UNCLASSIFIED

Verification of Open-Ocean Environments of Wind Speed and Wave Height

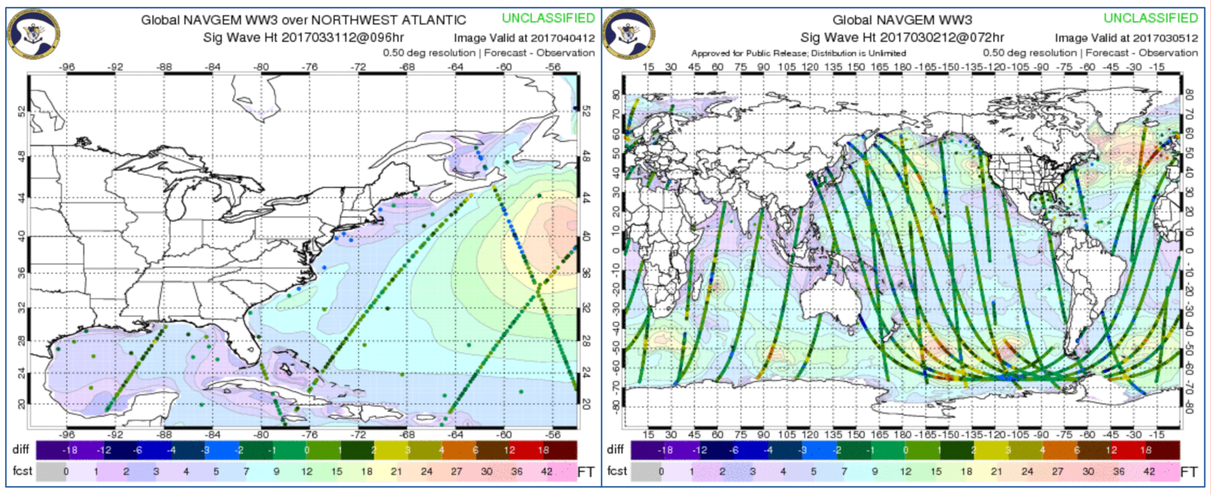
Raymond C. Lee[1], Charles E. Skupniewicz[1], Paul Wittmann[1]
[1] Fleet Numerical Meteorology & Oceanography Center, Monterey, CA

UNCLASSIFIED

Introduction

Fleet Numerical Meteorology and Oceanography Center (FNMOC) has the mission to operate global and limited area mesoscale NWP models in support of US DoD operations, exercises, humanitarian assistance, and disaster relief. As FNMOC primarily provides NWP information to US Navy assets, we focus mostly on open ocean environments where traditional observations of winds and waves tend to be lacking. We therefore use altimeter and scatterometer data as the observational truth to verify our models. Other verification activities at FNMOC will also be briefly discussed.

Wave Altimetry



The wave verification process uses bi-linear interpolation of the gridded wave height forecast field to the location of the altimeter or buoy observation for comparison and verification.The altimeter observations being read in are the super-observations being output by the Navy Coupled Ocean Data Assimilation (NCODA) program, producing a quality controlled and temporally thinned observation dataset.

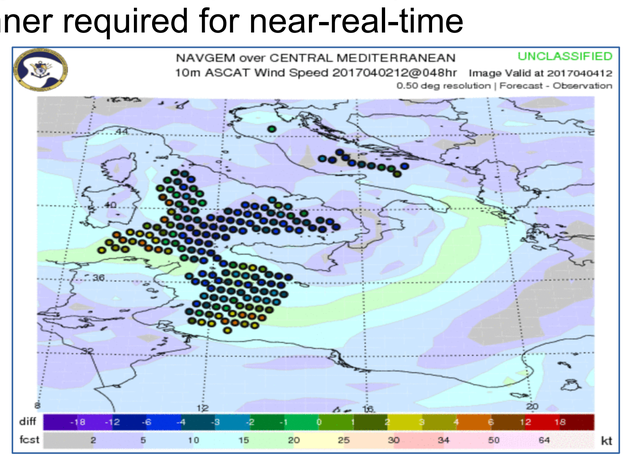
As the altimeter observations contain all altimeters, the program can compare all observations from all sources received in one step. Slight observation biases between satellite altimeters are not directly accounted for when gathering the observations. Given the lack of observations and buoys that are received in these regions from normal sources, a potential slightly larger observational error is acceptable in order to have observations over open-ocean environments.

Verification is performed on WW3 wave models driven by three different atmospheric forcing models, the Coupled Ocean/Air Mesoscale Prediction System (COAMPS), the Navy Global Environmental Model (NAVGEM), and the Global Forecast System (GFS). The first two models listed are run at FNMOC while the GFS is run by the National Center for Environmental Prediction (NCEP).

In addition to producing textual 'matchup' files of the observation and forecast, the software also makes verification images from the matchup files for display on the FNMOC model verification webpage.

