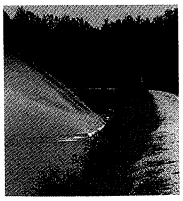
Earth Observation Services



A NASA INITIATIVE IS SPURRING PRIVATE INVESTMENT AND EXPANDING COMMERCIAL REMOTE SENSING TECHNOLOGY FOR ENVIRONMENTAL PROTECTION AND RESOURCES MANAGEMENT

More and more ocean-going vessels are taking advantage of the streams of information beamed to them by weather satellites of several nations — information about cloud formations, storms, weather paths, ocean current patterns, winds, temperatures and even — for those equipped with special receivers — positioning data.

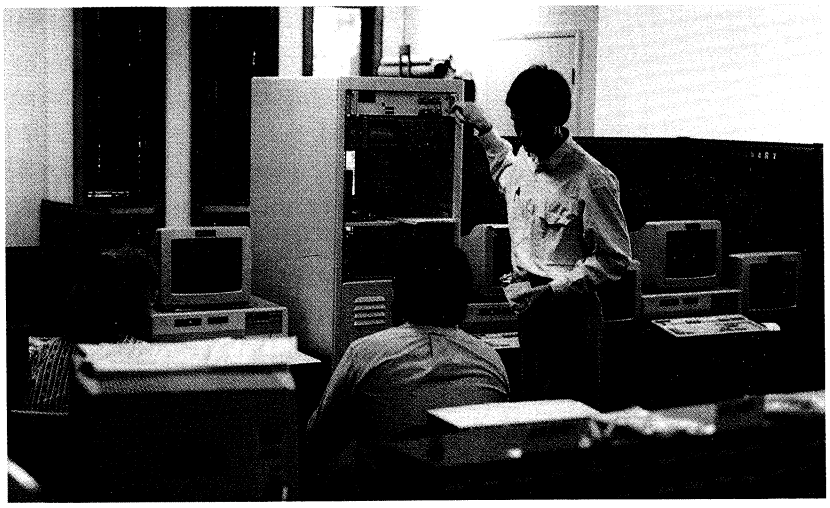
It's valuable information. Long distance yachts, for example, use it to find the best winds and best currents for a speed edge, or for shaving time off a voyage through precise satellite-aided routing. Commercial fishing boats use the information to locate upwellings, areas of temperature differences that indicate the presence of certain species of fish. And all mariners can sail safer by using the information to locate and avoid severe storms.

A small but growing industry supplies marine operators — and land-based users too — the satellite receivers and image processing systems needed to acquire and interpret the data. Among these companies, one that is making a name for itself is Systems West, Carmel, California, whose motto is "We bring affordable weather technology to the world." Systems West's compact, lightweight, easy to operate weather data microprocessors, the company declares, cost about one-third the price of conventional machines.

The marine market has been a major target for Systems West, due in part to the fact that the company was able to expand its expertise in that area through participation in NASA's Earth Observation Commercialization Applications Program (EOCAP). This effort, managed for NASA by Stennis Space Center, provides government co-funding to encourage private investment in, and broaden use of, NASA-developed technology for gathering and analyzing information about Earth and ocean resources. EOCAP seeks increased innovation in the commercial applications of largely proven remote sensing technologies and supports the transition of such innovations to the commercial marketplace; it is, essentially, a NASA-managed effort to generate expanded spinoff benefits to both industry and the user public.

The commercial fishing boat *Dakota* carries its own Systems West weather satellite data processing station, whose information guides the crew to the most productive fishing waters. Systems West developed the equipment as a participant in NASA's EOCAP program.

Systems West was among the first EOCAP participants. The company's EOCAP project involved development of both software and hardware for a shipboard system that receives, processes and displays images from polar orbiting satellites.



Company technicians check out a Systems West Model 5300 ground station, which receives and processes data from geostationary weather satellites.

