

NASA's effort to help private industry develop and commercialize new applications of remote sensing includes, in addition to the VIP program (see page 48), a government/industry cooperative program known as EOCAP, for Earth Observation Commercial Applications Program.

EOCAP provides government co-funding to encourage private investment in, and broader use of, NASA developed technology for gathering and analyzing information about Earth's land and ocean resources. Like VIP, EOCAP is managed by Stennis Space Center, but the programs differ in other ways: VIP generally involves short-term projects of three to six months and NASA funds the project; EOCAP projects can run three years or more and funding is shared on a 50-50 basis.

An EOCAP example is an important project that offers benefit potential to U.S. pipeline companies. These companies face ever-increasing operating and regulatory pressures that require mapping, inventories of facilities, pipe inspections, rehabilitation, environmental reporting, and facilities safety and notification programs. Keeping track of the facilities and updating associated records is a monumental task.

One obvious answer is automation and several pipeline companies have implemented Automated Mapping/Facilities Management/Geographic Information Systems (AM/FM/GIS).

But setting up an AM/FM/GIS and keeping it up to date is a costly and time-consuming endeavor. The cost of new photogrammetric mapping is significant; county and U.S. Geological Survey maps are not sufficiently detailed; and manual handling of hundreds of thousands of aerial photos is difficult.

James W. Sewall Company, Old Town, Maine, an AM/FM/GIS consulting firm, saw a solution. Looking for ways to help its customer -- Algonquin Gas Transmission Company, Boston, Massachusetts -- Sewall proposed an EOCAP project to develop a computerized system for storing and retrieving digital aerial photography of pipeline rights-of-way. The system would provide an accurate inventory of rights-of-way locations and pipeline surroundings for engineering, maintenance and regulatory purposes. Other project objectives included adapting a

NASA-developed digital camera system for pipeline monitoring, and uniting the digital aerial images acquired with an AM/FM/GIS system being developed by Algonquin to replace its manual method of mapping and information management.

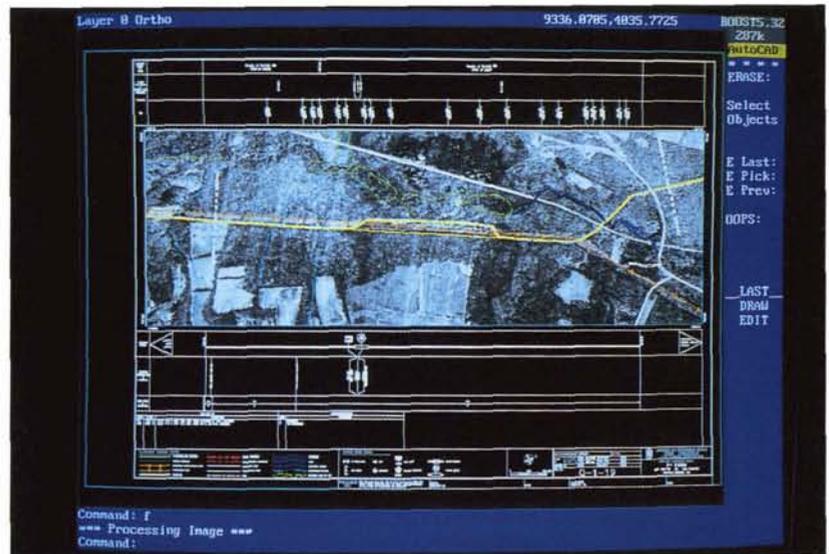
NASA accepted the proposal and Stennis Space Center joined with Sewall, Algonquin and NASA's Science and Technology Laboratory (located at Stennis) to implement the development effort. Begun in 1990, the project was largely concluded in 1993; the final phase, full operation of Algonquin's image-based AM/FM/GIS known as MAPS (Mapping Algonquin's Pipeline System), was nearing completion in 1994.

An important byproduct of the EOCAP project was Stennis Space Center's development of the Digital Aerial Rights-of-way Monitoring System (DARMS), a PC-based charge coupled device digital camera integrated with a large capacity recorder. DARMS was installed in one of Sewall's twin-engine Aztec aircraft for operational testing and development of imagery for the EOCAP project. In addition to its use in pipeline management, DARMS has excellent potential in such applications as transportation, municipal map updating and environmental monitoring; its advantage over traditional aerial photography is substantial time and money savings, particularly when the digital imagery is used in an AM/FM/GIS.

At left, Sewall employee Richard St. Pierre is working on a DARMS plot. At right above is a closeup of a DARMS screen showing the land image in black and white and the pipeline in false color, highlighting the important map features for the client. At right is a sampling of DARMS maps and the 8-millimeter Exabyte tapes used to collect and store the data from a pipeline survey.

The EOCAP experience enabled Sewall to develop new products and to expand its customer base in pipeline monitoring and other markets. Since undertaking the project, Sewall has tripled the size of its AM/FM/GIS division and extended its operations into the international marketplace. And for Sewall's customer, Algonquin Gas Transmission, the EOCAP project has provided technology for managing regulatory requirements more efficiently and more accurately.

