Originally Processed With FOIA(s):
1999-0093-F; 2005-0336-F

FOIA Number:
2005-0336-F

FOIA MARKER

This is not a textual record. This is used as an administrative marker by the George Bush Presidential Library Staff.

Record Group/Collection: George H.W. Bush Presidential Records
Collection/Office of Origin: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: Organization Files - NASA

OA/ID Number: 62074
Folder ID Number: 62074-006

Folder Title:
Physical Sciences: Space - NASA - EOS [Earth Observing System] [1991]

Stack:	**Row:**	**Section:**	**Shelf:**	**Position:**
	0	**0**	**0**	**0**

"Document Control"

TYPE: Information **DOCUMENT NUMBER:** 9129307
ORIGINATOR: 03 **STATUS** **DIRECTORATE STATUS** C

****

FROM: Richard Truly; NASA

TO: DAB

DATE OF CORRESPONDENCE: 12/26/91

SUBJECT: NASA has completed its restructuring of EOS. Report enclosed.

****

DIRECTORATE ASSIGNED: **STAFF ASSIGNED:**

ACTION REQUIRED: **STAFF ACTION:**

****

SENDER'S DUE DATE:
OSTP DUE DATE: **STAFF DUE DATE**
DATE COMPLETED: **DATE COMPLETED/DEPT:**

****

COPIES TO:

****

WHITE HOUSE TRACKING #: **CONTACT PERSON:**
PHONE: **EXT:**
REMARKS:

OSTP RECEIVED: **DEPT RECEIVED:** 12/31/91
FILE: PS-SPC-NASA-EOS

CENTRAL FILES:

5280 I 307

EOS

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

The Honorable D. Allan Bromley
Assistant to the President
for Science and Technology and
Director, Office of Science and
Technology Policy
Executive Office of the President
Washington, DC 20506

Dear Dr. ~~Bromley~~ Allan:

I am pleased to inform you that the National Aeronautics and Space Administration has completed its restructuring of the Earth Observing System (EOS) program. I have enclosed for you and your staff a report describing the technical and programmatic elements of both the restructuring process and the restructured EOS program itself.

NASA conducted an effort over the last few months to restructure the EOS program to fly the EOS instruments on intermediate and small spacecraft. In this restructuring, we sought to preserve the highest priority science goals of the U.S. Global Change Research Program (USGCRP) and the Intergovernmental Panel on Climate Change (IPCC). As such, the EOS instruments and spacecraft will focus on the key issue of global change research: to determine the extent, causes, and regional consequences of global climate change. The restructured program includes many of the recommendations of the EOS scientists, and it is fully consistent with the recommendations of a number of other external groups, including the EOS Engineering Review Committee (chaired by Dr. Edward Frieman) and Congress.

The restructured EOS program is more robust and flexible, and it accommodates the funding guidelines outlined by the Congress as part of the FY 1992 budget. Although some instruments will fly later than originally planned, the new configuration of spacecraft will allow us to accelerate the initiation of some important measurements compared to the original schedule. It also maintains our strong commitment to international cooperation in global change research, particularly with the European Space Agency, Canada, and Japan.

The restructured EOS program is an important part of Mission to Planet Earth (MTPE), providing critical space-based measurements for the USGCRP. It is also integrated into a carefully planned set of international global change research efforts. I would be pleased to arrange a briefing for you and your staff on the current status of the restructured program and its contribution to global change research. Please do not hesitate to contact me if I can be of further assistance.

Sincerely,

Richard H. Truly
Administrator

Enclosure

THE RESTRUCTURING OF THE EARTH OBSERVING SYSTEM

NASA has completed the restructuring of the Earth Observing System (EOS) from a program in which the instruments were to be flown on a series of large platforms to one in which the instruments will fly on intermediate-sized and smaller spacecraft. The restructuring was undertaken (i) to provide the EOS program with greater resilience and flexibility; (ii) to adjust the program to the reduced levels of funding expected from the Congress; and (iii) to take advantage of new launch opportunities for the EOS spacecraft, particularly, the expected availability of Atlas IIAS launch vehicles from the west coast. The restructuring effort was guided, in part, by the report of the EOS Engineering Review Committee chaired by Dr. E. Frieman (the Frieman Committee), and the results of the restructuring are wholly consistent with its recommendations. Further, the restructured program fully meets NASA's commitments under the Space Station Freedom international agreements for the polar platforms.

