The Earth Observer

An EOS Periodical of Timely News and Events

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EDITOR'S CORNER

What Happened to the Payload Announcement?

We apologize for the state of uncertainty surrounding the payload for the EOS-A observatory. The Conceptual Design and Cost Reviews (CDCRs) for the A observatory, the meeting of the Payload Panel in New Hampshire in August, the Headquarter's Retreat in early September, and the presentation to the OSSA Steering Committee in late September were all targeted to an announcement of the EOS-A payload in the early Fall of 1990. Yet, in mid-December, we still had not had an announcement.

Still at issue are the run-out budgets for the EOS-A observatory and its instruments, the EOS-B payload, EOSDIS, and the science investigations. The budgets, the scheduled 1998 launch for EOS-A, and the planned payload must be consistent. Therefore, the announcement is delayed until we have firmer assurance from the Office of Management and Budget (OMB) that requests for the needed monies will be supported by the President. EOS has a "New Start." But we still need to reach agreement among the EOS investigators, the science community, the NASA Administration, OMB, the White House, and the Congress on the components and goals of the mission. The EOS IWG has articulated clearly the important science questions addressed by components of the A-payload, but these must be reconciled with the schedule and funding profile.

What About EOS-B?

Given these constraints and the delay in the A-payload announcement, there is no need for haste in the Science Reviews and CDCRs for the B-payload. Moreover, the National Academy's assessment of the Global Change Research Program has directed NASA to thoroughly explore other launch options than a single platform. Accordingly, I have been in touch with several IWG panels about questions to be addressed in the January/February time-frame. Following the selection of instruments for the EOS-A series, some scientific questions must be answered to constrain options for the deployment of other EOS instruments needed to study global change.

Two options are under consideration for the EOS-B platforms. The baseline approach is for the EOS-B series platforms to be copies of the EOS-A platforms with identical capabilities but with a different payload. The alternative is to implement the EOS-B series of platforms through development of smaller satellites. With this array of potential flight opportunities, we must consider what grouping requirements exist among subsets of possible instruments and what orbits best meet requirements for various measurements.

Jeff Dozier
EOS Project Scientist

FOURTH IWG MEETING TAKES PLACE IN HAMPTON, VIRGINIA

(Home of NASA's Langley Research Center)

The EOS Investigators Working Group (IWG) held its fourth meeting in Hampton, Virginia on November 6,7, and 8. In a novel format, the first day's meeting took place on Tuesday at the Holiday Inn in Hampton, and was devoted to sessions of the IWG panels plus a meeting of the AIRS facility team. Plenary sessions were held on Wednesday and Thursday at the Langley Research Center (LaRC).

The Wednesday morning plenary session opened with introductory welcoming remarks from the LaRC director, Richard Petersen, who was followed by Shelby Tilford, Director of NASA's Earth Science and Applications Division (ESAD). Tilford reported that we have won a "major battle," having achieved our "New Start" approval from Congress providing for both the "A" and "B" series of long-term observations of planet Earth. EOS is to be implemented at a funding level significantly above the ten-percent annual increase limit that is being imposed on the rest of NASA as part of the five-year budget agreement.

Tilford also said that the National Academy of Sciences, Office of Management and Budget, and Congress are united in urging that NASA maintain fairly rapid development of the EOS Data and Information System (EOSDIS). There is still uncertainty as to whether we will go ahead with a single large platform for the B series of observations or adopt the "cluster" approach. There will probably not be any EOS attached payloads on Space Station. The Japanese EOS platform is now planned to have a 55-degree inclination orbit. The Earth Probes budget has been increased—TRMM and SeaWIFS are to be initiated, and at least four versions of TOMS are to fly.

Stan Wilson, EOS Program Scientist, discussed the new assignments at NASA Headquarters for managers of the interdisciplinary investigations (IDS) and the instrument investigations. He noted that the IDS funding for FY 91 has been settled and site visits to the IDS institutions are being planned.

Jerry Madden, the EOS Project Manager, announced that Chris Scolese, of Goddard Space Flight Center, is now the EOS Observatory Manager. Madden added that EOS was to be reviewed by the special panel headed by Norman Augustine and the presenters were to be Jeff Dozier, the EOS Project Scientist, and Tom Taylor, the EOS Ground System and Operations Project Manager.

Jeff Dozier introduced himself as the new full-time EOS Project Scientist, replacing Jerry Soffen who is now the manager of the Goddard University Affairs Office. Dozier said that after the B instrument selections have been made there will be "Comprehensive Science Forums" to review in depth the science to be provided by the selected instruments, both A and B.

Dozier also discussed the status of EOSDIS. Associate Administrator Len Fisk has promised that EOSDIS will be functioning in FY 94. The official RFP for EOSDIS is to be released in February 1991, and the winning contractor is to be selected by the Fall of 1991. Version "0" of EOSDIS is now being developed. It's objective is to make existing data sets available to the scientific community.

At the Thursday morning plenary session, Jeff Dozier addressed plans for "science reviews" to be held in connection with the B platform Conceptual Design and Cost Reviews (CDCRs). These reviews will probably be held a month or so earlier than the CDCRs, with one day set aside for each instrument science review. One intended result of the reviews would be a clearer understanding by the data users of how geophysical and biological information is derived from the physical measurements.

