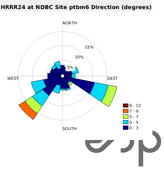

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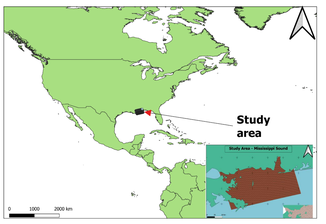
Wind Sensitivity and Coastal Ocean Response Analysis of the Mississippi Sound - A Modeling Study

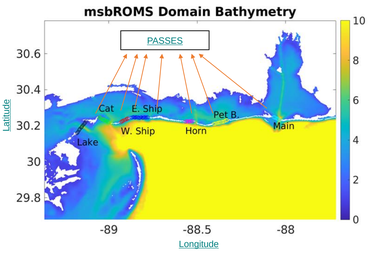
PROBLEM

As our study area is a shallow system, the impact of the wind, weather fronts, storms, and hurricanes could affect gravely the 3D circulation in the coastal and ocean zone. Therefore, we require a model to study the effects of these scenarios on inlets, ocean exchange and estuarine dynamics.



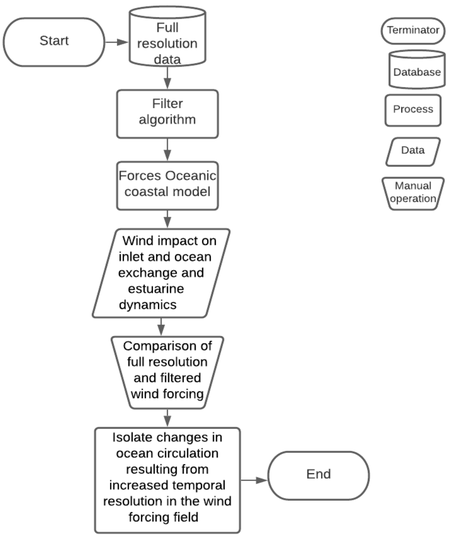
GENERAL OBJETIVE

To study the ocean response to the impact of wind on the hydrodynamics and morphodynamics of marine-coastal areas in the Mississippi Sound region.



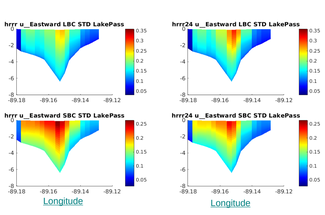
PROPOSAL

Creation of a model that helps us to understand the dynamics and physical drivers of freshwater transport in this region.
The present work developed a MATLAB computational algorithm that filters and interpolates the wind forcing file obtained through the High-Resolution Rapid Refresh (HRRR) product to model the two data sets (unfiltered and filtered) in the COAWST ocean model. The results obtained from the model were analyzed analytically and quantitatively. Oceanic fields that are sensitive to wind force in coastal processes and estuarine systems were then isolated. The results made it possible to perceive the impact of the wind on ocean currents, on the exchange of continental and oceanic waters (through stratified salinity in the water column) and impacts on coastal fronts. The mean wind speed in the filtered data obtained decreased by approximately 2 m / s in all directions compared to the speed of the full resolution data. The most notable differences in flow velocity were observed in low-pressure systems, obtaining more precise and consistent values in the filtered data.
The modeling tool created can be replicated and applied in different regions of the world as an instrument to understand and mitigate coastal marine impacts.

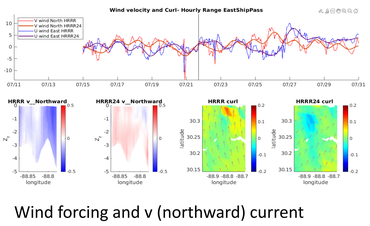


RESULTS

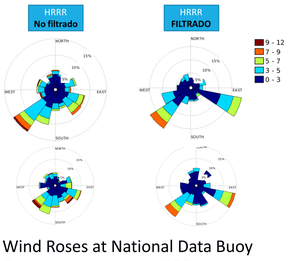
Winds predominance was observed for the southern zone, which ranged between West and East. Throughout MS, there are essential gusts of winds with high values between 9 - 12 m / s; these peaks can be seen in HRRR but are absent in HRRR24. There is also considerable variation in wind speed and direction for HRRR, which is more evident in the wind coming from the north. This generalized direction towards the South was determined as a pattern of periodic events that occur each year. During June, the predominant tendency is easterly and southeasterly, and during July and August, the dominant direction is in a more notable proportion towards the South.



Standard deviation of u current velocity vectors [m/s] in the water column [m] for the entire two weeks in Lake Pass only for Land and Sea Breeze Circulation periods



Wind forcing and v (northward) current velocity circulation for East Ship Pass on July 21, 2016, at 17:00 UTC



Wind Roses at National Data Buoy Center locations for HRRR unfiltered and filtered outputs

CONCLUSIONS

- The algorithm development to filter the wind force file was successful. The peaks or extreme values were ignored, and only those recurring values were conserved.
- By isolating the differences between HRRR and filtered HRRR, it was possible to isolate extreme events and analyze the impact caused.
- The areas with the greatest vulnerability to sudden changes in winds, and the oceanic behavior in front of these events, were determined.
- A detailed qualitative and quantitative analysis of the results improved the interpretation of the data, and now these can be used to develop a contingency plan and early response to extreme winds.