

125043
27583

REPORT BY THE
Comptroller General
OF THE UNITED STATES

Effects On Users Of Commercializing Landsat And The Weather Satellites

In March 1983, the administration proposed to transfer the National Oceanic and Atmospheric Administration's satellites--a land-observing satellite, called Landsat, and the weather satellites--to the private sector. This report discusses how these satellites are used worldwide and how their commercial operation might affect users.

In November 1983, the Congress enacted legislation to prevent the sale of the weather satellites; the administration is proceeding with its efforts to commercialize Landsat. In considering legislation to authorize a sale, the Congress should consider whether the sales terms proposed by the administration adequately protect the interests of Landsat users in the United States and abroad.

RESTRICTED...
Approved for release by the Director of the Central Intelligence Agency on 02/24/84.

RELEASED



123543



GAO/RCED-84-93
FEBRUARY 24, 1984

528180

Request for copies of GAO reports should be sent to:

**U.S. General Accounting Office
Document Handling and Information
Services Facility
P.O. Box 6015
Gaithersburg, Md. 20760**

Telephone (202) 275-6241

The first five copies of individual reports are free of charge. Additional copies of bound audit reports are \$3.25 each. Additional copies of unbound report (i.e., letter reports) and most other publications are \$1.00 each. There will be a 25% discount on all orders for 100 or more copies mailed to a single address. Sales orders must be prepaid on a cash, check, or money order basis. Check should be made out to the "Superintendent of Documents".



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

B-214057

The Honorable Jack Brooks
Chairman, Subcommittee on Legislation
and National Security
Committee on Government Operations
House of Representatives

The Honorable Charles McC. Mathias
United States Senate

The Honorable John C. Stennis
United States Senate

The Honorable Edward Zorinsky
United States Senate

This report discusses how the National Oceanic and Atmospheric Administration's remote sensing satellites--Landsat and the weather satellites--are used by federal agencies, other U.S. organizations, and foreign governments and how users might be affected by the commercialization of these satellites. It also outlines issues regarding the commercialization of Landsat for consideration by the Congress as it takes up legislation to authorize its sale. As requested by your offices, the report presents the information we developed on the weather satellites, even though their sale has been prevented by recent congressional action. Our classified report to you entitled National Security Implications of Commercializing Landsat and Weather Satellites (GAO/C-RCED-84-1, Feb. 1, 1984) discusses commercialization in relation to national security issues.

As arranged with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of the report. At that time we will send copies to the appropriate House and Senate committees, the heads of departments and agencies whose programs we discuss, Members of Congress, and other interested parties.

A handwritten signature in cursive script that reads "Milton J. Fowler".

Acting Comptroller General
of the United States

D I G E S T

The Department of Commerce's National Oceanic and Atmospheric Administration operates two remote sensing satellite systems--the weather satellites and Landsat--which produce data with worldwide uses. In March 1983, the administration announced its decision to transfer these satellites to private enterprise and rely on the private sector in the future for the data these systems supply. The administration wants to commercialize Landsat because it believes that the private sector can develop a market for Landsat data better than the federal government and can help the United States retain its international lead in this technology. Inasmuch as the Landsat activities are not presently economically self-sustaining, commercialization of the weather satellites was proposed so the private satellite owner would be assured of a source of revenue while the Landsat market was being developed.

The Chairman, Subcommittee on Legislation and National Security, House Committee on Government Operations, and Senators Mathias, Stennis, and Zorinsky, asked GAO to examine several aspects of the proposed sale, including

- its effect on the national security of the United States,
- the uses which federal agencies have or expect to have for satellite data,
- the effect of the sale on nonfederal United States and foreign government users, and
- conditions which could be included in the contract transferring the satellites to the private sector.

The national security aspects of the proposed sale are discussed in GAO's classified report entitled National Security Implications of Commercializing Landsat and Weather Satellites (GAO/C-RCED-84-1, Feb. 1, 1984). Recent congressional action has prevented the sale of the weather satellites, but the information GAO developed on these satellites is included in

this report at the request of the Members of Congress who asked for the GAO review. (See pp. 3 to 5, and 27 to 42.)

LANDSAT USES

Since 1972, the United States has maintained in orbit a series of land sensing satellites called Landsats. The current Landsat is the fourth in the series. Landsat "senses" the earth's surface and sends the data back to earth in a form which can be processed into photographic images or computer-compatible tapes. Landsat data are used around the world to estimate and manage crop production; explore for minerals, including petroleum; make and revise maps; and accomplish other purposes. Landsat data are used in the United States by federal and state agencies, industrial and service businesses, and universities. Landsat is also used extensively by foreign governments which operate 10 ground stations to pick up Landsat signals. The federal government had spent, through March 1983, about \$477 million to build, launch; and operate Landsat 4; to build a satellite to succeed Landsat 4; and for the Landsat ground system. The U.S. government charges Landsat users a fee designed to recover operating costs, but not building or launching costs. (See pp. 2 and 3.)

USER CONCERNS RAISED BY THE PROPOSAL TO COMMERCIALIZE LANDSAT

A change from government to commercial operation of Landsat could mean major changes for Landsat users. GAO discussed these possibilities with a sample of users, including representatives of 18 federal agencies, 16 other U.S. users, and 10 foreign countries. The views GAO obtained on commercialization were those of organization officials and may not represent the formal position of the organizations themselves. (See pp. 7 and 8.)

Federal and nonfederal domestic users of Landsat believed the present limited market for Landsat would not allow a private operator to make a profit at current prices. They were concerned that with monopolistic control over the supply of data, a private operator could increase prices and also reduce data quality. Both federal and nonfederal users believed that

a commercial operator would not perform sufficient research and development. (See pp. 11 and 12, and 23 to 25.)

Representatives of several nonfederal users recommended that commercialization of Landsat proceed in stages beginning with data distribution. These users said that a gradual turnover of the system to the private sector would improve the chance for successful commercial operation by allowing time for development of a profitable market. (See p. 25.)

Private companies which buy Landsat data from the government for analysis and resale--termed "value-added" companies--were concerned that a private operator would use its control over the source of data to drive them out of business. (See p. 23.)

Under federal operation, Landsat data have been broadcast directly from satellites to receiving stations operated by foreign governments. The United States has followed an equal access data distribution policy, making Landsat data available to all interested parties, including the country from which the data were sensed, at the same time and on the same terms.

Foreign governments were concerned that commercial operation of Landsat might change these data distribution arrangements. They were concerned that a private operator might, for commercial reasons, stop transmitting data to their ground stations--very often facilities in which they had invested considerable resources--or that the operator would increase prices to the point that they could no longer afford the data. Also, the foreign governments said that a private company might find it profitable to sell, for the exclusive use of outsiders, information on their countries' resources or activities, which would be harmful to their economic or national security interests. (See pp. 17 to 19.)

Although most federal and other U.S. Landsat users believed that commercialization could affect them adversely, some believed that private control of the satellites would help improve service and increase marketing of data. (See pp. 9 and 23.)

HOW THE REQUEST FOR PROPOSALS
ADDRESSES USER CONCERNS

Following the March 1983 announcement of the administration's decision to commercialize the satellites, the Department of Commerce set up a Source Evaluation Board to prepare requests for proposals. Requests for proposals were drafted for both Landsat and the weather satellites, but because the Congress enacted legislation in November 1983 to prohibit the sale of the weather satellites, only the Landsat request was issued. Responses to this request for proposals are due at the end of February 1984.

The Landsat request for proposals requires offerors to describe the type of land remote sensing system they would build to replace the current system and the operating and pricing policies they would follow. It also indicates that the government is willing to provide financial assistance to a private operator and invites offerors to state what form of financial assistance they would prefer. According to Source Evaluation Board officials, financial assistance is being considered because the current market for Landsat data is not strong enough to support a profitable operation. (See pp. 5 to 7.)

Complete information on the operating characteristics of a commercial land sensing system and the associated costs will not be known until a contract is agreed upon by the government and a private operator. However, the request for proposals does address many of the concerns raised by federal Landsat users. For example, the request for proposals requires a private operator to orbit a sensor which provides data at least equal to the current Landsat operational sensor. In addition, a prospective operator must describe methods for improving data coverage and timeliness and for ensuring that data quality is maintained. The request for proposals also states that the government plans to continue land remote sensing research and development.

However, the request for proposals satisfies fewer of the concerns raised by international and nonfederal Landsat users. For example, subject to U.S. government approval, the private operator could terminate broadcasts to foreign ground stations and change the

present federal data distribution policy by refusing to sell data to a country from which the data were sensed. A private operator might find these changes commercially advantageous. The request for proposals does not describe the criteria that the federal government would apply to requests by a private operator for these changes. But because Landsat will be a commercial venture, economic considerations may influence government policymaking to a greater extent than in the past. The private operator would also be permitted to enter the value-added industry. According to Source Evaluation Board officials, the request for proposals does not impose all the restrictions on a commercial operator that international and nonfederal U.S. users want, because the request is designed to encourage full commercial development of a land remote sensing system with a minimum of federal regulation. (See pp. 12, 13, 19, 20, and 25.)

MATTERS FOR CONSIDERATION
BY THE CONGRESS

The administration plans to propose legislation to the Congress to authorize commercialization. The Congress may set out in this legislation requirements for commercial operation in addition to or different from those contained in the request for proposals.

In deliberating on this legislation, the Congress may wish to consider the following:

- Should a private Landsat operator be required, under terms and time frames specified by the Congress, to continue present arrangements for broadcasting data to foreign ground stations?
- Should a private operator be required to continue the traditional U.S. government policy of providing a sensed country with equal access to data obtained on its territories and activities?
- Should protection be provided to firms in the value-added business so that they can compete with the private Landsat operator? For example, the Landsat operator could be required to make data available to all value-added firms on the same terms and as soon as the data are ready for analysis by the operator itself.

--Should a step-by-step approach to commercialization, beginning with data distribution, be an alternative to control of the whole system. (See pp. 20, 25, and 26.)

Any legislation authorizing the commercialization of Landsat must balance the financial interests of the private operator against the concerns of Landsat users that unregulated commercial operations will adversely affect their interests. Potential private operators will in turn consider whether legislatively or administratively established terms and conditions make private Landsat operation economically attractive.

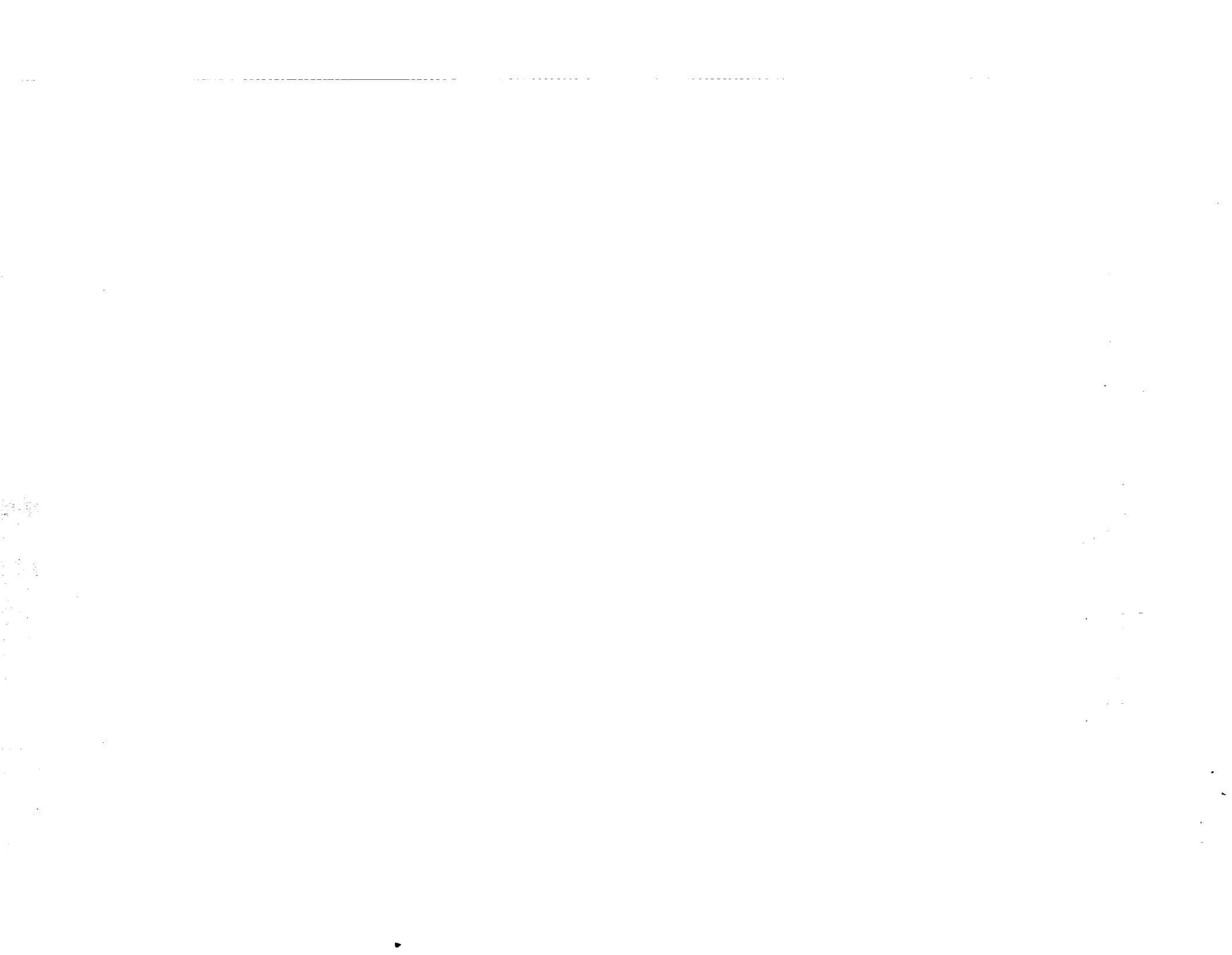
HOW THE CANCELLED PLAN TO
COMMERCIALIZE THE WEATHER
SATELLITES WOULD HAVE AFFECTED USERS

GAO discussed the proposed plan to commercialize the weather satellites, now cancelled because of congressional action, with officials of 7 federal agencies, 14 other U.S. users, and 11 foreign countries which use U.S. weather satellite data. Federal and domestic nonfederal weather satellite users wanted to avoid higher charges for weather data they now receive free or at low cost. They also wanted the current level of data and services to be maintained. Private companies that did value-added work on weather satellite data believed that entry of a private operator into their business would jeopardize their existence. Foreign users of weather satellites were concerned about charges for satellite data previously provided at no cost through programs such as the United Nations' weather information exchange system.

