The Earth Observer

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# International Coordination for the Eos Program

*by Lisa R. Shaffer, Science Applications International Corporation*

The Earth Observations International Coordination Working Group (EO-ICWG, or ICWG for short) was created in 1986 to coordinate Earth observation utilization of the polar platforms foreseen at that time by NASA and the European Space Agency (ESA). It has expanded to include the Earth observations offices of the other two Space Station partners, Japan and Canada, as well as representatives of the operational organizations in each country/region, i.e., NOAA (US), EUMETSAT (Europe), JMA (Japan), and the Dept. of the Environment (Canada). The eleventh meeting of the ICWG was recently concluded in Ottawa, Canada.

Operating under a charter developed and approved by all the participants in 1988, the group meets several times a year. It addresses the polar platforms within the Space Station Program, as well as Space Station attached payloads, the second (and subsequent) NASA polar platform, the second (and subsequent) ESA platforms, and the first Japanese polar platform. Its charter permits expansion to other payloads and platforms as agreed. This now includes the proposed NOAA common-interface free-flyer series for the afternoon operational payload.

For the above-mentioned missions, ICWG's objectives are promoting an integrated observing system which will advance the scientific understanding of the entire Earth system on a global scale and promoting the development of future operational services; promoting the continuity of operational services which are currently provided by the polar-orbiting NOAA satellites; and promoting effective use of Polar Platforms; all for a period of at least fifteen years after the launch of the first Polar Platform. This is accomplished through frequent meetings at which information is exchanged, and plans are coordinated and harmonized.

To date, work has focussed on the coordinated Announcements of Opportunity which were issued in 1988 by NASA, ESA, and Japan; development of strawman payload scenarios for planning purposes, now being refined in light of actual AO selections an continued platform definition; coordination of orbital parameters such as altitude, equator crossing time, etc.; examination of common instrument interface issues and proposed resolutions; and operations and data policy. Arrangements for formal agency commitments for the various cooperative elements the programs (e.g., provision of an instrument by agency for another's platform) are an area of active current effort.

The ICWG serves as the forum for developing the international guidance necessary to make sure we appropriately balance the participating agency interests and objectives with the limited resources available. ICWG will provide management level conflict resolution when necessary, for Earth observations cooperation. This process complements, but does not replace or compete with, the formal Space Station program management structure. ICWG will support Space Station by developing a coordinated utilization plan for the Space Station polar platforms so that the individual utilization plans of each partner are compatible and consistent when they go through the formal utilization planning process.

NASA's participation in ICWG is led by Dr. D... Butler, Eos Program Scientist, and Mr. Alex T... hov, Eos Program Manager. Mr. Wilfred Sc... ior Engineer, Space Station Office and Mr. R... Brescia of NASA's International Affairs Office participate. The next ICWG meeting will be N... 13-15, 1989 in Washington.

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# A Condensed History of the Earth Observing System (Eos)

*by Renny Greenstone, McDonnell Douglas Space Systems Company*

The Earth Observing System, Eos, had its foundations in the recommendations of an ad hoc NASA study group convened in 1981 to determine what could and should be done to satisfy integrated Earth science measurement needs. The group recommended that NASA consider the concept of a polar-orbiting platform to support a set of highly capable remote-sensing instruments for serving Earth science and applications. The study group (their activity was known as System Z) developed an implementation strategy which included recommendations for synergistic groupings of instruments and provided alternative concepts for instrument designs. The group also noted that the data system would ultimately be the key to mission success. NASA chose to go ahead with the implementation of the System Z findings, and a Science and Mission Requirements Working Group (SMRWG) was formed.

The charter of SMRWG was to examine the major Earth science questions for the 1990s and to define the requirements for low-Earth-orbit observations needed to answer these questions on a comprehensive multidisciplinary basis. As the study proceeded, the Group found it essential to define an information system to meet the global needs of Earth science research. The report of the SMRWG was issued in 1984 and listed five basic recommendations concerning Earth Science in the 1990s:

1. A program must be initiated to ensure that present time series of Earth science data are maintained and continued. Collection of new data sets should be initiated.

2. A data system that provides easy, integrated, and complete access to past, present, and future data must be developed as soon as possible.

3. A long-term research effort must be sustained to study and understand these time series of Earth observations.

4. The Earth Observing System should be established as an information system to carry out those aspects of the above recommendations which go beyond existing and currently planned activities.

