Record Group/Collection:	George H.W. Bush Presidential Records
Collection/Office of Origin:	Science and Technology Policy, Office of (OSTP)
Series:	O'Neil, John F., Files
Subseries:	Government Organization Files

OA/ID Number:	62098
Folder ID Number:	62098-003

Folder Title:
NASA – Earth Observing System [1 of 3]

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

National Research Council
National Academy of Sciences
National Academy of Engineering
Institute of Medicine

To: Rick Yannuzi Date: 4-11-92

From: Norman Metzger at NOTES Page 1 of 2

Sending Fax number: Use Originator's FAX

Receiving Fax number: 9-395-1572,62378

Subject: Classified Briefings

4/11/92 3:41PM

From : Norman Metzger at NOTES
To : Rick Yannuzi FAX#9-395-1572w62378 at FAX
cc : Charles Zraket FAX#916172717999w92979 at FAX
Karl Erb FAX#9-395-3719 at FAX
Subject : Classified Briefings

Message Contents

Rick,

Thank you, again, for arranging the briefing. I know it was a job, but I can assure you that we found it both well done and extremely valuable. It will make for a stronger final report of the EOSDIS panel; and, I suspect, at the same time you and your colleagues may benefit from the Panel's observations on the EOSDIS project, both in the interim report, which Karl should now have, and in the final report, due in August.

Again, our appreciation.

Norm

THE CENTER FOR SECURITY POLICY

D E C I S I O N B R I E F

PRESS RELEASE
For Immediate Release

Rush - See pg 2

No. 92-P 42
24 April 1992
Contact: Jennifer W. Macdonald
(202) 466-0515

FROM THE FOLKS WHO ARMED IRAQ: BUSH EXPORT DECONTROL DECISION ENSURES NEW SCANDALS ABOUT STRATEGIC TECHNOLOGY

(Washington, D.C.): Fresh evidence is in hand of President Bush's Faustian determination -- as he recently put it to journalist David Frost -- to do "*whatever* is necessary to be reelected." It can be found in his decision to eliminate controls on the preponderance of militarily relevant technologies sold to other Western nations and to rely upon *those nations'* own export controls to ensure that such technologies are not retransferred to dangerous end-users. **In choosing to pander to a *special* interest, in this case a small but vociferous group of American exporters, Mr. Bush has yet again opted for political expediency over long-term U.S. security interests.**

Rank domestic political considerations seem the only explanation for such an action in light of events of the past few years:

- In the aftermath of the war with Iraq, it has become clear that -- **even under the previous, relatively stringent export control regime -- too many strategic dual-use technologies were finding their way into the wrong hands.** Consider the attachment from today's *New York Times* which offers a partial listing of sales to Iraq approved by the U.S. Commerce Department from 1985-90. It shows that *before* this latest liberalization, to say nothing of *after* it, the Saddam Husseins of the world had a field day acquiring sophisticated computer systems and components for atomic weapons, chemical arms and other malevolent activities.

- What is more, allied nations -- in particular Germany -- have been even more irresponsible with respect to such sales. In addition to routinely approving purchases by questionable end-users of technologies *not* constrained by COCOM agreements (but dangerous nonetheless), **the Germans and other allies frequently sold equipment and know-how specifically proscribed for such sale by multilateral agreement.**

- European governments have over the past few days announced the arrest of a number of individuals accused of involvement with Soviet/Russian espionage operations in France, Belgium and the Netherlands. **The purpose of these spy rings reportedly was to acquire Western technology illegally, underscoring the continuing strategic significance of such technology even in the "post-Cold War" era.**

- What is more, at least some of the successors to the Soviet Union have shown themselves incapable of preventing the transfer of Soviet-originated high technology to unpalatable states in the Middle East and elsewhere. In fact, **given the extreme pressure for hard currency being experienced by *all* of the Soviet successor states, it is predictable that any marketable Western dual-use equipment will probably be rapidly made available for resale elsewhere.**

- more -

Under these circumstances, it is simply irresponsible for the Bush Administration to be dismantling those few export controls and associated institutional arrangements that remain. It is, moreover, entirely disingenuous for the White House and Commerce Department to maintain as a press release issued by Commerce's Bureau of Export Administration today does -- that such steps "do not weaken U.S. non-proliferation export controls."

The Center for Security Policy believes that it is an insult to the intelligence of the American people who have already been badly served by past official inattention to export control issues -- to suggest that there will be no adverse impact on proliferation when, as Commerce says, "licensing will no longer be required on *roughly 95 percent* of all national security controlled items exported to COCOM members and cooperating countries." (Emphasis added.) **If Congress does not wish to share fully in the blame that will flow from technology transfer scandals sure to result from this decision, it must take corrective action *at once*.** Such action should include:

- Hearings by the security-minded Armed Services and Intelligence Committees into the proliferation implications of past export control policies and of the proposed new standard.

- A fresh look at the importance of having the Defense Department and intelligence community involved in evaluating export control decisions. Reportedly, the prime movers behind the policy announced by President Bush yesterday was the handywork of **NSC staffers with no competence in defense technology issues** (Ed Hewett and Anthony Wayne, Director and Deputy Director respectively of the Russian and Eurasian Affairs office and Timothy Deal and Richard Barth, Director and Deputy Director responsible for international economic programs) **and the Commerce Department**.

What is this?

- A flat rejection of the Administration's proposal contained in the Freedom Support Act unveiled on 1 April that would have Congress extend a blanket endorsement for any reductions the executive branch wishes to make in the control list -- among other, ill-advised "blank check" changes to ostensibly "obsolete, Cold War" legislation.

- 30 -

Iraq's Bomb, Chip by Chip

The U.S. Commerce Department licensed the following strategic American exports for Saddam Hussein's atomic weapon programs between 1985 and 1990. Virtually all of the items were shipped to Iraq; all are useful for making atomic bombs or long-range missiles. United Nations inspectors in Iraq are still trying to find most of them. The list is based on Commerce Department export licensing records; the dollar amount of each transaction is as claimed by the exporting company. It was compiled by Gary Milhollin, a law professor at the University of Wisconsin and director of the Wisconsin Project on Nuclear Arms Control, and Diana Edensword, a research analyst at the project.

Atomic Bomb Builders

*Sales to: **Iraqi Atomic Energy Commission**, the main atomic research laboratory; **Badr and Daura sites**, where bomb fuel was made; **Al Qaqaa site**, where detonators were made.*

Canberra Elektronik: computers for measuring gamma rays and fast neutrons — $30,000
Cerberus Ltd.: computers — $18,181
Hewlett Packard: computers; electronic testing, calibration and graphics equipment — $25,000
International Computer Systems: computers useful for graphic design of atomic bombs and missiles — $1,600,000
Perkin-Elmer: computers and instruments useful for quality control of bomb fuels — $280,000
TI Coating Inc.: equipment for coating metal parts, useful for bomb production — $373,708

Atomic Bomb and Missile Builders

*Sales to: **Ministry of Industry and Military Industrialization**, which ran the atomic bomb, missile and chemical weapon factories; **Nasr state enterprise**, where equipment for enriching atomic bomb fuel was made; **Saiah Al Din site**, where electronic equipment for missiles and atomic bombs was made; **Ministry of Defense**, which oversaw missile and atomic bomb development.*

Axel Electronics: capacitors — $84,000
BDM Corporation: computers; computer-assisted design equipment — $52,000
Canberra Elektronik: computers for computer-assisted design — $21,552
Carl Zeiss: microcomputers for mapping — $104,545
Consarc Corporation: computers to run machine tools capable of manufacturing atomic bomb parts (this sale was stopped by Presidential order in June 1990) — $525,553
Data General Corporation: computers for mapping — $324,000
Gerber Systems: computers to run machine tools capable of manufacturing atomic bomb and missile parts — $367,428
Hewlett Packard: computers for making molds; frequency synthesizers and other equipment useful for operating secured military communications systems — $1,045,500
Honeywell Inc.: computers — $353,333
International Computer Systems: computers for manufacturing, tool design and graphics — $4,497,700
International Computers Ltd.: computers — $687,994
Leybold Vacuum Systems: computer controlled welder used by Iraqis to produce centrifuges for making atomic bomb fuel — $1,400,000
Lummus Crest: Radio spectrum analyzers; design computers; computers for factories producing mustard gas ingredients — $250,000
Rockwell Collins International: equipment for navigation, directional finding, radar communications or airborne communications — $127,558
Sackman Associates: computers and instruments capable of analyzing metals and powders for atomic bomb and missile manufacture — $60,000
Siemens Corporation: computers and instruments capable of analyzing metals and powders for atomic bomb and missile manufacture — $78,000
Spectra Physics: lasers; detection and tracking equipment for lasers — $19,000
Unisys Corporation: computers — $2,600,000
Wild Magnavox Satellite Survey: computers for processing satellite images that are useful for military mapping and surveillance — $270,000
Zeta Laboratories: quartz crystals for military radar — $1,105,000

Missile Builders

*Sales to: **Saad 16**, the main missile research site; **State Organization for Technical Industry**, the procurement organization for missile sites that bought most Scud missile parts and equipment.*

BDM Corporation: computers; superconducting electronics — $29,405
Carl Schenck: computers — $10,228
EZ Logic Data: computers — $27,800
Finnigan MAT: computers that U.N. inspectors believe monitored uranium enrichment for atomic bomb fuel — $483,030
Hewlett Packard: electronic testing equipment; computers; frequency synthesizers, radio spectrum analyzers — $589,257
International Computer Systems: computers — $1,375,000
International Imaging Systems: computers for processing satellite data; infrared equipment capable of aerial reconaissance and military surveillance — $988,000
Lummus Crest: computers to aid factory design — $44,320
Perkin-Elmer: computers — $24,560
Scientific Atlanta: equipment for producing radar antennas — $820,000
Semetex Corporation: computers — $5,155,781
Spectral Data Corporation: satellite data processing equipment — $26,880
Tektronix: high-speed electronics useful in developing atomic bombs and missiles; radio spectrum analyzers for developing microwave equipment — $102,000
Thermo Jarrell Ash Corporation: computers for testing materials — $350,893
Unisys Corporation: computers for production control — $7,796
Veeco Instruments Inc.: computers for factory design — $4,640
Wiltron Company: equipment for making radar antennas — $49,510

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

April 10, 1992

IC BRIEFING TO THE NRC PANEL ON EOSDIS

ATTENDEES

Charles Zraket
Chairman, NRC Panel
Scholar in Residence
The Kennedy School of Government
Harvard University
(617)495-8132

Kenneth Daugherty
Chief Scientist, Defense Mapping Agency
(703)285-9178

John Hopcroft
Dept. of Computer Science, Cornell University
(607)255-7416

Norman Metzger
National Research Council
(202)334-3061

Karl Erb
Associate Director Designate for Physical Sciences and Engineering
OSTP
(202)395-5130

Eugene Wong
Associate Director for Industrial Technology
OSTP
(202)456-7710

Michelle Van Cleave
Assistant Director for National Security Affairs
OSTP

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01a. List	NRC Panel Attendees [50 USC 403g, Sec 6] (1 pp.)	4/10/92	(b)(3), (b)(7c)	

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C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

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(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

(202)395-7326

Douglas Beason
Senior Policy Analyst
OSTP
(202)395-3840

John O'Neil
Senior Policy Analyst
OSTP
(202)395-3272

(b)(3)

(b)(7c)

Steve Harrison
Director for Advanced Concepts, Science, and Technology
National Space Council
(202)395-6175

REQUEST FOR APPOINTMENTS

TS SI/TK

To: Officer in Charge
Appointments Center
Room 060, OEOB

Please admit the following appointments on Friday, April 10, 1992,
for Dr. Karl Erb of OSTP.

Plus 3 from PFIAB.