A NASA PROGRAM HELPED A COMPANY DEVELOP A LINE OF COMMERCIAL IMAGE PROCESSING SYSTEMS

Systems West now markets a family of microprocessor-based systems for processing data from both polar orbiting and geostationary satellites. Typical of the line is the Model 4000 Marine Weather Satellite Information System, which offers automatic, unattended operation and allows users to view real-time images of weather systems, day and night, of areas covering as much as four million square miles — or to zoom in on a few square miles for closer analysis of specific matters of interest.

The images that appear on the color monitor allow mariners to locate subtle currents and eddies and optimize vessel speed to save time and fuel; to interpret wind direction and frontal movement; to improve safety with pictures and data on severe storms; or to use 256 colors or 64 shades of gray to identify sea surface temperature ranges and pinpoint fishing areas promising the best catch.

The company's product line is by no means limited to shipboard systems. The "affordable" and easy to use characteristics of Systems West equipment have built a market for the company among developing nations with small budgets and few trained weather station personnel; customers include Peru, Bangladesh, Mexico, Colombia and the Azores. Systems West also offers small tactical units for military operations and desktop models for local airports and rural/regional weather bureaus.

Systems West was formed in 1986 by space and weather expert Kenneth W. Ruggles, who is now president; electronics engineer Dick Reins; and retired Navy captain Bill Hubert, a specialist in marine technology. They saw an opportunity to bring down the cost of satellite weather stations by developing special software to enable satellite image processing by personal computer. The EOCAP program, says Systems West's president Ken Ruggles, not only created a new line of commercial systems for weather processing, it also provided a significant boost to the company's technological capability.

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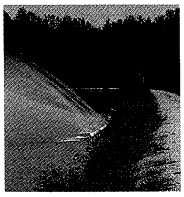
Earth Observation Services (Continued)



In the 1970s, NASA pioneered research in satellite remote sensing technology with the Landsat family of Earth resources monitoring satellites. The Landsat technology was commercialized in the 1980s and that step spawned an expansion of the complementary technology of airborne remote sensing.

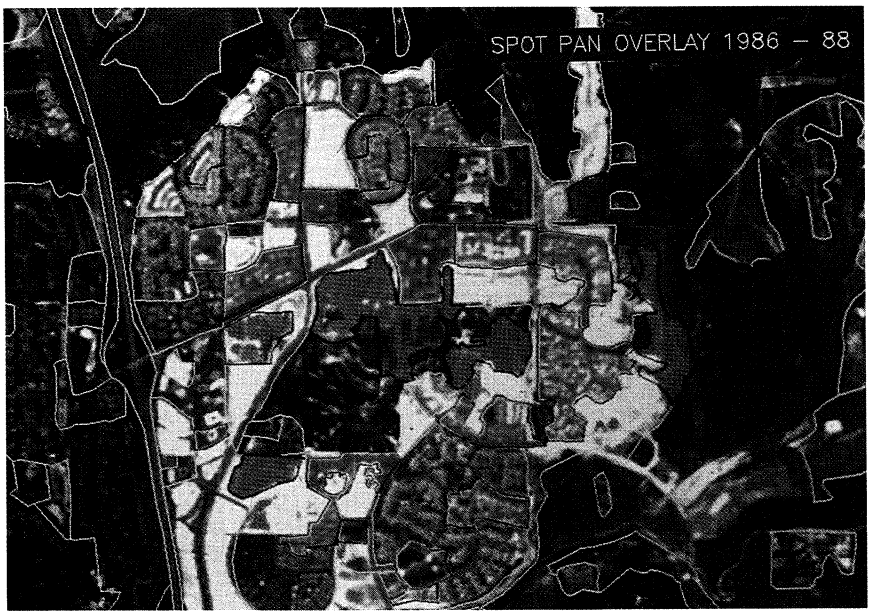
NASA's EOCAP program represents a new step toward broadening the benefits of remote sensing technology, a step that not only fosters new applications of the technology but also gives participating companies an opportunity to improve their technical expertise.

EOCAP was launched late in 1987 and since that time NASA has selected more than 30 proposals from industry and universities for co-funding contracts to develop new remote sensing applications and equipment. Here are some additional examples:

San Diego State University (SDSU), teamed with Environmental Systems Research Institute (ESRI), Redlands, California; ERDAS, Inc., Atlanta, Georgia; and the San Diego Association of Governments (SANDAG), a regional planning agency, to demonstrate a cheaper, easier way to derive information on regional land use and land development.

