HWRF Satellite Data Experiments

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Outline

- Stream 2.0 Demo Experiments
  - Configuration I (Rea-time and retrospective runs; HDA0)
  - Configuration II (Retrospective runs; HDA1)
- Verification
- Summary and Future Work

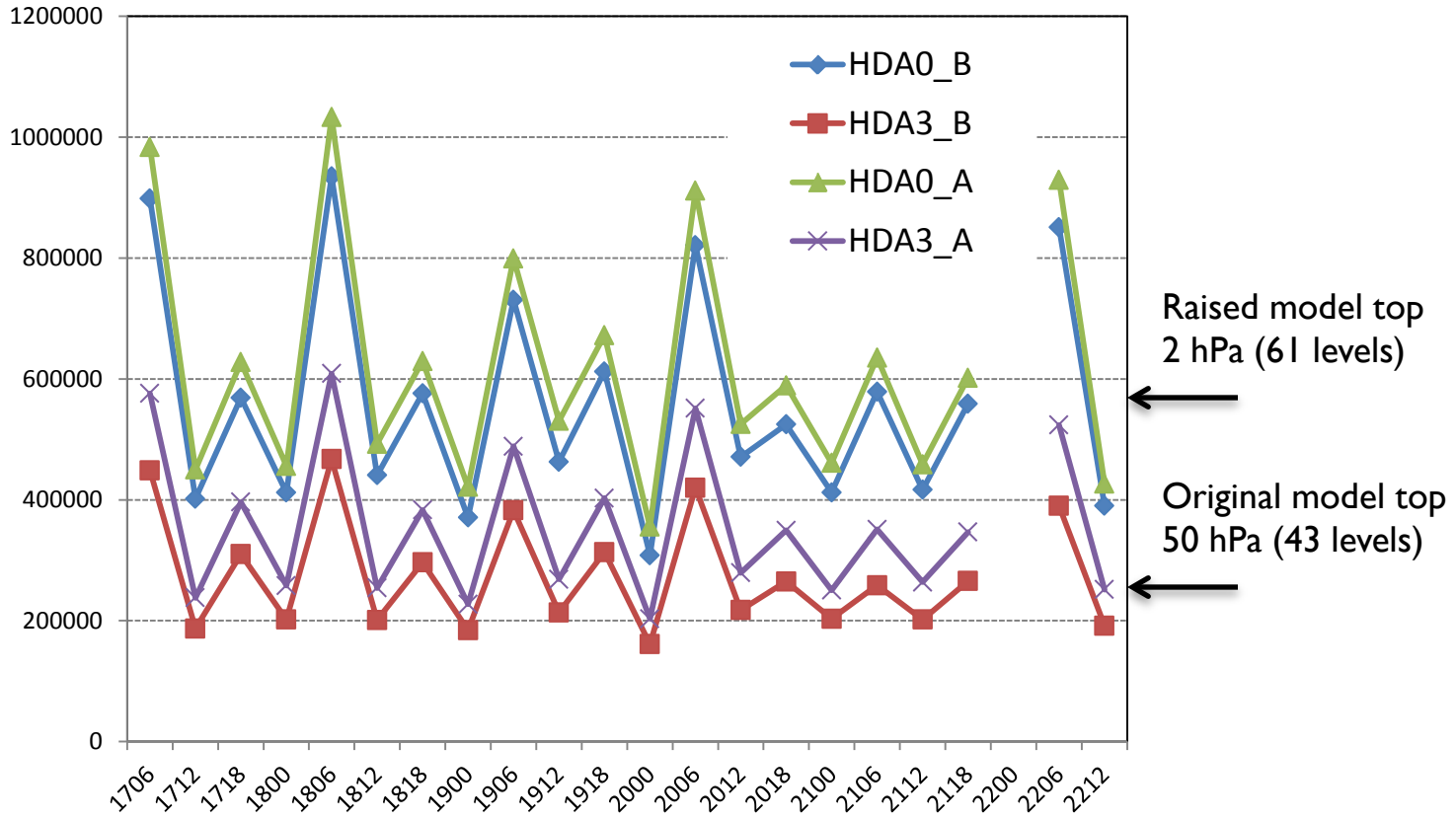
Stream 2.0 Experiment Configuration I

- HWRF Model:
  - Model top raised from 50 hPa to 2hPa
  - Model level increased from 43 levels to 61 levels
- GSI Analysis: (for both D_1 and ghost domains)
  - First Guess at Appropriate Time (FGAT)
  - GFS-HWRF blended vertical coordinate (76 levels)
  - Radiance bias correction estimation from global analysis
  - GFS ozone profiles
  - Satellite thinning box: 90 km for IR instruments and 45 km for MW instruments
- Data assimilated: (in both D_1 and ghost domains)
  - Conventional data and TDR
  - Bending angle from GPS Radio Occultation (GSPRO)
  - Calibrated brightness temperature from IR instruments (HIRS, AIRS, IASI, GOES Sounder)
  - Calibrated brightness temperature from MW instruments (AMSU-A, MHS, ATMS)
  - Satellite derived wind (IR/VIS cloud drift winds, water vapor winds)