The following sections, and the accompanying figures, describe the essential outcome of the restructuring effort. Further details on each of these sections are available.

<u>The Evolution of the Payload:</u> NASA has undertaken a systematic process, involving input from the Frieman Committee and a thorough review and analysis by EOS investigators, to determine the optimum payloads for intermediate-size and small-size EOS spacecraft. Figure 1 illustrates the evolution of the payloads during this restructuring exercise.

The outer edge of the figure illustrates the baseline EOS program, prior to restructuring. Each of the instruments is listed by its acronym, which is defined on an accompanying page. The instruments in the upper portion were to fly on the EOS-A1 platform, which was a large platform to be launched on an upgraded Titan IV. The instruments in the lower portion were candidates for the EOS-B platform series, whose configuration had not been determined. Also shown are the US instruments that were to fly on the European and Japanese spacecraft which are complementary to NASA's Mission to Planet Earth.

The next inner circle illustrates the payloads that were presented to the Frieman Committee in La Jolla, California, in July 1991, and endorsed in their report as the preferred "proof of concept" for an EOS which contains a "favorable measure of resiliency." The payloads were expected to be launched on Atlas IIAS-class vehicles. Note that the program would consist of two primary spacecraft, each in sun-synchronous polar orbits, but with different crossing times -- one AM and one PM. Also included are an additional Atlas-sized spacecraft for an altimeter and atmospheric instruments (ALT, MOPITT, and HIRDLS), and a smaller spacecraft for the tropospheric instrument, TES. The payload configurations satisfy the highest priority simultaneity requirements critical to the science objectives of the EOS program, without requiring that the spacecraft fly in formation.

On each of the next circles, from outside inward, are illustrated (i) the payloads that were discussed at the Seattle meeting of the Investigator Working Group of all EOS investigators in August 1991; (ii) the modifications to the Seattle payloads that were considered by NASA for further analysis by the EOS project; and (iii) the payloads that were endorsed in Easton, Maryland, in October 1991 by the Payload Advisory Panel, a committee comprised of the EOS interdisciplinary investigators that have the responsibility for the use of the EOS data, and is formally charged with recommending EOS payloads to NASA.

Finally, illustrated on the inner most circle are the payloads that NASA plans to implement as the restructured EOS program. These payloads are described in more detail in Figure 2. The final payloads satisfy the recommendations of the Payload Panel with the caveat that some of the instruments will fly later than recommended. The Payload Panel would prefer to fly the scatterometer instrument (STIKSCAT), the atmospheric instruments (HIRDLS and MLS/SAFIRE) and the altimeter before 2000, but budget constraints may preclude this.

The final payloads, with some rearrangement of instruments, are very similar to the La Jolla payloads endorsed by the Frieman Committee. There are three basic intermediate-size spacecraft and one smaller payload (requiring a Delta-class launch vehicle). The first intermediate-size spacecraft, labeled EOS-AM, has an AM crossing time, the other, EOS-PM, has a PM crossing, and the third, EOS-CHEM, carries the atmospheric instruments TES, HIRDLS, and SAGE-III, and the scatterometer STIKSCAT. The smaller mission labeled EOS-ALT conducts altimetry measurements.

A principal difference between the final payloads and the La Jolla payloads concerns the scatterometer instrument, STIKSCAT. The Frieman Committee assumed that STIKSCAT could be deleted in favor of the European C-band measurements. The Payload Advisory Panel does not share this judgment and recommends that NASA fly STIKSCAT. In the final payloads STIKSCAT is flown on the third intermediate-class spacecraft. An alternative noted in Figure 1 might be to fly STIKSCAT on the Japanese ADEOS-II mission in the year 2000, which is earlier than in the final payloads. This alternative, however, would require more funding in the early years of the EOS program than may be available, and would also necessitate discussions with the Japanese, which have not yet occurred.

