Geophysical Research Abstracts
Vol. 15, EGU2013-11515, 2013
EGU General Assembly 2013
© Author(s) 2013. CC Attribution 3.0 License.

Transport and fate of river waters under flood conditions and rim current influence: the Mississippi River test case

Villy Kourafalou and Yannis Androulidakis
University of Miami, RSMAS, MPO, MIAMI, United States (vkourafalou@rsmas.miami.edu, 305 421 4696)

Large river plumes are a major supplier of freshwater, sediments and nutrients in coastal and shelf seas. Novel processes controlling the transport and fate of riverine waters (and associated materials) will be presented, under flood conditions and in the presence of complex topography, ambient shelf circulation and slope processes, controlled by the interaction with rim currents. The Mississippi River (MR) freshwater outflow is chosen as a test case, as a major circulation forcing mechanism for the Northern Gulf of Mexico and a unique river plume for the intense interactions with a large scale ocean current, namely the Loop Current branch of the Gulf Stream, and associated eddy field. The largest MR outflow in history (45,000 m3/sec in 2011) is compared with the second largest outflow in the last 8 years (41,000 m3/sec in 2008). Realistically forced simulations, based on the Hybrid Coordinate Ocean Model (HYCOM) with careful treatment of river plume dynamics and nested to a data assimilated, basin-wide model, reveal the synergistic effect of enhanced discharge, winds, stratification of ambient shelf waters and offshore circulation over the transport of plume waters. The investigation targets a broader understanding of the dynamics of large scale river plumes in general, and of the MR plume in particular. In addition, in situ observations from ship surveys and satellite chl-a data showed that the mathematical simulations with high temporal resolution river outflow input may reproduce adequately the buoyant waters spreading over the Northern Gulf of Mexico shelf and offshore areas. The fate of the river plume is strongly determined and affected by deep basin processes. The strong impacts of the Loop Current system (and its frontal eddies) on river plume evolution are of particular importance under conditions of increased offshore spreading, which is presumed under large discharge rates and can cause loss of riverine materials to the basin interior. Flood conditions can increase both downstream (westward) and upstream (eastward) spreading. The high outflow rates enhance the anticyclonic bulge, strengthen the downstream coastal current toward the western Louisiana-Texas shelf. The substantial eastward spreading over the eastern Mississippi-Alabama-Florida shelf was highly correlated with the Loop Current northward extension. On the contrary, cyclonic eddies east of the Delta effectively block the offshore eastward spreading of the plume and may keep the river waters away from the eastern shelf. We show that the proximity of eddies to the shelf break is a sufficient condition for shelf-to-offshore interaction, which is facilitated by the steep bottom topography near the Delta.