IG-98-010

AUDIT REPORT

NASA'S PLANS TO SUCCESSFULLY ACHIEVE THE EARTH OBSERVING SYSTEM (EOS) SCIENTIFIC OBJECTIVES

APRIL 3, 1998

National Aeronautics and Space Administration

OFFICE OF INSPECTOR GENERAL

BACKGROUND

The Earth Observing System (EOS) Program was authorized as a Fiscal Year (FY) 1991 new start. The EOS Program is the centerpiece of NASA's Office of Earth Science (OES) Enterprise and is a major part of the comprehensive United States (U.S.) Global Change Research Program. The overall goal of the program is to advance the understanding of the entire earth system on a global scale.

The EOS Program consists of three components: (1) EOS Flight Systems, (2) EOS Data and Information System (EOSDIS), and (3) EOS Science Program. The EOS Science Program uses interdisciplinary research that focuses on defining the state of the Earth System; understanding its basic processes; and, developing and applying predictive models for these approaches. The seven objectives of the EOS Science Program are:

(1) The role of clouds, radiation, water vapor, and precipitation.

(2) The productivity of the oceans, their circulation, and air-sea exchange.

(3) The sources and sinks of greenhouse gases, and their atmospheric transformations.

(4) Changes in land use, land cover, primary productivity and the water cycle.

(5) The role of polar ice sheets and sea level.

(6) The coupling of ozone chemistry with the climate and the biosphere.

(7) The role of volcanoes in climate change.

Because of budget reductions that have occurred since FY 1991, NASA has changed the EOS Program's scientific focus from all encompassing global change to global climate change. Although the scientific focus has changed, the objectives of the EOS Science Program have remained the same.

NASA plans to accomplish the objectives of the EOS Science Program through Interdisciplinary Science (IDS) and Instrument Science teams. The IDS teams will use EOS instrument data to develop and refine integrated Earth system models to help in understanding the Earth as a system. The IDS teams' investigations cross research discipline boundaries by addressing more than one science objective. The Instrument Science teams define the scientific requirements for EOS instruments, and generate the algorithms that will process data from the instruments into useful products. NASA selected 29 IDS and 19 Instrument Science teams representing organizations such as NASA, universities, and other U.S. and foreign government agencies (See Appendices 1 and 2 for a description of each IDS and Instrument Science Team). NASA funds all U.S.-based IDS investigations and U.S. scientists on Instrument Science teams. NASA funds the IDS teams through ten-year research grants while they provide the Instrument Science teams' funds through contracts. For the period FY 1991 through FY 2000, the NASA-funded IDS and Instrument Science teams have an overall budget of $677 million. NASA's international partners fund the foreign-based teams as well as foreign members of U.S. teams.

The NASA Headquarters, Office of Earth Science (OES) has overall responsibility for the EOS Program. The EOS Program Scientist (OES Science Division) is responsible for oversight of the IDS teams. The EOS Senior Project Scientist (Goddard Space Flight Center (GSFC) Earth Sciences Directorate) is responsible for oversight of the Instrument Science teams. Together, these two scientists are responsible for ensuring the satisfactory accomplishment of the objectives of the EOS Science Program.

The EOS Program's original budget was $17 billion from FY 1991 through FY 2000. Three program restructures resulted in the budget being reduced to a current level of $7.25 billion through FY 2000.

OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

The audit objectives were to determine if:

- The declining EOS Program budget will affect the planned scientific objectives.
- Actions, planned or taken by NASA, will ensure accomplishment of the planned EOS scientific objectives.
- NASA has identified opportunities to accomplish the EOS scientific objectives through partnerships with other U.S. agencies, contractors, or the international community to reduce cost.

SCOPE AND METHODOLOGY

We performed the audit in accordance with generally accepted government auditing standards. As part of the audit, we interviewed Principal Investigators or Co-Principal Investigators from selected IDS and Instrument Science teams. In addition, we reviewed applicable EOS Program documentation such as research proposals, budgets, progress reports, biennial reviews, technical reports, special studies, memorandums of agreement, memorandums of understanding, correspondence, technical plans and performance reports.

