

Improved Coastal and Nearshore Wave Forecasting

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1. Introduction

Accurate nearshore and coastal wave forecasts are essential for the protection of life and property as well as enhancing the economy through safe and efficient commercial activities. Modeling the nearshore environment has remained both computationally intensive and challenging due to the strong interaction of waves with the ocean bottom in shallow water environments. Here we develop a new wave system approach for nearshore wave modeling that addresses these issues. Wave systems result from specific wind forcing events on the ocean surface. This approach extends earlier work on wave system partitioning and tracking [1,2,3,4] to assimilate coastal buoy observations into model output at the wave system level and model wave system transition through the shallow water environment. The resulting model is affectionately called Nessie.

2. Model Features

Unique attributes of Nessie include data fusion coupled with data assimilation and artificial intelligence. Data fusion synthesizes online data sources including model wind and wave forecasts and buoy observations with the latest nearshore beach profile measurements. Our custom data assimilation approach corrects model output for model-buoy offsets at the wave system level and propagates these corrections through space and time.

3. Surf Forecast

A mid-Atlantic surf forecast was created to demonstrate Nessie capabilities. The operational area extends from Virginia Beach to the South Carolina border. Nessie predicts wave face heights in the surf zone and employs an Artificial Intelligence model to assign an overall surf quality score from 1 to 10 at each of 119 forecast points along the coast. As depicted in Figure 1, a convenient user interface permits easy access to model products including zoom-able interactive maps and time series displays and comprehensive data tables. An online report template allows users to submit their own observations for use in model validation activities.

4. Validation

To assist in model validation, we formed a test team of 30 local surfers in the mid-Atlantic region. For a 4-month period they logged in-situ observations made while surfing. In addition to the test team, Nessie output is compared to NOAA WAVEWATCH III model predictions as well as to surf forecasts from other leading forecast

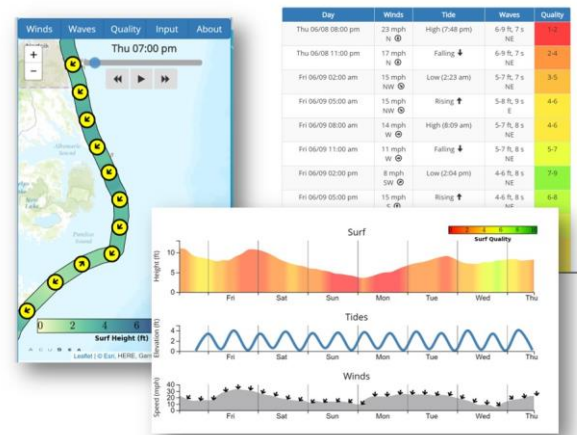


Figure 1. Nessie surf forecast products.

providers. Model validation results show that Nessie is often more accurate than existing commercial forecasts.

5. Ongoing Developments

Several improvements to Nessie are currently being developed. These include upgrading the source terms for fetch-limited wave growth, wave breaking and bottom friction to be synergistic with the latest research results in the shallow water environment. Furthermore, our custom data assimilation approach will be extended to be a fully 3D in space and time. Finally, the geographic extent of our surf forecast demo is being expanded to include more challenging wave environments such as the North Shore of Hawaii.

6. References

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