Dixon Butler, Chief, Advanced Missions and Interdisciplinary Science, ESAD, substituted for Greg Hunolt. He described current activities regarding Pathfinder data sets. The Pathfinder activity is to get under way as of November 12, 1990 and, so far, data from AVHRR, GOES, and TOVS are included, with SSM/I data next in line. The processed data will be distributed on SONY optical disks. By November 1991, all the Level 1 Global Area Coverage (GAC) data from AVHRR for the period 1981 to 1990 should be available on optical disk. For the period April 1987 to 1988, the highest priority will be given to Level 2 Vegetation Index and sea-surface temperature data.

Berrien Moore, chairman of the Payload Advisory Panel, gave the status of the panel's activities and its plans for next year. A topic for discussion at the next panel meeting will be participation in the science reviews of the B candidate instruments. (These reviews were discussed previously by Jeff Dozier.) The panel will also have its own short reviews of each of the B candidate instruments and will discuss "boundary" issues such as orbit choices, possible instrument clusters for the B mission, and European Space Agency and Japanese plans for their EOS missions.

The panel will meet again in May and have a final meeting in late August or early September, either at the University of New Hampshire or at the University of California, Santa Barbara. Moore said that the panel will have only one letter of recommendation to Dr. Fisk. (The panel's recommendations for the A payload had appeared in both draft and then final letters to Dr. Fisk.)

In addition to the more-formal presentations just described, there were short talks by the Principle Investigators and Team Leaders of almost all the facility and candidate PI instrument teams. A few notable points from these talks are given here:

- Anne Kahle announced that ITIR is now to be known as ASTER—the Advanced Spaceborne Thermal Emission and Reflection Radiometer

- Stan Wilson and Marty Donohoe said that NASA would like to propose eight U.S. candidates for the MIMR science team that will be established by ESA. (These people had previously been team members for the Japanese passive microwave instrument AMSR.)

- Dave Diner invited recommendations for additional *local mode* sites to be observed by the MISR instrument. He now has about 60 such sites.

Renny Greenstone
EOS Project Science Support Office
ST Systems Corporation

SEC MEETS IN HAMPTON, VA.

The Science Executive Committee (SEC) of the EOS Investigators Working Group met at the Holiday Inn in Hampton, Virginia on the evening of November 7, 1990. The meeting was held in conjunction with the fourth EOS IWG meeting (see companion article). Stan Wilson, EOS Program Scientist, and Jeff Dozier, EOS Project Scientist, co-chaired the meeting. Agenda items were these: adequacy of panel organization, responses to data policy, panel reports, linking interdisciplinary science (IDS) and instrument investigations, and date/location/agenda for future IWG meetings.

Bryan Isacks addressed the "adequacy of panel organization." He pointed to the considerable overlap that exists among a number of the current IWG panels, all dealing to some extent with land/atmosphere interactions: Atmosphere, Land/Biosphere, Biogeochemical Cycles, Physical Climate and Hydrology, and Solid Earth. On the other hand EOS science divides very neatly into atmospheric studies, atmosphere/ocean studies, atmosphere/land studies, and integrating global modeling studies. Isacks proposed that there be a restructuring of the panels to take better account of the natural interdisciplinary research groupings.

Rod Heelis added that there is a feeling among its members that the Particles and Fields Panel would be better served if the members were dispersed among the other panels. Then they would find themselves more involved in the planning to conduct EOS "Earth" science.

The responses that have been received regarding EOS data policy show a degree of confusion among the investigators as to what is required by NASA, particularly in regard to fast turnaround for EOSDIS. Shelby Tilford is concerned that there be an expedi-

tious flow of data through the system. It should be viewed as semi-operational. On the other hand, it was acknowledged that there has to be a checkout period to validate the data before it is made routinely available. Mark Abbott urged that there be a split between standard products that are routinely produced and those that are produced only on demand. Shelby Tilford endorsed a recommendation to have a tutorial on data policy, and the confirmation letters to the EOS investigators are to say that the data policy is expected to evolve.

Highlights from the panel reports follow:

- The Calibration/Validation Panel has established a peer-review mechanism to be followed at the Conceptual Design and Cost Reviews (CDCRs)

- The Land/Biosphere and Biogeochemical Cycles Panels had a joint meeting at which they expressed the need for Vegetation Index data on 5-to-10 day intervals. They also approved the 705-km orbit, and advocated a morning crossing time for the EOS platforms as the best choice to minimize cloudiness during observations. The Mission Design Panel is still studying the crossing-time issue.

- Members of the Biogeochemical Cycles Panel expressed concern with inadequate funding for aircraft support and occasional inadequate coordination of the support. Shelby Tilford said that he will take care of the flight coordination problem. Stan Wilson noted that expenses for IDS flights in calendar year 1991 will come out of the IDS FY 91 grants.

- Berrien Moore listed proposed meeting dates of the Payload Advisory Panel. The next meeting will be in May, and there will be a final panel meeting in late-August or September to prepare final recommendations on the B payload.

