Summary

By the early twenty-first century, satellite remote sensing systems will generate prodigous quantities of data about Earth's atmosphere, land, oceans, and ice cover. The value of these data will depend on how effectively they can be used. Turning remotely sensed data into useful information will require adequate data storage and computer systems capable of managing, organizing, sorting, distributing, and manipulating the data at exceptional speeds.

The large and fast growing information industry, which includes computer hardware and software and electronic data networks, is rapidly changing the way in which people handle data. Innovations in storage, imaging, and networking technologies could greatly improve the government's ability to analyze, archive, and manage remotely sensed data. However, in order to achieve higher performance from federal data management systems, the government will have to adapt quickly to changing technologies and allocate greater funding to data management.

Innovations in information technologies will also assist the rapid growth of a market for information produced from satellite data. However, significant market growth will depend on the availability of cheaper, improved data and less expensive, user--friendly software to process the data.

THE MANAGEMENT AND ANALYSIS OF DATA AND INFORMATION

The federal government maintains several major archives that store and protect U.S. satellite and other Earth data. In order to serve future data customers most efficiently, these archives will require periodic upgrades to improve data storage and retrieval, data search algorithms, and online communications capability.

Data collected by satellite are increasingly important for:

- predicting weather
- understanding climate
- assessing environmental change
- managing regional and global resources
- resource exploration
- land-use planning

The information industry is well-positioned to assist in improving the management of federal data archives. **Yet in the past, federal data analysis and management has often been underfunded. Congress may wish to scrutinize remote sensing budgets to assure that plans for data analysis, distribution, and archiving are adequate and that overruns of instrument and spacecraft budgets are not made up by underfunding data management.**

The rapid growth of online services and databases will markedly improve the ability of customers to locate and order data over the Internet and other online systems. **The widespread availability of high capacity networks is likely to increase significantly the number of users of remotely sensed data.** Despite major advances in database technologies, potential data users often have difficulty locating U.S. and foreign sources for data. In order to take full advantage of the existing investment in remotely sensed data, and to avoid duplication in future data acquisition, **Congress may wish to instruct federal agencies to develop a centrally coordinated "metadata set" that would provide a complete listing of the sources and types of remotely sensed data held in different U.S. facilities.** Such a metadata set should include a data tracking mechanism to provide government and private customers with access to data sources; it might also include listings of foreign and commercial archives.

Existing satellite data from the U.S. operational satellite systems—the Landsat system, the National Oceanic and Atmospheric Administration's polar-orbiting and geostationary systems, and the Defense Meteorological Satellite Program (DMSP)—constitute a unique record of regional and global change. **The United States should protect and maintain these data and make them widely available for global change research.** To create a more comprehensive global land data archive, Congress may wish to consider funding the purchase and archiving of a basic collection of Landsat scenes collected at foreign Landsat stations.

NASA'S EARTH OBSERVING SYSTEM DATA AND INFORMATION SYSTEM (EOSDIS)

The National Aeronautics and Space Administration has recognized the critical importance of data management in designing its Earth Observing System (EOS). **EOSDIS will be the largest and most challenging civilian data management system attempted to date.** To derive the greatest value from EOS data, NASA plans to process and manage extremely large quantities of raw data and make them available to researchers quickly. Data processing on this scale has never before been done on a routine basis with such large data sets.

NASA has structured EOSDIS to encourage interdisciplinary global change research. As scientific priorities change, NASA will face the challenge of remaining responsive to data-user needs while also developing new methods of data management and analysis. **Maintaining EOSDIS as an operational system routinely accessible by data users and keeping up with advancements in technology will require adequate and stable funding.**

The success of EOSDIS will be measured in large part by how extensively EOS data are used beyond the relatively small community of NASA principal investigators. Many users will find EOS data advantageous for scientific research and for managing U.S. public and private resources. NASA is now developing methods to allow extensive, flexible access to EOSDIS, including through private firms. If EOSDIS is successful, NASA could be faced with sustaining the data needs of more users than it is funded to support.

EOSDIS must be flexible enough to provide easy access to the governmentwide Global Change Data and Information System (GCDIS), which is being developed by the U.S. Global Change Research Program. EOSDIS would also likely serve as the core of an operational environmental monitoring data system that many believe should follow the 15-year EOS program. **Congress may wish to instruct the agencies involved in the U.S. Global Change Research Program to examine the long term (decadal timescale) needs for climate and other environmental data from satellites and other sources and recommend a data system to produce, archive, manage, and distribute these data.**

PUBLIC AND PRIVATE ROLES IN A DEVELOPING MARKET

The private sector is likely to play a crucial role in shaping the future of satellite remote sensing. Firms have already taken the lead in linking data sources to data users by turning raw data into productive information. These value-added companies, and firms that develop new, more efficient data management and processing software, will remain critical elements in expanding the remote sensing industry.

In addition, several private firms plan to market raw data from privately financed remote sensing systems. Their ability to operate a successful data supply business will depend on: strong market growth from new data applications; significant reductions in the costs of building and operating satellite systems; and the ability to transmit data to customers quickly and efficiently. **Government could assist in reducing industry's financial risks by: maintaining consistent, stable remote sensing policies and by not competing with private firms in providing value-added services. Government could assist market development by purchasing data rather than satellite systems from private enterprise.**

INTERNATIONAL COOPERATION

Once dominated by the United States and the Soviet Union, Earth remote sensing is now a broad-based international activity. This development has transformed the ground rules for intergovernmental cooperation and offers new opportunities to reduce the costs and improve the effectiveness of overlapping national remote sensing programs. **Over the last three decades the United States determined much of the scientific and operational agenda for international remote sensing activities, and set the technical standards; it now faces the more difficult task of leadership through cooperation.**

Global data from many sources are needed to forecast the weather and to understand global environmental change. The United States established the tradition of free and open exchange of data for these purposes. However, a growing interest in commercial applications and the desire, especially in smaller countries, to recover the costs of developing and operating remote sensing systems, have led to increasingly restrictive data access policies. **The United States should continue to press for open access to data that serve global environmental needs.**

The lack of adequate international coordination of data management systems has undermined the effectiveness of remote sensing programs. Users who need data from several satellites and ground systems are now forced to navigate a complex international array of data systems, each with its own policies and protocols. International coordination could greatly enhance the usability of remotely sensed data by encouraging the development of compatible data management systems, having adequate capacity to meet the needs of data users. **To improve U.S. access to global data, the United States should make the coordination of data management systems, including the creation of international metadata, a high priority in future negotiations.**