Although most federal and other U.S. satellite users said that commercialization could affect them adversely, some believed that private control of the satellites could help improve service and data marketing.

The unissued weather satellites request for proposals sought to ensure that, for the most part, commercial operation of weather satellites would not affect current users. The private operator would have been required to continue present services and supply the U.S. government with data and services to continue present international meteorological

cooperation. Users of the weather satellite communications services, however, might have faced price increases and the private operator would have been allowed to enter the value-added business. (See pp. 27 to 42.)



C o n t e n t s

		<u>Page</u>
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Characteristics and uses of the satellite systems	2
	Status of the administration's proposed sale of the satellites	5
	Objectives, scope, and methodology	7
2	COMMENTS FROM FEDERAL AGENCY OFFICIALS ON THE COMMERCIALIZATION OF LANDSAT	9
	Background on federal users of Landsat data	9
	Federal users' concerns about potential increases in the cost of Landsat	11
	Federal users' concerns about data, services, and research	11
	Terms and conditions suggested by federal users	12
	RFP treatment of federal user concerns	12
3	INTERNATIONAL IMPLICATIONS OF COMMERCIALIZING LANDSAT	14
	How other countries obtain Landsat data	14
	How other countries use Landsat	15
	Foreign countries' concerns about the commercialization of Landsat	17
	Matters for consideration by the Congress	20
4	COMMENTS FROM NONFEDERAL USERS OF LANDSAT	21
	Background on nonfederal users of Landsat data	21
	Nonfederal users' concerns about commercialization of Landsat	23
	Nonfederal users' suggestions for commercialization terms and conditions	25
	Matters for consideration by the Congress	25

5	DOMESTIC AND FOREIGN USERS' CONCERNS ABOUT COMMERCIALIZATION OF THE WEATHER SATELLITES	27
	Federal users of weather satellite data	27
	Foreign users of weather satellite data	30
	Nonfederal users of weather satellite data	35

APPENDIX

I	How federal agencies use Landsat and the weather satellites	43
---	--	----

ABBREVIATIONS

GAO	General Accounting Office
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
RFP	request for proposals

CHAPTER 1

INTRODUCTION

On March 8, 1983, the administration announced its decision to transfer the federal government's operational civil remote sensing satellites to the private sector. The satellite systems to be included in this transfer were Landsat (the land remote sensing satellite) and the weather satellites. Since the data produced by these satellites are used by numerous federal, international, and private organizations, the effect of any changes in the operation of Landsat and the weather satellites would be widespread. Questions were raised among all of these groups concerning the advisability of the transfer, the terms and conditions which should be included in the transfer, and the effect the transfer would have on users.

The Chairman, Subcommittee on Legislation and National Security, House Committee on Government Operations, and Senators Mathias, Stennis, and Zorinsky asked us to examine several aspects of the proposed transfer, including

- its effect on the national security of the United States,
- the uses which federal agencies have or expect to have for satellite data,
- the effect of the sale on nonfederal U.S. users and foreign government users, and
- possible conditions which could be included in the contract transferring the satellites to the private sector.

In November 1983, after the completion of our review, the Congress enacted Public Law 98-166 prohibiting the transfer of the weather satellites to the private sector. The requestors nevertheless asked us to report the information we had developed on the weather satellites as well as Landsat.

The national security aspects of the proposed sale are discussed in our classified report entitled National Security Implications of Commercializing Landsat and Weather Satellites (GAO/C-RCED-84-1, Feb. 1, 1984).¹ The remaining aspects of the proposed sale, including the reaction of federal, international, and private users of satellite data, are discussed in the following chapters.

¹See also our earlier report entitled Costs and Uses of Remote Sensing Satellites (GAO/RCED-83-111, Mar. 4, 1983).

CHARACTERISTICS AND USES
OF THE SATELLITE SYSTEMS

The United States currently has five civil operational remote sensing satellites in orbit--one land remote sensing satellite (Landsat) and four weather satellites. All of these satellites were developed by the National Aeronautics and Space Administration (NASA) and are operated by the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA).

Landsat

The first Landsat was launched in 1972; three replacements have been placed in orbit since then. The present Landsat, Landsat 4, was launched in July 1982 but is malfunctioning. A replacement for Landsat 4 is scheduled to be launched in March 1984.

Landsat "senses" the earth's surface and sends the data back to earth in a form which can be processed into photographic images or computer-compatible tapes. Landsat 4 carries two instruments: the multispectral scanner and the thematic mapper.² The multispectral scanner, which was one of the instruments carried on the previous Landsats, is considered the operational sensor. The thematic mapper is a more advanced sensor but is considered experimental.

Data transmitted from Landsat are received by the Goddard Space Flight Center in Maryland and by 10 foreign ground stations which are operated under cooperative agreements with the U.S. government.³ The data received at the Goddard Space Flight Center are transferred to the Department of the Interior's Earth Resources Observation Systems Data Center in South Dakota where they are processed, stored, and sold as photographic images or computer-compatible tapes.

Landsat data are used by numerous federal and state agencies, foreign countries, university researchers, private businesses, and individuals. The following table shows the percent of Landsat

²The multispectral scanner monitors materials on the earth's surface--water, crops, and forests for example--by measuring the light waves which they reflect. The thematic mapper is a more sophisticated sensor which monitors the earth's surface in greater detail than the multispectral scanner.

³In calendar year 1983, each of the following countries operated one ground station: Argentina, Australia, Brazil, Canada, India, Japan, South Africa, and Thailand. In addition, the European Space Agency operated two ground stations.

products sold at the Earth Resources Observation Systems Data Center to each of the user groups for fiscal year 1983.

FY 1983 Landsat Purchases From the
Earth Resources Observation Systems Data Center

<u>Customer</u>	<u>Products</u>	<u>Dollar</u>
	-----Percent-----	
Federal government ^a	47	75
State/local government		
Academic	4	3
Industrial	10	9
Individual	3	1
Non-U.S.	<u>34</u>	<u>11</u>
Total ^b	<u>100</u>	<u>100</u>

^aFederal government purchases may be higher than shown since some of the other categories of customers may include contractors for federal agencies.

^bFigures do not add due to rounding.

Purchases at the Data Center amounted to about \$7 million in fiscal year 1983. The prices of Landsat products are designed to recover operating but not building or launching costs. As of August 1983, the prices for photographic images ranged from \$26 to \$235; the prices for computer-compatible tapes ranged from \$650 to \$2,800. For the first 9 months of fiscal year 1983, the latest period for which information was available, Landsat operating costs amounted to about \$22 million.

Landsat data have a variety of uses, including mapmaking, mineral exploration, crop estimation, and wildlife habitat assessment. More detailed information on the ways federal, private, and foreign entities use Landsat data is provided in the following chapters.

The weather satellites

The U.S. weather satellite systems were first authorized in 1961 when the Congress directed the Department of Commerce to establish a satellite system that would continuously observe and report on worldwide environmental conditions. The government has launched and operated numerous weather satellites in the years since then. At present, the government has four civilian operational weather satellites in orbit--two polar orbiters and two geostationary satellites.

The two polar orbiting satellites circle the earth a total of four times daily to provide global coverage of cloud patterns, surface temperatures, atmospheric humidity, and other environmental data. The two geostationary satellites continually view North and South America and the Atlantic and Pacific Oceans as they orbit the earth above the equator at the same rate the earth turns. The information provided by the geostationary satellites includes cloud motion and wind data, precipitation estimates, and frost data. The satellites are valuable in making daily weather forecasts, in researching the environment, and in detecting and tracking severe storms.

Both groups of satellites use a variety of weather and environmental sensors to obtain the required data. These data are transmitted to two command and data acquisition stations in Wallops Island, Virginia, and Gilmore Creek, Alaska. Because the polar orbiting satellites regularly move beyond transmitting range from these stations, arrangements have been made with the French Government to receive some data at their command and data acquisition station at Lannion, France. These data are then relayed to the United States. In addition to the command and data acquisition stations, there are more than 800 direct readout stations around the world, owned mostly by foreign governments, which receive data at no cost from the polar orbiting or geostationary satellite sensors.

Geostationary satellite images can also be obtained by telephone link. To receive satellite data by this method, a user must acquire appropriate telephone communications and terminal display equipment and pay both an initial connection fee and an annual service fee. The images themselves are provided at no cost.

Historical and analyzed data from both polar orbiting and geostationary satellites are obtained by purchasing the data from NOAA's Satellite Data Services Division or by subscription to NOAA's Weather Facsimile System. This system transmits National Weather Service forecasts and other data via the geostationary satellites.

The capabilities of the polar orbiting and geostationary satellites go beyond sensing weather information from the earth's surface. For example, geostationary satellites carry a data collection system to collect and relay environmental data observed by a variety of remotely located platforms, such as river and tide gauges, buoys, ships, airplanes, and automatic weather stations. The polar orbiting satellites have a similar capability through a French-produced system which not only collects data from moving platforms but also provides information on where the platform was located at the time the data were received by the spacecraft. The newer of the two polar orbiting satellites also has the capability to monitor emergency radio broadcasts from ships or planes through a receiver called Search and Rescue Satellite Aided Tracking.

The federal government is the largest user of weather satellite data. NOAA's National Weather Service, the primary

recipient, uses satellite data to issue warnings about hurricanes, tornadoes, and severe storms; to gather environmental data for daily weather forecasts; and for research. The second largest federal user is the Department of Defense, which uses data from the civil polar orbiters to supplement its own Defense Meteorological Satellite Program. Weather satellite data are also disseminated abroad through a United Nations-sponsored system for the free, international exchange of weather data.

Other users of weather satellite data include state and local governments; university researchers; and private companies and individuals, such as the news media, airlines, and farmers. Chapter 5 of this report provides more detailed information on the users of weather satellite data.

STATUS OF THE ADMINISTRATION'S PROPOSED SALE OF THE SATELLITES

The proposal that Landsat be transferred to the private sector first received presidential endorsement in 1979 during the Carter administration. Following a lengthy review of the nation's space policy, President Carter decided to give NOAA responsibility for operating Landsat and announced the goal of eventually transferring it to the private sector. However, the administration also affirmed its intention to ensure continuity of Landsat data through the 1980's by launching three additional satellites in the Landsat series.

The Reagan administration terminated the government's commitment to ensuring Landsat data continuity through the 1980's because it believed that commercialization can occur more quickly. Instead of launching three more Landsats, the current administration intends to launch only one more. In addition, on July 13, 1981, President Reagan requested the Cabinet Council on Commerce and Trade, chaired by the Secretary of Commerce, to determine the best method of transferring Landsat to the private sector and to assess the advisability of transferring the weather satellites to private ownership. In December 1982 the Council recommended the transfer of Landsat and the weather satellites. President Reagan announced his endorsement of this recommendation on March 8, 1983. In congressional testimony, the Secretary of Commerce said that the administration wants to commercialize Landsat because it believes that the private sector can develop a market for Landsat data better than the government and help the United States retain its international lead in this technology. Commercialization of the weather satellites was proposed to allow a private satellite owner an assured source of revenue while the Landsat market was being developed.

In June 1983, the Secretary of Commerce chartered the Source Evaluation Board on Civil and Remote Sensing to draft a request for proposals (RFP). The Board issued a draft RFP in October 1983 to obtain industry input. The draft RFP would have allowed private firms to bid for one or more of the three systems:

Landsat, the polar orbiting weather satellites, and the geostationary weather satellites. In November 1983, however, the Congress enacted Public Law 98-166, which prohibited the use of funds by the Source Evaluation Board to develop or issue an RFP for the sale or lease of the weather satellites. In response, the Board cancelled plans to issue an RFP for the weather satellites. The final RFP for Landsat was issued on January 3, 1984. Responses to the RFP are due by February 29, 1984.

The objective of the RFP is to establish as quickly as possible a commercial land-observing satellite program which is subject to the least possible government regulation. Offerors are required to submit proposals to build and operate a satellite system to begin operating in 1987, after the last government-built Landsat stops operating. Offerors are also encouraged to buy or lease the government's system for its lifetime. This system includes (1) Landsat 4 and its successor satellite scheduled for launch in March 1984, (2) satellite command, control, and other functions at the Goddard Space Flight Center, (3) ground or other systems for satellite tracking and communications, and (4) data processing and distribution at the Earth Resources Observation Systems Data Center.

