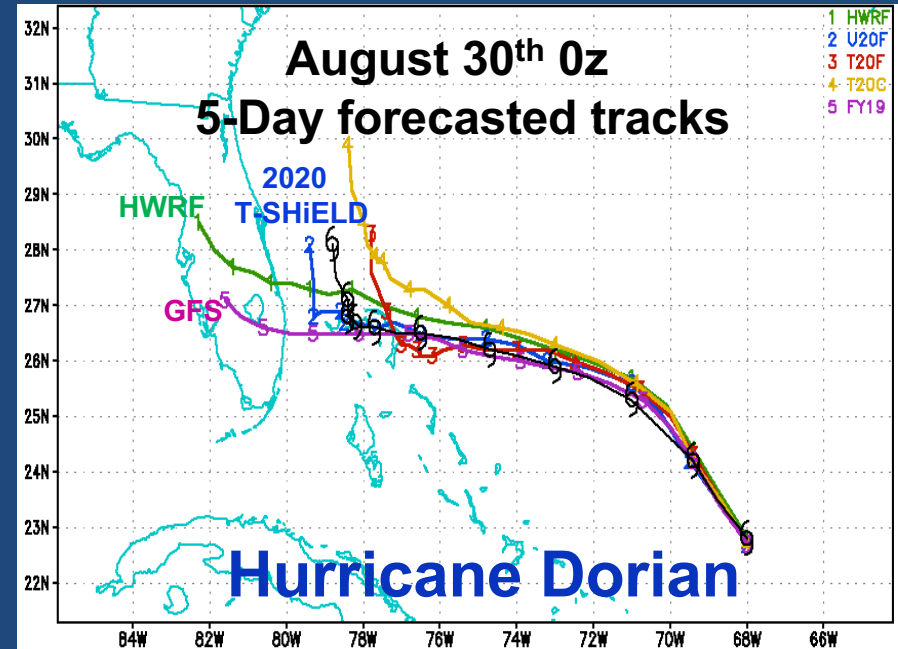


2020 GFDL T-SHiELD Near Real-Time System

 The picture can't be displayed.



