FNMOC/NCEP WW3 Ensemble Status

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Michael Sestak
Meteorologist

With the assistance of

Stephen Klotz, DoD HPCMO

Paul Wittmann, FNMOC

Arun Chawala, NCEP

OVERVIEW

- Wavewatch 3
  - Basic model information
  - NCEP and FNMOC ensembles
- Sample products
- Preliminary evaluation
  - Ensemble mean statistics
  - Ensemble distribution statistics
- Summary

Wavewatch 3 version 3.14

- solves the random phase spectral action density balance equation for wavenumber-direction spectra.
- Rectangular latitude longitude grid
- 24 directions, 29 frequencies at each grid point
- refraction and straining of the wave field due to temporal and spatial variations of the mean water depth and of the mean current (tides, surges etc.)
- Parameterizations of physical processes (source terms) include wave growth and decay due to the actions of wind, nonlinear resonant interactions, dissipation (`whitecapping'), bottom friction, surf-breaking (i.e., depth-induced breaking) and scattering due to wave-bottom interactions including shallow water
- sub-grid representation of unresolved islands
- dynamically updated ice coverage
- Up to 9 restart files per model run
- Multiple one-way nested or two-way nested runs
- Serial, MPI and OpenMP versions
- Tolman, 2009: User manual and system documentation of WAVEWATCH III™ version 3.14. NOAA / NWS / NCEP / MMAB Technical Note **276**, 194 pp + Appendices
- http://polar.ncep.noaa.gov/waves/wavewatch/wavewatch.shtml