According to officials of the Source Evaluation Board, the market for Landsat data is not strong enough to make operation of Landsat profitable at this time. The RFP states that the government is willing to provide financial support, such as loans or loan guarantees, during the early years of private operation and invites offerors to indicate what form of assistance they would prefer, but the government's ultimate objective is to purchase data, over the counter, from a self-sustaining commercial operation. The RFP also indicates that the government is willing to negotiate with a private operator for launch services.

The RFP requires an offeror to specify the type and cost of data and services which it will provide after the transfer. The RFP does not set a limit on the prices that a private operator could charge but does indicate that volume of federal data purchases will depend on data cost. After responses to the RFP have been received and evaluated, the Department of Commerce will select the preferred offeror and propose legislation to the Congress to authorize the commercialization of Landsat. If the legislation is passed, Commerce will contract with the successful offeror for a commercial Landsat system. The Congress can refuse to authorize the commercialization or may pass legislation which requires commercial operations different from those proposed by the selected offeror. Any operating requirement imposed in legislation would control the terms of a contract between Commerce and the commercial operator.

Any legislation authorizing the commercialization of Landsat must balance the financial interests of the private operator against the concerns of Landsat users that unregulated commercial operations will adversely affect their interests. Potential

private operators will in turn consider whether legislatively or administratively established terms and conditions make private Landsat operation economically attractive.

OBJECTIVES, SCOPE, AND METHODOLOGY

As requested by Chairman Brooks and Senators Mathias, Stennis, and Zorinsky, we identified the principal federal, international, and private users of satellite data and their uses of the data and discussed with them which conditions the users believed should be included in the contract transferring the satellites to the private sector. In our discussions with users we used a structured interview approach. Different sets of questions were developed for each of the user groups. Each user within each group was asked the same questions. Their responses have been tabulated in the report. In accordance with the requestors' instructions, we did not obtain agency comments on the report. The audit work on this assignment was done between May and September 1983 and, with the exception of not obtaining agency comments, was performed in accordance with generally accepted government auditing standards.

To obtain information on the federal uses of Landsat and weather satellite data we spoke with officials from 23 agencies. These agencies were in the Departments of Agriculture, the Interior, Commerce, Energy, Labor, Transportation; or were independent agencies like the Environmental Protection Agency, NASA, and the Smithsonian Institution. These users represent most of the federal civilian agencies which made significant use of Landsat and weather satellite data in 1982. See appendix I for a description of how these federal agencies use the satellites.

Information on the international implications of the sale was gathered by interviewing officials from 3 federal agencies, 5 international assistance organizations, and 11 foreign countries. The federal agencies contacted were the Department of State and the major suppliers of satellite data to other countries: the Agency for International Development and the Department of Commerce. Representatives from the World Meteorological Organization and other United Nations' agencies, World Bank, Inter-American Development Bank, and Asian Institute of Technology were interviewed because their organizations have funded projects involving the use of Landsat or weather satellite data. Finally, we visited foreign ministry, space agency, or meteorological officials in Argentina, Barbados, Brazil, France, Germany, India, Italy, Japan, Peru, Thailand, and the United Kingdom. Selection of these countries was made following discussions with officials from the Agency for International Development, NOAA's National Environmental Satellite Data and Information Service, and the National Weather Service. Countries were selected to include representative industrialized and developing countries in various geographical locations that use Landsat and weather satellite data.

We spoke with officials of 28 private and state government organizations selected after discussions with NOAA officials to achieve a representative cross section of nonfederal users.⁴ The organizations we contacted are in industries or consumer groups which are among the largest users of satellite data. The users included large and small private weather services, large and small oil exploration service companies, television weather services, data processing companies, a state government, a university, a public utility, and an airline. These groups were selected to include a diversity of satellite data users in a variety of geographical locations. The views on commercialization we obtained were those of organization officials and may not represent formal positions of the organizations themselves. A total of 2,980 non-federal organizations bought Landsat data from the Earth Resources Observation Systems Data Center in fiscal year 1982. (See ch. 5 for the number of nonfederal users of the various weather satellite data and services.) We also reviewed the Department of Commerce's RFP to determine the extent to which it addressed concerns raised by users about commercialization.

⁴Fourteen of the organizations used only Landsat data, 12 used only weather satellite data, and 2 used both.

CHAPTER 2

COMMENTS FROM FEDERAL AGENCY OFFICIALS

ON THE COMMERCIALIZATION OF LANDSAT

Most of the federal Landsat users believed that the cost of Landsat data would probably increase under private operation, and almost all believed that increases would cause them to curtail or even stop using Landsat data. Federal users were also concerned that a private operator's efforts to cut costs might result in a reduction in the type and quality of data and services and in remote sensing research and development. The only potential benefit which was mentioned by more than two users was that a private owner would probably improve the marketing of Landsat data. Virtually all of the federal users believed that the sales contract should include terms and conditions that would protect their interests.¹

The commercialization process has not proceeded far enough to determine how federal costs will be affected or how the character of land remote sensing data may change. However, the RFP for Landsat does address many of the concerns raised by federal users.

BACKGROUND ON FEDERAL USERS OF LANDSAT DATA

Twelve federal civilian departments or independent agencies² purchased Landsat data from the Earth Resources Observation Systems Data Center in calendar year 1983:

- Department of Agriculture
- Department of the Army, Corps of Engineers (Civil Works)
- Department of Commerce
- Department of Energy
- Department of the Interior
- Department of Justice
- Department of Labor
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation
- Smithsonian Institution

¹This chapter discusses all federal uses of Landsat except for national security and international assistance. International uses of Landsat are discussed in chapter 3 of this report. National security uses are discussed in our classified report entitled National Security Implications of Commercializing Landsat and Weather Satellites (GAO/C-RCED-84-1, Feb. 1, 1984).

²Excluding national security and international assistance agencies.

According to Data Center records these agencies spent about \$2.7 million on Landsat products in calendar year 1983 through August 17.³

We spoke with program managers from 18 units⁴ in seven departments and agencies. These departments and agencies included the largest, regular federal Landsat users. The managers we contacted use Landsat data to support projects which range from estimating worldwide crop production to predicting the course of forest fires. Examples of a few of the uses of Landsat data follow. (See app. I for individual descriptions of the ways federal agencies use Landsat data.)

- The Geological Survey uses Landsat data to assist in activities such as monitoring coastal shoreline changes, assessing the effects of floods and other natural disasters, and producing a national land use/land cover map series.
- The Fish and Wildlife Service uses Landsat data for planning National Wildlife Refuge activities.
- The Foreign Agricultural Service uses Landsat data to help estimate foreign crop production.
- The Bureau of Land Management uses Landsat data to map vast tracts of public lands and for resource inventories.
- The Corps of Engineers uses Landsat data for purposes such as studying the impact different flood levels could have on cities and communities.

³Data Center records understate federal agency purchases by not including purchases made on the agencies' behalf by contractors.

⁴The Department of Agriculture's Foreign Agricultural Service, Statistical Research Service, Soil Conservation Service, Agricultural Research Service, and Forest Service; the Department of the Army's Corps of Engineers; the Department of the Interior's Geological Survey, Bureau of Land Management, Bureau of Reclamation, Fish and Wildlife Service, National Park Service, Bureau of Indian Affairs, Bureau of Mines, and Office of Surface Mining Reclamation and Enforcement; the Department of Labor's Mine Safety and Health Administration; the Department of Energy; the Environmental Protection Agency; and the National Aeronautics and Space Administration.

FEDERAL USERS' CONCERNS
ABOUT POTENTIAL INCREASES
IN THE COST OF LANDSAT DATA

The possibility of increases in the cost of satellite data was the principal concern of most federal users of Landsat data we contacted. Landsat users in 14 of the 18 agencies said that cost increases were likely if the satellite was sold to the private sector. Users believed that a private owner would charge more for Landsat data because the current prices are too low to fully recover costs. NOAA has priced Landsat data to recover operating costs; a commercial operator would charge prices designed to recover the costs of building and launching Landsat as well as operating it. Under federal operation Landsat costs have been high. As of March 31, 1983, the federal government had spent about \$477 million to build, launch, and operate Landsat 4; to build a replacement for Landsat 4; and for ground systems.

Users in 16 agencies we contacted believed that an increase in the cost of Landsat data would either prevent them from continuing to buy the data or reduce the amount they could buy. Users in seven agencies said that no satisfactory alternative to Landsat data exists. For example, a Bureau of Land Management official said that Landsat plays a key role in helping the Bureau manage federal lands. According to the official, satellite data is irreplaceable for vast, relatively inaccessible areas such as parts of Alaska.

FEDERAL USERS' CONCERNS ABOUT
DATA, SERVICES, AND RESEARCH

Landsat users in 14 of the 18 agencies expressed concern about the type or quality of data and services they would receive from a private owner. These users believed that selling Landsat would result in poorer service, including interruptions or delays in data delivery. Another major concern was that certain types of data used by the agencies might no longer be available. Limited data availability was seen as resulting from the private owner's desire to discontinue unprofitable data types. Seven of the users believed that the products they now buy would be discontinued since they are likely to be low-selling items. In a related issue, users were concerned that a private owner might not continue archiving data for future use since this would probably not be profitable. Some of the users said that archived data was very useful in supporting their agencies' programs.

Officials of seven of the agencies were concerned that the quality of data they received might deteriorate. Users cited inexperience and increased emphasis on operational economies as reasons for possible reductions in data quality.

Seven users believed that research and development would be slowed under private ownership. These users believed that the federal government should continue to perform research and development for Landsat. For example, a Forest Service official said that a private firm might perform some research, but the government would have to do research in areas where commercial profits are unavailable.

TERMS AND CONDITIONS SUGGESTED BY FEDERAL USERS

Officials from 17 of the 18 Landsat-using federal agencies we contacted believed that if Landsat is sold, the federal government should include specific terms and conditions in the sales contract to protect the government's interests. Users from 16 of the 18 agencies supported a provision that would state the type of data that must be collected by the private owner of Landsat. Users from 15 of the agencies believed that standards for data quality should be required in the sales contract. Users in 13 agencies advocated provisions to ensure the timeliness of data delivery, the frequency of data collection, the continuation of research and development, and the establishment of a federal board to oversee the private owner's management of Landsat. All of these provisions were viewed as protecting the agencies' continued access to the type and quality of data needed to support their programs.

RFP TREATMENT OF FEDERAL USER CONCERNS

Full performance characteristics for the commercial Landsat system will not be established until a contract is reached between the government and a private operator. In addition, the costs of Landsat products and the amount of the federal subsidy to the commercial operator will not be known until a contract is signed. However, the RFP does require an offeror to orbit a sensor which provides data equal to or better than the current Landsat operational sensor. In addition, an offeror must describe methods for improving data coverage and timeliness and for ensuring that data quality is not reduced.

The RFP indicates that it is the administration's policy to continue federal research and development. It states that:

"It is the U.S. Government's strong belief that an aggressive, continuing Federal R & D effort in advanced remote sensing technology is critical to maintaining a U.S. leadership position in civil space technology, as well as to advancing the understanding of changes to global earth processes and their long-term impacts."

In addition, the RFP indicates that the government will continue to archive Landsat data which a commercial operator does not want to inventory.

The RFP also states that the government will have authority to oversee the operations of the commercial land sensing system, including authority to correct deficiencies that might affect operations. According to Source Evaluation Board officials, a federal interagency board will be established to advise the Department of Commerce, which will administer the contract with the commercial operator, on the operator's performance.

CHAPTER 3

INTERNATIONAL IMPLICATIONS OF

COMMERCIALIZING LANDSAT

Landsat is used extensively by other countries. These countries are concerned about how commercialization would affect the cost and accessibility of Landsat data. The RFP would permit major changes in the international distribution of Landsat information.

HOW OTHER COUNTRIES OBTAIN LANDSAT DATA

Countries obtain Landsat data in several ways. First, countries purchase data directly from the Department of the Interior's Earth Resources Observation Systems Data Center. According to the Data Center's records, foreign users bought 34 percent of the Landsat tapes and photographic images sold at the center in fiscal year 1983. Receipts from foreign users represented 11 percent of the Center's \$7 million sales during the same period.

Second, countries can receive direct Landsat broadcasts. In 1983, foreign countries and the European Space Agency received the data directly from Landsat at 10 ground stations. Ground stations are operated under agreements with the United States, requiring them to pay a \$600,000 annual fee and a fee for each Landsat product distributed. These countries also sell the data received by their ground stations to customers in other countries. In 1982, the latest year for which data were available, foreign ground stations received revenues of \$2.5 million from distributing about 59,000 Landsat tapes and images.

In addition, foreign countries obtain Landsat data and technical assistance through cooperative activities with federal government agencies. The largest federal user of Landsat data for international projects--the Agency for International Development--budgeted about \$500,000 for Landsat data in fiscal year 1983. Other federal agencies that use Landsat to aid in various international efforts include the U.S. Geological Survey, which has sponsored Landsat training courses for the international user community; and the Bureau of Land Management, which has cooperated with other nations on projects involving Landsat data. In addition, the Bureau of Reclamation helped Mexico use Landsat to measure salinity in the Colorado River.

Finally, foreign countries obtain Landsat data through projects funded by international organizations such as the World Bank, the United Nations, and the Inter-American Development Bank.