AUDIT FIELD WORK

We conducted audit field work from July 1996 through September 1997 at NASA Headquarters, GSFC, Langley Research Center, and the Jet Propulsion Laboratory. In addition, we visited the Woods Hole Oceanographic Institute, the National Center for Atmospheric Research, the University of California, Santa Barbara, Colorado State University, and Pennsylvania State University.

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OBSERVATION AND RECOMMENDATION

OVERALL EVALUATION

The OES has attempted to reduce the cost of accomplishing the EOS Science Program's original objectives. This has been done through the initiation of partnerships with contractors and other U.S. and foreign government agencies. The audit did show that NASA may not fully accomplish the program's original objectives. We discuss this observation in detail below.

ACCOMPLISHMENT OF THE EOS SCIENCE PROGRAM'S ORIGINAL OBJECTIVES MAY NOT BE POSSIBLE

NASA may not fully accomplish the EOS Science Program's original objectives. The program's ability to fully accomplish the science objectives has been affected by (1) significant budget reductions, and (2) unsatisfactory performance or non-responsiveness by five IDS teams. This has resulted in:

- IDS and Instrument Science teams eliminating or reducing integral research tasks, and
- near-term gaps in the EOS Science Program.

The OES needs to reevaluate, and if necessary, revise the science objectives to reflect limitations placed on the EOS Program because of budget reductions and unsatisfactory IDS teams performance.

BUDGET REDUCTIONS NECESSITATE THAT IDS AND INSTRUMENT SCIENCE TEAMS REDUCE TASKS

The OES significantly reduced the IDS and Instrument Science teams' budgets in response to three EOS Program restructures. For the period of FY 1991 through FY 1996,[1] the OES reduced the budget for the IDS teams 41.8 percent from $119.8 to $69.7 million. For the period of FY 1991 through FY 2000, the OES reduced the budget for the Instrument Science teams 31.2 percent from $459 to $316 million.

In response to the budget reductions, Principal Investigators (PIs) had to eliminate or reduce research tasks that are integral to the accomplishment of the EOS Science Program's objectives. Examples of actions taken include:

- Reducing the technical scope of EOS instruments.
- Eliminating science research tasks.

[1] OES Officials could not provide IDS team funding figures for FY 1997 through FY 2000.

- Reducing scope on scientific investigations by eliminating foreign site investigations.

- Reducing and eliminating funding for researchers working toward current science objectives.

These actions resulted not only in less data for instrument users, but also in data essential to completing some investigations not being collected. Further, the actions taken to eliminate or reduce research tasks could directly affect the ability of the IDS and Instrument Science teams to fully accomplish the EOS Science Program's objectives.

FUTURE BUDGET REDUCTIONS COULD FURTHER LIMIT ACCOMPLISHMENT OF OBJECTIVES

Both IDS and Instrument Science team PIs stated that any future budget reductions would further limit accomplishment of the EOS Science Program's original objectives. In response to past budget reductions, science teams either reduced or eliminated essential research tasks only to accomplish a portion of the program's objectives. Future budget reductions will further diminish the teams' chances of accomplishing the objectives.

REVIEWS IDENTIFY DEFICIENT IDS TEAMS

Reviews conducted in 1992 and 1995 identified deficient IDS teams (See Appendix 3 for details on the review process). Specifically, a programmatic review conducted in 1992 noted substantial deficiencies for five of the 24 IDS teams (reviews were not performed for five IDS teams). The deficiencies noted included (1) weak management, coordination and integration, and (2) a lack of expertise. Despite these findings, the OES did not cancel the teams' involvement with the EOS Science Program. OES officials informed us that they viewed the 1992 programmatic review as a team building exercise to acclimate team members, and to provide these five teams the time to correct noted deficiencies before the 1995 review.

A peer review conducted in 1995 resulted in the deselection of five IDS teams. The OES deselected four IDS teams because of unsatisfactory performance and one team because of its non-responsiveness to the peer review. According to an OES official, the four unsatisfactory IDS teams exhibited similar deficiencies during the 1992 review. As a result, the OES will "phase out" these five teams from the EOS Science Program. The "phase out" period was to be through the end of FY 1997. The results of the 1995 peer review stated that, "funding for these teams will be reduced by 50 percent during the next two years to allow a gradual transition, and minimize the adverse impacts on team members."