- The Modeling Panel had a joint meeting with the Atmospheres Panel where Ricky Rood and Ray Bates presented their stratospheric and general circulation data-assimilation models, respectively.

- The Oceans Panel is generally indifferent to the choice of platform crossing times to minimize cloudiness. They are concerned to get the "hard" facts on ESA instrumentation for the EOS platforms.

- In addition to hearing the data-assimilation modeling presentations, the Atmospheres Panel had presentations on SWIRLS, TES, SAFIRE, and MLS concerning possible descoping of each of these instruments. It was noted that SWIRLS PI, Dan McCleese, is to lead a small independent study group to study the EOS atmospheric measurement strategy. Dixon Butler said that there might be a need for a special study on the needs for, and methods of, achieving aerosol measurements.

- The Physical Climate and Hydrology Panel has begun preparation of a science plan and is also considering holding a general science meeting next summer, which will bring in Co-Investigators and team members, people who do not ordinarily come to IWG meetings.

- Jeff Dozier discussed the linkage of IDS and instrument investigators. The Comprehensive Science Forums, to be held in 1992, will bring both groups together by clarifying what products are needed and what measurements can be made to meet these requirements. Stan Wilson stated that a possible unifying theme would be the need to determine rainfall over South America—it is the subject of several diverse IDS investigations.

Plans for future meetings of the IWG are still tentative. The SEC's next meeting will be at the end of February in Washington, D.C.

Renny Greenstone
EOS Project Science Support Office
ST Systems Corporation

The Earth Observer is published by the EOS Project Science Office, Code 900, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, telephone (301) 286-3411, FAX (301) 286-3884. Correspondence may be directed to Charlotte Griner at the above address. Articles, contributions to the meeting calendar, and suggestions are welcomed. Contributions to the meeting calendar should contain location, person to contact, and telephone number. Deadline for all submissions is the 20th of each month.

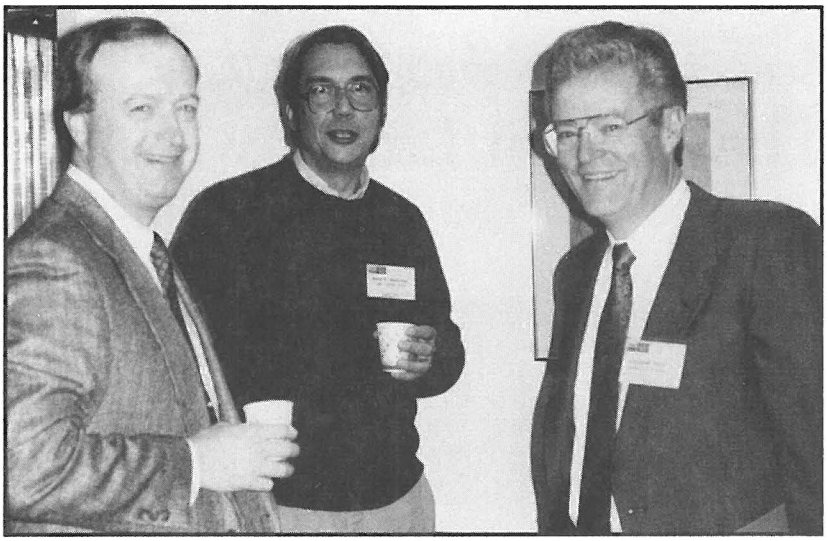
Scenes from November 6, 7, & 8
The IWG at Langley . . .

Jeff Dozier

Shelby Tilford (l) and Berrien Moore

(l to r) Ashok Kaveeshwar, Milt Halem, Wayman Baker, Mous Chahine and Richard Bishop

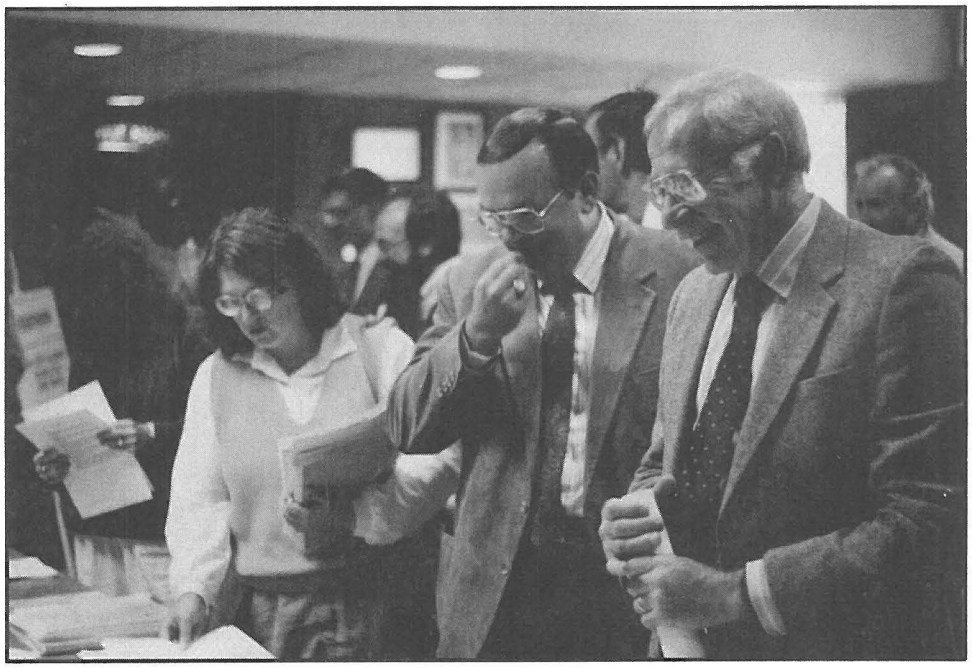
(l to r) John Gille, John Barnett, Doug McLennan and Shelby Tilford