✓ BERKO, FREDERICK	10/26/43
BOZZAY, JOSEPH	9/30/58
CALVELLI, FRANK	11/11/64
DATEMA, CHARLES	12/18/45
✓ DAUGHERTY, KENNETH	11/20/35
HAMMARSTROM, LEE	2/11/39
HARRIS, JEFF	6/28/53
✓ HOPCROFT, JOHN	10/7/39
MALINOWSKI, LEONARD	9/11/29
MEEHAN, PATRICK	12/27/45
MEHLBAUM, ALBERT	6/11/46
✓ METZGER, NORMAN	11/12/36
MIHARA, ROBERT	9/5/40
ROY, RICHARD	1/7/48
ROSEN, MORRIS	10/23/34
SNAPP, MIKE	1/16/47
SOTHERLUND, DANA	11/29/54
SPENCER, NORMAN	4/7/44
TOWNSEND, ALEX	4/8/43
WEIRICH, JERRY	12/25/53
ZALL, LINDA	11/15/50
ZELINSKI, GARY	3/3/56
✓ ZRAKET, CHARLES	1/9/24

15 - EOP/NRC
19 - IC
34

MEETING LOCATION:
Building OEOB

Room No. 208

Time of Meeting 9 AM

Requested by Jo Ann Ward

Room No. 572 Telephone 7326

Date of Request April 9, 1992

APPOINTMENTS CENTER: SIG/OEOB - 395-6046 OR WHITE HOUSE - 456-6742

→ Info Handl. System ←

* { EOS DIS > NRC NAS Study
Chairman, Mitre ? ~ Hirsch worked at Mitre.
Zraket }

(TOR)

Karl: Study + Executive Br.

(Lee Hammarstrom NRC POC) ~ Chief R&D 703/318-2130 ~ carphone (301) 807-4262 → (Betty)

Dozier met Lee. Lee onboard.

→ A NASA Study ←

Prelim Rept : 3/92
End : 7/92

Karl Erb

Alex Townsend

· Linda avers that to date the IC have done nothing to help the EOS people on the DIS. She spoke to Gore about this: who responded very well in Nov '91.
(Baker – Scripps Scientists
Leon Fuerth – Gore Staffer on this)

→ · Memo to Gates ←

POC: Joe Alexander, NASA
453-1430
Assoc Admin Admind

(FISK)

(TOR)

Brown / Bromley

Discussion of this issue

~ Linda's FAX
703/734-0062

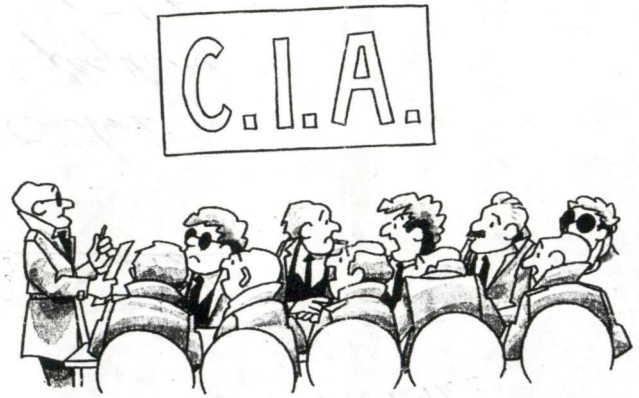
482-4303
-7713) Hirsch.

· Very good, Assoc w/ Harvard now. Former dir of Mitre. Expertise is relevant.

· Write Gates because the problem 2 fold.
① ~~Getting data from~~ Data collection, downlink problems (Walker group) + processing.
② Data exploitation + dissemination.

· Alex Townsend

· Norm Spencer ~~3[illegible]2~~ 318-2720
-2724 - desk.



"Of course one of us is a spy, you idiot...We're all spies!"

United States Senate

SELECT COMMITTEE ON INTELLIGENCE
WASHINGTON, DC 20510-6475

March 26, 1992

The Honorable Robert M. Gates
Director of Central Intelligence
Central Intelligence Agency
Washington, D.C. 20505

Dear Bob:

Knowing of your discussions with Senator Gore concerning the contributions our intelligence assets might make toward a greater understanding of global environmental change, I wanted to signal my interest in the issue.

By way of background, my first legislative initiative in 1981 was an Act to increase our national emphasis on Arctic research. That Act became law in 1985 as the Arctic Research and Policy Act. One of the things that Act recognized was the role and importance of the Arctic in understanding global change, and the need to address environmental protection in the Arctic through sound scientific research. Indeed, the Arctic is a natural laboratory for the study of global change, and scientists tell me that global change will first appear in the Arctic. So my interest in this issue is not new, and it is of immediate and direct interest to my constituents.

I would be extremely interested in having your views on the role the Intelligence Community can and should play in enhancing our understanding of global change and similar environmental matters. I would also be interested in your thoughts on ways to identify the data from national collection methods that might be useful to environmental scientists, as well as ways that the useful data could be sanitized to protect intelligence sources and methods.

One idea that has been proposed is to establish a panel of environmental scientists, and to clear and brief them on intelligence collection means that might make a contribution to our body of knowledge about global climate systems. If this strikes you as a satisfactory approach, I have some names of scientists that I'd like to submit for consideration.

I expect that the Committee may delve into this issue further, and I wanted you to know that I am willing to work with you and Senator Gore to protect our intelligence equities while exploring the contributions intelligence data might make. For the benefit of your staff, my staff contact on this matter is David Garman on the Senate Intelligence Committee staff.

I appreciate your assistance in this matter, and I look forward to hearing your thoughts.

Sincerely,

Frank H. Murkowski
Vice Chairman

United States Senate

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I appreciate your assistance in this matter, and I look forward to hearing your thoughts.

Sincerely,

Frank H. Murkowski
Vice Chairman

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To: Officer in Charge
Appointments Center
Room 060, OEOB

Please admit the following appointments on Wednesday, March 25, 1992, for Dr. Karl Erb of OSTP.

BERKO, FREDERICK	10/26/43
BOZZAY, JOSEPH	9/30/58
HAMMARSTROM, LEE	2/11/39
HARRIS, JEFFREY	6/28/53
MALINOWSKI, LEONARD	9/11/29
MEEHAN, PATRICK	12/27/45
MEHLBAUM, ALBERT	6/11/46
MIHARA, ROBERT	9/5/40
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TOWNSEND, ALEXANDER	4/8/43
WEIRICH, JERRY	12/25/53
ZALL, LINDA	11/15/50
ZELINSKI, GARY	3/3/56

Add:
CALVELLI, FRANK — 11/11/64
DAUGHERTY, KENNETH — 11/20/35

MEETING LOCATION

Building OEOB

Room No. 345

Time of Meeting 10 AM

Requested by Jo Ann Ward

Room No. 572 Telephone 7326

Date of Request March 24, 1992

APPOINTMENTS CENTER: SIG/OEOB - 395-6046 OR WHITE HOUSE - 456-6742
TELEFAX: 395-5349

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(George Bush Library)

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01b. Notes	EOSDIS Briefing (2 pp.)	3/25/92	(b)(1)	

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File Location: NASA – Earth Observing System [1 of 3]

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ALBERT GORE, JR.
TENNESSEE

ER 92-0145

393 RUSSELL SENATE OFFICE BUILDING
PHONE 202-224-4944

United States Senate

WASHINGTON, DC 20510-4202

January 7, 1992

The Honorable Robert Gates
Director
Central Intelligence Agency
Washington, DC 20505

Dear Mr. Gates: Bob

For some time, I have been pursuing the idea that the intelligence community has data that would be a unique and important source of information for use by environmental scientists, assuming that its exchange could be accomplished without endangering sources and methods.

In an effort to explore this concept, I recently chaired a panel discussion involving a number of leading environmental scientists. As you may be aware, members of the intelligence community were invited through the good offices of the Senate Intelligence Committee to attend as non-participating observers.

A summary of that discussion is attached to this letter. It shows that the potential for something very useful does exist, but that it cannot be realized without a commitment on all sides to establish priorities, exercise ingenuity in thinking through ways to bridge intelligence resources and scientific needs, and find ways to reconcile the scientists' desire for openness with the intelligence world's desire for security.

The need for something like this is recognized in Congress. It is written into law as part of the Strategic Environment Research and Development Program (SERDP), in the Defense Authorization Bill. It is in line with calls from the Senate Intelligence Committee for a broadening of intelligence output. And, if press reports are accurate, the Administration has recently asked the intelligence community for new ideas that could well include an environmental initiative.

I'm writing now in hopes of beginning a discussion with you about next steps. One way to proceed would be to create a small panel of scientists selected to be representative of a number of critical fields for environmental research, to clear these persons, to have them thoroughly briefed, and then to authorize detailed discussions between them and intelligence specialists.

Members of this panel would be charged with two responsibilities. One would be to explore the potential for a substantive exchange of information in their respective fields. In

each field selected for application, scientists would develop a highly detailed and specific matrix, linking their requirements to one or more possible outputs of intelligence collection capabilities. The second task would be collective, rather than unique to a given field--it would be to work out in close cooperation with the intelligence community general guidelines to support future efforts in other fields of environmental science as a continuing venture.

In both cases, it is essential to have the freest possible exchange between scientists who know exactly what the needs of their specialties are and intelligence personnel who know with equal precision what is available and under what conditions any of it can be released for unclassified applications. Experience gained by all parties to this process would be incorporated in future efforts.

I recognize that this is no small venture. On the contrary, it is a considerable undertaking, and one which cannot get underway without your personal support. In hopes of encouraging you to consider making a commitment to a procedure such as this, I would very much welcome--and am now requesting--an opportunity to discuss this matter with you in person at the earliest mutually convenient time. We can meet privately, if you would prefer, or with a small group of experts on both sides.

There is a related matter that I want to raise for discussion with you. It has been suggested to me that the intelligence community's experience in the collection and organization of data could be useful in the effort to design a system capable of handling the flood of information expected from EOS. As chairman of the Senate subcommitee charged with overseeing NASA and of drafting its authorization bill, EOS and its data management system, EOS-DIS, are matters of very direct concern to me. I would like to hear your views.

My office will be contacting yours in the near future in hopes of working out a satisfactory arrangement for a meeting. The point of contact on my staff is Leon Fuerth. Of course, as from the beginning, I will continue to work very closely with the Senate Intelligence Committee, whose chairman has been of extremely great help to me at every step.

Sincerely,

Albert Gore, Jr.
United States Senator

AG/bww
enclosure

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(George Bush Library)

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01c. Memorandum	To: Bob Gates From: Allan Bromley Re: Intelligence Community Assistance to the EOS (1 pp.)	1/3/92	(b)(1)	

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OSTP BRIEFING OUTLINE

(3/25/92)

TIME	TOPIC
1000-1010	INTRODUCTION (Norm Spencer)
1010-1025	COMMUNICATIONS OVERVIEW (Joe Bozzay)
	DISCUSSION (5 MIN.)
1030-1130	PROCESSING, DISSEMINATION, DATA BASES
	IMAGERY DATA HANDLING (Gary Zelinski)
	DATABASES
	RMS: (Gary Zelinski) NDS: (Al Mehlbaum)
	SIGNALS DATA HANDLING (Fred Berko)
	DATABASES (Fred Berko)
	MASINT DATA HANDLING (Bob Mihara)
	DISCUSSION (10 MIN.)
1130-1140	SYSTEM DEVELOPMENT METHODOLOGY (Len Malinowski)
1140-1150	R&D SUMMARY (Lee Hammarstrum)
	DISCUSSION (Linda Zall)
	WRAP-UP (Morris Rosen)

Rick

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

March 30, 1992

MEMORANDUM FOR THE DIRECTOR OF CENTRAL INTELLIGENCE

FROM: **KARL ERB**
ASSOCIATE DIRECTOR DESIGNATE FOR PHYSICAL SCIENCES AND ENGINEERING

SUBJECT: **LETTER OF APPRECIATION**

Last January, Allan Bromley requested a briefing from the Intelligence Community (IC) on the challenges they've encountered in their many years of collecting, processing, disseminating, and archiving large volumes of satellite data. OTSP's interest became more focussed as we helped develop the terms of reference for a National Research Council study of NASA's Earth Observing System Data and Information System.

The IC presented their briefing last Wednesday and it was in every respect outstanding. The topics were of direct relevance to EOSDIS. The briefers were extremely knowledgeable and professional. Moreover, it was clear from the number of briefers and diversity of topics that the presentation had involved a great deal of thoughtful organization. Please express my appreciation to all those involved in the briefings, and in particular to Linda Zall and Norman Spencer. We look forward to joining the IC on April 10th when they present the briefing to the NRC panel.