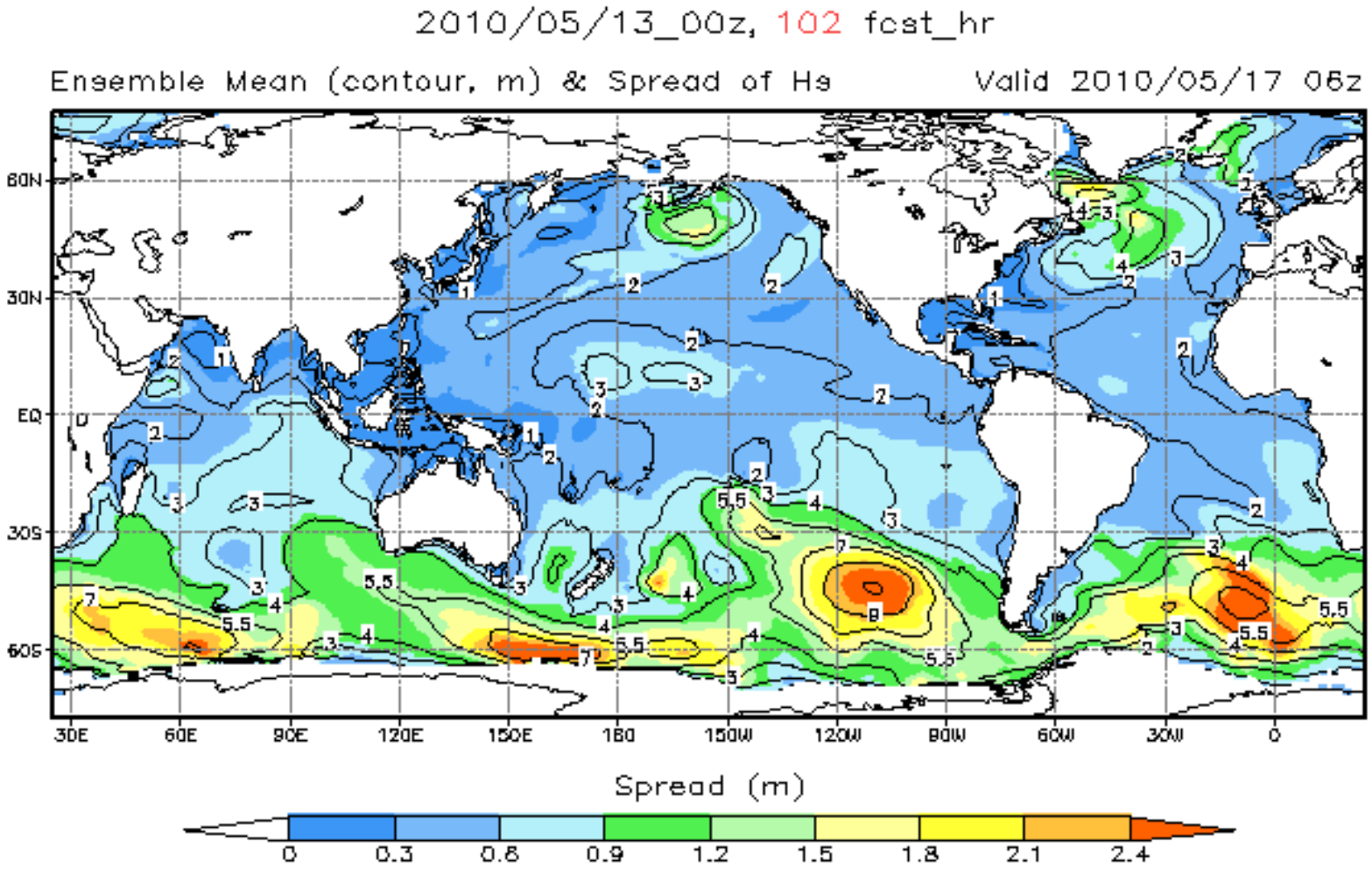
NCEP and FNMOC WW3 Ensembles

	NCEP	FNMOC
Grid	1x1 degree	1x1 degree
Members	20	20
Forecast	00Z, 06Z,12Z, 18Z for 240 hr	00Z and 12Z for 240 hr
Wind forcing	Bias corrected GEFS 10 m winds	Raw NOGAPS EFS 10 m winds
History	From each member	From each member
Data assimilation	None	In control only, satellite altimetry and buoys
Perturbations	None	None
Ice concentration/ edge and SST	GDAS	NCODA
Update Cycle	6 hr	12 hr
Same bathymetry, subgrid islands, coastlines http://polar.ncep.noaa.gov/waves/ensemble/viewer.shtml https://www.fnmoc.navy.mil/efs/efs_ww3.html		

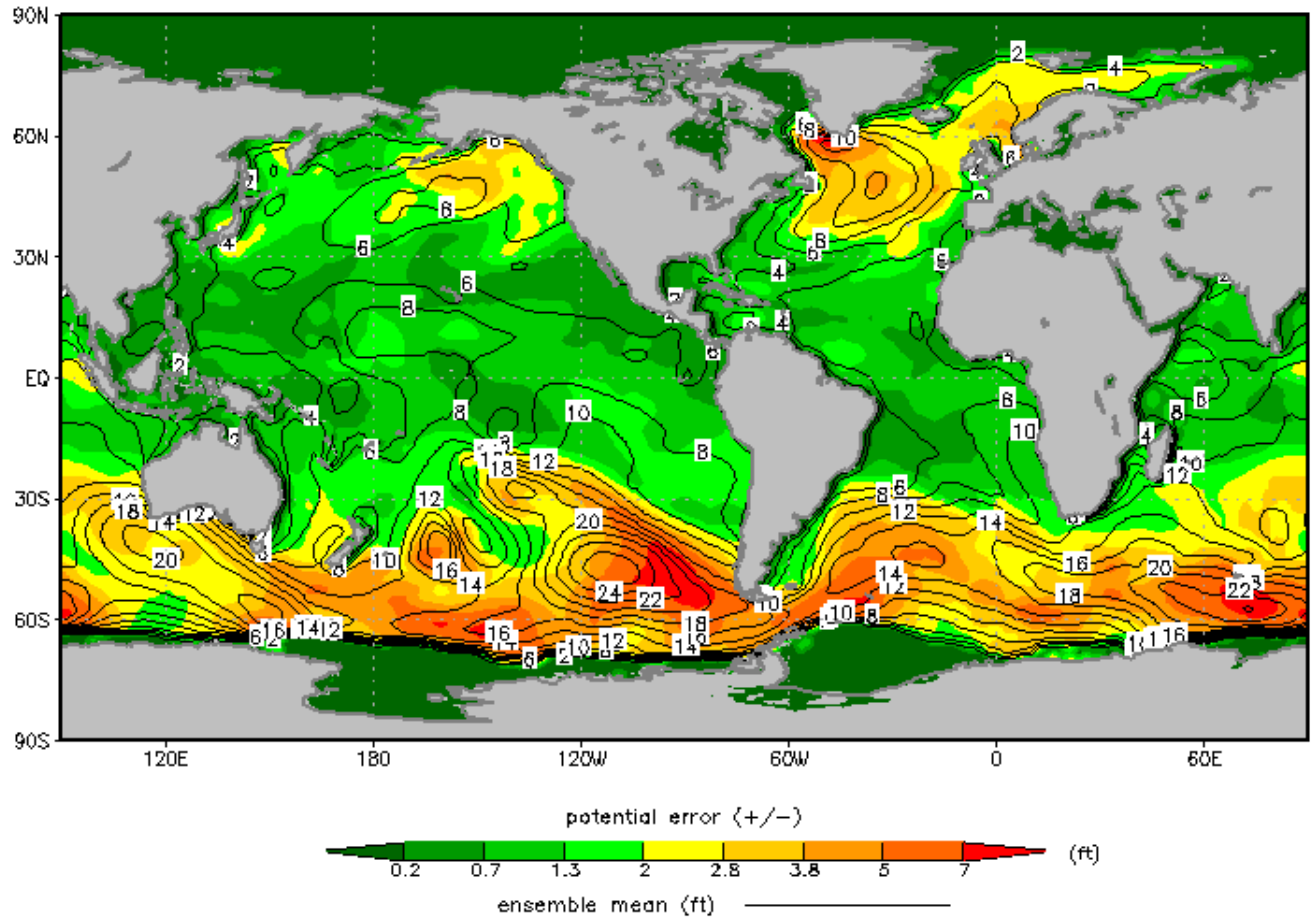
FNMOC and NCEP Sample Graphic Products

- Significant Wave Height Ensemble Mean and Spread
- Probability of Wave Height Exceeding a Threshold
- http://polar.ncep.noaa.gov/waves/ensemble/viewer.shtml
- https://www.fnmoc.navy.mil/efs/efs_ww3.html

