To Catch a Hurricane

On Aug. 25, 2011, the line projecting Hurricane Irene's path up the East Coast barreled smack into Woods Hole, Mass., spurring a whirlwind in Jeff Donnelly's lab at Woods Hole Oceanographic Institution (WHOI). Scientists and students hustled to create a network of instruments that would capture a hurricane in action. They scurried to get their supplies: 100 bottles of soda and a few dozen pairs of ladies' nylon stockings.

Donnelly is a coastal geologist who uncovers long-term records of past hurricane activity. His evidence is sand transported by hurricane winds and waves into quiescent lagoons and shoreline ponds. The sand settles in layers at the bottom and is buried by black, organic-rich mud that ordinarily sinks down in non-hurricane conditions. His lab group cores into these bottom sediments to extract a slice of a region's hurricane history, going further back in time as they dig deeper. Over decades and centuries, telltale hurricane layers, interspersed with organic mud, stand out like lines in a bar code. Radiocarbon dating of material in the layers reveals when the hurricanes occurred.

"We wanted to record how sediment is transported in an actual event—a modern analog we could compare with past records," said Andrea Hawkes, a postdoctoral investigator at WHOI. "The idea of a hurricane hitting here was not appealing, but scientifically, it was very appealing."

Not every experiment requires expensive equipment. For research on how storms transport sand, WHOI postdoctoral scientist Andrea Hawkes fashioned instruments out of plastic tubing, duct tape, and women's stockings (above) and installed them on telephone poles (right). Researchers also used soda bottles (far right) to make sediment traps submerged in shoreline ponds.

Tom Kleindinst, WHOI

Rivers of Pent-Up Carbon

With global temperatures continuing to rise, huge reservoirs of organic carbon stored in large river basins could be converted into heat-trapping carbon dioxide (CO_2) gas and intensify climate change, according to new research by Woods Hole Oceanographic Institution scientists.

Geochemists Valier Galy and Timothy Eglinton, with French colleagues, collected river sediments from the vast drainage basins of the Ganges River and the Brahmaputra River in Tibet, Nepal, northeastern India, and Bangladesh. They used radiocarbon dating to measure how long organic carbon remained in soils and river sediments before being flushed into the ocean. Although a fraction of organic carbon moved through the basins in a few hundred years, on average it remained in the river system for 3,000 years and in some cases more than 17,000 years.

That means heavy loads of organic carbon were not flushed quickly out of the upper reaches of the rivers. Nor was the carbon rapidly decomposed by microbes, a process that converts organic carbon into CO_2. The scientists hypothesize that warmer temperatures will stimulate more microbial decomposition of the stored organic matter and accelerate the release of more CO_2 into the atmosphere.

"Similar stocks of ancient carbon may exist elsewhere in

"We were sitting in a pub saying, 'What can we do to increase our understanding of sediments mobilized by hurricanes?' " said Pete van Hengstum, a WHOI postdoctoral fellow from Canada. "Over a pint, we hatched a plan with two components. First, we would capture the sand as it was being transported off the beach barrier by wind and water; and second, we would catch the sand once it got thrown into the ponds."

With Irene only a few days away, the researchers received a small rapid-response grant from the WHOI Coastal Ocean Institute. Hawkes and a cadre of lab technicians and summer students hurriedly fashioned their instruments. They cut small sections of clear plastic tubes. Onto each, they fitted an ankle-length nylon stocking with a hose clamp. The tubes would funnel sand into the socks.

Then they took to the field, screwing 30 of their sand-catchers to utility poles, signs, and even a piling on a beach house (with permission from the owner) along Surf Drive in Woods Hole. The road runs along a thin barrier beach that fronts Oyster Pond and Salt Pond.

Meanwhile, van Hengstum, technicians, and students hastened to construct underwater instruments. "We bought one hundred 2-liter bottles of a no-name brand of soda at ninety-nine cents a bottle," he said. "We tried to get used bottles, but they are shredded at recycling centers. So we put a lot of soda down the drain."

They cut off the bottoms of the bottles and secured 50-milliliter plastic centrifuge tubes into the bottles' mouths with duct tape. They attached their apparatus with the open sides up along a rope, spaced 1 to 2 meters apart with knots, and tied a cinderblock anchor to the bottom of the line and a float to the top. With winds signaling Irene's imminent approach, van Hengstum and colleagues used a boat to submerge 30 of the instruments in Oyster and Salt Ponds, Quissett Harbor, and Waquoit Bay.

Tom Kleindinst, WHOI

After scurrying for three days, the team was ready when Irene arrived in Woods Hole on Aug. 28. But by then it had weakened to a tropical storm, with winds slightly under the 74-mile-per-hour threshold for a Category 1 hurricane.

Ken Kostel, WHOI

After the storm, the team quickly retrieved its instruments. They got more than a few odd looks and questions from passersby who wondered about the bevy of sock contraptions that had sprouted in the neighborhood, Hawkes said. The impromptu sand- and sediment-catchers successfully collected the required data.

"We wanted to get a baseline estimate of how much sand is actually transported by a hurricane event," van Hengstum said. "Oyster and Salt Ponds are great recorders of past storms, but which layers indicate hurricanes versus just strong storms? Any information provided by this rapid test would allow us to better interpret sand layers in the long-term record. Irene showed us the signal of sand transported by a tropical storm, so anything greater than this signal in the prehistoric sediment record we can now interpret more confidently as a hurricane event."

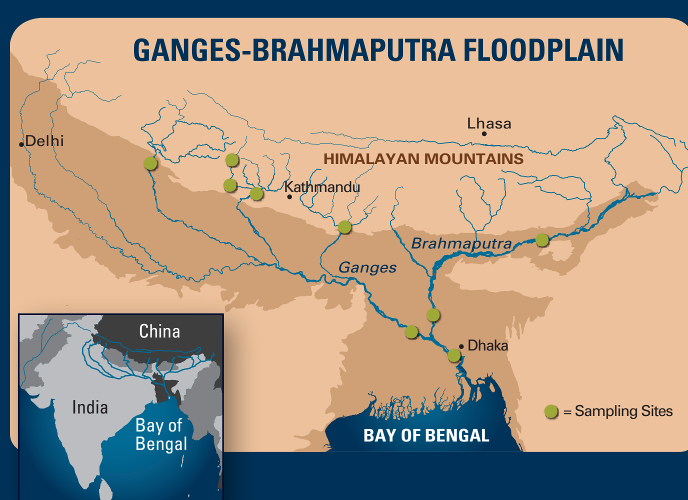
—*Lonny Lippsett*

Courtesy of Peter van Hengstum, WHOI

low-latitude river catchments," the scientists said. "Global warming would likely destabilize this ancient carbon, generating an extra flux of CO_2 to the atmosphere, which in turn would further warming."

Galy and Eglinton compared the potential situation to a similar one in the Arctic, where microbes in thawing permafrost could convert large amounts of stored organic carbon into CO_2.

The study was part of a multiyear project funded by the National Science Foundation on the flow of terrestrial organic carbon from world rivers into the ocean. It was published in November 2011 in the journal *Nature Geoscience.*



Amy Caracappa-Qubeck, WHOI