Spatial Characterization of Subtidal Flow in Little Egg Inlet

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Introduction

Little Egg Inlet is one of multiple inlets to New Jersey's coastal bays and is part of the Great Bay-Little Egg Harbor ecosystem, a shallow bar-built estuary located within the Jacques Cousteau National Estuarine Research Reserve.

Net flow of water through inlets affects larval dispersal, water quality and supports migration of bar-built barrier islands through sediment transport.

This study aims to observe the horizontal velocity of water along a set of survey lines in Little Egg Inlet and compare the lateral variability in velocity across the inlet.

Figure 1. Map of study area at Little Egg Inlet and set transect lines. The outer inlet transect is marked with an asterisk.

Methods

A 14-hour survey was conducted during a new moon spring tide with a boat-board Acoustic Doppler Current Profiler (ADCP) in August 2018 to collect velocity data along set transects over a semidiurnal tide cycle, following the methods of Chant (2001) and Kincaid et al. (2003).

Transects were chosen perpendicular to current flow and located in each branch of the inlet.

A 2-dimensional median filter was applied to screen outliers, and any gaps were filled by interpolation. A linear curve was assumed to extrapolate velocity to zero at the bottom to account for friction. A constant velocity was assumed to extrapolate from the shallowest measured bin (1.17m) to the surface.

Velocity data were separated into three sections along the outer inlet transect: shoal, slope, and channel, then averaged by distance to determine the net velocity for that section.

Results

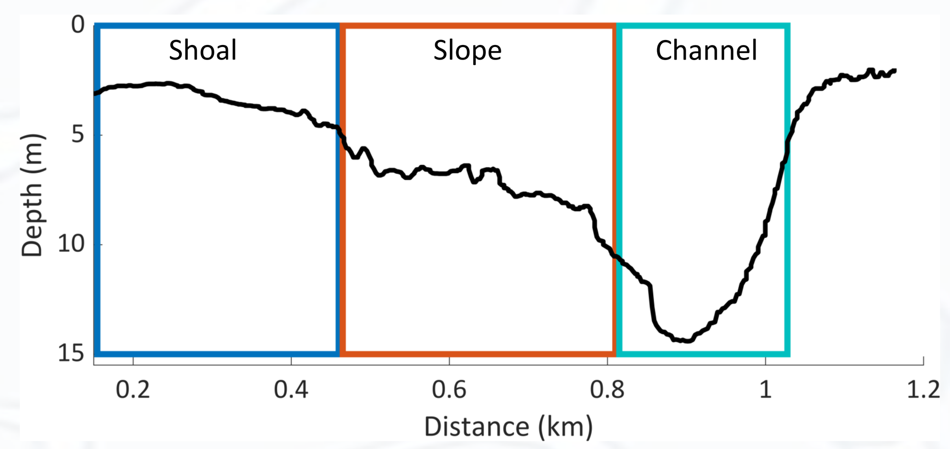


Figure 2. Outer inlet transect broken up by section.

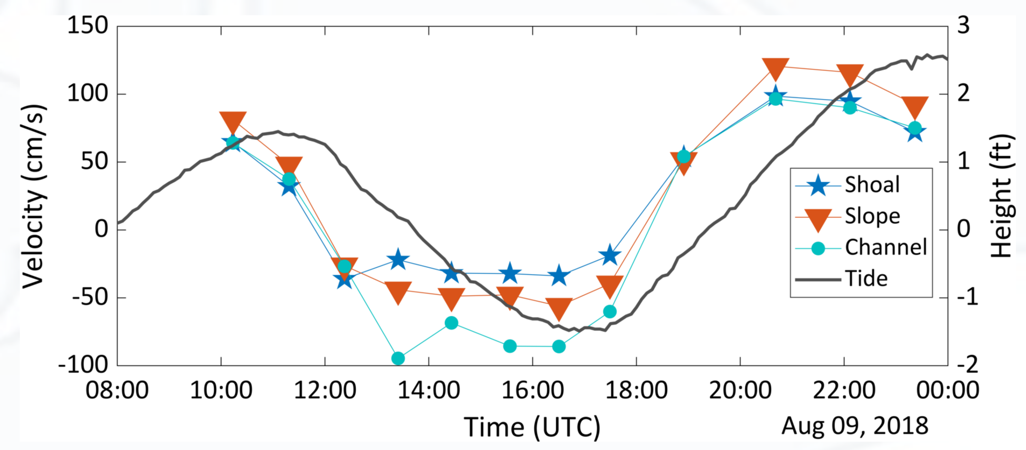


Figure 3. Averaged sections for each transect showing changing velocities over time from the Tuckerton, NJ USGS tide gauge.

