Engineer Research and Development Center

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Nearshore Video Imaging

Quantifying Coastal Processes & Morphology from Imagery of the Coast

Optical remote sensing is widely recognized as a useful tool for nearshore research and more recently as an operational tool for improved civil and military geospatial intelligence. Imagery of the coast can be collected from a variety of terrestrial and airborne platforms and exploited both qualitatively and quantitatively to provide information on coastal processes, beach & dune topography, nearshore water depths with error estimates, sandbar positions, wave runup elevations, as well as the condition of coastal infrastructure or navigability of harbor or inlet entrances.

Problem

Beaches and surf-zones evolve rapidly (hours to days) in response to changing waves and water levels that drive gradients in sediment transport. This natural evolution of the coastline can lead to rapid changes in coastal vulnerability and create navigation hazards if left unmonitored. In particular, during storms, large quantities of sediment can be redistributed and exchanged in the cross-shore between the beach and surf-zone, or moved along the coastline. Frequent monitoring of coastal morphology and processes can therefore provide valuable insight into the performance of coastal engineering projects and also be used to provide accurate boundary conditions to numerical models for improved predictions of coastal inundation, damage, and channel infilling during storms. Traditional in-situ surveying approaches can be time-consuming, expensive, and potentially un-safe. Video imaging offers an alternative to these in-situ surveys, by exploiting the optical signature of breaking and shoaling waves moving through the surf-zone to extract information on coastal processes and morphology. Wave speeds can be measured and inverted to provide information on water depths. Time-series analysis of wave breaking can be used to extract wave dissipation proxies and maximum wave runup elevations along the coast. All of these data can also be assimilated into coastal models to provide enhanced understanding of coastal processes and nearshore bathymetry estimates.

Technology

Research at CHL's Field Research Facility (FRF) in collaboration with Oregon State University, the Naval Research Laboratory, and the U.S. Geological Society has led to the development of three main video imaging observational platforms to quantify coastal morphology and processes:

- **Mobile Video Imaging Tower** – a trailerable, self-guying tower (up to 70ft) designed to be rapidly deployed in response to a storm event or to temporarily monitor a project site with coupled terrestrial lidar and video imaging capabilities to observe coastal morphology evolution along ~0.5 to 1 km of coastline.
- **ARGUS Continuous Monitoring –** a permanent video imaging station with multiple cameras that can be setup on existing tall coastal infrastructure (condo/hotel/lighthouses) to monitor coastal morphology. The Duck Argus station has been in operation for 30 years in conjunction with researchers at Oregon State University.
- **sUAS Littoral Zone Mapping System** – an inexpensive approach to utilize small Unmanned Aerial Systems (sUAS) to map sub-surface water depths, beach topography, and surf-zone wave breaking along multiple kilometers (~10s of km) of coastline. This effort marks the transition of R&D technology long-used by the nearshore research community to understand the littoral zone to an inexpensive solution that will allow district field engineers or the warfighter to rapidly map large stretches of coastline in advance of coastal storms or military operations.

Benefit

- **Mobile Video Imaging Tower** - This R&D system provides maximum flexibility for short-term monitoring of post-storm inlet breaches or beach nourishment/berm placements. It can provide topographic elevations of the beach within 500m of the tower and video images of the surf-zone within a kilometer which provide observations of sandbar position and nearshore water depths, as well as wave breaking processes, and surface currents.
- **ARGUS Continuous Monitoring** – Continuous Argus stations are permanent video camera installations on elevated infrastructure that provide real-time information on the condition of engineering infrastructure, harbor and inlet entrances, or beach and surf-zone morphology. These stations are best utilized in locations where there is a long-term commitment for continued coastline management.

