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Big Eyes in the Skies Watch Sea Levels Rise

Mike Caruso's computer provides a window on the activities of the world's oceans

In August, 1992, a rocket shot into the sky from a launch pad in Kourou, French Guiana. Called the Ariane Expendable Launch Vehicle, provided by France and built by the European Space Agency, it flew up to the altitude of 1,336 km (which is a little more than the distance between Chicago and New York City). There, Ariane deployed a satellite, built by the United States and France, that's changed the way we look at the ocean.

Called TOPEX/Poseidon, it has sent back millions of measurements of the height of the sea surface, and faith fully continues to supply newinformation at a fantastic rate as it circles the Earth every 112 minutes. The satellite completes its circuit of the world's ocean every ten days. For the first time ever, it's possible to have a continuous world-wide overview of the ocean's surface.

Knowing how the ocean circulates is important to understanding the interaction between the atmosphere and the ocean. Understanding that interaction is important to studying changes in the earth's climate.

TOPEX/POSEIDON'S TOOL

The satellite uses a device called a radar altimeter to beam a signal down to the sea surface. The altimeter measures the amount of time the beam takes to reach the surface and return back to the satellite. It can then calculate the distance between itself and the sea. The altimeter is amazingly accurate. Its measurements are within three centimeters (that's about the same size as the first joint on your thumb).

By knowing the height of the sea surface at different points, it's possible to figure out the paths of ocean currents. Studying these paths makes it possible to understand, better than ever before, how the ocean circulates.

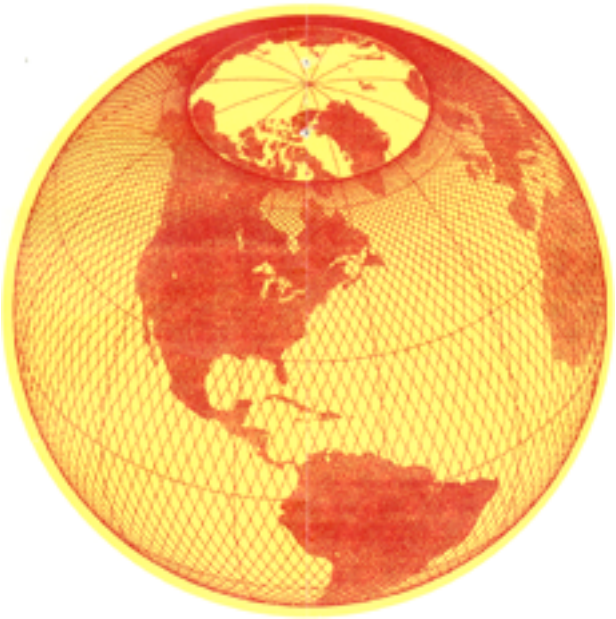
TOPEX/ Poseidon also keeps a very accurate record of the rate of sea level rise, which is another critical piece of information to those studying global warming. As water grows warmer, it expands. Warmer water also melts glaciers and icebergs.

EVERY PICTURE TELLS A STORY

WHOI physical oceanographer Mike Caruso starts his day by scanning the latest images sent back by TOPEX/Poseidon and other satellites.

"We've recently completed a study of how heat is transported in the ocean, and how it moves from the surface to the air in the Gulf Stream region," says Mike, speaking of work completed with colleagues Kathryn Ann Kelly and Sandipa Singh. "That's really important for understanding climate change."

Scientists don't yet understand the interaction of the atmosphere and the ocean. Mike creates computer programs, called models, to study these relationships.

