



Working Group Meeting for Space-Lidar Winds



Idealized Space-Based Doppler-Wind Lidar in a Hurricane OSSE

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Predictability Using Wind Observations

- Explore the predictability of a hurricane
 - **Goal:** Understand how wind observations influence hurricane forecasts
 - Set an upper limit for the best possible analysis and forecast
 - Test different combination of input variables
- Test how observations from an idealized polar-orbiting wind profiler alter the prediction of a hurricane
 - **Goal:** Understand how variable coverage of wind observations influence hurricane forecasts
 - Vary the timing of the observation coverage
 - Remove observations from the inner core of the hurricane

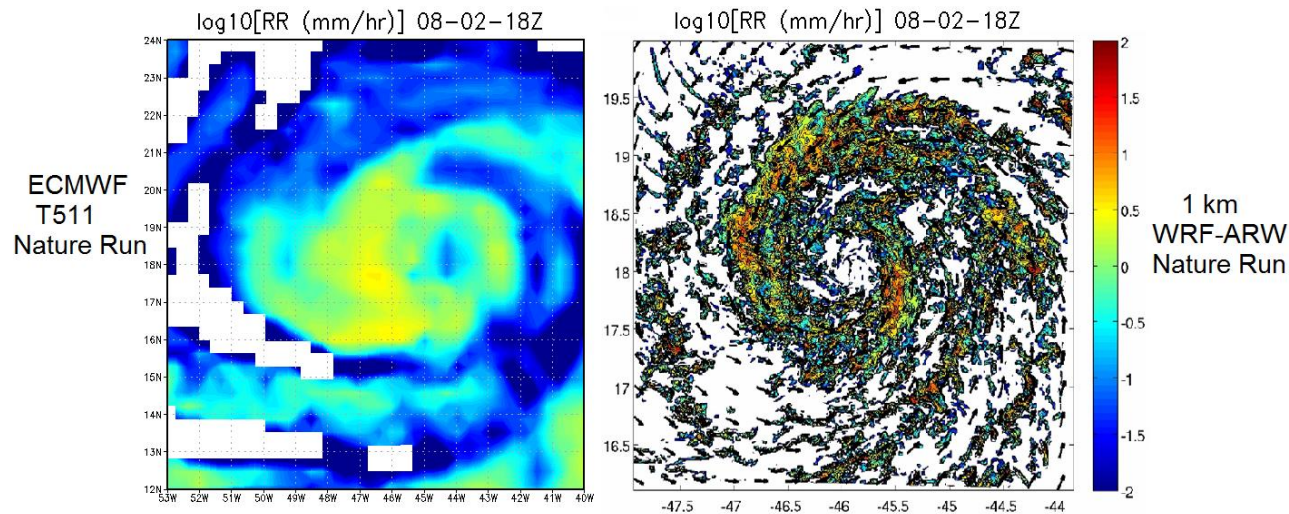
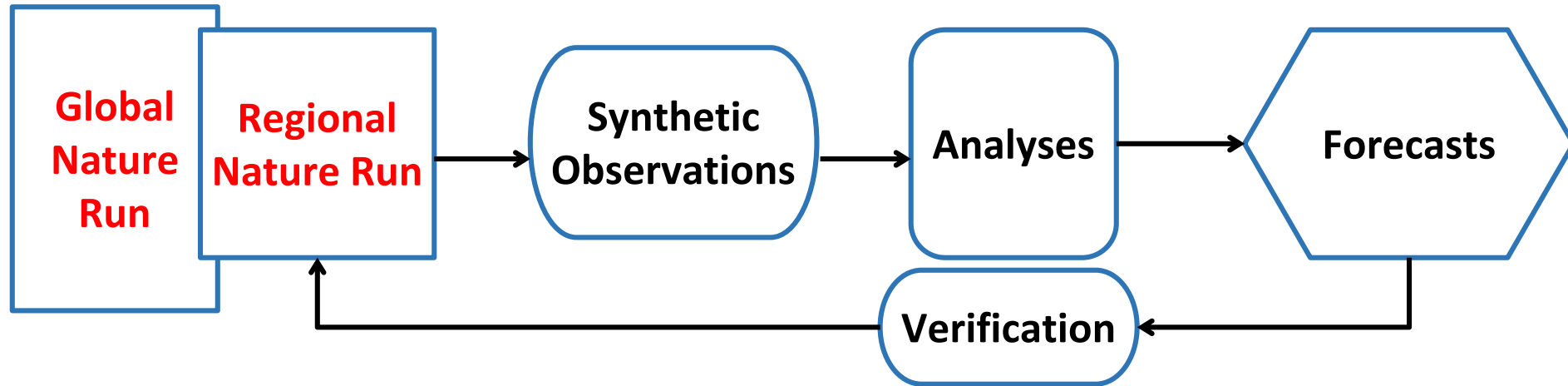


Description of OSSE

Observing System Simulation Experiment

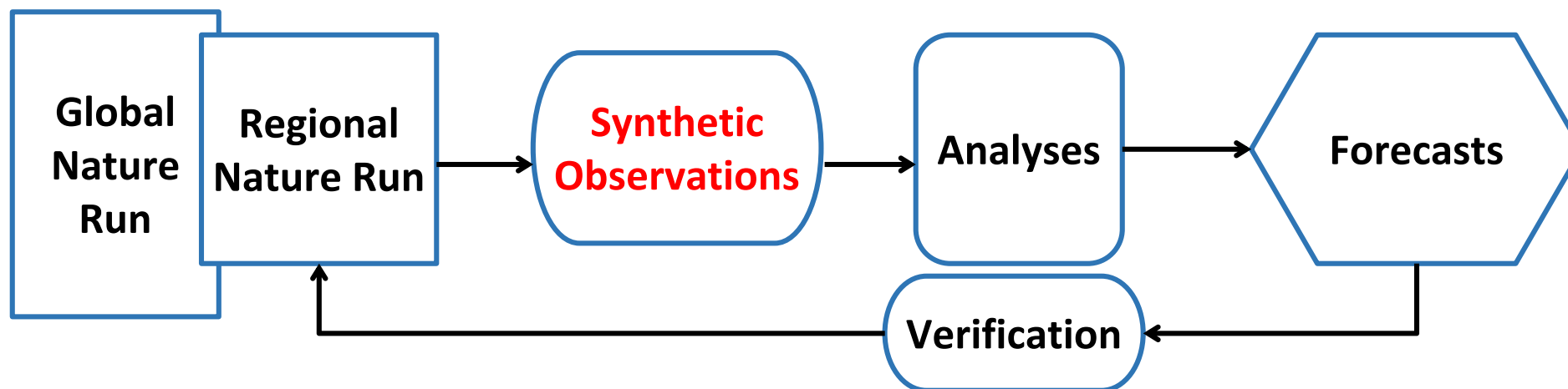
A virtual reality used to test
how observations from
new instruments could
change a forecast

Description of OSSE



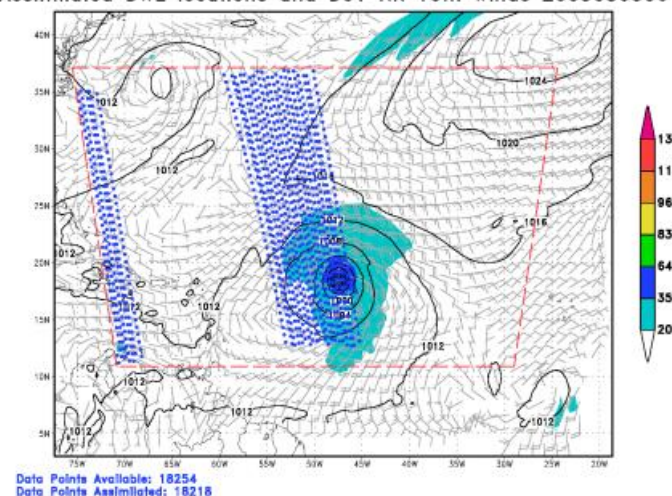
13-day WRF-ARW simulation
of a nested 1-km hurricane
from genesis to extra-
tropical transition *Nolan et
al. (2013)*

