Upgrades to the NCEP's Real-Time and UnRestricted Mesoscale Analysis Systems for the Significant Wave Height

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Introduction

The National Centers for Environmental Prediction (NCEP) provides weather guidance to the United States National Weather Service and consequently to their clients. The portfolio of operational products includes the Real Time Mesoscale Analysis (RTMA) and the UnRestricted Mesoscale Analysis (URMA) which provide hourly gridded analyses of surface (land and marine) meteorological variables, precipitation, and cloudiness for contiguous United States (CONUS), Alaska, Hawaii, Puerto Rico, and Guam [1]. Starting with version 2.6, the URMA provided significant wave height (SWH) analysis for the oceanic coasts of CONUS [2], and with version 2.7, the system was expanded to Alaska (AK), Hawaii (HI), and Puerto Rico (PR) domains [3].
This paper presents the upgrades concerning the SWH analysis for the next RTMA and URMA version, 2.8, for the existing domains. It also summarizes the expansion of the two systems to provide analysis of SWH to the Great Lakes and Guam.

Mesoscale Analysis of Significant Wave Height

RTMA and URMA are almost identical systems, both of them based on the community Gridpoint Statistical Interpolation (GSI) data assimilation system [4] and using the 2D-Var approach. More information on the current operational setups can be found in [5]. The analysis grid for all domains is 2.5km, except for AK (3km). The main difference between RTMA and URMA is that URMA runs six hours after the RTMA to ingest all the acquired observations. The current version (2.7) for the analysis of SWH has the following setup:

i. All the operationally available observations (from altimeters and in-situ) are assimilated.

ii. The background is provided by the operational multigrid wave prediction systems, based on the NWS WAVEWATCH III® model and is downscaled to the domains of the mesoscale analysis. The preprocessing is based on advanced scripting to fully utilize the wgrib2 [6] capabilities.

iii. The parameters (variance and correlation lengths) of the background error covariance function were estimated based on two years of analysis, and they are provided through external files.

Upgrades for the Mesoscale Analysis of Significant Wave Height

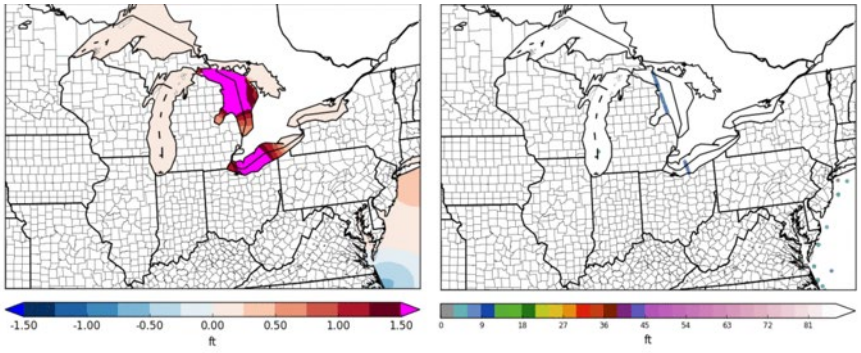

Figure 1. Increment (in ft) of significant wave height for the Great Lakes (left) and assimilated observations (right).

In the next version (2.8), the analysis systems have been upgraded as follows:

The URMA for CONUS includes SWH analysis for the Great Lakes (GL); the operational wave prediction system for the GL provides the background. Also, the operational surface ice analysis of NCEP is used to filter out the ice-covered sections of the Lakes. An example of the increment and the assimilated observations for the Great Lakes is shown in Figure 1.

The spatial resolution of all the analysis parameters for the PR domain will be doubled, from 2.5km to 1.25km. This upgrade does not have a statistically significant impact on the accuracy of the SWH analysis. Also, the option for assimilating observations from altimeters is activated; this upgrade has a limited effect on the analysis due to the satellite repeat cycle and the limited size of the domain.

Figure 2. Time series of bias, RMSE, and bias-corrected RMSE (BCRMSE), for the first guess (blue) and the analysis (red) at Guam.

An SWH analysis is added to the portfolio of the products for Guam. The default GSI values for global variance ($0.4m^2$) and horizontal correlation length (1.5 deg) for the SWH are used. The accuracy of the analysis is significantly higher in comparison to the background. But, as the in-situ observation locations are in shielded areas close to the coast of Guam, the spatial assimilation effect is minimal. Still, the assimilation of altimeter observations in the open ocean on the west side of the domain improves the nowcasting of the SWH significantly.

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