Researchers Test Beach-Nourishment Protocol

An interdisciplinary team of VIMS researchers is wrapping up a multi-year study in Virginia Beach designed to help government agencies more effectively monitor the environmental impacts of beach nourishment.

Beach nourishment involves mining sand from offshore or land-based deposits and transporting it to beach areas to make them wider and more stable.

Geologists Woody Hobbs, Scott Hardaway, and Jesse McNinch have joined forces in the project with biologist Bob Diaz and computer modeler Jerome Maa. Their goal is to test the Mineral Management Service's (MMS) protocol for monitoring the effects of sand mining on the living and physical resources of U.S. shorelines. The MMS is the federal agency charged with issuing permits for sand-mining from federally managed offshore areas.

Beach nourishment is a sometimes-controversial practice with costs and benefits to both the economy and the environment. The Army Corps of Engineers (ACOE) spends about $80 million a year to maintain the nation's coastline against erosion and rising sea level, with local governments chipping in another $40 million. In addition to supporting a healthy tourism economy that generates billions of dollars annually, healthy beaches can play a major role in protecting the shore from storms and erosion. Critics contend that some beach-nourishment projects actually hasten coastal erosion, and that the practice is ultimately unsustainable.

Virginia Beach, the Commonwealth's most popular seaside destination, has spent about $110 million on its 30-year beach-stabilization project, and earns about $40 million in taxes from the $500 million in tourist revenue that the beach generates each year.

The current study builds on VIMS' long history of collaboration with MMS, ACOE, and other coastal-management agencies. "We've had a series of one-to-two year projects going back over a dozen years with MMS, looking at various aspects of beach nourishment in Virginia Beach," says project leader Hobbs.

The initial studies defined the available reserves of sand offshore of Virginia Beach. A more recent study focused on the potential environmental impacts of offshore mining. VIMS scientists assessed the possible biological impacts to bottom-dwelling organisms and fish, and the possible physical impacts to the offshore dredge zone, the surf zone, and the nourished beach. Study results included computer models that MMS and ACOE use to evaluate and implement beach-nourishment projects.

The VIMS' studies were instrumental in guiding MMS officials during their review of Virginia Beach's (successful) request for permits to exploit the sand resources off its shoreline. In fact, the MMS was so satisfied with VIMS' efforts that the agency encouraged other institutes to use the studies as a template when submitting proposals for shoreline-impact studies in other states along the Atlantic seaboard.

"Ultimately, though," says Hobbs, "MMS realized that their studies were about the potential impacts, and that follow-through to see what really happened would be of great benefit. So they set about to create a protocol for monitoring offshore sand-mining areas."

"Monitoring would allow us to assess the accuracy of the predictions that were used in the design and consideration of the dredging process," notes Hobbs. "That would help improve the predictive models so that subsequent nourishment projects will last longer and have fewer detrimental environmental effects."

The current VIMS study is designed to review and enhance a trial protocol that was developed by a consultant using information obtained during a December 2000 meeting of scientists, engineers, and resource managers at VIMS.

The VIMS study is multifaceted. McNinch is studying how subsurface geology in the surf zone helps controls beach erosion. Hardaway is investigating the best ways to monitor a nourished beach to ensure that it lasts as long as possible. Diaz is exploring how best to conduct long-term studies of impacts to bottom-dwelling organisms in the dredge zone. Maa is testing a low-cost radar system for monitoring wave height shoreward of the dredge area (see sidebar).

The team expects to deliver its final report to the MMS in early 2006.

Sandbridge, Virginia (just south of Virginia Beach) before (L) and after (R) beach nourishment. The beach is much wider in the after-nourishment photo, even though that photo was taken after Hurricane Isabel.

Maa Rises to the Occasion

The Mineral Management Service's initial protocol for monitoring beach-nourishment projects called for use of a buoy to monitor waves at project sites, but VIMS researcher Jerome Maa and others were concerned that a single buoy would not provide broad enough spatial coverage for meaningful results. Maa is thus testing the effectiveness of using a low-cost radar system to monitor wave height along the beach. The current radar unit provides coverage over a radius of about 2.5 kilometers.

"The long-term goal is to use easily available X-band radar to monitor the wave height and current field," says Maa, "That's important because wave conditions affect sediment transport, the beach profile, and erosion along the beach."

Maa stationed his radar unit atop the 12-story Clarion Resort and Conference Center in Virginia Beach. "They were very kind to provide this high ground," says Maa. "You need a certain height to use radar for better wave images. The ideal height is 30 meters or more."

Unlike traditional wave gauges, which measure actual vertical displacement, radar images provide only a relative measure of wave height. Maa's most recent research effort was thus to place a pressure gauge within the radar's field of view in order to calibrate or "ground truth" the radar data. The gauge was deployed this past spring by marine technicians Bob Gammisch, Tim Gass, and Wayne Reisner, and graduate student Ho Kyung Ha.

Maa has also been working to develop the software needed to interpret and analyze the radar images, potentially saving the agency about $50,000 dollars at each radar-monitored sand-mining site.

Preliminary results suggest that the radar holds promise for long-term monitoring of beach-nourishment efforts. "Radar is not a perfect technique, but it is reasonable," says Maa. Land-based radar units are cheaper to maintain and operate than traditional marine gauges, and provide much wider coverage.

Due to budget cuts, the Army Corps of Engineers no longer operates a wave gauge for Virginia Beach. "But there is a need to know wave conditions and to use that as input to better simulate shoreline response," says Maa, "so I think that with local support, we will go back. Everyone is interested in maintaining a stable beach."