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U.S. REMOTE SENSING DATA FROM EARTH OBSERVATION -- LAW, POLICY AND PRACTICE

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Abstract

U.S. law and policy is presented on the collection and dissemination of Earth remote sensing data by the U.S. Government. The principles of "Open Skies" and "Non-Discriminatory Availability of Data" are detailed, as well as placed in context with other contemporaneous legal theories.

National Aeronautics and Space Administration (NASA) practice is also addressed. Data rights are examined for NASA-sponsored Earth observation satellite programs beginning with the 1960 launch of TIROS-1. What becomes apparent is that practice has varied depending on the program objectives, participants and funding availability.

The last part of the paper looks to the future to see what policies are being put in place which will determine data access in planned Earth observation programs, most notably the Earth Observing System (EOS). Factors which can conflict with public access to data, such as periods of exclusive scientific use and the desire for private sector investment in satellite programs are briefly discussed.

Introduction

The National Aeronautics and Space Administration (NASA), the federal agency responsible for U.S. civilian aeronautics and space (National Aeronautics and Space Act, 42 U.S.C. 2451 § 102(b) (1958)), has since its creation in 1958, utilized the space environment to better understand the Earth and its natural processes. One area of focus has been the collection and analysis of data taken of the Earth over long periods of time. One of the earliest examples occurred in 1960 with the launch of the Television and Infrared Observation Satellite (TIROS) designed to permit weather forecasting from space. Since that time, there have been a number of Earth observing programs, the most recent of which is the Mission to Planet Earth (MTPE) program. MTPE is a scientific program to provide multispectral, comprehensive, global observations of the Earth as part of an effort designed to understand the effects of both human-induced and natural environmental change. Involving participation from more than 20 international agencies, MTPE is designed to be far-reaching and achieve the broadest possible exchange of data. Determining the exact means by which the data will be widely distributed has been the subject of much discussion and negotiation among the MTPE parties. Participating countries, driven by local law and practice sought different outcomes. What is NASA's position? How has NASA's position evolved over time? This paper discusses NASA's practice with distributing Earth remote sensing data, from 1960 to the present, for programs involving partnerships. In this context, a partnership can be a program undertaken with significant contribution from a foreign government, an agency of the U.S. Government, or in one instance, a private company. "Data" refers to unenhanced data which is either unprocessed or preprocessed. NASA's practice is placed in context by presenting U.S. law and policy in this area. Because interest in Earth observing data is growing dramatically, there are sometimes conflicting interests, namely concerning public and/or private sector commercial access to government-generated data. These issues are also discussed.

This paper is not a statement of official U.S. policy. The opinions expressed herein are solely those of the author.

Mission to Planet Earth/Earth Observing System

NASA's cornerstone Earth observation program is the MTPE. "The basic scientific goal of MTPE is to understand the Earth as an integrated system, including the effects and couplings of the solid earth, land surface, oceans, atmosphere, and biota."[1] To accomplish this task, the data collection segment of MTPE must be diversified, which indeed it is. It includes . . ."EOS [Earth Observing System], Earth probes, geostationary satellites, and aircraft-and ground based programs . . ."[2] EOS alone provides a series of 17 satellites and supporting ground and data systems that will develop a 15-year environmental data base, focusing on climate change.[3] Because of the very large scope of the MTPE/EOS program, benefits derived from its data are expected to be great. It is intended that MTPE science can "provide an objective starting point for the development of sound global environmental policy" as well as "make important contributions to the reduction of hazards to human life and property from natural events such as earthquakes, volcanic eruptions, severe storms, and floods."[4] Program success will be based on the quality and quantity of the measurements taken, achieving broad dissemination and use, as well as success in analyzing and understanding the implications of the data.

In 1994, NASA concluded negotiations with its international partners on an overarching policy for International EOS (IEOS) data distribution. In the best of all worlds, for reasons of simplicity and clarity, there would be a uniform policy for all international participants. One permitting open, nondiscriminatory data distribution to all scientific users at the cost of reproduction and distribution would maximize use of the data. This was the approach advanced by NASA and the U.S. It would also provide an easily recognizable taxpayer return on NASA's investment. On the other hand, NASA's Earth observing programs undertaken to meet a demonstrable NASA mission or program requirement traditionally permitted principal investigators periods of exclusive use. Such periods are traditionally viewed as a mechanism to attract the best scientists in a given discipline. This provides them an opportunity to pursue specific peer-reviewed research objectives, as well as verify the accuracy of the recorded data prior to dissemination. Balancing these interests has proven challenging.

In addition, several countries such as those which are members of the European Space Agency, permit government-generated data to be copyrighted, which restricts subsequent distribution. Some countries also require the data-providing organization to recover its costs. Therefore, a scientist in the MTPE program who receives foreign IEOS data might have to agree to abide by any specific limitations imposed as a precondition of use and/or pay user fees. In contrast, the U.S. opposes the imposition of user fees, and by statute, works prepared by U.S. government employees as part of their official duties are not permitted copyright protection in the United States.[5] Moreover, NASA has stated that it does not intend to assert any protection internationally.[6] Thus distribution of data generated by the U.S. government is not subject to licensing restrictions either domestically or abroad.

U.S. Law and Policy

The basis of the U.S. position on nondiscriminatory data availability can be found in two early space policy pronouncements -- the United Nations (U.N.) established principle of "Open Skies" and public access to the results of NASA activities as provided in NASA's organic statute, the NASA Space Act of 1958, 42 U.S.C. § 2451 et. seq.

Open Skies refers to the right of a country with ownership of an Earth remote sensing satellite to collect and subsequently distribute data taken from space of the rest of the world. According to the U. S. Department of State, President Eisenhower first proposed Open Skies at the 1955 conference in Geneva. At that time, it was rejected by the Soviet Union.[7] Four years later, in a U.S. Policy on Outer Space, the Eisenhower Administration began to explore the appropriate position for the United States.

> An initial problem, in which all states have an interest, involves the permissibility of various activities in outer space. With respect to this problem, the report of the United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space expresses the following view which the

U.S. has supported: 'During the International Geophysical Year 1957-1958 and subsequently, countries throughout the world proceeded on the premise of the permissibility of the launching and flight of the space vehicles which were launched, regardless of what territory they passed over during the course of their flight through outer space. The Committee, bearing in mind that its terms of reference refer exclusively to the peaceful uses of outer space, believes that, with this practice, there may have been initiated the recognition or establishment of a generally accepted rule to the effect that, in principle, outer space is, on conditions of equality, freely available for exploration and use by all in accordance with existing or future international law or agreements.'

. . . Although the U.S. has not to date recognized any upper limit to its sovereignty, a principle of freedom of outer space, such as that expressed by the United Nations Ad Hoc Committee, suggests that at least in so far as peaceful exploration and use of outer space are concerned, the right of states to exclude persons and objects may not obtain. However, the full implications of a principle of freedom of outer space, in contrast with a principle of national sovereignty over outer space, remain to be fully assessed. It is possible that certain military applications of space vehicles may be accepted as peaceful or acquiesced in as non-interfering. On the other hand, it may be anticipated that states will not willingly acquiesce in unrestricted use of outer space for activities which may jeopardize or interfere with their national interests.[8]

The above policy statement demonstrates the initial considerations the U.S. addressed in supporting U.N. establishment of an Open Skies approach. However, certain issues such as how broadly "peaceful" or "non-interfering" uses of outer space would be interpreted were unresolved. Other nations disputed the underlying basis for Open Skies. According to Carl Christol, the different assertions regarding an individual state's right to sense, or in the alternative "not be sensed" are based on varying interpretations of the same legal theory, that of national sovereignty.[9] The U.S. position -- one equating sovereign rights with the right to acquire data from space -- is documented in 1978, in Presidential Directive NSC-37. The objectives of the policy, as stated are "(1) to advance the interests of the United States through the exploration and use of space and (2) to cooperate with other nations in maintaining the freedom of space for all activities which enhance the security and welfare of mankind."[10] By 1978, the U.S. had asserted its right to pursue the exploration and use of outer space for both peaceful purposes and in support of its right of self-defense. Specifically, the basic principles, as outlined include "rejection of any claims to sovereignty over outer space or over celestial bodies, or any portion thereof, and rejection of any limitations on the fundamental right to acquire data from space. The space systems of any nation are national property and have the right of passage through and operations in space without interference. Purposeful interference with space systems shall be viewed as an infringement upon sovereign rights."[11]

Those opposing the Open Skies theory, according to Christol, claim a right of "national privacy" or "the sovereign right of a State to be let alone."[12] In 1978, nine countries -- Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, and the Soviet Union -- formalized their position through a United Nations Convention on the Transfer and Use of Data of the Remote Sensing of the Earth from Outer Space. The treaty proclaimed that prior consent by the sensed state was required for disclosure of data having a resolution of greater than 50 meters.[13] The U.S. and other spacefaring nations refused to accept their position.

