Eos IWG as an Instrument P.I. Dr. William Barnes of Goddard will become a MODIS Team Member and Drs. Krishnamurti and Fitzjarrald, of Florida State and Marshall, respectively, will become LAWS Team Members as the result of their successful proposals of modifications to these facility instruments.

None of the changes indicated above will alter the terms of the selection letters sent to Eos investigators by Dr. Fisk. All selected investigations will remain strong candidates for confirmation for execution until the appropriate reviews of their progress have been made. Final selection of the Eos-A payload is still planned for September 1990. Final selection of the Eos-B payload will be no earlier than September 1991. We hope to obtain more early funding for Eos, but the extent of this is still under discussion.

Dr. Fisk is supporting us in our plan to set aside a fixed percentage of the annual Eos funding to support an expanded program of graduate fellowships in Earth science. Eventually, more than 100 new graduate students will be supported in this manner in addition to those students funded as part of the selected Eos investigations and through our on-going research and analysis tasks. The currently estimated budget for Eos allocates 10% to funding of actual research; this figure does not include computers for investigators, software developers for instrument algorithms, or the development and operation of EosDIS. This level of funding will eventually support the full-time equivalent of 1000 Earth science researchers, and this support will extend for 20 years. This implies roughly a doubling in the number of Earth scientists supported by NASA.

We will keep you informed as the budget process proceeds.

--Dixon Butler and Stan Wilson

*Science Focus**(Continued from page 1)*

answer to the question of priority. Combinations of issues, blending scientific, engineering, and societal issues, must be considered. The discussion of priorities will continue until there is a final selection of the payload and the specific science requirements of the individual investigations are known.

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Science Focus

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An accompanying article gives the background and status of the draft science requirements now in circulation. These have been distributed to the Investigators of the Interdisciplinary Science (IDS) teams and to the members of the SEC. The Program Office is currently assembling this information. At a later time when the Project is under change control, these requirements will become the documented requirements, and modification will be very difficult. Scientists who are working on the requirements are urged to make their comments now to the Project Science Office.

Background and Status of Eos Science Requirements Document

--Renny Greenstone

The first specific formulation of Eos science requirements appeared in the Science and Mission Requirements Working Group (SMRWG) Report, Volume 1, that was issued in 1984. Table 2 of that report was entitled Observational Needs and contained a long list of parameters that ought to be determined for Eos. For each parameter there were entries for application, accuracy, and approach. "Application" usually turned out to be a major area of Earth science, such as hydrologic cycle, surface energy budget, ecological processes, etc. "Accuracy" contained two subheadings: desired and required. "Approach" referred to spectral region or to active vs. passive, and sometimes to a specific instrument, such as SAR, or an instrument concept such as altimetry.

Another formulation of Eos science requirements was requested by the Eos Project Office from its contractor, the McDonnell Douglas Space Systems Corporation, and was available in draft form for the Eos "All Hands" meeting that was held in March of this year at Goddard. This document in essence took the parameters that were called for in the SMRWG Table 2 and arranged them in hierarchical order with accompanying explanations as to how each more-specific level of measurement requirement supported a broader requirement.

At the All Hands meeting, groups of the Interdisciplinary Scientists were formed for the purpose of reviewing the draft document. Four groups were set into being as follows: Climatological Cycle--chaired by Ray Bates; Hydrological Cycle and Biogeochemical Cycles (combined)--chaired by Eric Barron; Ocean Processes--chaired by Mark Abbott; and Geophysical Processes--chaired by Byron Tapley. There being only limited time available for this review, it was concluded that only a start could be made at reviewing and revising the draft, and that the appropriate thing to do was for the four chairpersons to assume responsibility for a continuing review to take place after the meeting ended. Also, it was decided that the most useful initial product of this review would be a revised table to replace the original SMRWG Table 2, and that writing text to go with the revised table could follow at a much later date.

In the weeks that followed the All Hands meeting, reports were received from the four panels, and a compilation was made showing the contributions of the panels and what had originally been shown by the SMRWG. In many instances, there were inconsistencies between the panels on various aspects of the listed requirements. This raised questions as to what should be shown at the NAR. As a short-term solution, and for convenience in terms of having a quickly available result for the NAR, a group of Goddard scientists from many Earth science disciplines was convened on May 14 and developed the compilation (dated June 12, 1989) that was shown at the NAR.