Stream 2.0 Experiment Configuration II

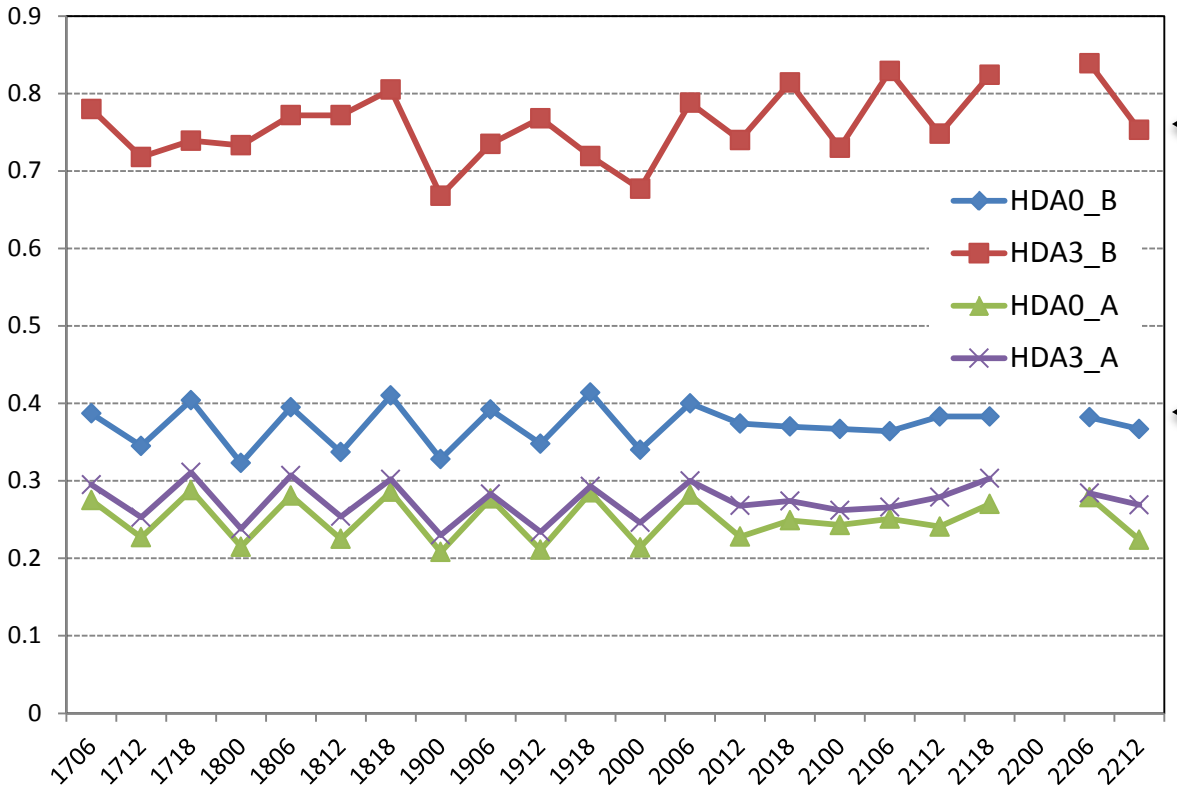
- HWRF Model:
  - Model top raised from 50 hPa to 0.5 hPa
  - Model level increased from 43 levels to 61 levels
- GSI Analysis: (for both D_1 and ghost domains)
  - No First Guess at Appropriate Time (FGAT)
  - No GFS-HWRF blended vertical coordinate (61 levels)
  - Radiance bias correction estimation from global analysis
  - GFS ozone profiles
  - Satellite thinning box: 90 km for IR instruments and 45 km for MW instruments
- Data assimilated: (in both D_1 and ghost domains)
  - Conventional data and TDR
  - Bending angle from GPS Radio Occultation (GSPRO)
  - Calibrated brightness temperature from IR instruments (HIRS, AIRS, IASI, GOES Sounder)
  - Calibrated brightness temperature from MW instruments (AMSU-A, MHS, ATMS)
  - Satellite derived wind (IR/VIS cloud drift winds, water vapor winds)

Benefit of the raised HWRF model top for GSI analysis



- Total satellite observations used by HDA0 and HDA3 before and after analysis

Normalized Cost Function J_o of HDA0 and HDA3 before and after analysis



Original model top
50 hPa (43 levels)

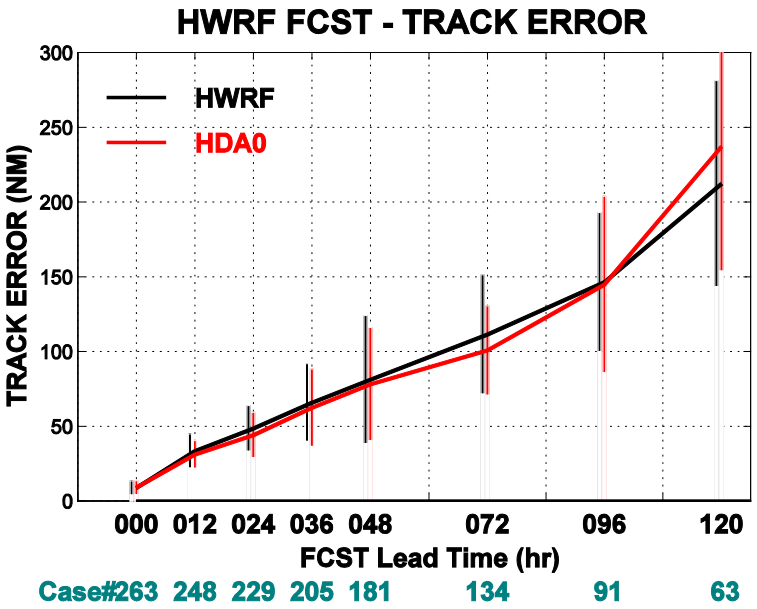
Raised model top
2 hPa (61 levels)

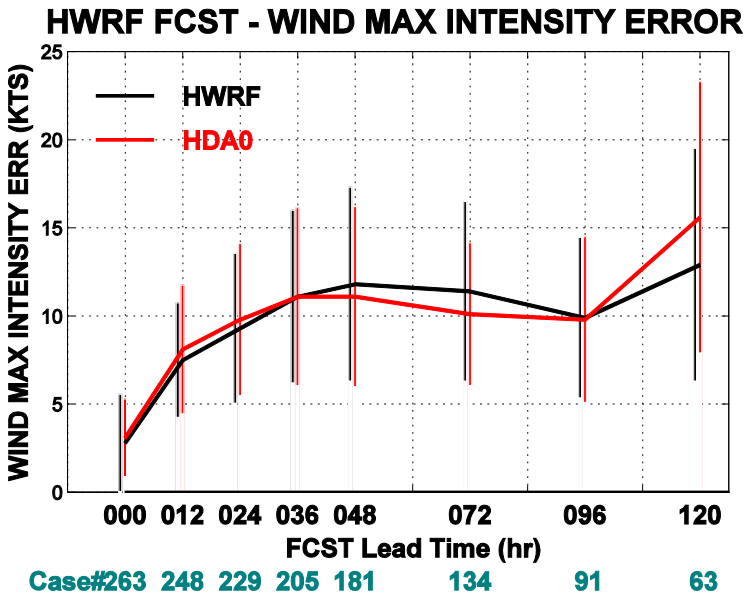
2013 Storms Completed in Stream 2.0 Runs

