The Earth Observer

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Eos Welcomes Selected Investigators

The Eos Project welcomed the selected Instrument Principal Investigators (24), Interdisciplinary Scientists (28), and Facility Instrument Team Leaders and Members (99) as well as various co-investigators at the "All Hands Meeting" (Investigators Working Group) March 19-24, 1989. The meeting, perhaps the only chance to get a full overview of the goals of Eos, took place for three days at GSFC and and two days at the Greenbelt Marriott. Short debriefings regarding the selection process from NASA HQ were followed by two days of 15-minute summaries from each PI, Interdisciplinary Scientist, and Facility Instrument Team Leader as well as briefings from the GSFC and JPL Project Offices. The last two days were spent in working sessions (see elsewhere in this issue). The next IWG has been scheduled for *October 11-13 (note change)* at the California Institute of Technology, Pasadena, California.

Eos Baseline Payloads

The following lists the new baseline payloads for Eos-A (NPOP-1) and Eos-B (NPOP-2). Each platform is in a 700 (705) km altitude orbit with approximately a 1:30 p.m. ascending equatorial crossing time.

Eos-A — *Launch: 12/96*

Facility Instruments:	*Team Leader:*
AIRS	Chahine
AMSU-A/B	NOAA
AMSR	Japan
GLRS	Cohen
HIRIS	Goetz
ITIR	Japan
MODIS-N	Salomonson
MODIS-T	Salomonson
ALT	Fu
SEM	NOAA

PI Instruments:	*PI's:*
CERES-IN	Barkstrom
SAGE III	McCormick
GGI	Melbourne
MOPITT	Drummond
TRACER	Reichle
HIRRLS	Gille
DLS	Barnett
HIMSS	Spencer
MISR	Diner
TIGER	Kahle
SCANSCAT	Freilich
EOSP	Travis
IPEI	Heelis
ENACEOS	Mauk
POEMS	Evenson

Eos-B — *Launch: 12/98*

Facility Instruments:	*Team Leader:*
SAR	Elachi
SEM	NOAA

PI Instruments:	*PI's:*
TES	Beer
MLS	Waters
SAFIRE	Russell
SWIRLS	McCleese
GGI	Melbourne
GOS	Langel
IPEI	Heelis
XIE	Parks
LIS	Christian

Note:

LAWS is currently assigned to the Japanese [illegible] Orbiting Platform, launching in 1998.

Facility Instrument Team Meetings

AIRS

Moustafa Chahine and George Aumann

Dr. Moustafa Chahine, AIRS facility team leader, presided over the first meeting of the Science Team on March 19 and 23, 1989. Fred O'Callaghan, the AIRS Project Manager, gave a brief overview of the current instrument design status. Each team member summarized his/her long range science objectives, their anticipated individual contributions to the team effort and position relative to the instrument requirements as stated in the original Background Information Package (BIP). All team members felt basically comfortable with the BIP requirements. A number of issues were discussed. Three of these issues are:

1. The Eos orbit was lowered from 824 to 700 km. With the current +/- 49 degree scan angle, full day/night repeat coverage (originally achieved above 35 degrees latitude) is now achieved only above 45 degrees latitude, i.e., most of the continental US no longer has 12-hour repeat coverage. The alternative of increasing the scan angle from +/-49 to +/-55 degrees may give the spatial coverage, but with questionable quality, and makes the AIRS scan pattern inconsistent with that of AMSU-A.

2. The number of visible channels needs to be increased from one to about five, with photometric rather than relative calibration.

3. The spectral area between 15.4 and 17 microns should not be allowed to drive the AIRS design because of the potential technical risk incurred.

Action items were given to team members and the Project to resolve these issues. No team meeting was scheduled in advance of the next general Eos meeting in October 1989.