The United States continues to assert the Open Skies principle. In addition to the referenced 1978 Presidential Directive, it can be found in the national space policies issued since that time, to include the most recent National Space Policy released on September 19, 1996.[14]

The U.S. position on Open Skies was reaffirmed in the 1967 Outer Space Treaty. Article 2 states that "Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[15] This principle reiterates the right of a country to explore and use outer space to

include passage through and operations in space over territory situated outside national boundaries. In fact, according to Christol, "During the negotiations attending the drafting of the agreement, and in subsequent State practice, it has become clear that the space environment is perceived in international law as a *res communis* . . . as an area available for inclusive uses, rather than for exclusive uses."[16] Thus the Outer Space Treaty limitations on space activities are few. Article 1 "authorizes the exploration, exploitation and use of the area and the resources of the area provided such 'activities' are carried out, as Article I specifies, 'for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.'"[17] As one of approximately 95 countries to have ratified the Outer Space Treaty, the U.S. and most spacefaring nations espouse these principles.

In addition, in 1986, the U.N. General Assembly tied key provisions of the Outer Space Treaty to activities associated with Earth remote sensing. The U.N. adopted 15 Principles relating to remote sensing of the Earth from space. These principles include an explicit statement that remote sensing activities have to be conducted in accordance with Article 1 of the Outer Space Treaty. In addition, nations are directed to conduct their activities on "the basis of respect for the principles of full and permanent sovereignty of all States and peoples over their own wealth and natural resources, with due regard to the rights and interests, in accordance with international law, of other States and entities under their jurisdiction. Such activities shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed State."[18] U.S. policy provides that the sensed state be provided a copy of the data it has collected through overflights. That position is incorporated in the Open Skies Treaty, signed by 27 nations in Helsinki, Finland on March 24, 1992. Signatories include nations from the former Warsaw Pact and NATO. In addition, other parties to the treaty, upon request, have the right to the data collected by the observing state. The treaty was ratified by the United States in December 1993, but has not yet entered into force.

A second doctrine affecting NASA practice is incorporated in NASA's organic statute, the NASA Space Act of 1958, 42 USC § 2451 et. seq. It directs NASA to undertake broad dissemination across-the-board in its work in aeronautical and space programs. Specifically the Space Act requires NASA to work with the scientific community in planning and undertaking measurements and observations using aeronautical and space vehicles as well as "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."[19] Thus from its inception, NASA was recognized as a public resource whose value to the public, in part, would be measured by how successfully it disseminates information, not only domestically but also abroad. Section 205 of the Space Act grants NASA authority to enter into international agreements. In the "policy and purpose" section of the Act, Congress directs NASA to accept as one of its objectives the conduct of aeronautical and space activities to include "Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof."[20]

These principles are reflected in NASA's Strategic Plan which recognizes that MTPE serves the public at large. "The ultimate beneficiaries of Mission to Planet Earth are the present and future generations of people on Earth. The primary customers of Mission to Planet Earth are those who use environmental information to make decisions, especially national policy makers in the Administration and Congress and their international counterparts. The world science community also uses Mission to Planet Earth data and information to produce assessments, forecasts and analysis, and to develop new understanding."[21]

Given these two overarching principles, has NASA consistently conducted its business in consonance with them, as documented in its agreements with partners? If not, are there subsequent U.S. law and policy changes that dictated NASA practice?

NASA Practice

The very first satellite launched by NASA was the polar orbiting, Television and Infrared Observation Satellite (TIROS) launched in 1960. The first in a series, TIROS was designed to permit weather forecasting from outer space. The program was

conducted as part of an agreement, dated April 1959, between NASA and the Advanced Research Projects Agency (ARPA) of the Department of Defense (DoD). Under the terms of the agreement, TIROS data was shared by both NASA and the DoD. Specifically, section 2 of the agreement required "close cooperation and full exchange of information between NASA and DOD." To effectuate full exchange of data, a committee with NASA and DoD participation was established. The agreement stated that:

> In order to insure the complete availability to DOD and NASA of all information developed under Project TIROS and to insure that the respective interests of both are fully recognized in carrying out the Project, the following arrangements are agreed to: a) A committee will be established under NASA chairmanship, with representation from both DoD and NASA, to advise NASA on technical matters related to Project TIROS, including DOD requirements, and to make any necessary arrangements for the close cooperation and full exchange of information between NASA and DOD.[22]

The TIROS program served NASA well in terms of establishing a standard for achieving "full exchange of data" among the participating entities.

During the next two decades, a series of TIROS satellites were launched which permitted continuity in weather forecasting. In 1961 however, after TIROS was recategorized as operational, responsibility for the program was transferred from NASA to the U.S. Weather Bureau. NASA was given responsibility, in 1964, for the next experimental meteorological satellite program, called Nimbus. The last in the series, Nimbus-7, was launched in 1978.

According to Richard Chapman, cited in "TIROS-NIMBUS: Administrative, Political, and Technological Problems of Developing U.S. Weather Satellites", TIROS was a great success and "literally created a worldwide appetite for weather satellite data and evoked worldwide praise."[23] President Dwight Eisenhower acknowledged NASA's 'startling strides' in weather forecasting, satellite communications and deep space probes in his January 12, 1961 address given just prior to the end of his term. He specifically called out the successful launching of TIROS-I and TIROS-II, which in his opinion, "promise[d] to revolutionize methods of weather forecasting."[24]

President John Kennedy likewise, took a keen interest in satellite technology. In his January 30, 1961 State of the Union Address, he invited all nations, including the Soviet Union, to join the U.S. in developing a weather prediction program, a new communications satellite program and planetary probes.[25] The President understood the potential value of space technology to people of all nations. He requested additional appropriations from Congress in May, 1961, not only to send a man to the moon and back within a decade, and for communications, but also to accelerate the weather prediction program to permit "world-wide weather observation" at the earliest possible time. . . "Such a system [of weather satellites], the President recognized, will be of inestimable commercial and scientific value; and the information it provides will be made freely available to all the nations of the world."[26]

It was not long before President Kennedy's vision was realized. By 1963, the United States was providing direct reception of weather data, free of charge, to users around the world. Currently there are more than 1,000 direct readout stations in over 130 countries. Users include public and private entities, as well as domestic and foreign governments.

Thus since the beginning of the meteorological satellite program, a tradition of making information "freely" available throughout the world was embraced at the highest levels of the U.S. Government. Weather information continues to be made available at no cost for public use and at the cost of reproduction for commercial use. The approach for U.S. Earth remote sensing programs, although not the same, has undergone changes which have brought it closer to achieving the maximum distribution possible.