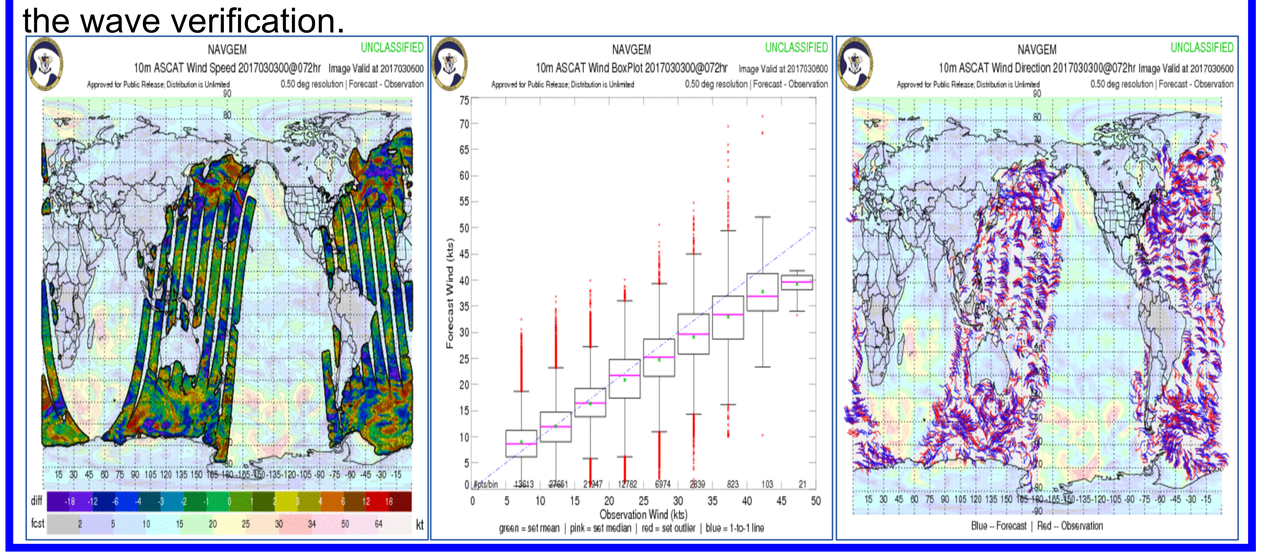
Scatterometer Wind Speed

The scatterometer verification software is an expansion of the wave verification with the spatial and temporal thinning of the scatterometer observations done in the verification program, not by a prior program. Thinning the observations allows processing of many forecast regions for multiple models (COAMPS, NAVGEM, and GFS) in the timely manner required for near-real-time operations.



Advanced Scatterometer (ASCAT) and WindSat data are able to be processed by the program with a quality control (QC) and quality assurance (QA) process from the model data assimilation software, the Navy Atmospheric Variational Data Assimilation System (NAVDAS).

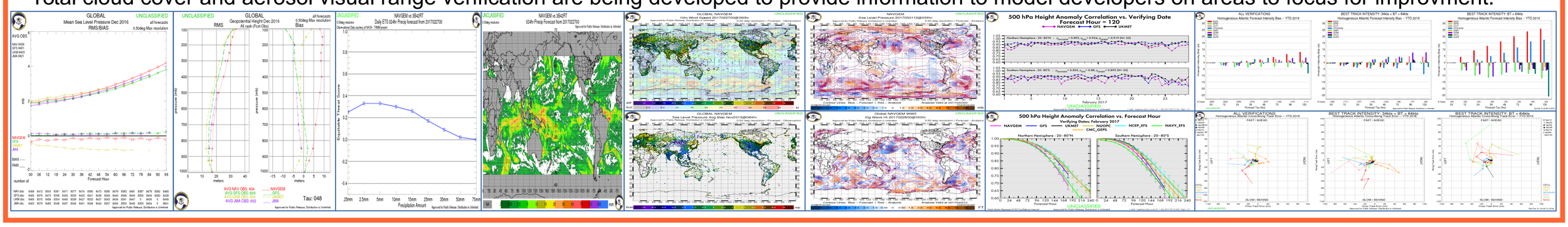
The verification process begins with a 6 hour window of raw scatterometer observations, the geographic region, verification date (valid time) and length of model forecast passed into the Fortran program. The 6hr observation window is centered on the verification date. After the initial QA/QC checking of the observations, spatial and temporal thinning is performed to select only the observation closest to valid time in a 1/4 degree square. Once the observations are thinned the process is the same as the wave verification.



Additional Verification

In addition to scatterometer-driven and altimetery-driven verification, FNMOC has multiple other verification processes to provide additional information to the fleet forecasters and model developers, specifically:

- Standard verification products include typical surface and upper-level temperature, pressure/height, and wind parameters for general model performance.
- Precipitation verification products perform QPF verification off multiple gridded precipitation datasets against the model.
- Model Versus Analysis products show the performance of the model forecast against the valid analysis and are a favorite among the fleet forecasters.
- Surface Bias verification products show the bias between the observation and the model forecast for daily or monthly time periods at observation locations.
- Global Self-Analysis and Anomaly Correlation products provide the standard 500mb Anomaly Correlation values for the global model for comparison to other forecast centers.
- Tropical Verification products show real-time verification of active tropical cyclones and performance of model aids to provide Joint Typhoon Warning Center forecasters real-time verification.
- Ocean verification products provide SST, currents, and salinity verification for mesoscale Air-Ocean coupled models.
- Total cloud cover and aerosol visual range verification are being developed to provide information to model developers on areas to focus for improvment.



Conclusion

FNMOC has leveraged altimeter and scatterometer observations to provide verification results of for the global and limited area mesoscale NWP models being run within an automated system in near-real-time. These processes allow many different traditionally data-sparse regions of the world to be rapidly verified without requiring manual intervention. This provides verification results to model developers and fleet forecasters to enhance capabilities and safety of the sailors at all times.

The authors would like to acknowledge Dr. Jason Nachamkin of the Naval Research Lab – Marine Meteorology Division for his assistance with improvements to many of the verification applications run at FNMOC.