NCEP Sample Wave Height Plot

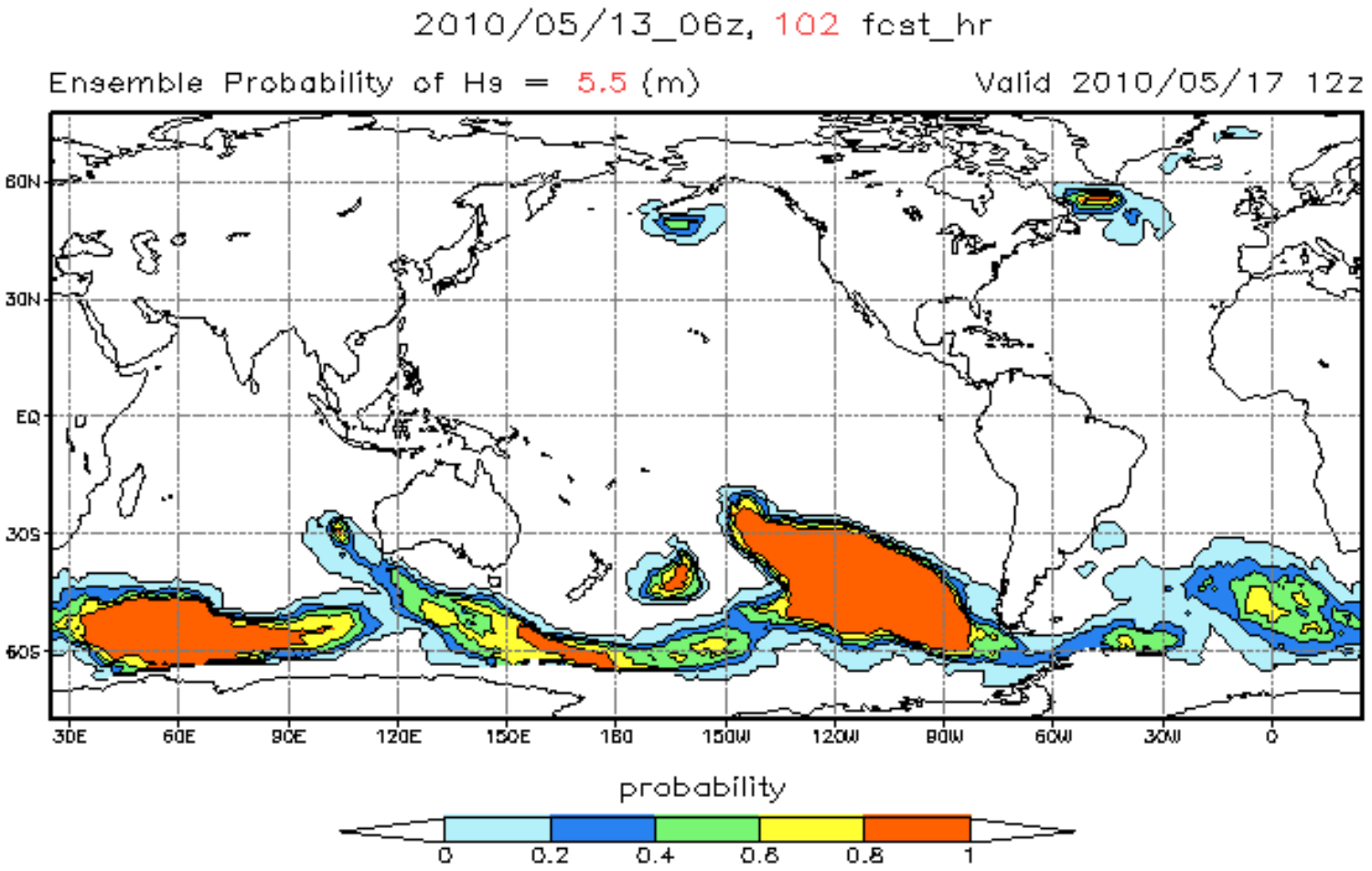


FNMOC Sample Wave Height Plot

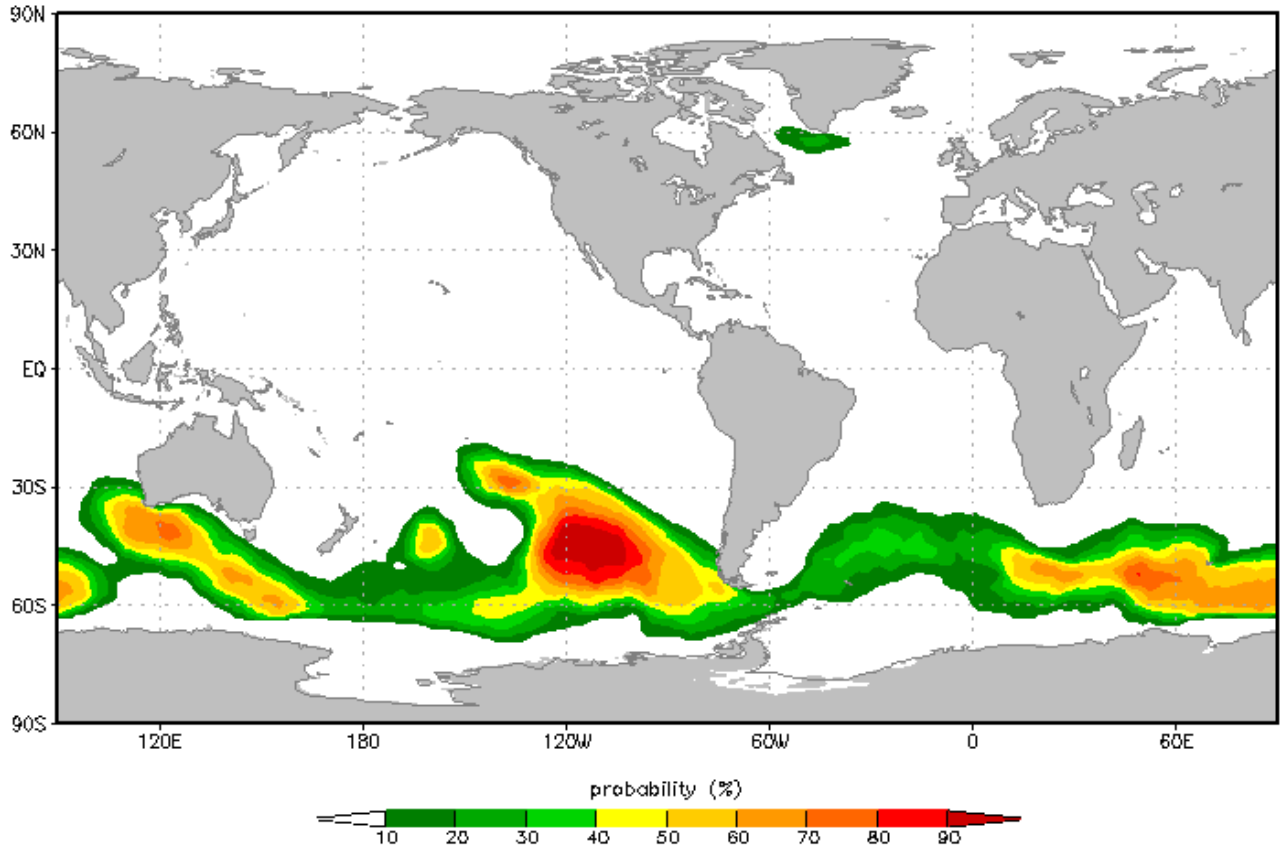


VT: 06Z 17 MAY 10