A subsequent Earth remote sensing program, undertaken by NASA in conjunction with the Departments of Interior and Agriculture, was the Earth Resources Technology Satellite (ERTS) launched in July, 1972. The program was designed to "determine the desirability and configuration of an

operational space-based earth resources survey system, and the problems associated with handling data from such a system."[27] According to Pitt Thome, quoted in a doctoral thesis, "NASA's Administrator, at the time of the ERTS program decided to make the data available to the public at the same time it was provided to selected Principal Investigators. His rationale was that if there was economic value in the data, as widely anticipated, he did not want NASA to be in a position of selecting potential beneficiaries of such economic value."[28] As a result, data was provided to the public, without restrictions, and at essentially the cost of fulfilling a user request, until 1984.

In May, 1972, NASA issued a policy directive addressing the availability to the public of all NASA-acquired Earth Resources Survey Imagery. It was to be made available at the cost of reproduction, both domestically and abroad, without restrictions except for national security concerns.

> Photographic products acquired by NASA for research and experimental use in the Earth Resources Survey Program from surface, airborne, or space-borne platforms, will, except as may be prohibited by law or regulations, be freely available for purchase by private and public parties, both foreign and domestic. Such photographic products will be placed in the public domain as soon as practicable after acquisition and before other use is made thereof. . . [29]

The policy also addressed the sale of imagery in the public domain. It could be provided free of charge by NASA and other Federal agencies engaged in the program: for purely educational or informational activities in the public interest; where there is a binding agreement between the government and another party in support of U.S. programs; where a foreign or domestic agreement exists calling for exchanges of data; when determined to be in the national interest; and when billing costs would exceed the return from charges. Government agencies providing imagery without reimbursement were given the responsibility to ensure the proprietary rights to the data were protected.[30]

The ERTS program generated a great deal of interest and excitement, according to a December 11, 1969 Memorandum for the President.

> . . . although the extent of the programs' future utility is not yet proved, progress in the field already has kindled a high degree of enthusiasm among proponents in the U.S. and has attracted considerable attention abroad. The enthusiasm centers on the belief that we are now on the threshold of a break-through in our capability to investigate, understand, and therefore to deal more effectively with, the earth's resources. Remote sensing by satellite (in conjunction with remote sensing by aircraft) offers not only promise of assisting in the acquisition of significant new information about resources. Perhaps, more important, it opens the door, for the first time, to a means by which regular inventory of resources might be taken, and therefore management of resources can be achieved to a degree far beyond anything previously thought attainable. The result, therefore, could be potentially and ultimately a major contribution to the solution of a number of the earth's food, water, and other resources problems as well as contributing to improvement of environmental quality.[31]

In September 1969, in a speech before the United Nations, then President Richard Nixon shared his vision for embarking on a truly global Earth resources satellite effort.

> The United States will (1) share the adventures and benefits of space and (2) as an example of our plans 'take actions with regard to earth resource satellites as this program proceeds and fulfills its promise' (3) dedicate the program to producing information not only for the U.S. but also for the world community; and (4) put 'several proposals in this respect before the United Nations.'[32]

Some of the "follow-up steps" to the U.N. speech were identified as well:

> To formulate and seek support for a resolution of the General Assembly which would, inter alia,

> invite Member States with experience in the field to make such experience available to the other Member States and encourage the latter to become familiar with the field; encourage examination of programs and participation where feasible and practicable in their development including programs relating to airborne sensing techniques; invite Member States to join in exploring the problems of data analysis dissemination and application of data; and request the Outer Space Committee to continue its studies regarding the possibilities of further international cooperation.[33]

It is interesting to note that many of these same goals exist for current U.S. civil remote sensing programs including MTPE.

The ERTS program was later renamed LANDSAT, which stands for Land Remote Sensing Satellite System. The LANDSAT spacecraft carried multispectral scanners to provide high spatial and spectral resolution of both land and ocean mass. The LANDSAT program, like TIROS, was developed with the understanding that broad data dissemination would be an integral part of the program. Initially, during the time it was considered to be a research and development asset, LANDSAT was managed and operated by NASA. Data was transmitted to ground stations and sold by the Department of the Interior, through its Earth Resource Observation Systems (EROS) Data Center. "American users received data either directly from the satellite at no cost or at very low cost from NASA or the U.S. Geological Survey Earth Resources Observation System Data Center." [34] NASA entered into agreements with foreign ground stations which permitted them to collect data directly from the satellite as it passed overhead for an access fee of $200,000 per year. As a precondition to any ground station agreements, the station operator had to accept the U.S. nondiscrimination policy in its subsequent distribution and sales.[35] In addition, in limited circumstances, NASA provided grants to universities, non-profit organizations and State and local governments to receive LANDSAT data either free of charge or at reduced prices.[36]

President Jimmy Carter likewise supported development of remote sensing systems on a global basis. In an "Announcement of Administration Review" dated June 20, 1978, the President determined that:

> The United States will develop and operate on a global basis, active and passive remote sensing operations in support of national objectives . . . Data and results from the civil space programs will be provided the widest practical dissemination to improve the condition of human beings on Earth and to provide improved space services for the United States and other nations of the world.[37]

The Carter position was reiterated in the U.S. Civil Space Policy issued in October of that same year. It included as one of its first tenants a promise to "Emphasize space applications that will bring important benefits to our understanding of earth resources, climate, weather, pollution and agriculture, and provide for the private sector to take an increasing responsibility in remote sensing and other applications."[38] The policy committed the U.S. to continue to provide data from the developmental LANDSAT program for all classes of users. Simultaneously, NASA and Commerce were directed to prepare a plan to look at means for encouraging private sector investment and participation in civil remote sensing programs. The LANDSAT program had been the subject of much debate regarding whether or not it could be managed by the private sector. Although the Federal Government was the predominant user of the data, it was thought that a great many more commercial users could be identified and encouraged to buy the data.

In 1979, as a first step in a process to privatize LANDSAT, the Carter Administration announced plans to transfer the system to an agency with experience in satellite operations, the National Oceanic and Atmospheric Administration (NOAA), within the Department of Commerce. The Commerce Department was directed to "seek ways to further private sector opportunities in civil land remote-sensing activities, through joint ventures with industry, a quasi-government corporation, leasing, etc., with the goal of eventual operation of these activities by the private sector." The policy also committed the U.S., in the interim, to continue to

provide LANDSAT data to foreign users as well as promote "development of complementary and cooperative nationally operated satellite systems so as to increase benefits for all nations."[39]

Transfer of LANDSAT to NOAA was achieved in 1982 as part of then-President Ronald Reagan's National Security Decision. In addition to the transfer, the policy included a commitment to provide public direct readout of Federal civil Earth remote sensing data to foreign users and ground stations.[40] In February, 1988 President Reagan released a subsequent space policy and commercial space initiative. The U.S. position remained the same with respect to its data policy. In addition, the administration declared an end to Federal subsidization of LANDSAT.

> The directive states that the United States Government will: (1) encourage the development of commercial systems which image the Earth from space competitive with or superior to foreign-operated civil or commercial systems; (2) discuss remote sensing issues and activities with foreign governments operating or regulating the private sector operation of remote sensing systems; and (3) continue a research and development effort for future advanced, remote sensing technologies. Commercial applications of such technologies will not involve direct Federal subsidy.[41]

In order to address the directive forbidding government subsidies, NOAA sought to bring the LANDSAT prices in line with the then-current operating costs of the program. In 1982, it began charging foreign receiving stations three times more than previously for the application fee. In addition, each station was charged a fee for the data it subsequently sold or distributed.[42] That same year, Earth Observation Satellite Company (EOSAT) was selected by the Department of Commerce to commercially operate LANDSAT. Contract negotiations were concluded in September, 1985 which gave EOSAT authority to operate and exclusively market LANDSAT 4 and 5 systems. EOSAT set prices for LANDSAT 1 through 6 data as well.

