Chapter 3

International Relations and Foreign Policy

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Among the most important and difficult issues to resolve in transferring civilian remote-sensing systems to the private sector are those related to international relations, international trade, and foreign policy. Data products from both the civilian meteorological and land remote-sensing systems have been and remain important instruments of U.S. foreign policy. These data and the technologies from which they spring remind other countries of U.S. leadership in space technology and U.S. dedication to using space for "the benefit of all mankind. "[1] Their use in numerous developing countries has allowed the United States to share its technological expertise and create good will for U.S. interests without transferring critical aspects of U.S. technology, In addition, data from these satellites have raised the level of awareness of major environmental problems throughout the world. By providing a means for self-directed resources management, remote-sensing systems help to create self-sufficient allies rather than technological dependents.

[1] National Aeronautics and Space Act (NAS) of 1958, sec. 102 (a).

Although many countries accept the use of U.S. remote-sensing systems, some have also questioned the right of the United States to sense their countries or to sell sensed data to third parties, and have argued that limits should be placed on the sensors' ground resolution. In addition, some countries that have accepted a U.S. Government-owned system have articulated deep concerns about the potential for abuse of data generated and marketed by privately operated systems.

Transfer of the metsat or Landsat systems to the private sector would likely affect U.S. relationships with the world community. Examination of the Landsat system's importance to international relationships, including trade, reveals that transfer of the active system would strongly affect foreign as well as domestic users of the data.

This chapter identifies and discusses the major international issues connected with remote sensing as they relate to the transfer of the U.S. civilian systems to the private sector. It also suggests requirements that might be imposed on a private corporation seeking to own and operate remote-sensing systems.

THE INTERNATIONAL CHARACTER OF REMOTE SENSING FROM SPACE

Aircraft or balloons are clearly limited in overflight by national legal restrictions on sovereign airspace, but spacecraft have no overflight restrictions. According to international treaty, "Outer space and celestial bodies are not subject to appropriation by claim of sovereignty, by means of use or occupation, or by any other means."2 This principle is understood by the United States and most other nations to mean that nations are free to place in orbit any satellite that does not violate other provisions of the 1967 Outer Space Treaty.

[2] "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon **and Other Celestial Bodies, " Oct. 10, 1967: art. II.**

This understanding has been called the "open skies" principle; it is a fundamental principle of the U.S. **space** program. The United States supports it in part by insisting on making civilian remote-sensing data available on a nondiscriminatory basis to anyone who wishes to receive them. Meteorological data are available free of charge to any country or organization capable of receiving the signals; land remote-sensing data are sold at uniform prices on an equal, nondiscriminatory basis.

The United States, through the U.S. Agency for International Development (AID), the U.S. National Oceanic and Atmospheric Administration (NOAA), and the international World Meteoro-

logical Organization (WMO), has been successful in helping some 125 countries and organizations purchase appropriate receiving terminals to receive meteorological data from U.S. satellites **(see table 1). For some of the poorest countries,** such stations are their only means of gathering synoptic weather data to warn of potentially destructive storms or dramatic climatic changes. In

Table 1 .—Countries With APT/HRPT Reception Capabilities

Countries with APT facilities:

Afghanistan
Algeria
Angola (status unknown)
Antarctica (USN res.)
Argentina
Australia
Austria
Azores
Bahamas
Bahrain
Bangladesh
Barbados
Belgium
Bermuda
Bolivia
Brazil
Bulgaria
Burma
Cambodia (status unknown)
Cameroon
Canada
Canary Islands
China (Mainland)
China (Taiwan)
Chile
Colombia
Costa Rica
Curacao
Czechoslovakia
Denmark
Dominican Republic
Ecuador
Egypt
El Salvador
Ethiopia
Fiji
Finland
France
French Guiana
Gambia
German Democratic Republic
Germany, Federal Republic of
Ghana
Greece
Guatemala
Guadaloupe
Guyana
Honduras
Hong Kong
Hungary
Iceland
India
Indonesia
Iran
Iraq
Italy
Israel
Ivory Coast
Japan
Jordan
Kenya
Korea
Kuwait
Madagascar
Malaysia
Mali
Malta
Martinique
Mauritania
Mauritius
Mexico
Mongolia
Morocco
Mozambique
Nepal
Netherlands
Netherlands Antilles
New Guinea
New Zealand
Nicaragua
Nigeria
Norway
Oman
Pakistan
Paraguay
Peru
Philippines
Poland
Portugal
Romania
Saudi Arabia
Senegal
Seychelles
Sierra Leone
Singapore
Somalia
South Africa
South Yemen
Spain
Sri Lanka
Sudan
Surinam
Sweden
Switzerland
Syria
Tahiti
Tanzania
Thailand
Trinidad and Tobago
Tunisia
Turkey
Union of Soviet Socialist Republics
United Arab Emirates
United Kingdom
United States
Upper Volta
Uruguay
Venezuela
Viet-Nam, Republic of (status unknown)
Yugoslavia
Zaire
Zambia
Zimbabwe

Countries with HRPT facilities:

Belgium
Brazil
Canada
China (Mainland)
Czechoslovakia
Federal Republic of Germany
France
Greenland (Denmark)
India
Indonesia
Iran
New Zealand
Norway
Saudi Arabia
Sweden
Union of Soviet Socialist Republics
United Kingdom
United States
Yemen (South)

SOURCE National Oceanic and Atmospheric Administration

return, these countries provide the United States with their local weather data which are crucial to both U.S. civilian and military users.

As the National Aeronautics and Space Administration (NASA) developed the Landsat system, it encouraged use of the system by other countries. Ten countries now own Landsat receiving stations. In return for a fee, these foreign stations receive Landsat data sensed over their region and sell or distribute data to domestic and foreign customers. Further, through AID and NASA, the United States has been a principal force in setting up foreign regional and national centers capable of processing and interpreting Landsat data. By integrating these data with meteorological, aircraft, and ground data of all kinds, these centers help developing countries to cope with the enormous problems of environmental protection and resource management, particularly in isolated, rural areas.