(l to r) Darrel Williams, Bruce Barkstrom and Alexander Goetz smile for the camera.

Barbara Walton and Bill Browne discuss proceedings during a break.

(l to r) Bruce Guenther, Bill Barnes, Les Thompson, and Dot Zukor



The paper trail began here, with registration. Alex Tuyahov and Ray Roberts (r) decide what materials to take.

PANEL REPORT

Minutes of the EOS Oceans Panel

The EOS Oceans Panel met in advance of the EOS IWG meeting in Hampton, Virginia on November 6, 1990. The purpose was to review the present status of EOS, especially the payload for EOS-A, and to discuss issues related to an EOS science plan.

The meeting began with a brief review of the present status of the NASA budget in regard to Earth Probes. It was noted that roughly $31M was added to the Earth Probes line (for a total of $56M). Funds for TOPEX/POSEIDON, NSCAT, and SeaWiFS were included. There is to be a full, competitive procurement for SeaWiFS, resulting in a delay of about one year, with a possible launch in late 1993. TOPEX and NSCAT are moving ahead, barring any unforeseen problems.

Although there is no firm decision yet on the EOS-A payload, we briefly reviewed the latest recommendations from the EOS Payload Panel. Some discussion was held concerning the status of various ocean-related EOS instruments. MODIS-T has been descoped somewhat in the areas of spectral and spatial resolution. The problem of "composite" mode for scenes containing both land and ocean pixels has been resolved. The SNR of MODIS-T is well within the ocean specifications. MODIS-N is having difficulty meeting on-board calibration specifications and suffers in comparison to the ESA infrared instruments. MODIS team members, Otis Brown and Ian Barton, have noted this point, and the EOS Oceans Panel recommends that the MODIS team continue to work with Brown and Barton to resolve this issue. Sea surface temperature is a critical variable in the global climate cycle, and it must be determined accurately. The altimeter team made recommendations concerning the need for continuing TOPEX/POSEIDON-quality altimeter measurements in the EOS time frame to study global changes in ocean circulation, sea level, and ice sheets. They recommended that continuing study be made of the repeat-track capabilities of the polar platforms (including the ESA platform) to see if altimetric requirements can be met. They also recommended that NASA continue to pursue opportunities for altimetric missions using free flyers.

The discussion of the European passive microwave instrument, MIMR, opened up the whole area of ESA instruments relevant to ocean studies. MERIS, which has been suggested in the past to be a possible replacement for MODIS-T, was discussed. It was thought until recently that MERIS could not tilt, thus seriously reducing its ability to collect global ocean color observations. (It would take approximately 10 days to collect complete, glint-free coverage at the equator.) The latest documents from ESA show that MERIS can indeed tilt, which would eliminate this particular objection. However, there remain serious concerns regarding SNR and calibration. Also, MERIS will not be able to collect any data over land because of its low saturating radiances. AMI-2, the combination SAR/scatterometer instrument on the ESA platform, will evidently be two separate instruments so that scatterometer measurements will be collected continuously. However, it has not been decided whether the scatterometer will be a one-sided or two-sided instrument. This has serious implications in terms of coverage. The panel noted that ESA instruments will play a crucial role in global ocean studies, as they will significantly increase data coverage. However, NASA has not provided much information to date, and most of our contacts have been through our ESA scientific colleagues. We strongly recommend that NASA collect such information on a regular basis (perhaps every 3-4 months) and provide it to the U. S. EOS community.

David Schimel of the EOS Biogeochemistry Panel provided a brief overview of the issues concerning orbit crossing time and cloudiness. The land community would like to move EOS-A to a 10:30 a.m. equator crossing time to reduce the impact of clouds. Some data produced by Piers Sellers shows that the diel cycle of cloudiness over the ocean varies from region to region. For example, eastern boundary current regions tend to be cloudier in the morning while western boundary current regions are cloudier in the afternoon. However, the change in cloudiness is slight; it is usually cloudy over the ocean! Thus the panel expressed no opposition to a morning crossing time. It was noted that EOS-A should follow the ESA platform by at least 0.5 hours in order to improve scatterometer coverage of surface winds, assuming EOS-A will carry STIKSCAT.