NASA has expended a total of approximately $12.2 million from FY 1993 through FY 1997 for the five IDS teams whose scientific investigations will not be used to accomplish the EOS Science Program's objectives. This occurred even though the OES knew in 1992 that the five teams were deficient, yet did not cancel their involvement with the program. This also occurred during a period when the EOS Program's budget was being reduced by more than 50 percent.

UNSATISFACTORY PERFORMANCE RESULTS IN NEAR-TERM SCIENCE GAPS

The five deselected IDS teams will not conduct investigations vital to the successful completion of the EOS Science Program's objectives. This is primarily because the IDS teams' investigations will cross research discipline boundaries and therefore address more than one science objective. Cancellation of these investigations could result in near-term gaps in the EOS Science Program, and potentially jeopardize accomplishment of each of the program's seven science objectives. Principal Investigators (PIs) from the five teams rated unsatisfactory and OES Officials both confirmed this conclusion. Three of the five PIs stated that their teams' investigations were integral to accomplishment of the science objectives. The two other PIs indicated cancellation of their investigations would jeopardize the accomplishment of near-term science objectives. OES officials acknowledged that the loss of the investigations by the five IDS teams will cause immediate EOS scientific gaps, specifically affecting the EOS AM-1 mission (scheduled for launch in 1998). These officials stated that replacement teams were selected who could potentially use data from instruments on the EOS AM-1 spacecraft to conduct investigations. However, the Research Announcement for soliciting these teams stated that the teams should propose science based on existing non-EOS data sets.

OES EXPECTS IDS AND INSTRUMENT SCIENCE TEAMS TO ACCOMPLISH ORIGINAL OBJECTIVES

Despite the problems of significant budget reductions and unsatisfactory performance, the OES continues to expect the IDS and Instrument Science teams to accomplish the EOS Science Program's original objectives. In interviews, OES officials provided various reasons for not revising the science objectives. One OES official informed us that he believed the IDS teams could still accomplish the original objectives despite the funding reductions. Another OES official stated that he advised procurement personnel to modify the contracts of the Instrument Science teams to reflect scope changes caused by budget reductions, such as deleting data products. However, procurement

personnel informed them that they did not modify the contracts because they are considered "level of effort" contracts, which do not require modification.

SUMMARY

The audit showed that significant budget reductions because of three EOS Program restructures have necessitated the elimination or reduction of research tasks. Any future budget reductions would further limit accomplishment of the EOS Science Program's objectives. In addition, five IDS teams identified during the 1992 programmatic review as deficient, were subsequently identified as unsatisfactory or non-responsive during the 1995 peer review. The "phase-out" of these five teams will result in not conducting investigations that are vital to completion of the EOS Science Program's objectives. This action could result in near-term gaps in the EOS Science Program and potentially jeopardize accomplishment of the program's science objectives.

RECOMMENDATION

The OES needs to reevaluate the EOS Science Program's original seven objectives and revise them to reflect limitations placed on the program because of budget reductions and unsatisfactory performance by IDS teams.

Management's Response

Concur in part. NASA stated that they basically agree with the recommendation. However, they stated that the recommendation is made in an incomplete historical context. NASA management stated that they will address the science requirements for EOS and the Earth Science Enterprise in science implementation plans to be issued in Spring 1998.

Evaluation of Management's Response

We believe that Management's action to issue science implementation plans in Spring 1998, which includes a review of the EOS Program as well as the overall Earth Science Enterprise, to be responsive to our recommendation. We consider this recommendation closed for reporting purposes. We want to reemphasize that there should be a formal written change to the EOS Program Science objectives resulting from NASA's ongoing efforts to update the Earth Science's mission, goal and objectives and themes. Based on the staff level discussions that have taken place since the issuance of our draft report, we are confident that this will occur. We take exception to the Deputy Associate Administrator for Earth Science (Programs) comment that "the recommendation is made in an incomplete historical context." Our audit focused entirely on the EOS program, which is a major component of the Earth Science Enterprise. The majority of the historical data the Office of Earth Science presented in its response

address the *overall Earth Science objectives*. Our audit concludes that *specific attention needs to be directed to the EOS Science Objectives*. Specific focus on the history of the EOS program clearly shows that the objectives have remained constant despite the overall changes to the Earth Science Program as discussed in the referenced attachment. We believe that the Introduction/ Background section of our report provides relevant data with respect to the EOS program. However, we have included NASA's attachment as part of the report for information on the broader Earth Science Enterprise history.