HOW OTHER COUNTRIES USE LANDSAT

We spoke with government officials responsible for space and remote sensing programs in 10 countries about how Landsat data is used.¹ Nine of these countries operate their own Landsat receiving stations or are members of the European Space Agency, which operates two receiving stations.² In addition, we spoke with officials of several international organizations that use Landsat data: the World Bank, the Inter-American Development Bank, the Asian Institute of Technology, and some United Nations' agencies. Generally, these officials told us that:

- Landsat has demonstrated value in a number of areas but is used mostly on a research and development or demonstration basis rather than an operational basis since program managers are still learning how to use it.
- The uses of Landsat data are expected to increase in number and variety as users gain experience and satellite technology advances.
- A commercial market for Landsat data is years away.
- Investments made by developing countries in acquiring the capability to receive and use Landsat data represent significant commitments of their governments' resources.
- Landsat has unique advantages over nonsatellite survey techniques for obtaining broad-scale geographic information.

In the countries we visited, Landsat has been used for a variety of purposes, including mapmaking and inventorying and monitoring natural resources. These Landsat uses are particularly important for the developing countries where less is known about the land and its resources than in the more technically advanced nations. Some examples of Landsat's uses follow:

- Brazilian officials said that Landsat had proven especially valuable for monitoring sugar cane--an important crop used both as food and in manufacturing synthetic fuels. Brazilian space agency officials said that the satellite data were needed because Brazil's large land area made the use of aerial photography for surveying the crop impractical.

¹Argentina, Brazil, the Federal Republic of Germany, France, India, Italy, Japan, Peru, Thailand, and the United Kingdom.

²Of the countries we visited, only Peru does not operate a Landsat ground station or is not a member of the European Space Agency.

--Peru has acquired Landsat data from Brazil and the United States to produce its first nationwide topographic map. Peruvian officials said that the nature and location of the nation's natural resources are not fully known because about two-thirds of the nation has never been accurately mapped. The officials said that mapmaking through aerial photography is too expensive and that flying in remote regions of Peru is too dangerous. The officials added that the speed at which Landsat provides information is especially important in a country like Peru, where natural disasters such as earthquakes, landslides, droughts, and floods can rapidly change roads, rivers, and agricultural conditions.

--Thai officials told us that increasing population has caused more and more land to come under cultivation. The impact of this expanded farming was not clear until Landsat images showed deforestation occurring at an alarming rate. Ground surveys and aerial photography had not disclosed the full dimensions of the problem. After seeing the Landsat pictures, the Thai Government strengthened controls on the clearing of forests.

--In India, Landsat's images of shrinking lakes provided graphic evidence of the effects of recent droughts and contributed to government decisions to provide relief to affected areas.

The more industrialized countries use Landsat data for a variety of purposes, including mapping, urban planning, agriculture, and research. For example, the National Remote Sensing Center in Farnborough, England, provides data to governmental entities, commercial organizations, and academic institutions. Governmental entities have accounted for 53 percent of the data sales from this center in recent years.

The European countries we visited believe that while Landsat data are very useful, a commercial market will develop in the next 5 to 15 years only as users gain experience and technology advances.

Foreign officials also told us of some future uses of Landsat:

--Brazil hopes to use Landsat on an operational basis for agricultural crop surveys and improved identification of deforested areas.

--Peru wants to use Landsat for land-use monitoring, monitoring marijuana and coca leaf production, monitoring the effects of floods and droughts, and identifying landslides.

FOREIGN COUNTRIES' CONCERNS ABOUT
THE COMMERCIALIZATION OF LANDSAT

Officials of the countries we visited were not opposed to the commercialization of Landsat per se but were concerned about possible changes that private ownership might bring. Specifically, they expressed concern about the potential for

- data sales policies contrary to their economic or national security interests;
- termination of direct satellite transmission to their ground stations or changes in the satellite signal, requiring expensive ground station alterations; and
- increased prices forcing reductions in data purchases.

Data sales policy

The United States has traditionally followed a policy of making Landsat data available to everyone, including the country over which it was sensed, on equal terms. Foreign countries, in turn, are required by their agreements with the United States to distribute data acquired by their Landsat ground stations in the same manner. This data distribution policy has muted criticism by countries about surveillance within their boundaries. Representatives of the developing countries we visited believed that their governments would object if a commercial satellite operator changed this policy. For example, they said that if Landsat data on natural resources in their own countries were available to others but not to themselves, they would be placed at an unfair economic disadvantage. They believed that this type of sales policy might be adopted to increase profits. In addition, they were concerned that as sensors on board the satellites become more sophisticated, the satellites could be used to acquire and distribute military intelligence harmful to their national interests.

Representatives of the Indian Space Research Organization said that one country's use of remotely sensed data from another country raises issues of national sovereignty. They cited a paper prepared for a 1982 United Nations conference on "The Exploration and Peaceful Uses of Outer Space" in which the Indian government said:

"India has always maintained that surveillance and remote sensing are but two faces of the same coin. . . . This very contentious issue arises out of conflicting national needs and interests which lead to deep mistrust and mutual suspicion of each other's motives among contending nations.

.

"Clearly . . . there is a need for timely and unrestricted supply of data from the sensing state to the sensed state. But dissemination of data to third countries should not take place without following accepted and agreed procedures."

Indian officials said that a policy which did not give India equal access to all data acquired on India might lead to complaints by the Indian Government.

In a message delivered to the same United Nations conference, the President of Brazil expressed concern about the possibility that remote sensing could be used against the interests of a sensed country:

" . . . [remote sensing from space] affects traditional concepts of security, violating the notion of national privacy and . . . marching towards the violation of individual privacy. Remote sensing impinges on the sovereignty of States over their natural resources and it may prejudice the capacity of countries of negotiating the sale of their agricultural products at fair and equitable prices. This is an instrument both valuable and dangerous."

The developed countries have also endorsed open distribution of satellite data. Leaders of several European nations, Japan, and the United States, meeting at Williamsburg, Virginia, in May 1983, approved the following statement of policy:

"In view of the inherently global benefits of remote sensing, extensive international participation and the strong interest expressed by numerous countries in the United Nations and other international fora, the Summit members recognize the important broader international context within which Summit member remote sensing activities are conducted. In this regard, throughout the above activities, the members of the Economic Summit . . . support the need to assure timely, public nondiscriminatory data dissemination and to seek continued availability of satellite data."

Transmission to foreign ground stations

Officials from several countries were also concerned that a private sector satellite owner would for commercial reasons stop broadcasting to foreign ground stations. Representatives of the developing countries, in particular, believed that their governments had made major investments in equipment, software, and training to receive and use Landsat data and would react negatively to the loss of direct reception. For example, Thai officials reported that about half of the annual budget of their National

Research Council, the principal government agency for sponsoring scientific research, is used for operating a Landsat ground station and processing Landsat data. The officials said that Thailand had recently spent about \$10 million constructing the Landsat receiving station and buying equipment, an amount which they consider a major outlay for scientific purposes. Thai officials also said that developing countries would find it very difficult to understand a shutoff of data to their ground stations in view of their significant investments. Thai officials said that Thailand provides a benefit to the entire Southeast Asian region by making data available to other countries at less than its own costs to receive and process them.

The President of Argentina's space agency reiterated to us a position taken by eight Latin American countries represented on the United Nation's Committee on the Peaceful Uses of Outer Space. These countries took the position that nations operating remote sensing satellites should assure countries operating ground stations of continued access to data and assistance in making ground station modifications required by technical changes in the satellites. Representatives of Brazil, one of the countries adopting this position, told us that Brazil had spent about \$40 million over 10 years to receive and use Landsat data.

Another concern frequently expressed by foreign officials was that commercial operation of Landsat might result in sharp price increases which would force them to limit their acquisition of data. Foreign government officials generally said that funds for Landsat data were limited, especially since most Landsat uses were in the research and development area. Representatives of several countries said that recent increases in the price of Landsat products had already reduced sales.

In summary, it was clear from our discussions with foreign officials that they regarded Landsat as an important tool for resource management and other purposes and were concerned about disruptions that commercial ownership might bring. Officials in several countries we visited said that the United States had built considerable goodwill abroad and provided effective foreign economic aid by supplying Landsat data worldwide at relatively low prices.

The RFP for Landsat does not
address foreign concerns

The RFP does not fully address the concerns raised by foreign Landsat users. The RFP does not require a private operator to continue present relationships with foreign ground stations. Subject to federal government approval, a private operator could terminate agreements with a foreign Landsat ground station operator. In addition, the RFP does not require the private operator to retain the current U.S. policy of equal data distribution. The private operator could sell data on a country's resources to outsiders for their exclusive use. The RFP does not indicate the

criteria the government would apply to requests by a private operator to terminate transmission of data to foreign ground stations or revise the U.S. government's traditional policy of equal data distribution. The private satellite operator could set prices for foreign customers at its discretion.

MATTERS FOR CONSIDERATION
BY THE CONGRESS

International reaction to a commercial Landsat system which quickly stopped broadcasting directly to foreign ground stations and denied a country information developed from remote sensing over its national territory is likely to be negative. In deciding on legislation to authorize the transfer of Landsat to the private sector, the Congress should consider whether a private Landsat operator should be required to

- continue present arrangements for broadcasting data to foreign ground stations under terms and time frames specified by the Congress and
- continue the traditional U.S. government policy of providing a sensed country equal access to data obtained on its own territories and activities.

CHAPTER 4

COMMENTS FROM NONFEDERAL USERS OF LANDSAT

Thirteen of the 16 nonfederal users of Landsat data we contacted were opposed to commercializing the current Landsat system at the present time.¹ Most of these believed that further market and technological developments are necessary to make the system commercially viable. Most users believed that a single company would not have the resources necessary to operate the current Landsat system. The majority of the users were concerned that a private company's inability to meet expenses would negatively affect data prices, continuity and availability of data, and investment in research and development. Six users--including those in the value-added service business²--were also concerned about the private owner having a monopoly of satellite-sensed land data.

Four of the 16 Landsat users cited potential benefits from commercialization, such as improvements in quality and marketing of data and services. Users also made suggestions for terms and conditions the government should include if commercialization takes place.

BACKGROUND ON NONFEDERAL USERS OF LANDSAT DATA

Nonfederal users purchase Landsat images and computer-compatible tapes from the Earth Resources Observation Systems Data Center in Sioux Falls, South Dakota. However, some of the users acquire additional data directly from foreign ground stations and through trades with other users. The following table shows the number of nonfederal U.S. customers by group at the Data Center in calendar year 1982 (the latest year for which information was available).

¹See chapter 1 for details on the nonfederal users we interviewed. Also, the views we obtained on commercialization were those of organization officials and may not represent formal positions of the organizations themselves.

²A value-added service is any service that is added to the raw data after the data are processed and formatted by the government for public dissemination. Such services would include making those products more useful to end users by enhancing, analyzing, and interpreting the standard satellite film or computer tape products.

Nonfederal Users of Data Center FY 1982

<u>Nonfederal users</u>	<u>Number</u>
Colleges/universities ^a	323
State and local governments ^b	73
Industry	1,041
Other or unclassified	<u>1,543</u>
Total	<u><u>2,980</u></u>

^aSince the University of Alaska acts as a distribution center for other academic institutions, the actual number of college or university users may be higher.

^bIncludes an unknown number of foreign embassy purchasers.

The following table shows the number and dollar amounts of image and digital items sold to nonfederal U.S. users by the Data Center in fiscal years 1981 to 1983.

Summary of Landsat
Data Sales to Nonfederal U.S. Users FY 1981-83

<u>FY</u>	<u>Image items</u>		<u>Digital items</u>		<u>Total dollar amount</u>
	<u>No.</u>	<u>Dollar amount</u>	<u>No.</u>	<u>Dollar amount</u>	
1981	51,511	\$758,617	2,176	\$439,972	\$1,198,589
1982	39,109	777,914	2,487	612,580	1,390,494
1983	9,269	471,543	585	329,660	983,685 ^a

^aIncludes thematic mapper and other new products, totaling \$182,482, which are not included as multispectral scanner image or digital items.

Landsat data are used in a variety of ways in the nonfederal sector. For example:

- Energy exploration companies use Landsat data to develop reconnaissance maps which are used in oil, gas, and mineral exploration operations.
- Value-added service companies use the data to provide various products and services, e.g., geological and

engineering studies, resource maps, and complete computer systems for processing and displaying Landsat data.

--State governments use Landsat data for mapping and surveying agricultural lands, marine environments, and other natural resources.

--Universities use satellite data to aid in solving engineering, geological, agricultural, and natural resource problems and as a teaching aid.

NONFEDERAL USERS' CONCERNS
ABOUT COMMERCIALIZATION OF LANDSAT

Most users opposed the immediate commercialization of the current Landsat system. Eleven users believed that a private company would not have the resources to make the current system commercially viable and would raise Landsat data prices significantly to defray the system's high operational costs. Thirteen were also concerned that a private company's attempt to cut its operational costs would adversely affect availability or continuity of data and investment in Landsat research and development. Twelve of the 16 users believed that since a private company would not invest in the costly, high-risk research and development necessary to advance the system's technology, commercialization would jeopardize potential future Landsat applications and the U.S. position as world leader in land remote sensing. Half of the users said that the system was not now commercially viable and that attempting to commercialize it would retard its development.

Six users--including value-added service businesses--were concerned that a monopoly would be created if a single company owned and operated the system. These users and six others were concerned that a private operator could exercise its proprietary control of the Landsat system to discriminate in its distribution of the data and charge unreasonable prices. This control could jeopardize the existence of companies in the value-added industry, most of which are small businesses.

The table on page 24 summarizes the nonfederal users' opinions and concerns.

Potential benefits cited by
nonfederal Landsat users

The majority of the users could not see any benefit to selling Landsat. However, four users believed that transferring the system to the private sector could result in a savings to the government. Four users also believed that a private company would improve on the quality and timeliness of service of the Earth Resources Observation Systems Data Center.