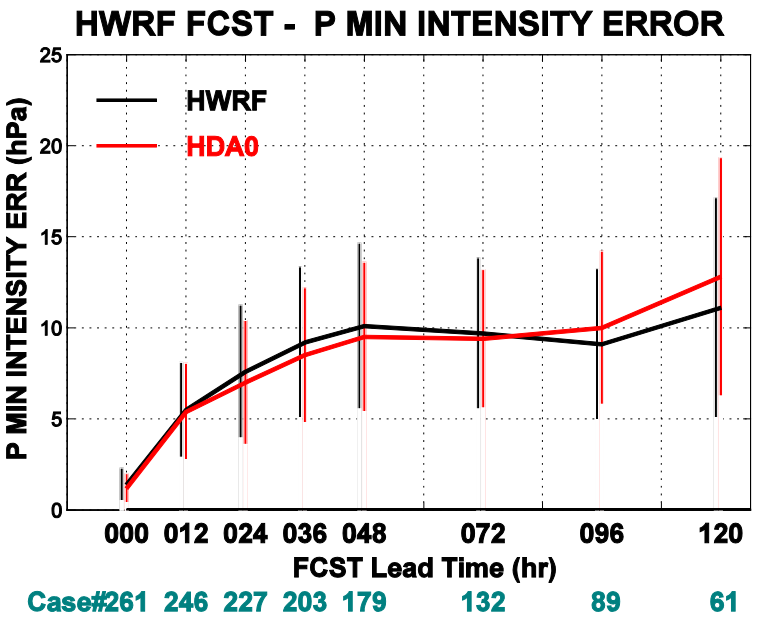
North Atlantic Basin		Eastern Pacific Basin		Western Pacific Basin	
01L	Andrea	04E	Dalila*	07W	Soulik
04L	Dorian**	05E	Erick	11W	Utor
05L	Erin	07E	Gil**	12W	Trami
07L	Gabriell*	08E	Henriette	14W	Kong-rey
		09E	Ivo	15W	Toraji

- Total 263 cycles completed for HDA0 (* storm not completed yet)
- Total 180 cycles completed for HDA1 (* storm not completed yet)

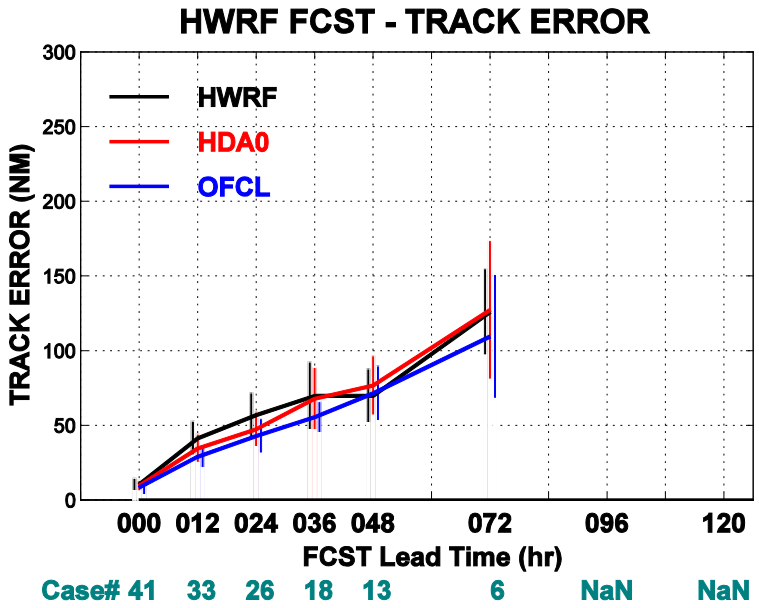
Verification for HDA0 - All basins combined