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ATTACHMENT 1

NASA MANAGEMENT RESPONSE

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: YM

TO: W/Acting Assistant Inspector General for Auditing

FROM: Y/Deputy Associate Administrator for Earth Science (Programs)

SUBJECT: Comments on Draft Report A-GO-96-009

Per your memo of December 11, 1997, we have reviewed the draft Report on NASA's Plans to Successfully Achieve the Earth Observing System (EOS) Scientific Objectives (A-GO-96-009). I partially concur. While the recommendation that this enterprise revise its science objectives is fine, the recommendation is made in an incomplete historical context. The enclosed comments provide that context so that the readers of the report will have a more accurate view of the EOS science program. Science requirements for EOS and for the Earth Science Enterprise as a whole are being addressed in science implementation plans to be issued this Spring.

I understand from staff-level discussions that, given the information provided, the report's recommendation can be closed upon issuance of the report. If you have questions on this matter, please contact Mr. Greg Williams at 358-0241.

W. F. Townsend

Enclosure

cc: YM/Mr. G. Williams
GSFC/900/Dr. M. King

NASA MANAGEMENT RESPONSE

Comments on Draft Audit Report on
"NASA's Plans to Successfully Achieve the Earth Observing System Objectives"

The report correctly identifies the past restructuring of NASA's Earth Observing System (EOS) program leading to reduction of its budget. It provides a brief summary of the evaluation processes that NASA has established to assure the high quality and performance by the funded investigators selected since inception of the EOS program in 1990. The report also provides some statistics on the composition of the original EOS Investigators Working Group (IWG) members, although these statistics are out of date. The report concludes that the science objectives of the EOS program have not evolved since inception and they should be examined in light of the past restructurings of the EOS program, and the loss of five of the original 29 EOS interdisciplinary science teams will have a major negative impact on scientific support for the upcoming EOS missions.

NASA believes, as documented below, the scientific objectives/priorities for the EOS program have evolved significantly since inception and the expansion of the EOS investigators group during the past few years is in direct response to such evolution. In addition, NASA believes the expanded EOS IWG (see below) will more than compensate for the loss of the five EOS interdisciplinary science investigations deselected due to a combination of their scientific performance and some management issues based on two sets of rigorous review processes. NASA made every effort to take full advantage of its investment in these teams by working very closely with them during a period of 1993-95 prior to their being deselected. The main reason for the gradual phasing out of four of the five teams was the consideration of continuity of support for graduate and postdoctoral students being trained by these four teams.

NASA has published a chronology of the evolution of EOS Science objectives and priorities commensurate with the past EOS program restructurings in the MTPE/EOS Reference Handbook. The initial scientific focus of the EOS Program was an all encompassing investigation of Global Change. Following its first two restructurings, the EOS science objectives were focused further on Global Climate Change rather than the much broader and all encompassing Global Change. In 1994, a document entitled EOS Science Strategy describing the EOS science priorities and approach was prepared by the EOS Program and Project Scientists with contributions from the EOS investigators and published by the American Institute of Physics Press. The EOS investigators have been developed the EOS Science Implementation Plan during the past two years that will be published shortly. Through these efforts and with active participation of the EOS investigators NASA has revisited the scientific focus/priorities of the EOS program in the past. NASA envisions that as the first series of EOS missions are executed during the next several years and the scientific understanding of the contemporary Earth science issues are improved, further refinement and evolution of EOS and its broader MTPE science focus/priorities are essential. NASA has put in place a formal mechanism called the "Biennial Review Process" for periodic assessment of its entire Earth science program that will support the evolution of EOS scientific focus/priorities.