Morris Bender, Kun Gao, Matthew Morin, Lucas Harris,
Timothy Marchok

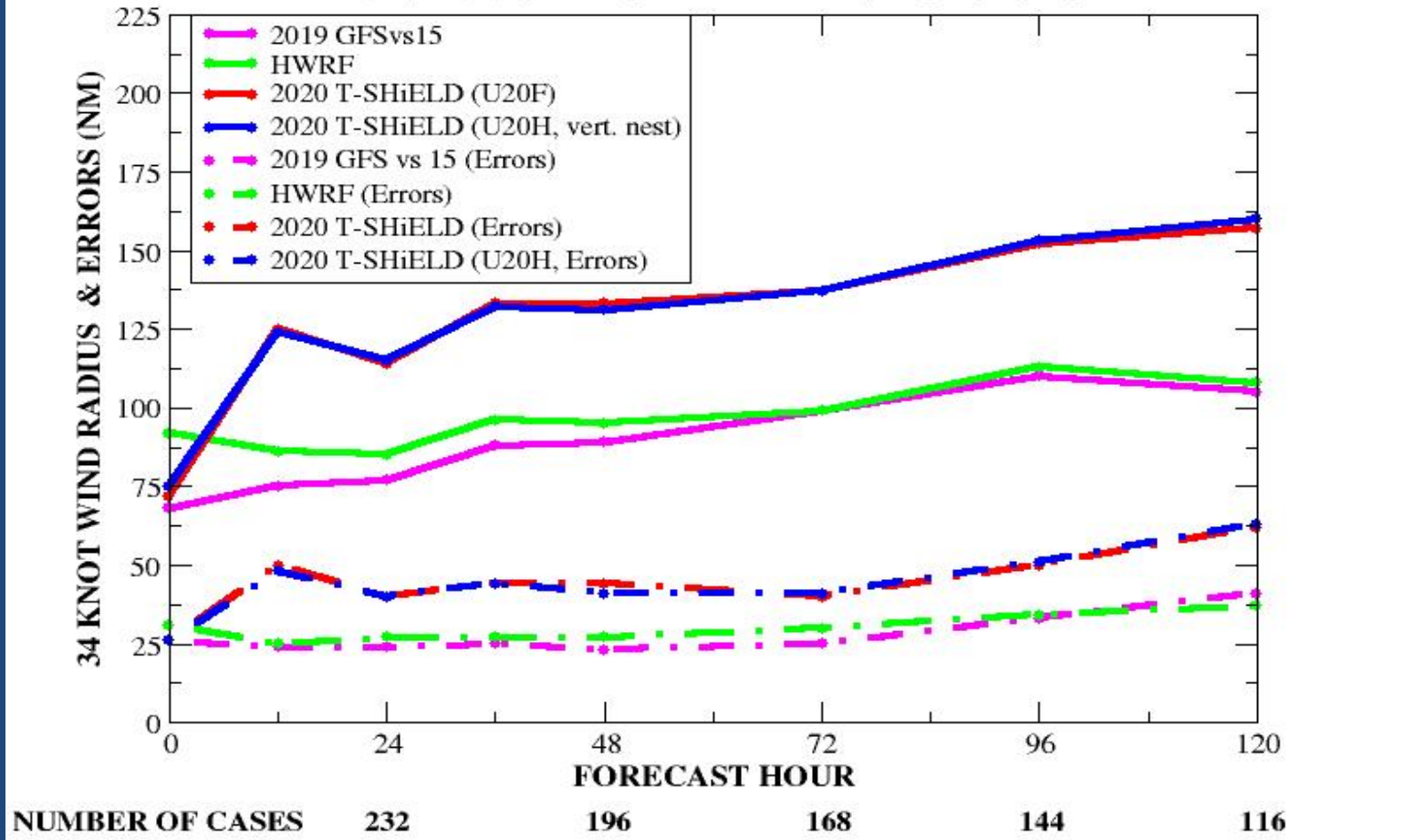
HAFS Coordination Meeting
July 22nd, 2020

During Previous HAFS Meetings some of the discussions focused on the expanding Gale Radii observed in most 3km high-resolution FV3 models.

The resulting high bias evolved quickly after the start of the forecast and produced large errors in the wind radii.

