



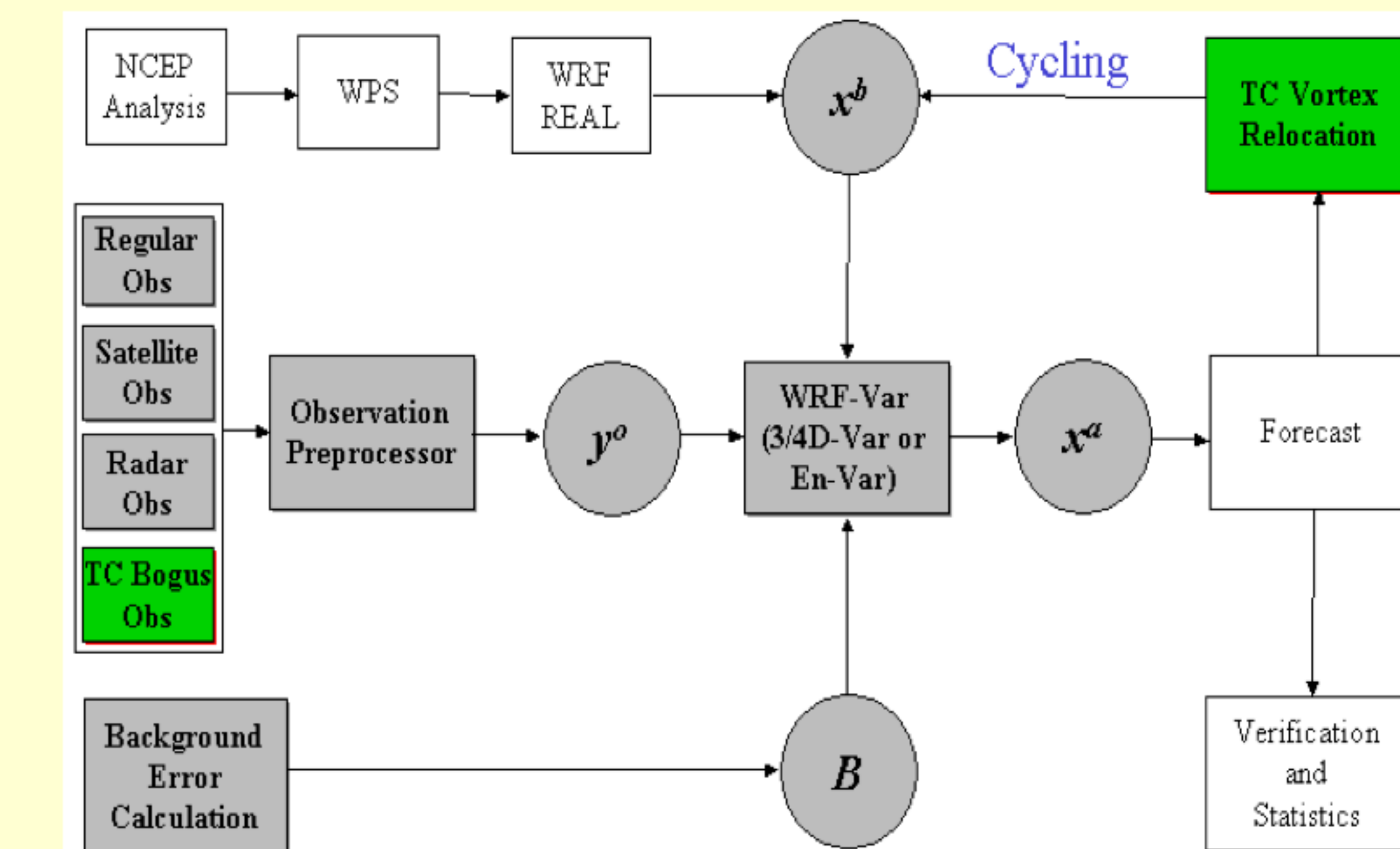
# A WRF Hurricane Initialization (WRF-HI) Scheme and Its Applications

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## Motivations

- WRF ARW improved track and intensity over official forecast beyond 36 h. However, its short-term forecasts (< 2 days) show a rather poor skill.
- An improved hurricane initialization using advanced data assimilation technique, can augment the skills of short-term forecasts for hurricanes.
- The development of WRF Hurricane Initialization (WRF-HI) scheme using WRF-Var will have a broad application for the WRF and WRF-Var community in research and real-time hurricane forecast.

