Topex/Poseidon

Mission to Planet Earth turns its gaze upon the oceans

By John R. Williams

From space, no other planet rivals Earth's blue hue. The oceans, covering nearly two-thirds of the surface, are Earth's hallmark. They are the key to life on this planet. Now an international effort is being launched to study the complex interactions between Earth's climate and its oceans.

The $400 million spacecraft, named Topex/Poseidon, is a joint effort between NASA and CNES, the French Space Agency. It is the first complete space probe built by the Fairchild Space Company of Germantown, Maryland. At the time this magazine went to press, the spacecraft's launch date was set for August 10. Carried into orbit aboard an Ariane 42P booster from Arianespace's Guiana Space Center, Topex/Poseiden is the first U.S. satellite to be launched by a non-U.S. booster. The Ocean Topography Experiment, or Topex, is the U.S. contribution to the mission, NASA's third in the "Mission to Planet Earth" series. Poseidon is France's side of the mission. Information from the probe will help answer key questions about ocean circulation, tides and the transport of heat from oceans to the atmosphere. Armed with such information, scientists can improve weather forecasting techniques and study long-term global climatic change. The Jet Propulsion Laboratory (JPL), which will monitor the mission from its Pasadena, California, headquarters, expects the mission to last three to five years, although NASA officials say that the spacecraft has enough fuel to remain in orbit for more than a decade.

"The key to this mission is precision orbit determination," says Edward Christensen, deputy project scientist at JPL. "We need to know where we are absolutely to enable us to form accurate models."

Topex/Poseidon will accomplish this with the aid of three precision location systems and the Global Positioning System (GPS). The satellite uses two radar altimeters to bounce signals off the ocean surface. To obtain a precise measurement of the spacecraft's distance from the ocean surface, an antenna collects the bounced signals and the device records the time it takes for the signal to return. The altimeters are similar to instruments used aboard Seasat, NASA's first oceanographic satellite, launched in 1978. The Topex/Poseidon data, however, when combined with GPS measurements provided by orbiting Navstar satellites, will guarantee that the craft's location will be accurate to within five inches. In con-

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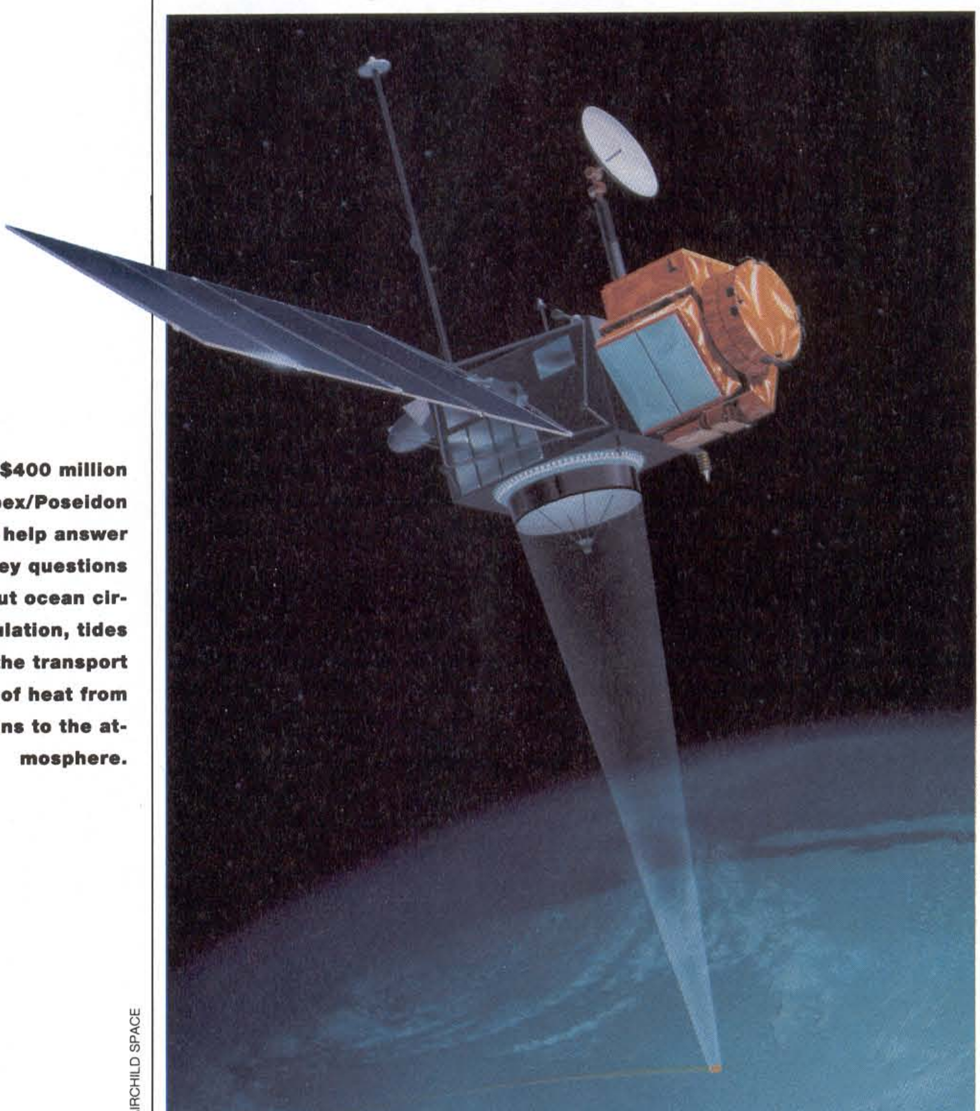