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01d. Letter	Re: Clearance (1 pp.)	3/13/92	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: O'Neil, John F., Files
Subseries: Government Organization Files
WHORM Cat.:
File Location: NASA – Earth Observing System [1 of 3]

Date Closed:	5/27/2010	**OA/ID Number:**	62098-003
FOIA/SYS Case #:	2005-0336-F	**Appeal Case #:**	
Re-review Case #:		**Appeal Disposition:**	
P-2/P-5 Review Case #:		**Disposition Date:**	
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Rich —

1) Meet with the Exec to Clarify OSTP recom. briefing first at (B)

(2) Call DMA person & give (2) name tell what going on — (3) will call — review & tech [illegible] save — ask him to flesh out

ask Karl — Plan — [illegible] OST at (B) level — 3 part briefing ala bullet

invite DMA guy —

We will give all details & together flesh out What NRC recommends & Gates approves

Ken Daugherty 3/2

- They're [illegible] a digital production system.
- 3/23 - Week of 23rd is OK.
- Delaying 3-4 weeks is OK.
- Panel set end of March for an overview/interim rpt. Final rpt in August.
- Chairs depend on Mgmt & [illegible] Strategy.

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01e. Memorandum	To: Norman Metzger Re: Intelligence Community Briefing in Support of EOSDIS Panel - An Update [50 USC 403g, Sec 6] (1 pp.)	3/12/92	(b)(3)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

March 12, 1992

MEMORANDUM FOR NORMAN METZGER

FROM: [redacted] (b)(3)

SUBJECT: INTELLIGENCE COMMUNITY BRIEFING IN SUPPORT OF EOSDIS PANEL - AN UPDATE

As it currently stands the DCI has given the green light for the Community to brief OSTP on March 25th. However, he has not yet approved providing the briefing to the NRC panel. This delay plus the fact that the Community wanted more time to prepare is why the March 23rd briefing was postponed. In the interim I've decided to proceed with the OSTP briefing and include Dr. Daugherty so that, assuming we get DCI approval, we can focus the subsequent Panel presentation to best meet their particular needs. In hopes that we receive a thumbs up from Bob Gates I'd suggest we schedule the Panel briefing for the 30th as you recommended. In the meantime please have the NRC SSO send the clearances of the panelists to OSTP. They should transfer their Top Secret Codeword clearances to Barbara Ferguson (395-7347).

I will be in Boston all of next week. If you have any questions please call either Doug Beason (395-3840) or my secretary Jo Ann Ward (395-3272). The focal point within the Community for this action is Dr. Linda Zall (703/482-7413). She works directly for Jim Hirsch.

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01f. Fax	From: Norman Metzger Re: IC Briefing [50 USC 403g, Sec 6] (2 pp.)	3/12/92	(b)(3)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: O'Neil, John F., Files
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File Location: NASA – Earth Observing System [1 of 3]

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(b)(3)

National Research Council
National Academy of Sciences
National Academy of Engineering
Institute of Medicine

To: (b)(3) Date: 3-12-92

From: Norman Metzger at NOTES Page 1 of 2

Sending Fax number: Use Originator's FAX

Receiving Fax number: 9-395-1572,62378

Subject: Briefings

This cc:Fax transmission comes to you courtesy of cc:Mail, Inc.

3/12/92 10:44AM

From : Norman Metzger at NOTES
To : [redacted] (b)(3)
Subject : Briefings

Message Contents

(b)(3)

I know the March 23rd briefing is cancelled; and that Ken Daugherty is scheduled to meet with you on March 25th, to discuss topics for the briefing you're arranging. The DMA briefing is now scheduled for March 30th, and it would be very helpful, if the Agency briefing could be arranged for the same day. At the moment those attending will be Charles Zraket, Ken Daugherty, myself, and possibly Anuta Jones. John Hopcroft is out.

Norm

P.S. My direct fax number is 202/334-2154.

Withdrawal/Redaction Sheet
(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01g. Letter	To: Linda Re: Briefing [50 USC 403g, Sec 6] (1 pp.)	2/24/92	(b)(3)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: O'Neil, John F., Files
Subseries: Government Organization Files
WHORM Cat.:
File Location: NASA – Earth Observing System [1 of 3]

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2/24.

Linda,

Zracket just called + said he'd like to schedule the briefings for 3/23. I've highlighted those on the panel he'd like to receive the briefing. Broadly stated he'd like the briefing to cover Communications, specifically, lessons learned in the following areas:

- space-to-gnd. Capacity, reliability,
- Dissemination of data from a commo perspective
- large database systems
- Multiuser access

I gave him your name as an impact. POC. He spoke of Hirsch as though he knew him very well. Lets talk soon.

(b)(3)

Historical perspective of how we got to where we are now w/all the bumps + detours + how we overcame them.

- Upward compatibility as the system evolves/matures.
  NASA had least experience. Most systems work.

- 5/10 minute overview of GOSDIS to mark the

→ Norman Spencer, DMA ←

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(George Bush Library)

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01h. Fax	From: Norman Metzger Re: Clearances (2 pp.)	3/2/92	(b)(6)	

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February 28th 1992

NRC EOSDIS Panel Members and Staff with Clearance

• Kevin Hall/550
202/334-2107
3695 (FAX)

TS SI, TK

✓ Charles A. Zraket
Scholar in Residence
The Kennedy School of Government
79 John F. Kennedy Street, Room P-18
Cambridge MA 02138
(617) 271-2356 (MITRE)
(617) 495-8132 (Harvard)
FAX: (617) 271-7999 (MITRE)
FAX: (617) 495-8963 (Harvard)

✓ Kenneth Daugherty
Chief Scientist
Defense Mapping Agency
8613 Lee Highway
Fairfax VA 22031
(703) 285-9178
FAX: (703) 285-9374

✓ Anita Jones
Chair, Computer Science Department
University of Virginia
Thornton Hall
Charlottesville VA 22903
(804) 924-7605
FAX: (804) 982-2214

✓ John E. Hopcroft
Department of Computer Science
Cornell University
4130 Upson Hall
Ithaca NY 14853
(607) 255-7416
FAX: (607) 255-4428

✓ Norman Metzger
Executive Director
Commission on Physical Sciences,
Mathematics, and Applications
National Research Council
(202) 334-3061
FAX: (202) 334-2154

• TS

Revised 2/11/92

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COMMISSION ON PHYSICAL SCIENCES, MATHEMATICS, AND APPLICATIONS

PANEL TO REVIEW EOSDIS PLANS

Membership List

Chairman

✓ Charles A. Zraket
Scholar in Residence
The Kennedy School of Government
79 John F. Kennedy Street, Room P-18
Cambridge, MA 02138
(617) 271-2356 (MITRE)
(617) 495-8132 (Harvard)
FAX: (617) 271-7999 (MITRE)
FAX: (617) 495-8963 (Harvard)

(Mailing Address for Mitre Corp.)

Mitre Corporation
Burlington Road
Bedford, MA 01730

Members

D. James Baker
Joint Oceanographic Inst.
1755 Massachusetts Ave.
Washington, D.C. 20036-2101
(202) 232-3900
FAX: (202) 232-8203

✓ Kenneth Daugherty (Bridge)
Chief "Scientist"
Defense Mapping Agency
8613 Lee Highway
Fairfax, VA 22031
(703) 285-9178
FAX: (703) 285-9374

• Wants to invite OSTP to DMA.

Richard E. Hallgren
American Meteorological Society
45 Beacon Street
Boston, MA 02108
(617) 227-2425
FAX: (617) 742-8718
Washington D.C. office
American Meteorological Society
1701 K Street, N.W., Suite 300
Washington, D.C. 20006
(202) 466-6070

Mailing Address
6121 Wayside Drive
Rockville, MD 20852

John E. Hopcroft
Department of Computer Science
Cornell University
4130 Upson Hall
Ithaca, NY 14853
(607) 255-7416
FAX: (607) 255-4428

Kenneth C. Jezek
Byrd Polar Research Center
125 South Oval Mall
Columbus, Ohio 43210
(614) 292-6531
FAX: (614) 292-4697

Anita Jones
Chair, Computer Science Department
University of Virginia
Thornton Hall
Charlottesville, VA 22903
(804) 924-7605
FAX: (804) 982-2214

Thomas R. Karl
Chief Global Climate Laboratory
National Climatic Data Center
NOAA
Asheville, NC 28801
704/259-0319
Fax: 704/259-0328

Fed Exp Mailing Address:
37 Battery Park Avenue
Federal Building
Asheville, NC 28801

Ethan J. Schreier
Space Telescope Science Institute
3700 San Martin Drive
Baltimore, MD 21218
(301) 338-4740
FAX: (301) 338-4767

Gael F. Squibb
Center for Astrophysics
60 Garden Street
Cambridge, MA 02138
(617) 495-7061
FAX: (617) 459-7356

Jeffrey D. Ullman
Professor of Computer Science
Stanford University
Stanford, CA 94305
(415) 723-1512
FAX: (415) 725-7411

Staff

Norman Metzger
Executive Director
Commission on Physical Sciences,
Mathematics, and Applications
(202) 334-3061
FAX: (202) 334-2154

Richard C. Hart
Space Studies Board
(202) 334-3477
FAX: (202) 334-3701

Monica Krueger
Computer Science and Telecommunications
Board
(202) 334-2605
FAX: (202) 334-2791

Lorraine Wolf
Board on Earth Sciences and Resources
(202) 334-3368
FAX: (202) 334-1377

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COMMISSION ON PHYSICAL SCIENCES, MATHEMATICS, AND APPLICATIONS

PANEL TO REVIEW EOSDIS PLANS

February 14 - 15, 1992
Washington D.C.

AGENDA

February 14, 1992 -- NAS 250

8:30 am	Continental breakfast	
	EXECUTIVE SESSION	
9:00	Welcome and Introduction	C. Zraket, Chairman
9:15	Discussion of Charge to the Panel	
10:00	Potential Sources of Bias	N. Metzger, Executive Director, CPSMA
	GENERAL SESSION	
11:00	EOS Overview - history, timelines	L. Fisk (NASA, Associate Administrator, Office of Space Science and Applications)
12:00 noon	LUNCH	
1:00 pm	Overview of Global Change Program	E. Shea (NOAA, Deputy Director, Office of Global Programs)
1:30	NASA plans for EOS	S. Tilford (NASA, Director, Earth Science and Applications Division)
2:00	Questions/Discussion with S. Tilford	
2:30	NASA plans for EOSDIS	

- Scientists' Views of EOSDIS -- J. Dozier (EOS Project Scientist)
- Background and Systems Overview -- T. Taylor (EOSDIS Project Manager)
- System Development Approach -- G. McConaughy (EOSDIS Systems Manager)
- Management -- T. Taylor

3:30	Questions/Discussion with J. Dozier, et. al.
4:30	Panel discussion
6:00	ADJOURN - Reception - NAS Rotunda
7:00	Panel Dinner - NAS Members Room

February 15, 1992 -- NAS 250

8:30 am Continental breakfast

EXECUTIVE SESSION

9:00 Panel discussion:

- Preliminary agreement on key issues
- Additional questions for NASA
- Additional presentations needed
- Agenda for next meeting

12:00 noon LUNCH

1:00 pm Panel Discussion (continued)

- Formation of subgroups and assignments
- Schedule
- Other matters

2:30 ADJOURN

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led by Aerospatiale produced the Arabsat 1A/B/C satellites.

Bairi said Arabsat 1C cost $45 million. The combined cost to Arabsat was placed at about $100 million, which includes its launch on Ariane, insurance costs, and its checkout and transfer to the final orbit position. "We chose not to insure the total mission costs because insurance costs are very high," Bairi said. "Our insurance coverage is for roughly $50 million."

Ariane V49's third stage achieved orbital injection with the planned perigee of 199.8 km. (123.9 mi.) and a 35,956-km. (22,292.7-mi.) apogee compared with a target of 35,959 km. (22,294.6-mi.). Inclination was on target at 7 deg.

Three brief launch holds occurred during the final countdown.

The third-stage fueling problem and clock synchronization difficulties that caused the holds were resolved, allowing the liftoff to occur before the end of the day's 50-min. launch window. □

Twelfth Block 2 Navstar/GPS satellite lifts off at Cape Canaveral Feb. 23 to resume the program after problems stalled launches.

NASA Reveals Scaled Back Plan for Six EOS Spacecraft

JAMES R. ASKER/WASHINGTON

The U. S. has unveiled a slimmed-down Earth Observing System—six satellites of varying size, with the first ready for launch in June, 1998, half a year earlier than previously planned.