However, by this time, Congress had enacted the Land Remote-Sensing Commercialization Act of 1984 (P.L. 98-365), which among other things, mandated nondiscriminatory access to LANDSAT data, even for private sector operators. "Non-discriminatory basis" was defined as meaning "without preference, bias, or any other special arrangements (except on the basis of national security concerns pursuant to section 607) regarding delivery, format, financing, or technical considerations which would favor one buyer or class of buyers over another."[43] This required EOSAT to set one price for all customers.

In addition to codifying the nondiscriminatory data access policy, the purpose of the Land Remote-Sensing Commercialization Act of 1984 was to provide a phased transition of the LANDSAT program from one managed and funded by the government, to a fully commercial system. Private operators could obtain government approval to operate remote sensing spacecraft by getting a license from the Department of Commerce. Where it made sense to have private systems, the Act directed the government to avoid setting up competing systems. In an effort to guarantee that the government would not compete, limitations were placed on its use of Federal experimental remote-sensing space data. Such data could only be used for related Federally-funded research and development (including applications) and/or cooperative research programs. In addition, the data could be sold en bloc, to any U.S. entity willing to market the data on a nondiscriminatory basis and consistent with national security and international interests. Congress hoped that by clearly delineating and narrowing the parameters for scientific use, the data would have commercial value as well.[44] This legislation illustrates the approach taken by the Congress to reach a balance between private sector commercial interests and scientific research goals. Whether Congress accomplished something that was ultimately in the best interests of the public has been open to debate. Certainly scientific use of government-generated data was affected negatively by EOSAT's pricing scheme. EOSAT had to recoup its operating costs, whereas previously, data was provided to government-sponsored scientists and researchers at a price which reflected the existence of large Federal subsidies.

Congressional oversight of the LANDSAT program continued unabated. In October, 1987, Congress passed amendments to the Land Remote-Sensing Commercialization Act of 1984 (P.L. 100-147), to clarify its intent that the system operator (EOSAT) was supposed to provide data for government-sponsored research and development programs. In addition, the Act explicitly limited subsequent use and distribution to preclude the data from being incorporated into commercial products. Specifically, EOSAT was instructed to provide data for any research and development program if the following conditions were met:

> (1) a complete and timely disclosure of the results of such research and development is made in the open technical literature or is otherwise made publicly available; (2) the system operator or marketing entity provides to the Secretary an annual report of all research and development data transactions including the nature of any cooperative agreements and the prices charged for data; and (3) the data are not used for commercial purposes or in substantial competition with data available from a licensee under this Act.[45]

In October 1992, Congress reversed itself; it repealed the Land Remote-Sensing Commercial-ization Act of 1984. In its place, a new act, the Land Remote Sensing Policy Act of 1992 (P.L. 102-555) was passed which gave management of LANDSAT 7 to NASA and the DoD. The Congress acknowledged that the expense of the data sets was discouraging their widespread use -- a situation that would not change in the near future because full commercialization was not then achievable. LANDSAT 6, the first of the LANDSAT series to be fully built and operated by a commercial entity, had failed. The Administration committed to maintaining LANDSAT data by supporting LANDSAT 7 construction and operation. The Act seeks to maximize the value of the program to the American public by providing LANDSAT 7 data to all users at the cost of fulfilling a request. The legislation specifies the following:

> (a) LANDSAT 7 DATA POLICY. -- The LANDSAT Program Management, in consultation with other appropriate United States Government agencies, shall develop a data policy for LANDSAT 7 which should -- (1) ensure that unenhanced data are available to all users at the cost of fulfilling user requests; (2) ensure timely and dependable delivery of unenhanced data to the full spectrum of civilian, national security, commercial, and foreign users and the National Satellite Land Remote Sensing Data Archive; (3) ensure that the United States retains ownership of all unenhanced data generated by LANDSAT 7; (4) support the development of the commercial market for remote sensing data; (5) ensure that the provision of commercial value-added services based on remote sensing data remains exclusively the function of the private sector; and (6) to the extent possible, ensure that the data distribution system for LANDSAT 7 is compatible with the Earth Observing System Data and Information System.
> (b) In addition, the data policy for LANDSAT 7 may provide for -- (1) United States private sector entities to operate ground receiving stations in the United States for LANDSAT 7 data; (2) other means for direct access by private sector entities to unenhanced data from LANDSAT 7; and (3) the United States Government to charge a per image fee, license fee, or other such fee to entities operating ground receiving stations or distributing LANDSAT 7 data.[46]

As for LANDSAT 4 - 6 data, (although LANDSAT 6 subsequently failed) an exception to the EOSAT pricing scheme established under the "nondiscriminatory" distribution policy is permitted so that data can be provided more cheaply to U.S. Government agencies, global environmental change researchers, and other researchers sponsored by the U.S. Government. This class of users can obtain data at the cost of fulfilling a request. In addition, the LANDSAT Program Management was directed to begin negotiations with EOSAT to bring the LANDSAT 4 - 6 data policy in line, over the life of the EOSAT contract, with the LANDSAT 7 data policy.[47]

Experimental space remote-sensing data no longer has to be sold en bloc through a competitive process to

any entity wishing to market the data on a nondiscriminatory basis. In its place, Congress has promoted fuller commercial participation from various business sectors able to use the unenhanced data. Such businesses are often interested in generating "value-added" products.

Likewise government-sponsored researchers again have access to LANDSAT data on terms that permit their science goals to be met. The LANDSAT 7 MOU, which will define the data dissemination terms and conditions, in consonance with the Land Remote Sensing Policy Act of 1992, has not yet been finalized. LANDSAT 7 is scheduled for launch in 1998.

During the signing ceremony for the Land Remote Sensing Policy Act of 1992, President George Bush articulated the highlights of the legislation. It will encourage future commercial opportunities in remote sensing by "supporting investments in new remote sensing technologies, removing unnecessary restrictions on the dissemination of privately gathered data; streamlining the licensing process for private remote sensing systems; and encouraging growth of the market for remote sensing data by pricing Federally provided data at the cost of fulfilling user requests, but no higher."[48]

The LANDSAT program highlights the difficulty of trying to bring scientific and commercial interests together. Subsequent efforts were made with other Earth observing programs, such as the Seastar (synthetic aperture radar)/SeaWiFS (Sea-viewing Wide Field-of-view Sensor) project. Signed in 1978, the 5-year contract will permit NASA, after the spacecraft is operational, to purchase ocean color data for government research purposes from a private source, Orbital Sciences Corporation (OSC). At the same time, OSC intends to market the data for commercial use as well.[49] Advanced funding by the government allowed OSC to secure the private financing required to design and begin building the satellite. The planned launch date was August 1993, but it has since slipped to February 1997.

The NASA/OSC contract permits NASA, in limited circumstances, to provide temporary real-time acquisition of data to specific authorized research users "where there exists adequate protections to ensure that the data will be used for research purposes exclusively, and when there is a compelling research requirement for real-time use by specified research users."[50] Otherwise 2 to 4 weeks processing time is built into the data availability schedule to permit OSC the opportunity to sell the same data to commercial users in real-time, and thereby provide them the greatest opportunity for making a profit.

NASA solicited proposals for no-cost research use of the SeaWiFS data through a "Dear Colleague" letter dated August 10, 1992. Data access terms were delineated as follows: researchers can obtain data, which for the most part will have a 4 km resolution, from the NASA archives (at preapproved ground stations) "at a cost which does not exceed the incremental cost of filling the individual user request." Such data will be provided after a delay of 2 to 4 weeks. NASA also agreed to obtain written agreements from each of its users guaranteeing that the data would only be used for research purposes.[51] Another category of data users are institutions and individuals. They can be granted authority to "directly receive encrypted data broadcast by the SeaWiFS satellite as it passes overhead. Non-U.S requests must be endorsed by an agency of the national government in the country. These data will be at 1 km resolution, but coverage will be limited to local data acquisition within the ground station mask. Costs for the ground station must be incurred by the requester. NASA may require a copy of the data received."[52]

Whether or not this is successful is to be seen since the satellite launch date has been so delayed. Success will have to be evaluated against NASA's scientific goals and OSC's commercial requirements. The unique SeaWiFS approach of time phasing data was initially applauded. However, OSC's repeated technical difficulties with the sensor and the possible availability of sea color data from the more recent launches of other remote sensing systems raise questions if this approach will ever receive a true market test.