The next step in the evolutionary process of arriving at "the Eos science requirements" is further review and update by the Eos Investigator Working Group (IWG). Already scheduled are reviews by the combined hydrological/biogeochemical panel chaired by Eric Barron and the ocean processes panel chaired by Mark Abbott. Both panels will meet on October 10, the day before the full IWG meeting. Ultimately, all IWG members will be asked to review all the science requirements.

EosDIS Science Database

--Yun-Chi Lu

The newly formed Science Processing Support Office (SPSO) of the EosDIS Project announces the development of two products of general interest to the Eos science community. The first is a PC-based database available on floppy disk. The database provides summary information describing the instruments, investigators, and proposed data products. Menu-driven commands are used to access the database contents.

The second product is still being developed. It is an on-line database providing direct electronic access to the science data processing information. A prototype version, similar to the PC database, will be available for demonstration at the October IWG meeting in Pasadena. A more operational version is expected by April 1990. For additional information or to submit database comments, please contact Yun-Chi Lu at (301)286-4093 or YLU/GSFCMAIL.

Topical Issues in the Atmospheric Sciences

--Bill Grose

A workshop entitled "Topical Issues in the Atmospheric Sciences" was held in Williamsburg, Virginia, August 28-31, 1989. The workshop was organized by Dr. William L. Grose, an Eos Interdisciplinary Scientist, under the sponsorship of the Atmospheric Sciences Division, NASA Langley Research Center. At the workshop a small group of distinguished scientists explored, in depth, specific discipline areas within the atmospheric sciences, emphasizing recent observational and theoretical results, identifying significant scientific questions, and suggesting future research needs. Much in the spirit of Eos, emphasis was placed upon the interdisciplinary nature of current research problems.

ENGINEERING PIPELINE

Marty Donohoe, the Eos Instrument Systems Manager, has been holding reviews with each P.I. Instrument Investigator. His instrument management team and the investigations they manage are:

- Andy Dantzer--ENACEOS, CERES, IPEI, SAGE, EOSP, MISR, SOLSTICE
- Doug McLennan--GGI, HIRRLS, ALT, SCAT, MOPITT, GLRS, DLS, LAWS, TRACER
- Dick Weber--MODIS-N, MODIS-T
- Pete Pecori--AIRS, AMSU A/B, SEM, HIMSS, WBDCS, POEMS, ITIR, TIGER
- Scott Lambros--XIE
- Marty Donohoe--HIRIS, ACRIM

An additional instrument manager, Kenneth Anderson, will join the team in October. The Eos B instruments are not yet assigned to specific managers...Chris Scolese, the Eos System Engineer, is currently participating with the Space Station project to study a common design for the first two spacecraft (A and B)...Chuck MacKenzie, the Eos Project Manager, has announced that he will retire at the end of this calendar year...Jerry Madden, Project Manager of the GRO Project at GSFC, has been named as Chuck's replacement...Pete Burr, former Project Manager of UARS, and current Deputy Director of the Flight Projects Directorate at GSFC, has been made the Director of Flight Projects and is currently overseeing a transition team to examine the possible transfer of the Eos platforms from the Space Station project to the Eos project.

MODIS STATUS REPORT

--Vince Salomonson

The Moderate Resolution Imaging Spectrometer (MODIS) is a facility instrument to be flown on the first Earth Observing System (Eos) platform, scheduled for launch in the latter half of the 1990s. MODIS is divided into two components. One component is a nadir-scanning (110 degree scan angle) instrument called MODIS-N (nadir). This instrument is presently being designed to have 36 bands supporting observations of the land surface, oceans, and atmosphere in the visible (0.4-0.7 μm), near infrared (0.7-1.0 μm), short wave infrared (1.0-3.0 μm), and thermal infrared (3.0-15.0 μm). The other component, called MODIS-T (tilt), is a scanning instrument (90 degree scan angle) that can tilt fore and aft along the satellite track. Detailed Phase B design studies have been completed for both MODIS-N and -T; extended Phase B work is currently being done in-house on MODIS-T. The overall schedule involves intense preparations for the

advocacy of a 1991 "New Start" of Eos leading to the launch of the first Eos platform in late 1997.