The final payloads also include two small missions (requiring Pegasus-class launch vehicles) -- EOS-AERO to fly the SAGE-III and EOSP instruments in a 57 degree inclination orbit, and EOS-COLOR to fly the SeaWIFS instruments for ocean color measurements, instead of the MODIS-T instrument. There is also a need to identify flights of opportunity for the small ACRIM and SOLSTICE instruments, and for either the MLS or SAFIRE atmospheric instruments, each of which is descoped from its original version. Finally, NASA plans to enter into discussions with ESA concerning flight of the SAGE-II instrument on their polar platform.

Launch Vehicles: All of the intermediate-size EOS payloads in the restructured program will be flown on spacecraft with 12-foot diameters that are compatible with the proposed Atlas IIAS launch vehicle, using a standard Atlas faring. The payload on EOS-PM has the largest volume and, although difficult to fit in an Atlas faring, can be accommodated.

It should be noted that in discussing the La Jolla payloads with the Frieman Committee it was assumed that the Atlas faring could be extended by 3 feet, and possibly up to 7 feet. Subsequent analysis revealed that the 7-foot extension is not possible and the 3-foot extension may be difficult. Detailed engineering studies by the EOS project have led to innovative packaging of instruments and spacecraft subsystems which permit the EOS payloads to fly in the standard Atlas faring.

Focusing the Science Objectives -- Deletion of Instruments: Of all the global change issues that could be studied, the one that is in most need of an improved scientific understanding, in order to make sound policy decisions, is global climate change. Accordingly, the restructured EOS will emphasize studies of global climate change and use the scientific priorities documented by the Intergovernmental Panel on Climate Change (IPCC). The restructured EOS will thus make only limited observations of stratospheric chemistry and solid Earth physics. This focusing of the science objectives and the resulting deletion of instruments has been endorsed by the Frieman Committee.

In particular, the restructured EOS does not include funding for the proposed stratospheric instrument, SWIRLS, or for the non-descoped version of the MLS and SAFIRE instruments. The geodynamics portion of the GLRS instrument, GLRS-R, the secondary instruments GOS, IPEI, and XIE, and the lightning instrument LIS are deselected from the program. The Laser Atmospheric Wind Sounder (LAWS) is an important instrument for global climate change studies but must be postponed (See discussion of the potential contribution of the Departments of Energy and Defense.) As in the recommendations of the Frieman Committee, the MODIS-T instrument is also deleted; its measurements of ocean color will be provided by the reflight of the simpler SeaWIFS instrument on a small, separate spacecraft and from MODIS-N measurements on both the EOS-AM and EOS-PM spacecraft.

Simultaneity Requirements: The sensitivity of the EOS instruments is such that they generally require simultaneous measurements from other instruments, through the same column of air, in order to make atmospheric corrections and/or to pursue their science objectives. Figure 3, which was prepared for the Frieman Committee, outlines the simultaneity requirements for the instruments that were to fly on the original, large EOS-A1 platform. The horizontal columns list the instruments that provide simultaneous measurements; the vertical columns list the instruments that use these measurements. The circled symbols indicate the most critical simultaneous measurements.

In the restructured EOS, in which the instruments are flown on intermediate-size platforms, the simultaneity requirements shown in Figure 3 are satisfied primarily by flying the MODIS-N instrument on two separate spacecraft, EOS-AM and EOS-PM. This solution for simultaneity is also used in the La Jolla payloads recommended by the Frieman Committee. Note by comparing Figures 1 and 3 that with MODIS-N on the EOS-AM spacecraft, the critical simultaneity requirements are met for ASTER, CERES, and MODIS-N. With MODIS-N on the EOS-PM spacecraft, the critical simultaneity requirements are met for AIRS, AMSU-A, MHS, CERES, MIMR, and MODIS-N.

It should be noted that, in principle, it is possible to fly MODIS-N on only one of the intermediate-size spacecraft, and then fly the other in close formation so that MODIS-N can provide the needed simultaneous observations for the latter's instruments. However, by duplicating MODIS-N on each spacecraft, it is possible to choose the optimum crossing time for each payload. The payload with ASTER, MISR, and MODIS-N primarily observes surface features, and thus the AM-crossing time, when cloud cover is at a minimum, is the preferred orbit. In contrast, the payload with AIRS, AMSU-A, MHS, CERES, MIMR, and MODIS-N has a PM-crossing time. This is due to the desire to (i) fly AIRS, a candidate next-generation atmospheric sounder for deployment on future NOAA operational satellites, at a time most useful for contributing data for meteorological forecasting, as well as (ii) obtaining observations from CERES and MODIS-N at a second time during the day, thus improving estimates of diurnal variability. Further, MODIS-N is the central instrument in EOS, and with it flying on two separate spacecraft, the program has important redundancy.

