NC STATE UNIVERSITY

COASTAL RESILIENCE CENTER
A U.S. Department of Homeland Security Center of Excellence

Evaluating a New Formulation of Hurricane Wave Behavior to Improve Model Predictions

CCEE Department

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1. Introduction

- Hurricanes can generate large waves that damage offshore and coastal infrastructure and contribute to deadly storm surge and inland flooding.
- Ocean wave models are used to predict wave behavior using physics formulations and observed data, to allow coastal areas to prepare for upcoming storms.
- When a new formulation is introduced, there is a need to test the accuracy.
- During this research project, a new physics formulation in a widely used wave model was tested for potential improved accuracy.

2. Methods

The accuracy of the new physics formula was determined using two main methods:

1. Time Series Plots

- Three wave model simulations were run: two using the default physics formulation and one using the new formulation.
- The three wave model simulations were plotted alongside observed data.
- Observed data was collected from the NDBC website.

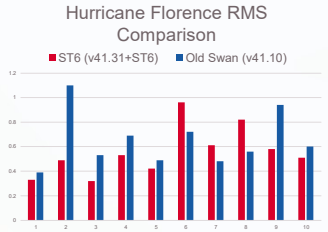
2. RMS Errors

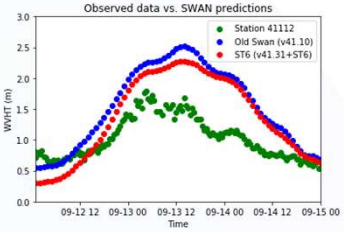
- RMS errors were calculated using the following formula:

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} (Predicted_i - Actual_i)^2}{N}}$$

- "Predicted" values- wave heights predicted using the three simulations
- "Actual" values- wave heights collected from NBDC.

3. Hurricane Florence

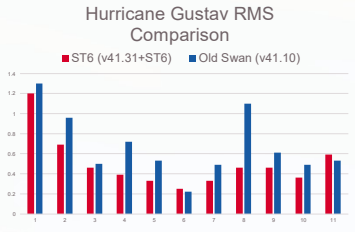


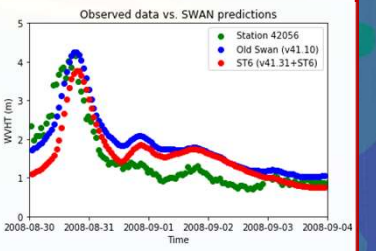


- Default physics formulation errors are shown in blue.
- New physics formulation errors are shown in red.
- Out of the ten test locations, seven show a lower RMS error for the new physics formulation.

- Default physics data plotted in blue.
- New physics data plotted in red.
- Observed data plotted in green.
- Wave heights are shown on the y axis and time is plotted on the x axis.
- The simulations were run for the duration of Hurricane Florence (9/11/12-9/15/12).

4. Hurricane Gustav





- Default physics formulation errors are shown in blue.
- New physics formulation errors are shown in red.
- Out of the eleven test locations, nine show a lower RMS error for the new physics formulation.

- Default physics data plotted in blue.
- New physics data plotted in red.
- Observed data plotted in green.
- Wave heights are shown on the y axis and time is plotted on the x axis.
- The simulations were run for the duration of Hurricane Gustav (8/30/08-9/04/08).

5. Conclusion

- It was found that the new formulation consistently produced more accurate predictions than the default formulation for both hurricanes tested.
- We recommend that wave modelers use the new physics formulation for real-time forecasting of hurricane wave effects.