The panel discussed the present GSFC data products list (>2300 data products). There are many duplications, and many of the products are either not "standard" or cannot be done. The Oceans Panel has

produced a "scrubbed" list of about 20 products that are based on realistic expectations of instrument performance and algorithm capabilities, but the EOS Project has not adopted this list. An alternative would be to use the product lists provided by each candidate instrument at the CDCRs.

The issue of "standard" versus "research" products was also discussed. It is likely that the research products will be the most intensively used by the scientific community as they will represent the cutting-edge science. At present, EOSDIS has isolated these products within the PI's science computing facilities (SCFs). In an attempt to reduce both the number of standard products and to increase the awareness of the research products, the panel recommends that a third category of data products ("candidate" standard products) be established. These products would require less support from EOSDIS (such as browse, etc.) and less support from the PI (in terms of documentation, etc.) but would still be produced within EOSDIS. As these candidate products are evaluated, they would eventually move into the standard product category.

The comprehensive science forums (CSFs) proposed by Jeff Dozier should alleviate the present gap of understanding between the data users and producers. However, the panel recommends that a special panel be established to study the issues related to data products and to coordinate the forums. There are several policy issues (such as where are research products produced and who is responsible for standard products) that will need to be addressed. As these issues will significantly affect budgets (sizing of EOSDIS and SCFs) and algorithm validation/calibration efforts in advance of the launch of EOS-A, they should be resolved soon. This panel could also address the issues raised by the software standards guide recently issued by the EOS Project.

The role of the EOS science plan was discussed at length. It is essential that the EOS Program articulate the purpose and audience of the document. Stan Wilson, EOS Program Scientist, noted that the science plan would not be a "glossy brochure" nor would it be used for "ranking" science projects. Rather, the document would be used to show how various EOS science activities fit together and address major Earth science goals. It was decided that rather than putting together another document showing the role of the ocean in global processes, the panel would focus on piecing together the funded EOS ocean science activities from the interdisciplinary investigators, the facility team members, and the PI instrument team members. The latter proposals will need to be acquired from the EOS Project.

The next section of the science plan would develop several "prototype" science questions or scenarios that would show how the various EOS and non-EOS resources would be used in a specific study. Lastly, the science plan would identify critical issues that need additional research. An example was the estimation of air/sea fluxes of heat, momentum, and materials (such as carbon dioxide). Surface fluxes are required for a number of studies involving ocean, atmosphere, and climate studies, and they cannot be considered "standard" products at the present time.

The panel recommends that the EOS Project office support a *focused workshop* on fluxes, focusing on estimates made on daily, weekly, and monthly time scales. Such a workshop would involve both instrument and non-instrument PIs. The goals of the workshop would be to describe the present state of knowledge and directions for future research. We recommend that such a workshop be held in the next 9-12 months.

The panel discussed the need for a strategic plan for EOS. In order to use the PIs more effectively, it is essential that the EOS Program define the overall structure of the program with an associated time schedule. For example, certain activities need to be accomplished by particular dates. What information is needed from the EOS investigators to complete these activities? In essence, we need a "roadmap" of where we are going within the program. Development of the roadmap will likely require a more proactive Science Executive Committee working on behalf of the EOS researchers.

A brief discussion was held on upcoming field programs and their relationship to Earth Probe missions. In particular, the Joint Global Ocean Flux Study (JGOFS) will require access to the SeaWiFS data set, and JGOFS data will be essential for algorithm development, validation, and sensor calibration for SeaWiFS. Active linkage to EOSDIS (perhaps through the Version 0 activity) needs to be pursued. Although much of the data transfer will be between individual scientists, we need formal procedures for access to the "global"

data sets, such as the JGOFS global pigment survey. Similar arrangements need to be made for the WOCE/TOGA data sets.

A brief review was given of the EOSDIS Version 0 activity. This project will incorporate much of the experience learned at the various NASA "Pilot" data centers. The focus is on connectivity between the data centers and access to new data sets (the so-called Pathfinder data sets). There was concern that much of this project might be taken up by interesting "information system" activities, rather than concentrating on improving access to science data. Each DAAC (Distributed Active Archive Center) will have a science oversight committee that will ensure that the DAAC meets Earth science needs, rather than information science needs. The Oceans Panel will be asked to nominate individuals for service on the NODS DAAC oversight panel.

Mark Abbott
Oceans Panel Chair

AIRS Science Team

The AIRS Science Team held an all-day meeting on November 6, 1990, at the Holiday Inn, Hampton, Virginia. It was attended by 12 of the 15 science team members and 14 observers from NASA HQ, GSFC and industry. Dr. Mous Chahine, the AIRS facility science team leader, gave the overview of science and measurement requirements status. Fred O'Callaghan, the AIRS project manager, gave an overview of the hardware status. The following key points were discussed at the meeting:

- The EOS-A instrument selection has not been announced. AIRS, together with AMSU is on the top of the candidate list.

- An updated AIRS Science and Measurement Requirements booklet is available on request from the AIRS project office at JPL. It includes a brief description of the AIRS science background, hardware design concept, the AIRS data products and ground data system.

- The entire 2 Mbit/sec data from AIRS is transmitted to White Sands and processed by EOSDIS. The current platform concept also calls for continuous broadcast on X-band to any interested X-band ground station.

