

**STUDY TITLE:** Analysis and Synthesis of Louisiana Coastal Boundary Current Data

**REPORT TITLE:** Aspects of the Louisiana Coastal Current

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**PROJECT MANAGER:** Lawrence J. Rouse

**AFFILIATION:** Louisiana State University

**ADDRESS:** Department of Oceanography & Coastal Sciences, Louisiana State University, Baton Rouge, LA 70803

**PRINCIPAL INVESTIGATORS:** Lawrence J. Rouse, Jr., William J. Wiseman, Jr.

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**BACKGROUND:** Many existing, reduced dimensionality models of the dynamics of the Louisiana Coastal Current are successful at reproducing the qualitative features of the circulation at specific time scales and periods of the year. Local, wind-driven models reproduce credibly the flow variability over the shallow regions of the west Louisiana/east Texas inner shelf, particularly during the winter season, at sub-tidal frequencies within the weather band (Crout et al, 1984; Lewis and Reid, 1985; Walker et al., 2001). Results are noticeably improved when care is taken to accurately account for variability of the bottom dissipation and far-field forcing (Current, 1996). The earlier models were unable to account for alongshore pressure gradients, while that of Current (1996) did. We were, thus, encouraged to assess the importance of such pressure gradients from observations.

The success of such wind-driven models is surprising, since they ignore the riverine buoyancy flux and consequent strong stratification that is characteristic of this region of the Gulf of Mexico. A fully three-dimensional, time-dependent model of the region (Herring et al., 1999) did not perform significantly better at reproducing observations, although it did a good job of capturing the long term mean flows and very low frequency

variability. It was also able to reproduce observed stratification moderately well (Wiseman et al., 2000).

**OBJECTIVES:** This study presents some new physical oceanographic modeling results obtained for the Texas-Louisiana shelf, as well as a review and assessment of past modeling efforts for this region. Extensive data sets are available from the Louisiana-Texas inner shelf region, and provide a vast source of information for model development, model forcing, and model verification.

**DESCRIPTIONS:** Several simple local models were successfully run for hindcasting observations, and results are presented in this study. Existing reduced dimensionality models, local wind-driven models, and a fully three-dimensional, time-dependant model of the region were employed in hindcast mode. Model output obtained for this study was compared with observational data, and information from independent data was used in model development and forcing. The value of including such factors as bottom dissipation, far field forcing, and alongshore pressure gradients in modeling the Louisiana Coastal Current was examined. These models have had some limited success in hindcasting observations, but all have issues that remain and these are discussed.

**SIGNIFICANT CONCLUSIONS:** In an attempt to discern the plausibility of treating the Louisiana Coastal Current as an arrested topographic wave (Csanady, 1978), we applied an existing vertically-integrated, non-linear numerical model forced by monthly mean wind fields. The results were intriguing but inconclusive. While the momentum balance generally appeared to be in quasi-steady state, i.e. the local accelerations were negligible compared to other forces, the advective accelerations in the model were, at specific sites, non-negligible. More interesting was the fact that the dominant balance of forces in the model was between the Coriolis forces, the surface wind stress, and the pressure gradients.

A qualitatively acceptable comparison of output from the Yankovsky and Chapman model with observations suggests that further development of a robust, time-dependent theory would be beneficial.

Comparisons of full water column velocity measurements from a bottom-mounted ADCP and alongshore bottom pressure gradients are far less satisfying. The bottom layer alongshore currents are significantly coherent with the observed alongshore pressure gradients in bands between 25 to 33 hours and near 50 and 100 hours. The source of the pressure gradient is unclear.

**STUDY RESULTS:** A summary and critique of model results is presented, as well as suggestions for fruitful areas of future progress and appropriate uses for these various types of models on the Louisiana-Texas inner shelf region.

There appear to exist situations in time and space along the Louisiana-Texas inner shelf where the bathymetry is sufficiently simple and a single forcing function sufficiently

strong that a simplified balance of forces realistically describes the first order dynamics of the coastal current. Such conclusions, though, cannot be generalized to the entire coast or to all time periods. The Louisiana Coastal Current is a fully three-dimensional, time-dependent system. True understanding of the system will only result from field, theoretical, and numerical simulation studies that account for all four dimensions.

**STUDY PRODUCTS:** Rouse, L. J., Jr., W.J. Wiseman, Jr., and M. Inoue. 2005. Aspects of the Louisiana Coastal Current. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-039. 50 pp.