



Interaction of tides, river discharge and bathymetric forms in the Santee River, SC, USA

Alexander Yankovsky, Legna Torres-Garcia, and Raymond Torres

University of South Carolina, Department of Earth and Ocean Sciences, Columbia, SC, United States
(ayankovsky@geol.sc.edu, +1 803 777 6610)

This study was carried out in the freshwater reach of the Santee River (South Carolina, USA) approximately 55 ± 4 km from the river mouth, where transition occurs from a two-directional tidally-driven flow regime downstream to a unidirectional riverine flow upstream. The data set comprises a bathymetric survey, current profile and bottom pressure measurements at two locations, and time series of discharge. Water depth reveals threefold variations from less than 2 m to over 5 m in the form of adjacent shoals and deeps. Complex bathymetry and a high ratio of the wave height (~ 0.5 m) to the mean water depth over shoals (~ 2 m) exceeding 0.25 result in nonlinear dynamics of the observed tidal waves. The nonlinear effects are evident in the generation of the M4 harmonic. The M4 along-channel velocity amplitude exceeds 40% of the corresponding M2 amplitude. Tidal velocities are highly asymmetric with strong, short-lasting floods and weaker, longer ebbs. In addition, bottom drag coefficients also exhibit asymmetry with higher values being observed during the flood. The ratio of the subtidal riverine velocity to the M2 velocity amplitude dramatically increases from 0.48 downstream to 1.15 upstream which indicates tidal dissipation and the transition to the river-dominated regime. Combination of asymmetric nonlinear tides/bottom drag with strong tidal dissipation produces a convergence of the maximal shear stresses which occur during the ebb at the upstream edge and during the flood at the downstream edge of the study area. This convergence can lead to the trapping of coarse sediments and to the maintenance of the observed shoals. In fact, the thickness of a sediment layer in the study area was larger than further downstream where intermittent areas of the exposed bedrock were found.