# Hurricane Weather Research and Forecast (HWRF) Vortex-Scale Hybrid Data Assimilation

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## Research Questions

1. What is the optimal cycling HWRF data assimilation strategy to improve the assimilation of tropical cyclone (TC) vortex-scale observations?
2. Does a TC defined by a cycling HWRF data assimilation system reduce the deterministic forecast TC *spin-down*?
3. How does this data assimilation research system integrate into the operational HWRF framework?

## HWRF Data Assimilation Strategy

**Ensemble and Control Analysis Cycling**

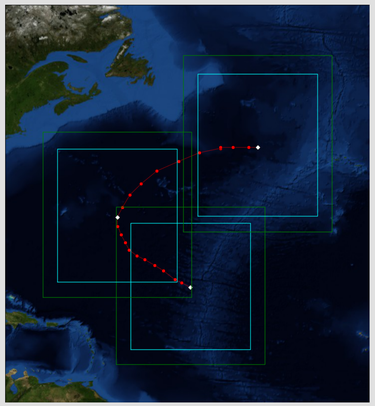

**Figure 1:** The observed track (red) for TC Edouard (2014) and the cycling HWRF 80-member ensemble (green) and control (cyan) forecast domains.

## Hybrid-HWRF Ensemble Data Assimilation Impacts

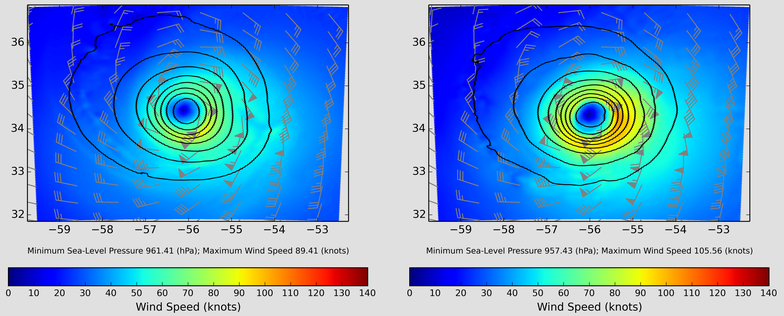


**Figure 2:** The GFS (left) and cycling HWRF (right) hybrid data-assimilation surface wind (shaded; barbs) and sea-level pressure (contour) analyses.

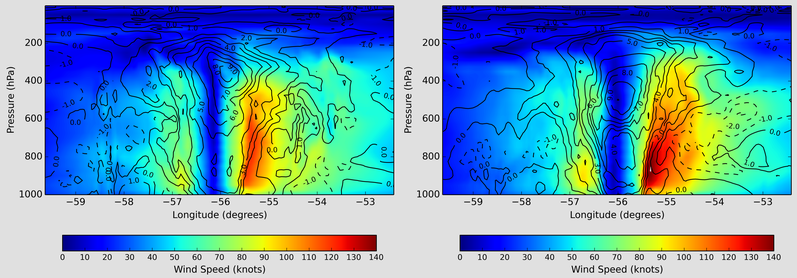


**Figure 3:** The GFS (left) and cycling HWRF (right) hybrid data-assimilation TC-centered longitudinal cross-section illustrating the wind-speed magnitude (shaded) and the TC relative pressure level temperature anomaly (contour).

## TC Forecast Spin-Down

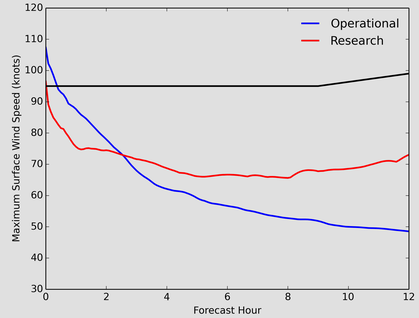


**Figure 4:** The time-series of the maximum surface wind speed for HWRF forecasts initialized using the current operational method and using the results from the cycling hybrid-HWRF ensemble data assimilation. The observed intensity is illustrated by the black line.

## Future Research and Transition to Operations

- This HWRF research system framework provides enhanced flexibility while analogous to the recently designed and implemented operational HWRF
- The data assimilation methods employed require additional tuning
- Working along-side colleagues at both NCEP/EMC and NOAA AOML/HRD, effective TC vortex-scale data assimilation methods will be integrated into the operational HWRF system