WMO is a specialized agency of the United Nations (U.N.), the purpose of which is to coordinate, standardize, and improve meteorological services throughout the world. It consists of more than 150 member countries and territories, each of which maintains its own meteorological service. Established under a 1947 convention, WMO has fostered international cooperation in meteorology through such programs as the World Weather Watch, a system for comprehensive global weather observation, and through the Global Telecommunications System for global exchange of meteorological data (fig. 1). The WMO convention itself imposes no obligation for data exchange, but the free interchange of meteorological data from terrestrial stations and satellites has become an established custom of great utility to the participating countries.

Satellites from several countries provide data for this exchange. The Geostationary Meteorological Satellite (GMS-Japan), Meteosat (operated by EUMETSAT and the European Space Agency), and most recently the INSAT (India) geostationary satellites provide visible and infrared imagery, data communications systems and weather facsimile (WEFAX) charts.* These satellites, plus the U.S. satellites and the planned Soviet geostationary satellite, make up the heart of the World Weather Watch of the WMO.

*INSAT does not furnish WEFAX transmissions.

INTERNATIONAL RELATIONS AND FOREIGN POLICY AIMS

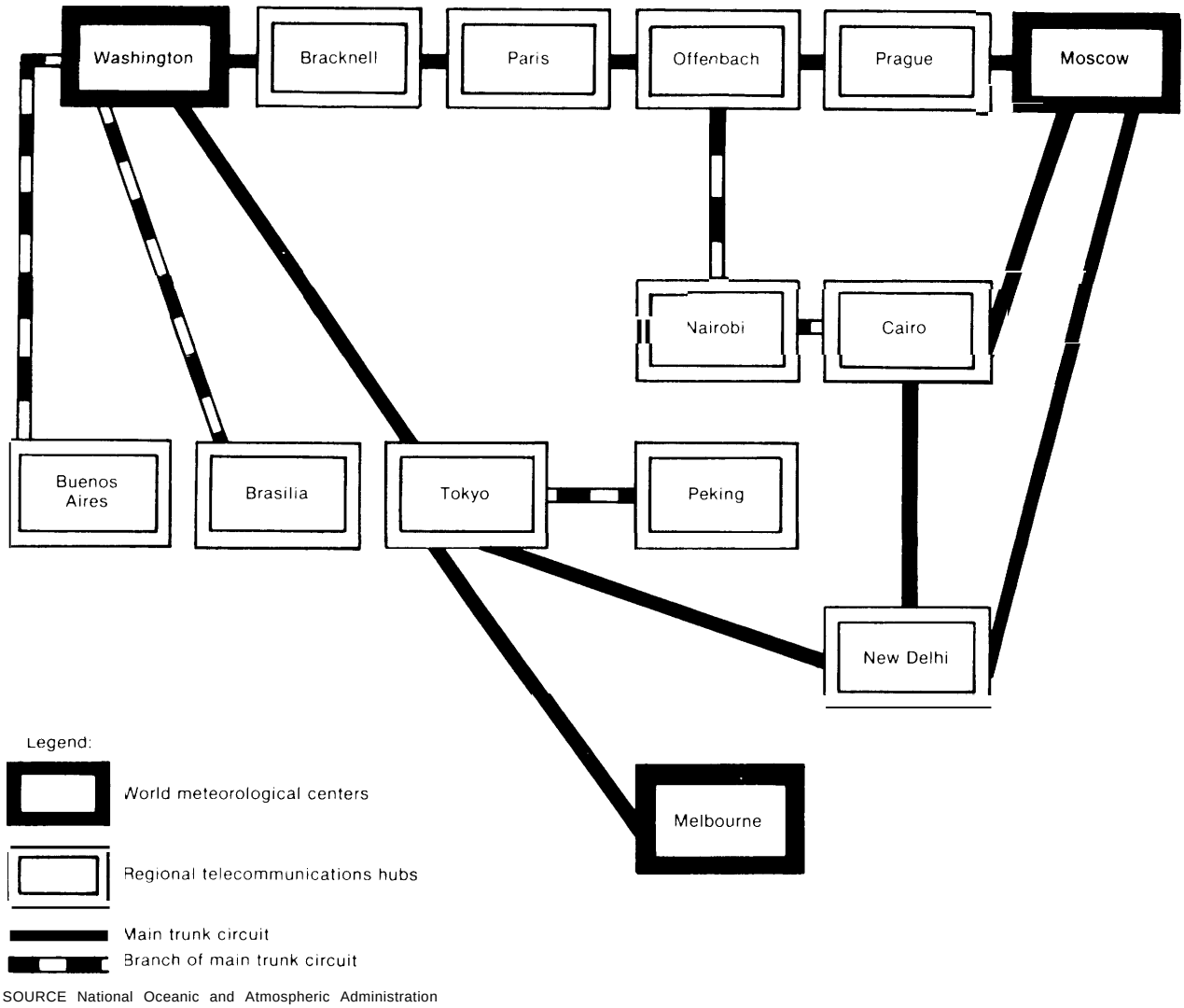
A recent administration report acknowledges that if the United States transfers its Landsat system to the private sector, it must consider the effect this step will have on a wide range of U.S. interests:

> In remote sensing the readily available products of United States meteorological and land satellites are used routinely by the world community. The result has been a large measure of good will and support of our positions in the U.N. and other international fora.[3]

[3]The President's Report to Congress on Science, Technology, and American Diplomacy for Fiscal Year 1982.