Significant Wave Height
WAVEWATCH III: 00Z 11 MAY 10, Tau 150

NCEP Sample Wave Probability Plot

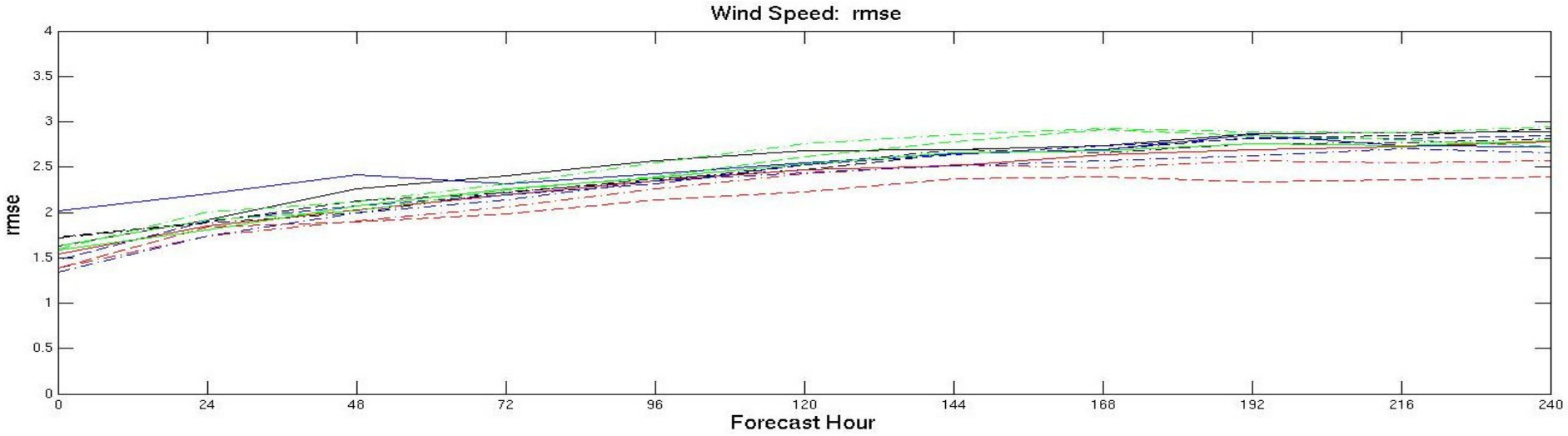


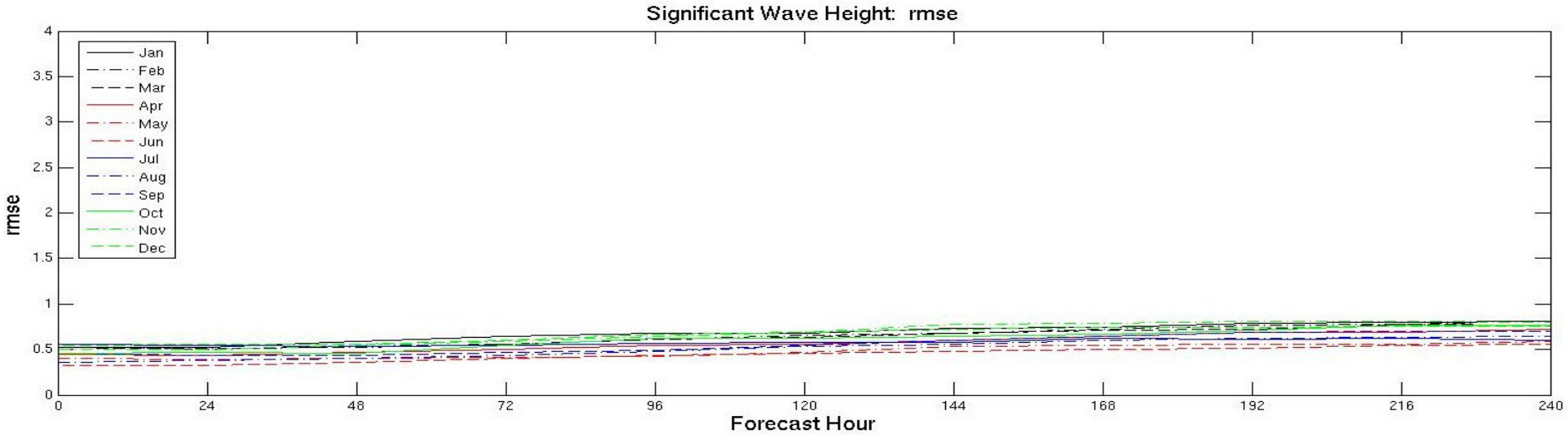