Under orders to cut projected EOS costs through the year 2000 from $17 billion to $11 billion, NASA scuttled or deferred 13 of 30 scientific instruments it hoped to fly on two massive spacecraft.

The new fleet of spacecraft, along with an elaborate system to distribute the environmental data they gather, will be focused more directly on the pressing issue of global climatic change.

Last week, congressional investigators criticized NASA's strategy for developing that computer system and network, called EOSDIS, for EOS Data and Information System. EOSDIS alone is slated to cost $3 billion. The General Accounting Office said NASA's effort to build experimental versions of the data system's components before awarding a contract to build the system is insufficient.

Lennard A. Fisk, the NASA associate administrator overseeing EOS, said the program has an entirely different philosophy of "prototyping" from that of the GAO. When it selects an EOSDIS contractor this summer, NASA will require extensive efforts by the winning bidder to assure that the system will keep up with changing computer technology and with environmental scientists' evolving needs.

Sen. Albert Gore, Jr., (D.-Tenn.), who chairs the Senate science, technology and space subcommittee, also is concerned about NASA's ability to make the data system as useful as possible. He urged NASA officials to draw on U. S. intelligence community expertise in manipulating massive data bases.

But Gore said he is pleased with the space agency's work in making EOS more manageable. Three scientists who periodically review EOS testified that they, too, were generally encouraged by the agency's new scheme.

Congress, the White House Office of Management and Budget and the National Space Council had balked at NASA's earlier plans for two 50-ft.-long, 15-ton EOS platforms. They complained that the program would be too expensive and too slow to answer the most pressing environmental question facing international policy makers: To what extent are humans causing global warming? And what, if anything, ought to be done about climatic change?

Last summer, some of NASA's own outside science advisers moved toward the camp advocating "smaller, cheaper, quicker" EOS missions (AW&ST Aug. 19, 1991, p. 24). Finally, Congress ordered the space agency to revamp the program.

Of the 30 scientific instruments once planned for the large EOS-A and EOS-B platforms, 17 will fly on the new fleet of six satellites. Six instruments have been deleted from the EOS program and seven are "deferred."

Fisk said two goals of the program were "de-emphasized" in paring down EOS: stratospheric chemistry, because earlier space missions have determined the causes for depletion of Earth's protective ozone layer; and "solid geophysics," because Earth's geology changes so much slower than other variables to be studied.

NASA still hopes to build and fly three copies each of the six satellites now planned for EOS, itself part of a larger, international Mission to Planet Earth. That would extend EOS to 2017 and drive costs much higher.

The six satellites in the new plan, their launch date, size and the areas they are to study are:

- EOS-AM (June, 1998, intermediate-class, polar-orbiting, sun-synchronous, 10:30 a. m. equatorial crossing)—characterize terrestrial surface; clouds, aerosols and radiation balance.
- EOS-Color (1998, small)—biomass and productivity of the oceans.
- EOS-Aero (2000, small)—atmospheric aerosols.
- EOS-PM (2000, intermediate, 1:30 p. m. equatorial crossing)—clouds, precipitation and radiative balance; terrestrial snow and ice; sea surface temperature; ocean productivity.
- EOS-Alt (2002, medium)—ocean circulation and ice sheet mass balance.
- EOS-Chem (2002, intermediate)—atmospheric chemicals and their transformations; ocean surface stress.

The intermediate-class spacecraft will fit within a standard payload shroud for General Dynamics Corp.'s Atlas 2AS launch vehicle. The U. S. Air Force is modifying a launch pad to accommodate the rocket at Vandenberg AFB, Calif. However, the biggest EOS satellites will also be built to withstand the more stressing launch loads of Martin Marietta's Titan 4 as a back-up.

The medium spacecraft would fit on McDonnell Douglas's Delta 2. The small satellites will be designed to require a vehicle no larger than Orbital Science Corp.'s Pegasus, Fisk said. □

NASA Response to the NRC Panel to Review EOSDIS

NASA appreciates the work of the National Research Council's Panel to Review the Earth Observing System Data and Information System plans. The technical integrity and fast response of the Panel are a credit to the Academy. NASA is encouraged by the Panel's finding that the agency can proceed with the procurement process that is currently underway for the EOSDIS Core System and the general approval of the architecture that is being pursued for EOSDIS. Many of the Panel recommendations seem aimed at strengthening, accelerating, and expanding NASA's plans for EOSDIS so as to better serve the aims of global change research. Many of the recommendations address improvements needed in a number of specific, detailed areas of EOSDIS which NASA can implement in the coming months. The Panel's praise for the EOSDIS Project Team's efforts, capabilities, and dedication is welcome acknowledgement of the agency's efforts.

NASA accepts the recommendations contained in the panel report. EOSDIS management will implement those within its control and seek the resources to implement those that require additional funding and personnel. NASA looks forward to the final report of the Panel and the opportunity to discuss with the Panel specific approaches to the implementation of their recommendations.

Several of the recommendations encourage NASA to accelerate its prototyping and pathfinder activities. EOSDIS management will work to provide more emphasis to these areas within our overall funding constraints and will examine the extent to which additional funding may be required to do more in these areas sooner. The Panel report certainly encourages NASA to continue with the EOSDIS Core System procurement. We are proceeding toward selection of the ECS contractor in June with contract award in December 1992.

NASA will redouble its efforts to work more closely with other US government agencies, our international partners, and the user community at large. In particular, we will work to develop means to interact more fully with the computer science community and to enable more user interactions with EOSDIS development which go beyond the role of advising. NASA will revise the Science Data Plan to identify the specific links to global change research objectives. NASA agrees that it is essential that the user community be a partner with the agency in EOSDIS.

NASA will develop a revised structure and staffing plan for the EOSDIS Project activities at the Goddard Space Flight Center. This plan will be designed to address four areas:

1. Increasing the amount of management attention given to EOSDIS;

2. Drawing more expertise to the project from other agencies;

3. Increasing the systems engineering team and strengthening its capabilities; and

4. Placing more management authority at the DAACs where it will be closer to the user community interface.

NASA will explore with other agencies the ways in which EOSDIS can better serve to provide leadership in the area of environmental data management without jeopardizing the on-going activities of these agencies. Steps are already underway to strengthen ties to the archives of DOE and NOAA while continuing our strong working relationship with the USGS. Staff members from several of the NSF supercomputer centers are now providing oversight advice to our overall Earth science and applications information system effort while representatives of NCAR remain involved in the EOSDIS Advisory Panel. NASA welcomes the encouragement to play more of a leadership role in data management through EOSDIS.

NASA believes that the overall effect of the Panel's report will be to strengthen the implementation of EOSDIS and the Global Change Research Program.

Mtg w/ DAB re EOSDIS

4/16

- Dixon Butler, Leonard Fish, OMB, NSpC
  - Fish wants to work interactively w/ Panel.
  - Del. final report per 2 months.

- DAB -- import for meet w/ Gore & Golden.

- Saw no technology barriers to the system.
  - NASA needs to broaden its vision to the whole GC community.

- Golden raised @ FCCSET mtg that they will be major purchasers of supercomputers.
  - Mentioned the Canadian NEC computer sale
  - DAB appealed to Panel to look at this & Zraket esp. agreed wrt the NASA work plans.
  - Zraket told DAB that the IC briefings were outstanding.

- How import is the int'l dimension of EOS? DAB: extremely vital!

- Davenport: importance of USG to exert its influence to effect the isolation of commo stds as they move from rec to data

Rick - Let me know if you need any more info.

Doug

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Attached to
Following Page

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

April 13, 1992

MEMORANDUM FOR THE FILES

FROM: DOUG BEASON

SUBJECT: EOSDIS INTERIM REPORT

BACKGROUND

o OSTP received an advance copy of the NRC EOSDIS Review Panel (chaired by Charles Zraket) Interim report dated 9 Apr 92 (embargoed until 17 April)

o NRC EOSDIS review panel requested by Adm Truly on 22 Nov 91, OSTP coordinated

OVERVIEW OF PANEL FINDINGS

o "EOSDIS is essential to the success of EOS"
- **"If EOSDIS fails, so will the Earth Observing System"**
- **"... and so may the U.S. Global Change Research Program"**

o In general, the panel does not see any serious risk to EOSDIS due to unavailable or inadequate technology

o Supports NASA's schedule for procuring a contractor for the EOSDIS Core System

o But finds major shortcomings in two primary areas in the actual plans for EOSDIS

1) Scale and pace of changes in computer and data management technology over long-term life of program
- **Great diversity of users**
- **How EOSDIS will evolve as scientific needs and technology changes**

2) Management structure
- **Large, complicated project over several years, costing several billions**
- **Complex mix of government, contractors and scientific community**

o "NASA ... must have the ultimate responsibility for implementing EOSDIS"

- "NASA should first ensure proper internal management attention and should use its own earth and computer science personnel, who can contribute to the successful design of the system"

- "NASA needs to bring the scientific user community into the project as a partner, rather than regarding users as simply customers"

- "NASA must accept the leadership role necessary to provide the essential unity among the user community"

o **The terms of the contract in the Request for Proposal are sufficiently flexible to accommodate the Panel's recommendations**

CONCLUSIONS AND RECOMMENDATIONS

o **"The ability of EOSDIS to serve the broad spectrum of users will be the final measure of EOSDIS success"**

USER INTERACTIONS

o **The report implies problems with NASA's science plan, data sets and interagency links**

- **"The panel recommends that the Science Data Plan identify the links between global research objectives and existing and planned data sets"**

- **"NASA [must] expand its efforts to increase interagency links by assuming an active leadership role among the agencies in achieving interoperability not only at the level of the Global Change Directory, but also at the level of providing access to the actual data"**

- **"NASA [must] develop ways to integrate the efforts of existing data centers and existing centers of data supported by NSF, DOE, and the USGS with the NOAA/NASA Pathfinder activities ..."**

o **"Long-term archiving of EOS data is an issue that has not been addressed"**

EOSDIS ARCHITECTURE

o **NASA must strengthen architecture team**

- **"NASA [should] produce a clear, concise statement of the design criteria for EOSDIS that focuses on facilitating global change research and that NASA communicate these criteria throughout the Project hierarchy."**

- **"A technical project of the magnitude and complexity of EOSDIS should have the very best system architecture team possible. NASA should make every effort to acquire such talent."**

EOSDIS MANAGEMENT

o **"EOSDIS lacks the attention of senior management at the Goddard Space Flight Center"**
  - **"EOS and EOSDIS are treated like ordinary projects within the Goddard Center"**
  - **The Project Manager is 2 management levels down within the Flight Operations Directorate (one of 10 Directorates at the Center)**
  - **"Recommends that the EOSDIS Project Manager have a higher management visibility within Goddard Space Flight Center"**
  - **"The Project could augment its staff with experienced personnel from other parts of the government in addition to NASA"**

o NASA is not sufficiently involving its own earth and computer scientists

- "The panel recommends that NASA involve Goddard Space Flight Center earth scientists to a greater degree in the management and operations of EOSDIS and also involve computer scientists both inside and outside of NASA to explore research and technology in those areas where EOSDIS will stress the state of the art in science and technology and where EOSDIS will evolve most rapidly"

CONCLUSION

The Panel believes its recommendations will not affect EOSDIS schedule

FOR DISCUSSION

What should the panel concentrate on now?

- **Approximately 4 to 5 months are left before the final report is due**

MA/EOSDIS

NATIONAL RESEARCH COUNCIL

2101 CONSTITUTION AVENUE WASHINGTON, D. C. 20418

OFFICE OF THE CHAIRMAN

April 9, 1992

Mr. Daniel S. Goldin
Administrator
National Aeronautics and
Space Administration
400 Maryland Avenue SW, Room 7137
Washington DC 20546

Dear Administrator Goldin:

Enclosed is an interim report by the National Research Council on NASA's plans for EOSDIS as well as a transmittal letter from the Chair of the Panel that prepared this report. As you know, EOSDIS is a very complex program, and the demands on the Panel that prepared this interim report were extraordinary—in understanding the program, in coping with a demanding schedule, and in reaching judgements. At the same time, my colleagues and I appreciate the importance of EOSDIS. To quote from the attached report: "If EOSDIS fails, so will EOS, and so may the U.S. Global Change Research Program."