As this passage indicates, in serving the international community, data products from the U.S. remote-sensing systems have been important instruments of U.S. foreign policy. Not only have these data aided other countries in predicting harmful weather patterns and in managing and exploiting their own resources, they have served to raise the general level of awareness of *growing* environmental problems throughout the world, The data from the metsat and Landsat systems have also provided the United States influence in some countries that strongly disagree with us on certain international political issues. In such developing countries as Thailand, Bangladesh and

Figure 1.—Diagram of the Global Telecommunications System



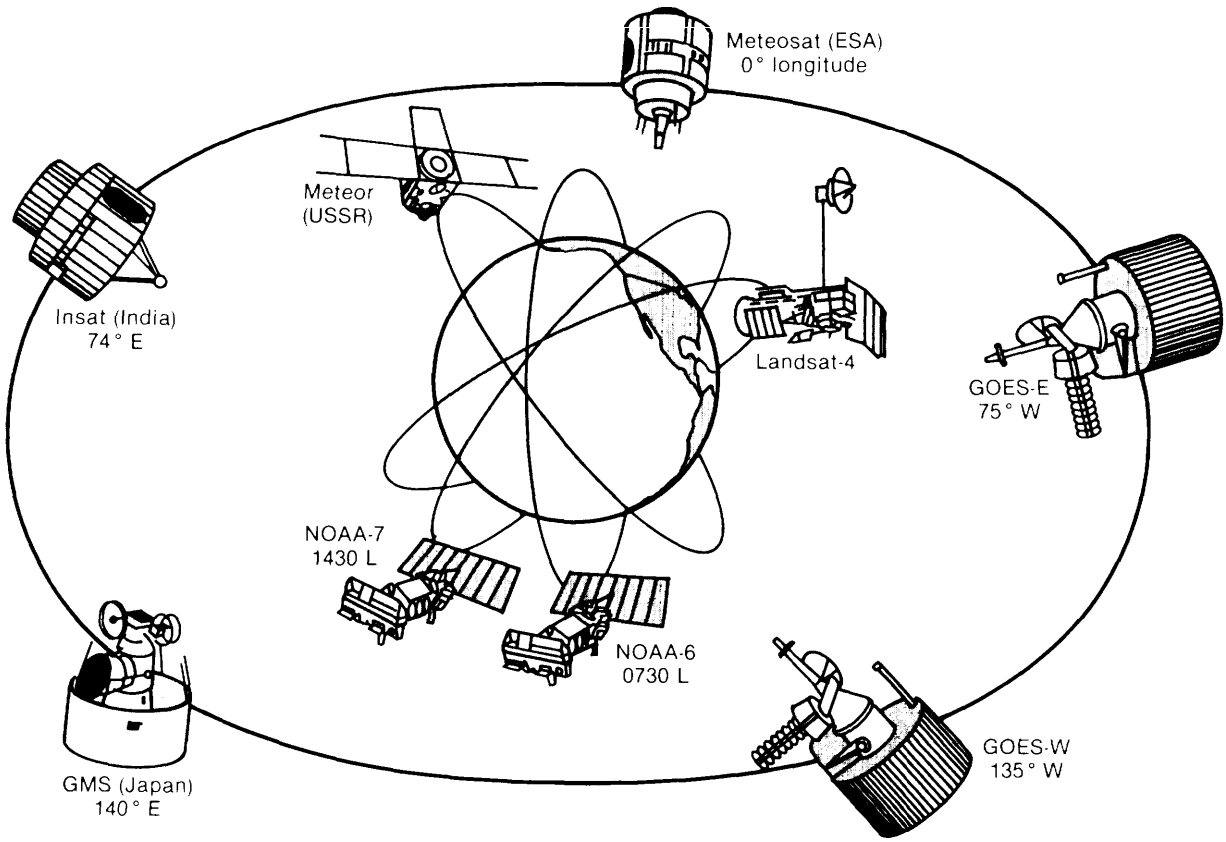
SOURCE National Oceanic and Atmospheric Administration

Kenya, the desire to use remote-sensing data from U.S. satellites has even effected changes in political and institutional structures (see section on "Developing Countries" in this chapter and app. A). The metsat and Landsat systems also remind other countries of U.S. leadership in space technology.

Primarily through the Landsat system, the United States has been able to overcome potential foreign opposition to satellite remote sensing for national security as well as civilian uses, and to offset repeated attempts by the Soviet bloc to impose regimes whose intent is to restrict the free flow of information. Indeed, the Landsat program can be considered to be a cornerstone of the U.S. "open skies" policy and of its policy on the use of space for "peaceful purposes for the benefit of all mankind."[4] By making data from the Landsat system available to all potential purchasers on a nondiscriminatory basis, the United States has been able effectively to blunt criticism that might otherwise have resulted from its extensive use of military reconnaissance and other satellites. Moreover, the open availability of Landsat data to anyone regardless of nationality or political persuasion is a powerful message to governments op-

[4] NAS Act of 1958, op. cit.

Operational Earth Observation Satellites



SOURCE National Oceanic and Atmospheric Administration

posed to the open interchange of ideas and information.

The following discusses several areas critical to foreign policy and international relations that any planning for the future treatment of land and meteorological remote-sensing satellite systems must address.

Meteorological Remote Sensing

Data Distribution Policy

As noted in the previous section, the U.S. policy on meteorological data conforms to the global practice of distributing such data freely and at no cost to the other countries of the world. Tentative suggestions by U.S. officials that the United States might begin to charge other nations for these data were met with warnings that the United States was tampering with well-established, long-term data practices and that other countries might reciprocate.

In addition, two of the instruments carried on U.S. metsats are provided by other countries. The United Kingdom, through the British Meteorological Office, has provided the Stratospheric Sounding Unit for the U.S. TIROS-N polar orbiter. In a tripartite agreement among NOAA, NASA, and the French Centre National D'Etude Spatiales (CNES), the French provide and operate the ARGOS data collection system for the NOAA polar orbiter. These arrangements help reduce NOAA's costs and make the polar-orbiting satellites much more capable than they would be otherwise.