FNMOC Sample Wave Probability Plot



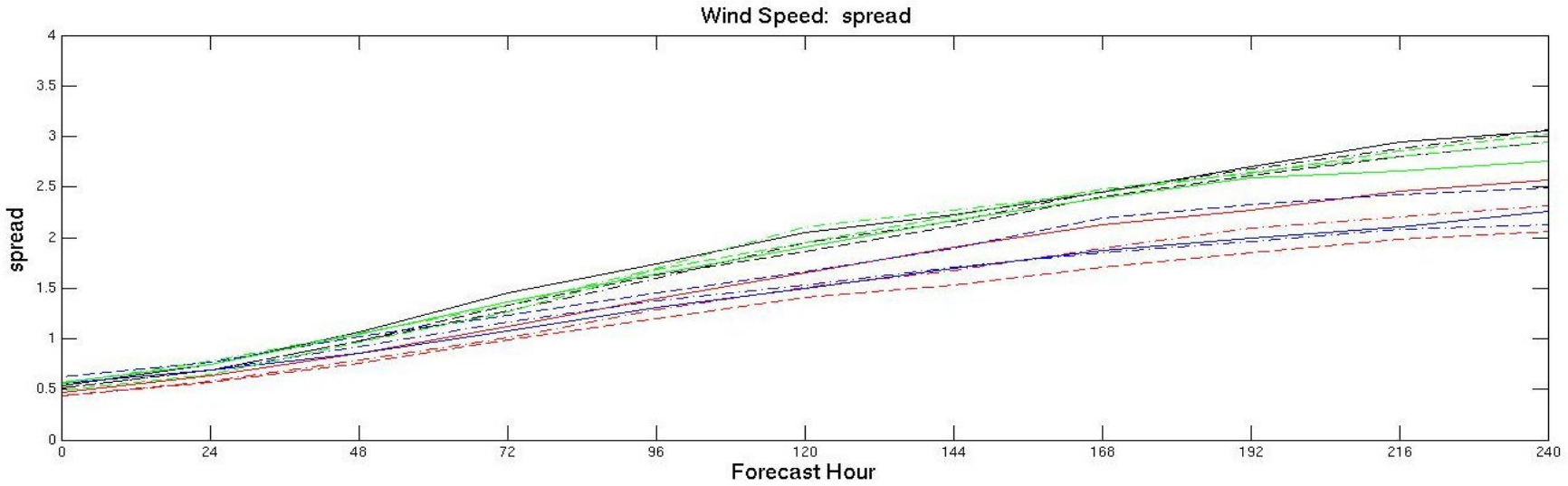
VT: 12Z 17 MAY 10
Probability of Significant Wave Heights > 18 ft
WAVEWATCH III: 00Z 11 MAY 10, Tau 156

