Earth Sciences

Richard Monastersky reports from San Francisco at the fall meeting of the American Geophysical Union

Underwater, how far is far?

As the Pacific plate dives under Alaska, creating occasional monstrous earthquakes in the process, how fast does it move? To study the Earth's plates, geophysicists need to be able to measure the speeds of these great blocks of lithosphere as they crash together or spread apart. On land, researchers can use a handful of different tools to measure how distances change from year to year. But the Pacific plate and many others lie mostly covered by water, and underwater measurement techniques are much less accurate. Now scientists are developing ways to help bridge the accuracy gap.

Last March, researchers at the Scripps Institution of Oceanography in La Jolla, Calif., tested new precision transponders that sit on the seafloor, transmitting and receiving sound pulses used to measure distance. While traditional systems must allow for a few meters' error when measuring several kilometers, the new transponders chart distances to within a centimeter, says project member Marie C. McIntyre.

Next March, the group will test a second new system designed to determine the absolute position of underwater locations, allowing comparisons between points on land and in water. This system uses a cigar-shaped floating platform that reaches 100 meters below the water surface to minimize motion from waves. On top of the platform, a receiver picks up signals from Global Positioning System satellites, allowing precise determination of the platform's location. Meanwhile, seafloor transponders monitor the platform's position relative to the ocean bottom.

Seawall's seal of approval

In an effort to protect houses built on erodible bluffs near the sea, coastline residents often erect seawalls. Yet some claim these structures hasten the erosion of sand from beaches in front of the wall—in a sense saving the bluffs to the detriment of the beaches. After spending more than two years examining the question, one group of geoscientists concludes that seawalls do not harm beaches.

Gary Griggs and James Tait of the University of California, Santa Cruz, studied seawalls and beaches at four sites in California's Monterey Bay area. While beaches in front of seawalls often lost sand during certain seasons, the sand returned at other times of years, so the seawalls only temporarily affected beach erosion. The group also concludes that it did not seem to matter whether the wall was made of concrete, large boulders or some other material.

First hot springs in U.S. waters

Searching along the barren desert that lies 2,800 meters below the sea surface, scientists have discovered a lush community of fish, crabs, giant tubeworms and other animals in a field of hot springs. Only 200 kilometers off the coast of Oregon, on the midocean spreading center called the Gorda ridge, this site is the first hydrothermal system found within the U.S. Exclusive Economic Zone, says Peter A. Rona of the National Oceanic and Atmospheric Administration in Miami.

Rona and his colleagues discovered the area while diving in the Navy's deep submersible, *Sea Cliff,* in September. Similar hot spring oases have been found on other spreading centers—where molten rock from the mantle rises to create new ocean crust as two adjoining crustal plates move apart.

Because of its proximity to the United States, the hydrothermal area will be an ideal study site, says Rona. Moreover, it may be a source for strategic minerals like manganese and cobalt. The hydrothermal water, which can reach temperatures of 400°C, often carries dissolved minerals that form deposits on the seafloor when the hot water mixes with the ocean bottom's normal 2°C water.

Space Sciences

Return of the Explorers

Faced with growing concern about terrestrial problems ranging from the ozone hole to deforestation, the National Research Council's Committee on Earth Sciences (CES) has recommended that NASA revive a satellite-planning approach that began in the space agency's formative years. NASA already plans a series of sophisticated, instrument-laden "platforms" whose orbits will carry them over Earth's poles to look down on the entire planet. But the CES urges NASA to develop a program of smaller, less costly Earth Explorer satellites to fill gaps in the primary program and to respond on shorter notice to newly perceived research needs.

NASA usually emphasizes big, individually managed projects, such as interplanetary probes, whose completion depends on annual appropriations from Congress for each satellite. However, a series of satellites called Explorers long has followed a different budgetary path. NASA seeks money each year to finance the Explorer effort as a whole, rather than seeking funds for each specific satellite in the series, whose missions have ranged from earth science and astronomy to space physics. The CES urges a separate, Explorer-type program to focus on the earth sciences.

CES also recommends the Earth Explorer satellites use standardized satellite designs, rather than creating a new design for each new mission. Having several craft built with the same basic design and buying more than one at a time would allow "important economies of scale." The same approach was advocated earlier by NASA's Solar System Exploration Committee for planetary flights, but missions using the first such standardized design have yet to win budget approval from the White House and Congress.

One crucial element, according to the report, is "flexibility." For example, rather than producing a whole Earth Explorer satellite for each new sensor, the committee suggests looking for alternative routes to orbit, such as putting earth sciences sensors on satellites from other U.S. agencies or even from other countries.

A Total Ozone Mapping Spectrometer (TOMS), for instance, has been at work on the Nimbus 7 weather satellite since 1978, but the report notes that "global ozone measurements are too important" to allow a long "data gap" in case Nimbus 7 fails before the proposed polar platforms are ready. U.S. and Soviet officials have thus been discussing the possibility of installing the next TOMS on a Soviet satellite. The United States and Japan are considering a joint Tropical Rainfall Measuring Mission, whose measurements would require an orbital inclination and altitude too low for the polar platforms.

NASA launched 41 Explorer satellites in its first decade (1958-'67), 27 of which related to what the CES lumps together as the earth sciences. The next 10 years saw only 21 Explorers, eight of them in earth sciences. In NASA's third decade, the numbers dropped to 9 and 4.

Why did the Explorer program slow so dramatically, given its relatively modest effects on NASA's tight money supply? In part, notes CES Executive Secretary Paul F. Uhlir, the individual Explorer satellites became more elaborate and costly. The CES report envisions a long-term congressional commitment to provide the program about $75 million a year, effectively removing Explorer craft from the annual budget battle.

With NASA's eye on its pocketbook, does the Earth Explorer program stand a chance? Perhaps not in bureaucratic Washington. "A program like this is seen by the budgeting authorities as representing a loss of control," says a National Research Council official. One problem might arise, he says, when the Office of Management and Budget must decide whether to support what is called a "level-of-effort program" rather than "micro-managing the individual projects."