Because the United States receives more data through WMO than it supplies to the rest of the world, charging for metsat data would result in a net cost to the United States. In part because of the negative response from other countries and in part because of the outcry from U.S. users of foreign data as well as Congress,[5] the administra-

[5]House Concurrent Resolution 168, Sept. 19, 1983; Senate Concurrent Resolution 67, Sept. 19, 1983: 98th Cong., 1st sess.

tion subsequently reaffirmed its commitment to supplying meteorological data freely and free of charge.

Value-Added Services

Value is added to meteorological data when they are used by specialized firms to predict severe impending weather for the benefit of specialized groups, such as regional farmers or the international shipping industry. Value-added firms and Government organizations are also learning how to process meteorological data conjointly with land remote-sensing data to predict crop yields, both domestically and abroad (see ch. 4).

A private operator would likely be interested in entering the value-added business, since outside the Government, there would be only a modest market for unprocessed data. Unlike the case of land remote sensing (discussed below), where the primary economic value of the data can only be realized after sophisticated and expensive data processing, the primary economic value of the data from the meteorological satellites is in their ability to warn of impending severe or unusual weather. Receiving terminals and the necessary data-processing equipment for obtaining basic meteorological data are relatively inexpensive; most countries and many smaller economic entities can afford to purchase and operate them. Thus, for meteorological data, no apparent conflict would exist in allowing the data supplier to sell value-added services, as long as the raw data remain freely available to everyone with the capacity to receive them.

Continued Applied Research

Although the meteorological satellites have been in operational use for nearly two decades, there is a continuing need to refine the observations they make, and to learn to integrate these observations with other land, ocean, and atmospheric data in order to make them more generally useful.

When the National Weather Service first assumed responsibility for operating the meteorological satellites, NASA was charged with continuing the research and development for new meteorological sensors and satellites. This work resulted in substantial improvements in the polar-orbiting satellites, and in the development of the geostationary meteorological satellites (GOES). However, in recent years the NASA R&D program for new satellites and sensors (the Nimbus series of experimental meteorological satellites) has diminished nearly to zero, and for budgetary reasons, NOAA has not been able to take up where NASA left off. Consequently, little hardware research is now being carried out in the civilian programs. In addition, military research on sensors has slowed considerably for lack of suitable civilian satellites to attach them to. Prior to the demise of the Nimbus program, NASA, NOAA, and the Department of Defense (DOD) used these satellites to test new sensors and techniques.

U.S. meteorological satellites have demonstrated U.S. leadership in this technology. If the United States is to continue to lead, it will be important to continue research in sensors, satellites, and other hardware development.

The Government has continuing research programs to utilize meteorological data to best advantage, both for short- and intermediate-term weather forecasting and for climate research. Much of this research is conducted in collaboration with industrialized and developing countries. Since receiving and processing meteorological data from satellites provide an excellent way to learn about and use space technology, it would be in the long-term best interests of the United States to continue applications research projects with both industrialized and developing countries. It will be especially useful to find new ways to integrate these data with ocean and land satellite data. Such work would most usefully be carried out in conjunction with private industry.

Land Remote Sensing

Data Sales and Foreign Policy

Because the U.S. space program and U.S. foreign policy have benefited from the policy of nondiscriminatory sale of Landsat data, this policy assumes importance in foreign relations. If the proposed transfer is made, the private firm will want to set its own data policies. In general, com-

mercial interests want private ownership of data and the ability to copyright them so data can be sold profitably. Thus, a commercial venture is likely to require proprietary rights in distributing data in order to gain or maintain economic advantage over possible competitors. However, this is contrary to notions of open access to information for the public good. Indeed, the Department of Commerce's Source Evaluation Board has recognized the interests of the private sector and the difficulties of the embryonic market for data in its Request for Proposals (RFP), in which it states simply:

> (1) Conform his [the owner's] Earth remote-sensing programs as closely as is commercially possible to traditional U.S. Government practices of providing civil land remote sensing satellite data to all users on an open, equal, nondiscriminatory basis; (2) Consult with and obtain the approval of the U.S. Government before instituting major changes in international data distribution practices, to ensure that such changes are in conformity with the international obligations and foreign policy objectives of the U. S.'

The question is whether it is in fact "commercially possible" to maintain the policy the United States has fought so hard to maintain in the United Nations and other international bodies. The formulation of the RFP would leave the matter largely up to private interests to decide. **In view of the continued importance of the "open skies" principle to the U.S. use of space, it will be important for Congress to consider carefully the implications of this potentially radical change of policy.**

Value-Added Services

Most of the profit from the use of land remote-sensing data will be gained by those corporations that enhance Landsat data to improve their usefulness (the so-called value-added industry). These companies integrate Landsat data with other information to make powerful analytical and predictive commercial products. They constitute a small, but growing, industry.

There can be little doubt that a private owner of the Landsat system would want to enter into the value-added business. The Source Evaluation Board's RFP proposes to allow the system's owner to process the primary data and to package those data in whatever ways it sees fit, including offering a variety of value-added products, as long as Federal data needs are met.[7]

However, many developing countries have expressed the fear that if the company owning the collection and distribution system were also allowed to offer value-added services, it might take special advantage of having control over the distribution process (i.e., a monopoly position) to gain economic leverage over countries that do not have the facilities or personnel to process and interpret the data themselves. For example, a company might delay distribution of data to a sensed country until after the company had a chance to exploit the data itself for resource information. From the standpoint of international relations, it may be appropriate for the United States to restrict the private owner from entering into the value-added business. At the least, the private owner would have to be closely regulated to see that unfair economic leverage was not applied over other countries or over other value-added corporations.

If the market for land remote-sensing services grows to the point that competitive, timely, data services are available, thereby limiting the power of one company to exert such unfair leverage, any restrictions could be relaxed because competition would make value-added services more readily available. A possible alternative strategy, but one that would be unlikely to gain the support of private companies, would be to require data analysis to be sold openly as well.