Description of OSSE

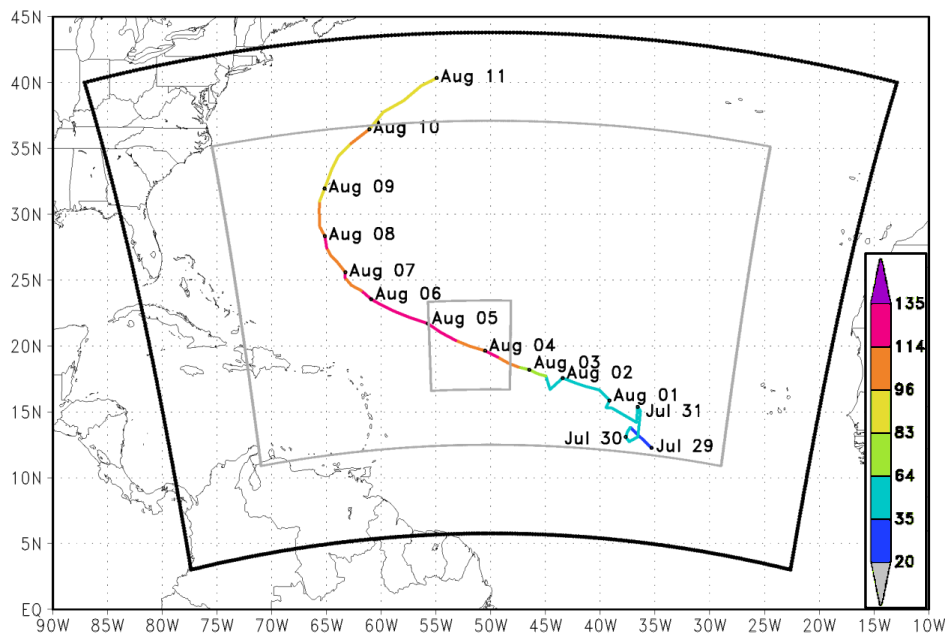
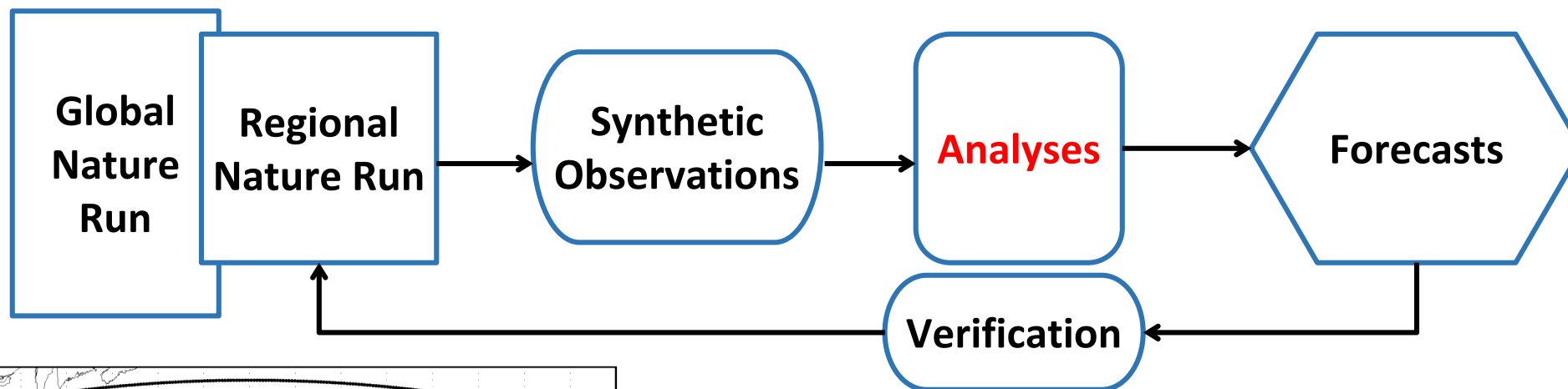


Subset the Nature Run by
simulating observations (realistic
spatial and temporal coverage,
observation errors, etc.)

Assimilated DWL locations and D01 NR 10m winds 2005080306

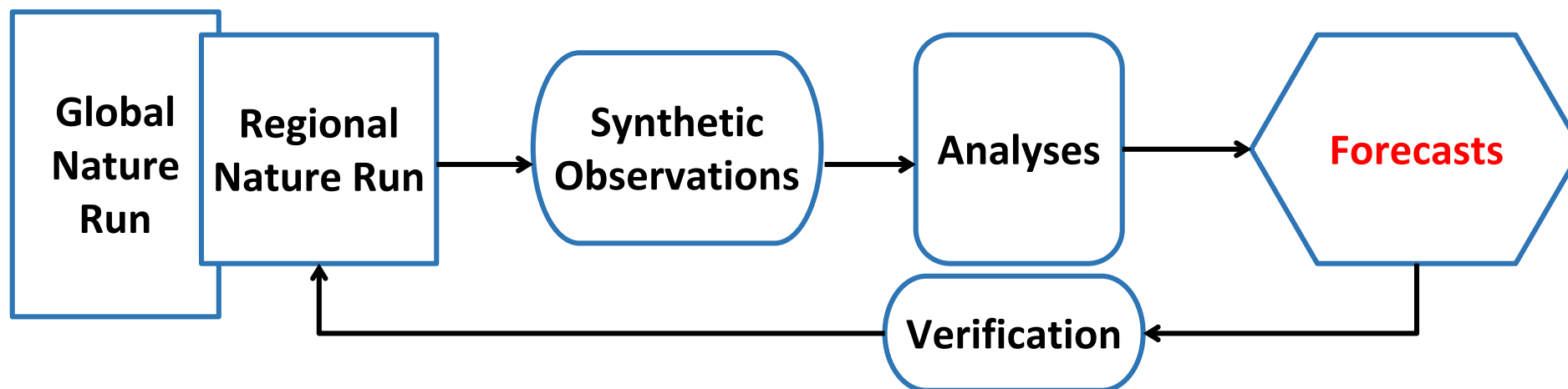


Description of OSSE



- Ensemble Kalman Filter (EnKF)
- 30 Members
- 0.9 Inflation
- 1 scale height Vertical localization
- 900km Horizontal localization

Description of OSSE



Nature Run Model

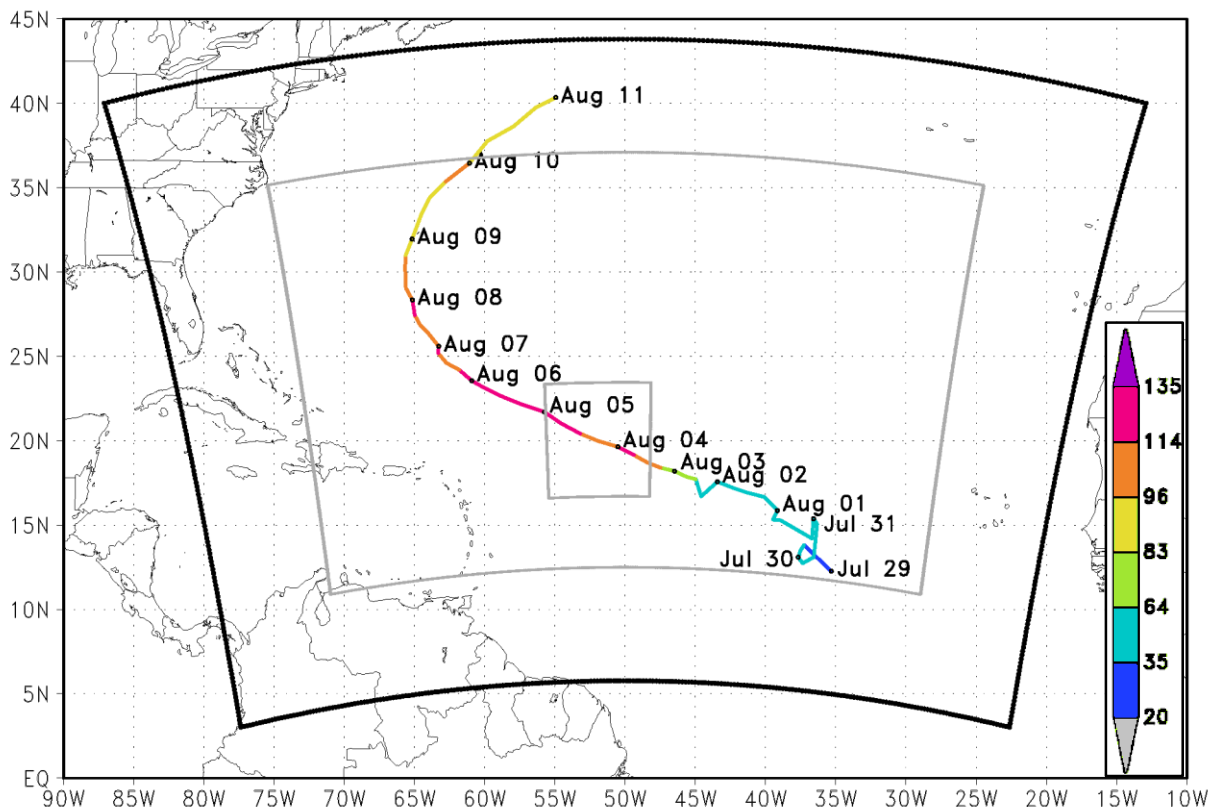
- WRF-ARW
- 27/9/3/1 km
- 61 vertical levels
- YSU PBL
- WDM6 microphysics