Several important developments and recommendations resulted from a MODIS Science Team meeting held at Goddard Space Flight Center, July 5-7, 1989:

1. There should be more interaction among instrument team members and the Interdisciplinary Science Principal Investigators, to clarify data product and science requirements.
2. An 8.75 μm channel was recommended for MODIS-N; such a channel would serve both the land and atmosphere disciplines. (This has more recently been altered to 8.55 μm .)
3. The Eos Data and Information System (EosDIS) needs to publish at regular intervals the currently planned data products for each instrument, so that each team can effectively design its products to be congruent/complementary with other instrument products.
4. Tentative algorithm development assignments were made to team members.
5. The need for sensor simulation prior to launch was identified; a list of possible instruments providing simulations of value to MODIS was developed.

Since the MODIS Team meeting, some important recent developments have occurred:

1. The polarization and 214 meter resolution channels have been deleted from MODIS-N, although the decision regarding the 214 meter channels is still under review; the number of channels has been reduced from 40 to 36. This was a NASA Headquarters Eos Program Office decision.
2. The number of MODIS-T channels has been reduced from 64 to 32. This has been accomplished by moving the center wavelengths from 10 to 15 nm apart and limiting wavelengths to between 410 and 875 nm. The actual bandwidths will be between 10 and 15 nm.
3. Studies are continuing on other possible reductions in instrument size and weight, with particular emphasis on MODIS-T.

MODIS-N and -T have made good progress through the Phase B studies. The most significant challenges being faced at present involve minimizing power, weight, and total volume for the instrument and supporting systems, as well as minimizing total data volume. Both MODIS-N and T are scheduled to enter Phase C/D activities on or about January, 1991.

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MODIS-NADIR (N) SUMMARY

<u>Parameters</u>	<u>Design Specifications or Expected Performance</u>
Platform Altitude	705 km
IFOV	1.21 mrad (856 m) 0.607 mrad (428 m)
Swath	110°/2,330 km
Spectral Bands	36 bands total (20/0.4-3.0 μm ; 16/3-15 μm)
Radiometric Accuracy	2% to 1 μm 3% 1-3 μm 1% 3-15 μm
Quantization	12 bit
Polarization Sensitivity	2% max out to +45° scan and $\lambda < 2.2 \mu\text{m}$
Modulation Transfer Function	0.3 at Nyquist
S/N Performance (Selected Bands) (70° Solar Zenith/ Oceans)	830:1 (443 nm) 1200:1 (653 nm) 500:1 (865 nm)
NEAT Performance (Thermal Bands) @ 300 K/Window Bands	<0.05 K
Scan Efficiency	TBD
Integration Time	TBD
Size (approx)	1 x 1.6 x 1 m
Weight	~200 kg
Power	250 W
Peak Data Rate	10 Mbps (daytime)
Duty Cycle	100%

If you would like to receive a copy of the newsletter, please phone the Eos Support Office at Birch & Davis Associates, Inc. at (301) 589-6760.

MODIS-TILT (T) SUMMARY

<u>Parameters</u>	<u>Design Specifications or Expected Performance</u>
Platform Altitude	705 km
IFOV	1.56 mrad (1.1 km)
Swath	90°/1,500 km
Spectral Bands (13 nm width*)	32 (0.410-0.875 μm) (area array)
Radiometric Accuracy (abs)	2%
Quantization	12 bit
Polarization Sensitivity	<2.3%
Modulation Transfer Function	0.3 at Nyquist
S/N Performance (Spec, Selected Bands) (70° Solar Zenith)	820:1 (440 nm) 700:1 (620 nm) 510:1 (860 nm)
Scan Efficiency	25%
Integration Time	4 msec
Collecting Aperture (dia)	50 mm
Size (approx)	75 x 140 x 100 cm
Weight	100 kg (spec)
Power	150 W
Peak Data Rate	7 Mbps (day)
Duty Cycle	Daytime 100%

*Undetermined; expected to be between 11 and 14 nm.

