Improved Understanding of Sediment Dynamics for the Coos Estuary

Project Location

Coos Estuary

Project Duration

November 2016 to February 2020

Project Lead

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Project Type

Collaborative research – Generating science that informs decisions

Products

- Journal articles on Coos estuary hydrodynamic modeling and historic bathymetry change
- Coos estuary bathymetry data and an accompanying data collection report
- Videos of hydrodynamic simulations
- Changes to the Coos Estuary Exhibit Panel
- Project website

Project Partners

- Coos Watershed Association
- Oregon State University
- Partnership for Coastal Watersheds
- South Slough National Estuarine Research Reserve
- Woods Hole Oceanographic Institution

Project Webpage

nerrssciencecollaborative.org/project/Sutherland16

Overview

The Coos estuary has many diverse users who share a need for better information about water and sediment flows through the estuary under current and future conditions. Designated one of Oregon's three "deep draft development" estuaries, planners must balance industry, restoration, and natural resource goals while addressing myriad management needs. This project filled data gaps, modeled circulation and sediment transport in the Coos estuary, and showed how the estuary can be expected to respond to natural and human-caused disturbances such as dredging and sea level rise.

The project provided users with a dynamic picture of estuary conditions and habitat that has already begun to inform decision-making. Its findings have direct application to the management needs of the South Slough National Estuarine Research Reserve and other estuary users, such as Coos County, the Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality, and the Oregon Institute of Marine Biology. These end users were actively involved throughout the project, from identifying research objectives and products to applying research findings in support of estuary health. The project informed a broad range of management actions, such as updating the estuarine management plan, improving the success of oyster restoration projects, informing fisheries habitat maps, and increasing data efficiency among community stakeholders.

Project Approach

The project team worked closely with the Partnership for Coastal Watersheds, a local stakeholder group that includes natural resource managers, businesses, land use planners, researchers, and educators, in an iterative process to develop products relevant to research and management needs. To better understand and predict estuarine water and sediment flows, the project collected new data and developed a hydrodynamic model. Researchers drew on existing data and maps, and gathered time-series data of water properties such as temperature and salinity, velocity, sediment type, and sediment concentration at monitoring stations in the South Slough National Estuarine Research Reserve and in the greater Coos estuary. Significantly, the project collected the first bathymetric data set to cover the entire Coos estuary, and expanded monitoring of sediment fluxes to the estuary.

Using these data, the team developed a hydrodynamic model for the Coos estuary that incorporated river discharge, wind, and tides. The model was validated and sediment dynamics predicted by the model were tested against observations. The team then used the model to run two perturbation experiments to analyze a proposed deepening and widening of the estuary's main navigation channel and to examine historic estuary conditions prior to many human impacts, such as jetty construction and ship traffic.

Results

The project's research findings, stemming from the creation of a new bathymetric data set for the Coos estuary, are discussed in two journal articles. A few highlights are outlined here.

- Exchange flow in the Coos estuary (responsible for the transport of salt, heat, nutrients, etc.) is primarily driven by tidal processes, rather than river discharge. This finding, revealed through compiling different observations and model development, makes the Coos estuary distinct from most West Coast estuaries.

- Sub-estuaries can have reverse salinity gradients, potentially affecting their circulation, residence times, and overall ecosystem health. Multiple connecting tributaries to the Coos estuary create a complex mix of water transport flows.

- A comparison of present-day and historical bathymetry shows significant changes to the estuary over the past 150 years. Total estuary area has decreased by 12 percent, the primary navigation channel deepened from approximately 6.7 meters to 11 meters, and volume increased by 21 percent. These changes drove a 33 percent increase in tidal amplitude, an 18 percent increase in salinity intrusion length, and an increase in the ebb and dominance of currents.

Benefits

- Increased ability for managers to promote the health of the Coos estuary and predict estuary response when making decisions about dredging projects, land use modifications, and climate change impacts.
- Improved data exchange and collaboration among estuary users, including new connections across user groups.
- A new, enhanced bathymetry data set for the Coos estuary that is a significant improvement on what was previously available. It has already been applied to a variety of management contexts, including an Institute for Applied Ecology blue carbon feasibility study, a South Slough National Estuarine Research Reserve eelgrass recovery plan, an Oregon Department of Fish and Wildlife shellfish habitat assessment, an Oregon Department of Environmental Quality oil spill response plan, an updated Coos County estuarine management plan, and modeling by private consultants of the impact of development projects.

What's Next

- A NOAA Effects of Sea Level Rise project will rely on the project's data and model to compare the impact of restoration efforts on nature-based estuarine services in Coos Bay, Oregon and Gray's Bay, Washington.
- The team will perform ongoing research to leverage the hydrodynamic model to understand circulation effects on oyster and crab larvae, as well as eelgrass habitat in the South Slough Reserve.
- The team will continue to work with the Oregon Department of Environmental Quality to update Total Maximum Daily Load criteria for the Coos estuary.
- The team will pursue opportunities to answer biological research questions by incorporating temperature and new sediment observations into the model.

About the Science Collaborative

The National Estuarine Research Reserve System's Science Collaborative supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is managed by the University of Michigan's Water Center through a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA). Funding for the research reserves and this program comes from NOAA. Learn more at nerrssciencecollaborative.org or coast.noaa.gov/nerrs.