Another unique example of a data distribution method began with the 1981 launch of a group of Earth observation experiments on the shuttle called the

Earth Spaceborne Imaging Radar series. These programs were begun as part of a research and development effort to evaluate the utility of radar remote sensing technology for Earth observations and mapping. The first spacecraft was designated SIR-A; the second, SIR-B, flew in 1984; and the third, SIR-C, flew in 1987. Only SIR-C was done in partnership with another entity. By way of comparison, the data access provisions for SIR-B and SIR-C are provided below.

The SIR-B, according to the 1984 agreement, was built to "measure the radar backscatter characteristics of preselected test site areas at variable angles of incidence."[53] Data distribution was bifurcated. Principal and Co-Investigators, whose proposals were pre-approved through a peer review process were given direct access to SIR-B data for the purpose of carrying out their pre-authorized research. They were not permitted to duplicate or give SIR-B data furnished by NASA to other individuals except those identified in their research proposal. A World Data Center was established to provide data, under restricted terms, to the general public and other interested parties in the scientific community.[54]

It was determined that SIR-B was subject to the applicable provisions of the Land Remote Sensing Commercialization Act of 1984 (P. L. 98-365). As a result, NASA limited its distribution of data to pre-selected Principle Investigators and prepared to conduct an "en bloc" sale of data for alternate uses. The "en bloc" sale was never conducted before the Act was repealed by the Land Remote Sensing Policy Act of 1992.[55]

In 1987, a SIR-C Memorandum of Understanding (MOU) was signed between NASA and the Federal Minister for Research and Technology (BMFT) of the Federal Republic of Germany. The Shuttle Imaging Radar was combined with the German provided X-band Synthetic Aperture Radar (X-SAR). It was intended that the SIR-C mission "provide multiple angles of incidence, multiple wavelength and multipolarization capability."[56]

As provided in the MOU, the science data rights permitted Principle Investigators an exclusive period of one year to validate and analyze the incoming data. Following that period, Germany controlled distribution of X-SAR data and the United States of SIR-C data to individuals outside the joint program. NASA intended to generally release SIR-C data immediately following the restricted period. The agreement read as follows:

> (1) Designated investigators will have a period of one year, beginning with the receipt of data in a form suitable for analysis, to perform verification and calibration and to engage in science activities in a manner coordinated between NASA and BMFT. General release of suitable X-SAR data sets is planned through DFVLR (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt). General release of suitable SIR-C data sets is planned in conformance with U.S. legislation governing release of experimental data by NASA. With regard to general distribution following the period of investigator activities, it is expected that NASA will arrange for X-SAR dissemination. NASA and BMFT may wish to engage in further data exchange of SIR-C and X-SAR data for experimental purposes. (2) Data provided to designated investigators under terms of this agreement can be used for experimental purposes only and will not be provided to any third party.[57]

The data provisions of the MOU were amended, by exchange of letters, in 1994 in keeping with NASA's movement toward broad data dissemination and use.

> Designated investigators will have a period of three months of exclusive data use beginning with the receipt of data in a form suitable for analysis, to perform verification and calibration and to engage in science activities coordinated between NASA and DARA. General release of suitable X-SAR data sets is planned through DARA/DLR and ASI. General release of suitable SIR-C data sets is planned through NASA. With regard to general distribution, following the period of investigator exclusivity, data sets will be placed in an appropriate archive and made available to users at no more than the marginal cost of filling the specific user request. During the period of investigator activity, designated investigators will

be given priority treatment over other users in receiving data products needed to conduct their investigations. NASA and DARA may wish to engage in further data exchange of SIR-C and X-SAR data for experimental purposes.[58]

For SIR-C, initial MOU provisions limiting data dissemination and use were amended to reflect the changing trend toward open data access policies espoused by the U.S. This situation will repeat itself in the next partnership as well.

An MOU was signed in March, 1987 between NASA and the French Centre National D'Etudes Spatiales (CNES) for a new Earth remote sensing program called TOPEX/POSEIDON. According to the MOU, the primary objective of the TOPEX/POSEIDON project was "to measure the surface topography of the global oceans for three years with sufficient accuracy and precision to enable the determination of the ocean's general circulation as well as its mesoscale variability." This was to be achieved through "radar altimetry, precision satellite tracking, and precision orbit determination."[59] Both NASA and CNES provided radar altimeters and tracking systems; the U.S. also provided a microwave radiometer. Data distribution rights mirrored those of the initial SIR-C/X-SAR program. Principal Investigators were given a period of exclusive use after which NASA would make the data generally available to the scientific community. Specifically the provisions read as follows:

> . . . (c) All TOPEX/POSEIDON Investigators will be expected to share data with one another, under procedures to be developed by the TOPEX/POSEIDON Science Working Team (SWT), in order to maximize the planned scientific return from the mission. The SWT will have exclusive use of the data for a period of time as mutually agreed but not to exceed twelve months after launch. NASA will make such data available to the general scientific community through NASA's Ocean Data System (NDOS) and/or such other U.S. facility, as appropriate. CNES will make such data available to the general scientific community through the French Ocean Data System (AVISO) under development. It is noted that NASA and CNES will take appropriate steps, as mutually agreed, to ensure compatibility between AVISO and NDOS.[60]

Although the Science Working Team was given exclusive data rights for a period of up to one year, they subsequently waived those rights and the data was made available to all users through the EOSDIS facility at the Jet Propulsion Laboratory immediately following the calibration period.[61] According to NASA program managers, "CNES and NASA had been very active in international discussions of data access for global change research and would have had difficulty justifying restrictive policies for TOPEX/POSEIDON with their public political positions encouraging widespread sharing of scientific data for research."[62]

Following the TOPEX/POSEIDON program, NASA negotiated an agreement with the USSR for the METEOR-3/TOMS -- Total Ozone Mapping Spectrometer Mission. An Implementing Agreement was signed on July 25, 1990 between NASA and the State Committee for Hydrometeorology of the Union of Soviet Socialist Republics (USSR). The program objective was to provide "continued mapping of global ozone from space and studying global and regional changes in the ozone as well the establishment of avenues of communication between the Parties at both scientific and technical levels to help resolve the question of global ozone modification."[63] NASA provided the TOMS/FM-2 instrument and interface adapter module. STATE HYDROMET USSR provided the spacecraft (Meteor-3), and the launch vehicle (Cyclone). Data sharing between countries was more limited than was provided in previous agreements with other countries. Probably this can be explained by the fact that the agreement was entered into during the height of the Cold War between the U.S. and U.S.S.R. Article XVII outlined each party's respective data rights.