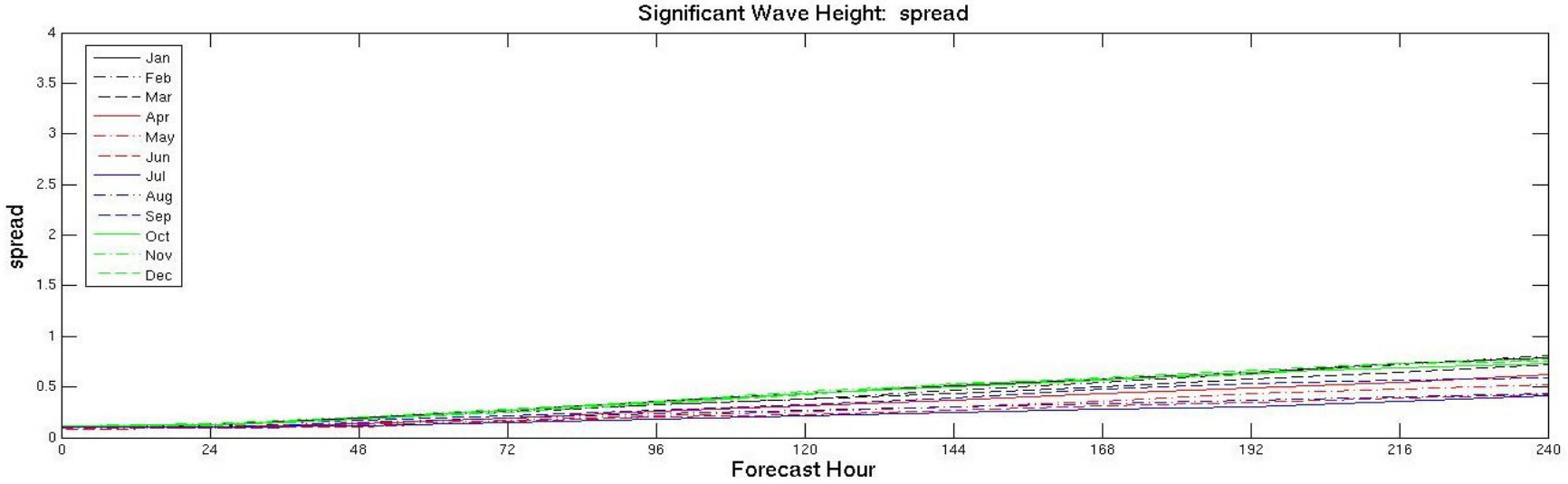
NCEP Ensemble Mean Skill



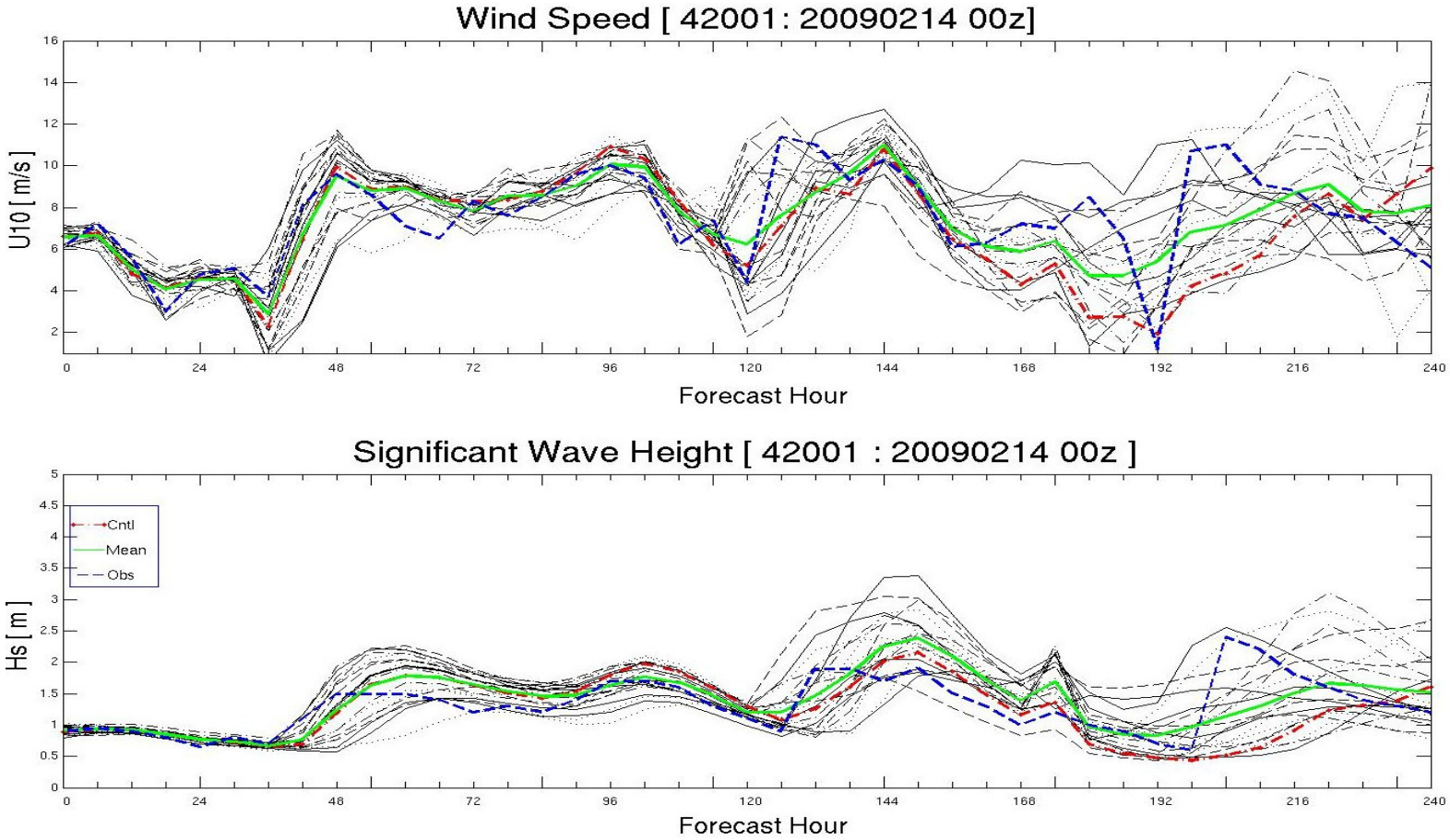


NCEP Ensemble Spread



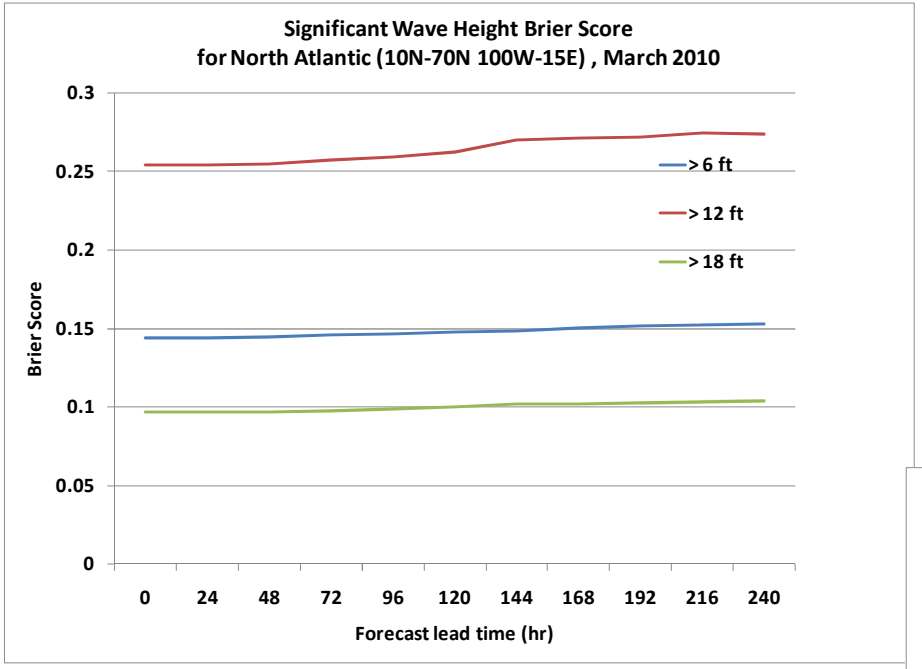


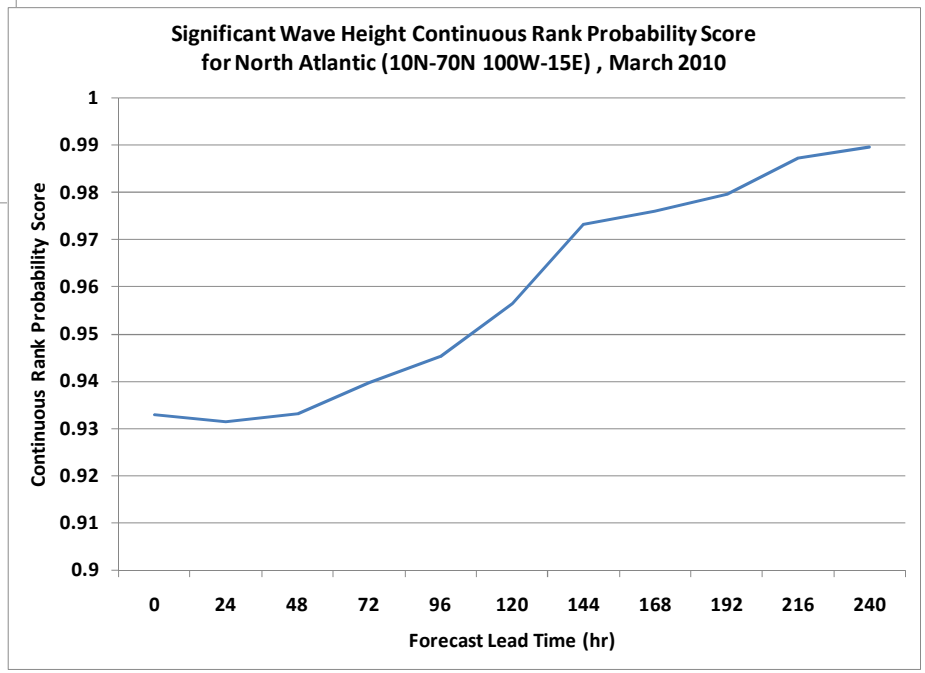
NCEP Ensemble Mean & Spread vs Obs



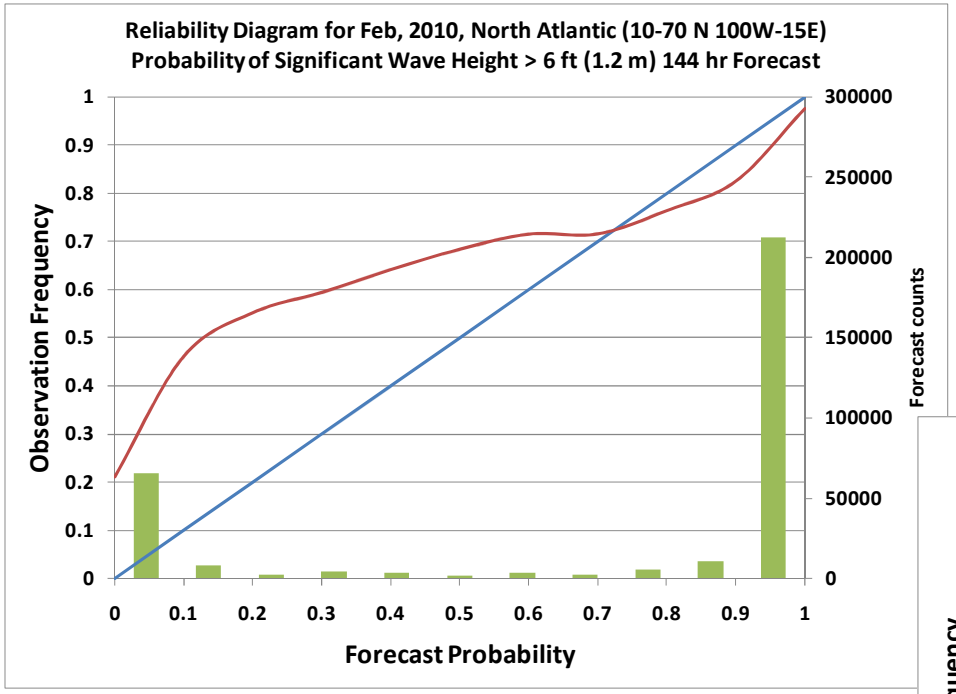