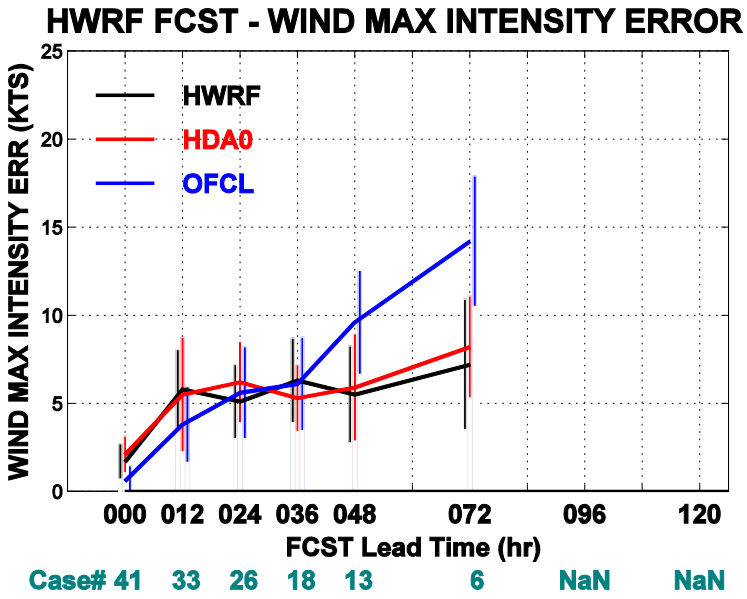


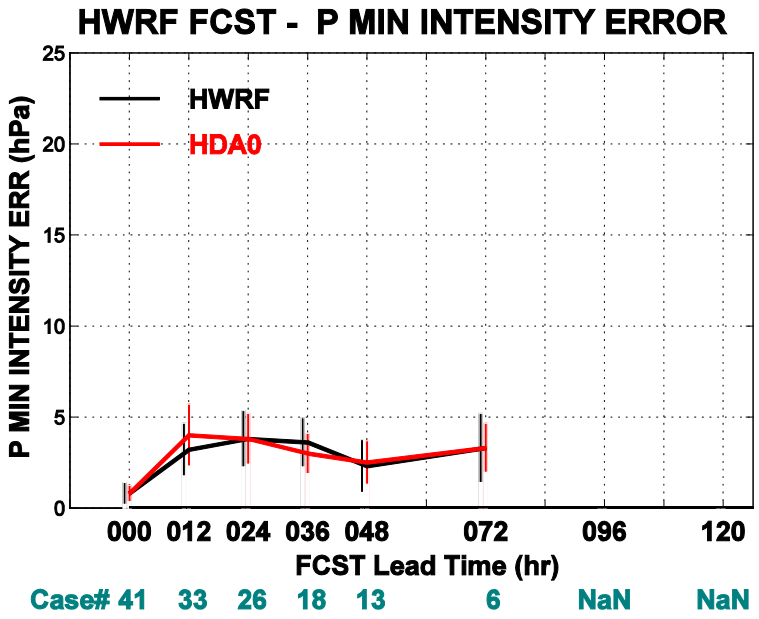




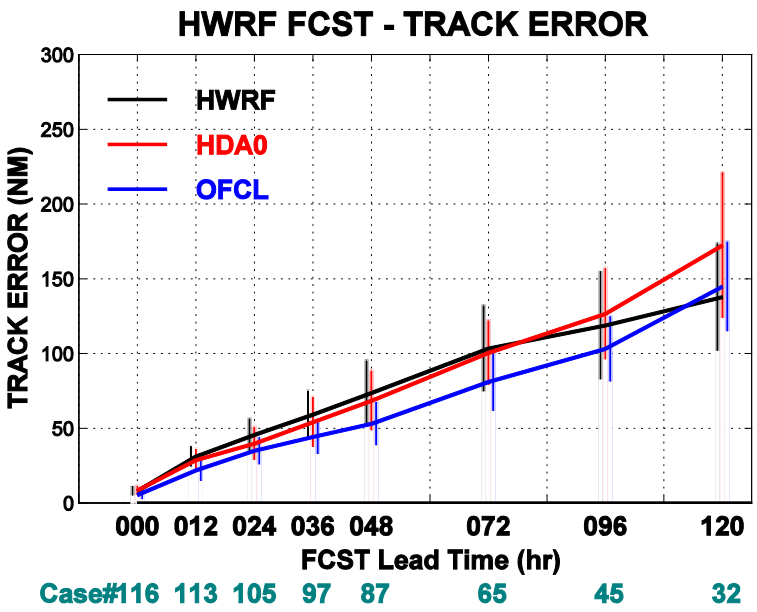
Verification – Atlantic Basin

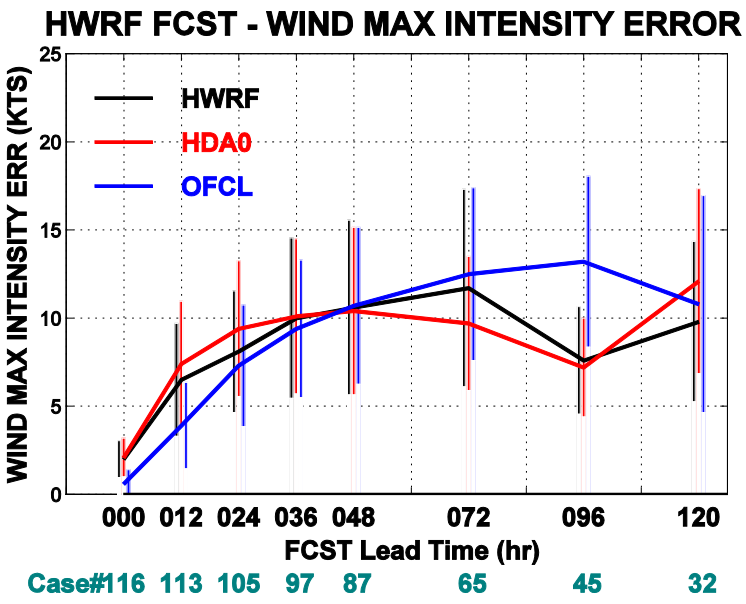


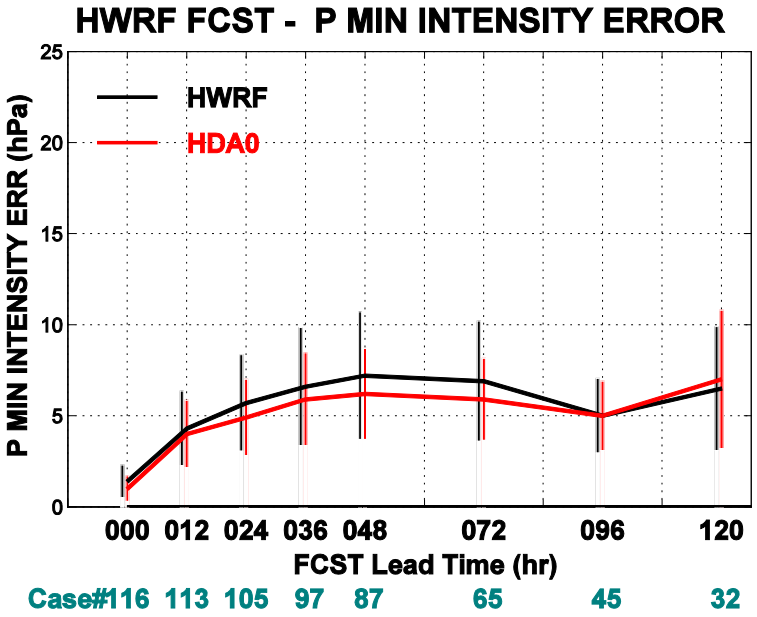




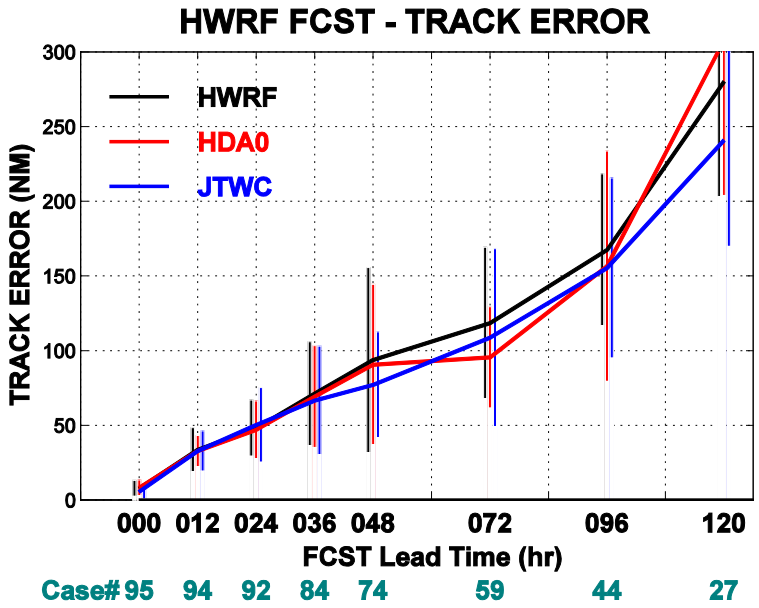
Verification - Eastern Pacific Basin