> NASA and STATE HYDROMET USSR will each be entitled to receive all raw flight data from TOMS on the Meteor-3 and may reproduce, use and disclose the data for any purpose at their discretion. It is the intention of the Parties that the raw, processed, and analyzed data will be made available to the international scientific

> community as noted in Article XIII and through publication or other appropriate means. [64]

Article XIII provided for the following concerning data analysis:

> NASA will reduce all the telemetry data to ozone values and will deliver archival ozone data tapes to National Space Science Data Center (NSSDC). NASA will provide to STATE HYDROMET USSR the TOMS radiance tables (look-up), a description of the physics and a description of the reduction algorithm which are in the public domain.[65]

Cooperation with respect to the sharing of analyzed data was kept to minimum. By comparison, "For EOS, NASA will acquire all data from its platforms and share the processing and archiving responsibilities with the foreign instrument providers." [66]

As the subject of her doctoral thesis, Dr. Lisa Shaffer, NASA's Director of MTPE Division, Office of External Relations, analyzed data access terms for NASA programs and determined that access varied depending on whether the program was undertaken to meet NASA mission requirements exclusively (autonomous programs) or if partnerships with foreign entities or agreements with other Federal agencies were involved. She concluded that:

> Autonomous programs have proprietary periods for Principal Investigators, while client and partner programs have open access policies. This may in part be a historical trend toward more open policies, since earlier programs tended to be autonomous, and more recent programs all involve partners. This reflects both the growing capability of NASA's potential international partners and the sophistication of the international scientific community. The difference in data access terms can also be explained by the desire of partners and clients to ensure their unrestricted ability to use output of their joint endeavor.[67]

In March 1991, NASA issued an internal NASA Management Instruction (NMI) stating its revised policy on dissemination of NASA-acquired experimental Earth remote sensing data to the public. NASA policy is determined according to the intended user. For all users participating in cooperative research programs or Federally-funded research, development, and application programs, spaceborne remote sensing data is to be made available as soon as practicable after acquisition and without any period of exclusive use. Furthermore, distribution costs are not to exceed the marginal cost of reproduction and distribution. In limited circumstances, the above-referenced users can get the data and products free of charge -- for educational or informational activities in the public interest; as part of a quid-pro-quo where a binding agreement exists; and when it is determined to be in the national interest of a government agency participating in the U.S. Global Change Research Program. Finally, as a precondition to access, the above users are required to specify that they would not engage in commercial applications of NASA-provided data without authorization.[68] Thus even for Earth remote sensing programs exclusively designed to meet NASA mission requirements, there can be no provision for exclusive access to data by the government-sponsored principle investigators. The other category of user addressed in NMI 8000.3 is one permitted by the Land Remote-Sensing Commercialization Act of 1984. The NASA policy specifies that spaceborne experimental remote sensing data could also be made available according to the terms of the Act (15 U.S.C. 4263)(although that Act has since been repealed).

NASA policy changed in that the NMI directs it to provide data free of charge in limited circumstances (previously, under NPD 8000.1, the data would have had to have been in the public domain), broadens the research user group to include those participating in applications or cooperative research programs, prohibits any period of exclusive use, and defines how the costs of disseminating the data will be assessed.

The Administration issued its own set of directives in its February 11, 1991 Presidential Directive on Commercial Space Policy Guidelines. The guidelines set forth the U.S. position with respect to commercial use and exploitation of space technologies. "The U.S. Government encourages private investment in, and broader responsibility for, space-related activities that can result in products and services that meet the needs

of government and other customers in a competitive market." However, "As a matter of policy, the U.S. Government pursues its commercial space objectives without the use of direct federal subsidies."[69]

U.S. policy was documented in a set of principles outlined by the Assistant to President Bush for Science and Technology, Dr. Allan Bromley, and as part of a broader policy encompassed in the Paperwork Reduction Act (PRA) of 1995 (44 U.S.C. § 3501 *et seq.*), with implementing regulations provided by the Office of Management and Budget (OMB) in Circular A-130 (February 8, 1996). The Bromley principles are entitled "Data Management for Global Change Research Policy Statements." They were issued as U.S. policy on July 2, 1991. Their stated purpose is to "facilitate full and open access to quality data for global change research." Seven principles are articulated which address the full scope of data management considerations. The principles include a commitment to high-quality, long-term data sets; full and open sharing; preservation of all data needed for long-term global change research; easily accessible data archives; use of national and international standards for media processing and communication of global data sets; provision of the data at the lowest possible cost; and availability of data as soon as it becomes widely useful.[70]

The Clinton Administration likewise placed high priority on global change research. Its U.S. Global Change Research Program (USGCRP) includes participation and coordination among several agencies of the U.S. Government. In a May 28, 1992 National Space Policy Directive, the Administration outlined its reasoning behind the creation of the USGCRP.

> The U.S. Global Change Research Program (USGCRP), is a key component of the nation's overall approach to global stewardship and is one of the nation's highest priority science programs. The program's goal is to provide a sound scientific basis for developing national and international policy relating to natural and human-induced changes in the Earth system. The ultimate success of the USGCRP depends upon an integrated set of ground and space-based observation and research programs. The United States is planning on implementing a series of satellite missions that include NASA's Mission to Planet Earth, related environmental satellites, and activities of other agencies to provide these global observations for the next several decades. For purposes of this document, these systems are collectively referred to as the Space-based Global Change Observation System (S-GCOS).[71]

The implementing guidelines expect Federal agency participation in the USGCRP and interagency coordination. They also encourage Federal agencies to explore potential international cooperation in space-based global change observation.

Likewise, numerous international organizations are tackling the problems associated with coordinating and implementing a truly global initiative. Issues such as determining international standards for data processing, archiving and dissemination needed to be addressed. In September 1994, a multinational group, the Committee on Earth Observing Satellites (CEOS) agreed on principles for operational environmental use of data for the public benefit. Although not legally binding, the principles give an indication of the degree to which the U.S. data access policy is in sync with the international community. The CEOS agreed to do the following:

> Take into account the needs of users of data for operational environmental use for the public benefit . . . make data available on time scales compatible with user requirements and within agency capabilities . . . CEOS data supplier should provide easily accessible information and the data and related mission parameters . . . recognized standards should be used to the greatest extent practical . . . appropriate data provision mechanism should be used to optimize the use of data for operational environmental use for the public benefit . . . programs should have no exclusive period of data use except where there is a need to provide for data validation. An initial period of exclusive data use should be limited and explicitly defined. The goal should be release of data in some preliminary form within three months after the start of routine data acquisition.[72]

The international principles articulate on the one hand, objectives that mirror U.S. data access policy. On the other hand, the principles permit, within the overarching guidelines, interpretation and implementation to vary depending on national law and policy. This runs counter to U.S. goals for accomplishment of a broad-based global Earth remote sensing program -- one that fully utilizes all resources.

In October 1994, the U.S. entered into the first of several MOUs with foreign partners on the IEOS program. This first significant cooperation, with Japan, was called the Advanced Earth Observing Satellite (ADEOS). NASA provided a scatterometer and the Total Ozone Mapping Spectrometer (TOMS). Japan, through its National Space Development Agency (NASDA) provided the launch vehicle. ADEOS was developed by NASDA in order to establish platform technology for future spacecraft and inter-satellite data relay technology for transmitting Earth observation data, and to contribute to the observation of global environmental change. The U.S.-provided scatterometer was designed to take "190,000 measurements per day of the speed and direction of winds within about 1.5 inches of the ocean surface . . . " The TOMS sensor "will help extend the unique data set of global total column ozone measurements begun by a TOMS carried aboard NASA's Nimbus-7 satellite in 1978."[73]

The ADEOS MOU incorporated by reference, the 1994 data distribution provisions drafted by the Earth Observation International Coordination Working Group (EO-ICWG). These Data Exchange Principles (DEP) are intended to be included in each IEOS MOU. In addition, EOS investigators are required to agree to the DEP as a pre-condition to their selection for the program. The DEP provides for the following:

> [1] All IEOS Data will be available for peaceful purposes to all users *("users" does not include commercial users in this context)* on a non-discriminatory basis and in a timely manner.
> [2] There will be no period of exclusive data use. When the need to provide validated data is recognized, any initial period of exclusive data use should be limited and explicitly defined. The goal should be release of data in some preliminary form within three months after the start of routine reception of instrument data.
> [3] All IEOS Data will be available for the use of each of the Agencies and its designated users at the lowest possible cost for non-commercial use in the following categories: Research, Applications, and Operational Use for the Public Benefit . . .
> [8] All data required by the Agencies and their designated users will be made available on condition that the recipient agrees to applicable intellectual property rights, terms and conditions and/or proprietary rights consistent with these Data Exchange Principles, and ensures that the data shall not be distributed to non-designated parties, nor used in ways other than those for which the data were provided, without the written consent of the Data Providing Agency."