Summary of Nonfederal Landsat Users'
Opinions and Concerns
Regarding Commercialization

User's organization ^a	Opinion on immediate commercialization of the entire Landsat system	<u>Would commercializing Landsat create problems in the following areas?</u>			
		<u>Monopoly</u>	<u>Discriminatory/unreasonable pricing</u>	<u>Continuity and quality of data or service</u>	<u>Decrease in research and development</u>
American Soc. of Photogrammetry	Opposed	No	Yes	Yes	Yes
Arco Oil & Gas Co.	Opposed	Yes	Yes	No	Yes
Amoco Production Co.					
Bechtold Satellite Technology Corp.	Opposed	Yes	Yes	Yes	No
Cartwright Aerial Surveys	Not opposed	No	Yes	Yes	Yes
Earth Resources Data Analysis Systems	Not opposed	Yes	Yes	Yes	No
Earth Satellite Corp.	Opposed ^b	Yes	Yes	No	Yes
An exploration geologist	Opposed	No	No	Yes	Yes
The GEOSAT Comm., Inc.	Opposed	No	No	Yes	Yes
Metrics, Inc.	Not Opposed	No	No	No	No
Mobil Research & Development Corp.	Opposed	No	Yes	Yes	Yes
Pecten International Co.	Opposed	No	Yes	Yes	No
State of Florida Department of Transportation, Topographic Bureau	Opposed	Yes	Yes	Yes	Yes
Sun Exploration & Production Co.	Opposed	No	Yes	Yes	Yes
Terra-Mar	Opposed	No	No	Yes	Yes
University of Florida	Opposed	No	Yes	Yes	Yes

^aThe views expressed were those of organization officials and may not represent formal positions of the organizations themselves.

^bOpposed if Landsat operator could enter the valued added business, which the RFP permits.

NONFEDERAL USERS' SUGGESTIONS FOR COMMERCIALIZATION TERMS AND CONDITIONS

Ten users recommended that the government ensure the continuity of long-term, high-risk land remote sensing research and development. The users believed that strong government support is necessary to stimulate development of new technology in the field. A few users expressed concern that if the United States did not maintain a viable system, foreign satellite owners might control the land remote sensing market.

Eight users also recommended that controls be established --e.g., price regulations and performance standards for quality of data and service--if a single company owns and operates Landsat.

Seven users recommended that the commercialization of the Landsat system should be a staged process commencing with the ground segment. For example, some suggested that the data distribution functions carried out by the Earth Resources Observation Systems Data Center might be turned over to the private sector first. They believed that if the government continues operating Landsat's space segment and performing high-risk research and development, the private sector could develop (1) a viable market for Landsat products and (2) "next generation" computers to keep in step with sensor technology. The users believed that during the transition period the value-added industry would play an important role in marketing Landsat products. One user also believed that as Landsat technology advances, a range of industries would develop to provide launch, reception, and dissemination services aimed at meeting the needs of the market.

How the RFP addresses nonfederal users' concerns

The RFP addresses some of the concerns raised by nonfederal domestic users of Landsat. As discussed in chapter 2, the RFP indicates that the government will continue to perform research and development on remote sensing from space. In addition, the RFP requires a minimum technical capability for a commercial Landsat operation and requires the private operator to describe the performance features of its system. However, the RFP does not permit a phased approach to the commercialization of Landsat, and it permits the private operator to enter the value-added business.

MATTERS FOR CONSIDERATION BY THE CONGRESS

Fundamental purposes of the RFP are to rapidly divest the government of its land remote sensing operations and to encourage the commercial development of land remote sensing with minimum government supervision. Therefore, the RFP calls for the immediate takeover of the entire Landsat system, satellite and ground operations included, and does not establish special safeguards for the protection of value-added businesses. Therefore, in

considering legislation to commercialize Landsat, the Congress should consider two questions:

- Should a phased approach to the private operation of Landsat, beginning with the data distribution functions currently carried on by NOAA, be an option to controlling the whole system?
- Should protection be provided to firms in the value-added business to enable them to compete with a private Landsat operator? For example, legislation might require the Landsat operator to make data available to all value-added firms on the same terms and as soon as the data are ready for analysis by the operator itself.

CHAPTER 5

DOMESTIC AND FOREIGN USERS' CONCERNS ABOUT COMMERCIALIZATION OF THE WEATHER SATELLITES

Foreign governments, federal agencies, and other U.S. organizations use weather satellite data chiefly for monitoring and forecasting weather, particularly severe and potentially dangerous weather. The data are also used to route ships and airplanes, make agricultural projections, and for research. Most foreign nations participate in the United Nations' World Meteorological Organization, which arranges for the free international exchange of weather information, including satellite data. The United States, as well as foreign nations, benefits from this exchange.

Although Public Law 98-166 prohibited the commercialization of the weather satellites, we are reporting the information we collected on these satellites at the request of Members of Congress who asked for this review.

FEDERAL USERS OF WEATHER SATELLITE DATA

All of the federal users of weather satellites we contacted were concerned about the impact of commercialization on the price of weather satellite data. Most were also concerned about service. The draft RFP issued in October 1983 recognized several of these concerns. However, the transfer process did not proceed far enough to determine the impact of commercialization on prices or whether commercialization agreements would have ensured contractor performance satisfactory to all federal users. To obtain the views of federal users of weather satellites, we spoke with officials from seven agencies: the Bureau of Land Management, Bureau of Reclamation, Coast Guard, Federal Aviation Administration, National Weather Service, Environmental Research Laboratories in NOAA, and the Smithsonian Institution. (See app. I for individual descriptions of the ways federal agencies use weather satellite data.)

Background on federal users of weather satellite data

Federal agencies obtain imagery, measurements of the environment, and other data from the weather satellites. The following table shows various ways federal users¹ obtained satellite data in fiscal year 1983.

¹Excludes national security agencies.

Federal department	Direct broadcast ^a receiving stations	Telephone transmission subscribers	Data collection systems platforms		Archived data ^b product deliveries
			<u>G^c</u>	<u>P^d</u>	
Agriculture			199		770
Commerce	17	56	436	96	14,077
Interior			1,443		47
Transportation	4	25		10	159
NASA	5	6			9,820
Other	<u>1</u>	<u>4</u>	<u>85</u>	<u>17</u>	<u>8</u>
Total	<u>27</u>	<u>91</u>	<u>2,163</u>	<u>123</u>	<u>24,881</u>

^aDirect, real-time satellite transmissions of images, environmental data, and search and rescue distress signals and delayed transmissions of processed data.

^bIncludes pictures, tapes, and other products, such as charts.

^cGeostationary satellites.

^dpolar orbiting satellites. Figures show number of platform years. For example, two buoys used for 6 months each equal 1 platform year.

Federal users pay NOAA only for archived data² and pay a French firm for use of the data collection system on board the polar orbiting weather satellites. However, each agency buys its own equipment to receive and use the satellite data and data collection platforms, such as buoys and other remote sensors.

The federal agencies we contacted use the satellite data in various activities. The largest user of weather satellite data, NOAA's National Weather Service, uses the data to provide weather forecasts to the general public and to issue warnings against such destructive natural events as hurricanes, tornadoes, and floods. Other federal applications include protecting life and property through forecasting hazardous weather for pilots, monitoring icebergs, and locating aviation or boating accident victims; managing public resources under jurisdiction of the federal government, such as fire protection activities on lands managed by the Bureau of Land Management; monitoring the condition of the environment, such as detecting solar disturbances by the NOAA Space Environment Services Center and collecting weather information from remote locations; and advancing scientific knowledge about the atmosphere, oceans, and lands, such as the Smithsonian Institution's monitoring of volcanic eruptions.

²A small connection and yearly maintenance fee is also collected for a hookup allowing a user to receive telephone line transmission of geostationary satellite data. The data are free.

Concerns of federal users

All of the federal users of weather satellites we contacted had some reservations about the possible consequences of selling the satellites to the private sector. In general, the concerns focused on (1) increased costs of satellite data and (2) decreased data and services under private ownership. All federal users expected costs for satellite data to increase and expected problems with the data and services provided by a private owner. Officials in six of the seven agencies we contacted also believed satellite research and development might suffer.

Federal officials mentioned several reasons for these concerns about commercialization. Four federal users attributed possible cost increases and changes to or discontinuation of data or services (types of data collected, data archives, and methods for providing data) to the need for a private owner to make a profit. Three believed the administrative process of buying satellite data from a private firm would be more costly. Two also believed that additional costs for data processing equipment and software would result from changes to the format of the data provided to federal agencies. Five users expected poorer service (timeliness and data quality problems), particularly during a transition period, because a private firm would be less responsive to the needs of federal agencies and not have the technical skills and expertise or working relationships with federal agencies.

Federal officials in all of the seven federal agencies we contacted believed that specific terms and conditions were needed on the quality and timeliness of data delivered to federal users. They explained that such terms and conditions were needed to prevent deterioration of quality and timeliness or provide incentives for high quality services. Officials of the National Weather Service responsible for issuing forecasts of hurricanes and severe storms were especially concerned that the sale of the weather satellites be made on terms which assured their continued access to timely, useful data.

Federal officials in four agencies believed that advances in weather satellite technology might be slowed because of private ownership. Weather Service officials, for example, believed that a private operator would not be as familiar with National Weather Service needs as a government operator.

RFP treatment of federal users' concerns

The RFP proposed by the Department of Commerce addressed many of the concerns expressed by federal users of weather satellites. The RFP required the private operator to provide present services such as direct broadcasting, data collection services, and relaying search and rescue distress signals. The government was to receive all satellite data from the private operator. Federal agencies would have continued to receive, free of charge, the

services they now receive from the National Weather Service. The RFP specified what items were to be delivered, in what manner, and at what times.

The government was to continue present services such as the telephone line transmission of geostationary satellite data, archives, and free international exchange of satellite data. Federal research and development programs were to continue, and test flights of new sensors and equipment on operational satellites were anticipated. For example, the search and rescue equipment on the most recent polar weather satellite is part of an international cooperative research and development program. The government wanted similar arrangements for flights aboard commercial satellites.

One concern of federal users of weather satellites was not satisfied by the RFP. Some cost increases for data and services would have been likely because the data collection systems were to be fully commercialized services. Currently, users of the polar orbiters' data collection system service pay a French firm for processing data. NOAA processes and provides the data from the geostationary satellites' data collection system free of charge. Under commercialization, federal users would have been expected to pay for such services.

FOREIGN USERS OF WEATHER SATELLITE DATA

How other countries receive U.S. weather satellite data

U.S. weather satellite data is shared with other countries in several ways: through a United Nation's exchange system, via direct satellite transmissions of sensor readings and other information, and by relaying transmissions of data collection platforms located in oceans and rivers. The most extensive method of satellite data distribution involves the United Nations' World Meteorological Organization. Most nations participate in the Organization's Global Telecommunications System, a communications system for sharing weather information worldwide in a program called the World Weather Watch. The United States and other nations that operate weather satellites include satellite data in the system. U.S. weather satellite data are also transmitted directly to ground stations in other nations. As of February 1983, NOAA reported that 120 nations owned more than 800 ground stations for the direct reception of U.S. weather satellite data. Foreign countries also use the satellites' data collection systems.

How other countries use U.S. weather satellite data

The U.S. weather satellites are important to other countries for predicting severe weather, for improving the accuracy of longer term weather forecasting, and for supplying weather

information for areas not covered by more traditional data sources. One of the most critical uses of the weather satellites is in the Caribbean where a geostationary satellite provides information for predicting and tracking life-threatening hurricanes. The Director of the Barbados weather service said that without direct readout from the satellite he could not provide adequate hurricane warnings. The Director pointed out that time for preparation before a hurricane is critical for saving lives and property. He also said that hurricane warnings have more credibility with the general population when satellite imagery can be viewed on television.

Satellite data are also important for more general weather forecasting. The Director of the weather service in Barbados said that the polar orbiting satellite is essential for weather forecasts in the Caribbean. In general, the greater the number of reporting points for temperature, wind speed, and other environmental phenomena, the more accurate a weather forecast will be. In recent years, there have been too few ships in the Atlantic, east of the Caribbean, acting as reporting points, so that Barbados and other Caribbean nations depend on the satellite data. According to the Director of the weather service in Brazil, the satellites are crucial in the Southern Hemisphere to track fronts and for the quantitative evaluation of fronts. Weather officials in Japan and Thailand told us that the U.S. weather satellites made important contributions to longer term forecasts and to monitoring ocean areas.

The satellites serve several other useful purposes, such as providing hydrographic data, contributing data to international weather research projects, aiding international search and rescue missions, and conducting crop inventories. For example:

- Brazilian weather officials said that without the transmission via the geostationary weather satellites of information from data collection platforms on the rivers, it would be difficult to learn about flooding and droughts in remote regions of the country.
- The World Meteorological Organization operates research programs to promote better understanding of the environment. The U.S. weather satellites provided data for the First Global Atmospheric Research Program of 1979, a coordinated effort of several World Meteorological Organization members to solve some of the major questions about the atmosphere for long-term weather prediction.
- The latest U.S. polar orbiting satellite, launched in March 1983, has the capability to locate emergency broadcasts of aircraft and oceangoing vessels in trouble. An example of the international cooperation involved in satellite search and rescue efforts occurred in 1982 when a Soviet weather satellite picked up the emergency transmitter signal of a downed aircraft in

Canada. The Soviets relayed the location of the aircraft via the U.S. Coast Guard.

--The United Nations' Food and Agriculture Organization uses the U.S. polar orbiter satellites for broad-scale views of natural resources in short time periods. The Organization's Remote Sensing Center provides technical assistance and training for many nations using these data.