- The AMSU A1 and A2 will be on EOS A, but without the AMSU-C modification (the stratospheric channels). AMSU-B will be on the payload, if it is provided by EUMETSAT in a timely manner.

- Two changes to the measurement requirements were requested by NASA HQ and were accepted with concurrence of the team:

  - The spectral coverage of AIRS is now contiguous from 3.4 to 15.4 micron. Originally it extended from 3.4 to 17 micron with 118 specific channels.

  - The 15 micron NEDeltaT requirement for a 250K scene temperature was changed to 0.35K for a single FOV, with NEDeltaT=0.2K as a goal. The requirement for NEDeltaT=0.2K at the shorter wavelengths remains unchanged.

- The AIRS Phase B hardware contract is on schedule and cost. It will terminate at the end of December 1990 with the transition to the phase C/D contract with LORAL in Lexington, Masachusetts (previously known as Honeywell Electro-Optics Division).

- The current design concept of AIRS meets all measurement requirements. It is based on a producible design and realistic technology assumptions and provides a balanced performance/risk approach.

- During the Phase B study, all key hardware issues have been analyzed to provide a realistic cost estimate. AIRS has passed a system requirements review, a conceptual design review and cost review at NASA HQ.

- JPL has received the execution phase proposal from LORAL. The contract is now in the negotiation phase.

- The AIRS HgCdTe detector arrays are cooled to about 60K with active coolers. The mechanical coupling of two active coolers at JPL shows that vibration cancellation to the required level is feasible.

- The latest detector tests indicate that the focal plane can be populated with HgCdTe PV arrays from 3.4 to 14.6 micron and PC arrays from 14.6 to 15.4 microns. The original PV/PC cross-over occurred at 13.6 microns.

The next team meeting was tentatively scheduled for two days in February 1991 in Pasadena, California, with a specific date to be announced.

H. H. Aumann
AIRS Team

3RD TOPEX/POSEIDON SCIENCE WORKING TEAM MEETING

The third meeting of the TOPEX/POSEIDON Science Working Team (SWT), (Interim EOS Altimeter Science Team) was held at the Holiday Inn Georgetown in Washington DC, on October 2-5, 1990. The main objective of the meeting was to review the status of our understanding of the altimetry system in making precise measurements of sea level. The goal was to provide a forum for discussing key issues in various components of the altimetry measurement system so that the team could be well prepared for the use of the TOPEX/POSEIDON data.

The team was first welcomed by Dr. Dixon Butler of NASA Headquarters on behalf of NASA's Associate Administrator, Dr. Lennard Fisk. Dr. Butler addressed the importance of TOPEX/POSEIDON in NASA's long-range plans for earth sciences. The rest of the first morning was devoted to reports by the Program and Project Managers on the status of the mission, and to reports on other programs and projects that are relevant to TOPEX/POSEIDON, including WOCE, TOGA, ERS-1, Geosat Follow-on, EOS Altimeter, and the International Space Year.

Brief reports on the subcommittee activities were delivered in the early afternoon of the first day. The rest of the meeting was conducted as a series of technical sessions focused on various aspects of altimetry measurement system and data applications. The following are the session names and the corresponding chairpersons:

DORIS Status and & Ionospheric Correction
P. Escudier

Precision Orbit Determination
B. Tapley

Geoid
R. Rapp

Monitoring Sea Level from Altimetry
J. Minster

Topospheric Corrections
A. Ratier

Atmospheric Pressure Loading
C. Wunsch

Ocean Tide Models
C. Le Provost

Sea-State Bias
L.-L. Fu

Modelling and DataAssimilation
W. Holland

Each session featured 4-9 presentations followed by discussions. It is apparent that a great deal of progress has been made in each of these areas. Directions for future work have also been identified.

A discussion on post-TOPEX/POSEIDON altimetry missions during the EOS time frame was led by M. Lefebvre and L. L. Fu. The team has adopted a resolution that urges the international space agencies to ensure the continuity of high-quality (with TOPEX/POSEIDON standard) altimetric sea level measurement for an extended period of time (> 15 years) to study the global changes in ocean circulation and sea level.

R. Rapp led a discussion on future spaceborne gravity missions. The team has recognized the critical importance of a gravity mission for obtaining an accurate geoid, and has adopted a resolution that urges

the international space agencies to attach high priority to the ARISTOTELES Mission.

Of the 38 investigation teams, 33 were represented in the meeting. On average, about 80-90 investigators and program/project personnel were in attendance. A working dinner was held the evening of October 2 at the Holiday Inn, allowing more interaction among the attendees in a relaxed atmosphere. The evening of October 4, the SWT was invited by Fairchild Space to visit its Germantown facility. During the visit, the SWT was briefed on the status of the TOPEX/POSEIDON spacecraft and viewed the flight hardware under construction.

A more detailed report of the results of the meeting is available from the author at the following address: Mail Stop 300-323, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109 (Telemail: L.FU/OMNET)

L. L. Fu
Interim Altimeter Team Leader

TES TEAM MEETS

The 2nd Science Tropospheric Emission Spectrometer (TES) Science Team meeting was held at Atmospheric & Environmental Research Inc., Cambridge, MA. on October 23 and 24, 1990. In addition to most of the co-investigators, members of the JPL engineering and project staff attended, as well as representatives from the GSFC Project and HQ Program offices.

