MAKING WAVES: GRAD STUDENT'S WAVE RESEARCH EARNS AGU AWARD

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It's a common human experience: Sitting on a beach, watching as the waves lap against the sand. You feel your worries start to melt away as your mind focuses on the breaking waves, one after another. You notice the differences between them—how some build up height as they near the shore until they curl forward into a dramatic pipeline that's the stuff of surfers' dreams. Others seem to spill over themselves as they reach the shore, water and foam tumbling over the front of the wave and pouring onto the beach.

For Andrea Albright, studying the ways waves break is more than a practice in beachside relaxation. "There's a lot of questions about which kinds of waves drive erosion versus moving sand back onto the beach," says Albright, a graduate student in the Cullen College's geosensing systems engineering and sciences program.

Albright's research is providing answers to these questions. But it's not only her research findings that are making waves?her ability to explain the significance of her work has earned her the distinction of grand prize winner of the American Geophysical Union (AGU) 2017 Data Visualization and Storytelling Contest.

As one of six total winners chosen across the U.S., Albright will receive a $2,500 travel stipend to attend the 2017 AGU meeting this December in New Orleans. At the meeting Albright will give a presentation on her research using NASA's Hyperwall, a large video wall used to display multiple high-definition data visualizations.
A visualization problem

NASA’s Hyperwall will surely come in handy for Albright in presenting her work — visualization is key when it comes to understanding waves.

The shape of waves as they break has a big impact when it comes to coastal erosion, she explains. Some waves introduce energy into the water column, which is thought to move sediment towards the shore, altering the geography of the coastlines they break on. Others break more gently and are thought to slowly erode sand away from the shoreline as the wave retreats, pushing the coastline farther inland.

But understanding which types of waves impact coastal erosion (and how) has been a real challenge for researchers. Usually sensors are placed under the water to gauge how tall a wave is and how fast it’s moving towards the shore, but that doesn’t provide any information on the shape of the wave at the surface — a detail which, as it turns out, plays a big role in coastal erosion.

Researchers often supplement underwater sensors with video recordings of waves to extrapolate information on their shape and size.

“It’s a challenge for oceanographers,” Albright says. “How do you measure exactly how tall a wave is or how it’s shape changes? It is difficult to extract that kind of quantitative information from a video.”

Albright has a better way to visualize and study waves, one that takes us away from two-dimensional pictures and deep into 3D space.

The wave of the future

The geosensing systems engineering and sciences graduate program at the UH Cullen College of Engineering is the only program of its kind in the world. Administered through the National Center for Airborne Laser Mapping (NCALM) at UH, the program trains the next generation of scientists in the rapidly changing field of geospatial engineering, providing students with hands-on experience using state-of-the-art sensors and remote sensing technologies for a wide variety of Earth science applications.

The center’s premiere technology is LiDAR, or light distance and ranging. It works by shooting thousands of laser pulses per second at the ground from a plane or terrestrial platform. How quickly that light returns to its source can be used to calculate its distance from the source. Researchers often use these data sets to produce detailed topographic maps. LiDAR data collected by NCALM has been used for a variety of applications, from archaeology and to mapping coastal erosion.

The technology is relatively new and so widely applicable that novel uses for it are still being discovered. Part of Albright’s work is applying LiDAR to the study of waves and coastal erosion, and the other part is explaining her work to a public that’s never heard of this technology before.

“I had to focus on moving people away from two-dimensional photographs and into three-dimensional LiDAR space,” Albright says.

And it’s here, at the cutting edge of cutting-edge, that Albright finds herself riding the wave of the future.

Waving goodbye

Albright conducted her research at the US Army Corps of Engineers Field Research Facility in Duck, a small town located in North Carolina’s Outer Banks, a group of barrier islands just off the coast. Using a 35-foot-tall amphibious platform called the CRAB (an acronym for coastal research amphibious buggy), the team placed sensors beneath the water to capture information on the speed and height of the waves while another system
collected water samples to quantify the amount of sediment each wave carried. The researchers positioned the LiDAR equipment on a long arm of a platform that extended over the water and shot thousands of laser beams at the waves below, calculating the distance each laser traveled from the platform to the surface of the water and back again.

?The consequence of shooting a swath of lasers is you can see the surface of the water as it moves, and we can actually make a movie of a wave as it?s moving. It?s a whole new way to look at this sort of phenomena,? Albright explains. This data was supplemented by video footage of the waves shot by a GoPro camera attached to the CRAB.

The next step for the researchers is to combine data from each laser and calculate wave statistics, which describe each type of wave and how it breaks based on the individual properties of each wave. ?The qualities of each wave will be used to characterize the wave types,? Albright says.

When the research is completed and Albright is ready to wave goodbye, she hopes to leave the barrier island with data for wave models that will help in planning and remediation efforts for coastal erosion.

But for now, Albright is looking forward to introducing a new application of LiDAR to an audience of hundreds of esteemed peers at the AGU conference, where her 3D research images will be making waves on NASA?s big screen.

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