U.S. Technological Leadership in Cooperative Projects

During the decade that the Landsat system has existed, the United States has encouraged both industrialized and developing countries to participate in generating applications for Landsat data (i.e., applied research). That this approach has been successful is demonstrated by the fact that

"'Request for Proposals for Transfer of the United States Land Remote Sensing Program to the Private Sector, " U.S. Department of Commerce, Jan. 3, 1984, VII. 6-3.

'Ibid., p. ii.

10 countries now own Landsat receiving stations and pay a yearly fee of $600,000 to the U.S. Government to receive data. Although the stations are owned and operated by the host country and some of the equipment is manufactured outside the United States, the receiving stations clearly demonstrate U.S. leadership in developing and transferring high technology.

The United States has also benefited directly from helping to establish these receiving stations, for they have provided critical foreign multispectral scanner (MSS) data for U.S. Government projects, both domestic and bilateral. Without these foreign resources, worth millions of dollars, the success of the Landsat program would have been severely limited. Some companies have found data from foreign ground stations to be crucial in their business. Thus, they benefit from existing bilateral agreements with foreign ground stations and from the exposure of a wide variety of potential data users to Landsat data products.

It is critical for the United States to maintain its cooperative basic and applied research programs in remote-sensing technology with other countries, both to advance U.S. research objectives and to retain U.S. leadership in the technology of outer space. Without help from the Government, a private owner is unlikely to have the resources or the inclination to pursue research with other countries. Still, private industry has a significant role to play in applications demonstrations.

INTERNATIONAL OBLIGATIONS: TREATIES AND AGREEMENTS

The United States is a party to four major international agreements formulated by the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS) that may affect the operations of private Earth resources remote-sensing systems:

- **Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies** (1967). Among other things, the treaty defines the principles for the exploration and use of outer space and holds States responsible for the space activities of their citizens.
- **Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched Into Outer Space (1968). This agreement provides for the rescue and return of downed or stranded astronauts as well as the return of a space object and "its component parts." It specifies that "the State responsible for launching" shall pay the expenses for recovering and returning the space object or its parts.**
- **Convention on International Liability for Damage Caused by Space Objects (1972). This convention is an extension of articles VI and VII of the 1967 treaty. It defines "damage" as loss of life, personal injury, impairment of health, loss or damage to property or persons or property of international organizations. "Launching" is held to include attempted launching and a "launching State" is one that either launches or procures the launch of a space object. It is also one "from whose territory or facility a space object is launched."**
- Convention on Registration of Objects **Launched Into Outer Space (1974).** The information registered includes the name of the launching State or States, an appropriate designator or a registration number, the date and territory of the launching, the initial basic orbital parameters including the nodal period, inclination, apogee, perigee, and the general function of the space object.

Of particular importance to potential private operators of remote-sensing satellite systems or any other space system, is the 1967 Outer **Space Treaty.** Article VI of this treaty states: "The activities of non-governmental entities in space . . . shall require authorization and continuing supervision by the appropriate State party to the treaty." Although the terms "authorization" and "continuing supervision" have been interpreted differently, article VI clearly requires some form

of licensing and adherence to Government-imposed regulations.

Similarly, article II of the 1972 Liability Convention makes the launching State responsible for personal and property damage caused by any satellites or launchers even if they are no longer under the operation or direct control of the Government. At a minimum, the Government would require assurance that the owner of the satellite system had purchased adequate insurance to cover possible damages.

The U.S. Government has not yet decided on the precise mechanisms of ensuring that private corporations comply with international treaty obligations. Given the importance of this technology to U.S. foreign affairs, it is clear that the Department of State must play a major role.

The Role of the Department of State

In general, private operation of the U.S. remote-sensing systems may lessen the potential for using them as a tool of U.S. foreign policy. Transfer to the private sector could also diminish the accountability of remote-sensing operations to international law and public opinion by removing them from direct public control. The Department of State therefore should have two primary concerns: 1) to ensure that a private owner meets all the international obligations of the United States; and 2) to see that its activities support, or at the least do not interfere with, other U.S. diplomatic interests.

The Department of State would have to assure a private operator's adherence to the provisions of the various U.N. treaties on space discussed above. The specific regulatory mechanisms it would use and the penalties to be imposed for noncompliance are presently undefined. The Department's function in assuring that the activities of a private corporation support U.S. diplomatic interests is important, but difficult to execute because the Department would have to work directly and continuously with the private sector. Such a role would require the Department to assess the past benefits of Government remote-sensing activities and determine which of these should be retained in the future. The private company, on its own, cannot be expected to understand and comply with U.S. foreign policy objectives.

In this process, it would be important to distinguish between those benefits which do not outweigh the advantages of private sector operation and those which are essential to U.S. interests. The essential benefits must somehow be preserved by the transfer agreement. **The State Department should examine closely the degree to which past remote-sensing projects have aided U.S. efforts at the U.N. and other international forums dealing with all issues related to outer space, then establish the means to continue to use this technology in the service of U.S. foreign policy and international relations.**

In regulating a private land remote-sensing system the Department of State and other Federal agencies (e. g., the Department of Commerce), would be breaking new ground. They therefore have an opportunity to develop imaginative strategies for dealing with the private sector. These strategies are particularly important because they would deal with a technology which, because of its economic implications (i e., the data can be used to help in exploring for the resources of countries), raises the political sensitivities of other countries. Some countries worry they will lose control over resources under their sovereign control.

One possible mechanism would be to establish a permanent private sector advisory group to work with the Department of State to advise on ground roles for international operation of the system. Nevertheless, the Bureau of Oceans and International Environmental and Scientific Affairs (OES) of the Department of State, which would likely be charged with this responsibility, would have to strengthen its expertise in space technology and its commitment to using space technology as part of the outreach of the United States.