--The Agency for International Development uses the weather satellites for a disaster early warning system which indicates possible food shortages triggered by climatic changes. This enhanced capacity to identify and evaluate disaster conditions provides greater lead time for planning food assistance strategies. The early warning information can be provided 30 to 60 days prior to the harvest of grain crops or 3 to 6 months prior to an actual food shortage. According to Agency for International Development officials, the better prepared a country is for disaster, the less probability there is of death, suffering, and property damage.

The United States benefits from the international sharing of weather information

Weather data have been shared freely among nations for more than a century. Besides ground and upper air observations obtained through the World Meteorological Organization system, the United States can receive direct readouts from other nations' weather satellites. Western Europe, Japan, and India have geostationary satellites and the Soviet Union has a polar orbiting satellite. The United States can obtain data directly from each of them. The European, Japanese, and United States satellites share a common Weather Facsimile transmission frequency allowing for the sharing of weather data.

Foreign nations have also contributed sensors and technical support for U.S. polar orbiting satellites. The United Kingdom provides the stratospheric sounding unit, a temperature-reading device on board the polar orbiters, at no cost to the United States. France and Canada jointly provide the search and rescue instrument. France provides the data collection system on board the polar orbiting satellites at no cost to the United States. The French space agency also acts as a backup to NASA after the launch of a polar orbiter. The French agency has the capability to receive soundings and take command of the satellite.

The United States benefits from free international exchange of weather data by getting

--worldwide information needed for more accurate longer range predictions of U.S. weather,

--overseas weather information to support its worldwide commercial and defense interests, and

--data it could otherwise acquire only by spending additional funds for observations in foreign areas and by receiving observations that might be impossible to make without foreign cooperation.

Concerns of foreign users

The administration's March 1983 decision to proceed with the commercialization of the weather satellites caused various countries to express concern about its possible consequences. In addition, representatives of the foreign weather services we met with had concerns. The concerns centered mainly around (1) charges for satellite data to the World Meteorological Organization, (2) the termination of free transmission of compatible data to foreign ground stations, and (3) disruptions in international cooperation.

The United Kingdom's Department of Industry prepared a position paper on the proposed commercialization, urging continued international cooperation and free data exchange. The United Kingdom paper stated that:

"The UK considers that any scheme for commercialization of the provision of meteorological satellites in the USA should take account of existing and potential international agreements to provide instruments as contributions towards the US polar-orbiting satellite system. There are doubts regarding the feasibility of such agreements under the new system. These uncertainties are already causing difficulties and delays in securing financial authority for UK participation in the proposed Advanced Microwave Sounding Unit."

.

"The UK strongly recommends that any internal re-arrangements within the USA should safeguard the existing principle that no charge be made for meteorological observations provided to other national meteorological services. This should extend to data directly broadcast by meteorological satellites and the derived data (e.g. temperatures, winds) exchanged through normal meteorological telecommunications channels. No contrary decision should be made without a full examination of the likely consequences of charges being made for all meteorological observations on a world-wide basis."

The Canadian Government prepared a paper indicating concern about the sale as follows:

"Canada's data collection activity, especially in the north, at least equates with the U.S. contribution of satellite acquired data. Thus, on a bilateral basis, both countries make essential contributions to weather prediction in North America. It is our hope that the free exchange of weather information will continue between Canada and the USA, and on a global basis."

In June 1983, the World Meteorological Organization held its quadrennial conference in Geneva. The Organization reaffirmed the principle that "data and products available within the World Weather Watch system should be exchanged freely and without charges between members. . . ." Another principle stated that "meteorological satellites, both polar orbiting and geostationary, in their observation, data collection and dissemination roles, are of fundamental importance for the operation of the WWW [World Weather Watch]."

The RFP would have continued international arrangements for use of the weather satellites

The cancelled RFP for the weather satellites addressed most foreign concerns about the weather satellites. The RFP would have required that the U.S. government review and approve or disapprove decisions of the private operator on matters and issues involving foreign policy and international obligations and that:

- The private operator must continue the functions of the foreign sensors provided by France, Canada, and the United Kingdom, or replace those instruments.
- The private operator provide the same volume and quality of data to the World Meteorological Organization network via NOAA as is currently provided.
- The private operator continue the current volume and quality of weather satellite data to foreign ground stations via direct readout.
- The U.S. government continue to archive the data.

Despite these RFP provisions, representatives of weather services in Argentina, Barbados, and Brazil told us that commercialization reduced the prospects for continued, long-term, free exchange of weather information and made international cooperation more difficult. These officials said that continued free access to data in the future would be less certain with the

commercial operation of the satellites. They said they preferred continued operation by a government agency.

NONFEDERAL USERS OF
WEATHER SATELLITE DATA

Ten of the 14 nonfederal weather satellite users we contacted were opposed to commercialization of these satellites at this time.³ Even those nonfederal users that were not opposed to commercialization had several concerns which they believed should be addressed by the government before transferring the systems to the private sector. Nearly all of the users, whether or not they opposed commercialization, were concerned about the danger of a private owner having a monopoly on the supply of weather satellite data with a resulting negative impact on prices, service, and research. Some users indicated that commercialization, with proper government regulation, could benefit both public and private users.

Background on nonfederal users
of weather satellite data

Nonfederal users obtain weather satellite data from either the geostationary or polar orbiting satellites. Users obtain real-time data from the satellites if they have their own receiving stations, referred to as direct readout stations. Users obtain near real-time geostationary satellite data via telephone line. Archived data are obtained from NOAA's Satellite Data Services Division or by subscription to NOAA's Weather Facsimile system. Nonfederal entities also use the weather satellites' data collection systems. The following table shows the number of nonfederal users of the various forms of weather satellite data.

³The views we obtained on commercialization were those of organization officials and may not represent formal positions of the organizations themselves.

Nonfederal Users of Weather Satellite Data

	<u>Number of nonfederal users</u>
Direct readout stations	208 (as of Jan. 1, 1983)
Subscribers to geostationary satellite telephone line transmission ^a	73 (as of Jan. 17, 1983)
Archived data buyers	724 (from Oct. 1, 1982, to Aug. 19, 1983)
Weather facsimile subscribers	69 (as of May 31, 1983)
Data collection system subscribers	311 (as of Aug. 1, 1983)

^aThese are primary subscribers; an unknown number of other users receive a secondary transmission of data from the primary subscribers.

Nonfederal users pay the government only for the ability to receive telephone line transmissions of geostationary satellite data and archived data. To obtain the geostationary satellite data, a user pays an initial fee of \$1,000 and a yearly service fee of \$100. For archived data, user fees, which run up to \$175 for an image and \$154 for a computer tape, depending on the product purchased. The following table shows the numbers and dollar amounts of archived computer tapes and photographic products sold by NOAA to nonfederal U.S. users in fiscal years 1981 through August 19, 1983.

Summary of NOAA's Archived
Weather Satellite Data Sales
FY 1981-83

<u>FY</u>	<u>Photographic products</u>		<u>Computer tapes</u>		<u>Total dollar amount</u>
	<u>No.</u>	<u>Dollar amount</u>	<u>No.</u>	<u>Dollar amount</u>	
1981	13,125	\$71,524	671	\$49,649	\$121,173
1982	10,389	109,253	467	61,432	170,685
1983 (to Aug. 19)	7,974	93,678	475	64,656	158,334

Weather satellite data are used in the nonfederal sector in a wide variety of ways by a wide variety of users. For example:

- State and local governments use satellite data to issue storm and freeze warnings to their residents to protect lives, homes, farms, and businesses.

- Television and radio stations use satellite data in preparing weather forecasts which are broadcast to the public.
- Private companies use weather satellite data for numerous purposes, such as to route airplanes and transoceanic ships, plan construction of offshore oil exploration projects, develop agricultural crop production estimates, plan agricultural irrigation and pesticide spraying activities, and predict demand for natural gas and electrical power.
- Colleges and universities use satellite data in performing basic and applied research for agriculture, water management, data processing, and other projects.
- private individuals use satellite data (via their own receiving stations) to obtain up-to-the-minute weather information for personal use.

Concerns of nonfederal users

As the table on page 38 shows, all 14 nonfederal users we spoke with expressed some concern about the proposed commercialization of the weather satellite systems. Nearly all users were concerned that commercialization might create a monopoly for the single, private owner of the entire satellite system. Users were concerned that the private owner would not only have complete control of the "raw" satellite data but, if unchecked, would eventually have a monopoly over the value-added service market.

Many of the users' other concerns--unreasonable and discriminatory data prices, discriminatory data access, and decreases in quality of data and service--were directly related to the potential for monopoly. These users said that the creation of a monopoly with power to set discriminatory or unreasonable prices and discriminatory sale policies violated the principles of free enterprise and open competition. They also explained that decreases in quality of data and service could have disastrous effects; for example, if satellite data are disrupted or of such poor quality that a freeze in a citrus region or a hurricane off the coast is not accurately forecast, lives and millions of dollars in property could be lost. Four users expressed further concern that if a monopoly existed, the government and taxpayers would incur costs to regulate and audit the private owner in addition to the costs the government would have to pay to receive the data.

Four of the 14 users we contacted said that government regulation could control the problem that a monopoly on satellite data could cause. They believed that, even if it had a monopoly, the private owner would charge reasonable prices and provide acceptable service because to do otherwise would severely limit sales

Summary of Nonfederal Weather Satellite
Users' Opinions and Concerns
Regarding Commercialization

Would commercializing weather satellites create problems
in the following areas?

<u>User's organization^a</u>	<u>Opinion regarding commercialization</u>	<u>Monopoly</u>	<u>Discriminatory unreasonable pricing</u>	<u>Discriminatory access to data</u>	<u>Continuity/quality of data or service</u>	<u>Additional cost to government/taxpayers</u>	<u>Decrease in research and development</u>
Earth Satellite Corp.	Not opposed	Yes	Yes	Yes	No	No	Yes
Eastern Airlines	Opposed	Yes	Yes	Yes	Yes	Yes	Yes
Environmental Satellite Data, Inc.	Opposed	Yes	Yes	Yes	Yes	No	Yes
Florida Weather Service, Inc.	Opposed	Yes	Yes	Yes	Yes	Yes	Yes
Global Weather Dynamics, Inc.	Opposed	Yes	Yes	Yes	Yes	Yes	Yes
Gordon Barnes Weather Service	Not opposed	No	No	Yes	No	Yes	No
Gulf Coast Weather Service and WTVT Weather Service	Not opposed	No	Yes	Yes	Yes	No	Yes
Harris Corp.	Not opposed	Yes	Yes	Yes	Yes	Yes	Yes
National Farmers Union	Opposed	Yes	Yes	Yes	Yes	Yes	Yes
Nowcasting, Inc.	Opposed	Yes	Yes	Yes	Yes	Yes	No
Oceanroutes, Inc.	Opposed	Yes	Yes	Yes	Yes	Yes	Yes
Pacific Gas and Electric Company	Opposed	Yes	Yes	Yes	Yes	Yes	No
Robert Ryan, Meteorologist	Opposed	Yes	Yes	Yes	Yes	Yes	No
University of Florida	Opposed	Yes	Yes	Yes	Yes	Yes	Yes

^aThe views expressed were those of organization officials and may not represent formal positions of the organizations themselves.

and profits. One user believed that a private owner could not adequately serve all end users throughout the nation and, therefore, would not monopolize the value-added industry.

Examples of other areas of concern follow:

- Ten users expressed concern that under private ownership, weather satellite research and development would suffer. They believed that a private owner would not have the resources or incentives to undertake the expensive, high-risk research and development necessary for continued technological advances in satellite sensing and data processing. One user questioned whether the federal government would or should continue to do expensive research and development only to have the results turned over to a single, private company.
- Twelve users believed that weather information (including satellite data) is a public good and that providing this information should therefore be a governmental function. They also told us they were satisfied with the data and service provided by the government; they viewed commercialization as resulting in few benefits and many potential problems to the government and users.
- Twelve users also were concerned that the public investment in the satellites would not be recovered in a sale and that commercialization would increase government costs. Taxpayers, they told us, have spent millions of dollars to develop the satellite systems to their present status. These users believed that commercialization would undoubtedly lead to taxpayers paying, directly or indirectly, for the data. They believed that having taxpayers pay a private company's profit margin for data coming from the taxpayers' own investment would not be fair.

Potential benefits cited by
nonfederal weather satellite users

Six of the nonfederal users we contacted said that private ownership of the weather satellites might provide some benefits because a private owner's profit motive would result in lower costs and better service to customers. According to these users, a private owner would be better able to

- quickly respond to the individual needs of users,
- quickly implement advances in satellite and data processing technology,
- efficiently and effectively operate the satellite systems,
- improve the marketing of data products, and

--save the government and taxpayers money in the long run.

One user believed that commercialization would be a first step toward streamlining and reducing the National Weather Service's operations. This user believed that the private sector is better able to provide localized weather information and services to the public and, furthermore, that forecasters currently employed by the National Weather Service would be better utilized if they were employed by private companies providing such local weather services.

Nonfederal users' suggestions for
commercialization terms and conditions

The table on page 41 summarizes the nonfederal users' suggestions for terms and conditions the government should have required if commercialization of the weather satellites had occurred. Most users indicated that these suggested terms and conditions should have been clearly defined and explained in the government's request for proposals for the weather satellite systems.