The ebb tide transect shows strongest flow in the channel (-85.8 cm/s) with weaker flow over the shoal (-33.9 cm/s) and slope (-56.1 cm/s).

The flood velocity was uniformly distributed across all three sections of the transect, with slightly stronger flow over the slope (120.6 cm/s) than over the shoal (98.5 cm/s) and channel (96.5cm/s).

The timing of the tidal currents are similar but vary in magnitude in the three subsections of the transect (Figure 3). Maximum velocities occurred up to 3 hours before low or high tide.

Average velocities show a stronger net inward flow for both the shoal and slope (Table 1).

Average velocity in the channel is relatively small, indicating the flooding and ebbing velocities had a cancelling effect.

Figure 4. Contours of outer inlet transects showing velocity in cm/s (a) max ebbing transect at 16:30 (b) max flooding transect at 20:40.

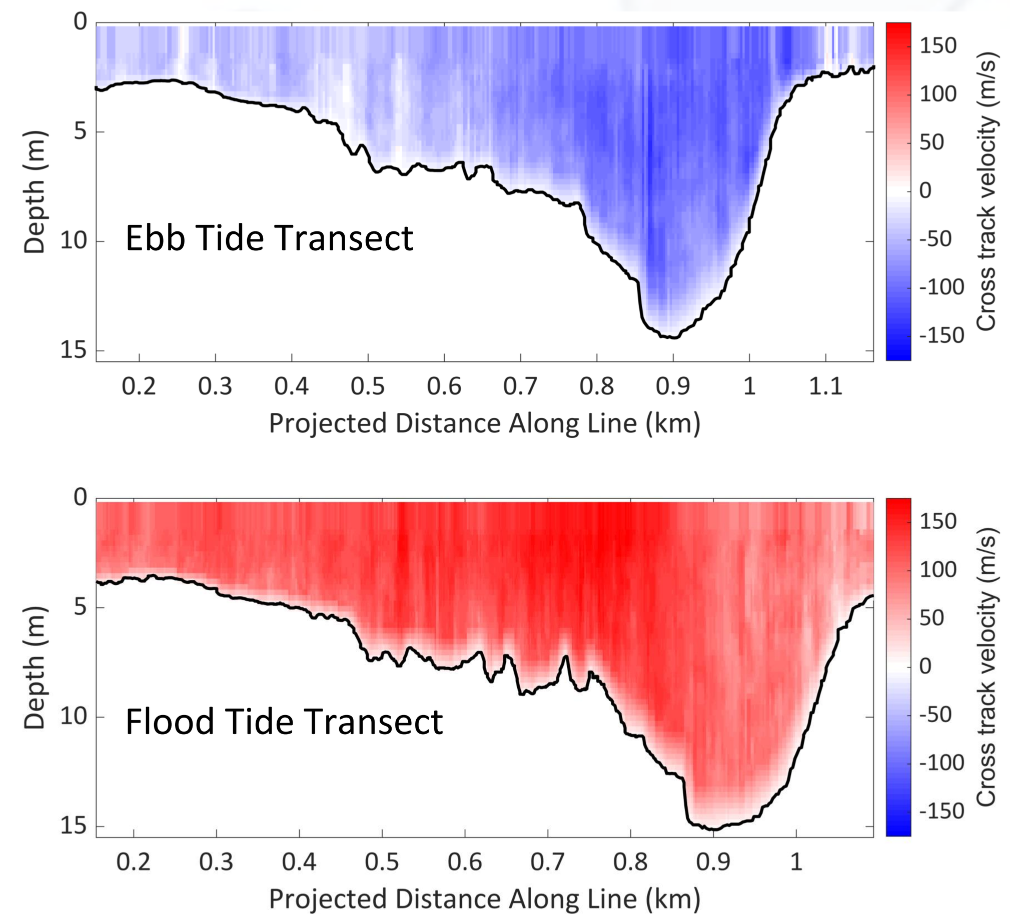
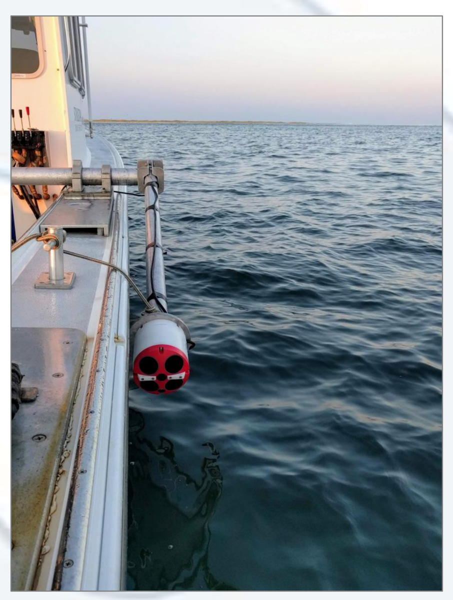
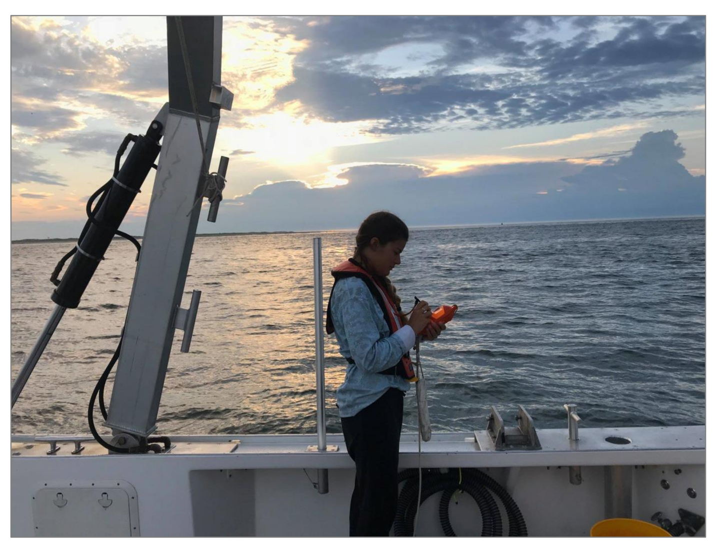