In the past, NASA has taken the lead in establishing cooperative ventures with other countries; it will continue to do so for most space projects. One reason NASA has been so successful is that it is well based in the technology and has carefully chosen projects that directly served the best inter-

ests of **NASA. * The Department of State has never had a strong interest in cooperative programs** in space technology,[9] in part because space technology constitutes only a very small part of its total mission. Yet, as private sector involvement in space grows, the Department will be in the difficult position of mediating between U.S. private companies, which would want as few restrictions **as** possible, and foreign countries which might want strong restrictions. The Department might have to choose between making friends and influencing nations abroad and rallying domestic support.

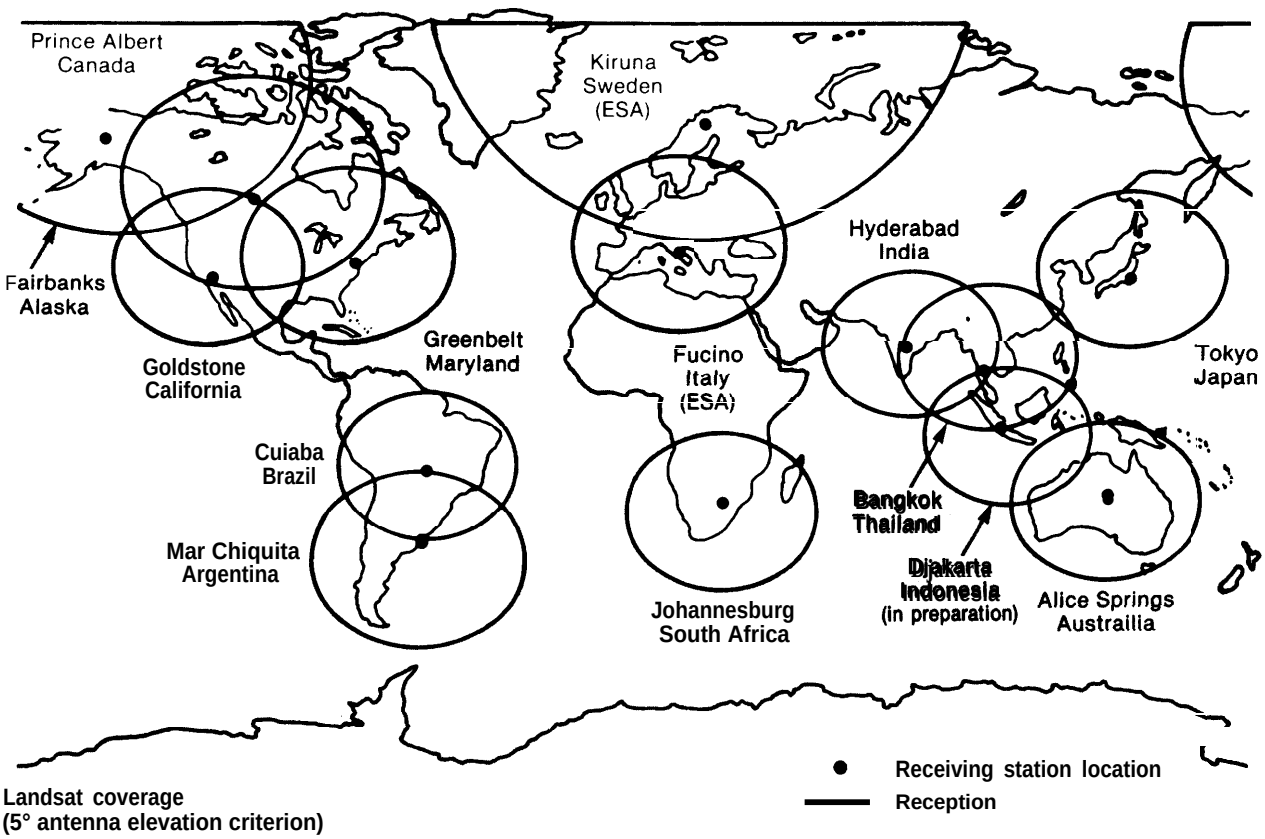
[8] *UNISPACE '82: A Context for International Cooperation and Competition-A Technical Memorandum* **(Washington, D. C.: U.S.** Congress, Office of **Technology Assessment, OTA-TM-ISC-26, March 1983), app. B.**

[9] **T. K. Glennan, "Technology and Foreign Affairs, A Report to Deputy Secretary of State Charles W. Robinson, " December 1976, p. 33; Norman A. Graham, Richard L. Kauffman, and Michael C. Oppenheimer, "A Handbook for U.S. Participants** in Multilateral Diplomacy: The U.S. and U.N. Global Conferences, " report prepared for the Department of State by the Futures Group, September 1981, p. 15.

Relationship of Private Sector to Foreign Ground Stations

The foreign ground stations are all government-owned and government-operated and receive data from the Landsat satellite by agreement with the U.S. Government. Each station is now required to pay $600,000 per year for the right to receive and distribute or sell MSS data from the satellite. Before fiscal year 1983, the charge was $200,000. According to the terms of the Memoranda of Understanding between NOAA and these governments, the stations may receive and preprocess these data and sell them to their

Distribution by Foreign Ground Stations (as of Jan. 1, 1984)



SOURCE National Oceanic and Atmospheric Adminlstration

customers. In return, they agree to abide by the same nondiscriminatory sales policy practiced by the United States. If the private owners of the remote-sensing systems are permitted to pursue discriminatory data policies, the United States will lose its leverage over operations and data product distribution policy of the foreign ground stations.