GLRS

Steve Cohen and Linda Bell

The GLRS instrument name has recently been modified from the "Geodynamics Laser Ranging System" to the "Geoscience Laser Ranging System." This change emphasizes the multidisciplinary nature of GLRS and its ability to operate both as a pointable laser ranger (retroranger), used to make precise distance measurements to ground retroreflector targets, and as a high-resolution altimeter, used to determine surface heights and cloud-top locations. In the retroranging applications, the target locations will be monitored to detect surface movements due to either strain accumulation in seismic zones or other processes. As an altimeter, repeated satellite height measurements will be used to deduce the surface topography and mass balance of ice sheets, conduct land morphological studies, and develop cloud-top height statistics.

At the March "All-Hands" meeting, the GLRS team discussed the design of the retroreflector targets. It is likely that several types of retroreflector targets will be considered. For geodynamic applications the targets will be designed to minimize survey errors at the millimeter accuracy level. Thus, they will be sufficiently flat to assure a consistent far-field energy pat tern. In addition, the targets must be easy to deploy in remote locations. There are, however, other appli cations for which the accuracy requirements are less stringent. For measuring the large strains and veloc ties on major ice sheets the targets can have reduced geodetic quality, but must be designed to withstand the rigors of a harsh environment. For many gener survey applications, subcentimeter precisions are not required. In these cases yet another design may be employed.

The team also noted that the laser altimeter may be used to calibrate microwave measurements of surfac roughness. With its small spot size (80 m) and high vertical resolution, GLRS will provide a unique roughness data set to Eos investigators. The next GLRS Facility Team Meeting will be May 23-24, 198 in Greenbelt, Maryland.

HIRIS

Alexander Goetz

The HIRIS Team met the week of March 19 in Greenbelt, Maryland. No major changes in the existing scientific requirements or proposed instrument design were discussed. However AVIRIS flights and support for data analysis are of prime importance t the verification of the requirements.

Calibration, ground, on-board and through the atmosphere will receive major attention during the life of the Team. Serious consideration must be give to observations of the moon that will fill half the HIRIS field-of-view and to the question of glare defi nition and the expected scattering from objects on t Platform.

The internal data rate of HIRIS is presently 405 Mbps. The Team will deliberate the relative merits data compression, editing or reduction of the swath and/or encoding requirements to meet the 280 Mbp platform data rate.

The next HIRIS meeting will be September 6,7, and 1989, in Boulder, Colorado.

LAWS

W.E. Baker

The March 1989 LAWS Science Team meeting in Greenbelt, MD, was very productive with excellent discussion on science requirements/hardware desi issues. Critical areas which require attention over the next several months in order to affect the hardware design include:

* The extent to which the signal-to-noise ratio in marginal aerosol regions can be optimized through signal processing,

* The science impact of proposed coverage changes to extend laser lifetime through laser shot management utilizing Observing System Simulation Experiments,

* The level of background aerosol at the 9.11 μm wavelength (to be sampled by the field phase of the Global Backscatter Experiment (GLOBE) in the Fall of 1989 and Spring of 1990),

* Anticipating that thin cirrus or sub-visible cirrus will provide excellent backscatter for LAWS, an effort is underway to assess the global cirrus distribution, and

* Defining the best calibration methodology for LAWS backscatter and velocity measurements.

The next LAWS Science Team meeting will be at Marshall Space Flight Center August 7-10, 1989.

MODIS

Vincent V. Salomonson

On Sunday, March 19, an overview of MODIS activities was provided by Vincent Salomonson. Following this presentation, each member delivered short summaries of their investigations.

On Thursday, a presentation was provided on the MODIS data system by D. Han of GSFC and supporting contractors. During the presentation it was requested that the compilation of algorithms by the supporting contractor team be put in a data base form and made available via electronic mail. The presentation generally described the EosDIS environment in which MODIS products will be produced, stored, and delivered. Future actions will address what algorithms are required to support the team and the rest of the Eos investigations and how this activity will be accomplished.

