CARICOOS

The CARICOOS Operational Wave Modeling System

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LONG-TERM GOALS

Develop accurate, high-resolution operational wave models and wave-prediction products with the goal of enhancing available information that supports decision-making by stakeholders in the maritime sector.

MILESTONES / OBJECTIVES

The following table includes the wave modeling milestones / tasks as included in the FY16 scope of work, and their current status.

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
Improve wave, current and circulation modeling for ports in the region					May 2017	Completed
Continue operation of the Yabucoa Port Metocean observation and prediction system					May 2017	Completed
Implement a new version of the CARICOOS sea state point forecast online interface with integrated wave height maps					May 2017	Completed
Develop an online product to provide along-track sea state forecasts (waves, wind) for popular shipping and boating routes in the region					May 2017	Delayed
Maintain and enhance the operational CARICOOS - Sea Grant Nearshore Breaker Model					May 2017	Completed
Continue and enhance SWAN modeling					May 2017	Completed

MILESTONE / TASK	Q1	Q2	Q3	Q4	Original Completion Date	Status
Explore operational implementation of unstructured SWAN					May 2017	Completed

These objectives do not include Dr. Canals' duties as CARICOOS Technical Director.

WORK COMPLETED

1. Improve wave, current and circulation modeling for ports in the region

Completed, as described below in more detail.

2. Continue operation of the Yabucoa Port Metocean observation and prediction system

The Yabucoa operational wave model has run successfully since its release in April 2016. The visualization component was successfully migrated from FTP to Amazon S3 storage. No setbacks have been encountered.

3. Implement a new version of the CARICOOS sea state point forecast online interface with integrated wave height maps

This task was completed in October 2016. See:
http://www.caricoos.org/waves/forecast/SWAN/PRVI/hsig

4. Develop an online product to provide along-track sea state forecasts (waves, wind) for popular shipping and boating routes in the region

This task is delayed. CARICOOS has refocused its navigation products after extensive consultation with stakeholders. For the most part, stakeholders have requested simpler, text-based products as opposed to complex online interfaces with highly scientific graphics. This task will be revisited once stakeholders agree on the proper way to visualize along-track sea state forecasts.

5. Maintain and enhance the operational CARICOOS - Sea Grant Nearshore Breaker Model

The Nearshore Breaker Model (NBM) was improved in Spring 2017 to take advantage of the new 2D spectral partitioning capabilities included in the latest version of the CNWM. At each beach, spectral partitioning output is obtained from the CNWM just outside the surf zone. Once the parameter values (wave height, direction and peak

period) of each partition are obtained, the wave energy flux *P* of each i-th partition at a forecast point is computed. This wave power density is then used to compute the breaker height envelope taking into account all spectral components. Validation of this new approach to breaker height prediction is ongoing.

6. Continue and enhance SWAN modeling

As mentioned in the previous progress report (December 2016), 2D spectral partitioning has been implemented for the point forecasts component of the CNWM. During the performance period covered by the present progress report, initial work has been conducted to obtain spatially coherent forecasts of individual spectral components using the method of Hanson & Phillips (2001). At the moment, spatially varying fields of the spectral components are being obtained from SWAN 41.10 for the Northwest PR nested grid (NWPR) as a case study. Figure 1 shows sample model output for the first three partitions for a specific time step.

7. Explore operational implementation of unstructured SWAN

Complete. Both the unstructured version of SWAN and the FVCOM unstructured implementation of SWAN (FVCOM-SWAVE) were explored for operational implementation. At the moment, the flexibility of the modular structure of the existing operational implementation using structured SWAN 41.10 is advantageous over unstructured SWAN or FVCOM-SWAVE since there is no need to generate a new mesh every time a new grid is modified or added based on stakeholder needs. A direct comparison of structured vs unstructured SWAN for operational modeling by Pallares et al. (2017) did not reveal any significant advantages or increased accuracy of unstructured SWAN over structured SWAN except for the obvious advantage of computational cost. The latter, however, is not a limiting factor at the moment for the CNWM.