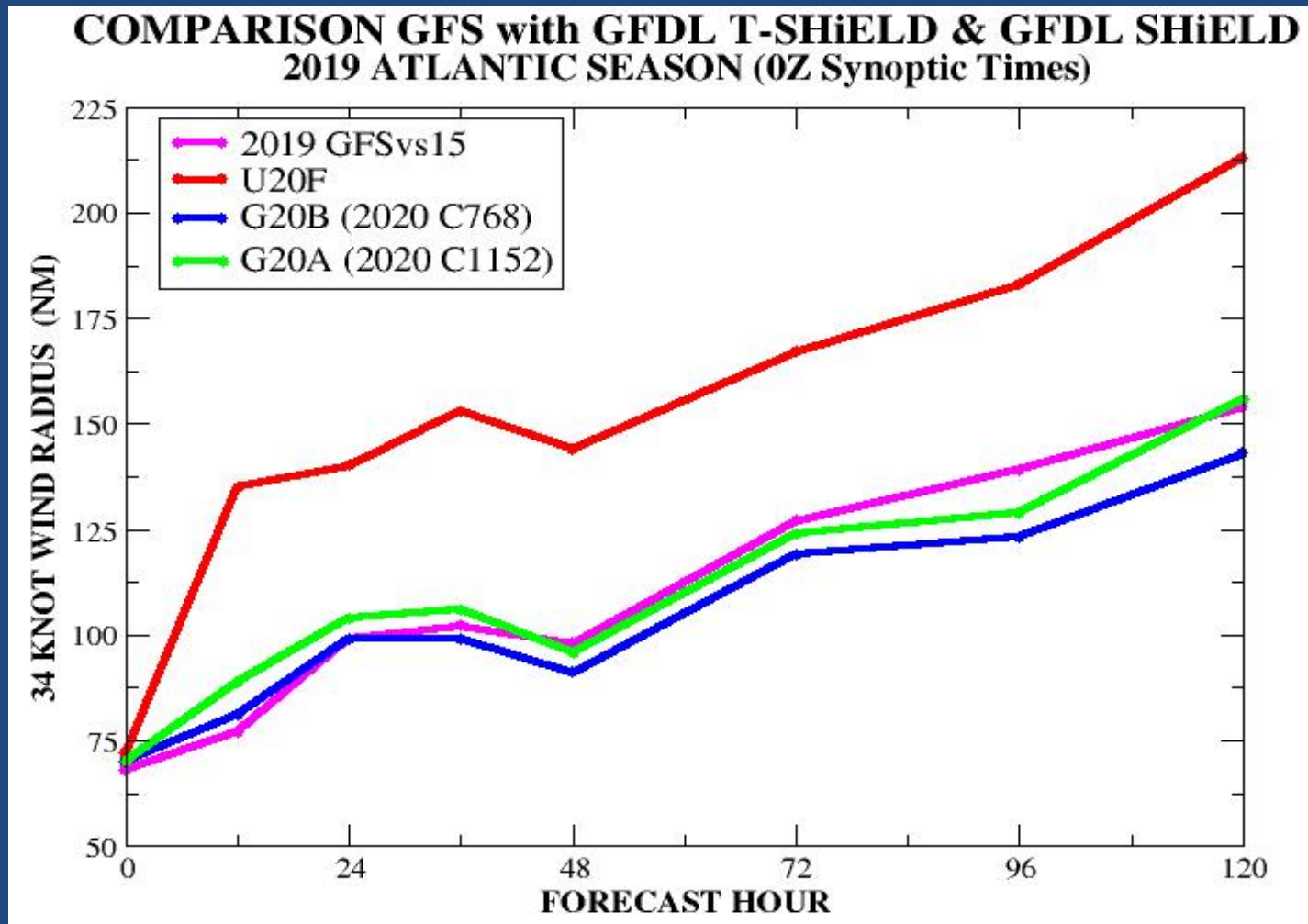
More careful analysis was needed to understand what may be happening

COMPARISON of 2020 T-SHiELD VS. OPERATIONAL MODELS 2018-2019 SELECTED ATLANTIC CASES



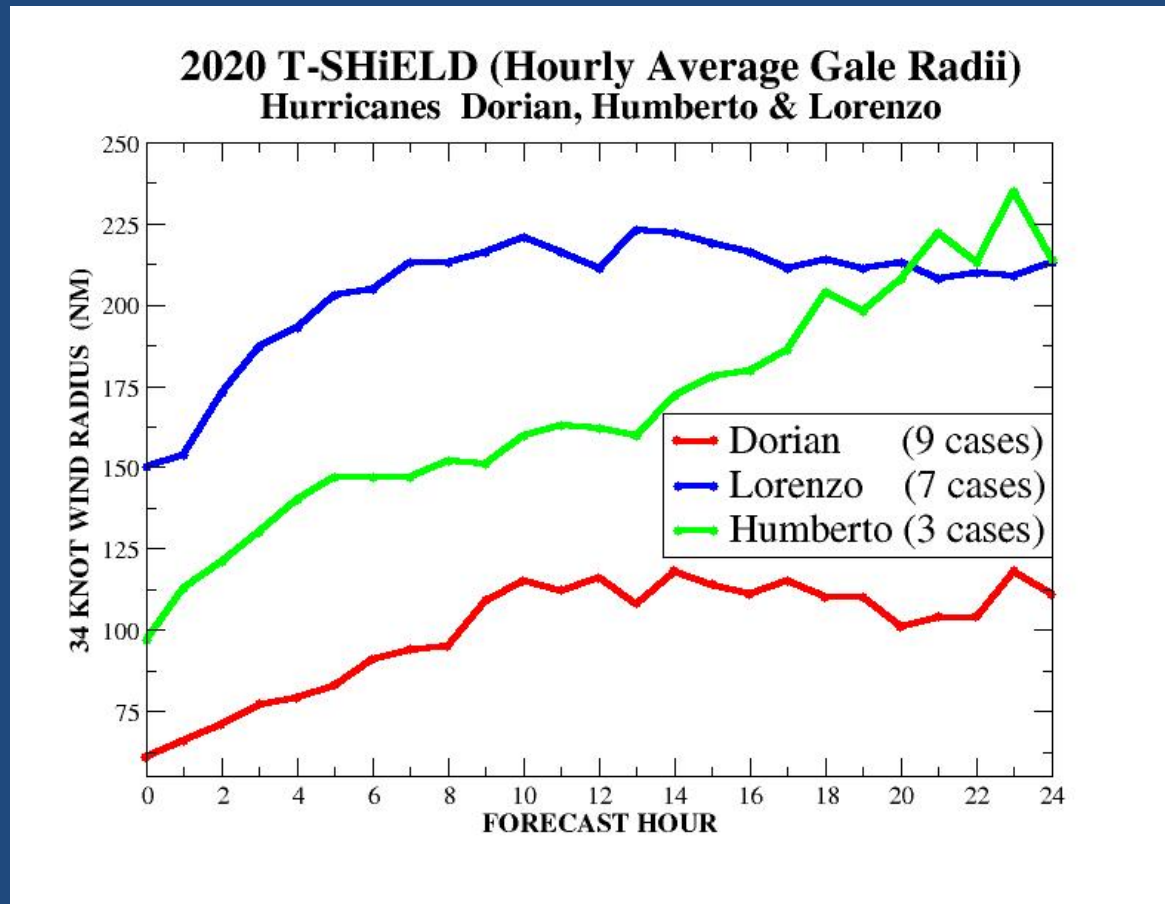
Example of Expanding Gale Wind radii in GFDL T-Shield compared to Operational HWRF and the GFSvs15

