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BATHYMETRIC INFLUENCES ON TIDAL CURRENTS AT THE ENTRANCE TO A HIGHLY STRATIFIED, SHALLOW ESTUARY

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ABSTRACT

Bathymetric effects on tidal currents are investigated at Main Pass, which is the primary inlet of Mobile Bay, Alabama. A 12-hr ship-mounted ADCP survey, which covered nearly one-half of the diurnal tide during flood conditions, included 24 repetitions. The resulting velocity data demonstrate significant tidal variability in the horizontal and vertical current structure between the ship channel and the shoals. The diurnal tidal flows, the dominant tidal forcing, are 72° (4.8 hr) ahead of the water level throughout shallower areas of Main Pass, indicating near-standing wave conditions. Moving across the mouth, a phase lag (5.37° or 20 min) develops with the deep channel tidal currents lagging the shoal region. The vertical tidal structure is also modified across the mouth where near-bottom flows change their direction first in the ship channel, while near-surface flows change their direction first over the western shoal. This may be related to the seaward pressure gradient associated with the relatively large (~1715 m³/s) freshwater discharge or the discharge interaction with a nearby opening, Pass-aux-Herons. Current magnitudes over the shoals and in the ship channel vary by as much as 1 m/s. Flows at the east side of Main Pass, close to Mobile Point, behave oppositely to those in the rest of the transect during the survey. This inconsistent flow pattern is caused by an anticyclonic eddy that is triggered by flow separation at Mobile Point.

Keywords: Mobile Bay; estuarine circulation; spatial variability; bathymetry; diurnal tides; ADCP