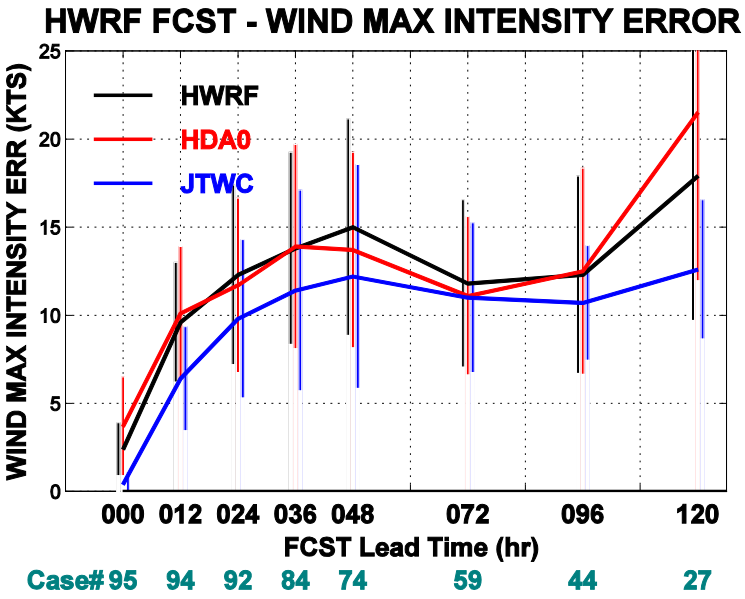


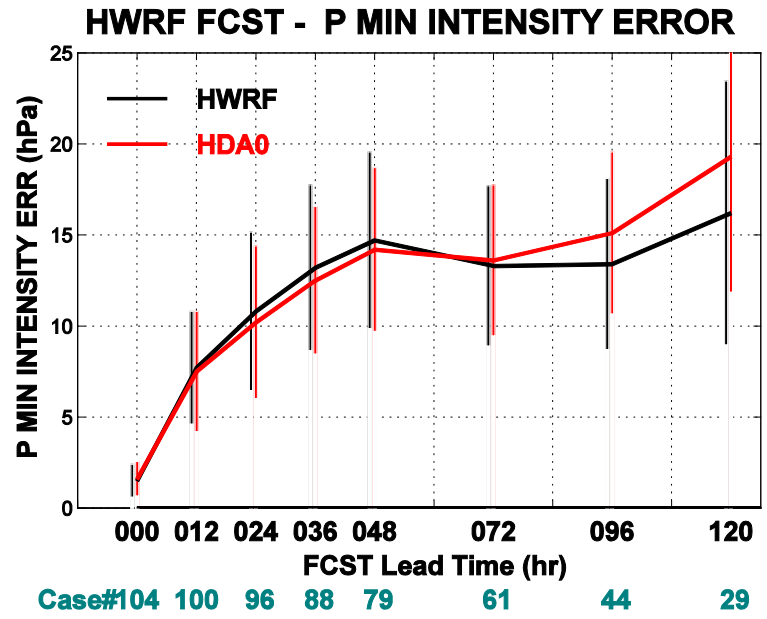




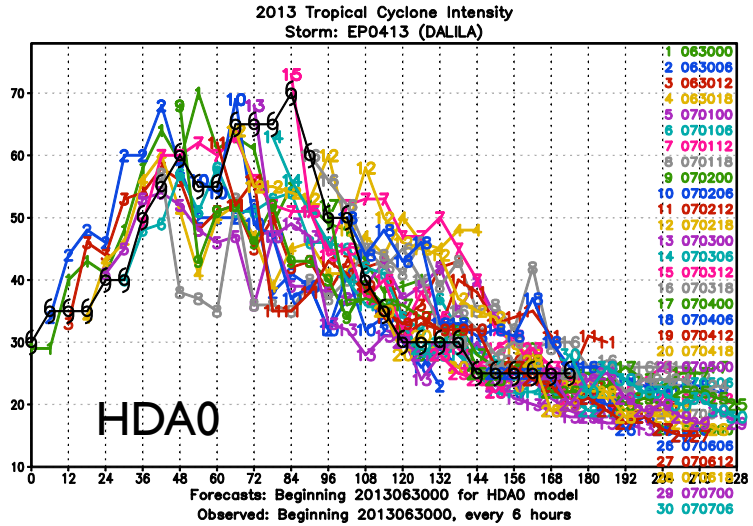
Verification - Western Pacific Basin

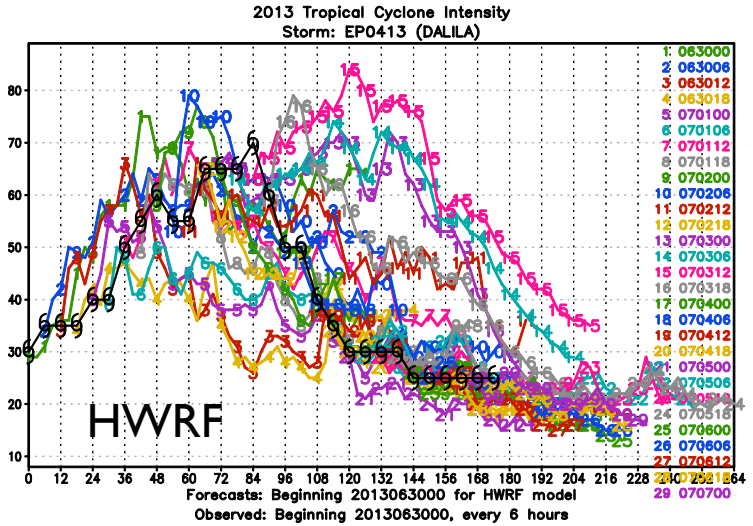


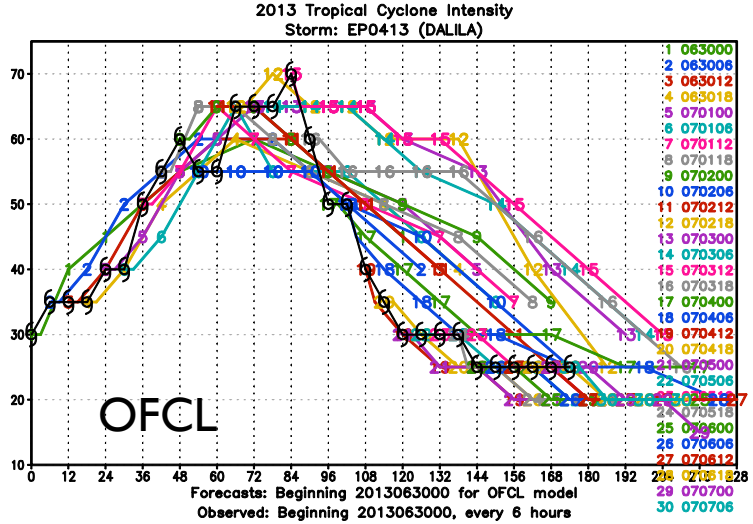


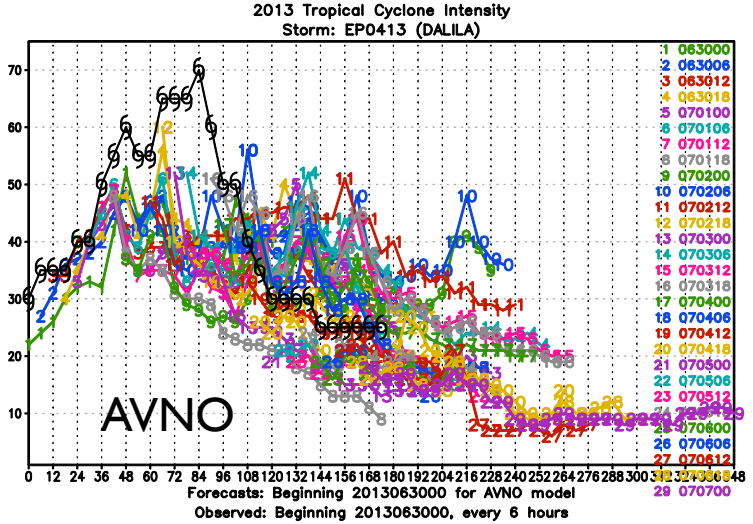