5. The scientific direction of the Earth Observing System should be established and continued through an international scientific steering committee.

Successor to the SMRWG has been the Eos Science Steering Committee (SSC), which issued a report in 1987 summarizing the Eos mission concept as it had matured and also providing an overall implementation strategy. The SSC noted that Eos is a part of an integrated scientific study of Earth which has come to be known as Mission to Planet Earth. (In a roughly parallel study effort the Earth System Sciences Committee (ESSC) had already laid out a co sponding broad strategy for progress in Earth scie built upon the recommendations of the various boards of the National Research Council and, in p ticular, on the reports of the Committee on Earth ences of the Space Science Board.) The ESSC repo recognized Eos as the centerpiece of the future im mentation strategy. By proceeding to carry out t ESSC plan, including Eos, the SSC argued that it would be possible to move from the bits and piece single-discipline research to a comprehensive un standing of the Earth that will be the basis for a f casting capability that will guide mankind in the wise development of our home planet.

The Eos concept, as defined by the SMRWG, calls the deployment of the Eos space segment in the m 1990s, with growth in the number and quality of remote-sensing capabilities into the first decade the twenty-first century. Ultimately, there will b four polar space platforms in low-Earth orbit, tw provided by the U.S. (NASA), one by the Europea Space Agency (ESA), and one by the Japanese Sp Development Agency (NASDA). The NASA platf will be in sun-synchronous orbit at 705 kilomet crossing the equator in the afternoon and the ES platform will be in sun-synchronous orbit at 8 crossing the equator in the morning. The full s is to operate long enough to acquire time series requisite Earth observation data of at least ten y duration with many of the crucial measurement being obtained for a period of fifteen years. In ad tion to the low-Earth polar-orbiting platforms, has the opportunity to place a limited number o Earth-viewing instruments as attached payload the low-declination orbiting Space Station Free

Every planning group, starting with System Z, th has addressed the development of Eos has stresse the importance of providing a major data and in mation system. Responding to this guidance, ar organization formally called EosDIS (for Eos D and Information System) has been set into bein The EosDIS will have both centralized and dist uted facilities and will provide for both comma and control of the flight instruments and for th cessing of data from them. It will also be the ce source for the distribution of data from both the instruments and the Eos scientific research bas the instrument data. It will provide access for t Earth science and applications research comm to all Eos data and to the results of research wh makes use of this data. EosDIS will be unique in unprecedented volume of data it must process a speed with which it must accomplish this vi mission.

The SMRWG defined four major Earth scien areas that should be addressed by Eos: the h cycle, biogeochemical cycles, climatological p cesses, and geophysical processes. Examples of nature of these study areas follow. The study of the hydrologic cycles requires investigation of the processes of precipitation, evaporation, evapotranspiration, and runoff on a global basis; also investigation of the effects of sea and land ice. The study of the biogeochemical cycles requires investigation of the cycling of carbon, nitrogen, phosphorus, sulfur, and trace metals, and the investigation of transport of tropospheric gases and aerosols and determination of the strengths of their sources and sinks. The study of climatological processes requires investigation of the variability of incoming solar radiation and outgoing terrestrial radiation, investigation of the modes of large-scale and low-frequency variability of meteorological variables such as wind, pressure, temperature, cloudiness, and precipitation. Finally, the study of geophysical processes requires investigation of atmospheric, oceanic, and solid-Earth processes.

The SMRWG defined a conceptual Eos payload which was grouped into three packages plus a data relay capability to illustrate the synergistic relations that would exist among the instruments. The three packages were the surface imaging and sounding package, the sensing with active microwaves package, and the atmospheric physical and chemical monitors package. Within the three packages were active and passive instruments, operating in the visible/infrared regions and in the microwave region.

As an approach to implementing the SMRWG recommendations, NASA defined six major research instruments that would be developed by NASA and serve as Research Facilities whose data would be made available to Eos investigators for interdisciplinary studies. These Research Facility instruments were the Moderate Resolution Imaging Spectrometer, the High Resolution Imaging Spectrometer, the Synthetic Aperture Radar, the Atmospheric Infrared Sounder, the Geodynamics Laser Ranging system, and the Laser Atmospheric Wind Sounder. Other instrument concepts were also defined by NASA and offered as opportunities to members of the international scientific community to propose their development.