VS

Forecast Model

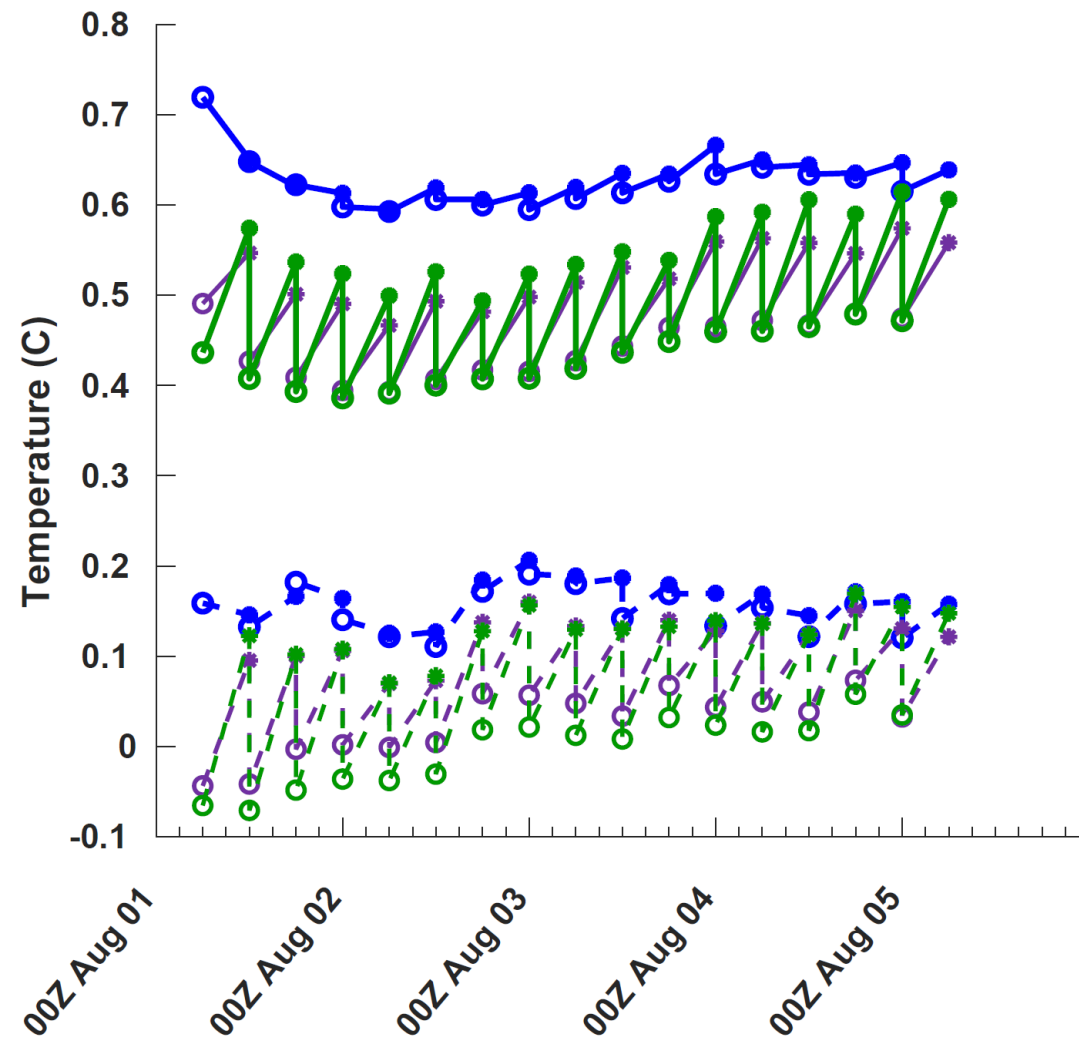
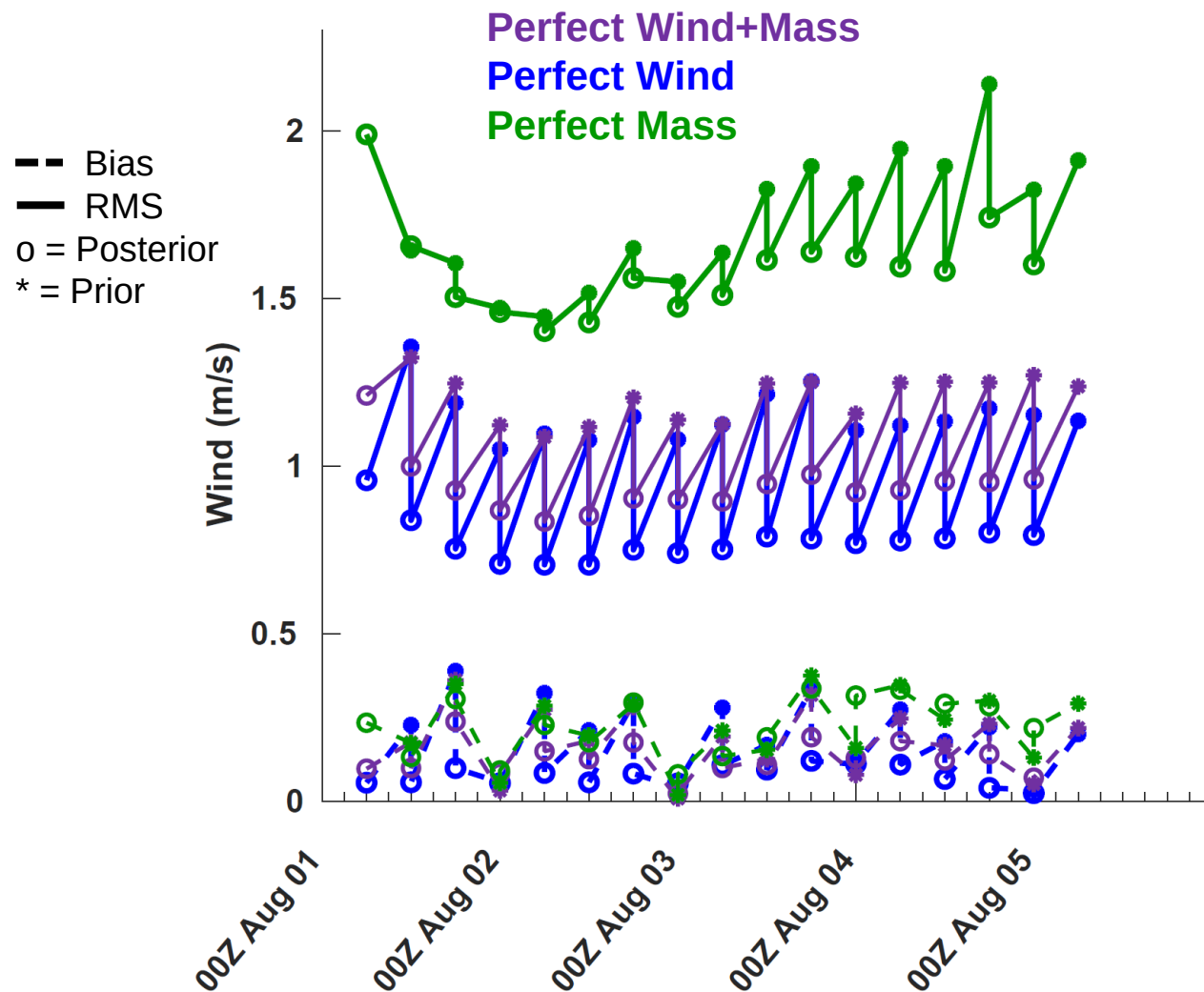
- HWRF
- 9/3 km
- 61 vertical levels
- GFS PBL
- Ferrier microphysics