Vmax Forecasts of Tropical Storm Dalila









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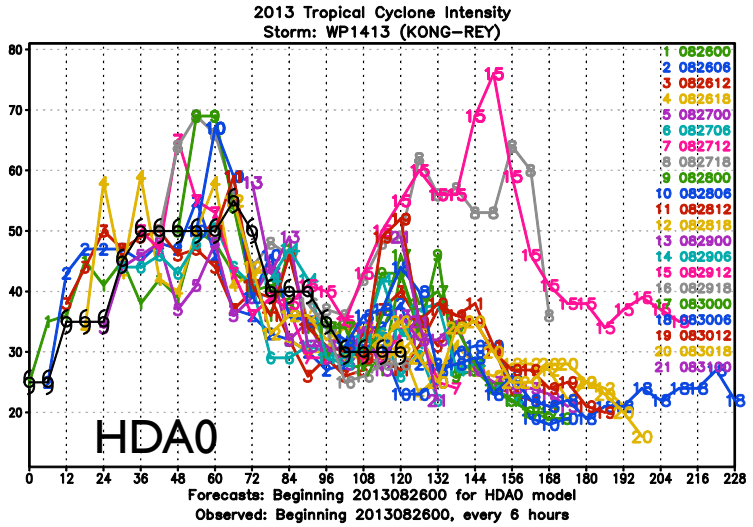
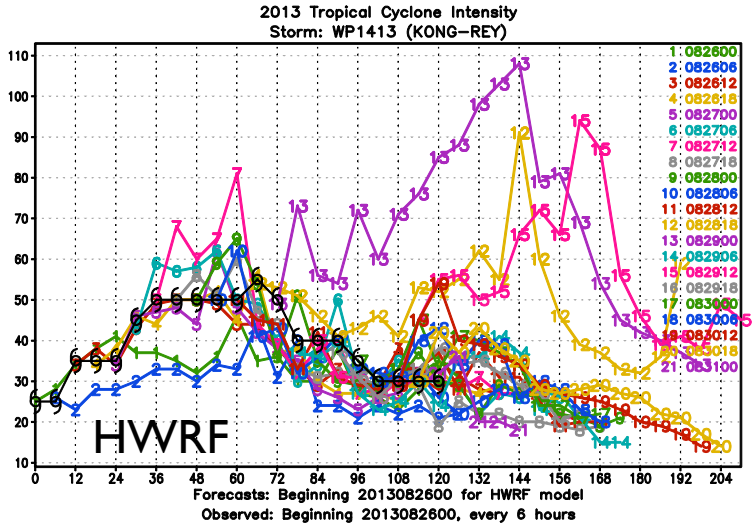
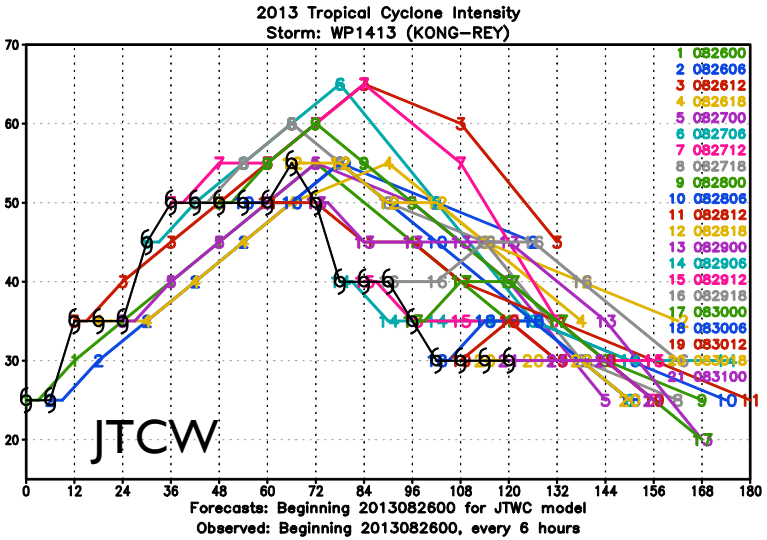
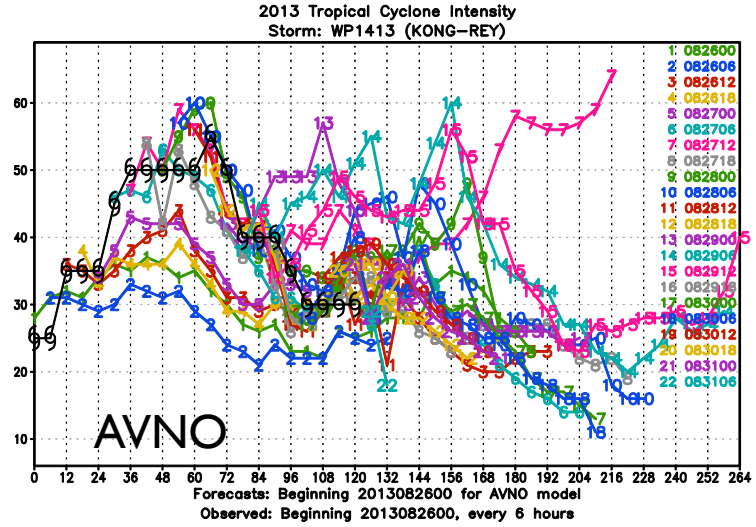
Vmax Forecasts of Tropical Storm Kong-rey