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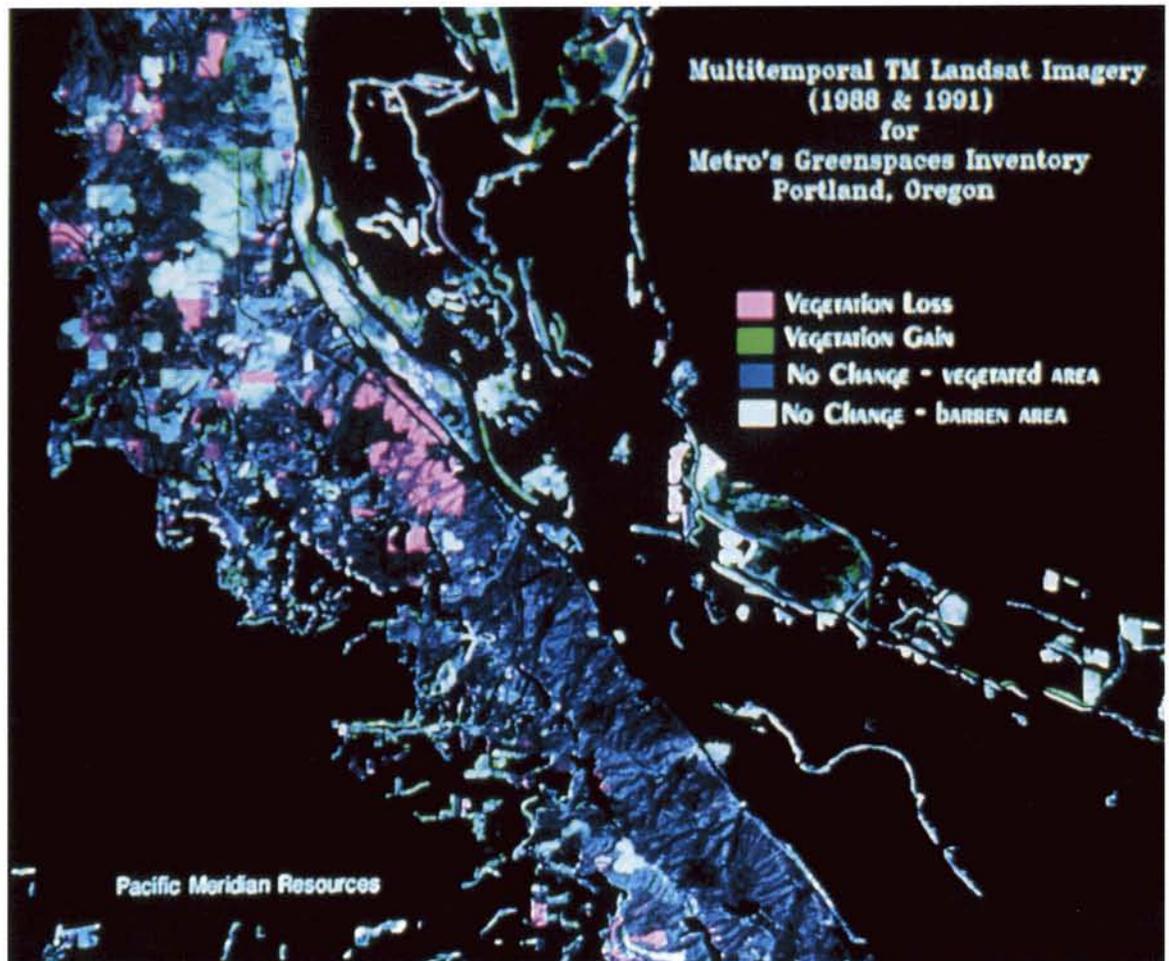