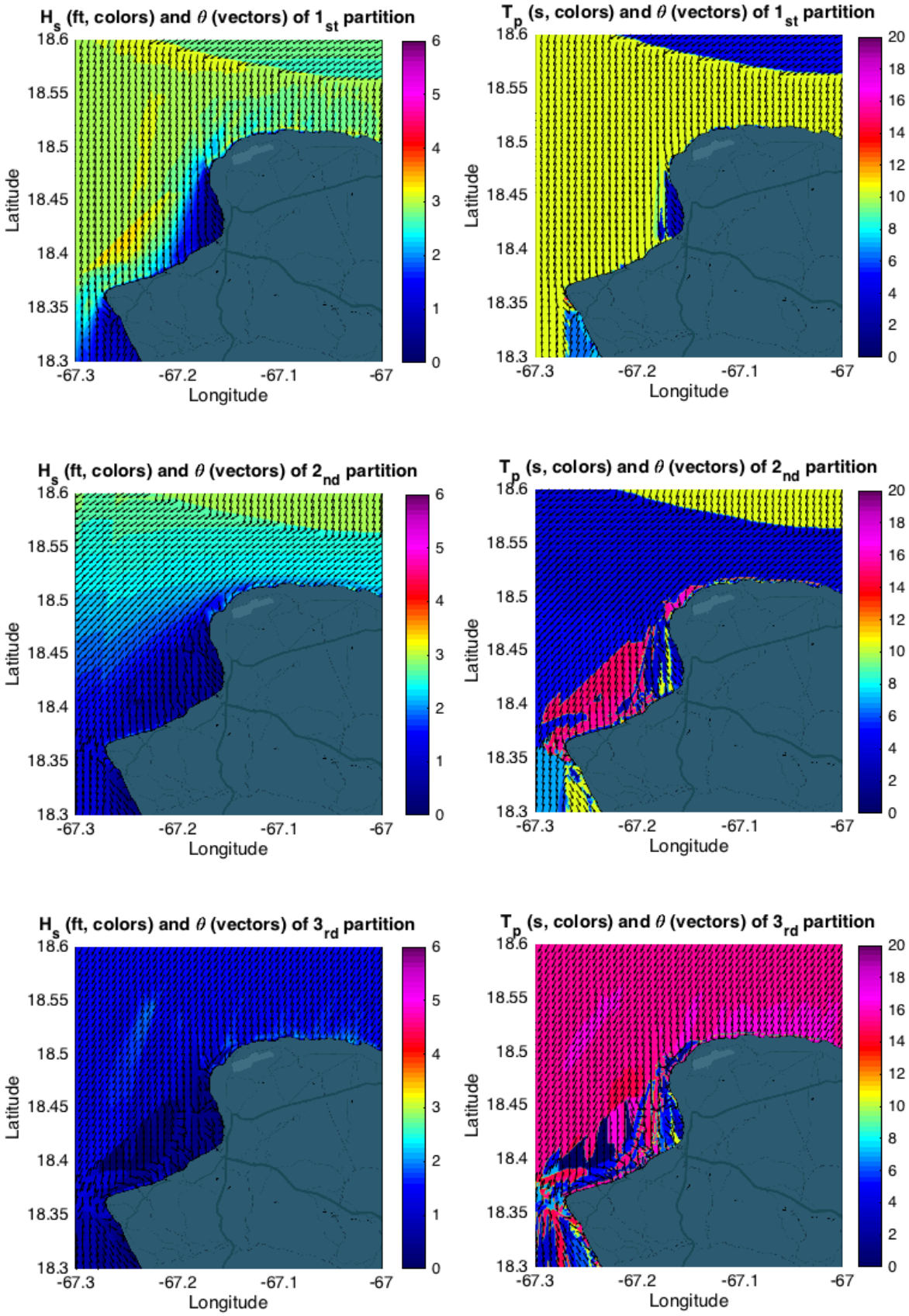

Figure 1. Sample model output for the first three partitions for a specific time step for the NWPR grid. Left column: Wave height of first three spectral partitions. Right column: Peak wave period of each partition.

MAJOR OUTCOMES

- The CARICOOS Nearshore Wave Model now takes full advantage of 2D spectral partitioning
- The CARICOOS Nearshore Breaker Model now uses 2D spectral partitioning to predict frequency-dependent breaking wave heights
- There has been significant progress in FY16 towards providing forecasts of the spatial distribution of the spectral components. This capability will be completed in early FY17.

WORK PLAN FOR UPCOMING PERFORMANCE PERIOD (June 1 – November 31 2017)

Work will focus on producing forecasts of spatially coherent fields of spectral wave components (using 2D spectral partitioning), and collaborating with the CARICOOS outreach and web development team to produce much simpler, text-based sea state forecasts for consumption by non-scientific CARICOOS users.

RELATED PROJECTS

None

REFERENCES

Devaliere, E.-M, J.L Hanson and R.A. Luettich, Jr., 2009. Spatial tracking of numerical wave model output using a spiral tracking search algorithm, *Proc. 2009 WRI World Congress on Computer Science and Information Engineering*, Los Angeles, CA, Vol. 2, 404–408.

Hanson, J.L. and O.M. Phillips, 2001: Automated Analysis of Ocean Surface Directional Wave Spectra, *Journal of Atmospheric and Oceanic Technology*, Volume 18, Issue 2 (February 2001), pp. 277–293.

Pallares, E., Lopez, J., Espino, M., Sanchez-Arcilla, A. Comparison between nested grids and unstructured grids for a high-resolution wave forecasting system in the western Mediterranean Sea. *Journal of Operational Oceanography*, 2017, vol. 10, núm. 1, p. 1-14.

RELATED PUBLICATIONS & PRODUCTS

N/A