Comparison of 2020 T-SHiELD vs. Global SHiELD and GFS



However: Gale Wind Radii did not expand in Global 13 km and 8.5 km GFDL SHiELD models (*G20A*, *G20B*) but was comparable to GFS

Hourly Change in Average Gale Wind Radii for 3 Major 2019 Atlantic Hurricanes



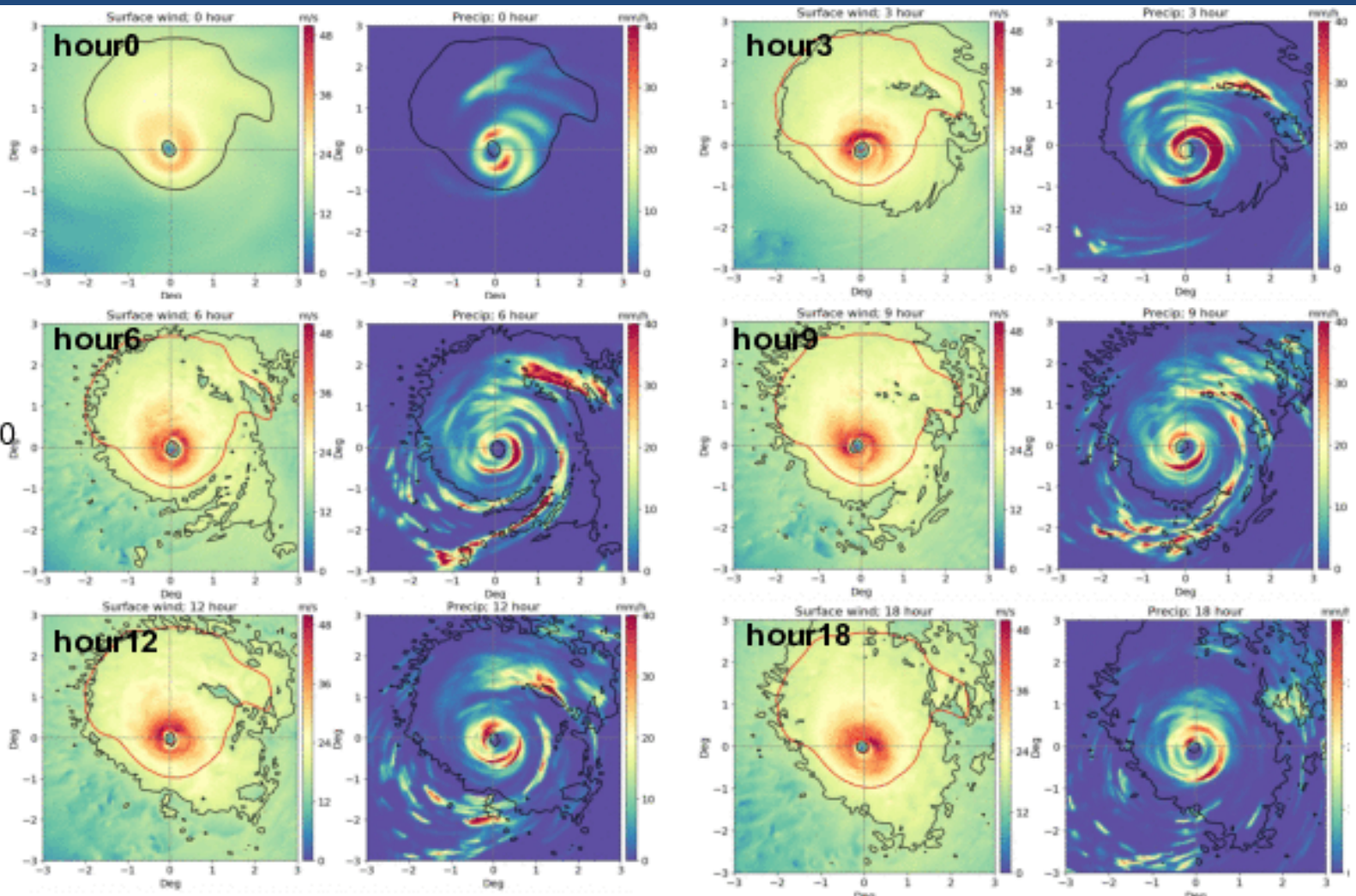
Expanding of the Gale Wind radii occurred during the first 6-8 hours of the forecast suggesting this resulted from significant adjustment in the vortex fields !!