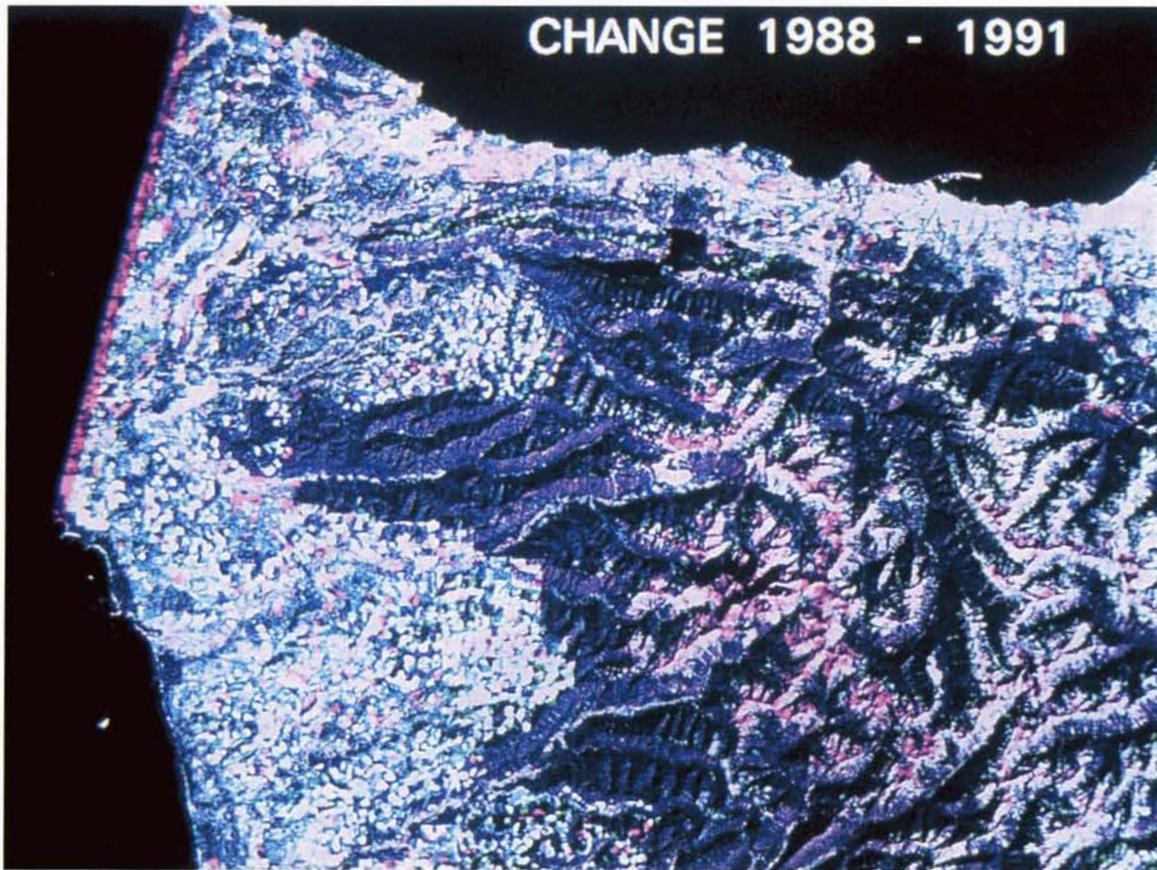
Changes on Earth's surface are becoming more extensive and they are occurring more rapidly than ever before. The changes become more significant as the planet's population grows and the available land base declines. Planners and resources managers need a reliable way to assess the consequences of change by detecting, quickly and accurately, changes in the way land is used.

Pacific Meridian Resources, Emeryville, California teamed with NASA on an EOCAP project to develop a system for monitoring changes in land cover and land use, incorporating the latest change detection technologies (which have advanced significantly in recent years) and factoring in the economic, political and biological issues relevant to a particular land use problem.

The goal of the project was not to develop new technologies, but to tailor existing technologies to a comprehensive system that could be commercialized for a variety of users. The objective, as stated by the project team, was "to take existing geographic information system (GIS) and satellite image processing technologies and develop production-oriented methods and services for assessing and monitoring land use/land cover change."

The EOCAP project was a broad-based effort involving NASA, the Portland (Oregon) Metropolitan Service District, the Washington State Department of Natural Resources, other government agencies and private organizations; each contributed funds, imagery and/or personnel time. The primary thrust of the project was development of a Land Use and Cover Change Analysis System of meth-





ods to assess land cover change over time; land cover changes would then be related to land use change, which in turn would be associated with demographic and economic change.

For change detection input, Pacific Meridian used imagery acquired by the Thematic Mapper (TM) aboard the NASA-developed Landsat satellite, specifically summertime scenes of the Portland metropolitan area taken three years apart (1988-91). The major aim was to identify areas that had sustained substantial loss of vegetation, principally through timber harvesting and developmental activities. **At left** is a Landsat TM change detection image covering the Olympic Peninsula that shows (in magenta) areas that sustained an appreciable loss of vegetation, green a gain, blue no change in a vegetated area, white no change in a barren area (no change means a gain or loss of less than 30 percent of the vegetation cover). **Above** is a summary image of 1988-91 change in the Portland Metropolitan District; red indicates a loss of vegetation, green a gain, blue no change in a vegetated area, white no change in a barren area (no

change means a gain or loss of less than 30 percent of the vegetation cover).

Pacific Meridian was successful in accomplishing the primary EOCAP objective, development of image processing methods to identify change, measure the extent of change, and update GIS maps to incorporate the change. The company plans further investigation to link land cover/land use change to environmental and economic impacts; additionally, it plans to increase marketing activities to boost the exposure and acceptance of its change detection products.

Pacific Meridian considers the EOCAP project "a vital component for the development of future services to its clientele." EOCAP participation helped Pacific Meridian to stay on the cutting edge of change detection techniques by providing R&D funding, a commodity not often available to young, rapidly growing companies. Partially as a result of the EOCAP project, Pacific Meridian has grown from six employees in a single office to 60 in five offices, and annual revenues have increased from \$200,000 to \$3,500,000.