HWRF based Ensemble Prediction System and Joint Multi-Model Ensemble: Real Time Performance Evaluation in 2014 Hurricane Season

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In this study, the operational Hurricane Weather Research and Forecasting (HWRF) based EPS at NCEP/EMC is presented, and its real time performance in 2014 hurricane season is evaluated and compared to its deterministic version. The HWRF-EPS system takes into account three main sources of uncertainties related to the initial/boundary conditions and the model physics by 1) using the large scale fields from the EMC's Global Ensemble Forecast System (GEFS) to include uncertainty in the initial conditions as well as boundary conditions; and 2) stochastically perturbing initial vortex position, intensity and structure; and 3) stochastically perturbing the cumulus convection parameterization scheme and Planetary Boundary Layer (PBL) scheme in order to capture model physics uncertainties. The system is further extended to a joint multi- regional model EPS by combining HWRF, COPAMPS-C, and GFDL ensembles.

The verification shows that HWRF-EPS outperformed its deterministic version in real time 2014 storms in Atlantic, West Pacific and Indian Ocean basins in terms of both track and intensity forecasts. The errors from HWRF-EPS are reduced by about ~15% in track forecasts and ~20% in intensity forecasts, compared to its deterministic version (Fig. 1). The joint multi-regional ensemble system also demonstrated that multi-model further improves track and intensity forecasts, compared to each individual EPSs.

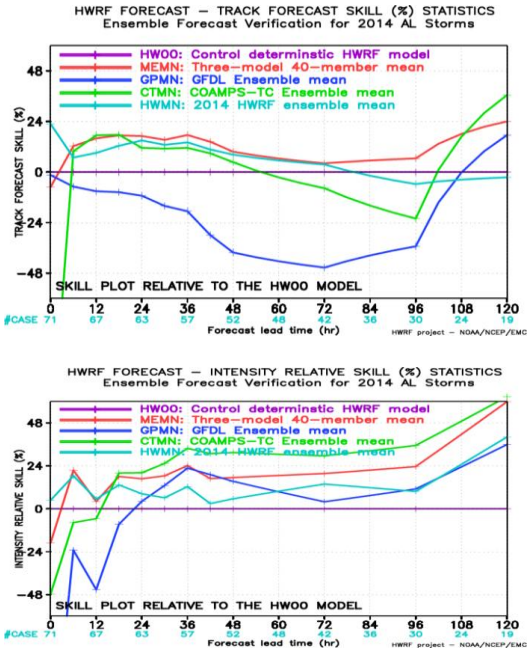

Fig. 1 Forecast skills (%) from individual EPSs (HWMN,GPMN,CTMN) and milti-model EPS (MEMN) over deterministic HWRF (HW00), in terms of track (top) and intensity (bottom).

The statistical characteristics of each individual EPSs as well as the joint system are also investigated and analyzed to ensure the effectiveness and robustness of the system. The results shows that HWRF-EPS has a adequate forecast error/ensemble spread relationship in terms of track forecasts, while the intensity of HWRF-EPS is under-dispersed. The joint multi ensemble system has a better forecast error/ensemble spread relationship than individual EPSs (not shown). Probabilistic forecasts from HWRF-EPS and joint model ensemble system are also verified using Continuous Rank Probability Score, which indicated both HWRF-EPS and joint multi-model EPS have relatively low track/intensity forecast errors (Fig. 2).

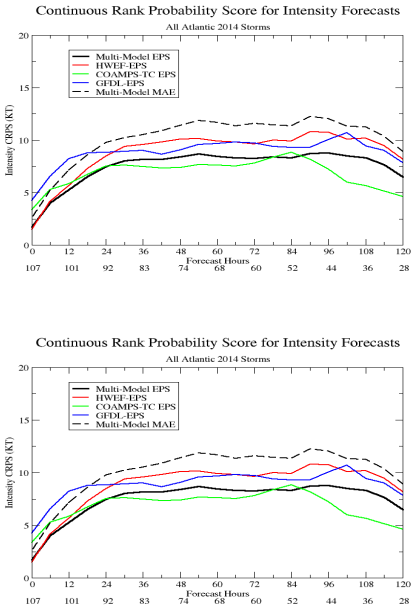

Fig. 2 Continuous Rank Probability Score (CRPS) for track (top) and intensity (bottom). The dash line is Mean Absolute Error from Multi-Model EPS.