

For a coastal engineer, a day at the beach means an opportunity to make waves. By **RICH WARREN.**

To some people, the seashore is a tranquil setting, a place to splash in the surf or catch a few rays. After events such as Hurricane Katrina and the Asian tsunami, however, others may see it in less placid terms, as a place where powerful forces collide.

Welcome to Diane Foster's world. As a coastal engineer, Foster studies one of the most dynamic environments on the planet, the place where sea and shore intersect. Though she jokes that she gets paid to go to the beach, she's actually trying to understand the changes that occur when the shoreline is assaulted by storms.

Foster studies flow and sediment transport. In plain English, that means the movement of sand grains and other sediment. Though crashing waves may be the most dramatic evidence of a storm's power, Foster is fascinated more by what waves do to the sand below the surface.

To study the mechanics of the seabed's mobility, Foster—an assistant professor of civil and environmental engineering and geodetic science—received two grants from the National Science Foundation. They included a Faculty Early Career Development award, one of the most prestigious a young researcher can earn. She has already uncovered some fascinating information.

For one thing, she's found that sand underwater and sand on the earth's surface behave differently. Not surprisingly, sandbars move as waves slam against them. But you might expect them to move gradually, like dunes in a wind-storm. Using underwater cameras, Foster learned instead that sand can shift suddenly, going from a rippled surface to a flat one in just a few seconds.

She also has footage of the crests on the sand wiggling quickly back and forth. The "feedback" between the sand and the wave intrigues Foster. "Once the shape of the seabed

changes, it affects the waves. So it's not just being acted upon; it's also playing an active role," she said.

Based on these observations, researchers can create computer models to predict how ocean waves will alter the shape of a beach over time. In practical terms, Foster's work might help determine how beaches erode, or how to slow down or prevent erosion. At present, coastal states spend millions of dollars each year in beach nourishment, the process of replenishing sand that has been washed away both onshore and off. With better understanding of sand's natural movements, coastal engineers might predict times of year or more specific places where replenishment could be most useful.

Because half of the U.S. population lives within 50 miles of a coastline (including the Great Lakes), Foster says it's important for us to advance our knowledge of coastal engineering. Especially in areas susceptible to hurricanes, the public needs to understand that coastal features such as beaches—and the structures built on or near them—may not be permanent. "We have to adjust our expectations," she said. "We've got to accept that our coastal areas are going to change."

Coastal engineers could work in tandem with planners to determine which areas are most at risk, Foster said. Or they could help decide what types of structures might hold up to a storm's fury, or how to build better levees. "If we're going to build in areas prone to storms, we have to understand the risks and make informed decisions," Foster said.

And when it comes to hurricanes, we're still learning, she added. Katrina, for example, brought its share of surprises. Katrina's enormous storm surge was expected to result in massive beach erosion, but surprisingly, some beaches remained unchanged. It was the structures inland that bore the brunt of the water's power.

Foster began her studies in mechanical engineering at the University of Massachusetts. Then, in graduate school, she took a course in wave theory and was hooked. She earned her master's degree from the University of Maine in 1991 and her Ph.D. from Oregon State University in 1996.

Last year she returned to Oregon for further study at the largest laboratory wave facility in North America. The four-year Cross-Shore Sediment Transport Experiment taking place there involves a consortium of seven institutions, including Ohio State.

Despite its lack of a nearby coastline, Ohio State does attract students to the field. Foster works tirelessly to convince potential students that with facilities like the university's Coastal Sediment Transport Lab, coastal engineering can be studied inland, then supplemented with trips to the seashore to see how laboratory observations match those in the field.

Foster's enthusiasm translates into ways to help people see waves in action. Last year she worked with Ohio State's civil engineering department to install a 14-foot wave tank at the Center of Science and Industry in downtown Columbus. Visitors can pull a lever and see how waves of different length, height, and frequency affect the sand beds under the surface and reshape the tank's "beach" area. Her goal: "I want to show that science and engineering can be fun."

Next year, Foster will travel to the Netherlands to work in an international collaboration looking at how noncohesive sediments respond to waves. She hopes someday to experiment with "smart" sediment, which would involve putting sensors inside a simulated grain of sand to observe how it moves.

Wherever she goes, there's no need to wonder if Foster will continue to make waves in her field. In fact, you could say it's a "shore" thing. ■

PHOTO BY MEGAN NADOLSKI

A woman with short dark hair and a joyful expression is buried up to her neck in fine, light-colored sand. Several seashells of various shapes and colors are scattered around her head on the sand surface. The overall mood is peaceful and nostalgic.

She studies sand by the seashore