We encourage you to submit articles & letters on subjects relevant to Eos and the Earth science community. They should be sent to:

The Earth Observer
c/o Eos Project Office
Code 600
Goddard Space Flight Center
Greenbelt, MD 20771

GUEST COLUMN

The June 16 issue of *Science* carried a review by Eliot Marshall, which gave a rather poor impression of the Eos "All Hands" meeting that was held last March. The following letter by Dr. Gerald Soffen, the Eos Project Scientist, was written to provide a more reasonable perspective on the meeting. (Dr. Soffen's letter appeared in the August 18 issue.)

"Eliot Marshall (News & Comment, 16 June, p. 128) describes our first Earth Observing System (Eos) meeting as an "inquisition." Was I perhaps at some other meeting?"

In response to an Eos Announcement of Opportunity sent around the world, NASA received hundreds of proposals from interested scientists in all fields of Earth science who want to play a major role in this mission. About 150 investigators were selected this past February. In March, we held our first All Hands meeting at the Goddard Space Flight Center for the selected scientists to meet one another and exchange ideas for a few days, since they will be sharing data with one another for the next two decades. About 500 scientists and their collaborators attended; the numbers were limited only by the size of our largest auditorium. I had numerous calls from attendees praising the favorable climate for freedom of expression and the openness of questioning.

Marshall focuses on some minor remarks about the need for support for graduate students in competition with funds for "satellite building." This need is not really in dispute. One needs to consider the complexities of the scientific issues and the ambitious step forward that is Eos. Of course training the next generation of students is important. In NASA we have recognized the need for new talent and advancing beyond the hardware issues that we do understand. We must now address the problem of understanding the Earth as a planetary body if we are going to learn to predict this changing system. The primary goal of Eos is directed toward understanding the Earth on the global scale; the data, not the hardware, are the hallmark of Eos.

Marshall does not report the key role in Eos to be played by the 28 Interdisciplinary Investigator teams that were selected for Eos. The Interdisciplinary Investigators have specifically been brought into Eos early, long before any hardware is built or flown, to aid in the scientific direction of Eos and to see that the unprecedented flow of Eos data will indeed become scientific information to be placed at the service, ultimately, of mankind. The Interdisciplinary Scientists will guide the development of the data and information system. They are expected to use all data from the Eos instruments and to publish their results in the open literature. Their work is to lead to the development or improvement of theoretical models that will shed further light on the Earth as a system. Eos Interdisciplinary Scientists come from a multitude of universities and national research organizations from around the western world.

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HIGHLIGHTS AND SPOTLIGHTS

- The Non-Advocate Review (NAR) was held June 12-16 as a six-segment review: management, science, systems engineering, instruments, EosDIS, and resources. The NAR Committee reported to NASA Headquarters on July 11. The Eos Project Office was highly complimented for its accomplishments. Specific recommendations were made regarding each of the segments. In the science part the Committee recommended that NASA prioritize the science goals. This process is currently underway. (See accompanying article on page 1.)
- The US/USSR Joint Working Group on Earth Sciences, co-chaired by Dr. Tilford for the US and Dr. Kondratiev for the USSR, held its second meeting in Washington, DC, July 17-21. The group agreed to cooperate in two sub-orbital experiments related to land-atmosphere interactions, outlined plans for a joint research program in volcanology, and agreed to cooperate in studies of changes in the Earth's cryosphere in response to global climate warming. Both sides noted with satisfaction the progress achieved in the preparation of the US Total Ozone Mapping Spectrometer to be flown on the Soviet Meteor 3 spacecraft in the second half of 1991. Both sides expressed support for continued interaction between the US and USSR in oceanographic research related to understanding ocean processes of importance in global change.

A protocol was drafted that calls for numerous joint activities. Wes Huntress of NASA Headquarters is the point of contact.

- The IWG Science Executive Committee (SEC) met on July 21 and discussed the NAR, the science priorities, the IWG charter, and the agenda for the October IWG meeting. The SEC will meet again in Washington, DC on September 14, 1989.
- Jeff Dozier and members of the Data Panel attended a four-day review of EosDIS Phase B contractor presentations by Hughes and TRW, on July 25-28. The Panel has prepared a response to the review from the science point of view. A report will be distributed at the October IWG meeting. It may also be obtained from Dr. Dozier upon request.
- Dr. Len Fisk, Associate Administrator of Code E, presented his "New Start" request to the Administrator of NASA, Adm. Richard Truly, on July 31. Code EE is looking forward to a formal New Start announcement in the President's Budget, on or about January 20, 1990. There are strong indications that the Eos Project has done well so far, as it travels through the government pipeline.
- MODIS, HIRIS, SAR, AIRS, LAWS, and GLRS have all held team meetings to establish their instrument parameters. Additional meetings are planned for the fall.