ATTACHMENT 1

NASA MANAGEMENT RESPONSE

The membership of the EOS Investigators Working Group (IWG) has evolved significantly since inception of the EOS program in 1990. There were a total of 528 official EOS investigators and IWG members as of May 1996. Of the 528 official EOS IWG members, 362 were from the U.S. and 166 were from 12 other nations. As a result of NASA initiatives to open up the EOS program to broader participation, to strengthen the areas identified through the programmatic and peer review processes in 1992 and 1995, and to replace the expertise lost due to deselection of the five EOS interdisciplinary investigations, the EOS membership has increased gradually. NASA issued a research announcement in 1995 and solicited scientific investigations in five major areas: (i) to support and augment the existing EOS instrument science teams, based on weaknesses identified throughout the evaluation of these teams by the EOS Project Science Office at GSFC; (ii) to establish science teams for the first time for the Landsat satellite; (iii) to add new interdisciplinary research investigations to support the new EOS science foci resulting from the evolution of the EOS program since inception in 1990; (iv) to establish the New Investigator Program (NIP) for the first time to allow participation of early career Earth scientists in the EOS program; and (v) to award education supplemental grants to enable transfer of up to date scientific knowledge and information to K-12 and undergraduate curricula. As a result of this, the total number of EOS IWG members increased to 653 by December 1996, with 480 members from the U.S. and 173 from 13 other nations.

In 1996 and 1997, NASA issued two more research announcements in cooperation with the National Science Foundation (NSF) and the National Oceanic and Atmospheric Administration (NOAA) to replace the expertise lost as a result of the deselection of the five original EOS interdisciplinary investigations, and to add new investigations to support further evolution of EOS science objectives. In addition, NASA released a research announcement in 1997 to support investigations aimed at validating data products derived from measurements on EOS AM-1, TRMM, and SAGE III. There are currently 802 official EOS IWG members. This number represents all EOS-funded PIs, Co-Is, team leaders, and team members (including the New Investigator Program PIs and type 2 (EOS) validation PIs and Co-Is). In addition, each year EOS funds 150 graduate students pursuing their training at U.S. institutions of higher education. More than 400 students have completed their Ph.D. degrees through this program since its inception in 1990.

Of the 802 official EOS IWG members, 179 are affiliated with NASA Centers and 199 come from 13 nations other than the U.S. Specifically, there are now 73 interdisciplinary science teams, 43 type 2 (EOS) validation investigations, and 21 New Investigator Program investigations. The list of current IDS investigations can be found on the EOS Project Science web site at http://eospso.gsfc.nasa.gov/eos_homepage/invest.html .

Currently, NASA is evaluating a group of proposals to select about 10-12 more EOS interdisciplinary research investigations to support a new scientific focus in the area of atmospheric aerosols. NASA intends to evaluate periodically through its Biennial Program Review the Earth Science Enterprise and EOS science focus/priorities and

NASA MANAGEMENT RESPONSE

solicit and support the participation of U.S. and international scientists in its Earth science program.

It is NASA's opinion that evolution of the EOS program (including evolution and period reviews and modifications of the instrument teams, not specifically addressed in this audit report) has been healthy. One of the four IDS teams deselected in 1995 has regrouped and reproposed successfully and has once again been incorporated into the EOS program, albeit with a smaller and more focused investigation. The new enthusiasm and capabilities of the recently added IDS investigations, which brought the number of IDS investigations from an initial 29 to a current 73, has been healthy.

APPENDIX 1

EOS Interdisciplinary Science (IDS) Teams and Principal Investigators

1. Coupled Atmosphere Ocean Processes and the Primary Production in the Southern Oceans,
   Dr. Mark Abbott, Oregon State University

2. Global Water Cycle: Extension Across the Earth Sciences,
   Dr. Eric Barron, Pennsylvania State University

3. Interdisciplinary Studies of the Relationships Between Climate, Ocean Circulation, Biological Processes, and Renewable Marine Resources,
   Dr. Ian Barton, Marine Laboratories, Hobart, Australia

4. Northern Biosphere Observation and Modeling Experiment,
   Dr. Josef Cihlar, Canada Center for Remote Sensing, Canada

5. NCAR Project to Interface Modeling on Global and Regional Scales with EOS Observations,
   Dr. Robert Dickinson, University of Arizona

6. Hydrology, Hydrochemical Modeling, and Remote Sensing in Seasonally Snow-Covered Alpine Drainage Basins,
   Dr. Jeff Dozier, University of California, Santa Barbara