An Announcement of Opportunity (AO) to propose investigations for the Eos program was issued in January 1988. A Background Information Package that accompanied the AO contained extensive conceptual descriptions of the Research Facility instruments in the form of reports by specially commissioned Eos science study panels. In addition, the AO referred prospective instrument investigators to the Eos Science Steering Committee report for descriptions of instruments that might be proposed to make up the rest of the candidate payloads for the four Eos platforms. In responding to the AO, proposers could offer to be interdisciplinary investigators, typically carrying out the sorts of studies that had been defined by the SMRWG as key Earth science study areas; or they could propose to be members of Research Facility teams formed by NASA to provide scientific guidance for the development of the NASA Research Facility instruments and to analyze and interpret data from them; or they could be instrument developers for the non-Facility instruments who must propose to carry out scientific investigations with data from their instruments.

The Eos selection process was completed in February 1989 with six Team Leaders (and corresponding Tean Members) for the six NASA Research Facility Instruments, 24 Instrument Principal Investigators, and 28 Interdisciplinary Investigation Principal Investigators notified of their selection to participate in definition-phase investigations for Eos. At about the same time as the selection process was taking place, NASA recognized the need to have a radar altimeter on board the platforms for ocean surface altimetry and so the microwave radar altimeter ALT was addec to the payload with a corresponding Research Facility Team. The Japanese instruments, Intermediate and Thermal Infrared Radiometer and Advanced Microwave Sounding Radiometer, are also designate Research Facility Instruments and have correspond ing Research Facility Teams. The definition phase i to last eighteen months after which time a selected number of Investigators will be chosen to stay on for the execution phase of Eos. Team Leaders and Princi pal Investigators make up the members of the Investigator Working Group, which has been formed to gi scientific guidance to the Eos Project. Coordination with the international partners is achieved through the International Coordination Working Group (ICWG), whose members will include the Program Sc entists and Managers from NASA, ESA, and Japan and representatives from NOAA, Canada, and the European Meteorological Satellite program, Eumetsat.

Following the notifications of selection that went o to 154 Principal Investigators, Team Members and Team Leaders, the Eos Project Office convened the first Eos "all-hands" investigators meeting. This meeting took place in mid March at the Goddard Space Flight Center and provided the first opportunity for all investigators to meet each other and to meet members of the Eos Program Office (NASA Headquarters) and of the Eos Project Office (Goddar Space Flight Center and Jet Propulsion Laboratory) This was also the opportunity to gain further insigl into the Project management structure and to learn what is being planned for the Eos Data and Inform tion System (EosDIS). In both formal and informa settings the investigators were able to learn each ot ers' plans for instrument development and for research studies that will place requirements on th instruments. In a sense this was also the first meet ing of the Investigators Working Group, which is a body that will continue to serve as an advisory grou to the Eos Project.

Eos is now underway and carrying out those steps that are necessary to assure its "New Start" in fisca year 1991.

# The Need for Real-Time Response to Eos Data and the Targetting of High Resolution Instruments

*by Peter Mouginis-Mark*
*University of Hawaii*

Many of the interdisciplinary experiments to be carried out by Eos will involve imaging sequences that can be designed several months, or even years, prior to their acquisition. A key aspect of many oceanic, atmospheric, and biophysical experiments lies in obtaining long time series data sets to identify and interpret changes on a monthly to decade timescale. In many instances, use of the high spatial resolution instruments to study the ocean or land will be programmed weeks in advance to image targets known at that early time of planning.

While many of the solid earth investigations have less stringent requirements for repetitive data, a second set of geology experiments require time-critical, high resolution, observations on a timescale of a few hours to a couple of days in order to study transient phenomena. One such Eos interdisciplinary investigation is designed to study dynamic volcanic eruptions and their effects on the atmosphere ("A Global Assessment of Active Volcanism, Volcanic Hazards, and Volcanic Inputs to the Atmosphere from the Earth Observing System", PI: Peter Mouginis-Mark, University of Hawaii). Compounding the problem of imaging these volcanic events, which may only last a week or so, is the fact that volcanoes erupt quite infrequently and may occur in many unexpected places around the world.