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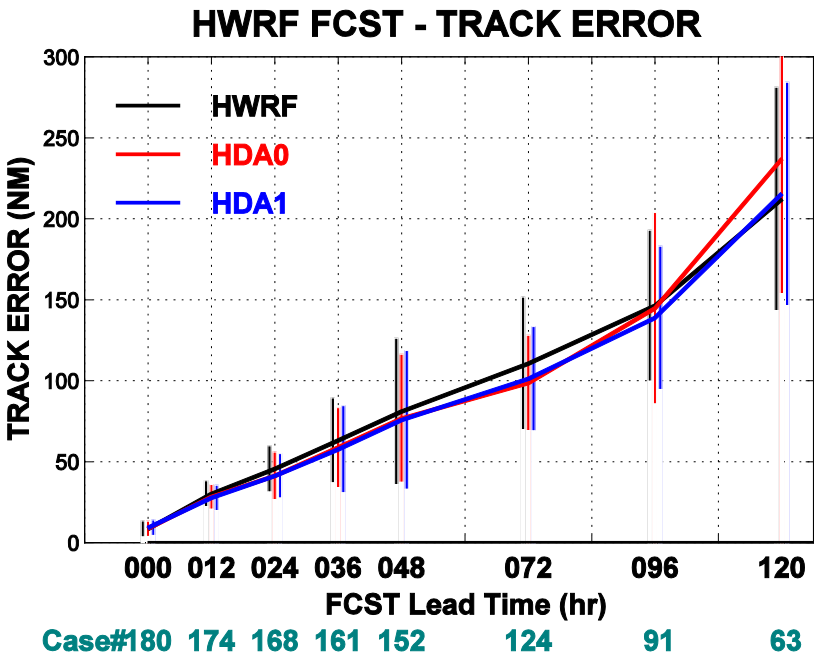
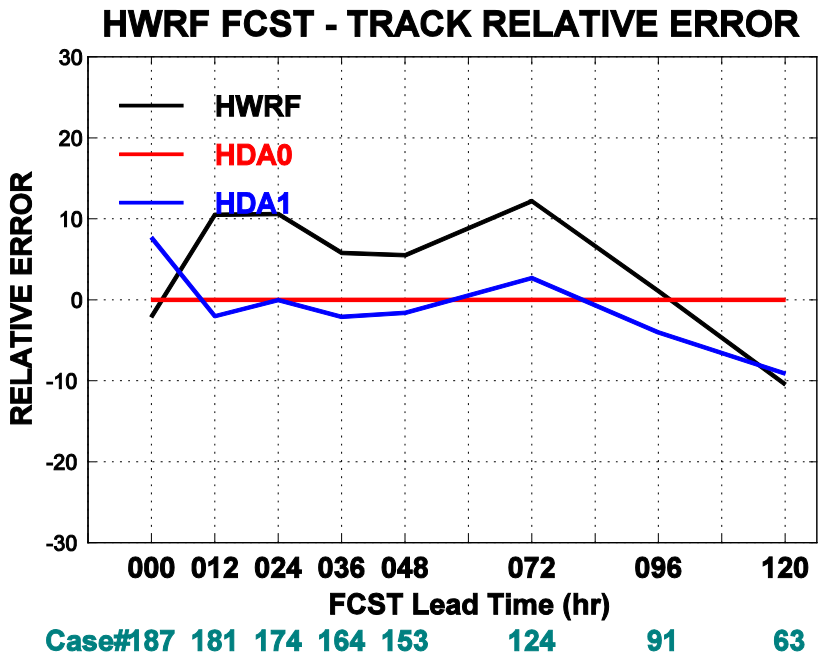
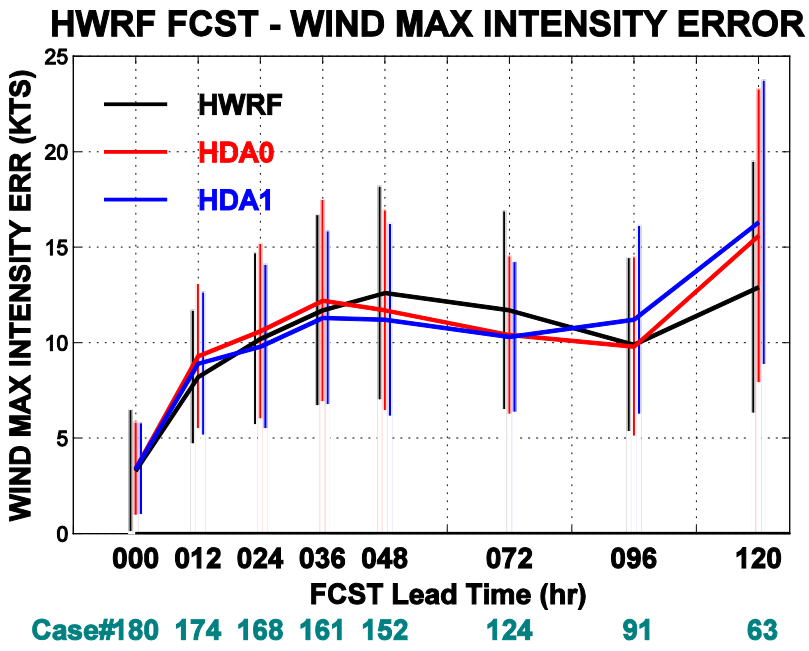
Track Verification – All basins combined

