

Statement of Need

Metrics Verification Support Services for IOC-1 for the Unified Ensemble

National Unified Operational Prediction Capability (NUOPC)

15 October 2010

1.0 Background

NUOPC provides the basis for a NOAA, Navy, and Air Force led national effort to coordinate an Initial Operating Capability for the Unified National Ensemble. Successful implementation of the ensemble will require standardized performance metrics to benchmark and measure improvement in the overall forecast skill of the ensemble output.

The purpose of this Statement of Need is to request each agency to implement the NUOPC-coordinated basic set of standardized metrics.

2.0 Requirement

Currently, Agencies employ a number of methods to verify ensemble skill and measure customer impact; however, it is not always straightforward to compare these performance measures between agencies. Implementation of the Unified National Ensemble will require standardized performance measures and a monitoring system to track ensemble skill for a common assessment among the Agencies. The NUOPC Technical Transitions Processes (TTP) Metrics subcommittee has developed a minimum set of common metrics for IOC-1 to enable repeatable measurement of skill at the three agencies. These initial metrics will be applied as an immediate solution while the committee develops additional metrics for future NUOPC phases that will further assess value and impact.

The Metrics subcommittee has actively worked for agreement on standard methodologies for evaluation of model and ensemble performance, standard climatology to benchmark skill measurements, standard test cases, and common metrics for operational impact. Key elements of the recommended metrics are agreed to statistical measures, a common set of observations for verification, a common analysis which will not favor a single agency model, a single standard gridded climatology, and common regions over which the ensembles will be verified. The recommended metrics will be applied to the raw ensemble data and the statistically adjusted ensemble data in order to accurately and uniquely assess ensemble performance and the impact of model changes and statistical adjustments. The subcommittee also tried to

incorporate metrics which are already common to all three agencies in order to reduce development and implementation overhead. A table of initial metrics and parameters to be assessed is illustrated in Table 1.

Parameter	Thresholds	Statistics	Regions	Ground Truth	Fcst Hour Interval	Comments
500 mb HGT	N/A	Anomaly Correlation, RMSE/Bias Ensemble Mean, Spread, CRPS	20N-20S,20N-80N,20S-80S, Northern Hemisphere, Southern Hemisphere, CONUS	UKMO, Observations (After IOC)	12hr	NCEP provides gridded climatology
10 Meter Winds	>20,35,50kts	Brier Score, CRPS, RMSE/Bias Ensemble Mean, Spread, Conditional Metrics (Forecast RMSE > 35kts/50kts)	20N-20S,20N-80N,20S-80S, Northern Hemisphere, Southern Hemisphere, CONUS	UKMO, Observations (After IOC)	12hr	
24hr Accumulated Precipitation	>.25,.5,1,2"	Brier Score, CRPS	20N-20S,20N-80N,20S-80S, Northern Hemisphere, Southern Hemisphere, CONUS	Observations	12hr	
700mb Dew Point	N/A	RMSE/Bias Ensemble Mean, Spread, CRPS	20N-20S,20N-80N,20S-80S, Northern Hemisphere, Southern Hemisphere, CONUS	Observations (After IOC)	12hr	
2 Meter Temperature	N/A	RMSE/Bias Ensemble Mean, Spread, CRPS	20N-20S,20N-80N,20S-80S, Northern Hemisphere, Southern Hemisphere, CONUS	UKMO, Observations (After IOC)	12hr	
Significant Wave Height	>12,18,24ft	RMSE/Bias Ensemble Mean, Spread, CRPS	20N-20S,20N-80N,20S-80S, Northern Hemisphere, Southern Hemisphere	Observations	12hr	
250mb Wind Speed	N/A	RMSE/Bias Ensemble Mean, Spread, CRPS	20N-20S,20N-80N,20S-80S, Northern Hemisphere, Southern Hemisphere, CONUS	UKMO, Observations (After IOC)	12hr	
Total Cloud Cover (percent)	N/A	RMSE/Bias Ensemble Mean, Spread, CRPS	Northern Hemisphere, Southern Hemisphere	Hemispheric World Wide Merged Cloud Analysis (WWMCA)	12hr	AFWA provides WWMCA
Hurricane Tracks	N/A	Spread, Mean Track Error	As Required	Best Track	Best Track Interval	Verified after the fact once best track is available

Table 1. NUOPC Weather Verification Metrics Draft

Definitions of parameters for weather verification metrics:

CONUS - Continental Boundaries between Canada and Mexico and the east and west coasts

Bias - average difference between model and observed value based on either standardized analyses or observations over a fixed period.

CRPS - Continuously Ranked Probability Score - measurement of how well a probabilistic ensemble forecast predicted a categorical observation (e.g., rain/no rain)

RMSE - Root Mean Square Error - measure of square root of the average squared error between model and observation

Spread - measure of the furthest distance of an ensemble forecast distribution from the ensemble mean

Ensemble Mean - average of all ensemble forecasts for a parameter at a specific point and time.

Anomaly Correlation - measure of similarity of departures of model and observation values from the standardized climatological mean field.

These metrics will be computed at each operational center on their operational ensemble and shared among the operational centers. Combined multi-model ensemble metrics will be computed at AFWA (and other agencies as desired). This metrics implementation requires a process that maximizes available resources and must also minimize impact on the current plan for IOC-1 for the Unified National Ensemble.

3.0 Reporting:

The NUOPC Project Manager will be providing regular IOC-1 schedule updates to the NUOPC ESG and will include metrics implementation status.

Request each Agency provide an implementation schedule that includes milestones and identifies any anticipated risks to implementing prior to IOC-1. Prior to each ESG update, the NUOPC staff will request updates on progress toward implementation.