## WRF-HI using WRF-Var



## Hurricane Dean (2007)

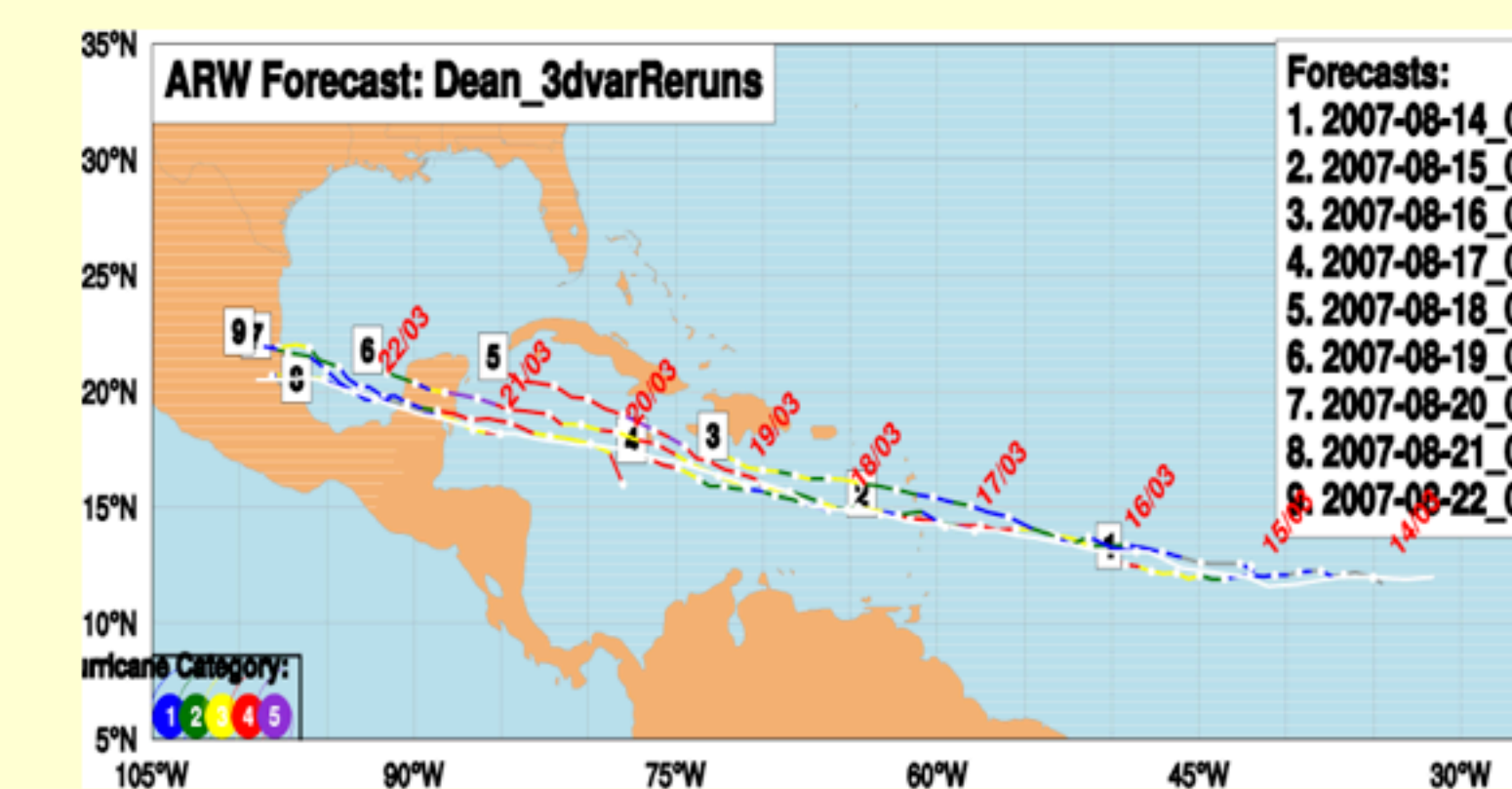
The general intensifying and decaying trend of the forecasts were predicted. The landfall time and location were predicted well. However, it over-predicted the intensity when Dean was weak, and under-predicted the intensity when Dean became strong.