Conceptual Design

The JPL Design Team presented the changes in the instrument concept that have occurred over the past year (see the EOS Reference Handbook for the baseline concept). Some of the changes were as a consequence of design maturation, some at the request of the co-investigators and the IWG, and some as a result of the verbal instruction given at the March 1990 IWG to TES, SWIRLS, MLS and SAFIRE to investigate descoping.

A major change to TES has been the introduction of interchangeable foreoptics to permit both high-resolution (0.5 x 5 km) targeted observations of localized and transient phenomena (pollution episodes, volcanos, etc.) in 32 contiguous pixels and also a monthly global-gridded survey mode with a 50 x 150 km footprint. The survey will encompass every detectable species (including 0_3, CO, CH_4, H_2O and NO_y) pertinent to tropospheric chemistry, troposphere-biosphere interactions and troposphere-stratosphere exchange. In addition, the problem of concatenating limb and nadir observations has been addressed by moving the limb observations to a trailing in-track position: limb data can be co-located with nadir views with a time delay of only 7 minutes.

In the arena of "descoping", several actions have been taken:

- It has been decided to replace the He/Ne control laser by a solid-state Nd:YAG system with a consequent improvement in reliability and a reduction in weight and power. Simultaneously, the TES filter set has been revisited and the total number (across 4 detector arrays) reduced from 17 to 13 with only minor science impacts. Indeed, it has proven possible to add a filter specifically to detect volcanic HF, although the same filter will also be useful for additional measurements of CO and CH_4, in the lower troposphere. One benefit of these changes has been a significant reduction in data rate.

- It has been decided to eliminate the integral star-tracker from TES and to rely on the platform itself for attitude information. While this reduces our ability to perform controlled pointing to no better than ±1 pixel, it was judged that the substantial reduction in resource requirements that ensues makes this descoping worthwhile.

- Provided that TES can be accommodated on the "cold" side of the platform, we can eliminate 2 Stirling-cycle coolers and employ radiative cooling to keep the spectrometer optics at 150 K. The reduction in power requirements would be substantial.

A number of other changes have been made to the design, but these three are the most scientifically significant.

Objectives and Data Products

A major topic of discussion was a "tightening" of the science objectives and the definition of the consequent data products. The outcome is shown as Figures 1 and 2. This led naturally into the subject of cloud interference and detection. It was agreed that:

- SAGE data gives us good confidence that our limb observations will regularly penetrate down to at least the mid-troposphere and offer a potent capability for the measurement of important trace constituents (including species such as pernitric acid, HNO_4).

- Dense clouds in the field-of-view generate a dramatic reduction in radiance that can be used to flag corrupted interferograms. Note, however, that these data will be useful in their own right, but only as special products.

- TES has 32 adjacent pixels in each of 4 spectral bands. Pixel-to-pixel changes over scenes of uniform radiance (e.g., oceans) will be a good indicator of broken-cloud interference.

- The N_20 column density is one of the least naturally-variable parameters in the atmosphere. TES routinely monitors this number (currently about 6.5 x 10^{18} mol/cm^2) to a few percent so fractional cloud interferences are readily discernible.

ADEOS/IMG

During August 1990, two members of the TES team, R. Beer (TES PI) and T. Glavich (TES Instrument Manager) were invited to a workshop in Tokyo to learn about a Japanese infrared spectrometer called IMG (Interferometric Monitor of Greenhouse Gases) scheduled to fly on the ADEOS spacecraft in 1995, and to discuss possible future collaborations. IMG is

Figure 1. TES SCIENTIFIC OBJECTIVES

Tropospheric Chemistry:

- Change in the oxidizing power of the troposphere (CO, NO_y)
- Regional pollution and the increase in tropospheric ozone (O_3 , CO, NO_y)
- Acid deposition precursors (SO_x, NO_y)

Troposphere-Biosphere Interactions:

- Increase in greenhouse gases (CH_4, O_3, ...)
- Sources and Sinks (CO, CH_4, C_2H_2, C_2H_6, NH_3, ...)

Troposphere-Stratosphere Exchange:

- Vertical distributions through the upper troposphere and lower stratosphere (O_3, H_2O, CH_4, SO_x, NO_y, ...)

