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Radar system taking pulse of the Pacific

By Paul Rogers
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Tracking oil spills. Finding lost sailors. Restoring fish populations. Preventing water pollution from making beachgoers sick.

Some of the most vexing problems affecting America's oceans can't be solved because so little is known about how ocean currents work.

But now, in the largest effort of its kind in the world, California researchers are attempting to find answers by assembling a network of radar stations along all 1,100 miles of the state's coastline from Mexico to Oregon. The goal: to produce real-time color images of the speed, direction and intensity of the ocean's movements, and then post them on the Internet.

The \$21 million system is a high-tech way to take the pulse of the Pacific and help the environment, public health and marine research. It is being built by a partnership of 13 major universities and research centers including the University of California-Santa Cruz, Scripps Institution of Oceanography and the U.S. Geological Survey.

When finished in 2009, it will feature 57 sites, most with two 12-foot-tall high-frequency radar antennas perched on bluffs, rooftops, marinas and other waterfront locations averaging roughly 20 miles apart.

Already, 16 radar stations are in operation around San Diego, Santa Barbara and the San Francisco Bay Area from Big Sur to Bodega Bay. Scientists added the two most recent ones in December in Tiburon and at the Berkeley Marina in San Francisco Bay.

Oceans make up 71 percent of the earth's surface. But scientists' understanding of them is decades behind what they know about land. Faster, cheaper computer chips offer an opportunity to catch up.

``This is really exciting. I think it is some of the most fun stuff that we are engaged in," said Sam Schuchat, executive officer of the California Coastal Conservancy, a state agency in Oakland that funded most of the project.

``It has only become feasible in the last 10 years because of innovations that have happened in Silicon Valley."

Other systems

Similar radar projects are operating off Maine, the Gulf of Mexico and on the Oregon coast. Last June, the Maine system played a key role in tracking a massive ``red tide" toxic algae bloom that caused the closure of shellfishing beds from Maine to Cape Cod, Mass. The federal government has said it hopes to one day have a national network of ocean observing systems.

Environmental groups contend the technology is vital to better stewardship of the seas.

``You can't manage the ocean unless you know what it is doing," said Warner Chobot, vice president of the Ocean Conservancy, in San Francisco.

``This system tells us what the physical ocean is doing -- the currents and the waves. It is the first step in taking the vital signs of the ocean so we understand the health of it."

Some real-time images from sites around the United States and California are already posted on the Internet at www.oceancurrents.us.

How it works

The system works much like radar weather maps.

The antennas bounce radio waves out into the ocean at a frequency range between radio and TV signals. Most of the radar sites cover about 800,000 acres of water each -- an area nearly three times the size of Los Angeles. Receivers on the shore measure the reflections, and compute how fast the ocean currents are moving by the shift in frequencies.

``The Doppler weather radar images you see on TV measure water droplets in the air. This system does the same thing, but with the sea surface itself," said Jeff Paduan, an associate professor of oceanography at the Naval Postgraduate School in Monterey who is helping set up the system.

As he spoke on a sunny morning Friday at UC-Santa Cruz's Long Marine Laboratory, large sets of waves rolled into the coast from Monterey Bay, two porpoises glided 100 yards offshore and pelicans and cormorants flew overhead. The radar maps, updated hourly, have enormous potential benefits, he said.

For example, state researchers are working to design ``no fishing" areas in the ocean. But they don't know where fish reproduce unless they can measure where the currents take their larvae. Already, scientists are using the radar images from sites around Monterey Bay to study where most fish larvae end up, so they can help design the most effective marine reserves.

Helping humans

Another use is rescuing people, said Burr Heneman, an early advocate of the radar system and director of ocean policy at Commonweal, a Bolinas environmental group.

``If the Coast Guard gets a distress call from a vessel and they give you a pretty good location and their radio dies or the thing blows up," he said, ``they'll have real-time information showing where the currents are moving that vessel or person in the water with a life jacket on. There's a better chance of finding them."

The radar antennas are made by CODAR Ocean Sensors, a Mountain View company whose founder, Donald Barrick, was one of the inventors of the technology. When its images are viewed on the Web, currents are depicted as colored arrows coded by ocean speed. The images from standard systems go out to about 30 miles offshore, with long-range systems going 120 miles.

Some will invariably ask if the antennas are harmful.

``No," said Paduan. ``These are broadcasting basic radio waves at lower power than a typical TV set in your house."

Knowing how the currents work also will allow cities to design better outflow pipes from their sewage plants, so the treated sewage doesn't wash back toward beaches. It will allow researchers taking down dams, such as the Matilija Dam in Ventura County, to see which beaches the tons of released sand will wash up on.

It also will allow emergency crews to predict which beaches an oil spill might foul, so they can mass cleanup crews there. Or it could allow the Coast Guard to run the images backward and find which ship might be responsible, if that's in doubt. It even can be used to track large ships in the ocean, a potential security use.

Some problems remain. The project, coordinated by the Coastal Conservancy, doesn't have local approval for all the radar antennas yet. Also, when the money runs out in 2009, the universities will need \$2 million a year to keep the system running.

Nevertheless, researchers have plans for even more high-tech uses over the next decade. Among them: combining the radar images with images of plankton growth from satellites, currents from underwater vehicles and other data from equipment on the bottom of boats.

``From your computer, you could see the surface, then fly down under the water to see how the currents are moving all the way to the ocean floor," said Paduan.

Add to that data from transmitters on fish, such as tuna, and scientists could gain new understandings into El Niño storms, polluted runoff, beach erosion and wildlife.

``This is part of a global movement toward understanding and monitoring the Earth in real time," said Schuchat.

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