Summary of Nonfederal Users'
Suggestions for Terms and Conditions
for Commercialization of Weather Satellites

<u>Non-federal user's organization^a</u>	<u>Ensure nondiscriminatory/ reasonable prices</u>	<u>Ensure equal access to data</u>	<u>Establish performance standards^b</u>	<u>Prohibit owner from value-added industry</u>	<u>Regulate similar to public utility</u>
Earth Satellite Corp.	Yes	Yes	Yes	Yes	No
Eastern Airlines	Yes	Yes	Yes	No	Yes
Environmental Satellite Data, Inc.	Yes	Yes	Yes	Yes	No
Global Weather Dynamics, Inc.	Yes	Yes	No	Yes	Yes
Gordon Barnes Weather Service	Yes	Yes	Yes	No	Yes
Gulf Coast Weather Service and WTVT Weather Service	Yes	Yes	Yes	No	Yes
Harris Corp.	Yes	Yes	Yes	Yes	No
Nowcasting, Inc.	Yes	Yes	Yes	Yes	Yes
Oceanroutes, Inc.	Yes	Yes	Yes	Yes	No
Pacific Gas and Elec. Co.	Yes	Yes	Yes	No	Yes
Robert Ryan, Meteorologist	Yes	Yes	Yes	No	Yes
University of Florida	Yes	Yes	Yes	No	No

^aTwo users did not express any views on sales terms because they said that they were opposed to commercialization on any terms. Also, the views expressed were those of organization officials and may not represent formal positions of the organizations themselves.

^bThis column includes performance standards for continuity and quality of data and service, fulfillment of international agreements, fulfillment of federal agencies' and national security requirements, and research and development requirements.

As the table shows, nearly all nonfederal users who offered suggestions told us that the government should

- ensure nondiscriminatory and reasonable data prices for all users,
- ensure equal access to data by all users, and
- establish performance standards which the private owner must meet.

Six users believed that the private owner should be prohibited from performing value-added services. They explained that a private owner with complete control of the data could destroy all competitors in the value-added industry. On the other hand, some of the users said that barring the owner from the value-added industry would lead to many potential private owners not bidding for the weather satellite systems. Seven users told us that the satellite owner should be regulated by the government in the same manner as public utilities.

How the RFP addressed nonfederal users concerns

The cancelled weather satellite RFP addressed most of the concerns raised by nonfederal domestic users of weather satellites. The RFP stated that the private operator was to provide all satellite data to the U.S. government, which would have continued to process and distribute that data and its products to government agencies and private sector organizations. The RFP indicated that the government would have continued current services to the private sector, such as telephone line transmission of geostationary satellite data and archiving data, and required the private operator to continue direct broadcasting of sensor data and weather facsimile information to privately owned receiving stations. A private owner would have been expected to meet the quality standards already in use for current weather satellite systems. The government would have continued to do research and development on weather satellite technology.

On the other hand, the private operator would have been permitted to enter the value-added business for weather data and charge a fee for the use of the weather satellites' data collection systems. The communications channels on these systems are rapidly becoming fully subscribed. Present users of these systems might have faced price increases under commercial operation.

HOW FEDERAL AGENCIES USE LANDSATAND THE WEATHER SATELLITESDEPARTMENT OF AGRICULTUREForeign Agricultural Service

The Foreign Agricultural Service monitors and forecasts crop production on a global basis and disseminates the information to the general public. The crop forecasts are based on a variety of information, such as U.S. embassy reports, press reports, foreign government publications, trade and weather reports, and land and weather satellite data. The Service's primary means of estimating foreign crop production is through onsite inspections by U.S. embassy personnel. Satellite data are used as a supplement to refine the estimates and make them more reliable. In certain countries, however, satellite data are the primary source of information because the travel of U.S. embassy personnel is restricted or the area of coverage is too large to use embassy personnel. For instance, the Soviet Union restricts onsite inspections; China and Brazil have extensive crop areas.

Service crop production analysts told us that Landsat is a useful tool for estimating crop production because it provides a relatively high-resolution image of crops. The weather satellites are also useful to the Service because they provide continuous time comparisons of the same area. Service officials told us that Landsat is not expected to replace ground observation as the primary information-gathering tool in the foreseeable future because the science of interpreting Landsat images is not precise. Vegetation is shown on images as "red," and the intensity of the color indicates the potential yield of the vegetation. Uncertainty exists, however, in estimating the yield based on the color intensity. Officials said that the Foreign Agricultural Service does not plan to increase its use of satellite data.

Statistical Reporting Service

The Statistical Reporting Service is responsible for preparing domestic agricultural statistics, including estimates of domestic crop production. The Service, like the Foreign Agricultural Service, uses onsite farm inspections as its primary tool for estimating crop production. Over the years, the Service has conducted or participated in a number of studies to assess the usefulness of Landsat. Generally, the studies' results have shown that Landsat is an effective tool for classifying land into various categories, such as rangeland, cultivated lands, and irrigated lands. Currently, the Service is using Landsat data on an experimental basis in conjunction with the traditional ground sources to estimate major crops in Arkansas, Colorado, Illinois, Iowa,

Kansas, Missouri, and Oklahoma. The Service plans to expand coverage to other states if funds can be obtained for such purposes. The Research Division Director told us that he believes Landsat is a valuable tool in crop estimating and the data provided often result in adjustments to estimates derived from traditional sources.

Soil Conservation Service

The Soil Conservation Service is responsible for developing and carrying out a national soil and water conservation program. Generally, the Service carries out its program through onsite, labor-intensive investigations by field office personnel. However, the Service uses Landsat on an experimental basis in four states as an aid to field personnel engaged in soil surveys and in two states as an aid in conducting land-cover studies. The Service makes soil surveys to identify and catalog specific types of soils throughout the nation. Landsat is used to identify soils with similar composition. Field personnel then take soil samples for analysis to determine whether the soils are identical. Land-cover studies involve identifying how the land is being used, such as for crops or as pasture, forest, or urban areas.

Although Landsat is currently only being used to a limited extent, the Service believes Landsat holds considerable promise in conducting soil surveys, resource inventories, and watershed analysis. A Service official told us that Landsat will become an important tool as high technology is substituted for the high cost of labor.

Agricultural Research Service

The Agricultural Research Service is the primary research arm of the Department of Agriculture. It uses Landsat to examine how remote sensing technology can be used to provide information about the ecological balance of agricultural areas. In addition, the Service is developing a computer program to eliminate atmospheric interference in Landsat images.

The Service conducts basic and applied research in support of the operational programs of other departmental agencies, such as the Foreign Agricultural Service and the Statistical Reporting Service. Examples of research efforts involving weather satellite data include

- determining water use rates by plants and crops,
- determining aridity indexes of land areas, and
- developing a computer program to eliminate cloud cover from satellite images.

A Service official told us that the Service plans to increase its use of Landsat data for assessing crop conditions and related variables. He also stated that weather satellite data hold considerable promise and that much of the Service's remote sensing research is evolving in that direction.

Forest Service

The Forest Service promotes and manages national forests. Its responsibilities include protecting and improving the quality of air, water, soil, and natural beauty of the forests and to assure balanced uses of forest products by private enterprise.

The Service currently uses Landsat satellite data on an experimental basis to inventory the renewable resources of Alaska and to conduct nationwide land-use surveys. Service officials believe that Landsat's potential is great because of the vast areas that can be covered at relatively low cost for mapping, surveying, and land management. For example, with Landsat data, nationwide, land-use surveys are now possible annually instead of every 10 years.

The Service uses the geostationary satellites' data collection system to collect data on wind, temperature, humidity, soil temperature, and moisture from its Remote Automated Weather Stations to prepare input for a national fire-rating system. The data collection system is less expensive than transmitting information by telephone line, the system it is replacing. The fire rating gives an indication of likely fire danger areas for planning purposes, i.e., for staging and moving people to fight fires. According to the Service's National Fire Planning Specialist, the Service is dependent on the Remote Automated Weather Stations' data for improving the accuracy of its fire danger model.

If the Service's use of Landsat in land management and resource assessment is successful, it plans to expand its use of satellite data into areas such as locating the outbreak of various forest pests and in mapping.

DEPARTMENT OF THE ARMY

Corps of Engineers (Civil Works)

The Corps of Engineers uses both the Landsat and weather satellite systems to support its natural disaster preparedness mission. Landsat data are used to, among other things,

- determine land cover as an aid in estimating the runoff potential of watersheds,
- produce economic studies of the impact different flood levels would have on cities and communities, and

--aid in planning mitigation efforts for presidentially declared major disaster areas.

According to Corps officials, these and other activities require the frequency and breadth of coverage which Landsat offers.

The Corps uses the geostationary satellites' data collection platforms and weather facsimile communication systems to obtain information on natural disasters. Satellite data are particularly important in flood control, which requires near real-time data.

DEPARTMENT OF COMMERCE

National Weather Service

The Department of Commerce's National Weather Service is the primary federal user of weather satellite data. The Service uses satellite data to provide general weather forecasts and warnings of severe weather such as hurricanes, tornadoes, and floods. According to Service officials, the weather satellites are particularly valuable for forecasting severe weather and for making long-term weather forecasts. The geostationary satellites are uniquely suited to detecting the formation of severe storms and hurricanes and tracking the movements of hurricanes through the Atlantic Ocean and coastal areas of the United States. The polar orbiting satellites are particularly useful in producing long-term U.S. forecasts because they provide data not otherwise available on the Pacific Ocean, where most of the nation's weather originates.

The Service uses two types of data from the geostationary satellites: visual images and quantitative environmental data. The visual images are supplied by two specialized instruments which remotely sense the earth's surface. The images have several uses, including locating actual or potential severe storms, following cloud motion, and determining wind speed and direction. Quantitative environmental data is provided by other sensors and by the geostationary satellites' data collection system which collects and relays environmental data obtained by remotely located platforms, such as seismology and tide guage platforms, data buoys, river and rain guages, aircraft, and automatic weather stations. For example, the seismology and tide guage platforms detect tsunamis (a very large ocean wave caused by an underwater earthquake or volcanic eruption) and provide early warning information to the Service's Tsunami Warning System Program. Data buoys provide measurements of ocean weather in areas away from coastal weather forecasting facilities or outside of shipping lanes. River and rain guages provide a near-instantaneous source of data on rainfall and runoff that is used in flood forecasting. A variety of other data platforms supply a continuous source of information to help the Service provide weather forecasts and severe weather warnings to the public.

The National Weather Service uses both quantitative data and image data from the polar-orbiting satellites. The quantitative data are used to improve the base for the Service's numerical weather prediction models. The data are obtained from a variety of sensors as well as through the data collection system. The data collection system is a French-produced system capable of collecting data from remotely located platforms and recording the location of those platforms at the time data were received from them. The system provides information such as the direction of ocean currents, rainfall amounts, surface winds and pressures, and subsurface ocean temperatures. Image data are obtained through other sensors and are used for a variety of purposes, such as

- producing global cloud maps to aid in analyzing weather patterns,
- analyzing ice conditions over ocean areas and the Great Lakes, and
- estimating snow pack in watersheds and predicting spring melt.

Environmental Research Laboratories

The Environmental Research Laboratories use weather satellites in various programs, such as analyzing convective (summertime) clouds and the precipitation processes in them, improving weather forecasting, studying cases of severe weather, monitoring solar variations not detectable from the ground, planning hurricane research flights, evaluating monsoons, studying ice conditions, and providing sea surface temperature maps to aid in understanding climate.

Most Environmental Research Laboratories expect to increase their use of satellite data, especially as technology advances. Some future uses include studying x-ray images of the sun to better forecast geomagnetic disturbances and constructing global wind circulation models.

DEPARTMENT OF ENERGY

The Department of Energy, through contracts with the National Laboratories and other research establishments, uses Landsat data in an increasing number of research applications. Specifically, Landsat data have been used to site energy-generating facilities, develop explorational techniques for energy resources, and characterize potential nuclear waste repository sites. Satellite images are used to locate geographical areas such as salt domes and granite formations suitable for dumping nuclear waste.

The Department of Energy will continue to perform research on the possible uses of Landsat in both energy and environmental research applications. An Energy official stated that a growth rate in the use of Landsat data of up to 20 percent per year for the next 5 years is possible. This estimate is dependent upon continuity and reliability in providing Landsat services.

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency has experimented with Landsat data to monitor air and water quality. For example, Landsat data have been used to classify land uses for monitoring air quality and to monitor the acidity of lakes. The Agency uses Landsat data experimentally because of resolution limitations. For small areas, the Agency believes that aerial photography is better than satellite data because it offers better resolution and can be obtained faster than satellite data. The Agency does not expect to increase its use of satellite data without improvement in the data resolution.

DEPARTMENT OF THE INTERIOR

United States Geological Survey

Current U.S. Geological Survey uses of Landsat data include (1) mapping of geologic structures to investigate likely occurrences of minerals and fossil fuels and to assess geological hazards, (2) geologic analysis in support of nuclear disposal program, (3) surface water inventories in the conterminous United States and Alaska, (4) national land-use/land-cover mapping, (5) preparing image maps in poorly mapped regions of Antarctica, the Middle East, and other regions to support international cooperative programs, (6) monitoring coastal shoreline changes, (7) detecting and monitoring oil slicks, (8) assessing and monitoring water quality and turbidity, (9) monitoring snow cover and melt in watersheds and hydroelectric dams for use in predicting runoff calculations, and (10) assessing the impact of floods and other natural disasters.

As uses of satellite data become more routine and integrated into the Geological Survey's programs, usage is expected to increase. With possible advancements in satellite sensor technology, telecommunications, computer processing technologies, and information extraction methods, it is expected that use of satellite data will increase many times over its present use, both operationally and in research.