## Implementations in 2007 Season

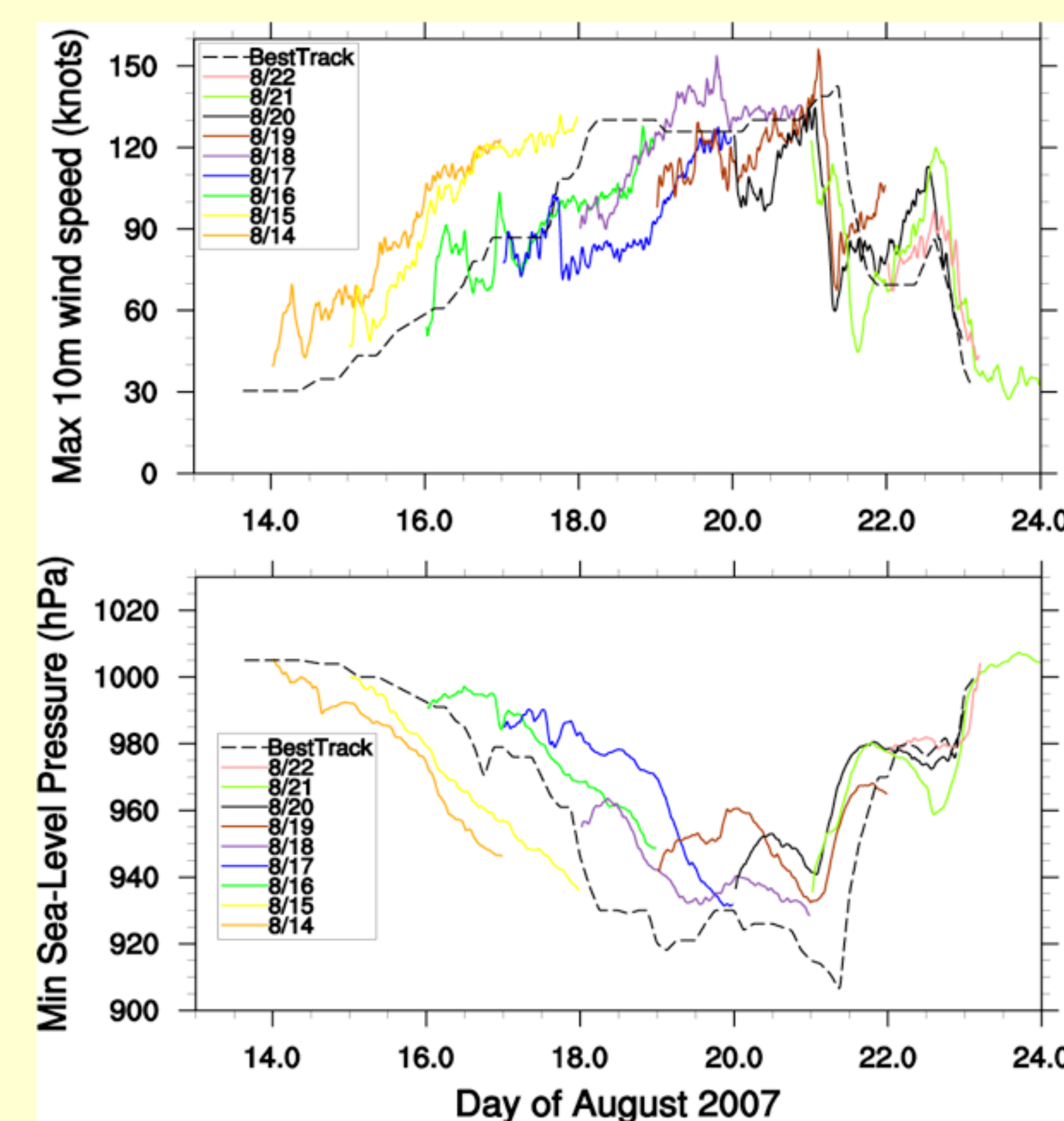
- Observations:** Synthetic vortex (CSLP and winds); All conventional data (TEMP, SYNOP, METAR, PILOT, AIREP, SHIPS, BUOY, etc.); Satellite retrievals (QUIKSCAT and GOES WINDS, GPS PW and Refractivity); Satellite radiances (AMSU-A and AMSU-B from NOAA-15, 16, and 17).