The MOPITT instrument (See Figure 3) has a critical simultaneity requirement for atmospheric temperature observations from AIRS which is not met in the restructured EOS. However, this deficiency is not considered to be serious since the MODIS-N instrument, which will fly together with MOPITT, can provide some temperature measurements with reduced resolution in altitude. The scatterometer instrument (STIKSCAT) has a critical requirement for passive microwave observations from MIMR. This requirement can be met by placing the EOS-CHEM spacecraft which includes STIKSCAT in a similar orbit with the EOS-PM spacecraft that includes MIMR. If STIKSCAT is flown on the Japanese ADEOS II mission instead, it is likely that there will be an appropriate Japanese instrument to provide the needed microwave measurements. The simultaneity requirements of LIS and MODIS-T instruments are not considered since these instruments have been deleted. Finally, it should be noted that with MISR on the EOS-AM spacecraft, and AIRS and MHS on EOS-PM, the critical simultaneity requirements for MISR are not fully satisfied. Although this is a deficiency in the restructured program, the alternative of flying the spacecraft in formation to meet this requirement is considered less desirable than permitting each payload to have its optimum crossing time.

Launch Sequence: The large EOS-A1 platform was scheduled to be launched in December 1998. In the restructured EOS program, the EOS-AM spacecraft will be launched six months earlier, in June 1998. This launch date is determined by the time required to develop, test, and calibrate the instruments. The EOS-AM spacecraft will be followed two and a half years later, in December 2000, by the EOS-PM spacecraft, and in 2002 by EOS-CHEM with the scatterometer and the atmospheric chemistry instruments. The smaller missions, EOS-COLOR, EOS-ALT, and EOS-AERO, are interspersed among the intermediate-size missions.

The EOS-AM spacecraft is scheduled to launch first because (i) it will yield important measurements of both clouds and radiation and surface characteristics, and (ii) it is more straightforward to execute than the EOS-PM spacecraft. The EOS-AM spacecraft includes only one challenging US instrument, MODIS-N, whereas the EOS-PM spacecraft includes both the MODIS-N and the AIRS instruments. Thus, the cost and schedule for EOS-AM are less demanding. Indeed, within the funding levels expected for EOS in the next few years, EOS-PM cannot be launched before 1999 and, if first, would delay the acquisition of EOS data. The Payload Advisory Panel, in consideration of the schedule and budget requirements for the EOS-AM and EOS-PM spacecraft, recommended that EOS-AM launch first.

<u>EOS Data and Information System (EOSDIS):</u> With the restructuring of EOS, there will be delays in some of the observations from what was expected in the original program. The EOS-AM spacecraft will fly in advance of the original large platform; however, the EOS-PM spacecraft is delayed. Thus, the EOSDIS that will be required by the year 2000 will be smaller than was originally envisioned. This adjustment can be made without altering the basic architecture, or the evolutionary design of EOSDIS, which is to be a flexible, distributed system, developed in successive versions, each version building on the experience of the previous version. The budgets for EOSDIS, however, can be reduced substantially, and scale approximately with the reduced cost of the space hardware for EOS. The National Research Council is being asked to convene a panel of experts to review NASA's plans for EOSDIS, including the validation of its engineering and technical underpinning, and to assess whether current plans provide sufficient resiliency to be adaptable to changing requirements.

<u>Funding Requirements:</u> The restructured EOS program, including the spacecraft (AM, PM, CHEM, ALT, AERO, and COLOR), EOSDIS, and the supporting science (the latter two items representing approximately half the cost) has been designed to accommodate the $11 billion funding cap through FY2000, as directed by Congress. The restructured program requires relatively modest growth over the FY1992 funding level in FY1993 and FY1994. However, it is essential that this funding profile be maintained in order to preserve the launch schedule for the EOS-AM spacecraft in 1998 and EOS-PM in 2000. The funding requirements for the restructured program increase substantially in FY1995. This increase is necessary to execute the complete set and sequence of spacecraft required for the restructured program.

