Digital Elevation Modeling

Coastal landscapes are in a constant state of flux. Tides, storms, and development all impact the physical and ecological characteristics of estuarine areas. One technique utilized to analyze changing landscapes is Digital Elevation Modeling (DEM), which is currently being used by a team of North Carolina National Estuarine Research Reserve (NCNERR) and National Oceanic Atmospheric Administration (NOAA) scientists to measure the sediment accretion effects of an alternative shoreline stabilization demonstration project. . The demonstration project is a small part of the recently completed Sustainable Estuarine Shoreline Stabilization: Research, Education and Public Policy in North Carolina project, a partnership between scientists at NOAA, NCNERR, the University of North Carolina Chapel Hill - Institute of Marine Sciences (UNC-IMS), and University of North Carolina Wilmington (UNCW). The demonstration project was designed to stabilize estuarine shoreline while maintaining the function and health of the adjacent estuary and was constructed in partnership with Drs. F. Joel Fodrie and Antonio Rodriguez of UNC-IMS.

A GPS unit is mounted on a bicycle to collect data.

DEM creates a three-dimensional representation of a terrain's surface by collecting high precision and accuracy xyz (latitude, longitude, and elevation)data using a Real Time Kinetic (RTK) GPS unit. Modeling elevation over a defined time series can reveal changes in landscape characteristics. For example, areas with higher elevations at the end of a time series may have retained or accumulated sediment, while areas whose elevation lowered over time may have lost sediment due to erosion from waves or tides. By collecting three-dimensional data, DEM allows researchers to calculate the volume of sediment contained in the measured area, which is useful for comparisons across locations or time scales.

Dr. John Fear of the NCNERR and Dr. Carolyn Currin of NOAA are utilizing this technology to understand how the demonstration project is performing in terms of mitigating erosion. The demonstration project was constructed in May 2012 using mounds of loose oyster shells and marsh grass plantings. The use of loose oyster shells, rather than bagged shells, was an innovative approach that decreased labor costs, and involved careful planning to take advantage of natural oyster spat settlement needed to bind the loose shells together shortly after their placement.

Technical specialist Michael Greene collects DEM measurements along an oyster sill

DEMs were obtained prior to construction, and immediately after construction activities were completed. The research team returned this year to determine if the oyster shell structures had trapped sediment on the landward side, which would indicate that the sill was effectively preventing erosion, and possibly even accumulating sediment. In order to get the elevation data over muddy, slippery terrain, NOAA technical specialist Michael Greene had to get a little creative. To keep the GPS unit a consistent distance from the surface and obtain continuous elevation recordings along the length of the measured area, Greene fastens the GPS to a long pole attached to a bicycle. This helps the GPS "roll" easily through muddy, wet substrate while

maintaining consistent contact with the ground. The creative data collection method heralded some interesting looks from nearby boaters, but got the job done efficiently and accurately!

The Digital Elevation Model created from this data will help research partners from NOAA, NCNERR, and UNC-IMS determine the effects of the oyster shell structures on sediment movement and erosion rates. Researchers hypothesized that data collected in future years will show increased elevation over time, indicating sediment retention landward of the living shoreline. This long-term data collection, along with UNC-IMS research about oyster settlement and salt marsh vegetation success at the demonstration site, may eventually help make the case for the effectiveness of oyster sill living shorelines as a sustainable, natural method of stabilizing estuarine shorelines.

The Sustainable Estuarine Shoreline Stabilization project is funded by the NOAA/University of New Hampshire Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET). The final report is available on the NCNERR website.