## Hurricane Humberto (2007)

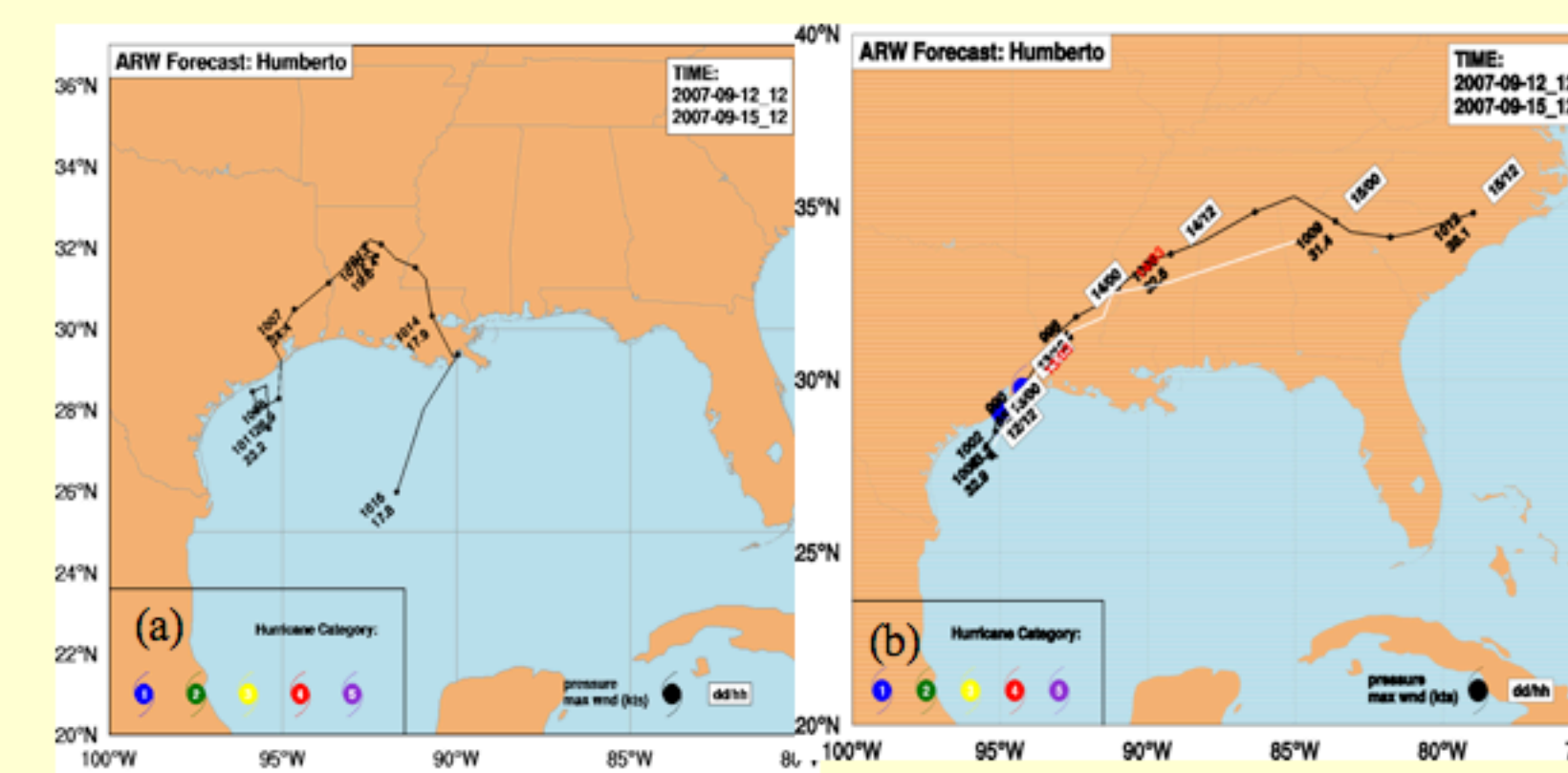
The intensification from tropical storm to Category-I hurricane just before landfall was predicted better than using the GFDL initialization. The trend of weakening after landfall was predicted. However, it over-predicted Humberto's strength inland.



