swash zone Studies

By Dale Beardsley

Hurricanes and tropical storms are feared by many due to their devastating winds, which destroy homes and businesses, and extreme flooding that gouges up roads and major highways. Some, however, see the aftermath of these events as a means for exploration—specifically coastal engineers, geomorphologists and university research groups.

Measuring erosion and recovery of northwest Florida beaches

In an effort to predict beach response and better manage coastal zones to promote beach recovery and avoid future devastation, such specialists seek to understand the dynamics of these sporadic natural occurrences and their impact on coastlines.

Interest in the geomorphology of the swash zone has increased over the years, as the importance of swash processes to the development of nearshore sandbars and coastal dunes has become recognized. A swash zone refers to a specific area of the beach alternately covered by water flowing upward and then backwashing, following a wave break.

Diminishing Dunes

Taking place during late summer and early fall, hurricanes and tropical storms are the culprits for delivering large volumes of water and sediment onshore, eroding sand from dunes and changing the overall shape of beaches, making the coastal dune system difficult to preserve. This vital system needs to be protected and restored because it is the best defense against coastal flooding, erosion and sea-level rise, which can produce catastrophic effects.

During the summer months, when storms are smaller, sand often accretes onto the beach from the offshore zone or sandbar by the onshore swash, carrying sand and water onto the beach. This increases the width of the beach both internally and externally. The backwash flow is almost eliminated because the beach absorbs the water and the sand is deposited. As the sand dries out, it becomes available for transport by wind into the backing dunes, leading to a growth in height and width of the beach.

The most dramatic change in the coastline occurs during the winter months, when most large-scale storm events take place. Hurricanes and tropical storms cause the ocean water level to rise (the storm surge), resulting in a saturated beach that limits infiltration and delivers large waves onto the beach. If this backwash movement of waves has enough energy, the beach will erode and sand will be transported offshore to become a nearshore sandbar, thereby limiting the availability of sand to the dune system.

While water level variation along transects is typically measured, there has been little work done to look at the variation in water surface elevation over a larger area (both cross-shore and alongshore) and how it relates to sandbar morphology.

This process should be the subject of any research study involving sediment transport, as it is critical in determining the rate of post-hurricane and dune recovery.

Post-Storm Studies

The aftermath of storms occurring between September 2004 and July 2005, including Hurricanes Ivan and Dennis as well as Tropical Storm Arlene, caused significant beach erosion and deterioration of the dune system along Florida's northwest coast. With funding provided by the Florida Sea Grant and the National Park Service and in an effort to determine beach recovery, Texas A&M University's geography department is completing two studies within the next year on a barred beach in northwest Florida affected by these storms.

The first test, already completed, was a preliminary study for students to not only become familiar with advanced measurement techniques used to acquire precise water level measurements, but also to further analyze the changing beach characteristics at the scale of individual waves, tidal cycles and in response to storms. The study also helped in determining how the asymmetry of the waves running up and down the beach affects the amount of sediment deposited on the beachface.

The test was implemented with the use of Pressure System's KPSI Series 735 level transducers. The level transducers were integrated into a larger system that included acoustic doppler velicometers and ultrasonic sensors to quantify wave phenomena by measuring changes in bed elevation at the scale of an individual grain of sand within the inner surf and swash zones of the beach.

"Having used Pressure Systems' Series 735 for water measurement applications in the past, we used these transducers again for their ability to deliver highly accurate measurements," said Chris Houser, assistant professor of coastal geomorphology at Texas A&M. "In addition, the transducers were the perfect solution to determine how the asymmetry of waves affect the amount of sediment accreted or eroded, which ultimately leads to beach development."

3-D Research

The research group will also begin studying 3-D water surface elevation and the effect rip currents have on beaches, which has been an under-researched area of oceanographic exploration. With the use of these submersible hydrostatic level transducers, the department's ultimate goal is to implement a large-scale examination with approximately 60 transducers to further analyze sediment transport and beach recovery.

"The results of these series of tests will eventually grant us insight to the rates of beach recovery, which were previously unattainable due to the lack of advanced water level measurement techniques available in the past," Houser said. "Now, with the use of such advanced systems like the Series 735, studying beach morphology has become easier and more accurate than ever before, and has enabled coastal geomorphologists to have a better understanding of managing coastal zones following the detrimental effects of hurricanes and tropical storms." WWD

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