Volcanology:

- Distribution of fumarole gases (H_2O, CO_2, CO, SO_2, HCl, HF, H_2S)

Figure 2. TES DATA PRODUCTS

Standard Products:

Level 1: Geographically-located, radiometrically-calibrated, infrared spectra of the Earth's surface, troposphere and lower stratosphere in selected bands 600 - 4350 cm^{-1} (2.3 - 16.7 μm)

Level 2: Geographically-located vertical concentration profiles (0 - 30 km) of key tropospheric species

Level 3: Interpolated global and regional maps of key species on selected pressure/altitude surfaces

Special Products:

Level 1: Radiometrically-calibrated infrared spectra of local and transient events such as volcanos, biomass burning and major industrial accidents

Level 2: Local column densities and vertical profiles (when appropriate) of selected chemical species at specific locations

Level 4: Physical/chemical models of the present and future state of the Earth's troposphere

Ancillary Level 2 Products:

Atmospheric temperature profiles 0 - 30 km (STANDARD)
Atmospheric humidity profiles 0 - 30 km (STANDARD)
Surface reflectance and brightness temperature (STANDARD)
Cloud top temperature and optical depth (SPECIAL)
Any unexpected species having an infrared signature (700 - 4350 cm^{-1}) (SPECIAL)

a nadir-staring, uncooled, Fourier Transform spectrometer similar to the IRIS system that flew on Nimbus IV. The spectral coverage is 600 - 3000 cm^{-1} resolution and the footprint is 8 km square. IMG is an interesting precursor to TES but by no means a substitute: the ADEOS mission will be over before EOS-A is even launched; IMG lifetime is only 1 year; IMG has no limb capability, indeed is not pointable off-nadir; and under current circumstances can operate only during line-of-sight access to the sole Japanese ground station because of limited on-board storage. Nevertheless, it was agreed that an exchange of investigators between TES and IMG would be valuable. The main benefit to TES would be access to a precursor data set upon which to test out retrieval algorithms.

Working Groups

It was agreed to establish 3 working groups as subsets of the TES investigator team; Data Analysis & Retrievals (R. Norton, Chair); Spectral Databases (J. Margolis, Chair); and Calibration & Validation (C. Bruegge, Chair). These groups will be free to invite ad hoc participants for any areas that they feel need strengthening. It is probable that a modeling working group will be formally established in the future, although it already exists in embryonic form given that the co-investigators currently involved in this arena are all from one institution—Harvard University.

Next Meeting

It was agreed that the next Science Team Meeting will be held at the University of Denver on March 27 & 28, 1991. The Working Groups will meet the day before (March 26). A major topic will be the preparations for the upcoming CDCR (currently scheduled for July 9, 1991) and the Science Review (April/May, 1991). The TES team invites participation at the meeting by anyone interested in attending; please contact Reinhard Beer (JPL) at (818) 354-4748 or FTS 792-4748 for further information.

Reinhard Beer
TES Principal Investigator

GLOBAL CHANGE MEETINGS

Jan. 13-18	71st Annual Meeting - American Meteorological Society, New Orleans, Louisiana. Featuring the 2nd Symposium on Global Change Studies; 7th Symposium on Meteorological Observations and Instrumentation; 7th Joint Conference on Applications of Air pollution Meteorology with AWMA; 7th International Conference on Interactive Information and Processing Systems for Meteorology, oceanography and Hydrology; 1st International Winter Storm Symposium; and a Special Session on Laser Atmospheric Studies. ContactEvelyn Mazur at (617) 227-2425.
Jan. 29-Feb.1	4th Airborne Geoscience Workshop, Techniques, Results, and Future Needs, LaJolla, California. Contact Debby Critchfield at (202) 479-0360, or FAX (202) 479-2743.
March 20-22	Remote Sensing Society Conference, TERRA-1, *Understanding the Terrestrial Environment: The Role of Earth Observations from Space*, The Guildhall, Winchester, England. Contact Prof P.M. Mather, Geography Department, The University, Nottingham, NG7 2RD, England. Telephone: 0602 484848 Ext. 3040.
March 28-30	*Squeezed States and Uncertainty Relations Workshop*, University of Maryland, College Park, Maryland. For information contact D. Han, NASA/GSFC, (301) 286-9414.

FUTURE EOS SCIENCE MEETINGS

Feb. 4-6	LAWS Science Team, Clearwater, Florida,. Wayman Baker, (301) 763-8005.
Feb. 28	Science Executive Committee (SEC), Washington, D.C. Debby Critchfield, (202) 479-0360.
Feb. TBD	AIRS Science Team. H. H. Aumann, (
March 12-13	EOS SAR Meeting, Pasadena, California. JoBea Way, (818) 354-8225.
March 26-28	TES Science Team, University of Denver, Colorado. Reinhard Beer, (818) 354-4748.
May 7-9	Payload Advisory Panel, Easton, Maryland. Berrien Moore, (603) 862-1766.
May 29-31	EOS SAR Meeting, Bergen, Norway. JoBea Way, (818) 354-8225.
July TBD	LAWS Science Team, Aspen, Colorado. Wayman Baker, (301) 763-8005.

EOS SCIENCE MEETINGS 1991

	Monday	Tuesday	Wednesday	Thursday	Friday	Sat/Sun
					1	2 3
FEBRUARY	4	5 LAWS Science Team Clearwater, Florida	6	7	8	9 10
	11	12	13	14	15	16 17
	18	19	20	21	22	23 24
	25	26	27	28 SEC Washington, D.C.	1	2 3
MARCH	4	5	6	7	8	9 10
	11	12 EOS SAR Meeting Pasadena, California	13	14	15	16 17
	18	19	20	21	22	23 24
	25	26	27 TES Science Team Denver, Colorado	28	29	30 31