Table 1. The average velocity into (+) or out of (-) the inlet by subsection.

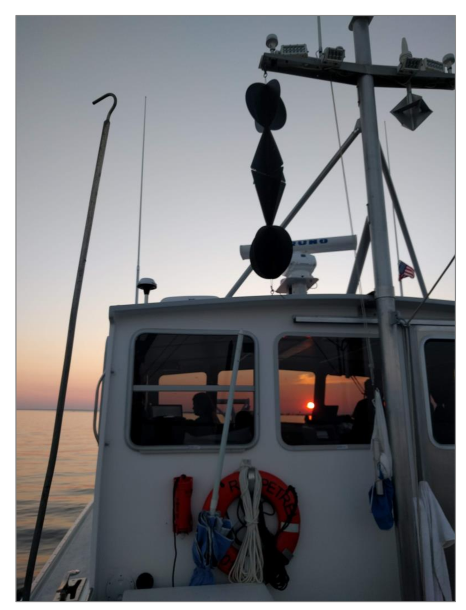
	Shoal	Slope	Channel
Average Velocity (cm/s)	20.3	20.6	-0.3



RiverPro ADCP



Taking CTD casts



R/V Petrel

Conclusions

Flood tide velocity was stronger than the ebb tide velocity. However, maximum ebb velocities were sustained for a longer period of time compared to the maximum flood.

The lateral variation of velocity differed across the flood tide and ebb tide transects.

Time-averaged velocities were strong into the inlet over the shoal and slope regions and close to zero in the channel.

Although averaging the tide cycle transects approximates the net velocity, the next step is to quantify the net flow through the inlet by a tidal harmonic fit.

Data from this study will become part of a catalog on physical circulation in the estuary, and establish a baseline for water flow in an inlet experiencing rapid shoreline change.

Acknowledgements

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References

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Kincaid, C., R. A. Pockalny, and L. M. Huzzey, Spatial and temporal variability in flow at the mouth of Narragansett Bay, *J. Geophys. Res. 108*(C7), 3218, doi: 10.1029/2002JC001395, 2003.

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