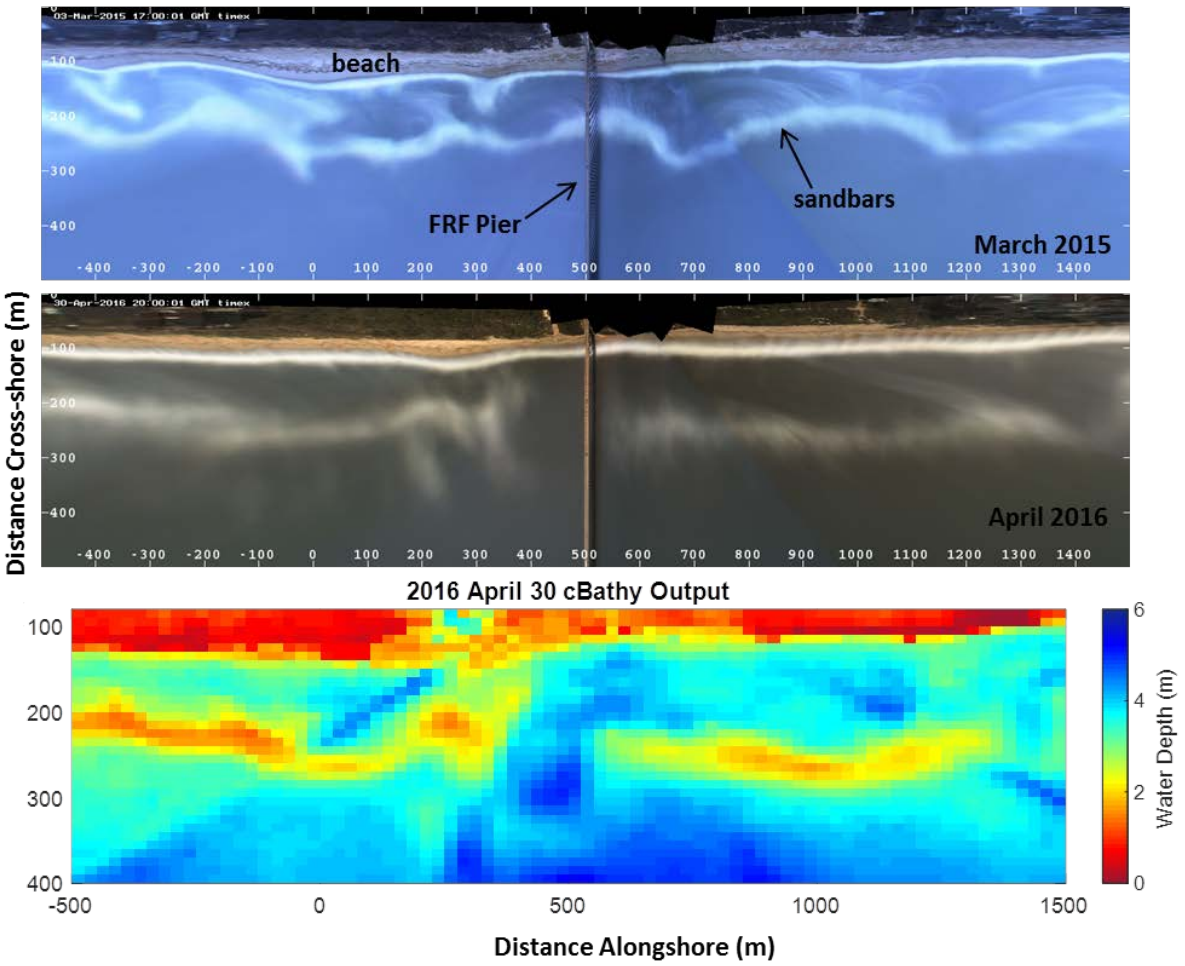
- **sUAS Littoral Zone Mapping System** - This system will ultimately provide up-to-date information on the current state and morphology of the coastal zone – information critical for planning military landings or predicting coastal inundation and damage from extreme storms.

Status

- **Mobile Video Imaging Tower** – recently deployed in Kitty Hawk, NC to observe overwash of a dune and overtopping of a roadway during a coastal storm in collaboration with the USGS.
- **Argus Continuous Monitoring** – data are available now @ http://navigation.usace.army.mil/CHL_Viewer/FRF/ and at http://frf.usace.army.mil for Duck, NC. Argus is currently being transitioned to a joint working group run by the Naval Research Laboratory, the US Army Corps of Engineers, and the US Geological Society with an emphasis on improving data access and processing capabilities to more users.
- **sUAS Littoral Zone Mapping System** – system is in development and is scheduled for DEMO to military personnel in FY18.

Image and Caption

Example Video Imaging Data Products from Duck, NC – top two panels show sandbar morphology from imagery time-averages, bottom panel shows water depths.



ERDC Points of Contact

Questions about nearshore video imaging?

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