It was against such an understanding that the National Research Council accepted this task, believing that we are obliged to assist the government, even when the time is short, the amount of information to be marshalled great, and the imperative to provide judgements urgent.

I believe the Panel that prepared this report has done an exceptional job, ably assisted by the people of NASA. At the same time, the judgements as well as the limits of this interim report should be clear. While the Panel supports the *schedule* for procuring a contractor for the EOSDIS Core System, it finds major shortcomings in the actual plans for EOSDIS, and provides substantial recommendations for implementing the program that the Panel believes will help ensure its success. Therefore, this report cannot be construed as an endorsement of NASA's current plans for EOSDIS, but rather a substantial critique of flaws, which, if addressed, will in the Panel's judgement help ensure a strong and responsive program over the long term. The Panel believes that the terms of the contract as stated in the Request for Proposal are sufficiently flexible to accommodate its recommendations.

The limits of the report should also be plain. It is an *interim* report, provided in response to requests from NASA and other interested parties for an early alert as to the

Panel's views of EOSDIS plans. The Panel's final report this August will offer detailed analyses for these interim judgements, and will also respond directly to the specific issues as posed in the Terms of Reference for this task.

I look forward to your comments on this interim report. And the Panel looks forward to a discussion with NASA officials involved in EOSDIS planning on this report and any further issues to be considered in preparing the final report. We are arranging for your colleagues at NASA with responsibility for the EOSDIS Project to be briefed by the Panel next week, and intend to release it publicly on April 17th.

Yours sincerely,

Frank Press
Chairman

cc: L. Fisk, J. Alexander, S. Tilford, D. Butler—NASA
A. Bromley, K. Erb—Office of Science and Technology Policy
J. Hezir, J. Fellows—Office of Management and Budget
S. Harrison—National Space Council
R. Corell—National Science Foundation
Congressman George Brown, R. Byerly, P. Cunniffe—House of Representatives Committee on Science, Space, and Technology
Senator Albert Gore, S. Palmer—Senate Subcommitee on Science, Technology, and Space

NATIONAL RESEARCH COUNCIL

COMMISSION ON PHYSICAL SCIENCES, MATHEMATICS, AND APPLICATIONS

2101 Constitution Avenue Washington, D.C. 20418-0001

Telephone: (202) 334-3061
Fax: (202) 334-2154
BITNET: (CPSMA@NAS)

April 9, 1992

Mr. Daniel S. Goldin
Administrator
National Aeronautics and Space Administration
400 Maryland Avenue, S.W., Room 7137
Washington DC 20546

Dear Administrator Goldin:

I am pleased to submit the interim report of the National Research Council's Panel to Review Earth Observing System Data and Information System (EOSDIS) Plans. This contains the panel's preliminary observations and recommendations on the current plans for EOSDIS, based on the information provided. The panel looks forward to an early opportunity to discuss these recommendations with NASA and other interested parties, as well as to issuing its final report in August 1992.

On behalf of the panel, I wish to thank all of those at NASA who responded quickly and professionally to our very substantial requests for information and to our many and often difficult questions. We could not have done our work without their full and ready cooperation.

I also wish to express our gratitude for the splendid cooperation from the staff of the National Research Council that enabled the panel's work on this interim report to be completed in less than two months.

Sincerely,

Charles A. Zraket, Chair
Panel to Review EOSDIS Plans
National Research Council

National Research Council

Panel to Review EOSDIS Plans

Interim Report

This interim report identifies several issues regarding NASA's plans for developing the Earth Observing System Data and Information System (EOSDIS) and offers a number of recommendations that NASA should consider as it proceeds with procuring a contractor to build the system. This report does *not* respond in detail to the items in the terms of reference--that will be the subject of the panel's final report. Given the short time available for the panel's initial assessment, it has not been able to pursue the issues it identified to the depth it would like. The panel hopes, nevertheless, that NASA will find its interim conclusions and recommendations useful in the negotiations that will take place with the selected contractor to define the ongoing work plans for the EOSDIS Project.

The appendices of this report include NASA's letter of request for this study, the terms of reference for the task, a list of the members of the panel and brief biographies, the work done and the meetings held to enable the panel to write this interim report, a brief description of EOSDIS for readers not familiar with the Project, and a brief description of the U.S. Global Change Research Program and its objectives.

The panel was selected to have the competencies demanded by its charge--in understanding the needs of those who will use EOSDIS (including both EOS and non-EOS investigators), in the computer science and technology underlying EOSDIS, in the creation and implementation of large data systems, and in the recent history of large space-based data systems. The fact that the procurement for the EOSDIS Core System was concurrent with the panel's work required extreme care to avoid either the reality or perception of conflict of interest. Thus, in addition to following the National Research Council's standard procedures for dealing with bias and conflict of interest, the panel--and those who provided it information and briefings--took pains to consider only publicly available information. The panel, to the best of its knowledge, has not been provided with nor has it considered any proprietary information related to the procurement.

OBJECTIVES AND MAJOR FINDINGS

In combination with other programs of the U.S. Global Change Research Program, the Earth Observing System (EOS) is intended to reduce the current uncertainties about global climate change. Its Data and Information System (EOSDIS) is essential to the success of EOS. If EOSDIS fails, so will the Earth Observing System and so may the U.S. Global Change Research Program. The panel has been told repeatedly by responsible government officials that EOS is critical to the larger, global change program--one involving many agencies of government, and other national and international participants--and that EOSDIS offers a unique opportunity to begin building a national, and eventually, international, information system for global change research.

To achieve these aspirations, EOSDIS will have to evolve to meet the changing needs of global change research over the next two decades and beyond. The panel believes that the recommendations offered in this report are necessary to ensure that growth and evolution. Specifically, the panel offers its judgments in terms of the following objectives it believes essential to the success of EOSDIS:

- EOSDIS must facilitate the integration of data related to the aims of the U.S. Global Change Research Program. Without this integration, the multidisciplinary and interdisciplinary research objectives of the U.S. Global Change Research Program will not be achieved. The EOSDIS program must be structured and managed to facilitate interactions with the other agencies involved in the U.S. Global Change Research Program so that existing data and future data collected by NASA and by other national and international organizations--using research and operational satellites as well as in situ sources --are available to all global change research scientists.

- EOSDIS must serve a large and broad set of users to facilitate the aims of the U.S. Global Change Research Program in supporting a community concerned with understanding the earth as a system. To serve that larger community, EOSDIS must provide its information in a manner that is simple, transparent,

and inexpensive; it also must assure availability of its data to both the earth science community and the larger scientific community.

- EOSDIS must ensure that service to current users--including those involved with Version 0--will not be interrupted as the development of the system proceeds, and that Version 1 and subsequent versions will be implemented as soon as possible to meet the needs of the users, both in the EOS program and in the larger U.S. Global Change Research Program.

- EOSDIS, as it evolves, must maintain the flexibility to build rapidly on relevant advances in computer science and technology, including those in databases, scalable mass storage, software engineering, and networks. Doing so means that EOSDIS should not only take advantage of new developments, but also should become a force for change in the underlying science and technology where its own needs will promote state-of-the-art developments. Flexibility also requires organizational and management structures and processes that can respond to evolving requirements and implement the means for meeting them.

- EOSDIS needs substantive user participation in the design and development of the system, including involvement in the decisions on data acquisition and archiving, standard or ad hoc product generation, and interfaces that directly affect science users.

- The structure of the EOSDIS management organization and the attention it gives to the project should reflect the importance of the program in terms of its role as one of the major and most costly programs NASA has ever undertaken as well as its central role in the U.S. Global Change Research Program.

The EOS program was recently restructured from a mission consisting of two large, orbiting platforms containing a total of 30 instruments to a series of six smaller spacecraft containing a total of 20 instruments. The amount of data expected to be collected from EOS, however, has decreased only slightly: from 330 gigabytes/day to 240 gigabytes/day. The estimate for the total amount of processed data (from the EOS spacecraft and the other missions and instruments that will be flown) that will be managed by EOSDIS changed from 1300 gigabytes/day to about 1100 gigabytes/day, a reduction of only 15 percent. Furthermore, the

capabilities of the EOSDIS System are tied to the existence of the seven Distributed Active Archive Centers (DAACs) and the data they contain, more than to the flight rates. Although the panel will certainly examine this issue further for the final report, it appears that the recent restructuring of the EOS flight program has had little effect on the requirements for EOSDIS and thus does not affect the preliminary conclusions of this interim report.

In general, the panel does not see any serious risk to the EOSDIS program due to unavailable or inadequate technology. The panel believes that the prototyping plans of the EOSDIS Project Office, to be implemented after the contractor is selected, should be accelerated in order to assure that Version 1 is completed in accord with design objectives.

There are risks, however, in two aspects of the planning for EOSDIS. One area of risk derives from the scale and pace of changes in computer and data management technology that can be expected over the long-term life of the program, and from the great diversity of users who must interface with EOSDIS. NASA needs to focus immediate attention on planning how EOSDIS will evolve to continue to be a useful system as the scientific needs and the technology change over time.

Another area of risk concerns the management structure of EOSDIS. EOSDIS is an exceptionally large and complicated project that will cost several billion dollars, involve thousands of people, and continue for many years. The management will involve a complex mix of government, contractors, and a scientific community that is diverse and spread around the world. Each has an important role to play, and each will interact in a variety of ways with the other elements. In its recommendations in this interim report the panel has attempted to provide a number of mechanisms and approaches that it believes will help define these roles and interactions.

NASA, of course, must have the ultimate responsibility for implementing EOSDIS. To do so effectively, however, NASA should first ensure proper internal management attention and should use its own earth and computer science personnel, who can contribute significantly to the successful design of the system. Secondly, NASA needs to bring the scientific user community into the project as a partner, rather than regarding users simply as customers. Finally, NASA must accept the leadership role necessary to provide the essential unity among the user community (including other federal agencies and international participants), DAAC elements (management and scientific), and contractors. The complexity of this project demands that a structure be developed to ensure that all interests are properly integrated into the design of EOSDIS.

The panel believes that NASA can proceed prudently with the procurement process for EOSDIS, *provided* the agency builds in the flexibility to make the adjustments necessary to ensure the success of the project. The conclusions and recommendations offered in this interim report can help NASA to incorporate that flexibility into work plans during the contract negotiations that will soon take place. This flexibility could be accommodated within the scope of the current procurement as long as it is planned ahead of final contract negotiations and the contract terms are compatible with this approach. The panel believes that its recommendations should not materially affect the EOSDIS schedule and that they can be implemented in work plans resulting from the pending contract negotiations. It is important to all users that EOSDIS implementation proceed as closely as possible to the planned schedule.

The panel has divided its assessment into three parts: user interactions, EOSDIS architecture, and EOSDIS management. The recommendations for each area offer actions that NASA should consider in order to meet the objectives for EOSDIS described above without halting the current procurement. The panel also recognizes that requirements may change over time and that NASA may have to adjust its work plans over the life of the project.

In order to be of service to NASA during this important stage of negotiating with the selected contractor, the panel believes that it is necessary to provide this advice now, in this interim report. The final report will expand on the issues discussed in this interim report and will respond in detail to the terms of reference.

CONCLUSIONS AND RECOMMENDATIONS

The following are the panel's judgments concerning the user interaction, architecture, and management issues that it believes must be addressed if EOSDIS is to meet the objectives integral to its success. In each instance, the panel points to strengths and weaknesses in the program, and offers recommendations.

USER INTERACTIONS

Strengths

NASA has stated its intention to incorporate user feedback throughout EOSDIS development and evolution. The panel applauds this approach. The ability of EOSDIS to serve the broad spectrum of users will be the final measure of EOSDIS success. In this context, it should be acknowledged that NASA has led other agencies in developing the Global Change Master Directory, which will be a comprehensive description of all global change data sets. The panel also commends NASA for its plan to share software code and toolkits with users who wish to import them for their own systems.

Panel Concerns

In its review, the panel has identified several areas in which an augmentation or strengthening of critical user interactions could substantially improve the likelihood for success of the EOSDIS program. Areas of concern are NASA's Science Data Plan, links with other agencies, use of Pathfinder data sets, treatment of operational and historical data, long-term archiving, involvement of nontraditional communities, and ability to provide customized data sets.