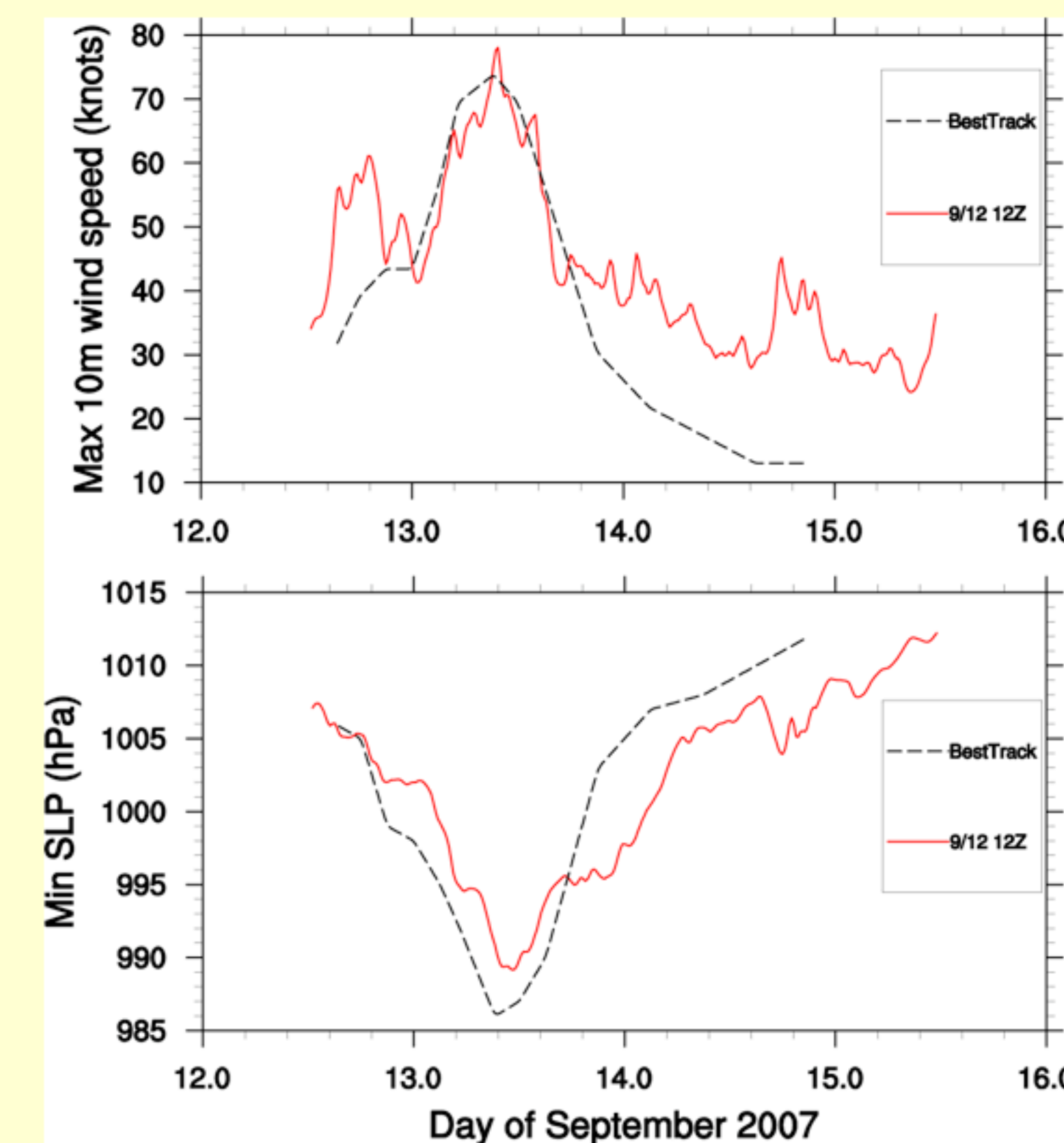
3-day forecasts of track for Hurricane Dean (2007) at 0000 UTC daily



