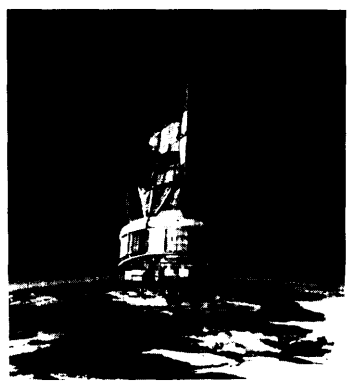
Executive Summary

Over the past two decades, data from Earth sensing satellites have become important in helping to predict the weather, improve public safety, map Earth's features and infrastructure, manage natural resources, and study environmental change. In the future, the United States and other countries are likely to increase their reliance on these systems to gather useful data about Earth.

U.S. and foreign satellite remote sensing systems often have overlapping requirements and redundant capabilities. **To improve the nation's return on its investment in remote sensing technologies, to meet the needs of data users more effectively, and to take full advantage of other nations' capabilities, Congress may wish to initiate a long-term, comprehensive plan for Earth observations.** A national strategy for the development and operation of future remote sensing systems could help guide near-term decisions to ensure that future data needs will be satisfied. By harmonizing individual agency priorities in a framework of overall national priorities, a strategic plan would help ensure that agencies meet broad-based national data needs with improved efficiency and reduced cost.



ELEMENTS OF A STRATEGIC PLAN

A comprehensive strategic plan would endeavor to:

- incorporate the data needs of both government and nongovernment data users,
- improve the efficiency and reduce the costs of space and data-handling systems,
- involve private operators of remote sensing systems,
- incorporate international civilian operational and experimental remote sensing programs, and

- guide the development of new sensor and spacecraft technologies.

Meeting Data Requirements

To provide the foundation for a strategic plan, the federal government should aggregate and consider specific data needs from all major data users. Options for strengthening the process for setting data requirements include:

- developing methods to increase the interactions among users, designers, and operators of remote sensing systems,
- involving a broader range of users in discussions of requirements, and
- developing a formal process for revising agency satellite programs in response to emerging capabilities and needs from a broadened user base.

Primary Elements of the U.S. Remote Sensing Community

Federal government civilian operators and data users
- *Scientists*
- *Operational users (e.g., resource managers, planners, geographers)*

Military and intelligence users

Private industry
- *Value-added companies*
- *Data suppliers*
- *Commercial data users*

State and local governments

Nonprofit sector
- *Universities*
- *Environmental organizations*

Private Sector

A strategic plan for Earth observations should capitalize on the expertise resident in private industry. The collection of private firms that supply data-processing and -interpretation services is small but growing rapidly. In setting requirements for future remote sensing systems, the federal government may wish to take into account the needs of private-sector data users, who provide an important source of innovative applications of remotely sensed data.

U.S. firms are now developing land and ocean sensing systems with new capabilities. **If private systems succeed commercially, they are likely to change the nature and scope of the data market dramatically.** Congress could assist the remote sensing industry and enhance its international competitiveness by:

- directing federal agencies to purchase data rather than systems from private industry.
- providing oversight to ensure that federal agencies do not compete with industry in developing software, providing analytic services, and developing remote sensing systems, and
- supporting the development of advanced technologies to assist government remote sensing programs and private-sector needs.

International Cooperation

To reduce costs and improve the effectiveness of remote sensing programs, a strategic plan should include mechanisms for exploiting international capabilities. The open exchange of data is essential to international cooperation in remote sensing, especially for weather forecasting, global change research, ocean monitoring, and other applications that require data on a global scale. To enhance the benefits of international cooperation in remote sensing, the United States could consider pursuing one or more of the following:

- increase U.S. efforts to promote sharing of data gathered from national systems,
- participate in a formal international division of labor, which would allow countries to specialize in the types of data they collect, and
- support development of an international remote sensing agency, to which each participating nation would contribute funding to develop an international satellite system.

Countries and Organizations with Significant Remote Sensing Programs

- Canada
- European Space Agency (ESA)
- European Organisation for the Exploration of Meteorological Satellites (Eumetsat) (ESA)
- France
- Germany
- Japan
- Russia
- United States

DATA COLLECTION

As part of its strategic plan, the United St ates needs to improve its programs for:

- collecting atmospheric data to support weather forecasting and severe-weather warning,
- monitoring the land surface,
- monitoring the oceans and ice caps,
- collecting data to support research on global environmental change, and
- monitoring key indicators of global change and environmental quality over decades.

B Converging the Polar-Orbiting Meteorological Satellite Systems

The Clinton Administration's plan to consolidate the two polar-orbiting systems operated by the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense (DOD) is one important component of a broader strategic plan. DOD, NOAA, and NASA will contribute personnel and funding to an Integrated Program Office within NOAA, which will operate the converged polar-orbiting system.

This proposal arose from the desire to reduce program redundancy and costs. Yet, convergence of the agencies' satellite programs into a single program could have several benefits even if it achieved no cost savings. These include the institutionalization of mechanisms for moving research instruments into operational use, the development of long-term environmental monitoring programs, and the strengthening of international partnerships.

The convergence plan would continue U.S. cooperative relationships with Europe through Eumetsat, which plans to operate the METOP-1 polar-orbiting meteorological satellite system beginning in 2000. The plan also increases U.S. dependence on Europe for meteorological data. DOD's desire to control the flow of data from U.S. sensors aboard the Eumetsat METOP during times of crisis may impede the completion of a U.S.-Eumetsat agreement. In the future, the United States and Eumetsat may wish to expand their cooperative satellite program by including Japan and/or Russia as partners.

The U.S. government has few examples of successful long-term, multiagency programs. Ensuring stable funding and stable management in programs that now involve multiple agencies and multiple congressional authorization and appropriations committees will challenge Congress and the Administration. Nevertheless, convergence of the polar-orbiting programs could serve as an important experiment in determining the feasibility of developing and executing a long-term strategic plan for Earth observations.

▮ Land Remote Sensing

Despite significant advances in remote sensing technology and the steady growth of a market for data, the United States continues to approach the Landsat program more as a research effort than a fully operational one. As currently structured, the Landsat program is vulnerable to a launch-vehicle or spacecraft failure. It has also suffered from instability in management and funding. The current management arrangement, in which responsibility for satellite procurement, operation, and data distribution is split among NASA, NOAA, and the U.S. Geological Survey, risks failure should differences of opinion about the value of Landsat arise among these agencies or the appropriations committees of the House and Senate.

High system costs have prevented the U.S. government from committing to a fully operational land remote sensing system. To reduce taxpayer costs, the government could:

- return to an EOSAT-like arrangement, in which the government supplies a system subsidy but allows the firm to sell the data at market prices,
- contract with industry suppliers to provide data of specified character and quality,
- create a public-private joint venture in which the government and one or more private firms cooperate in developing a land remote sensing system, and/or
- lead the development of an international land remote sensing system with one or more foreign partners.

Ocean and Ice Remote Sensing

The United States may eventually wish to provide ocean and ice data on an operational basis. Not only do NASA, NOAA, and DOD have applications for scientific and operational data, but so also do ocean fishing companies, private shipping firms, and operators of ocean platforms. Europe, Japan, and Canada are emerging as primary sources of ocean and ice data for research and operational purposes. If Congress wishes to support a U.S. commitment to civilian operational ocean and ice monitoring, it could direct NASA, NOAA, and DOD to:

- broaden their scope for monitoring ocean and ice on existing systems,
- develop a comprehensive national ocean observation system,
- take part in developing an international ocean monitoring system,
- purchase data from commercial satellite operators, or
- rely primarily on data exchanges with other countries.