The procedure to study volcanic eruptions may well drive the broader Earth Science Community's ability to request the rapid acquisition of data that have not been planned for months in advance. In the case of the volcanology studies, first an eruption (either the eruption of a lava flow on the flanks of a volcano, or the explosive injection of an eruption plume into the atmosphere) must be automatically identified from the synoptic data set. It seems likely that MODIS-N will play a key role in this detection and eruption alert procedure, since both thermal anomalies (spikes in the near-IR flux) and eruption plumes (anomalous locations and/or colors and structures) may be identified without the need for an operator to review all of the data stream as it is obtained. Once an eruption alert is generated, a means will have to be developed wherein Eos collects target specific high resolution data from HIRIS, ITIR/TIGER and SAR to enable the analysis of physical processes. These targets are likely to be ~20 x 20 km in extent for a lava flow, but may extend over several hundred kilometers in the case of an eruption plume. Other data will also be required for specific volcanic events, such as the analysis of eruption plume height and topography by GLRS and MISR, the analysis of volcanic gases by TES and SAGE III, and the study of surface deformations with GLRS. It is likely that data management will be a pressing issue in such investigations. Although imaging scenarios for studying either lava-produci (effusive) eruptions and explosive eruptions may be developed before a specific example is identified, th implementation of this scenario for a real eruption will most likely challenge the sequencing and targe ing capabilities of the different sensors.

The quick-look, quick-response capability for Eos described here will not only be required for the vol nology experiment. Hurricane damage along coast lines, flooding of rivers, monitoring forest fires or spills, and the investigation of landslide damage, cier surges and the results of earthquake will also require such a capability. Many of these phenome occur in unexpected parts of the world and have a major impact over areas of a few hundred to thousand square kilometers, but last for only a few day or weeks. Monitoring the change in size of forest fires such as those that swept through Yellowstone 1988, or the migration of the oil spill off the Alask coast in Spring 1989, will require that data be obtained as early as possible during the course of t event so that the initial conditions and rate of c can be determined. It is thus paramount that Eos EosDIS develop the ability to enable previously unprogrammed targets to be imaged by Eos within few days, otherwise the data for these events will l lost.

Obviously such flexibility requires rapid through of quick-look synoptic data within EosDIS and th ability of the investigator to command data acquis tions in a matter of hours after the target is identified. Scheduling and implementation priorities fo the Eos instruments will thus have to be flexible to both permit transient events to be studied and ena the planned data sequences to be obtained at the r available opportunity. No doubt lively discussio will arise when an important ocean or biosphere data-take cannot be obtained because the sensors repointed to study a new eruption plume or lava that threatens some remote part of the world. Re ing such issues will no doubt be one of the many t pleasures and challenges of the interdisciplinary nature of Earth System Science during the next decade.

Submitted to the Eos Newsletter by:

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Review on June 12, 13, and 14.

| Instrument | ORBIT DETERMINATION | INTERIOR EARTH STRUCTURE | PLATE MOTION AND CRUSTAL DEFORMATION | SURFACE SOIL MOISTURE AND WETLANDS EXTENT | LAND SURFACE COMPOSITION | LAND SURFACE BIOLOGICAL ACTIVITY, PHENOLOGY AND PHYSIOLOGICAL STATE | SURFACE TOPOGRAPHY | SURFACE TEMPERATURE | SNOW AND ICE EXTENT AND CHARACTER | SEA ICE EXTENT, CHARACTER, AND MOTION | SEA SURFACE WINDS | OCEAN WAVES | OCEAN CIRCULATION | OCEANS AND LAKES BIOLOGICAL ACTIVITY | AEROSOLS | TROPOSPHERIC WINDS | TROPOSPHERIC COMPOSITION | CLOUD PROPERTIES | ATMOSPHERIC TEMPERATURE | ATMOSPHERIC WATER CONTENT | PRECIPITATION RATE | LIGHTNING | UPPER ATMOSPHERIC WINDS | UPPER ATMOSPHERIC COMPOSITION | PARTICLES AND FIELDS ENVIRONMENT | IONOSPHERE | EARTH RADIATIVE BALANCE | SOLAR OUTPUT |
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| **INSTRUMENT INVESTIGATIONS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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# Eos Update

## Schedule of Meetings

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

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

Date: August 9-11, 1989
Location: MSFC, Huntsville, Alabama
Topic: LAWS Facility Instrument Team Meeting