3-day forecasts of intensity for Hurricane Dean (2007) at 0000 UTC daily



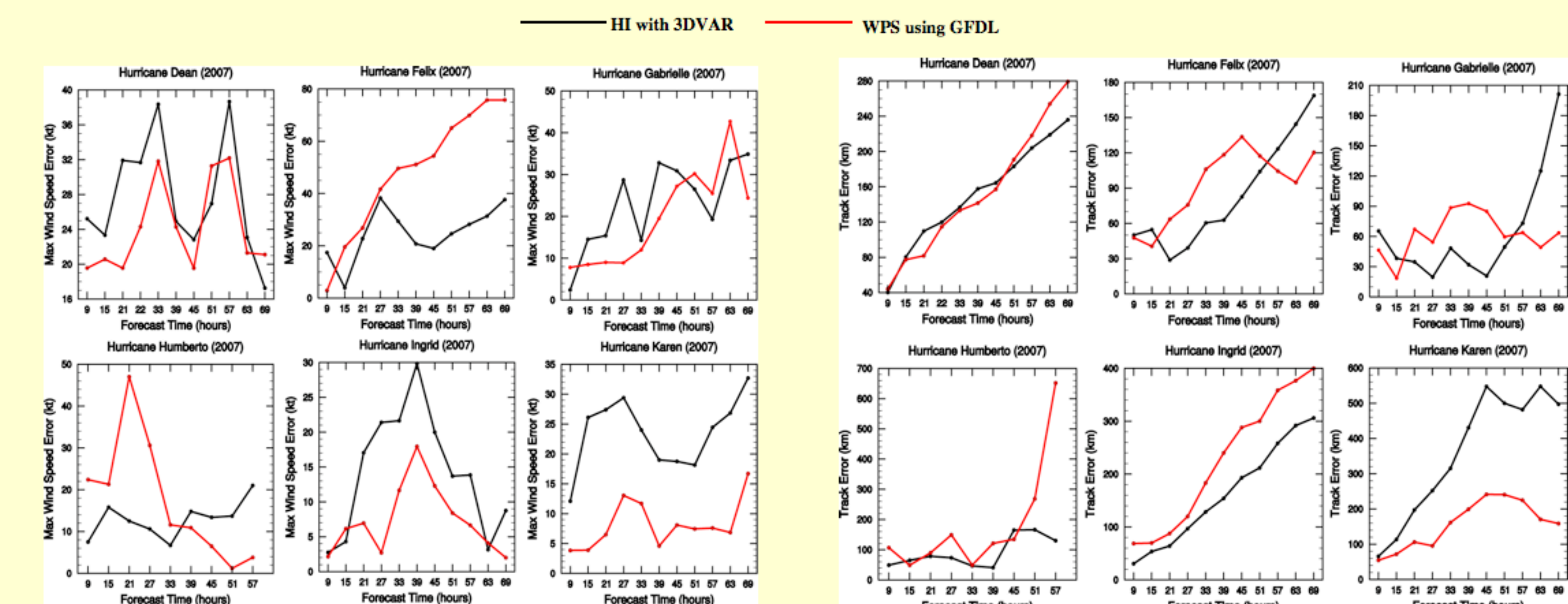
3-day forecast of track for Humberto at 1200 UTC 12 September 2007 with a) WPS of GFDL, and b) WRF-HI using 3D-Var. The white line in (b) is the best track till 2100 UTC 14 September 2007



3-day forecast of Intensity for Humberto with WRF-HI at 1200 UTC 12 September 2007

