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Long-term Observations of Tidal and Storm Surge Waves and Weather Associated Flushing of Louisiana Bays

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1. Introduction

Tidal waves and storm surges are usually amplified in the shallow water areas along the coast. Their impact to the coastal inundation and flushing of estuaries and bays is therefore significant, especially in a region where the land and shelf have only small gradients in elevation. The impact is further complicated by the weather systems in the region: hurricanes during the hurricane season (June to November) and winter storms ([1]-[5]) between the Fall and Spring (~October to April). Although hurricanes occur only sporadically and are limited to relatively small areas mostly within the radius of maximum wind, the local damages can be quite significant. The winter storms, even though less severe for the most part, occur from 20 to 30 times from mid-autumn to late spring every year and with a much larger spatial scale (~ 1000 km). These atmospheric activities acting on the water have implications to the land-ocean exchange, land-estuary exchange, and bay-ocean exchange in water, salt, nutrients, sediment, and other suspended and dissolved substances and the fate and activities of plankton and fish.

In the Louisiana coastal water, semi-enclosed bays are separated from the coastal ocean by a series of barrier islands. Water exchange occurs through narrow tidal inlets. As discussed in [3], winter storms can produce significant exchange flows in a multi-inlet system, in which some inlet(s) may experience inward flows while the rest experience outward flows. This may be dynamic and can change with conditions.

The continuous quantification of storm surge waves caused by either the summer or winter storms under the influences of tides is usually practiced without some of the required major parameters: usually only the water levels are measured but not the current velocity. The oscillation and flushing of bays under severe weather conditions can be quantified more completely by measurements of water velocity across all the tidal inlets. Our work involves the very first of its kind to measure continuously the flows across all the major inlets of the Barataria Bay of Louisiana.

2. Methods

To accomplish our objective of continuous measurements of flows across all the major inlets, i.e., Barataria Pass, Caminada Pass, and Pass Abel, we used several different horizontal acoustic Doppler current profilers (Sontek Argonaut, RD Instruments HADCP, and Nortek Awac), or ADCPs. For each ADCP, we used a lead acid battery charged by a 60 W solar panel through a solar controller. The data were saved every 5-20 minutes, depending on the deployment. Deployments usually lasted 2-3 months before a data download was made. If biofouling was observed, the ADCP was recovered for cleanup. The deployment roughly covered the period from August 2013 to July 2014; on December 19, 2014 sampling was restarted since there was a data gap of 146 days after July 2014 owing to a technical error in the setup. The data however are unique and support examination of flushing in the multi-inlet bay under tidal waves and severe weather, thereby providing insights to the weather induced hydrodynamic processes important to the geomorphology and land-ocean exchanges.

3. References

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