Accelerating change in the San Diego area — and in many other areas — makes it difficult to keep geographic information systems (GIS) up to date. The team, headed by principal investigator Douglas Stow, SDSU associate professor, is applying satellite imaging and image processing techniques to GIS updating.

The project employs a system known as ARC/INFO Live Link, an integration of a processing program developed by ERDAS, Inc. and a computerized GIS developed by ESRI. Commercial activities include marketing the Live Link system and County-in-a-Box, which includes geocoded satellite image data that can be used with Live Link to update GIS data layers. The cost effectiveness of Live link and County-in-a-Box has been demonstrated by SANDAG, which used these products for land use and other applications, such as mapping vegetation distribution and preserving wildlife habitats in San Diego County.



This composite image of an area in San Diego, California is a computer generated representation of the land use changes that occurred over a two-year span, obtained by combining satellite imagery acquired in 1986 and 1988. Part of an EOCAP project led by San Diego State University, the image shows newly completed construction (red), areas where land use changed (green) and areas that did not change (black, gray, white).

Another of the early EOCAP efforts involves Professors Greg S. Biging of the University of California at Berkeley and Russell G. Congalton of the University of New Hampshire, who applied remote sensing technology to commercial forest inventory. They demonstrated that satellite data, used in conjunction with ground data, can produce forest classifications of the same or better accuracy than can be obtained by traditional techniques applying aerial photography. A completely accurate comparison of satellite observations and aerial photo interpretation has not hitherto been available.

Photo by Jerry Morse

Shown analyzing forest imagery, Professor Greg S. Biging of the University of California at Berkeley heads a team demonstrating that satellite data can generate forest classifications with equal or better accuracy than traditional aerial photography techniques.

The project is being conducted jointly with Sierra Pacific Industries (SPI), Anderson, California, a major California timber company.

Biging and Congalton assembled the computer programs and analysis techniques developed in the EOCAP effort into a processing package called CALFIRST (California Forest Inventory and Remote Sensing Technology). CALFIRST is undergoing pilot testing on SPI land in the Sierra Mountains, using some 300 test sites ranging in size from 50 to 250 acres. The first year's results showed that CALFIRST can discriminate forest species, size class and density for the mixed conifer species stands in northern California better than professional aerial photography interpreters.

The University of California at Berkeley team plans to market CALFIRST to forest companies and government agencies using several technology transfer routes, including the University of California Extension Service. Commercialization is being aided by two consulting firms whose job it is to take the technology developed under the EOCAP program and move it into the marketplace; they are Pacific Meridian Resources, Emeryville, California and VESTRA Resources, Redding, California, both engaged in remote sensing and natural resources management activities.

In another EOCAP project, Research Planning, Inc. (RPI), Columbia, South Carolina, in cooperation with Stennis Space Center and the University of South Carolina, has developed advanced techniques for "environmental sensitivity" oil spill mapping.

Traditional techniques for developing Environmental Sensitivity Index (ESI) maps for oil spill response are expensive, often inaccurate and unavailable in many parts of the world. The RPI/EOCAP project sought an advanced method of providing decision makers with timely, highly accurate, more readily updatable and more comprehensive ESI maps incorporating satellite remote sensing and GIS technologies.

A Landsat image shows the spread of a Persian Gulf oil slick that occurred during the war-caused spill of February 1991. Research Planning, Inc. developed a remotely sensed information system for prioritizing protective measures during oil spills.

RPI successfully achieved that goal and the company demonstrated the efficacy of its system in February 1991, following the oil spill in the Persian Gulf that occurred during the Gulf war. Dr. Jacqueline Michel, RPI vice president, headed an effort to provide remotely sensed information to military and civilian officials involved in assessing the damage potential of the oil slick and identifying the natural and socioeconomic resources threatened by the spill.

As a result of its EOCAP work, RPI is marketing a commercial ESI product that focuses on oil spill response, coastal zone development and environmental assessment using remote sensing and GIS technology. •