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Guest Column

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All of us have come to recognize the urgency and importance of Earth science in the next century, and we have little time for distraction. All of the ideas reported by Marshall are good: James Hansen's, Dixon Butler's, Francis Bretherton's, and those of the 500 who attended this meeting and the thousands who will use the Eos data. Our problem is sorting and establishing the priorities, finding out the missing pieces of the puzzle, deciding those we can afford, and encouraging participation by partners nationally and internationally who can help and contribute.

What did the meeting produce? More scientific insight, organization into scientific teams, and plans for developing our scientific strategy.

In the next century the nations of the world will depend on understanding this unique and fragile planet on which we live."

Highlights...

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- NASDA (Japan) and ESA (Europe) have been active in developing their respective missions. Members of the TIGER team have been in contact with the Japanese agency (MITI) responsible for the ITIR instrument.
- Reinhard Beer, P.I. of the TES Investigation, made a presentation to the Eos Program Office to describe recent tropospheric data obtained from the balloon flight of an interferometer that is a precursor to the TES instrument.
- The MODIS team held a series of meetings to identify requirements, engineering problems, and trade-offs. Many items were resolved. Those that were not were referred to NASA Headquarters. Specific changes that were made are reported in this edition of *The Earth Observer* by Vince Salomonson, the MODIS Team Leader. (See page 4.)

UPCOMING MEETINGS

Topic: On Global Warming
Date: September 29-30, 1989
Location: Virginia Polytechnic Institute and State University, Blacksburg, VA
Contact: John Cairns, Paul Zweifel, Co-Chairs

Topic: Hydrological Cycle/Biogeochemical Cycles Panel Meeting
Date: October 10, 1989
Location: JPL, Pasadena, CA
Contact: Eric Barron (Penn State), Chair (814) 865-1619

Topic: Ocean Processes
Date: October 10, 1989
Location: JPL, Pasadena, CA
Contact: Mark Abbott (Oregon State University), Chair (503) 737-4045

Topic: Second Eos Investigators Working Group (IWG) Meeting
Date: October 11-13, 1989
Location: JPL, Pasadena, CA
Contact: Gerald Soffen (GSFC), Stan Wilson (NASA HQ), Co-Chairs (301) 286-9690, (202) 453-1725

Topic: AIRS Facility Instrument Team Meeting
Date: October 16-17, 1989
Location: JPL, Pasadena, CA
Contact: George Aumann (JPL), (818) 584-2934

Topic: GLRS Facility Instrument Team Meeting
Date: October 16-17, 1989
Location: GSFC, Bldg. 26, Rm. 212
Contact: Steve Cohen (GSFC), Team Leader (301) 286-8826

Topic: TOPEX/Poseidon Science Working Team
Date: October 17-20, 1989
Location: Toulouse, France
Contact: Michele Dorrer, Omnet: M.DORRER

Topic: Modeling the Global Carbon Cycle, a study conference organized by the IGBP Coordinating Panel on Global Analysis, Interpretation, and Modeling
Date: October 18-20, 1989
Location: Heidelberg, FRG
Contact: IGBP Secretariat, Royal Swedish Academy of Sciences, Box 50005, S-104 Stockholm, Sweden

Topic: Symposium on Impact of Climate Change in the Arctic
Date: October 25-27, 1989
Location: Ottawa, Canada
Contact: Jim McCulloch, 15 Elmsy Dr., Richmond Hill, Ontario, L4C 8N2, Canada

Topic: National Conference on Geosphere-Biosphere Changes in Southern Africa
Date: December 4-8, 1989
Location: University of Capetown, South Africa
Contact: The South African IGBP Secretariat, Foundation for Research and Development, CSIR, P.O. Box 295, Pretoria 0001, South Africa

Topic: Ninth Miami International Congress on Energy and Environment
Date: December 11-13, 1989
Location: Miami Beach, FL
Contact: Lucille Walter, 9MICEE Coordinator, Clean Energy Research Institute, University of Miami, Coral Gables, FL, 33124

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