Science Data Plan. Version 0 science data requirements are being compiled into a Science Data Plan by the EOSDIS Project through regular interactions with the user community. The intent is to solicit regular review of these requirements from the science community to make certain that evolving needs are adequately reflected in the EOSDIS Project planning. Care must be taken to ensure that the Science Data Plan continues to emphasize the links between global change research objectives and the acquisition of individual data sets. A clearer picture of base-level requirements can be achieved by a continuing assessment of science objectives, existing holdings that might meet the objectives, and requirements for future data streams.

> **The panel recommends that the Science Data Plan identify the links between global change research objectives and existing and planned data sets.**

Interagency Links. The research priorities of the U.S. Global Change Research Program cut across the missions of individual federal agencies. The distribution of current holdings as well as data to be acquired underscores the need for interagency interoperability and cooperation. NASA has been an active participant in interagency efforts for the U.S. Global Change Research Program through a variety of working groups, and is currently a full partner in developing a tri-agency (NASA, NOAA, USGS) data and information

implementation plan, of which EOSDIS is a critical component. The panel endorses the efforts of these agencies to work cooperatively.

The Global Change Master Directory is an excellent first step in helping users to identify relevant data sets for global change research. A similar effort is needed in achieving interoperability for access to the data. Success will require both technical developments and leadership in order to integrate and provide broad access to disparate data types currently distributed throughout the agencies. The panel believes that NASA is the logical agency to initiate this step in the context of EOSDIS. Moreover, EOSDIS will be much more effective in broadening its user base if it serves as the vehicle for integrating data.

> **The panel recommends that NASA expand its efforts to increase interagency links by assuming an active leadership role among the agencies in achieving interoperability not only at the level of the Global Change Master Directory, but also at the level of providing access to the actual data.**

Pathfinder Data Sets. Prototyping has been a routine component of EOSDIS planning and Version 0 implementation by the Project Office. NASA has been successful in establishing prototype earth science data systems that are currently acquiring, processing, distributing, and archiving pre-EOS data. Lessons from such prototyping activities can identify problems associated with the manipulation and distribution of extremely large data sets.

Pathfinder data sets provide an early means to evaluate the handling of large data sets, the development of products, and the distribution of data and products. NASA and NOAA are cooperating in a Pathfinder data program for selected satellite data. This program will be extremely valuable to the U.S. Global Change Research Program and to the prototyping of various functions of the overall data and information system.

> **The panel recommends that NASA develop ways to integrate the efforts of existing data centers and centers of data supported by NSF, DOE, and USGS with the NOAA/NASA Pathfinder activities. Further, the Pathfinder data program now under way should be accelerated.**

Operational and Historical Data. Data from past and currently operating satellites already are being provided to several DAACs. NASA has shown considerable foresight in recognizing the importance of data streams from NASA, NOAA, DOD, and foreign

satellites in establishing long-term data sets for global change research. Although the EOSDIS Request for Proposal addresses data management of NASA's EOS platform instruments as well as NASA's commitment to maintaining data sets acquired by pre-EOS sensors, the panel wishes to emphasize the need for the accessibility of non-EOS instrument data streams to EOSDIS users.

The panel believes that the full benefit of EOSDIS to the U.S. Global Change Research Program will not be realized until an effort similar to that for EOS data is undertaken to manage the immense collection of historical data related to global change research already collected through operational observing systems. This collection includes the routine data from the space-based and surface-based observing systems of NOAA and DOD, as well as the routine and special data collected by USGS, USDA, EPA, DOE, NSF, and the Census Bureau. Integration, interpretation, and synthesis of such data, as part of a modern data and information system for long-term operational measurement, are critical to the goals of the U.S. Global Change Research Program and the interpretation of EOS measurements.

The panel recommends several ways to address the issue of integrating the operational and research data from other agencies into EOSDIS:

a. NASA should articulate a plan for incorporating operational and non-EOS instrument data streams into EOSDIS. Where EOS and non-EOS instruments have similar functions, NASA should develop a strategy to enhance the use of both data streams. This strategy should also include consideration of cross-calibration between basic radiometric data and higher-level products of an EOS instrument with a non-EOS instrument.

b. To test the interoperability of EOSDIS and to integrate the critical long-term operational data that now exist at Affiliated Data Centers into a global change data and information system, NASA should perform a full-function test of the EOSDIS architecture and software on some of the Affiliated Data Centers, in particular, centers with holdings (such as long-term satellite or in situ data records) critical to the U.S. Global Change Research Program and to the synthesis and interpretation of data from EOS instruments.

c. **NASA should articulate its policy on how Affiliated Data Centers will move up through the different levels of interoperability that are specified for linkage with EOSDIS.**

Long-Term Archiving. Long-term archiving of EOS data is an issue that has not been addressed. Long-term commitment to maintaining data collected as part of EOSDIS is a critical component of the U.S. Global Change Research Program. NASA, in its response to questions from the panel, correctly pointed out that the issue of maintaining long-term archives is one that must be addressed by all participating federal agencies. Without a concrete plan and agency coordination for establishing permanent data archives, however, the overall objectives of EOS, and, therefore, of the U.S. Global Change Research Program, are jeopardized. As in the case of increasing interagency links, the panel believes that NASA can provide the leadership in addressing this need.

The panel recommends that NASA develop an adequate plan and technology for long-term data archiving in conjunction with the other federal agencies participating in the U.S. Global Change Research Program.

Involvement of Nontraditional Communities. NASA has identified ways for broadening the user community and providing information about EOSDIS to those unfamiliar with the system through professional journals and newsletters. Such publications may be adequate for reaching users in certain disciplines but may be ineffective for those in other fields, particularly in the nonphysical sciences. For example, one of the science priorities identified in the U.S. Global Change Research Program is to assess the human dimensions of global change. A detailed plan for involving potential user communities beyond the traditional disciplines associated with the earth and environmental sciences has not been clearly delineated for the panel.

Many approaches could be taken to encourage users from nontraditional communities (e.g., legal, educational, political, and social). A useful approach could include the distribution of sample products that would allow users to become familiar with the various types of data sets available and to judge whether those data would be helpful to their research.

The panel recommends that NASA take an active role in facilitating access to EOSDIS by other, nontraditional disciplines through a program that includes representatives from those disciplines in NASA's user advisory groups and develops products useful to them.

Customized Data Sets. NASA clearly recognizes the importance of involving the user community in the development of EOSDIS. An approach to encourage active user participation is to provide customized data integration and synthesis of various products. The availability of software tools that conform to standards in an open architecture environment would facilitate participation by active users. For example, these tools might enable a user to assemble a customized set of specific time- and/or space-averaged data that could not otherwise be assembled without the user having to develop new software.

> **The panel recommends that NASA encourage broad user participation by providing greater opportunities to create customized data sets.**

EOSDIS ARCHITECTURE

Strengths

The panel in its several lengthy discussions with EOSDIS technical staff was impressed by the staff's competence and motivation. The staff has devised a process for designing the EOSDIS Core System that would rely on open systems, including multiple levels of interoperability for both users and the DAACs as well as the ability to handle evolving international standards. These two approaches--use of an open system and adoption of standards even though they will change over the lifetime of EOSDIS--will strengthen the program.

The Project plans to deliver EOSDIS in incremental stages (via Versions 1 to 6 and Data Product Levels 0 to 6) that are expected to provide the flexibility necessary to meet user needs, to respond to budget uncertainties over the next decade, and to adjust to EOS flight schedules.

Panel Concerns

Design Control. Any large software system requires design criteria that are set by project management and articulated clearly and precisely throughout the project hierarchy. This is particularly true for EOSDIS because of four reasons: (1) the unprecedented size of the

system's storage and processing capacity; (2) the extraordinary heterogeneity of both user computation systems and user requirements; (3) the large variation in scale of both the mass stores and the granules of data to be simultaneously managed; and (4) the high degree of evolution expected in the system. The combination of these factors will make the design, implementation, and evolutionary control of the system a substantial architectural challenge.

Although NASA has assured the panel that EOSDIS will serve the needs of global change researchers, the EOSDIS Core System Statement of Work and the Functional and Performance Requirements documents of the Request for Proposal seem to be based on the management of data holdings resident with or owned by NASA or the DAACs and the created data products related to those holdings. It is entirely likely that data and/or data archives that are not within the exclusive purview of NASA or the DAACs will need to be made accessible to users through EOSDIS, without changing ownership of the data or the autonomy of the data repository. In anticipation of the need for accessibility, EOSDIS software should be built in the form of modular components with open, configuration-controlled interfaces so that other national and international agencies will be able to link with the system and provide products and services to the broader global change research community.

The panel believes that responsibility for the design criteria and for their enforcement to guide the system architecture must reside with the government. The government must assure that the contractor's detailed architecture and implementation decisions follow the directions given by the government system architects.

The panel recommends that NASA produce a clear, concise statement of the design criteria for EOSDIS that focuses on facilitating global change research and that NASA communicate these criteria throughout the Project hierarchy.

The panel recommends that NASA strengthen its internal system architecture team by acquiring additional experienced people and that it give them the responsibility, authority, and budget to ensure that the design criteria are met as the system design and implementation proceed. A technical project of the magnitude and complexity of EOSDIS should have the very best system architecture team possible. NASA should make every effort to acquire such talent.

Logically Distributed System. The research that will be possible through the resources provided by EOSDIS is difficult to characterize at present. Some research will focus on narrow disciplinary questions, while other work will be interdisciplinary. Since we cannot, indeed should not, attempt to specify the future directions that earth science research will take, EOSDIS must be flexible enough to respond to a wide variety of approaches. Furthermore, EOSDIS will be only a part, albeit a major one, of the efforts directed at managing data and information for global change research.

The EOSDIS development plan provides for centralized control over the specification and implementation of the system. Each DAAC will implement an Information Management System that will be centrally developed by a single contractor. Although a centralized system is desirable for the management, operation, and control of the satellite and its instruments, the data will be distributed and dispersed among geographically separate and discipline-specific DAACs. Achieving the proper balance between the common elements that should be developed centrally and those that should be developed in a distributed fashion is critical to the success of the overall U.S. Global Change Research Program. At present, it appears as though the EOSDIS development plan is too heavily oriented toward a centralized approach.

The panel recommends that the EOSDIS Project adapt its development plan to ensure a more logically distributed system, including:

a. **Designing EOSDIS so that all users (EOS and non-EOS investigators, DAACs, other data centers) can easily build selectively on top of EOSDIS components. EOSDIS should not constrain local implementation of diverse functions by users and DAACs. The development plan should reflect a philosophy that it is "easy to interact with EOSDIS" with minimum loss of autonomy. EOSDIS must be able to tolerate different versions of functionality and partial sharing of the components and toolkits it exports.**

b. **Identifying those areas of interdisciplinary research that will require special interfaces among discipline-specific products and formats. The Project should specify the interfaces, build prototypes, and run simulations to exercise them, permitting users to evaluate them prior to developing final specifications and proceeding to full implementation. A contractor team that resides at each DAAC and works closely with the**

DAAC as well as the contractor's "central core" team should facilitate the development of these prototypes.

This type of distributed development can be accomplished within the scope of the current procurement as long as it is planned **ahead of final contract negotiation, and contract terms are compatible with this approach.**

Incremental Prototyping. The current EOSDIS development plan closely ties the availability of the distributed archive and product generation functions to the EOS flight schedule. There is much work that should be done, however, prior to the first scheduled launch of EOS instruments in 1998 to strengthen prototyping efforts already under way. For example, there are both existing archives and data expected from pre-EOS satellites that will be invaluable to the U.S. Global Change Research Program. Although the EOSDIS Project team has initiated the early prototyping effort for Version 0, more can and should be done to benefit current global change research and to enhance user feedback for final system design.

The panel recommends that EOSDIS Project management extend its incremental development plan so that all user interfaces, all toolkits, and the end-to-end network system are:

a. Specified in detail early in the development of Version 1 and prototyped or simulated sufficiently, and

b. Evaluated in depth by users and DAACs prior to full implementation in Version 1. This will require a system network simulation and sufficient testing tools for users to assess and validate the specified functionality.

Usability Evaluation. Prudent practice in the design of complex data management systems ordinarily includes a means of measuring the usability of the data. To the extent possible, such measures should be quantitative. Early evaluation exercises should be designed to measure ease of use, quality of interface specifications, and convenience of interoperability of heterogeneous system components. These exercises should ensure that individual users and data archivers can acquire piecemeal both functional capabilities and data sets. It is also prudent practice to involve independent judgment by having this evaluation performed by a group other than those responsible for developing the system.