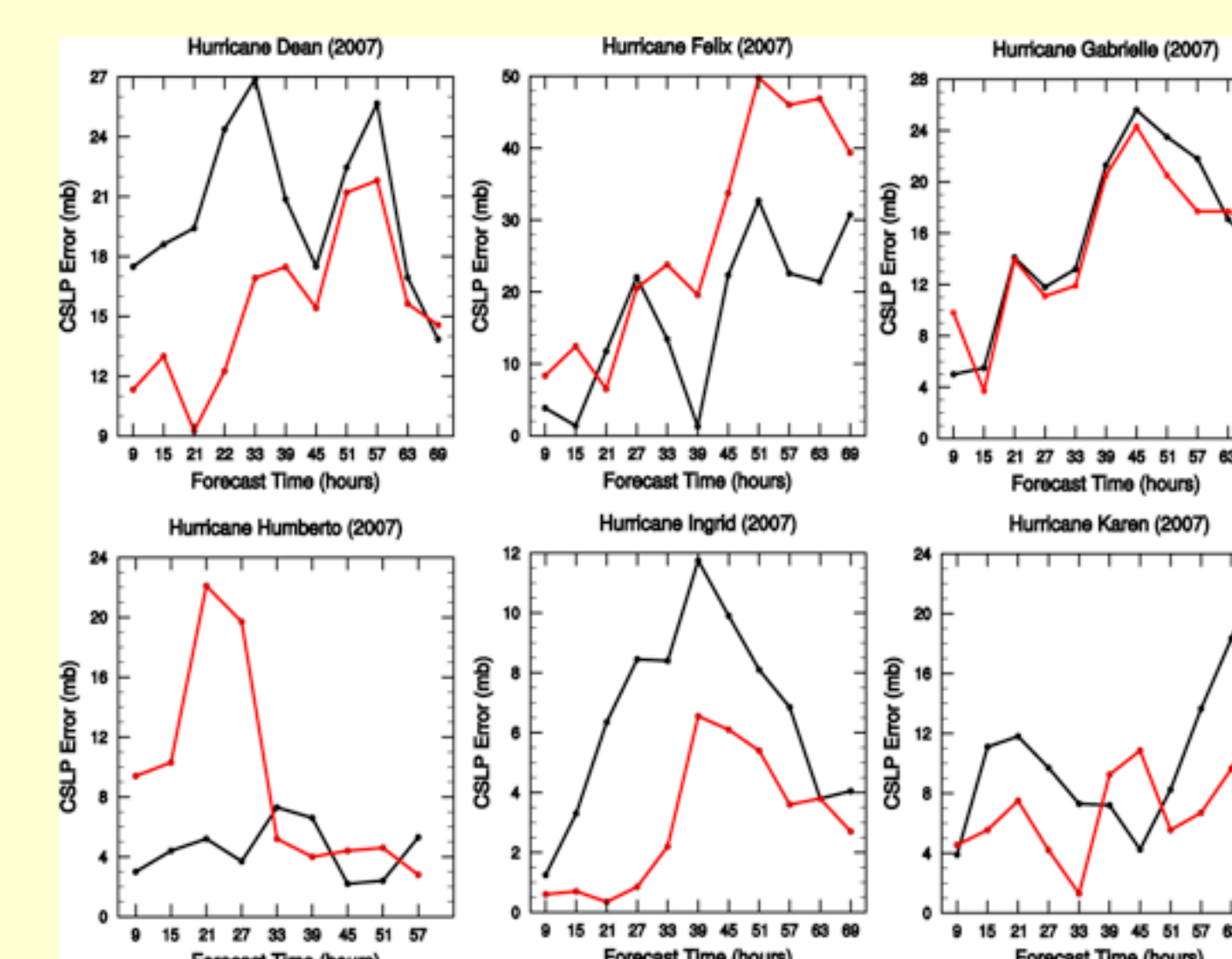
- Model:** WRF V2.2 with 3 domains, 2-way moving nest of Domains 2 and 3, 35 vertical layers, and grid-spacing of 12, 4, and 1.33km. Physics package includes WSM5 microphysics, YSU PBL, Kain-Fritsch cumulus for Domain 1, coupled 1D ocean mixed layer model.