FAIRCHILD SPACE

The $400 million Topex/Poseidon will help answer key questions about ocean circulation, tides and the transport of heat from oceans to the atmosphere.

Boundaries

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trast, Seasat's position was known only to an accuracy of 20 to 40 inches.

By pinpointing the craft's location above the ocean surface in relation to the rest of the world, scientists can draw an accurate picture of the ocean surface. Instead of a simple line drawing, scientists will get a topographical map of the ocean surface, outlining every ripple, every smooth spot at a given time.

While scientists using ships have gained a good understanding of overall ocean circulation patterns, Topex/ Poseidon's panoramic view will offer insights into small-scale circulation patterns such as currents, eddies and meanders. "Some circulation patterns are only inches across," Christensen says. "If we can go beyond five inches, we can see more than we ever dreamed."

The 5,764-pound satellite will orbit the Earth at an inclination of 66 degrees. Christensen says that scientists picked the orbit to optimize measurements of tides. The highly inclined orbit brings Topex/Poseidon to the same spot about every ten days. The satellite's ten-day period is just different enough from the tidal period that scientists will catch an individual tidal peak at a different position as it sloshes around the ocean basin. This gives researchers a better profile of tides, how they move and how they affect sea level.

Scientists can extract other information, such as wind speed, from the signals received by the spacecraft's radar altimeter. Winds whip up waves, which in turn scatter the radar signals, resulting in less energy being collected by the spacecraft's antenna. By studying this loss of energy, researchers can map the velocity of the wind blowing across the ocean surface.

This increased database will not only aid short-term weather forecasting, but will also allow researchers to better understand long-term climatic effects, such as "El Niño." El Niño is a warm-water current that drifts in off the coast of Ecuador every seven to ten years. While El Niño manifests itself off the coast of Ecuador, its effects are felt worldwide, spawning droughts in some areas while drenching others.

Perhaps one of the mission's most important aspects is monitoring sea level over the next decade. Some researchers and environmentalists speculate that human-made increases in the production of carbon dioxide and other greenhouse gases will warm the planet, causing dramatic shifts in weather patterns. An increase in sea level resulting from deglaciation and the melting of polar ice caps would give scientists the ammunition they need to validate the greenhouse effect. ■

John Williams wrote about lightning on Venus in our November/December 1991 issue.