The spacecraft in the restructured program will be funded with the normal reserves for major NASA flight programs. Further, in compliance with the recommendations of the Frieman Committee, the restructured program has additional budget flexibility in that the launch dates of the CHEM, ALT, AERO, and COLOR spacecraft can slip within a modest range without drastically impacting the science observations. Every effort, however, will be made to preserve the launch dates of the AM and PM spacecraft.

The cost estimates for the instruments that were to have flown on the original large EOS-A1 platform and the EOS-AM spacecraft bus are well understood since both elements are under contract (although the spacecraft contract will be modified to reflect the current downsized configuration). Cost estimates for subsequent spacecraft and for the instruments that are not currently under development are preliminary, based on derivation from the current EOS-AM definition and development estimates and analogy with previous flight project experience. These estimates will be updated before beginning development of these spacecraft and instruments.

<u>Missions in Advance of EOS:</u> A calendar of the launch dates for all of the missions that will make observations of global change in advance of EOS is shown in Figure 4. This era is known as Phase 1 of the Mission to Planet Earth. It is important to note that all of the instruments that will fly on EOS have important, but less capable versions, or in some cases even identical versions, that will fly on these Phase 1 missions. Thus, the Mission to Planet Earth is an evolutionary program. It is providing important information on global change today, will provide more such information throughout Phase 1, and will evolve into more comprehensive and detailed observations when the EOS spacecraft fly.

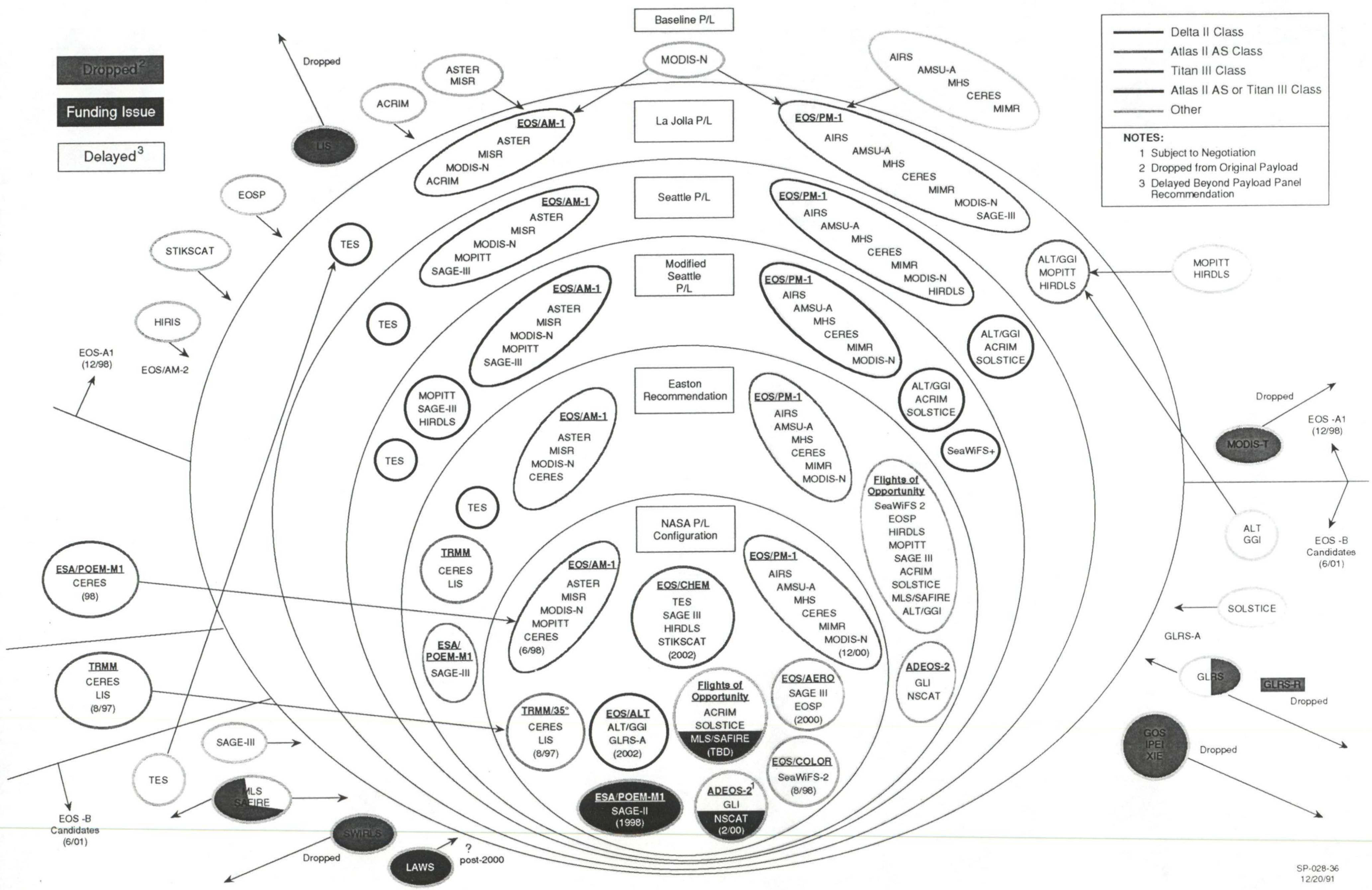
<u>The Role of the Departments of Energy and Defense:</u> As noted by the Frieman Committee, the DOE and DOD can make important contributions to the Mission to Planet Earth. In particular, the DOE may be able to provide an additional spacecraft to Phase 1 of the Mission to Planet Earth. Although there are a large number of missions that fly during Phase 1, several review committees have noted that there is a discontinuity in Earth radiation budget observations, between NASA's ERBE measurements on ERBS and NOAA 9 and 10, and NASA's CERES measurements on the Japanese TRMM mission and subsequent EOS spacecraft. The DOE is considering providing one or more small spacecraft which can provide these observations. To be useful the observations need to commence no later than 1995, since TRMM flies in 1997, and their calibration needs to be well understood to help provide continuity between the ERBE and CERES observations.