In the afternoon, the team attended the Eos Calibration and Verification presentation. Then the MODIS-T Phase-B Team presented the results of their study to date. Following this, the team discussed aspects of the present design that needed to be improved to meet their requirements, particularly the ocean requirements. It was clear, given the primary purpose of this instrument component of MODIS, that the signal-to-noise requirements and performance of the MODIS-T must be equal to that of the ocean bands on MODIS-N. Contingent upon the achievement of that requirement, means should be pursued to retain as much dynamic range as possible for obtaining observations over land features. A considerable amount of discussion concerned how the bi-directional reflectance distribution function (BRDF), land-related research could be accomplished without compromising the ocean processes purpose of the instrument. To a first approximation, the strategy will be to confine BRDF observation sequences for MODIS-T to the interiors of large continents.

On Friday, the focus of the team was placed on the Phase-B studies being conducted by two contractors, Perkin-Elmer Corporation of Danbury, Conn., and Santa Barbara Research Center of Goleta, Calif. Following their presentations the meeting was closed to all but the team and supporting GSFC personnel for discussion of team observing requirements for MODIS-N. The Land and Oceans groups within the team delivered recommendations followed by discussion. Several refinements of band placement and, in some cases, bandwidth were proposed. These will be studied further. It was fairly clear that the two 1.2 nm bands (numbers 15,16 in the present list of MODIS-N bands) will be dropped and replaced by an alternative agreed upon by the team.

It was tentatively decided that the next team meeting will be held at GSFC July 5-7, 1989.

SAR

Charles Elachi and Diane Evans

The SAR Facility Team, led by Team Leader Dr. Charles Elachi, met March 23 and 24. Topics of major concern included the current baseline design, presented by Wu-Yang Tsai of JPL. The SAR length has been reduced from 20 m (as specified in the SAR Panel Report) to 16 m as a result of payload mass constraints; a 12 m option is also being studied to further reduce mass. Similarly, power constraints have limited simultaneous operations of channels. These changes will impact the science capabilities of the SAR, and the magnitude of that impact will be a subject of further study for the team. Dr. John Curlander presented an overview of the SAR Ground Data System and its interface with EosDIS.

Three required steps were identified to address critical Eos SAR engineering tradeoffs:

1. Focussed aircraft experiments to refine requirements (SNR, calibration, polarization and frequency diversity, angle range, up/down chirp, SAW vs. digital chirp, BFPQ calibration), evaluate engineering tradeoffs, and begin algorithm development

2. Continued dialogue, in addition to journal publications, between science teams and system engineers to discuss recent advances

3. Identify funds to address geometric calibration and automatic coregistration technique development

The SAR Team will hold its next meeting May 31-June 1 at the Jet Propulsion Laboratory.

Eos Update

Schedule of Meetings

Date: May 18, 1989, 8:30 - 10:30 a.m. PDT
Location: JPL/GSFC Video link
Topic: Science Executive Committee Meeting

Date: May 23-24, 1989
Location: Greenbelt, Maryland
Topic: GLRS Facility Instrument Team Meeting

Date: May 31-June 1, 1989
Location: JPL, Pasadena, California
Topic: SAR Facility Instrument Team Meeting

Date: July 5-7, 1989
Location: GSFC, Greenbelt, Maryland
Topic: MODIS Facility Team Instrument Meeting

Date: July 20, 1989
Location: Denver Sheraton, CO
Topic: Science Executive Committee Meeting

Date: August 7-10, 1989
Location: MSFC, Huntsville, Alabama
Topic: LAWS Facility Instrument Team Meeting

Date: September 6-8, 1989
Location: Boulder, Colorado
Topic: HIRIS Facility Instrument TeamMeeting

Date: October 10, 1989
Location: JPL, Pasadena, California
Topic: Hydrological Panel Meeting
(contact Eric Barron, Chairman)

Date: **October 11-13, 1989** (DATE CHANGE)
Location: CalTech, Pasadena, California
Topic: Second Meeting of the IWG

Date: October 17-20, 1989
Location: JPL, Pasadena, California
Topic: TOPEX Science Team