Obs are generally in ensemble range, ensemble mean generally outperforms deterministic control, clear change in predictability at 100h, with waves lagging winds

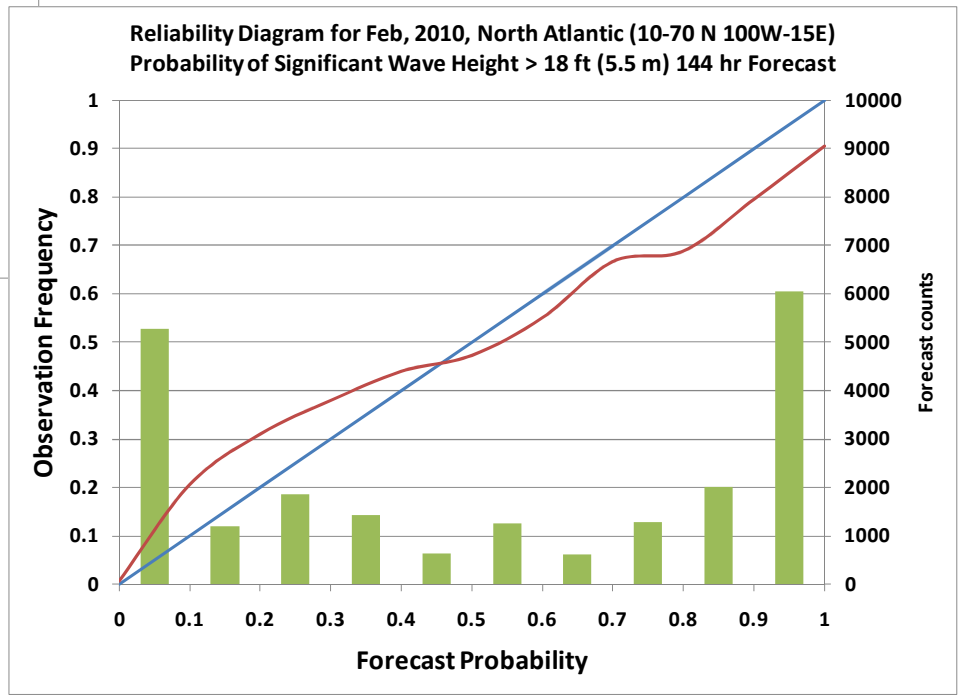
FNMOC Ensemble Skill





FNMOC Ensemble Skill





Summary

- Thus far, simple individual member driven wave model ensembles appear promising, though both initial condition and model uncertainty are likely to add skill
- Both NCEP and FNMOC are in the process of developing both products and verification systems for combined WW3 ensemble products

Questions ?

BACK-UP SLIDES

- In the Feb 2010 WW3 innovation data there are :
- 40,374 wave height obs > 6ft
- 18,279 wave height obs > 12ft
- 5,136 wave height obs > 18ft