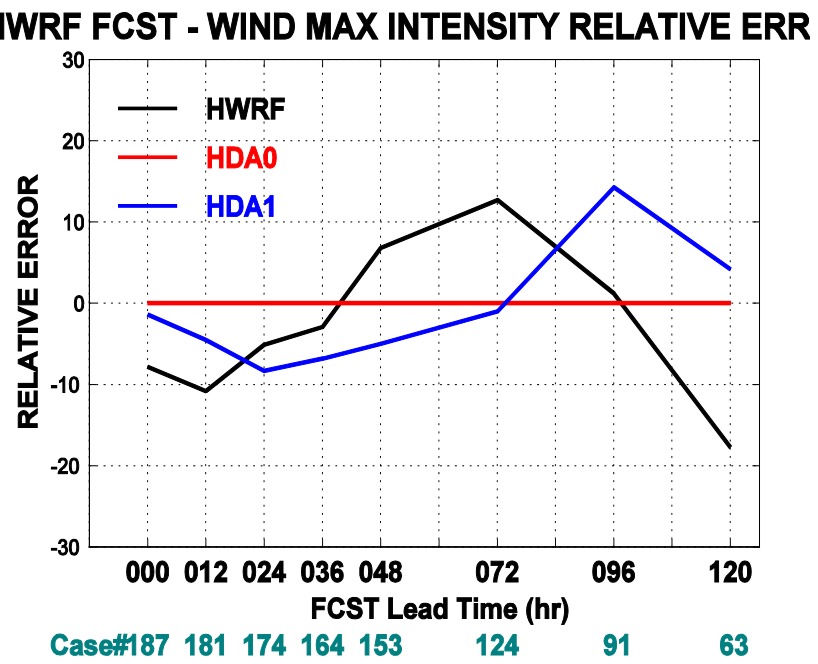
HDA0 vs. HDA1



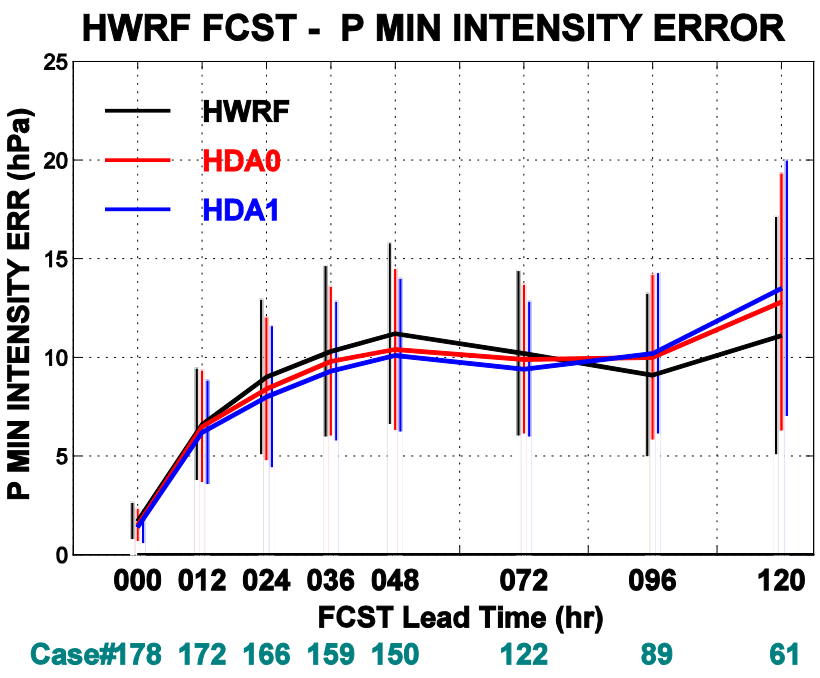


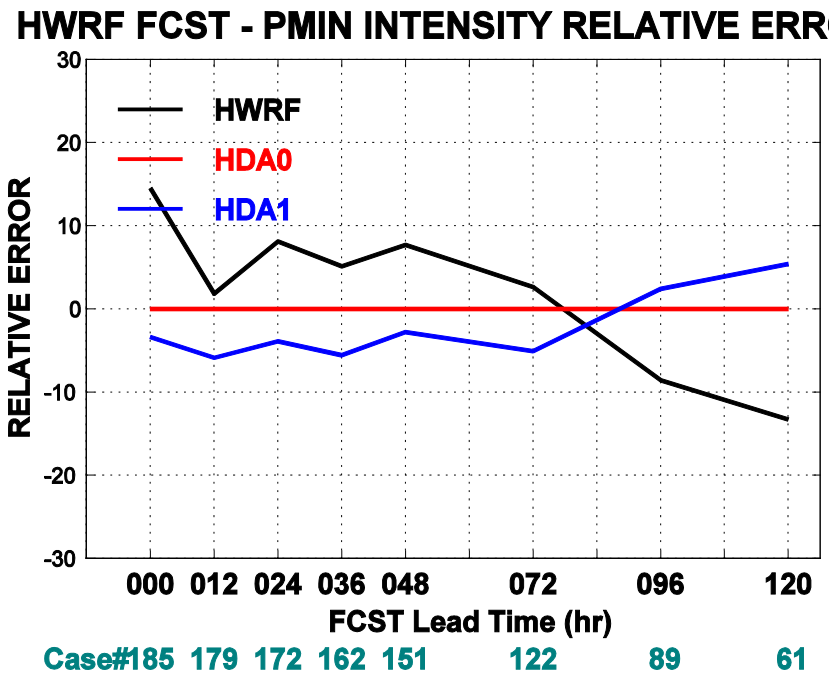
Intensity Verification – Maximum Wind
All basins combined
HDA0 vs. HDA1





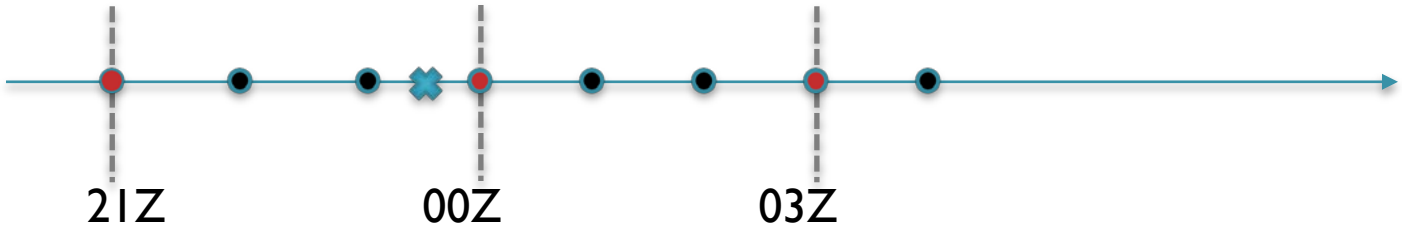
Intensity Verification – Minimum Pressure
All basins combined
HDA0 vs. HDA1





Summary and Future Works

- 2013 HWRF/GSI is re-configured to include more vertical layers and higher model top for better use of satellite radiance data
- Compare to operational HWRF, the addition of satellite data in HWRF improves the track forecast and storm intensity in terms of minimum pressure. The impact on maximum wind is neutral and slight positive up to forecast day 4, and is degraded towards day 5
- Compare to HDA0 runs, the raised model top to 0.5 hPa without FGAT and blended vertical coordinate (HDA1 run) further improve the intensity forecast up to day 3. The track forecast is also improved
- For storm changing its status rapidly, the use of 3 hourly FGAT in the ghost domain near the storm may have negative impact on the analysis and forecast. The background field may be misrepresented due to the coarse resolution in time. The hourly FGAT is more appropriate to use with observations in the ghost domain



Summary and Future Works

- Future works: (short-term)
  - Conduct control experiment (no satellite data)
  - Conduct observing system sensitivity experiments
  - Assess the impact of hourly FGAT (work with Mingjing)
  - Test the impact of satellite derived hourly winds with hourly FGAT