The panel recommends a usability evaluation program starting as soon as possible that involves:

- **Selecting key functions, interfaces, and system behavior attributes for evaluation;**
- **Defining a set of metrics and expected values of those metrics for each parameter to be evaluated;**
- **Creating prototypes, simulations, and test suites to stress aspects of usability;**
- **Using the evaluations to guide final specification of system components; and**
- **Implementing this program so that most of the evaluation and validation is done by groups other than the prime contractor.**

EOSDIS MANAGEMENT

Strengths

NASA is to be commended for developing the plans for EOS as its flagship for U.S. participation in global climate change research. NASA and the EOS Project are further to be commended for their dedication to producing an adequate data system for EOS and for its user community. The unprecedented level of funding allocated for EOSDIS and the high level of planned contingency funding are evidence of the commitment NASA has made to this important national research effort. The panel is impressed with the degree of dedication and commitment of the EOSDIS Project team. The team is working diligently and competently toward both prototyping key system and subsystem capabilities and planning for the procurement of the full EOSDIS system.

Panel Concerns

Visibility and Management Attention. Although EOSDIS appears to receive substantial attention from management at NASA Headquarters, in the panel's view, EOSDIS lacks the attention of senior management at the Goddard Space Flight Center. The EOS Project is the largest single development effort the Goddard Center has undertaken. Even without the flight hardware components, EOSDIS by itself probably satisfies that description. EOSDIS is an extremely complex interdisciplinary science project and must integrate the most advanced data and system technologies. EOSDIS also contains both the flight operations segment and the ground data system. The fact that schedules overlap and that the prime contractor probably will use different groups of personnel to implement these two very different elements will amplify the government's oversight and management challenge. Yet the panel has heard substantial evidence that from the management standpoint, EOS and EOSDIS are treated like ordinary projects within the Goddard Center. For example, the Project Manager for EOSDIS is two management levels down within the Flight Operations Directorate, which is only one of ten directorates at the Goddard Center. In addition, the Project Office is quite small for the task at hand, with plans for only 45 government employees when fully staffed. This small core of dedicated staff provides inadequate programmatic and managerial depth and expertise in the development of large, distributed data systems and in computer science and technology.

Given the preeminent position of EOS and EOSDIS in the U.S. Global Change Research Program, the panel believes that it is essential to increase the level of management visibility of the Project and the size and skills of the Project staff. In addition to learning from other government agencies that have had experience in the development and operation of large distributed data handling systems, NASA could, as needed, add to the Project experienced systems development personnel from other parts of the government.

The panel suggests that greater flexibility in defining success criteria and in using the process for setting award fees for direct feedback from the Project Manager to senior-level contractor management would help to assure that the contractor will do an outstanding job on EOSDIS. The panel commends NASA for including users in its performance board for contract evaluation and urges the active participation of users in setting award fees.

> **The panel recommends that the EOSDIS Project Manager have higher management visibility within Goddard Space Flight Center. The staff authorizations and skills should be sized to the scope and complexity of the**

Project. Further, the Project could augment its staff with experienced personnel from other parts of the government in addition to NASA.

The panel recommends that the EOSDIS Project use the award fee process to best advantage through greater differentiation of success and failure criteria for evaluating contractor performance and by involving users in determining award fees.

Scientific Involvement at Goddard Space Flight Center. The Goddard Center's in-house earth scientists have a very limited role in the management and operations aspects of the EOSDIS Project. Although NASA has established a variety of science advisory and data working groups, such groups cannot replace the continuing and even daily involvement of the external scientific community and the Goddard Center staff to ensure that the eventual system is responsive to user needs.

Likewise, the nation's computer science community currently has very limited involvement in the Project, despite the fact that EOSDIS, to be successful, must implement the latest advances in scientific data management technology and, in some cases, stimulate the development of new technologies. The development of EOSDIS would benefit from substantive use of expertise in systems design and exploitation of information processing technology. Because underlying technologies, such as storage density, processor speeds, and transmission rates, are doubling roughly every three years, EOSDIS must be able to exploit rapidly expanding capabilities during its lifetime of a generation or more.

EOSDIS will also stretch the limits of what can be done by a mammoth database management system shared by a very diverse and demanding user community. Certainly, many of the underlying technologies such as storage will evolve on their own. Other technologies, however, will have to be encouraged, such as large-scale data management, visualization, and integration of heterogeneous information. Possible ways to stimulate technology include establishing an intramural computer science research capability comparable to those in other sciences, supporting and using the external computer science community, and using DAACs to establish formal and informal links with the computer science research community in their neighboring universities.

The panel recommends that NASA involve Goddard Space Flight Center earth scientists to a greater degree in the management and operations of EOSDIS and also involve computer scientists both inside and outside of NASA to explore

research and technology in those areas where EOSDIS will stress the state of the art in science and technology and where EOSDIS will evolve most rapidly.

DAAC Involvement. The DAACs are not well integrated into the EOSDIS management structure, particularly during the development phase. The DAAC managers do not have well-defined authority or accountability in building EOSDIS. DAACs should be involved early, in contrast to the current plan, in which their primary role appears to be to operate the hardware and software at their sites after delivery, and to deliver data products to users.

There should be mechanisms for feedback on scientific utility and operational effectiveness from the individual DAACs and associated archive centers to the central Project since the DAACs will be the primary sites for user interaction. There should be a coherent overall development, management, and science advisory structure that includes the DAACs. The panel understands that DAAC managers and scientists are involved in advisory roles. Advisory roles, however, are not sufficient for developing capabilities for and at the DAACs.

Overall, the centralized management of the design and implementation of EOSDIS functions at each DAAC is not conducive to active user involvement and responsiveness to changing technology. What is needed is a structure that strengthens the local role of each DAAC beyond the present DAAC advisory group and thus enhances the responsiveness of each DAAC in meeting the needs of its user community, gives the DAAC some control over its destiny, and yet ensures that an interoperable system is developed to meet the requirements of EOSDIS.

The panel recommends that NASA create, at each DAAC, a Development Team of full-time staff and active science users to address DAAC and user concerns. These teams should evaluate EOSDIS planning and implementation, including architecture, DAAC interface definitions, and other deliverables essential to ensuring that the DAACs will be responsive to user needs and that the EOSDIS system will be interoperable. In accomplishing these tasks, the teams should monitor the contractor's activities on behalf of user communities and prepare test data sets to verify system interfaces. Each DAAC Development Team should validate that DAAC's operational capability to use the evolving EOSDIS system as each of the program releases is implemented. Finally, NASA should provide the DAACs with modest funding to respond to specific user needs so that the DAACs will be able to parallel the evolution of the user community's ability to manipulate, integrate, and model data.

APPENDICES

Appendix A: Letter of Request for Review of NASA's EOSDIS Plans

NASA
National Aeronautics and
Space Administration
Washington, D.C.
20546
Office of the Administrator

NOV 22 1991

Dr. Frank Press
President
National Academy of Sciences
Washington, DC 20418

Dear Dr. Frank:

NASA is restructuring the Earth Observing System (EOS) program to fly instruments on intermediate and small spacecraft as opposed to a series of large spacecraft. This action will make the program more robust and flexible in the face of future uncertainty and is consistent with the recommendations of a number of groups including the EOS Engineering Review Committee chaired by Dr. Edward Frieman. This restructuring will result in a different sequencing of measurements and changes in the volume of data relative to the original EOS program.

Now that we have a better understanding of how the EOS spacecraft will be configured, it will be necessary to adjust our data system requirements to reflect the needs of the program. Accordingly, as we discussed last week, I would like to request that the Academy undertake a high level review of our plans for the EOS Data and Information System (EOSDIS) to ensure that this effort is compatible with the restructured program and best serves the interests of a broad range of users. The EOSDIS is designed to process, archive, and make readily available the data from EOS as well as data from past, current, and upcoming Earth observing spacecraft that fly in advance of EOS. The user community will depend on this data to develop an understanding of the vital aspects of global change.

Your study should examine some of the fundamental questions regarding the EOSDIS, particularly its responsiveness to the global change research community requirements and its technical feasibility. In addition, you should review the EOSDIS in terms of flexibility and compatibility in addressing evolving requirements, adequate opportunities for user review and input, and balance between distributed and centralized elements.

NASA is determined to proceed as rapidly as possible with the restructuring of the EOS program in order that there will be no unnecessary delays in program implementation. It is important that your study be accomplished such that an interim or status report can be available to us by March 1992 and a final report of your findings by summer 1992.

I have asked Dr. Lennard A. Fisk of our Office of Space Science and Applications to work with you to define in more detail the terms of reference for this study and to provide full support for your activities. I appreciate your assistance in this important research initiative.

Sincerely,

Richard H. Truly
Administrator

Appendix B: Terms of Reference

The National Aeronautics and Space Administration is restructuring the Earth Observing System (EOS) to be configured to fly on a series of intermediate and small spacecraft, as opposed to a series of large spacecraft. This reconfiguration will result in a different sequencing of measurements and changes in the volume of the data compared to the original EOS program.

The EOS Data and Information System (EOSDIS) is designed to process, archive, and make readily available to a broad range of users the data from EOS and also from appropriate current and upcoming spacecraft that fly in advance of EOS. Accordingly, the EOSDIS architecture will need to be compatible with the program.

The National Research Council will convene a panel of technical experts to conduct a review of NASA's plans for EOSDIS. Members of the panel should be drawn from appropriate National Academy of Sciences and National Academy of Engineering bodies and the technical community in order to bring together a broad mix of expertise in space data systems, data archival and distribution systems and in global change research. A significant proportion of the panel should have expertise in the procurement, technical, and management aspects of large database systems outside the area of global change research. As recommended in the Report of the Earth Observing System (EOS) Engineering Review Committee, the goal of the review should be to validate the engineering and technical underpinnings of the EOSDIS; assess its potential value to scientific users; suggest how technical risk can be minimized; and assess whether current plans provide for sufficient resiliency to be adaptable to changing requirements (i.e., budget environments, data volumes, etc.).

The EOSDIS program is currently selecting an EOS Core System contractor through a competitive procurement. Consequently, access to information by the review panel will be constrained to publicly available documents and presentations. Furthermore, no member selected to participate on the panel should have a significant financial interest in any of the competing contractors.

The panel will review NASA's plans for EOSDIS in order to address the following questions:

- Does the current EOSDIS plan reflect the restructured EOS global change data traffic model (i.e., are EOSDIS features properly sequenced with the complexity of the instruments to be flown and other data sources)? Can/should some of these features be delayed given the current data traffic model?

- Are the plans for EOSDIS technically realistic and appropriate to meet the

information systems demands of the EOS program, with adequate milestones and prototype demonstrations of capabilities? Do these milestones and demonstrations provide adequate benchmarks for monitoring the progress and performance throughout the development and operational phases of the EOSDIS?

- Does the EOSDIS plan meet the requirements of expected research users, especially the global change research community? Do the plans for EOSDIS provide adequately for involving university, national laboratory, government, and other users in influencing the character of each incremental phase of the system?

- Is NASA's plan for the development of EOSDIS sufficiently flexible to match the pace and scope of an observing program that is developed in an evolutionary fashion (i.e., is EOSDIS structured to respond to budget fluctuations or variations in the users demands)? If not, what actions would you recommend NASA taking to address this issue?

- Is NASA's EOSDIS management plan appropriate? For example, is the planned allocation of responsibilities between distribution and centralized elements of EOSDIS conducive to user utilization as well as efficiency and cost effective execution of the EOS program (i.e., is the allocation between distributed and centralized elements optimal)? If not, what actions would you recommend NASA taking to address this issue?

- Is the planning and design for EOSDIS sufficiently flexible to accommodate possible advances in computer hardware and software technologies that may occur over the lifetime of the system? Can/should additional flexibility be built into the design of the database?

- Does the plan for EOSDIS include provision for expansion of the system to include or access other data systems (e.g. National Space Science Data Center, National Geophysical Data Center, Earth Resource Observation System Data Center, and other national and international data systems)? What changes would be required to achieve sufficient flexibility to permit expansion?

Overall, the panel will provide a critical review of NASA's plans for EOSDIS, identify potential problems, and recommend actions that should be taken to address these problems. It will not be expected to offer a redesign of the system.