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

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

Date: October 11-13, 1989
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
Eos = Earth Observing System
Eos-A, C, E = first platform and replacements
Eos-B, D, F = second platform and replacements
EosDIS = Eos Data and Information System
EPOP = European Polar Orbiting Platform (Eos)
ERS-1 = Earth Remote-sensing Satellite (ESA)
ESA = European Space Agency
ESSC = Earth System Sciences Committee
GREM = Geopotential Research Explorer Mission
GSFC = Goddard Space Flight Center
ICWG = International Coordination Working Group
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
SMRWG = Science and Mission Requirements Working Group
SIR-C = Spaceborne Imaging Radar-C
SSC = Eos Science Steering Committee
TOPEX/Poseidon = Topography Experiment
UARS = Upper Atmosphere Research Satellite
XSAR = X-band SAR (DFVLR)

## 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 |
| Eos-A | December, 1996 |
| EPOP -1A | 1996 |
| Eos-B | December, 1998 |
| JPOP | 1998 |
| Eos-C | 2001 |
| Eos-D | 2003 |

* tight launch window due to desire to cover two northern hemisphere winters in the expected 18 month lifetime of UARS

## *Flight Delays*

As a result of the large number of contributions t the newsletter this month, the increased activity preparing for the NAR, and further scheduling co firmation needed for upcoming flights, the aircr story mentioned in the May issue of *The Earth Observer* has been delayed until later this summ

If you and/or your colleagues are planning to fly related experiments this summer or even in the year, we would like to hear from you. Please sen a short summary of the goals of your experimen list of instruments that you plan to use, and you approximate flight dates and locations. We hop include this information as an ongoing series i *Earth Observer*.

# Letters to the Editors

*The Earth Observer* welcomes letters to the Editors on subjects relevant to Eos and the Earth science community. 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. We know you're out there; we'd like to hear from you!

## 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. The newsletter will be released monthly, mailed on the first of the month (assuming no problems at the printer!). The newsletter will also be available on the GSFCMAIL Eos bulletin board 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.

*NOTE: The editor is on the move -- watch this space for further updates on my whereabouts.*

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# Back Issues

To access computer files of the old issues of this newsletter as well as files of information related to Eos, please log onto the JPL VAX as described below. This is a read-only user area. If you have input to these files, please send it via telemail to the editor or executive editors of this newsletter.

*VAX prompts are shown in italics. Phone number is for 1200 baud.*

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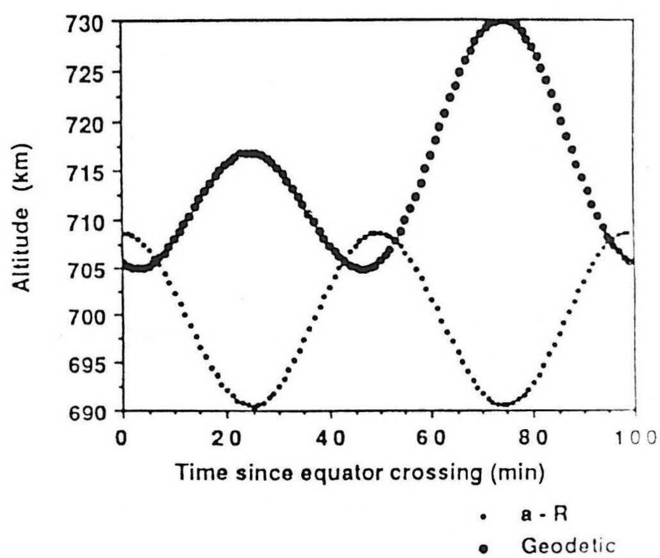
*Enter Username:* Eos
*Local:* C JPLMRS (JPL ILAN users: type C MRSVAX and continue from here)
*Username:* EOSINFO
*Password:* (please call the editor)
To log off: LO or BYE

# 700 = 705?

*by Daren Casey*

Well is it the Eos 700 km orbit, or the Eos 705 km orbit? Both are correct. If you are interested in the repeat cycle of the orbit you would say that the average semi-major axis is 700 km greater than the equatorial radius of the earth, resulting in a 16 day repe[at]. If you are concerned with the platform altitude you would say it's 705 km at the equator. The chart bel[ow] illustrates these two viewpoints. The semi-major axis (a) of the orbit varies between 691 and 709 km above the earth's equatorial radius (R), but has an average value of 700 km. The geodetic altitude (actual height above the surface) ranges from 705 to 717 km in the northern hemisphere (the first half of one orbit) and from 705 to 730 km in the southern hemisphere. (These differences are due to the orientation of the orbit with respect to the earth - the point of closest approach (perigee) is near the north pole.)



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