Future International Coordination

The United States currently participates in the deliberations of the Landsat Ground Station Operators Working Group and the Coordination on Land Observing Satellites, organizations which coordinate standards for land remote-sensing systems. With transfer of the land remote-sensing satellite system to private ownership, it would be important to spell out how private firms would have to interact with the agencies that represent the United States in these organizations, *

*It is not clear that the Government would still have a role to play in the Landsat Ground Stat Ion Operators Working Group upon transfer of the system to private hands

DEVELOPING COUNTRIES

Landsat and metsat technology, and U.S. programs through AID, NASA, and NOAA to transfer data-processing technology to developing countries, have affected the institutional structure of developing countries, and the manner in which the countries treat environmental problems. These programs have also affected their relations with the United States. *

In the developing world, AID and NASA have been the principal agents in setting up regional and national centers capable of collecting, processing, and interpreting Landsat data and combining them with other data. The resulting information has helped developing countries to cope with the enormous human and physical problems of resource management, particularly in isolated areas. The United States has shown the rest of the world how to use Landsat data as a powerful tool for attacking such serious global environmental problems as deforestation and desertification, problems that respect no political boundaries.

In short, in helping to solve these pressing problems, satellite remote sensing has made a distinctive contribution to the international image of the United States as a leader in the effort to assess and protect global resources.

For the past 25 years the United States has stated in international gatherings that its exploration and research in space would be used for the benefit of all mankind. For the past 15 years, developing countries have been told that the current satellite remote-sensing system (Landsat) was experimental and that eventually an operational system would exist in the spirit of international cooperation that has been a hallmark of the U.S. civilian space program. In addition, in the face of strong international opposition, the United States has stood by its policy of open dissemination of data gathered by satellite. Now, as the administration moves toward transfer of the Landsat system to private hands, many observers question the effect the transfer proposal would have on the broader agenda of U.S. relations with the developing world and on past U.S. commitments.

Transfer of the Landsat system to the private sector would have some positive effects on the use of satellite data in developing countries (e. g., private firms should be able to offer more timely data and provide a greater variety of services than does the U.S. Government). Nonetheless, some of these countries see the transfer as another signal that the United States is reversing its longstanding policy for outer space and becoming less cooperative in space activities with developing countries.

Transfer of the Landsat system could well contribute to already deteriorating relations between the United States and developing countries in international forums and negotiations. U.S. policymakers should decide whether the goal of immediate private sector ownership and operation of remote-sensing systems is more important for po-

‘See app. A for a more detailed treatment of this subject.

litical/economic principle and domestic budgetary reasons than long-term political relations between the United States and the developing world. A phased transfer or limited transfer could ease the political problems the United States might face.

One reason AID and NASA have been able to promote the use of Landsat data in other countries is that the data have been readily available at very low prices (the greatest costs have been borne by NASA through its funding of the Landsat program). Such a policy is appropriate during research and development, when it is important to encourage many potential users to experiment with the data. However, now that the system has been declared operational and may be transferred to private ownership, the price for data must approach the costs of building and maintaining a system. There are other price and cost issues that must be resolved; for instance, will the United States continue to provide data for projects that draw "good will and support?" It will be increasingly difficult for AID and other agencies to provide data and other support for remote-sensing projects in an era of increasing costs and decreasing budgets. Yet U.S. mission agency technical programs have been largely responsible for the development and maintenance of the international community of users of data from Landsat. The small market for remote-sensing data that exists abroad today exists because of previous U.S. financial and technical assistance. Further, if such assistance were to stop after the technology was transferred to private ownership, it might re-ignite the international debate over ownership and dissemination of the data from remote-sensing satellite systems (see discussion in the following section),

We must also consider the costs to the United States of not continuing this aid to other countries. From the standpoint of developing markets for U.S. products, it is clearly in the best interests of the United States to continue to encourage other countries to become familiar with land remote-sensing data and their uses. **If the transfer to the private sector is made, it will therefore be important for Congress to assure that appropriate funding is continued for these worthy projects.**

INTERNATIONAL LEGAL ASPECTS OF REMOTE SENSING

Countries are well aware that the possession of satellite remotely sensed data and the ability to analyze them gives others power to affect their resource development. Data from the meteorological satellites are generally not in question because they are low resolution and are widely perceived by other countries to be of little use in exploiting a country's resources. Private ownership of the land remote-sensing system may heighten suspicions that such data would be used to enable interests outside the sensed country to gain **a** competitive advantage, or that information on crop conditions or military activities of States might be sold preferentially to political adversaries. The developing countries are particularly concerned about this issue, since many lack the indigenous ability to analyze the data. *

Some countries maintain that they should have priority access to data derived from the sensing of their territory, while others have argued that their consent should be obtained before these data are transferred to third parties. These states base their claims on the political-legal concept of national sovereignty over resources.

The United States has consistentl, opposed efforts to limit the distribution of Landsat data, arguing that remote sensing is a peaceful and beneficial use of space in which the constraints of national sovereignty have no valid application. Further, it has held that the free collection and dissemination of primary data and analyzed information is supported legally and encouraged by the 1967 Outer Space Treaty and article 19 of the U.N. Declaration of Human Rights.

Some countries carried this debate into the UNISPACE '82 conference, held in Vienna,

*Their concerns over remote-sensing data are directly linked to similar concerns over access to information of all kinds as well as their ability to use it.

Austria, in August 1982. Mexico, on behalf of the Group of 77, submitted a position paper at the conference which stated:

> The Group of 77 believes that sensed states should have timely and unhindered access on a priority basis . . . to all data and information obtained over their territories. Dissemination of such data and information derived from it to a third party should not be done without the prior consent of the sensed country. [10]

This wording was rejected for the final UNISPACE '82 report, but the United States can expect similar attempts to restrict the sale of data in the future.