7. Long-Term Monitoring of the Amazon Ecosystems Through EOS: From Patterns to Processes, Dr. Joao Soares, Instituto Nacional de Pesquisas Espaciais Divisao de Sensoriamento Remoto, Brazil
   Dr. Tom Dunne, University of California, Santa Barbara

8. Use of the Cryospheric System to Monitor Global Change in Canada,
   Dr. Barry Goodison, Atmosphere Environment Service, Canada

9. Biological Fluxes at the Ocean/Atmosphere Interface,
   Dr. Catherine Goyet, Woods Hole Oceanographic Institution

10. Observational and Modeling Studies of Radiative, Chemical, and Dynamical Interactions on the Earth's Atmosphere,
    Dr. William Grose, Langley Research Center

11. Interannual Variability of the Global Carbon, Energy, and Hydrologic Cycles,
    Dr. James Hansen, Goddard Institute for Space Studies

12. Climate Processes Over the Oceans,
    Dr. Dennis Hartmann, University of Washington

13. Climate, Erosion, and Tectonics in Mountain Systems,
    Dr. Bryan Isacks, Cornell University

14. The Hydrologic Cycle and Climatic Processes in Arid and Semi-Arid Lands,
    Dr. Yann Kerr, Center National d'Etudes Spatiales, France
    Dr. Soroash Soroashian, University of Arizona

15. Hydrologic Processes and Climate Interdisciplinary Investigation,
    Dr. William Lau, Goddard Space Flight Center

16. The Processing, Evaluation and Impact on Numerical Weather Prediction of AIRS, AMSU, and MODIS Data in Tropics and Southern Hemisphere,
    Dr. John LeMarshall, Bureau of Meteorology Research, Australia

17. The Role of Air-Sea Exchanges and Ocean Circulation in Climate Variability,
    Dr. W. Timothy Liu, Jet Propulsion Laboratory

18. Changes in Biogeochemical Cycles,
    Dr. Berrien Moore III, University of New Hampshire

19. A Global Assessment of Active Volcanism, Volcanic Hazards, and Volcanic Inputs to the Atmosphere from EOS,
    Dr. Peter Mouginis-Mark, University of Hawaii-Manoa

20. Investigation of the Atmosphere-Ocean-Land System Related to Climate Processes,
    Dr. Masato Murakami, Meteorological Research Institute, Japan

21. Chemical, Dynamical, and Radiative Interactions through the Middle Atmosphere and Thermosphere,
    Dr. John Pyle, Cambridge University, United Kingdom

22. Biosphere-Atmosphere Interactions,
    Dr. David Randall, Colorado State University

23. The Development and Use of a Four-Dimensional Atmospheric-Ocean-Land Data Assimilation System for EOS,
    Dr. Richard Rood, Goddard Space Flight Center

24. Polar Exchanges at the Sea Surface (POLES) the Interaction of Ocean, Ice, and Atmosphere,
    Dr. D. Andrew Rothrock, Goddard Space Flight Center

25. Using Multi-Sensor Data to Model Factors Limiting Carbon Balance in Global Arid and Semiarid Land,
    Dr. David Schimel, National Center for Atmospheric Research, Boulder, Colorado

26. Investigation of the Chemical and Dynamical Changes in the Stratosphere,
    Dr. Mark Schoeberl, Goddard Space Flight Center

27. Middle and High Latitude Oceanic Variability Study,
    Dr. Meric Srokosz, Chilworth Research Center, United Kingdom

28. Earth System Dynamics: The Determination and Interpretation of the Global Angular Momentum Budget Using EOS,
    Dr. Byron Tapley, University of Texas

29. An Interdisciplinary Investigation of Clouds and the Earth's Radiant Energy System Analysis,
    Dr. Bruce Wielicki, Langley Research Center

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APPENDIX 2

EOS Instrument Science Teams and Principal Investigators

1. Active Cavity Radiometer Irradiance Monitor (ACRIM),
   Dr. Richard Wilson, Columbia University

2. Advance Spaceborne Thermal Emission and Reflection Radiometer (ASTER),
   Dr. Anne Kahle, Jet Propulsion Laboratory
   Dr. Hiroji Tsu, Geological Survey of Japan, Japan