Acronyms

ADEOS = Advanced Earth Observing Satellite
EPOP = European Polar Orbiting Platform (Eos)
ERS-1 = Earth Remote-sensing Satellite
GREM = Geopotential Research Explorer Mission
GSFC = Goddard Space Flight Center
JERS-1 = Japanese Earth Remote-sensing Satellite
JPL = Jet Propulsion Laboratory
JPOP = Japanese Polar Orbiting Platform (Eos)
MSFC = Marshall Space Flight Center
NPOP = NASA Polar Orbiting Platform (Eos)
NSCAT = NASA Scatterometer
Radarsat = Radar Satellite
SIR-C = Spaceborne Imaging Radar-C
TOPEX/Poseidon = Topography Experiment
UARS = Upper Atmosphere Research Satellite
XSAR = X-band SAR (DFVLR) (to be flown with SIR-C)

Earth Observer Launch Schedule

ERS-1	October, 1990
UARS	September, 1991
SIR-C/X-SAR ,1st flight	February, 1992
JERS-1	February, 1992
TOPEX/Poseidon	June, 1992
GREM	1992
SIR-C/X-SAR, 2nd flight	March, 1993
Radarsat	April, 1994
SIR-C/X-SAR, 3rd flight	1994
NSCAT/ADEOS	February, 1995
NPOP-1	December, 1996
EPOP -1A	1996
NPOP-2	December, 1998
JPOP	1998
NPOP-1'	2001
NPOP-2'	2003

Publications

Please notify the editors of any new publications that may be of interest to the Eos community.

Houghton, Richard A. and George M. Woodwell, "Global Climate Change," *Scientific American*, Vol. 260, No. 4, April 1989.

Special Issue on the Earth Observing System (Eos), *IEEE Trans. Geosci. Remote Sens.*, Vol. 27, No. 2, March 1989.

"EPA's Plan for Cooling the Global Greenhouse," in *Science*, Vol. 243, p. 1544, March 24, 1989.

"Mission to Planet Earth," *Aviation Week & Space Technology*, Vol. 130, No. 11, March 13, 1989.

"Our Future in the Stars?" in *Science*, Vol. 243, p. 890, February 17, 1989.

Letters to the Editors

The Earth Observer welcomes letters to the Editors on subjects relevant to Eos and the Earth science community. Letters should be kept to 200 words, and we reserve the right to edit letters when necessary in order to permit a greater number of views to be expressed. Questions of general interest may also be answered through this column. Letters should be mailed to the editor or sent via telemail (addresses below) by the tenth of the month in order to appear in the next newsletter. In the interest of fostering communication on the mission, we will give equal time (and space) to opposing opinions.

Note From the Editors:

If you would like to include anything in this newsletter, please send it to Marguerite Schier, the editor, preferably via telemail, by the *10th* of the month *(please note the change of date)*. The newsletter will be released monthly, mailed the first of the month. The newsletter will also be available over telemail and on a JPL VAX. If you would like to receive a copy of the newsletter, please phone the Eos Support Office at Birch and Davis Associates, Inc. at (301) 589-6760 with your address and telemail address.

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FROZEN ORBITS?

By Daren Casey

Ok, so the Earth isn't a perfect sphere. But without this minor character flaw a sun-synchronous orbit would not be possible.

The Earth is an oblate spheroid -- its radius at the poles is 21 km less than at the equator. This causes a "classical" orbit to precess about the polar axis. The plane of the orbit thus rotates at a rate determined mainly by the orbit altitude and inclination. We may choose the rate so that the orbit plane keeps pace with the sun resulting in a "sun-synchronous" orbit by finding the right altitude/inclination combination. Another oblateness effect causes the perigee point (point of closest approach) to move in the orbit plane -- this means that the altitude over a given target varies from day to day! But wait....

The oblateness of the Earth isn't perfect either -- the northern and southern hemispheres were not created equal. This introduces long-term changes in the perigee point and orbit eccentricity. A location of the perigee point and a small eccentricity can be found so that both are nearly constant in the long run. Such an orbit is called a "frozen" orbit. This frozen orbit is still sun-synchronous and the platform altitude at a given latitude is nearly constant.

The Eos "700" km frozen orbit has an eccentricity of 0.00103 and perigee point near the north pole.

In the next issue of the Earth Observer: Upcoming aircraft campaigns in preparation for Eos

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