The Upper Threshold

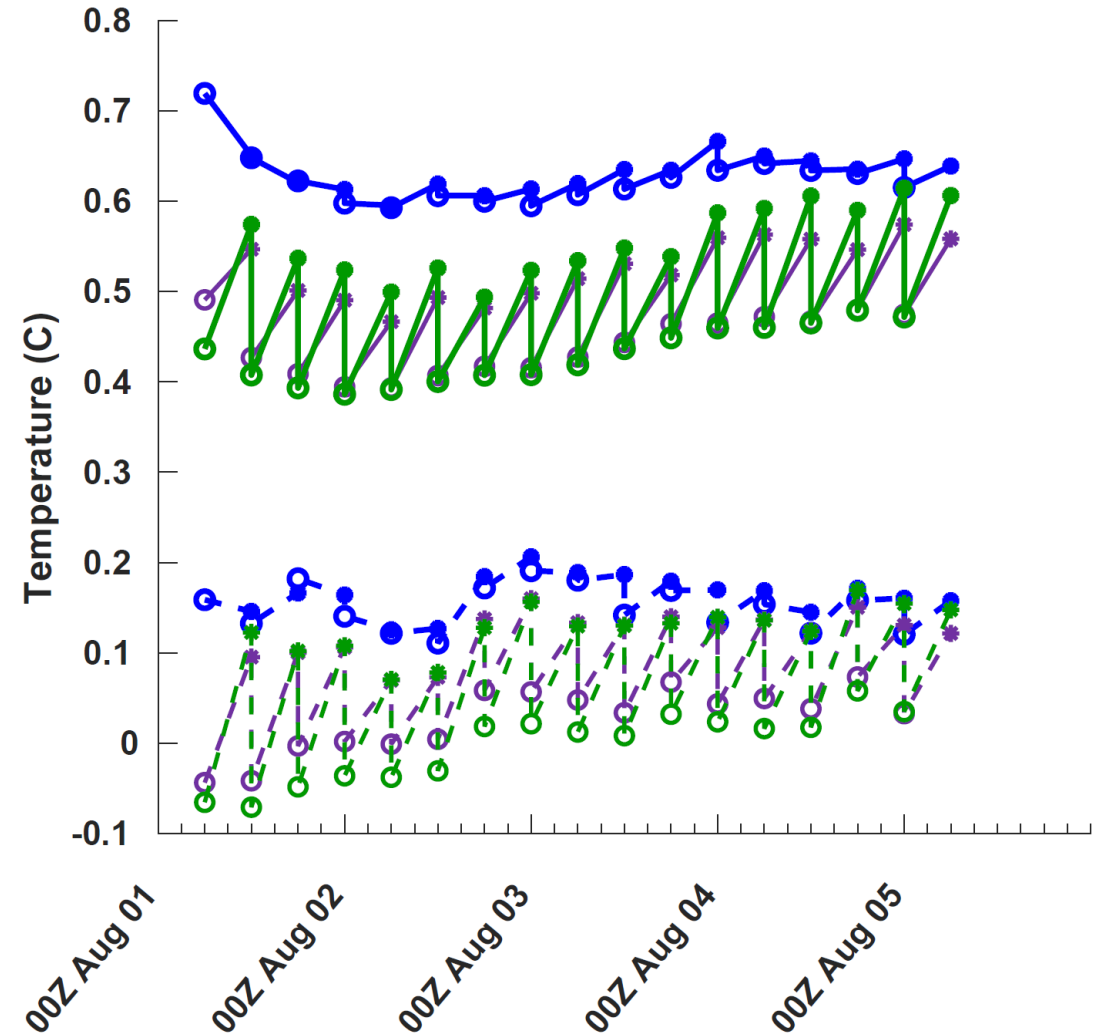
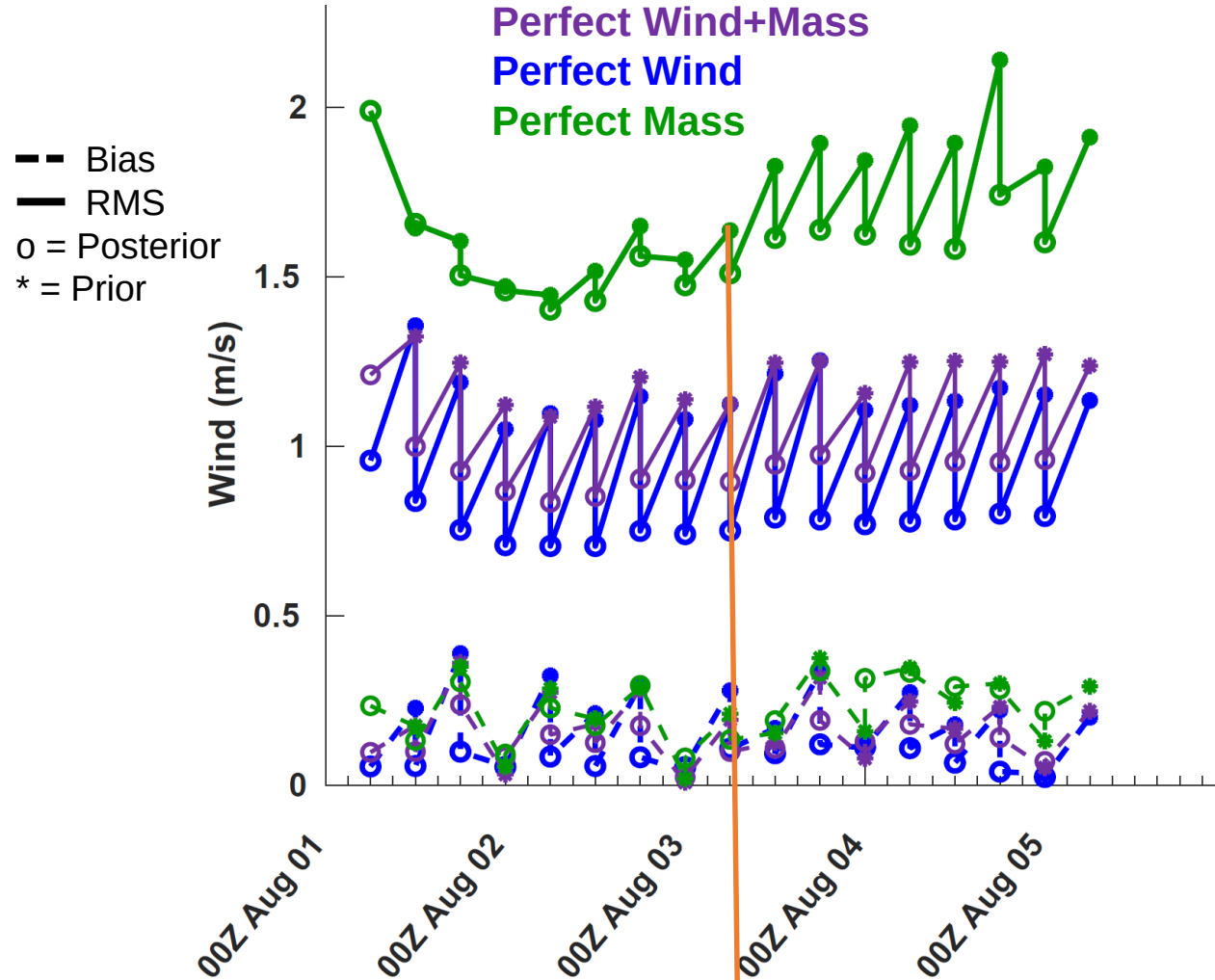


- 3 Experiment sets:
 - Perfect Winds, Temperature, and Moisture
 - Perfect Winds
 - Perfect Temperature and Moisture
- Observations from 27km Nature Run grid
- 16 cycles with 6 hour cycling interval
 - 06Z Aug 01 → 00Z Aug 05
- 5 day forecasts every 6 hours