## Verifications

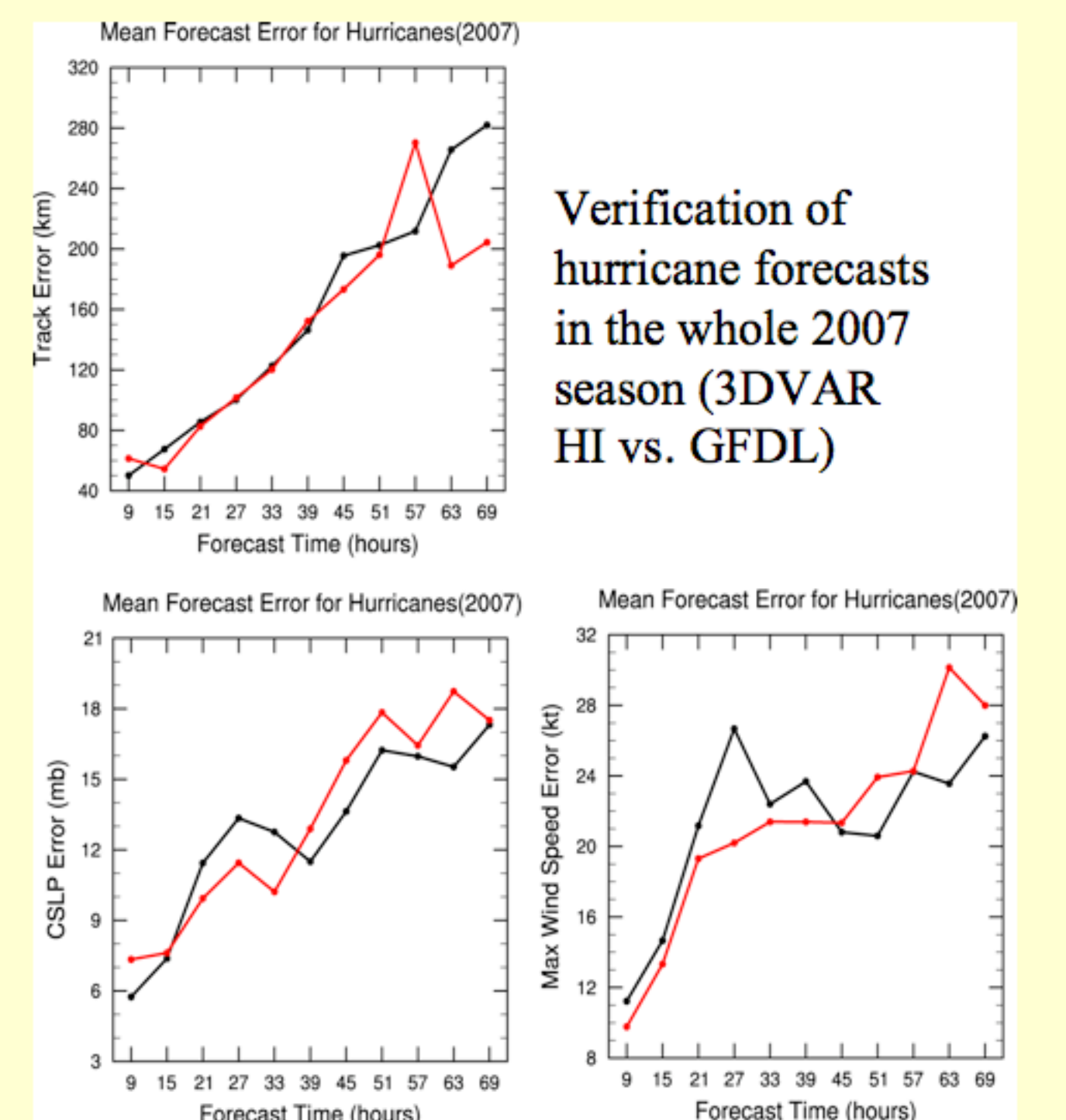


Maximum wind speed verification of selected hurricane forecasts in 2007 (3DVAR HI vs. GFDL)

Track verification of selected hurricane forecasts in 2007 (3DVAR HI vs. GFDL)



Central Sea Level Pressure (CSLP) verification of selected hurricanes forecasts in 2007 (3DVAR HI vs. GFDL)



## Conclusions:

- The WRF Hurricane Initialization (WRF-HI) using 3/4D-Var can assimilate all available observations (in-situ and remote-sensing) and BDA.
- Case studies demonstrated positive impact of the hurricane initialization scheme (WRF-HI) on the subsequent hurricane forecasts (track and intensity).

- Statistics from 21 cases in 2004 and 2005 hurricane seasons indicated that hurricane track and intensity forecasts were improved from the forecasts using the GFS-interpolated initial conditions.
- The WRF-HI was implemented in real time runs in the 2007 hurricane season. It ran smoothly and robustly. The results are comparable with the runs from GFDL-interpolated initial conditions.

