Monitoring Hydroacoustic Flow and Tracers of Offshore Dredge Material near South Padre Island, Texas

Douglas J Schnoebelen, Hydrologist, U.S. Geological Survey, San Antonio, TX, dschnoebelen@usgs.gov
Frank L. Engel, Geographer, U.S. Geological Survey, San Antonio, TX, fengel@usgs.gov
Brian Petri, Hydrologic Technician, U.S. Geological Survey, San Antonio, TX,
Charles Hartman, Hydrologic Technician, U.S. Geological Survey, San Antonio, TX,
Patrick Bryan, Hydrologic Technician, U.S. Geological Survey, San Antonio, TX pbryan@usgs.gov
Michael Lee, Hydrologist, U.S. Geological Survey, Houston, TX, mtlee@usgs.gov
Dwight Sparks, Hydrologic Technician, U.S. Geological Survey, Austin, TX, dsparks@usgs.gov

Abstract

Beaches and water recreation are important to the South Padre Island, Texas area and across the United States. The movement of sediment in channels along beaches and the nearshore environment is important for coastal stakeholders and resource managers. Sediment removed by maintenance dredging is often placed back into the littoral system for potential beach replenishment. The movement of sediment from offshore berms to onshore beaches is not well known. Sediment transport is highly dependent on local current conditions and seasonal conditions. This study combines the use of tracer sand, sediment sampling, and continuous hydroacoustic data to provide valuable monitoring data for understanding the water/sediment resource and how the sediment delivery system operates. These data are vital for regional sediment management to assess 1) the best locations for placing dredged sediment offshore, 2) if sediment material places in offshore berms can replenish beach areas, and 3) providing data to other coastal areas across the Nation.

Introduction

The movement of sediment in channels along beaches and the nearshore environment is important for coastal stakeholders and resource managers. Sediment can deposit over time in entrances to harbor channel areas impeding boat traffic and requiring dredging. Beaches can erode with time losing valuable shoreline areas. In addition, beaches often are often not self-sustaining and require the replenishment of sand to maintain recreational areas. One tool to help maintain beaches is the placement of the sediment dredge material in offshore berms that may have the potential to replenish beaches as this sediment migrates alongshore (Poleykett and others, 2018).

Understanding the sediment and water interaction and how the sediment delivery system operates is needed for beach management. However, the movement of sediment from offshore berms to onshore beaches needs to be better quantified. In addition, sediment transport is highly dependent on local current conditions. Monitoring data (temporal and spatial) for the near shore and offshore environment (velocities, sediment sampling, and currents to name a few) are needed to better evaluate the success of offshore beach replenishment projects

(Peterson and Bishop, 2005). Monitoring data are vital for resource managers in making informed decisions for future prioritization of project and funds. These monitoring data also are important for the calibration and validation of sediment transport models that can help predict "what if" scenarios and future planning.

Study Design and Methods

An channel area near South Padre Island, Texas was dredged in July of 2018 by the US Army Corps of Engineers (USACE). The dredge material, dominated by fine sands (similar in size to existing beach material), was placed in an offshore berm from South Padre Island beaches. The City of South Padre Island contracted with Partrac GeoMarine, Inc. (Partrac) to place sediment tracer material on the offshore berm to be used in the future tracking of sediment movement. The U.S. Geological Survey (USGS) also was contracted to do the sediment sampling and hydroacoustic data collection for the study. The movement of tracer or "tagged" sediment particles in context of hydrodynamic (currents, waves, and velocities) data can help in the understanding sediment migration from the berm to the beach over time. The tracer material is a fine quartz sand (125–250-micron size range) with a fluorescent pigment and magnetic coating applied (fig. 1). The material is nontoxic and inert. The goal of the study is to better understand sediment movement for beach replenishment. The final offshore berm (600 m by 1,500 m in size) was constructed 1.2 km to 1.5 km off shore of South Padre Island Beaches. Approximately 2000 kg of tracer sand material was added to the berm after completion.

In August of 2018 the sediment sampling collection surveys (campaigns) and hydroacoustic date collection began. Campaigns consisted of both an off-shore and on-shore sampling events. Following tracer placement, approximately eight (8) sediment sampling campaigns were conducted from August 2018 to May 2019. There were 60 sediment offshore grab samples and 60 onshore grab samples collected per campaign. The off-shore sample grid locations were approximately centered over the berm—with grid squares about 300 m in size. The offshore sediment samples were collected using a Van Veen or Ponar type sampler from a stationary vertical from the boat (fig. 1), according to USGS protocols (Edwards and Glysson, 1999). Onshore samples are collected at the land/water line during low tide at approximately 600 ft intervals along the beach. The onshore samples were collected using a 10 cm by 10 cm square box core. For each of the campaigns, samples are collected from the same fixed site locations to allow for comparability between campaigns. The approximate amount of sediment material in the sampler (full, ½ full, ¼ full etc.) was noted. Texas A&M University laboratory is measuring the amount of tracer material in each sample. In addition to scheduled sampling periods, a post storm campaign (if needed) may be performed if a tropical storm hits the area.

Hydroacoustic data (current, velocity, and bed movement) at each sampling campaign was collected by the USGS from a boat mounted ADCP (Acoustic Doppler Current Profiler) at The USGS followed standard USGS protocols for collection, processing, and storing of the hydroacoustic data (Montgomery and others, 2016). These data provide a synoptic "snapshot" of currents, velocities, and bed movement at the time of sample collection. In addition, the USGS deployed a continuous ADCP instrument for gathering wave and current data between the berm and nearshore from the beginning of the sampling to run until the end of the study. The ADCP is fixed to a sea mount "barnacle" that sits on the sea floor in about 30 to 50 feet of water depth (fig. 2). Data from the ADCP are downloaded approximately every month. Together, the boat mounted and barnacle mounted ADCP data will provide more continuous data and a better understanding of local current conditions affecting sediment transport through the life of the project. These data are critical calibration datasets for developing computer simulation models of sediment transport. When coupled with the sediment concentration data as verification

datasets (that is, how much sand moved and where did it actually transport to), model simulations are anticipated to be significantly enhanced and give decision makers unique sophisticated tools to represent real world conditions.

Figure 1. Tracer sand and sediment sampler used in the sediment tracking study.

Figure 2. USGS barnacle before deployment and immediately after recovery with hydroacoustic instrumentation used for the study.

References

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