The Upper Threshold



The Upper Threshold

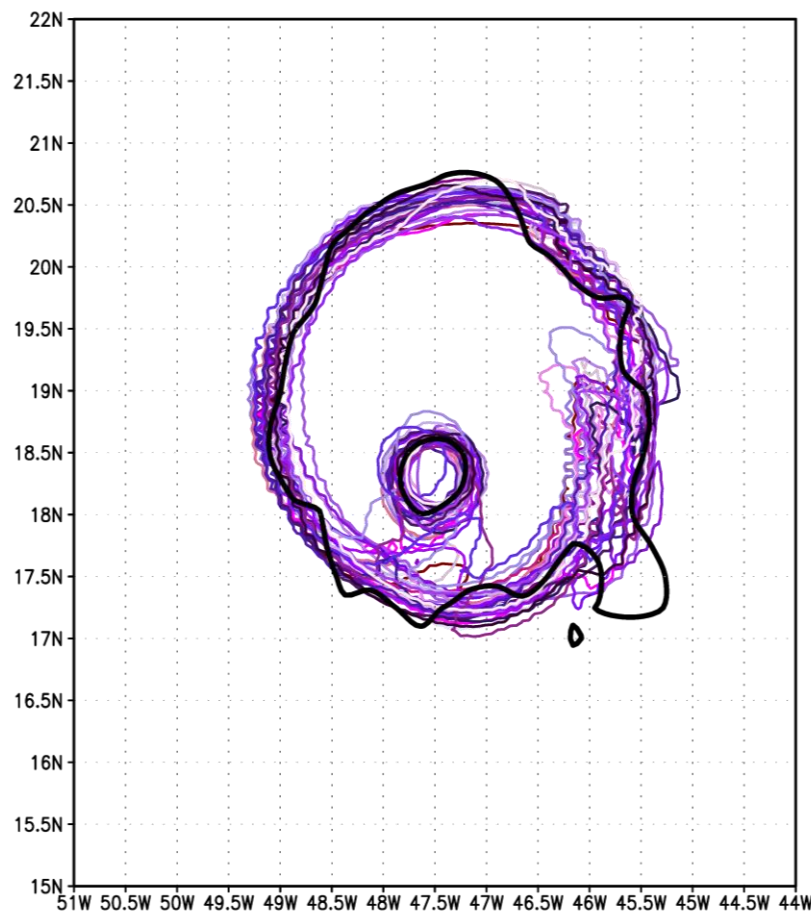


Onset of Rapid Intensification

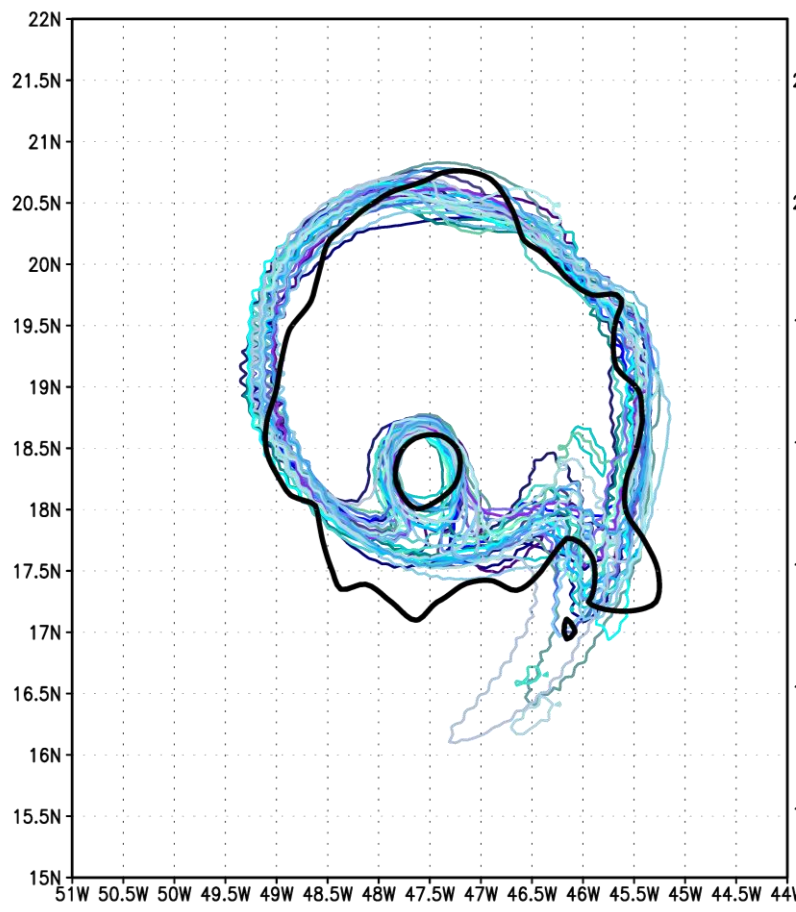


The Upper Threshold

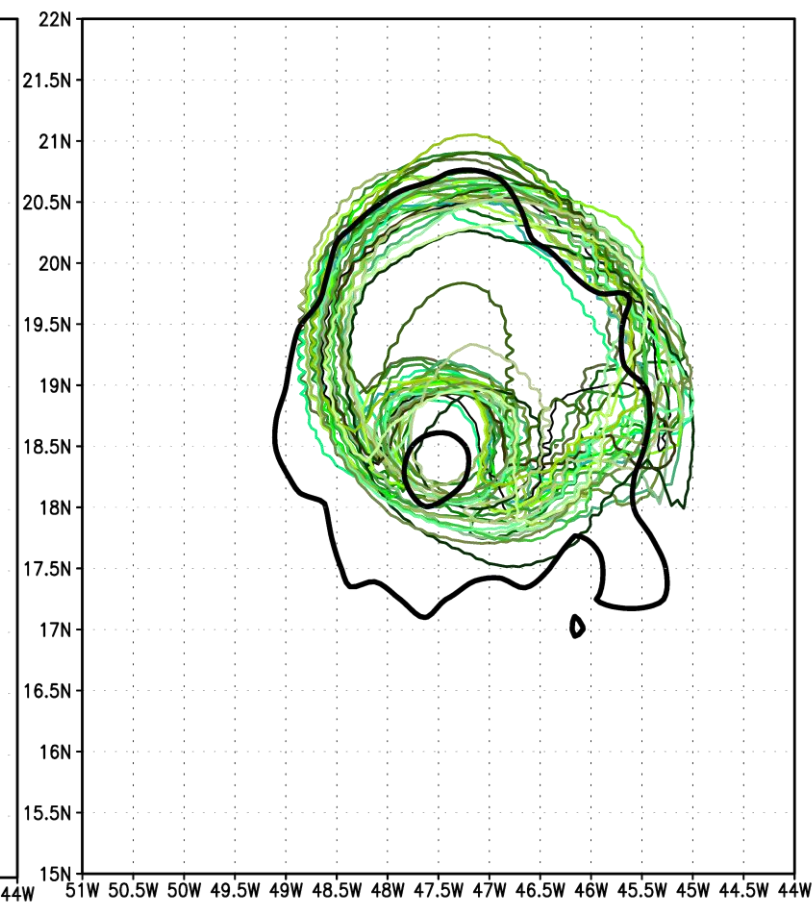
Perfect Winds & Mass



Perfect Winds



Perfect Mass

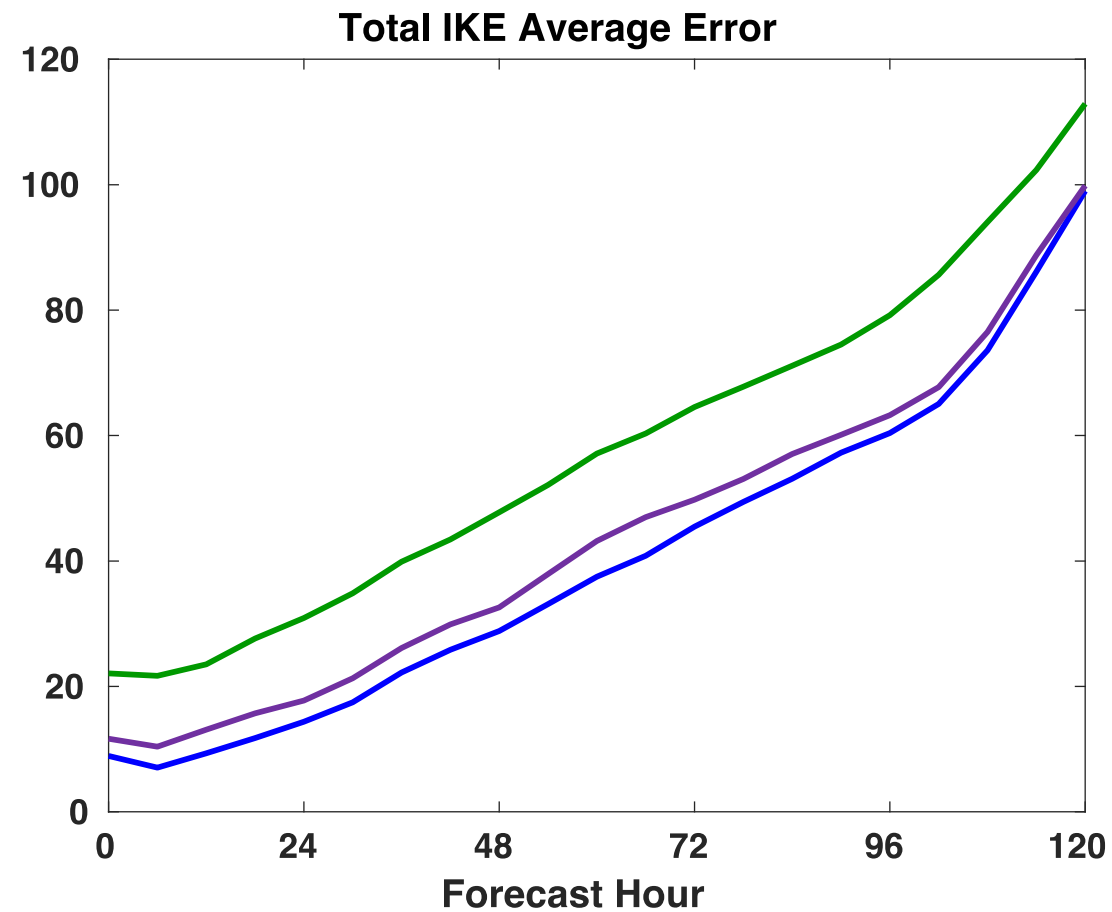
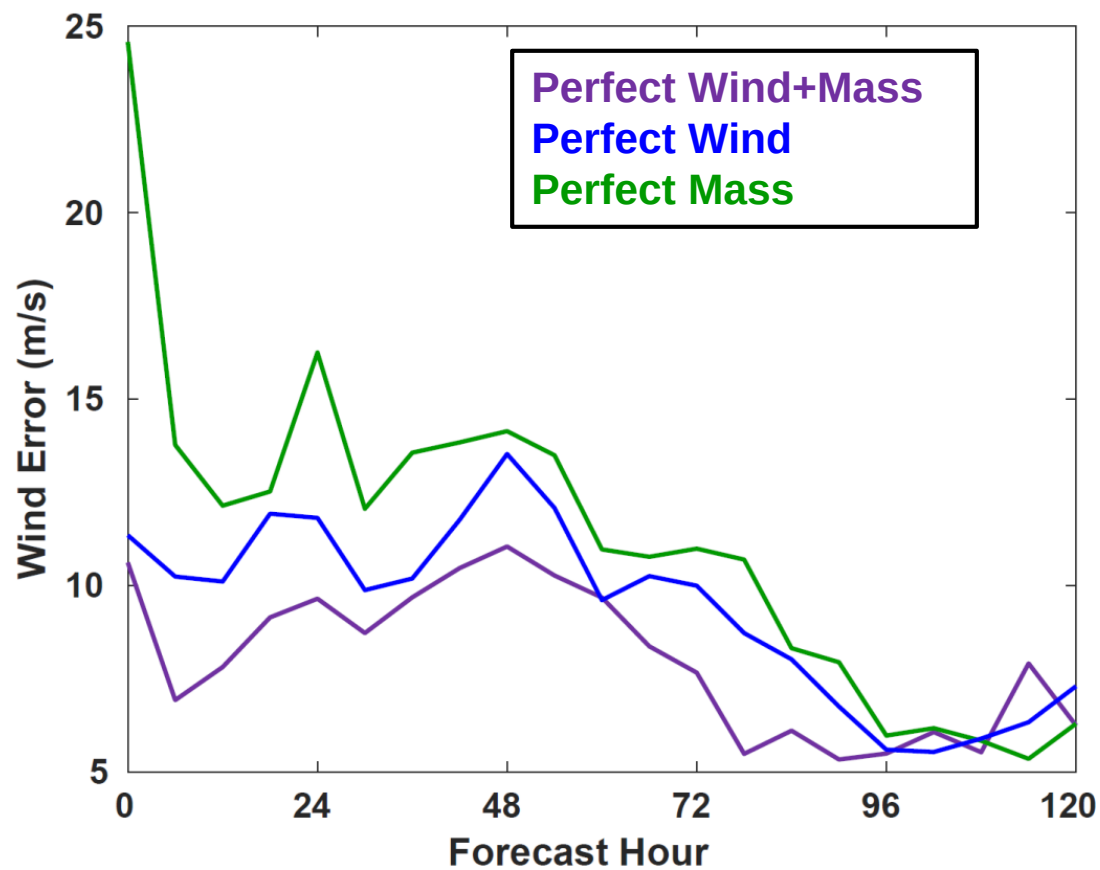