Key definitions include the following:

> *"Non-discriminatory Basis* means that all users in a clearly defined data use category can obtain data on the same terms and conditions, and the categories are defined in such a way that all potential users will be included in categories with access to data."
>
> *"Non-commercial Operational Use for the Public Benefit* is the utilisation of data to provide a regular service for the public benefit as distinguished from conferring an economic advantage on a particular user or group of users."
>
> *"Applications Use* of data is a limited proof of concept study toward: 1) the solution of an applied program to demonstrate the utility of the data; or 2) the demonstration of the operational use of the data." [74]

As for commercial access to IEOS data, terms and conditions are not included in the DEP. Therefore, instrument providers can establish access terms so long as the data dissemination is nondiscriminatory.

There are several IEOS platforms from different partner agencies which are subject to the DEP. IEOS platforms and corresponding instruments include: The NASA Earth Observing System (EOS), beginning

with EOS-AM1; the ENVISAT-1 element of the ESA Polar Orbit Earth Observation Mission (POEM) programme, the NOAA Polar-orbiting Operational Environmental Satellites (POES), beginning with NOAA-N, the Japanese Earth Observing System (JEOS) [beginning with the Advanced Earth Observing Satellite (ADEOS)]; and the NASA/Japanese Tropical Rainfall Measuring Mission (TRMM). International agencies include the European Space Agency (ESA), the European Organization for Exploitation of Meteorological Satellites (EUMETSAT), NASA, the National Oceanic and Atmospheric Administration (NOAA), the Japanese Science and Technology Agency (STA), the National Space Development Agency of Japan (NASDA), the Ministry of International Trade and Industry of Japan (MITI), the Japan Environment Agency (JEA), the Japan Meteorological Agency (JMA), and the Canadian Space Agency (CSA).[75]

As for NASA's predominant portion of the program, the EOS elements consist of 17 instruments to assess global climate change. The program begins with the launch of EOS-AM in June 1998, which is a partnership program with Japan and the U.K. Other spacecraft in the series include EOS PM, EOS Color, EOS AERO, EOSALT, and EOS CHEM.[76] The computer and data collection system is called the EOS Data Information System, or EOSDIS.

In addition to designating specific programs subject to the IEOS DEP, the partners have agreed to attempt to include future Earth observation missions as well into the overall IEOS framework (to include acceptance of the IEOS DEP).[77] Thus, by 1994, a new revised framework was put into place for spaceborne Earth imaging to bring the U.S. and its international partners closer to the free exchange of data that prevailed in the earlier U.S. meteorological satellite programs. Scientists pursuing preapproved research (basic and applied), and researchers involved in the operational use of Earth observing data for the public good are provided for as part of the overall mission of the IEOS. However, as stated, the principles permit international partners to observe national laws and policy that to some degree, run counter to the program goals. Examples include requirements to pay user fees and observe copyright restrictions. For its part, the United States intends to provide all MTPE data from U.S. sources to researchers and scientists without restriction, at the cost of dissemination, and without regard to intended use.[78] "NASA plans to contract with a vendor to distribute data from the U.S. EOS platforms; the vendor will serve domestic and foreign commercial users under the same terms and conditions."[79]

In the international context, NASA continues to be active in advocating the free and unrestricted exchange of environmental data within the international community.[80] "The EOS program had a clear objective of obtaining and sharing the broadest possible suite of data for long-term monitoring of the Earth and its environment. The needs of the scientific research component of the EOS program exceeded the funding and capability of the space segment which NASA could develop. NASA is using its offer of full and open data sharing to push its international partners to follow the same approach. In this case, broad data availability is a fundamental NASA objective, extending to data beyond that provided by the NASA satellites."[81]

Across-the-board, the U.S. federal sector has a strong policy for public dissemination of data acquired at taxpayer expense. The Paperwork Reduction Act of 1995 (P.L. 104-13) addresses public access to government information generated in all sectors of the government. Two of its stated purposes are to:

> ensure the greatest possible public benefit from and maximize the utility of information created, collected, maintained, used, shared and disseminated by or for the Federal Government . . . and provide for the dissemination of public information on a timely basis, on equitable terms, and in a manner that promotes the utility of the information to the public and makes effective use of information technology."[82]

Implementing the Paperwork Reduction Act, Office of Management and Budget (OMB) Circular A-130 establishes a uniform, governmentwide policy for the reproduction and distribution of government information. It states that:

> Government information is a valuable national resource. It provides the public with knowledge of the government, society, and economy -- past, present, and future. It is a means to ensure the accountability of government, to manage the government's operations, to maintain the healthy performance of the economy, and is itself a commodity in the marketplace."[83]
>
> The open and efficient exchange of scientific and technical government information, subject to applicable national security controls and the proprietary rights of others, fosters excellence in scientific research and effective use of Federal research and development funds.[84]

In order to effectuate these principles, federal agencies, in essence, are instructed to be more user friendly and to promote the free flow of information between the government and the public. They are cautioned to avoid charging fees or royalties or setting up practices which interfere with the availability of information to the public on a timely and equitable basis. OMB advised all agencies that where user fees are required, the rates should not exceed the cost of dissemination, nor should they include the costs associated with the original collection and processing of the information.[85]

Thus, even though a program does not fall within the IEOS DEP, the same principle of full and open availability of data in a timely manner is found in U.S. domestic law and policy, and affects all U.S. agreements in the area of Earth remote sensing. NASA's practice has indeed evolved over time, to the point where there is a standard approach to data access.

The most comprehensive U.S. policy document addressing space data access issued in the Clinton Administration is the recent U.S. Space Policy Presidential Directive, issued on September 19, 1996. It again reiterates the value to the U.S. of space-based Earth observation and commits to providing government-generated civil Earth remote sensing data to users on a nondiscriminatory basis. In this instance, users include commercial firms as well.

> The United States requires a continuing capability for space-based Earth observation to provide information useful for protecting public health, safety, and national security. Such a capability contributes to economic growth and stimulates educational, scientific and technological advancement. The U.S. Government will: . . . Support the development of U.S. commercial Earth observation capabilities by . . . providing U.S. Government civil data to commercial firms on a non-discriminatory basis to foster the growth of the "value-added" data enhancement industry; and making use, as appropriate, of relevant private sector capabilities, data, and information products in implementing this policy.[86]

NASA is also directed to "make use of relevant private sector remote sensing capabilities, data, and information products and establish a demonstration program to purchase data products from the U.S. private sector . . ."[87] Here, the government is trying to capture growing private sector capabilities to lower mission costs. Initial program emphasis by NASA on the attainment of scientific and foreign policy goals has shifted toward a recognition that private sector interests are not necessarily incongruent. The taxpayer can expect to share in the benefits of government-generated data, in terms of enabling a quality of life that is improved through scientific inquiry and discovery. Others can expect to be given the opportunity to participate and/or have access to the results of government activities as well.

Public/Private Partnership Considerations

The final part of this paper will focus on future policies that are being put in place which could affect data access in planned Earth observing programs. Much of what has been discussed, most notably the September 1996 National Space Policy, the IEOS DEP and OMB Circular A-130 are still very new. Yet, especially in the area of commercial remote sensing, changes to current policy are being sought by the private sector. As private industry becomes more capable in its ability to offer the government Earth remote sensing products and services, both it and

NASA have sought to redefine their relationship and find mutually beneficial public/private partnerships.