Further, the DOE and DOD may be able to assist in the development of new technologies for use in subsequent generations of EOS instruments. The restructured EOS does not include a Laser Atmospheric Wind Sounder, an advanced Synthetic Aperture Radar, or a light-weight, high-resolution imaging spectrometer. These instruments will be important for global change studies. It would be very helpful for the

DOE and DOD to execute technology demonstration projects that would lead to reliable, more compact, and less expensive versions of these and other advanced instruments.

It should be noted that the DOE and DOD are not expected to develop technology for the first generation of EOS spacecraft. The instruments for these spacecraft are currently under development using state-of-the-art technology. Similarly, the spacecraft designs are straightforward extensions of previously successful NASA spacecraft.

Follow-on EOS Spacecraft: EOS is to be a long-term program, providing continuous observations of the causes of global climate change. The principal EOS spacecraft, EOS-AM, EOS-PM, etc., will thus be repeated twice on five-year centers for at least fifteen year coverage. However, the payloads on the follow-on EOS spacecraft could change, depending on the evolution of scientific understanding of global change and the development of technology. For example, the ASTER instrument on the first EOS-AM spacecraft could be replaced by the high resolution spectrometer, HIRIS, on the second EOS-AM spacecraft. Actual decisions on instruments to fly on follow-on spacecraft do not need to be made for some years. However, technology development efforts need to continue to insure that subsequent generation instruments are available when needed.



SP-028-36
12/20/91

FIGURE 2

Descriptions of EOS Missions

Missions before the end of 2000

Missions	Instruments Planned	Instrument Description	Mission Science Objectives
NASA AM-1 6/98	CERES (2 Scanners)	Clouds and Earth's Radiant Energy System—Two broad-band scanning radiometers	• Physical and radiative properties of clouds • Air-land exchanges of energy, carbon, and water • Vertical profiles of CO and CH^4 • Volcanology
	MODIS-N	Moderate-Resolution Imaging Spectrometer—Global physical and biological processes	
	MISR	Multi-angle Imaging Spectro-Radiometer—Global maps of planetary and surface albedo, and aerosols and vegetation properties	
	ASTER (Japan)	Advanced Spaceborne Thermal Emission and Reflection Radiometer—High-resolution images of land surface, water, and clouds stereo	
	MOPITT	Measurements of Pollution in the Troposphere–Vertical profile of CO and CH_4 column	
	WBDCS	Wide Band Data Collection System—Collects data from ocean buoys	
NASA SeaWiFS II 1998	SeaWiFS	Sea-Viewing Wide Field-of-View Sensor—Ocean color and productivity	• The oceans' role in carbon cycle
NASA Aero 2000	SAGE III	Stratospheric Aerosol and Gas Experiment III—Global profiles of aerosols, clouds, temperature, and pressure	• Tropospheric and stratospheric aerosol properties
	EOSP	Earth Observing Scanning Polarimeter—Globally maps radiance and linear polarization of reflected sunlight	