34-kt contour at 10m on 06 UTC Aug 3rd

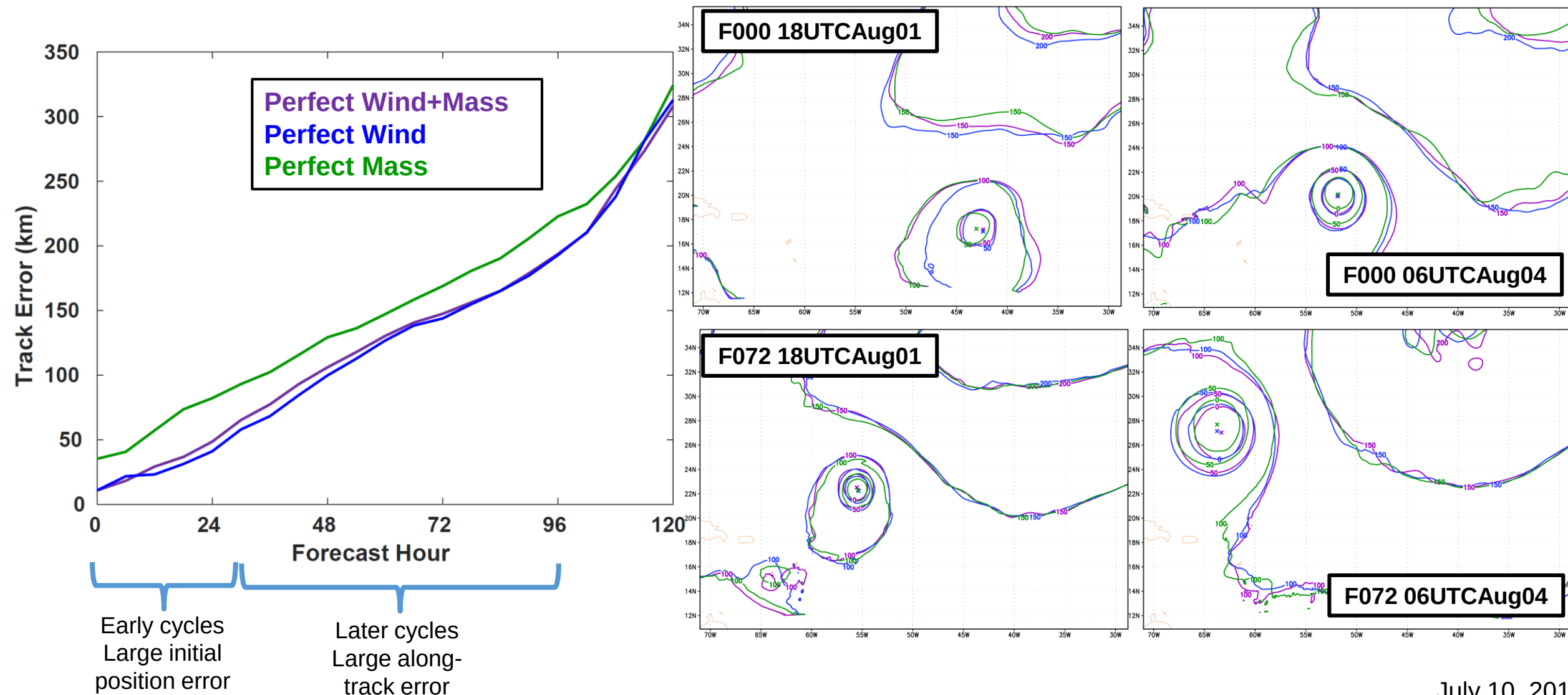
Color contours: 30-member posterior analyses Black contour: NR