In part, the increased attention given to closing the gap between public and private sector participation in Earth imaging can be attributed to the increasing sophistication of private sector providers. NASA has responded by evaluating, across-the-board, the potential role of the private sector in MTPE. Working with industry, NASA has drafted a "Commercial Strategy for Office of Mission to Planet Earth." The strategy includes a description of the MTPE "Implementation Principles and Policies." It outlines nondiscriminatory data access in the first paragraph and, in addition, addresses the long-term activities NASA will undertake in promotion of the commercial space industry:

> MTPE will plan to acquire and provide scientific data products by the most cost-effective means available. The objective of the data policy is to maintain an appropriate balance between the scientific need for open low cost data with the commercial need for proprietary rights. As a matter of policy MTPE will:
>
> - provide science and commercial users with unrestricted access to science data acquired through MTPE capabilities;
> - provide MTPE-acquired Earth science data for the cost of dissemination;
> - establish rights to distribute proprietary science data acquired from commercial sources on a unique case-by-case basis. The respective contribution by each partner will be a key determinant in the balance between open and proprietary data.
>
> Within its obligation to meet critical science objectives, MTPE will not compete with, but will in fact support development of a competitive commercial remote sensing industry. MTPE will:
>
> - make best efforts to purchase data and value-added services from the commercial sector when that data meets MTPE science requirements;
> - seek out purchase arrangements where NASA is not the dominant customer over the long term;
> - not arbitrarily withdraw support from MTPE efforts or activities which are critical to commercial success, subject to national policy direction and the availability of appropriated funds; and
> - avoid establishing commercial monopolies or forcing partnerships among commercial providers by its actions.[88]
>
> Finally, the shift in emphasis toward incorporation of commercial interests can be seen in the NASA Strategic Plan. Recall that the 1995 plan identified the MTPE beneficiaries as follows:
>
> The ultimate beneficiaries of Mission to Planet Earth are the present and future generations of people on Earth. The primary customers of Mission to Planet Earth are those who use the environmental information to make decisions, especially national policy makers in the Administration and Congress and their international counterparts. The world science community also uses Mission to Planet Earth data and information to produce assessments, forecasts and analysis, and to develop new understanding.[89]

The 1996 plan includes a similar section outlining MTPE beneficiaries. In this instance however, primary customers are defined much more broadly to include commercial firms and other non-scientific users. The plan states that:

> The ultimate beneficiaries of MTPE are the present and future generations of people on Earth. The primary customers are researchers seeking answers to key Earth science questions, commercial firms using MTPE data and technology to expand their businesses, public sector managers exercising stewardship of our national resources, and educators teaching the next generation of scientists, engineers and citizens. The outcome is the major contribution

to the scientific foundation for sustainable development.[90]

What are some of the potential commercial products and services that NASA is considering? Generally they include private sector (1) data processing, archiving and distribution of government remote sensing satellite imagery; (2) secondary use of NASA-generated data for commercial purposes to include the value-added industries; and (3) sales of industry-generated Earth remote sensing imagery to NASA.

As an example of the first category, it was originally intended that the data collected as part of the EOS program would be sent to government-run data processing and distribution centers, called Distributed Active Archive Centers (DAACs) for further distribution to intended users. Private sector companies have more recently expressed an interest in competing for the business rather than having the government operate the DAACs. The National Research Council evaluated the situation and subsequently recommended that responsibility for the DAACs (characterized as product generation, publication and user services) be determined through an open competitive process.[91] In response, NASA has outlined a plan to implement these recommendations and to select privately-run data centers for the MTPE program.

With respect to secondary uses of scientific data, NASA is planning to issue a Cooperative Agreement Notice in 1997, seeking proposals for development of commercial applications from EOS science data.[92] These data can be processed further, analyzed for a specific customer, and presented in the form of tailored charts, maps, or graphs, thus adding value to the original data. Estimates vary as to how large a market might exist for a value-added industry. Potential customers include map makers, land developers, resource managers, fisheries, mining companies, and others.

NASA and industry efforts to define a policy for data access by commercial users could be affected by newly enacted law, signed by the President on October 2, 1996. Entitled the Electronic Freedom of Information Act (FOIA) Amendments of 1996 (P.L. 104-231), it broadens the scope of FOIA (5 U.S.C. § 552) which provides private citizens a guaranteed right of access to government agency records, except where specific exemptions are provided by statute. The 1996 amendments change the definition of agency record to include records maintained in electronic format. A goal of the new legislation is to provide on-line access to government information. Yet, depending on how the implementing regulations are drafted, the government could be required to provide space Earth remote sensing data to any requester under the provisions of the Act. Under FOIA, fees charged to a requester are kept to a minimum to encourage public inspection and oversight. At most, for commercial use of any data, the fees include "reasonable standard charges for document search, duplication, and review . . ."[93] As a result, efforts to establish a separate data access policy for such programs as MTPE could be hampered.

Finally, NASA is exploring ways to purchase science data directly from the private sector. In two instances, NASA has already done this -- through the Seastar/SeaWiFS contract and the Student Explorer Demonstration Initiative. In its fiscal year 1997 budget, NASA requested a separate appropriation of $50 million to permit additional private sector purchases. As a means of getting industry input about possible opportunities, NASA issued a Request for Information. Seven private Earth imaging companies have received licenses from the Department of Commerce per the licensing scheme established under the Land Remote Sensing Policy Act of 1992. Any of these seven could potentially sell their imagery services to the government. At least one of these operators plans to deploy a satellite with the capability of providing one-meter resolution images, which far exceeds the 30-meter resolution capability of both LANDSAT 5 and 7.

A potential obstacle to data purchases by NASA is commercial intellectual property rights which restrict subsequent use and dissemination. Depending on the rights sought by the commercial provider, NASA may find that requirements to include company logos, pay licensing fees, or limit data usage might prove prohibitive. As commercial providers work to secure the greatest return on their investment, NASA's

commitment to nondiscriminatory availability of scientific data cannot be compromised. NASA has taken steps to address this issue in one new program called Earth System Science Pathfinder (ESSP) Program. The ESSP was initiated so that spaceborne imaging missions could be accomplished with greater frequency -- every 2 years -- and at low cost, using innovative methods. Proposers were encouraged to cofund and/or provide like-kind resources as part of the program plan. The understanding was that by providing commercial opportunities (while still accomplishing the science objectives) proposers would be motivated to share the costs of development and mission operations. Through this shared funding mechanism, NASA is able to sponsor a greater number of missions and generate more scientific data than if the programs were to be undertaken as traditional NASA procurements. In its ESSP Announcement of Opportunity, dated July 19, 1996, NASA outlined data access requirements. Data from ESSP missions which are fully funded by the government will be distributed according to the IEOS DEP. For those missions which include significant private investment, NASA will consider innovative data management approaches so long as the data is immediately available to users at the cost of reproduction.

> U.S. Government information must be disseminated without restriction at no more than the cost of dissemination. Therefore, data from ESSP missions fully funded by the U.S. Government will be distributed in the same way as other NASA MTPE data. However, for data from missions in which there is significant U.S. private sector investment, NASA will consider innovative data management approaches that afford protection of commercial opportunities while still maximizing non-proprietary scientific return. The mission science team approved by NASA must have immediate and complete access to the basic data and products defined and produced by the mission. NASA encourages unique proposals for other distribution arrangements, such as purchase of data on delivery, as long as the full data set is ultimately available for long-term archival and open distribution. As with any NASA program, higher level products developed from Government-provided data by users outside of NASA-funded investigations are not subject to Government data policies or controls.[94]

The above discussion provides an indication of where NASA is headed in its efforts to promote and utilize the commercial space industry. Privatization of LANDSAT proved difficult and was never fully accomplished. Hopefully the lessons learned will make future government/private sector partnerships in this area more successful. At the same time, NASA will endeavor to make sure that MTPE and other Earth remote sensing mission objectives are met and the current data access principles incorporated in future agreements with international partners and industry. Finally, NASA will be an advocate abroad for immediate availability of government information at no more than the cost of dissemination.

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Additional Resources

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Also see Paul F. Uhlir, The Public International Law of Civilian Remote Sensing: An Overview, Vol. 2, American Enterprise, The Law, and the Commercial Use of Space 25 (Phillip D. Mink ed., 1986).