Descriptions of EOS Missions

Missions before the end of 2000

Missions	Instruments Planned	Instrument Description	Mission Science Objectives
NASA PM-1 12/00	CERES (2 Scanners)	Clouds and Earth's Radiant Energy System—Two broad-band scanning radiometers	• Cloud formation, precipitation, and radiative properties • Air-sea fluxes of energy and moisture • Sea-ice extent and heat exchange with the atmosphere
	AIRS	Atmospheric Infrared Sounder—Clear-column temperature profiles	
	AMSU-A	Advanced Microwave Sounding Unit—Temperature sounding from surface to 40 km	
	MHS	Microwave Humidity Sounder—Atmospheric water vapor profiles	
	MODIS-N	Moderate-Resolution Imaging Spectrometer—Global biological and physical processes	
	MIMR (ESA)	Multi-Frequency Imaging Microwave Radiometer—Precipitation, cloud water, sea surface temperature and roughness, and ice, snow, soil moisture	
NASA ALT 2002	ALT	Altimeter—Dual frequency radar for topography	• Ocean altimetry and circulation • Ice sheet mass balance • Geological features application
	GGI	Global Positioning System (GPS) Geoscience Instrument—Tracks 18 GPS for 3-cm positioning, global geodesy, atmospheric temperatures, and gravity wave characterization	
	GLRS-A	Geoscience Laser Ranging System-Altimeter Only—Ice sheet and glacier topography	

Descriptions of EOS Missions

Missions after 2000

Missions	Instruments Planned	Instrument Description	Mission Science Objectives
NASA Chem 2002	HIRDLS	High-Resolution Dynamics Limb Sounder—Global distribution of temperature and greenhouse gases	• Chemistry of troposphere and lower stratosphere, including stratosphere/troposphere exchange • Air-sea chemical fluxes and forcing of ocean circulation
	TES	Tropospheric Emission Spectrometer—3-D profiles on a global scale of all infrared-active species from surface to lower stratosphere	
	STIKSCAT	Scatterometer—Sea surface wind vectors	
	SAGE III	Stratospheric Aerosol and Gas Experiment III—Global profiles of aerosols, clouds, temperature, and pressure	
2003 and 2005		Follow-on AM and PM missions with some substitutions are planned to ensure data continuity	

EOS A-1 Instrument Synergy

User \ Provider	MODIS-N	MODIS-T	CERES	ASTER	MISR	EOSP	AIRS	AMSU-A	MHS	MIMR	STIKSCAT	MOPITT	LIS	HRDLS	ACRIM
MODIS-N		C/P	C	C/P	C/P	C/P	C/P	P	P	P					
MODIS-T	C/P			C	C/P		P	(P)	P	P	P				
CERES	C/P			(P)	P	C/P	C/P	P	P	P					
ASTER	C	C			P		P	(P)	(P)	(P)					
MISR	C/P	C		(C)		C/P	P	(P)	P	(P)					
EOSP	C/P	P			C/P		P		P	(P)					
AIRS	C/P							P	P	P					
AMSU-A	P						P		P	C/P					
MHS	P						P	P		P					
MIMR	P						P	(C/P)	P						
STIKSCAT										P					
MOPITT	P						P	P	(P)						
LIS	P						(P)	(P)	(P)	P					
HIRDLS					(P)	(P)	(P)	(P)							
ACRIM															