The Upper Threshold

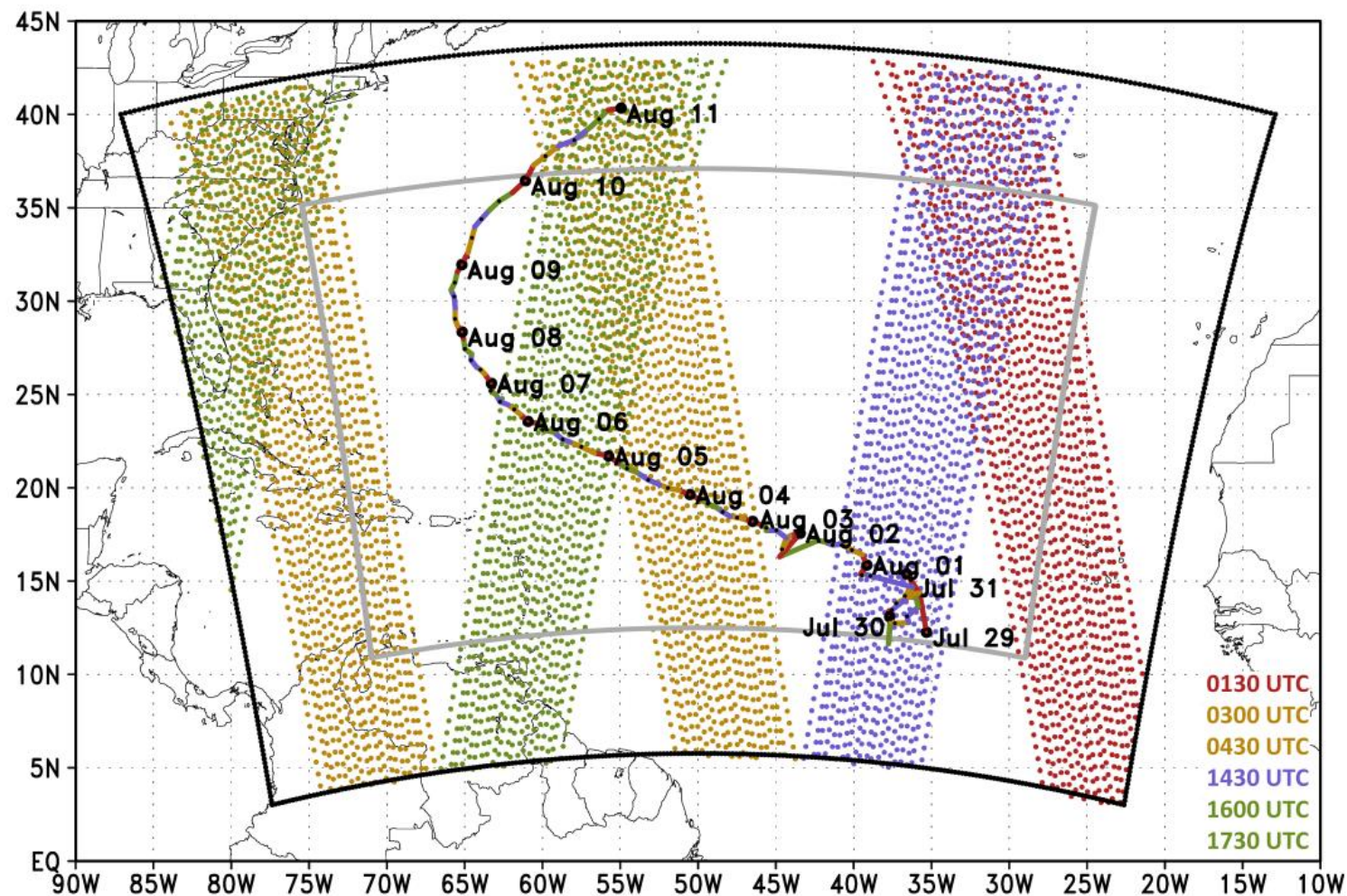


The Upper Threshold



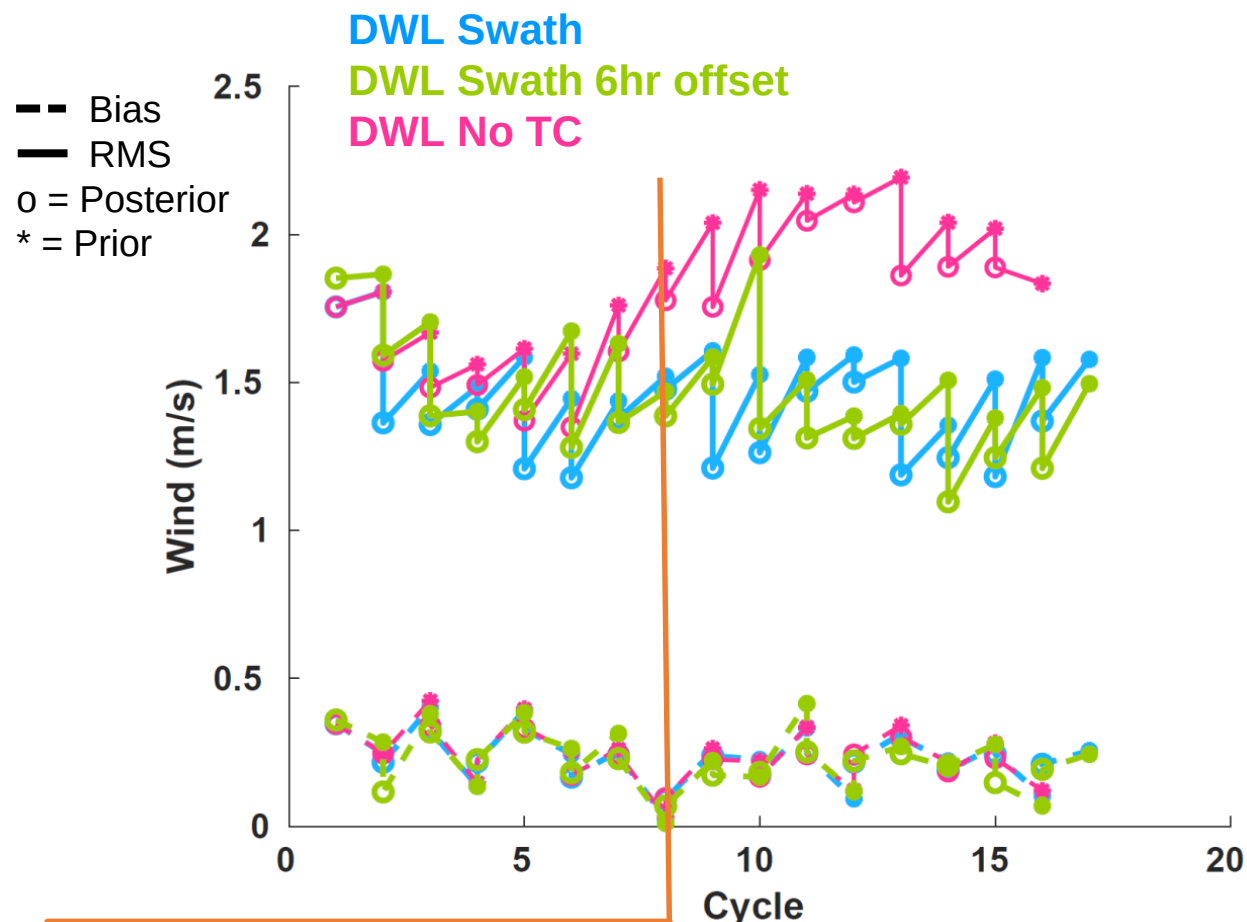
Idealized Space-Based Wind Profiles

- 3 Experiment sets:
 - Perfect Winds Profiles
 - Perfect Winds Offset by 6 hours
 - No Winds within 500 km of TC center
- Observations from 27km Nature Run grid
- 16 cycles with 6 hour cycling interval
 - 06Z Aug 01 → 00Z Aug 05
- 5 day forecasts every 6 hours