The panel will provide a status report in March 1992 summarizing the progress of the EOSDIS

review, including the principal issues identified by the panel for consideration, and will provide a final report summarizing the findings and conclusions of the review by August 31, 1992.

Appendix C: Panel Members and Biographies

PANEL TO REVIEW EOSDIS PLANS

Charles A. Zraket, *Chair,* Center for Science and International Affairs, Harvard University
D. James Baker, Joint Oceanographic Institutions Incorporated
Kenneth I. Daugherty, Defense Mapping Agency
Richard E. Hallgren, American Meteorological Society
John E. Hopcroft, Cornell University
Kenneth C. Jezek, Ohio State University
Anita K. Jones, University of Virginia
Thomas R. Karl, National Oceanic and Atmospheric Administration
Ethan J. Schreier, Space Telescope Science Institute
Gael F. Squibb, Harvard-Smithsonian Center for Astrophysics
Jeffrey D. Ullman, Stanford University

Staff

Richard C. Hart, Space Studies Board
Monica B. Krueger, Computer Science and Telecommunications Board
Norman Metzger, Commission on Physical Sciences, Mathematics, and Applications
Lorraine W. Wolf, Board on Earth Sciences and Resources

Biographies of Panel Members

Charles A. Zraket, *Chair.* Scholar-in-Residence, Center for Science and International Affairs, Harvard University. Past President and CEO, MITRE Corporation. S.M.E.E., Massachusetts Institute of Technology; Honorary Doctorate of Engineering, Northeastern University. Member, National Academy of Engineering; Fellow, American Academy of Arts and Sciences, I.E.E.E., AIAA, American Association for the Advancement of Science. **Research interests:** International and national security; global environment, science and technology policy.

D. James Baker. President, Joint Oceanographic Institutions Incorporated; Distinguished Visiting Scientist, Jet Propulsion Laboratory. Ph.D., Cornell University. Member, Global Change Research Committee, Committee on Environmental Research, Climate Research Committee, Joint Scientific Committee for the World Climate Research Program. **Research interests:** Physics of large-scale ocean circulation and climate; ocean and satellite instrumentation; research policy and management.

Kenneth I. Daugherty. Chief Scientist, Defense Mapping Agency (DMA). Ph.D., Uppsala University, Sweden. Former Assistant and Associate Director, Hawaii Institute of Geophysics; Former Deputy Director, Research and Engineering, DMA, and Director, DMA Systems Center. Fellow, IAG; Recipient, DOD Distinguished Civilian Service Award. **Research interests:** Geodesy; world coordinate systems; advanced surveying/positioning techniques; mapping technology and production systems.

Richard E. Hallgren. Executive Director, American Meteorological Society. Ph.D., Pennsylvania State University. Former Associate Administrator for Environmental Monitoring and Prediction, Assistant Administrator for Oceanic and Atmospheric Sciences, and Director of the National Weather Service. Member, Global Change Research Committee, National Committee for International Decade for Natural Disaster Reduction, Committee on Earth Sciences. **Research interests:** Meteorology, weather systems technology and management.

John E. Hopcroft. Joseph C. Ford Professor and Chair, Computer Science Department, Cornell University. Ph.D., Stanford University. Member, National Academy of Engineering, NASA Space Science and Applications Advisory Committee, and USAF Scientific Advisory Board. **Research interests:** Algorithms, modeling and simulation.

Kenneth C. Jezek. Director, Byrd Polar Research Center, Ohio State University. Ph.D., University of Wisconsin. Member, Committee on Geophysical Data, Committee on Glaciology, and Committee on Earth Studies. **Research interests:** Hemispheric-scale observations of the growth motion and decay of polar ice using spaceborne instruments.

Anita K. Jones. Professor and Chair, Department of Computer Science, University of Virginia. Ph.D., Carnegie Mellon University. Member, Defense Science Board. **Research interests:** Computer system design and construction; scientific databases; computer security.

Thomas R. Karl. Chief, Global Climate Laboratory, National Climatic Data Center, NOAA. M.S., University of Wisconsin. Member, NRC Climate Research Committee, WMO/UNEP Intergovernmental panel on Climate Change, NRC Effects Subpanel on "The Policy Implications of the Greenhouse Effect." Ex officio Chairman, American Meteorological Society Applied Climatology Committee. **Research interests:** Climate and climate change; Earth system information management

Ethan J. Schreier. Associate Director for Operations, Space Telescope Science Institute. Ph.D., Massachusetts Institute of Technology. Member, Astronomy Survey Committee Panel on Computing and Data Processing, NASA Astrophysics Division Science Operations Management and Operations Working Group. **Research interests:** Astronomy; observations of x-ray sources, active galaxies and jets; development and operations of astronomy satellites and distributed data systems for astronomy, including portable software, archives, networks.

Gael F. Squibb. Manager, Advanced X-ray Astrophysics Facility (AXAF) Science Center, Harvard-Smithsonian Center for Astrophysics. M.S., University of Southern California. Chairman, NASA Astrophysics Data System Study. Jet Propulsion Laboratory: Flight Director, Surveyor Project; Operations Director, Mariner Venus Mercury; Manager, Information Systems Sequence Section; Manager, Infrared Astronomical Satellite Project; Manager, Infrared Processing and Analysis Center. **Research interests:** Astronomy; satellite systems.

Jeffrey D. Ullman. Professor and Chair, Department of Computer Science, Stanford University. Ph.D., Princeton University. Member, National Academy of Engineering. **Research interests:** Database systems, especially deductive database systems; database integration.

Appendix D: Activities of the Panel to Review EOSDIS Plans

The panel met for the first time on February 14 - 15, 1992, at the National Academy of Sciences facilities in Washington, D.C., to review NASA's plans for EOSDIS. The panel was given the following background material: a copy of the EOSDIS Request for Proposal; summaries of Space Studies Board (SSB) reports on data management and on earth science from space; the 1991 *Report of the Earth Observing System (EOS) Engineering Review Committee* (Frieman report); the 1992 GAO report, *EOS: Information on NASA's Selection of Data Centers*; the 1991 *EOS Reference Handbook* (NASA/GSFC); the 1989 report of the Science Advisory Panel for EOS Data and Information, *Initial Scientific Assessment of the EOSDIS*; the CEES report, *Our Changing Planet: The FY1992 U.S. Global Change Research Program*; the 1991 NRC Committee on Geophysical Data report, *Solving the Global Change Puzzle: A U.S. Strategy for Managing Data and Information*; the 1991 SSB report, *Assessment of Satellite Earth Observation Programs, 1991*; and the 1990 NRC Committee on Global Change report, *The U.S. Global Change Research Program: An Assessment of the FY1991 Plans.* The panel also received a draft copy of the 1992 GAO report, *Earth Observing System: NASA's EOSDIS Development Approach is Risky.*

During the first meeting the panel received a number of briefings and presentations: (from NASA/HQ) L. Fisk, "EOS Overview"; S. Tilford and D. Butler, "NASA Plans for EOS"; (from NOAA) E. Shea, "Overview of the Global Change Program"; (from NASA/GSFC) J. Dozier, T. Taylor, H. Ramapriyan, and G. McConaughy, "NASA Plans for EOSDIS."

The panel was divided into three subpanels (User Interactions, Engineering Assessment of System Architecture, and Development/Procurement Process) that each produced a written set of questions for NASA. NASA responded with detailed, written answers. In addition, two of the subpanels visited Goddard Space Flight Center (the Development/Procurement subpanel on February 27 and the System Architecture subpanel on March 5) in order to gain further information from project officials.

The panel met for the second time on March 9 - 11, 1992, at the National Academy of Sciences facilities and heard additional information from NASA (J. Dozier, D. Butler, H. Ramapriyan, and G. McConaughy), a presentation on interagency data management efforts and NOAA data management activities (G. Withee), and a discussion with a DAAC manager (R. Dunkum, NASA Langley Research Center). During this meeting the panel prepared the draft of its interim report.

Appendix E: The EOSDIS System*

The U.S. government has undertaken a multiagency program designed to study the Earth from a global perspective to help develop sound national and international policies related to global environmental issues, particularly global climate change. NASA's contribution to this program is the Mission to Planet Earth, a series of scientific initiatives and spaceflight programs known collectively as the Earth Observing System (EOS). A central element of EOS is the Data and Information System (EOSDIS), a system to make the data obtained from the flight projects and scientific investigations available to the research community.

EOS will consist of a series of spacecraft that will be flown over a 15-year period to investigate the Earth's atmosphere and surface and the interactions between them that could influence global climate changes. Although originally conceived as two large polar-orbiting platforms with 30 instruments, EOS has recently been restructured to six smaller spacecraft with a total of 20 instruments. NASA hopes to fly three copies of each of the spacecraft over the 15-year period. In addition, a number of other U.S. and international space missions will examine various aspects of the Earth's environment. The data produced by this array of spacecraft will need to be processed, stored, and distributed to a research community estimated at 10,000 users. The EOSDIS is being planned by NASA to acquire, process, store, and distribute the spacecraft data; manage the information about the data; provide the networks necessary to access the data as well as the computing facilities necessary to analyze them; provide and maintain the standards and formats for the system; and administer the scheduling of observations and the command and control functions of the spacecraft and instruments. The EOSDIS program is to provide the tools needed to use the data, in activities such as the development and integration of algorithms for scientific products, communication and exchange of data among scientists, archiving of scientific products for access by others, checking on the health and calibration of instruments, and planning and scheduling for acquisition of new data. The system will be expected to manage a data volume of about 600 terabytes/yr.

EOSDIS will be structured around seven research science-oriented Distributed Active Archive Centers (DAACs) that will receive the raw data from the spacecraft, process them, and provide them to the users through a Product Generation System (PGS), which will produce standard sets of earth science data, an Information Management System (IMS), which will give users access to all the data throughout the EOSDIS system, and a Data Archive and Distribution System (DADS), which will serve as the archive and distribution mechanism for the data produced by EOS.

In addition to the Science Data Processing Segment of the DAACs, the architecture for EOSDIS will also include a Flight Operations Segment (FOS) for mission and instrument planning,

scheduling, control, and monitoring, and a Communications and System Management Segment for overall management and coordination of ground system resources such as inter-DAAC communications and interfacing to the NASA Science Internet.

NASA is currently developing a prototype of EOSDIS (Version 0) in order to improve access to existing data and to test the interoperability of existing systems. NASA will select a contractor to develop EOSDIS (Versions 1 through 6) in May 1992, with the expectation of having the full system operating by mid-1998.

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*This description has been abstracted from the background material available to the panel (as described in Appendix D) and the briefing documents presented to the panel during the February 14 - 15, 1992, meeting.

Appendix F: The U.S. Global Change Research Program

The U.S. Global Change Research Program (USGCRP) was established as a Presidential Initiative in the FY 1990 Budget to address global environmental issues, with particular emphasis on global climate change. The Committee on Earth and Environmental Sciences (CEES) of the Federal Coordinating Council for Science, Engineering, and Technology is the interagency group charged with the task of developing the program.* The primary goal of the USGCRP is to establish the scientific basis for national and international policies relating to natural and human-induced changes in the global Earth system. In accordance with this goal, the CEES has outlined the following objectives:

- To establish an integrated, comprehensive, long-term program of documenting the Earth system on a global scale;
- To conduct a program of focused studies to improve our understanding of the physical, geological, chemical, biological, and social processes that influence Earth system processes and trends on global and regional scales; and
- To develop integrated conceptual and predictive Earth system models.

The USGCRP is organized around seven science priorities: climate and hydrologic systems, biogeochemical dynamics, ecological systems and dynamics, earth systems history, human interactions, solid earth processes, and solar influences. These science priorities reflect the interdisciplinary approaches necessary for achieving the goal of the Program. **In addition to increased understanding in each of these research areas, the success of the USGCRP will require an effective data and information management system.** The CEES, through the Interagency Working Group on Data Management for Global Change, is currently planning such a system.

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*For a detailed overview of the USGCRP, see: *Our Changing Planet: The FY 1992 U.S. Global Change Research Program*, Committee on Earth and Environmental Sciences (CEES), Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), Office of Science and Technology Policy (OSTP), Washington, D.C., 1991; and *Our Changing Planet: The FY 1993 U.S. Global Change Research Program*, CEES, FCCSET, OSTP, Washington, D.C., 1992.