In future meetings of the U.N. Committee on the Peaceful Uses of Outer Space, the United States will have to defend any new policies with respect to private sector use of outer space. **Therefore, it will be extremely important that these policies be thoughtfully formulated and defensible in international forums. Our previous strict policies of nondiscriminatory data sales and the free flow of information have served us well in deflecting many attempts to restrict the right to sense other countries and sell those data to third parties.**

Should the Group of 77, or other concerned nations, obtain a consensus about the necessity of prior consent for remote-sensing activities, such a decision could negatively affect the private sector's ability to market data internationally. Although the decision would not bind the U.S. private firm to follow certain procedures, its existence could cause countries to place sanctions on U.S. remote-sensing products, or turn to other suppliers of data. More important, a "prior consent" regime could affect Government data acquisition programs.

[1]UNISPACE 82; *A* Context *for* International *Cooperationand Competition,* op cit ,, app H

INTERNATIONAL TRADE

As noted earlier, outside of limited distribution of land remote-sensing data by the Soviet Union, the United States has been the sole supplier of land remote-sensing data to the world. Yet today, while the United States deliberates over the appropriate disposition of the Landsat system, other countries are developing their own land and ocean remote-sensing systems. Canada, France, India, Japan, and the European Space Agency all plan to launch remote-sensing satellites by the end of the decade. Indonesia and the Netherlands are considering building a system appropriate for the Tropics in the 1990's. Two facts are highly significant to the U.S. debate: 1) in addition to the indigenous capabilities, these foreign systems rely directly on experience and technology their designers have gained from U.S. R&D efforts; and 2) they are designed to be operational, rather than R&D, systems. Some of these systems will be technically directly competitive with the current Landsat system; some will far exceed Landsat's capacity to return useful data to data users.

The following summarizes briefly the characteristics of the foreign systems. In order of planned deployment, they are:

- **West Germany—Modular Optoelectronic Multispectral Scanner (MOMS) –(1984/85). This instrument** was flown on the Shuttle Pallet Satellite (SPAS) developed by Messerschmitt-Boelkow-Blohm GmbH (MBB) aboard shuttle flight 7. MBB, COMSAT, and the Stenbeck Reassurance Co., Inc., wish to market selected 20-meter resolution multispectral (2-color) land remote-sensing data collected on shuttle flights beginning in 1984. NASA's agreement will be needed. The West Germans are developing a stereoscopic sensor and have already tested a limited synthetic aperture radar aboard Spacelab on shuttle flight 9.
- **France—System Probatoire d'Observation de la Terre (SPOT)—1985.** Since 1978, the French have been planning the world's first commercial remote-sensing satellite service. They expect to fly a series of four satellites. Although the first satellite will not be launched until January 1985, they are currently preparing the sales market through a French Government-owned company, SPOT-Image. A Washington-based American subsidiary called SPOT-Image Corp. is now

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developing the U.S. market for SPOT data. The U.S. corporation has flown a successful series of tests from high-altitude aircraft over the United States using sensors designed to simulate the data that will eventually flow from the SPOT system. Customers from U.S. private firms, State governments, and the Federal Government have purchased data sets from these flights.

The SPOT satellite will carry pointable multispectral linear-array sensors capable of resolving images at least as small as 20 meters in three wavelength bands. In addition, the satellite will be capable of lo-meter resolution operating in a panchromatic mode. These are higher resolutions than are possible on Landsat 4 or D'. Because the sensors are pointable, they are capable of producing quasi-stereo images. Although the system is a commercial effort, the French Government is spending a minimum of $400 million to develop the system and will subsidize its operation for a period.

- **India-IRS (1985). This low-resolution "semi-operational" land remote-sensing satellite will be built** in India but launched by a Soviet launcher. It will carry solid-state sensors.
- **Japan Marine Observation Satellite-1 (MOS-1)—1986. The MOS-1 will carry sensors capable of resolving objects 50 meters across in three visible and one infrared (IR) wavelength bands. It will also carry a microwave scanning radiometer and a variable-resolution radiometer (900 to 2,700 meters) with one visible and three thermal IR bands. Although this satellite is being developed primarily for ocean sensing of wave heights, ocean color, and temperature, these data will also be useful for land remote sensing. The Japanese are also planning a land remote-sensing satellite (JERS-1), which is planned for launch by 1990. It will carry a synthetic aperture radar.** They have not yet announced plans for distributing or selling data from MOS-1 or JERS-1.
- **European Space Agency (ESA) Remote Sensing Satellite, ERS-1—1987/ 88.** This satellite is planned primarily for passive sensing of the coastal oceans and weather over the oceans. In addition, it will carry a synthetic aperture radar for active sensing of land masses through any cloud cover. It is the first of a planned series of three satellites to be launched by ESA.
- **Canada Radarsat-1990.** Under development by Canada for routine observations of polar sea ice, the satellite will provide C-band radar images of Earth's surface. It will have a steerable beam and a spatial resolution of about 30 meters and be able to gather information on the surface of Earth through cloud cover. Data from this satellite will be available for direct sale or by arrangement though offset programs. In order to reduce its costs, Canada is seeking partners in this venture, and is discussing the possibility of working with the United States.
- Brazil—Brazil is working on a moderate-resolution land-sensing satellite to be launched in the late 1980's.

It is evident from this too brief summary that other countries, building on the experience gained from U.S. applications technology as well as on their own capabilities, see the development of the full range of remote-sensing satellites as an integral part of their entry into space. Besides constructing systems competitive with the U.S. Landsat system, they are also developing systems that will sense the physical parameters of the oceans and the coastal waters. The United States, though it has a program within NASA to develop new sensors to fly on the relatively short shuttle missions, has announced no plans to develop civilian operational systems that would provide data over the long term with repeat coverage. Thus, the United States, to obtain certain important data, **may have** to rely on foreign systems. In the absence of a Government system, or strong Government support for a private system, the private sector would be left to compete with foreign government-funded enterprises.

For research purposes, and for certain civilian Government requirements, these data will suffice. However, as is discussed in chapter 6, foreign suppliers will hardly be appropriate to supply U.S. intelligence and defense data. In the event appropriate U.S. civilian data are unavailable, the Department of Defense might seek to develop its own system.