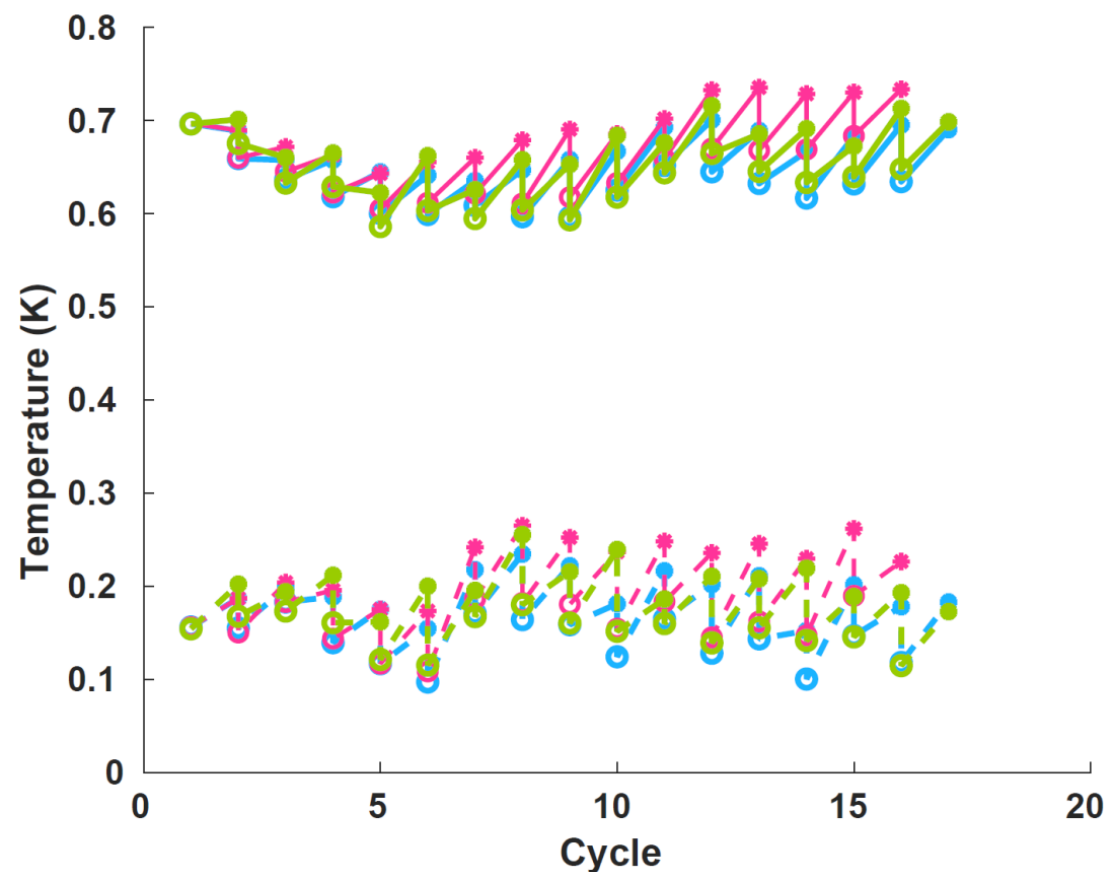


Wind Profile Horizontal Resolution ~70km; Vertical Resolution ~1km

Idealized Space-Based Wind Profiles

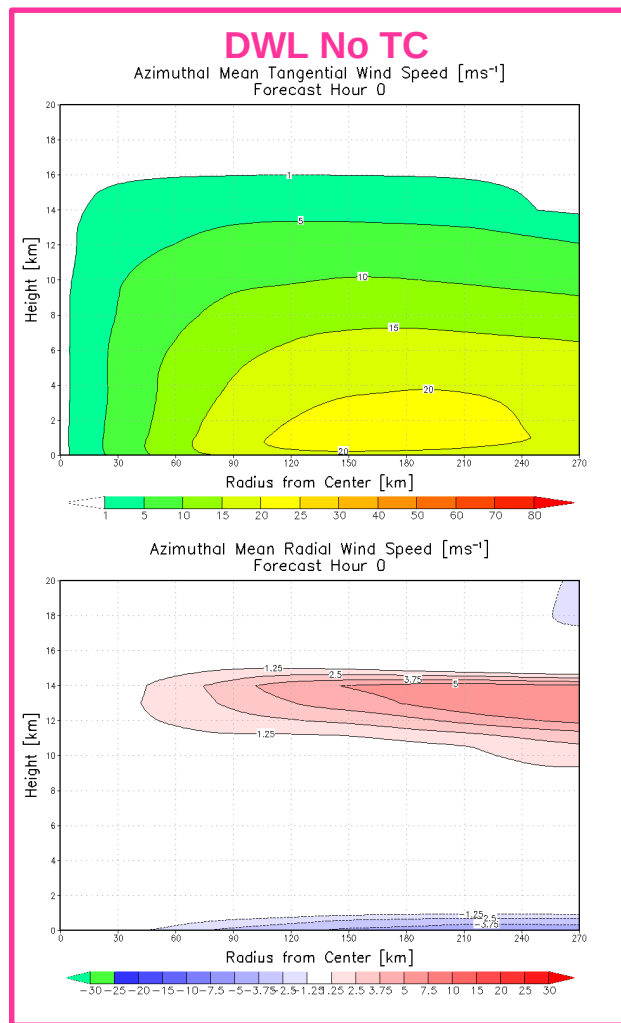
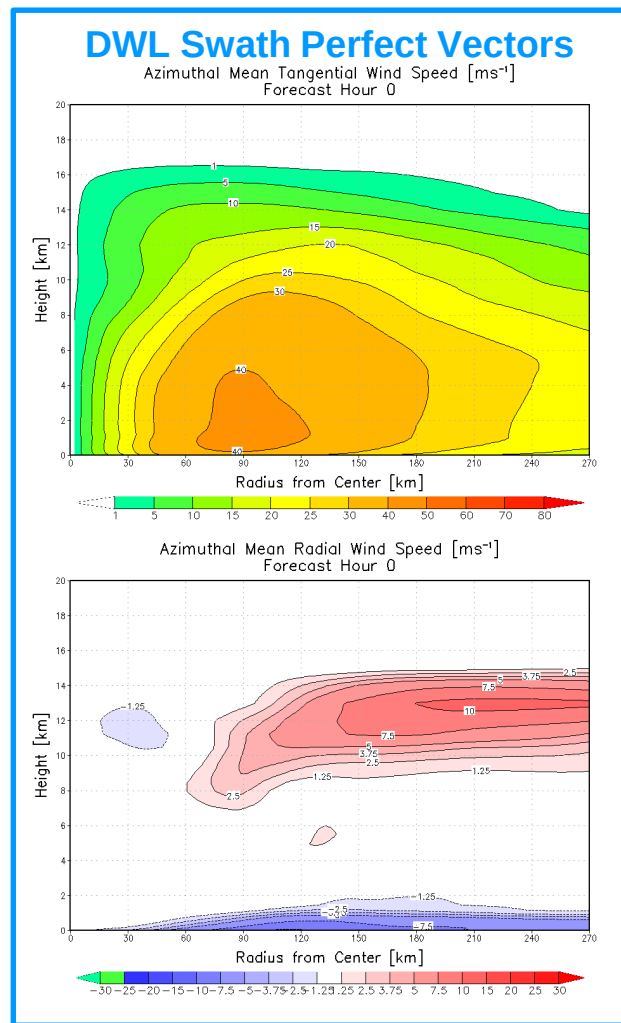


Onset of Rapid Intensification



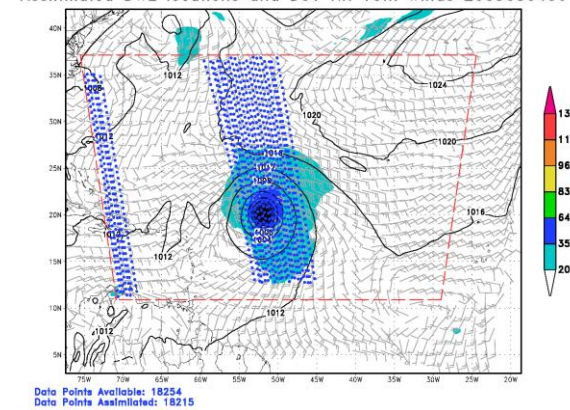
Idealized Space-Based Wind Profiles

Azimuthally averaged tangential & radial wind analysis from August 4th, 2005 at 06 UTC

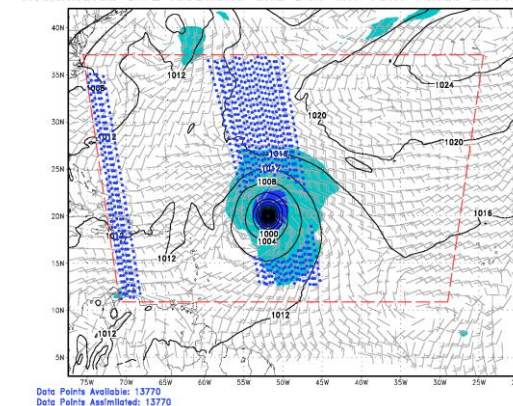


Observation Locations

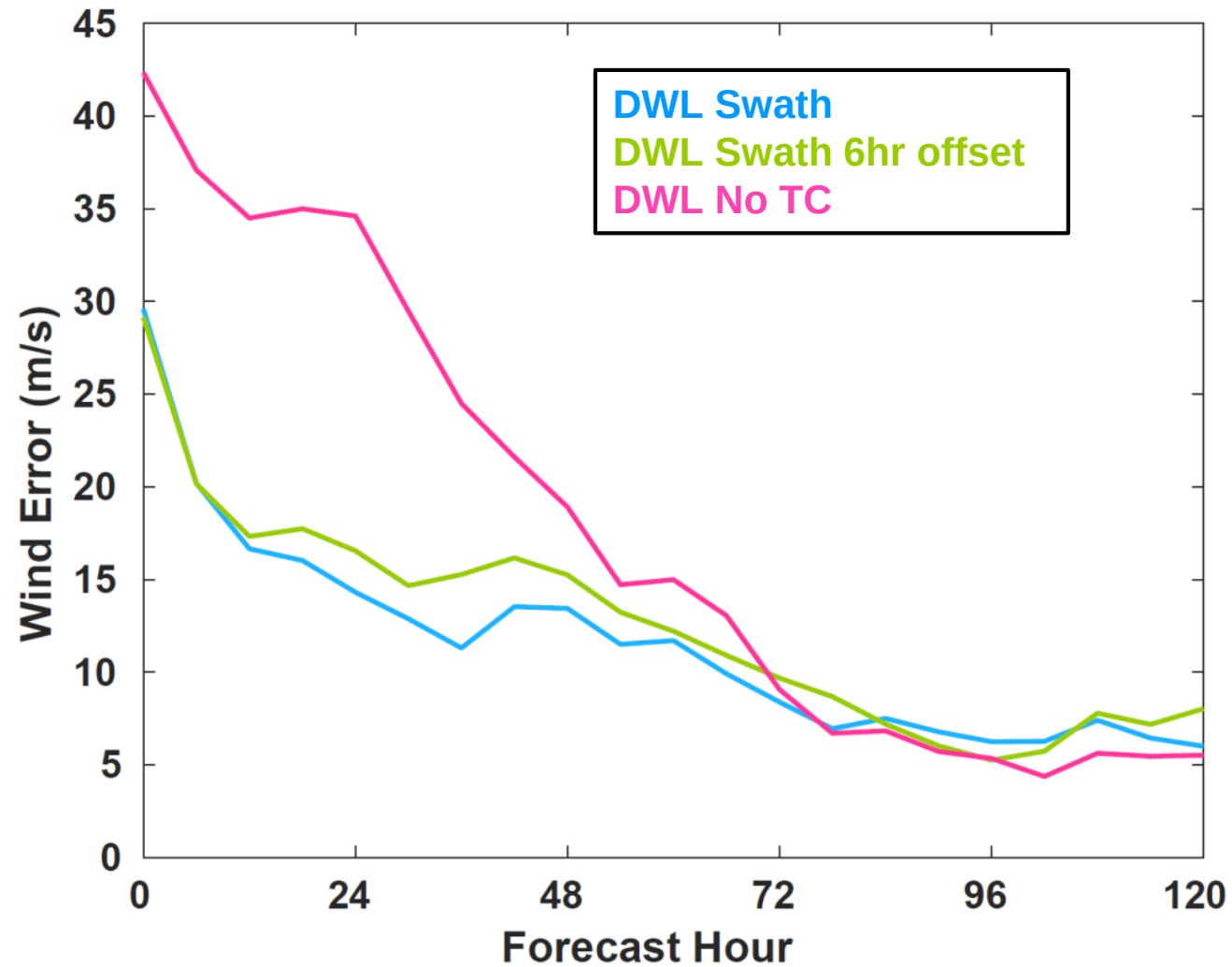
Assimilated DWL locations and D01 NR 10m winds 2005080406



Assimilated DWL locations and D01 NR 10m winds 2005080406



Idealized Space-Based Wind Profiles





Summary & Conclusions

- Combination of winds and mass observations provide the best forecast
 - Wind only observations still capture good structural analysis and produce comparable forecasts
 - Mass only observations fail to produce quality initial conditions
- Important to study metrics beyond verifying the maximum 10m wind
- Inner core observations are critical
 - Especially during rapid intensification of a TC



Future Steps

- Move towards more realistic DWL observations
 - Assimilate LOS instead of vectors
 - Remove observations due to cloud coverage
 - Reduce swath to single LOS
- Sensitivity of hurricane forecast to radius in which observations are removed
- Sensitivity of hurricane forecast to inner core only observations