KEY

C = Cross Calibration Connection

P = Observed Phenomena Connection

O = Critically Required

= Required

( ) = Potential Contribution

FIGURE 3

PHASE I OF MISSION TO PLANET EARTH*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1991			△ METEOSAT-5		◐ NOAA-D (AVHRR)		▲ ERS-1	■ SSBUV-3 ▲ TOMS (Meteor-3)	■ UARS ○ DMSP-11 (SSM/I)			
1992		▲ JERS-1 ◐ NOAA-I (AVHRR)			■ ATLAS 1 (SSBUV-A-01)		○ LANDSAT 6 ● TOPEX/ POSEIDON				■ LAGEOS II	
1993	△ METEOSAT-6		○ DMSP-12 (SSM/I)		■ ATLAS-2 (SSBUV-A-02)			◐ SeaStar (Ocean Color)		■ SRL-1		○ GOES-I ● TOMS ◐ NOAA-J (AVHRR)
1994	△ GMS-5			■ ATLAS-3/ CRISTA-SPAS (SSBUV-A-03)	■ LITE	▲ ERS-2 (Proposed)			◐ NOAA-K (AVHRR)		■ SRL-2	▲ RADARSAT ○ GOES-J ○ DMSP-13 (SSM/I)
1995		● TOMS NSCAT/ADEOS						■ LITE II			■ ATLAS-4 (SSBUV-A-05)	○ DMSP-14 (SSM/I)
1996							◐ NOAA-L (AVHRR)	■ SRL-3				
1997				◐ NOAA-M (AVHRR)	■ ATLAS-5 (SSBUV-A-06)	● TOMS-2		● TRMM	○ DMSP-15 (SSM/I)			▲ POEM-M (Proposed)
1998		▲ JEOS-Polar									○ DMSP-16 (SSM/I)	○ GOES-K ● EOS-A1

■ SHUTTLE
● ELV R&D
○ ELV OPERATIONAL
◐ 1/2 R&D 1/2 OPERATIONAL
▲ FOREIGN MISSION R&D
△ FOREIGN OPERATIONAL

* Dates for US Missions are Estimates and Reflect Current (August 1991) NASA Manifest and Planning, as Well as Planning by NOAA and DOD. Dates for Foreign Missions are Estimates Provided by Those Nations.

SP-033-11d
10/22/91

ACRONYMS

ACRIM	Active Cavity Radiometer Irradiance Monitor
ADEOS	Advanced Earth Observing Satellite (Japan)
AIRS	Atmospheric Infrared Sounder
ALT	Altimeter
AMSU-A	Advanced Microwave Sounding Unit
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CERES	Clouds and Earth's Radiant Energy System
EOSDIS	EOS Data and Information System
EOSP	Earth Observing Scanning Polarimeter
ERBE	Earth Radiation Budget Experiment
ERBS	Earth Radiation Budget Satellite
ESA	European Space Agency
GGI	GPS (Global Positioning System) Geoscience Instrument
GLRS	Geoscience Laser Ranging System
GOS	Geomagnetic Observing System
HIRDLS	High-Resolution Dynamics Limb Sounder
HIRIS	High-Resolution Imaging Spectrometer
IPCC	Intergovernmental Panel on Climate Change
IPEI	Ionospheric Plasma and Electrodynamics Instrument
LAWS	Laser Atmospheric Wind Sounder
LIS	Lightning Imaging Sensor
MHS	Microwave Humidity Sounder
MIMR	Multifrequency Imaging Microwave Radiometer
MISR	Multi-Angle Imaging Spectro-Radiometer
MLS	Microwave Limb Sounder
MODIS-N	Moderate-Resolution Imaging Spectrometer-Nadir
MODIS-T	Moderate-Resolution Imaging Spectrometer-Tilt
MOPITT	Measurements of Pollution in the Troposphere
NOAA	National Oceanic and Atmospheric Administration
NSCAT	NASA Scatterometer
POEM	Polar Orbit Earth Observations Mission (ESA)
SAFIRE	Spectroscopy of the Atmosphere Using Far Infrared Emission
SAGE III	Stratospheric Aerosol and Gas Experiment
SAR	Synthetic Aperture Radar
SeaWiFS	Sea Wide-Field Viewing Sensor
SOLSTICE	Solar Stellar Irradiance Comparison Experiment
STIKSCAT	Stick Scatterometer
SWIRLS	Stratospheric Wind Infrared Limb Sounder
TES	Tropospheric Emission Spectrometer
TRMM	Tropical Rainfall Measuring Mission
XIE	X-Ray Imaging Experiment