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River Mouths & Inlet Dynamics Field Pilot Studies: Inlet Tracer Dispersion & Moving AUV Observations

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LONG-TERM GOALS

The goal of our effort is to understand river and tidal flow dynamics through in situ field observations and model validation.

OBJECTIVES

The main objectives of our effort are:

- Measure the intra-tidal three dimensional flow velocity distribution
- Measure the concurrent suspended sediment concentration (the accompanying sediment transports will be obtained by multiplying the concentration with the simultaneously measured velocity).
- Extract the tidal flow circulation with Delft 3D to retrieve the residual flow circulation associated with the forcing by waves, wind and density differences
- Verify Delft3D in predicting the complex velocity field and concurrent sediment transports under a range of environmental conditions (i.e. waves, wind and potentially stratification)

APPROACH

Measure the 3-dimensional flow structure within the inlet area using a combination of mini-catamarans (which are deployed from a small boat) and unmanned surface. All catamarans will be equipped with a downward-looking ADCP to measure the flow velocity structure and concurrent sediment concentration (to be inferred from the acoustic backscatter). In addition, an autonomous winch will be integrated onto the USVs and equipped with a CTD and a WETLABS triplet optical sensor to measure temperature, salinity, turbidity, and CHL-A vertical profiles. The mini-catamarans will be deployed in shallow areas, whereas the USVs will operate in the deeper parts of the channel and the ebb-tidal delta. We intend to position the catamarans in such a pattern (see Figure 1) that we can extract the tidal velocity field from the measurements making use of Delft3D, throughout the domain and thereby obtain accurate estimates of the residual flow circulation. We will also deploy a sediment pumping

tripod to calibrate the ADCP and optical backscatter for sediment concentrations. We will drive the model with both the offshore water elevation and the water elevation within the channel.

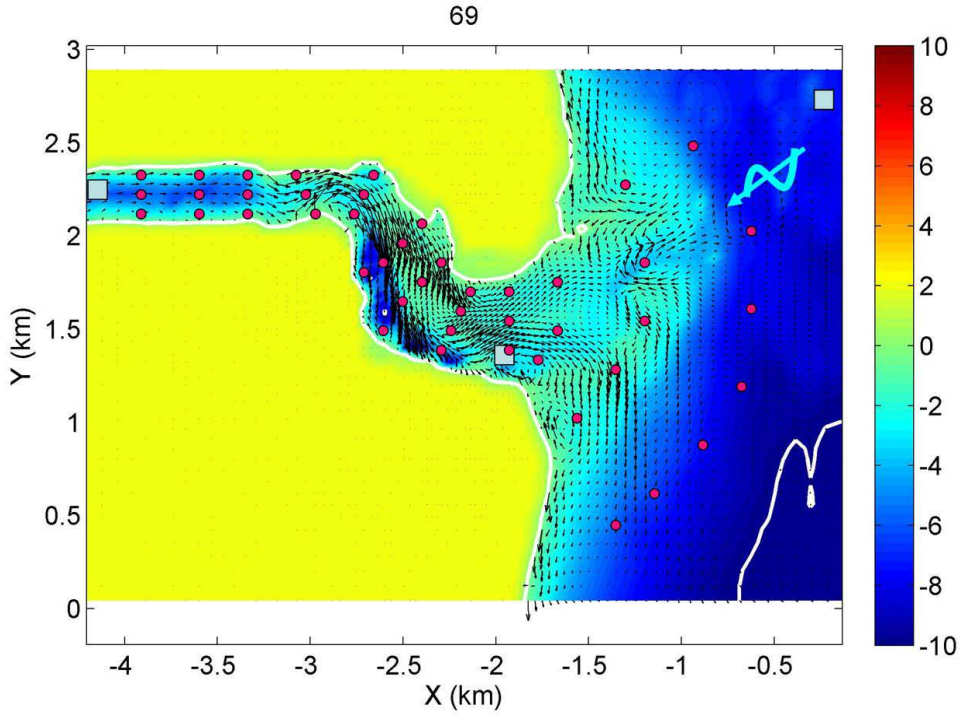

Figure 1 D3D-calculated snapshot of surface velocity field at the New River Inlet during outgoing tide with waves obliquely incident on the beach (indicated by the cyan arrow). The bathymetry is in meters water depth (indicated by the color bar). Tentative locations for the pressure recorders are indicated by the squares and catamaran positions (both USV and mini's)are indicated by the red dots. Deployment of catamarans is contingent on locally non-breaking wave conditions.

With a tidal harmonic analysis (T-TIDES), we can either use the tidal elevation only (to be used in the extraction operation to retrieve the residual flow circulation) or use the measured elevations obtained from self-logging pressure sensors (see Figure 1 for approximate locations) and include forcing by waves/wind/density for model verification/validation. We will have drifters and dye available to examine interesting flow features like eddies (see Figure 1), but we feel that the focus of our efforts should be on measuring and understanding the three-dimensional velocity field and concurrent sediment transport.

WORK COMPLETED

This is a new project that just started. In anticipation of the upcoming field experiment in 2011 at the New River Inlet we performed a number preliminary Delft3D model simulations to determine the optimal deployment of our in-situ instruments to measure the three dimensional state of the river-inlet system (see Figure 1 for an example).

IMPACT/APPLICATIONS

The observation are important for understanding river and tidal inlet processes by providing high-quality data for numerical model validation.

PUBLICATIONS (2009-2010) acknowledging ONR support

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