

## Trends in Tropical Cyclone NWP in the HFIP decade 2007-2017

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The 10-y goal of the first phase of the NOAA Hurricane Forecast Improvement Project (HFIP) was to reduce ‘forecast error’ by 50%. While the definition of a tropical cyclone (TC) forecast in HFIP was somewhat vague, track error is still a fundamental measure of forecast quality.

We first give a long-term overview of TC NWP and show how model track error has dropped nearly 80% from the 1980s to 2010s –arguably the greatest success story in the history of NWP.

Improvements in TC NWP during the HFIP decade have been less dramatic, but still significant, especially for the three major hurricanes of the 2017 Atlantic season (HARVEY, IRMA and MARIA). However, the promise of improved TC forecasts by the limited-area models (LAM), e.g., HWRF, compared to global models has not been achieved.

The nature of an official TC forecast and the contribution of position and intensity error to TC forecast error is reviewed and it is shown that not only is position error dominant, but that for large position error, intensity error has no effect on TC forecast error. We then analyze the position error at the short (12-24 h), medium (48-72 h) and long-range (96-120 h) forecast time periods of the ECMWF and NCEP global models and the HWRF limited-area model during the 11-y HFIP era of 2007-2017.

One of the more surprising findings is that the ECMWF global model has superior short-range (12-24 h) position error despite having large initial position error. Finally, reasons for the limited success of the LAM are offered based on the size of the position errors and the nature of the lateral boundary conditions.

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