Collaboration efforts between CarICOOS and NWS-San Juan

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Marine Forecast Process

Regional Models

Local Models

Wind Obs

Buoy Obs

ANALYSIS & FORECAST

Wind Forecast

Wave Forecast
CariCOOS’ efforts for expanding the buoy network and the implementation of a high resolution wave model (SWAN) at WFO San Juan allow us to increase from 5 to 10 marine zones to provide detail information of sea state in the surrounding waters of Puerto Rico and the U.S. Virgin Islands.
Forecast Verification
Internal Products

2014-03-11 Model Initialization
NWPS/SWAN vs. Buoy 41053

Wave Height (feet)

Mar10 Model Run
Mar11 Model Run

Mar10 12Z 18Z 00Z 06Z 12Z 18Z 00Z 06Z 12Z

Model     Buoy     Overestimation     Underestimation

Last updated 2014-03-11 17:00Z
Internal Products
Using CariCOOS Data (buoys and weather stations)

Virtual Buoy Forecast

Monthly Summary

Observations (last 24 hrs)
NOAA Collaboration

NOAA Sea Grant (Puerto Rico)

- Project for Aquatic Safety in Puerto Rico.
  - The research was used to pick the most dangerous beaches in Puerto Rico for the Surf Zone Forecast (SRF).

NOAA IOOS (CariCOOS)

- Sea Grant funded CariCOOS to develop a Nearshore Breaking Wave Model
  - The breaking wave height equation is currently used to calculate the surf height inside of the SRF.
Product Components

Beaches
- Selected using the Sea Grant Project for Aquatic Safety in PR

Breaking Wave Height
- Use the equation from the CariCOOS-Sea Grant Breaker Model

Rip Current Risk
- The rip current risk is calculated using the wind speed, wind direction, wave height and wave period from our local NWPS/SWAN model at 500 meters.

Weather Forecast
- Use the official weather forecast prepared by WFO San Juan
Collaborative Research

CariCOOS: Real-time data validation of high-resolution wind forecast

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Abstract—CariCOOS has implemented a mirror run of the operational numerical weather prediction model employed by the National Weather Service Weather Forecast Office San Juan (NWS WFO SJU), which is based on the WRF WSM4 model. The model consists of an ensemble of 10 single-domain simulations each with a horizontal resolution of 6 km and 25 levels, respectively. CariCOOS developed a single-domain configuration of the WRF WSM4 model having a finer horizontal spatial resolution of 1 km. This model, in general, is discrete approximations in space and time of a continuous geophysical medium being simulated. The solutions to these models are not an exact representation of reality. The fundamental problem is to use the numerical approximation to solve the complex Navier-Stokes equations used to simulate atmospheric flows. One goal is to keep track of the discrepancy level in order to improve model skill performance. The real-time validation results presented in this paper focus on current operational products by CariCOOS and NWS WFO SJU. These models are referenced as WRF-NSM-2KM, WRF-NSM-1KM and NWS NDFD operational product [3].

II. METHODOLOGY

The validation of modeled forecast M0 from the WRF model configurations and NWS NDFD is validated using in-situ wind observations (95) from CariCOOS Observing Network, shown in Figure 1. CariCOOS observing network consists of 5 buoys equipped with meteorological instrumentation [1] and fifteen land-based meteorological stations. The land-based instrument stations were deployed by WeatherFlow Inc. (13 sites) and CariCOOS (2 sites). Additional details of CariCOOS assets are presented in [5].

1. INTRODUCTION

Validation of a numerical model is an important aspect of the implementation process and operational phase. Model skill performance can be assessed in how well the model results compare with reliable in-situ observations or predicted events. The Caribbean Coastal Ocean Observing System (CariCOOS) has implemented a mirror run of the operational numerical weather prediction (NWP) model employed by the National Weather Service Weather Forecast Office San Juan (NWS WFO SJU), which is based on the Weather Research and Forecast (WRF) model. The WRF model system contains two dynamical cores, referred to as the ARW (Advanced Research WRF) [1] and the NMM (Non-hydrostatic Mesoscale Model) [2], the first developed at the National Center for Atmospheric Research (NCAR), and the second at the National Centers for Environmental Prediction (NCEP). The NWS WFO SJU currently employs WRF-NSM model since it provides faster simulations run when compared to WRF ARW core, making it appropriate for operational forecasting. Also, both WRF core models are fit for use in a broad range of applications across scales ranging from meters to thousands of kilometers. The model configuration implemented by the NWS WFO SJU consists of a one-way nesting of two domains with a horizontal resolution of 6 km and 2.5 km, respectively, for the parent and child domains. Employing similar model setup, CariCOOS implemented a single domain WRF model configuration with a horizontal spatial resolution of 1 km. Both model configurations are implemented with 45 vertical levels. Boundary and initial conditions are driven by the Global Forecast System (GFS) and high-resolution sea surface temperature (SST) from NASA Short-term Prediction Research and Transition Centre (SPARC). These models, in general, are discrete approximations in space and time of a continuous geophysical medium being simulated. The solutions to these models are not an exact representation of reality. The fundamental problem is to use the numerical approximation to solve the complex Navier-Stokes equations used to simulate atmospheric flows. One goal is to keep track of the discrepancy level in order to improve model skill performance. The real-time validation results presented in this paper focus on current operational products by CariCOOS and NWS WFO SJU. These models are referenced as WRF-NSM-2KM, WRF-NSM-1KM and NWS NDFD operational product [3].

A MATLAB script was developed as a tool to enable real-time validation of WRF model. The main tasks performed were: (i) gathering of all model data, (ii) gathering of all in-situ observations and compute statistical parameters, and (iii) generate graphical results for CariCOOS web portal. The first task involves accessing model data from CariCOOS BAMC Catalogue THREDDS Data Server (TDS) and interpolating it to each in-situ GPS coordinates.

\[ u_p = u_s - \frac{\ln(z_p)}{\ln(z_s)} \]
Case Studies
Winter Swell Events

WPC/OPC Surface Analysis

Observations (last 24 hrs)

Buoy Observations - from Nov 19 to Nov 26

NDBC/CarICOOS Buoy Data
Post-Storm Reports

CariCOOS/WeatherFlow stations are used in Post-Storm Reports.
Interagency Collaboration

• **CariCOOS** and **NWS San Juan** have worked together on several projects since 2009.

• A key goal of this collaboration is to improve forecasts of meteorological and oceanographic phenomena by speeding up the transfer of new technology and research ideas into forecast operations. This is accomplished by combining the skills and mutual research interests of scientists and forecasters.