3. Advanced Microwave Scanning Radiometer (AMSR),
   Dr. Roy Spencer, Marshall Space Flight Center
   Dr. Akira Shibata, Meteorological Research Institute, Japan

4. Atmospheric Infrared Sounder (AIRS), Advanced Microwave Sounding Unit (AMSU),
   Humidity Sounder from Brazil (HSB),
   Dr. Moustafa Chahine, Jet Propulsion Laboratory

5. Clouds and the Earth's Radiant Energy System (CERES),
   Dr. Bruce Barkstrom, Langley Research Center

6. Dual Frequency Altimeter (DFA), Jason Microwave Radiometer (JMR),
   To Be Determined

7. Earth Observing Scanning Polarimeter (EOSP),
   Dr. Larry Travis, Goddard Institute for Space Studies

8. Enhanced Thematic Mapper Plus (ETM+),
   Dr. Sam Gunard, University of Maryland

9. Geoscience Laser Altimeter System,
   Dr. Bob Schutz, University of Texas

10. High Resolution Dynamics Limb Sounder (HIRDLS),
    Dr. John Barnett, Oxford University, Oxford, England
    Dr. John Gille, National Center for Atmospheric Research, Boulder, Colorado

11. Lightning Imaging Senor (LIS),
    Dr. Hugh Christian, Marshall Space Flight Center,

12. Measurement of Pollution in the Troposphere (MOPITT)
    Dr. James Drummond, University of Toronto, Toronto, Canada

13. Microwave Limb Sounder (MLS),
    Dr. Joe Waters, Jet Propulsion Laboratory

14. Moderate-Resolution Imaging Spectroradiometer (MODIS),
    Dr. Vincent Salomonson, Goddard Space Flight Center

15. Multi-Angle Imaging SpectroRadiometer (MISR),
    Dr. David Diner, Jet Propulsion Laboratory

16. SeaWinds,
    Dr. Michael Freilich, Oregon State University

17. Solar Stellar Irradiance Comparison Experiment (SOLSTICE),
    Dr. Gary Rottman, University of Colorado

18. Stratospheric Aerosol and Gas Experiment III (SAGE III)
    Dr. Patrick McCormick, Hampton University

19. Tropospheric Emission Spectrometer (TES),
    Dr. Reinhard Beer, Jet Propulsion Laboratory

APPENDIX 3

PROCESS FOR 1990, 1992 AND 1995 IDS TEAM REVIEWS

The OES has used various reviews to evaluate the scientific progress of the IDS teams. This review process provides the OES the opportunity to evaluate the IDS teams in areas such as progress of science investigations, management plans, team management, collaboration contacts, and requirement changes. The OES uses the results of these reviews to (1) establish funding guidelines for IDS teams, and (2) ultimately determine whether an IDS team's investigation warrants continuation. The OES conducted reviews in 1990, 1992 and 1995.

1990 Programmatic Review - The 1990 programmatic review (one year after selection of the IDS teams) was limited to programmatic issues in preparation for submitting execution phase proposals.

1992 Programmatic Review - The 1992 programmatic review consisted of on-site reviews of the IDS teams performed by the EOS Program Scientist and other scientists from NASA Headquarters. Each IDS team was rated as either successful or deficient as a result of this review.

1995 Peer Review - The 1995 peer review focused on areas such as past and future accomplishments of investigations, major findings, and contributions to the objectives of the EOS Science Program. For this review, the OES instituted an objective, two step review method to rate each IDS team. Each IDS team was directed to submit progress reports to related discipline scientists at universities, private industry, NASA, and federal agencies for review. These discipline scientists submitted their reviews to a panel of distinguished scientists for further review. The panel of scientists rated the teams as either exemplary, satisfactory or unsatisfactory.

Note: A similar review process was also followed for the Instrument Science teams.

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General Accounting Office
Special Counsel, Subcommittee on National Security, International Affairs, and Criminal Justice

APPENDIX 4

Chairman and Ranking Minority Member - Congressional Committees and Subcommittees

Senate Committee on Appropriations
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Congressional Members

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