Bureau of Land Management

The Bureau of Land Management uses both Landsat and weather satellite data in managing over 300 million acres of public lands. Weather satellite data are used in wildfire management for

lightning detection (lightning causes 60 percent of all major fires on public lands), mapping of types of burnable material, and calculating likely fire intensity and spread. These data help management make a decision on suppressing the fire or permitting it to burn itself out. Landsat data are also used in resource inventories (environmental assessments of oil and gas leases and mining), boundary location, trespass and easement determination (settlement of disputed boundaries, illegal easements, mining trespassers), geological mapping (glacier ice deposits, bedrock documentation, and minerals potential), and renewable resource condition assessment (monitoring rangeland for overgrazing, estimating numbers of grazing animals, determining whether to lease grazing lands).

Bureau officials expect to expand their use of satellite data in such areas as updating inventories, supporting evolving range-monitoring programs, creating geographic data bases for the Bureau's Alaska lands, monitoring dam safety, and collecting data for more accurate river and streamflow forecasts.

Bureau of Reclamation

The Bureau of Reclamation uses both weather satellite and Landsat data in (1) developing cloud seeding technology for increasing the nation's fresh water supplies, (2) surveying for wind energy sites, (3) investigating cathodic protection methods (pipe corrosion), (4) studying water evaporation on lakes, and (4) monitoring oil spill movements. In addition, the Bureau uses satellite data for (1) assessing uses of lands which may affect or change water resources in the area, analyzing geological structures (faults) which may affect the safety of a dam, canal, or other water structure, (2) measuring water quality and surface area of waters over large geographic areas, and (3) measuring the use of irrigation waters.

The Bureau expects its future uses of Landsat data to increase as satellite capabilities are developed and to continue ongoing programs in the remote sensing area.

Fish and Wildlife Service

The Fish and Wildlife Service uses satellites mostly as an auxiliary data source for habitat mapping for national wildlife refuge planning, and for water resource project impact evaluations. For example, satellite data are used to monitor snow melt on Arctic goose breeding grounds to predict nesting success and regulate bird hunting. The Service's officials said that the agency will increase its use of satellites if improvements are made in resolution. Future uses include updating the National Wetlands inventory and continuing ongoing applications.

National Park Service

The National Park Service uses Landsat data to survey land cover, land uses, and geology for resource management and planning. For instance, one major application is for fire fuels modeling and fire behavior modeling. From these data, fire hazard maps are created and aid in determining whether a fire should be suppressed or allowed to burn. Landsat data are also used to determine how commercial activities, such as mining and animal grazing, affect land areas and to assess the habitat of endangered species, such as the grizzly bear. Other uses include evaluating the effects of man-made interference with water resources in the Everglades and for archeological investigations. In addition to continuing present programs, the Service expects increases in satellite use, including updating data bases on every large park every 10 to 15 years, monitoring how facilities (such as power-plants) in national parks use coal and how parks are affected by its use, and updating the quality of park maps to include natural history and trail guides.

Bureau of Indian Affairs

The Bureau of Indian Affairs uses Landsat data on an experimental basis to provide current land-use and land-cover information on Indian lands. The pilot project is to determine potential irrigable lands and to develop a rangeland trend and condition monitoring system. The Bureau expects its use of satellite data to increase in the future. In addition to land-use and land-cover applications, future uses of satellite data include determining the extent of natural resources on Indian lands, such as forests, rangeland, water, fish, wildlife, and minerals. The Bureau also plans a pilot study to determine the usefulness of using weather satellite data for monitoring and assessing drought conditions.

Bureau of Mines

The Bureau of Mines has used Landsat data on an experimental basis to detect the expansion of mines, monitor waste dumping to ensure proper disposal of waste from mines, and study the wilderness studies.

The Bureau has found Landsat especially useful in detecting faults which can cause mine cave-ins. Once faults are identified, the Bureau alerts mining companies so that steps can be taken to avoid mining accidents, loss of life, and production. Also, the Bureau provides information to the Mine Safety and Health Administration within the Department of Labor for use in safety and health enforcement activities.

Landsat use is expected to expand as new geographic areas are examined and other areas are reexamined to detect geological changes. Computerized evaluation of ground hazards will be a

major development. Instead of manually examining images to identify faults, computers will be used in the future to analyze Landsat data. Long-term goals include developing hazards maps in order to forecast potential problems in mined-out areas and monitoring waste piles and dams.

Office of Surface Mining
Reclamation and Enforcement

The Office of Surface Mining Reclamation and Enforcement uses Landsat data to make decisions on issuing mining permits. Landsat imagery is used to detect alluvial areas and determine the potential success of revegetation. Alluvial valley floors are geographical areas that are naturally watered with no need for irrigation and are protected to retain crop productivity. The Office expects its future use of Landsat to increase if the quality of data improves. For example, the Office is responsible for detecting, controlling, and extinguishing mine fires. Landsat's infrared capability could be used in this effort if the current image resolution were improved. Officials of the Office said that increased precision of Landsat images would make it possible to examine more land surface features, decreasing the need for more expensive data collection methods.

DEPARTMENT OF LABOR

Mine Safety and Health Administration

The Mine Safety and Health Administration uses remote sensing data to help prevent or reduce mine accidents and occupational diseases. Used in conjunction with high- and low-altitude aerial photography and topographic maps, Landsat can detect faults which can cause mine cave-ins. Landsat images provide views of a large area that cannot be duplicated with similar resolution by other means and are very useful in studying regional geography. The Administration has found Landsat images especially useful in detecting faults located in bedded deposits, such as coal mines, but not as useful in hard rock deposits. However, neither Landsat images nor aerial photography alone is capable of providing the entire condition of a geographic area and the Administration must verify this information with onsite observation. With the improvements made to Landsat through the addition of the thematic mapper, the Administration expects to become better at detecting faults.

The Administration is currently trying to update its Landsat images of current mining areas with the use of new products from Landsat 4. The end-product will be linear maps that can be used to design mine roof-control plans or highlight possible fault problems which mining companies can use to help decide where to place future mines.

Most mining areas have already been covered with Landsat imagery, and since geographical features do not change rapidly, future use of satellites will remain constant for the next 5 years. However, a project may be developed to aid the Bureau of Indian Affairs in monitoring mine waste impoundments and waste refuse piles. The project, if implemented, will be used to ensure that nonusable rock excavated from coal mines and deposited into bodies of water (mine waste impoundments) or accumulated into dry piles (refuse piles) do not endanger the safety of the surrounding community or environment.

DEPARTMENT OF TRANSPORTATION

Coast Guard

The Coast Guard uses weather satellites for (1) search and rescue--saving people and property distressed at sea, (2) marine environmental protection--minimizing the damage caused by pollutants, such as oil spills, (3) ice operations--operating the nation's icebreaking vessels for such purposes as facilitating maritime transportation and supporting U.S. polar installations, and (4) the International Ice Patrol--providing an iceberg warning service in the area of the Grand Banks of Newfoundland. It receives imagery and radio signals from the polar orbiting meteorological satellites and uses NOAA and Navy products, such as the Weekly Sea Current Chart, derived from the polar orbiting and geostationary weather satellites. In addition, the Coast Guard is participating in an international demonstration program to investigate using signals relayed from emergency distress radios at sea by the polar orbiting meteorological satellite. The Coast Guard has also used Landsat data in monitoring oil spills.

The Coast Guard expects the use of weather satellites for search and rescue satellite-aided tracking to become fully operational in the future. It also expects to use satellite data to monitor merchant vessel traffic and permit year-round trafficability in Western Arctic waters.

Federal Aviation Administration

The Federal Aviation Administration uses weather satellites in preparing preflight weather briefings to pilots and hazardous weather advisories to help route aircraft around a storm. National Weather Service meteorologists assigned to Federal Aviation Administration air route traffic control centers and Federal Aviation Administration personnel at flight service stations use images from the geostationary weather satellites to prepare the weather advisories and the weather briefings. Data from National Weather Service radar and other Weather Service products, such as maps of surface and upper level winds, are also used. The Federal Aviation Administration considers the satellite pictures to be critical to generating the weather advisories and briefings, believing that program objectives could not be achieved completely without the satellite data.

The Administration expects to continue its use of geostationary data but in the future will receive satellite data directly at its air route traffic control centers, rather than indirectly through the National Weather Service as is done now.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

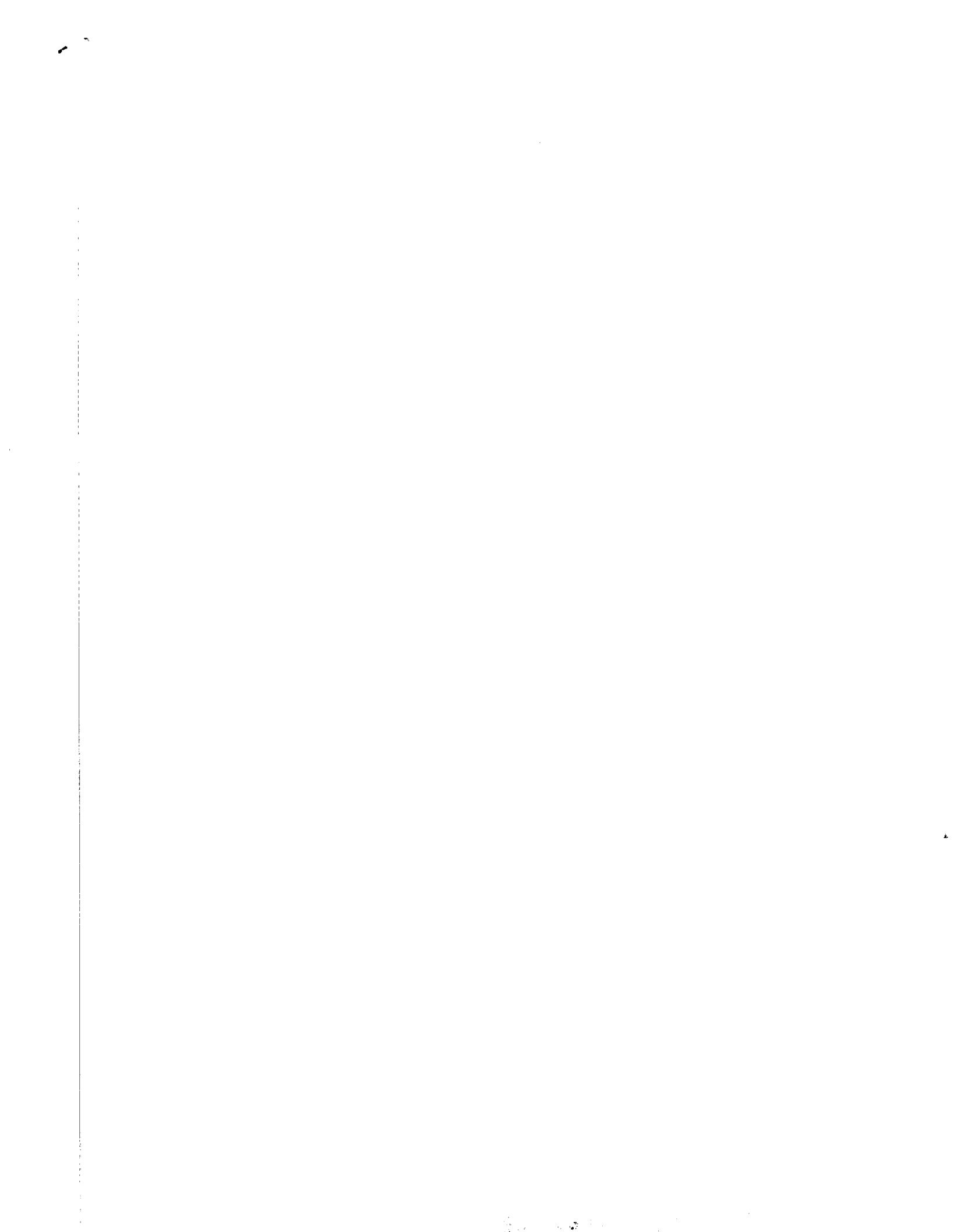
The National Aeronautics and Space Administration (NASA) uses the weather satellites and Landsat in its Earth Science and Applications Research program. NASA integrates the data from these operational systems and other systems, such as its research and development satellites for its programs. NASA also flies experimental equipment on operational satellites, such as the thematic mapper on Landsat and search and rescue equipment on the most recent polar orbiting weather satellite. NASA works with other federal agencies, state governments, and foreign groups. For example, NASA, NOAA, and the Department of Agriculture have worked jointly on agricultural uses of remote sensing technology. NASA, NOAA, and the Departments of Defense (Air Force) and Transportation (Coast Guard) are working jointly on an international demonstration program for using a satellite system to aid in the search and rescue of aircraft and ships in distress. NASA also has separate agreements for joint participation by Canada and France in the program.

SMITHSONIAN INSTITUTION

The Smithsonian Institution uses weather satellite images to monitor volcanic activity. The Smithsonian created a Scientific Event Alert Network to serve the scientific community by gathering and disseminating information on volcanic activity, earthquakes, and meteorites. Information is gathered from a variety of sources, including scientists, government officials, interested amateurs, and the news media. Satellite images are acquired through interagency cooperation with NOAA. Satellite data add to both the number of eruptions reported and the quality of information about eruptions. For example, satellite data help Indonesia to monitor many dangerous volcanoes in a large, densely populated country with limited transportation and communications by giving a nearly instantaneous overview of explosive volcanoes.

(082124)





27583.

AN EQUAL OPPORTUNITY EMPLOYER

**UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548**

**OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300**

**POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE**



THIRD CLASS

GF