Florida Bay Circulation and Exchange Study

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Objective

The goal of this project is to study of the interaction and exchange of Florida Bay with the connecting coastal waters of the Gulf of Mexico and the Atlantic in the Florida Keys. The research is designed to address several of the key scientific questions presented in the NOAA/COP Florida Bay Implementation Plan concerning circulation and water quality as critical to understanding the functioning of the ecosystem and future evolution from restoration actions. Observational methods consist of a combination of bi-monthly interdisciplinary surveys, in-situ moorings, shipboard Acoustic Doppler Current Profiler (ADCP) transport transects in the major Keys flow passages, and Lagrangian surface drifters to describe and quantify the circulation within the Bay as related to local forcing and coupling with the waters of the Atlantic and Gulf. These observations will also help to provide necessary boundary conditions for physical and biological models.

Accomplishments

The previous enhanced mooring array was maintained from September 1997 until October 2000. In October 2000 the moorings in the enhanced mooring array was reduced to include a subset of those moorings in each region of the previous array. On the southwest Florida shelf, the offshore portion of the array consisted of 2 bottom mounted Acoustic Doppler Current Profilers (ADCP) moorings with near-surface T/S sensors along a line due west from Cape Sable. Offshore of Shark River, there was a continuation of the Shark River plume array which consisted of 4 T/C sensors to monitor changes in the Shark River discharge nearfield. Along the Florida Keys reef tract moorings measured interaction and exchange between the southwest shelf, Everglades discharge, Florida Bay, Keys coastal waters and the Florida Current. These consisted of a single current/T/C mooring near the western boundary of Florida Bay, and 3 current/T/C in the Florida Keys coastal waters. In addition there were two bottom pressure instruments to measure the cross-Keys pressure gradient.

The third year results of interdisciplinary surveys show the influence of anomalous lower rainfall associated with an ongoing La Nina event and persistent drought conditions throughout Florida in 2000 and 2001. The rainfall shortage due to these ongoing events resulted in high salinity values in the southwest Florida nearshore waters and Florida Bay throughout 2000 and until the end of 2001. In addition, there was no direct influence on the South Florida watershed during the 2000 and 2001 hurricane seasons from tropical systems which can contribute significant amounts of fresh water into the watershed as was the case during Hurricane Irene's passage in October 1999.

Synthesis of drifter trajectories continue to indicate a net southerly flow from the Gulf of Mexico to the Florida reef tract through western Florida Bay in all seasons except the summer months. The

strength of this southerly flow varies with season and is at its strongest in the winter (3 to 4 cm/s). During the past two summer seasons, with very little influence from tropical systems, the drifters exhibited a very slow drift to the north or northwest such that they never left the nearshore waters between Shark River and Lostman's River on the west coast of Florida. Drifter trajectories are strongly influenced by local tide and wind forcing. Now that the study has encompassed both a El Nino (1998) and a La Nina (1999-2001) years along with representative active and inactive hurricane seasons, the cause and variability of the residual background currents may be further investigated in relation to these varying climatic conditions.

Future Plans

Research planned for FY2002 will attempt to quantify the circulation in the Gulf transition area to the west and north of Florida Bay and the rates and patterns of exchange with western Florida Bay by continuing the combined use of interdisciplinary surveys with Eulerian and Lagragian observations flow and water mass fields. The frequency of rapid surveys within Florida Bay have been increased to one per month with greater spatial coverage and more emphasis on exchange processes. The data sets from the 1998 El Nino year with its abnormally wet winter and increased wind forcing will be compared with the more recent La Nina years with its abnormally dry winter. We also hope to better understand the response of Florida Bay and surrounding waters to severe storm events by continuing the investigation of the influence of hurricane Georges and Irene on the circulation and exchange using results from our in-situ array. Considerable emphasis will be placed on publishing results from the first two years of intensive measurements. This information is particularly needed for boundary conditions and verification of hydrodynamic and water quality models of Florida Bay and for planned plankton ecosystem models. Our proposed observations will also help to quantify the rates, patterns and variability of transports and interactions of waters of the southwest Florida shelf with discharges from the Everglades and Florida Bay and ultimate influences on the FKNMS. This information is needed by other investigators of the SFERPM to help understand nutrient cycles and the persistence of algal blooms, and will benefit EPA and FKNMS by providing an improved understanding of the mechanisms that regulate water quality in the reef Sanctuary and the sustainability of coral ecosystems.