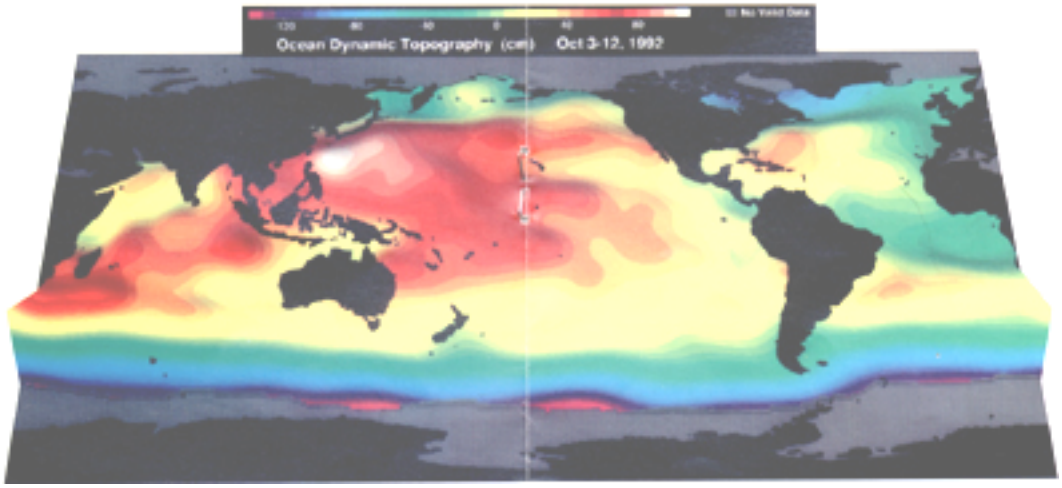


This is a drawing of the path that Topex/Poseidon takes as it travels around the world. Like yarn wound in a ball, the satellite winds around the globe. Each circuit of the globe takes 112 minutes. The satellite views 90 percent of the world's ice-free oceans once every ten days.

Before TOPEX/Poseidon, most of the data Mike and others worked with were collected by researchers on ships. "There were a lot of bulk estimates made," says Mike. "Until recently, we haven't had the vast amount of data we needed to do this. We're starting to build that up. And there are future satellites that are going to be used, so we will have a long continuous time sequence of this data." (See "Tools for the Future".)

Collecting data over a long period of time is a necessary part of this process. "In the two years TOPEX/Poseidon has been up, we've seen about a millimeter per year of sea level rise," says Mike. "That's nothing to get worried about, because it could be a natural fluctuation." That's the kind of information satellites will help deliver, because they send back data on a global scale. With this type of world-wide information, scientists can make predictions with more certainty.

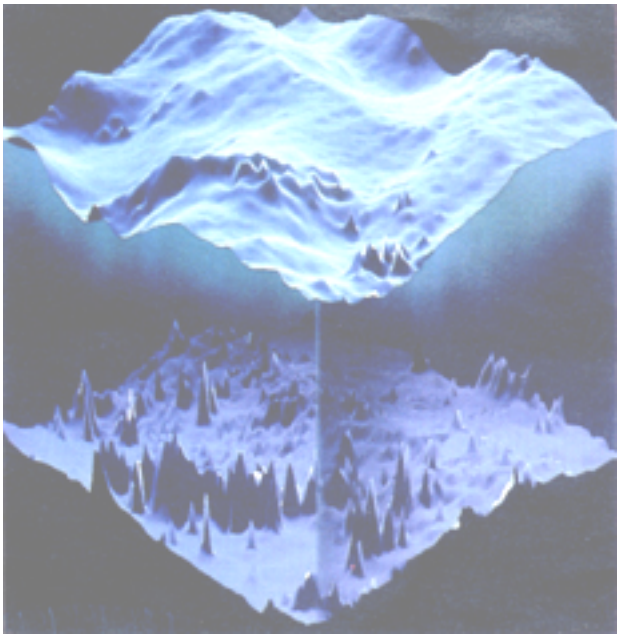
"You can look at things like this millimeter sea level rise and start to analyze what's really happening," says Mike. "We can make measurements on scales we've never been able to work with before."



This is an image of the topography of the sea surface, thanks to TOPEX/Poseidon. Oceanographers use images like these to figure out the speed and the direction of ocean currents

INSTANT DATA

What has really challenged Mike and other scientists is the experience of trying to lasso this vast amount of information, and to use it to make pictures that people can easily understand. The computer images on these pages were the result of enormous efforts on the parts of many people.



Oceanographers can use TOPEX/Poseidon information about the sea surface to make computer images of the sea floor. By the way, the vertical scales in this computer-generated image are very exaggerated.

Mike looks forward to the day when computer models will be powerful enough to create usable images on their own. Then, the scientists' focus will be able to shift to trying to understand what the pictures mean. "All we'll have to do is sit there and come up with ideas about how global change is occurring," says Mike.

He makes it sound simple, but it's not. Even so, being freed up to use their imaginations to understand complex processes could lead scientists m the future to many new discoveries.