Hurricane Lorenzo (September 26th, 0z) Surface wind and Precipitation every 3 Hours

Lorenzo
20190926.00Z

Black contour
17.5m/s wind

Red contour
17.5m/s at hour0.

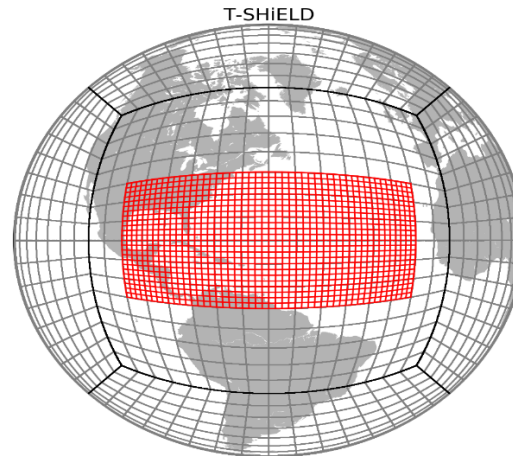


Large Precipitation beyond storm core in early hours of the forecast likely enhanced expansion of gale wind radii as vortex adjusted to much higher resolution. Suggests need for development of Vortex DA !!!

Evaluation of 2020 T-SHiELD

Key features of 2020 T-SHiELD

- Updated FV3 Dynamical Core
- Updated in-line GFDL Microphysics and cloud-radiation interaction schemes
- Refined nested domain for faster speed
- Reconfigured horizontal advection schemes (hord=6 for dynamical and positive-definite -5 scheme for tracers)
- Deep convection disabled and shallow convection retuned in the nest
- YSU PBL with GFDL stability/efficiency modifications
- Retuned 1-D mixed-layer ocean for simple ocean coupling
- New ocean surface drag scheme under high wind conditions



2020 T-SHiELD (ATCF-ID: “U20F”) was evaluated on selected cases from past 3 hurricane seasons.

In the final configuration a more diffusive advection scheme (Hord=6) gave much better results compared to the less diffusive scheme (Hord=5) used in the GFS and was thus selected for 2020 T-SHiELD

In this talk

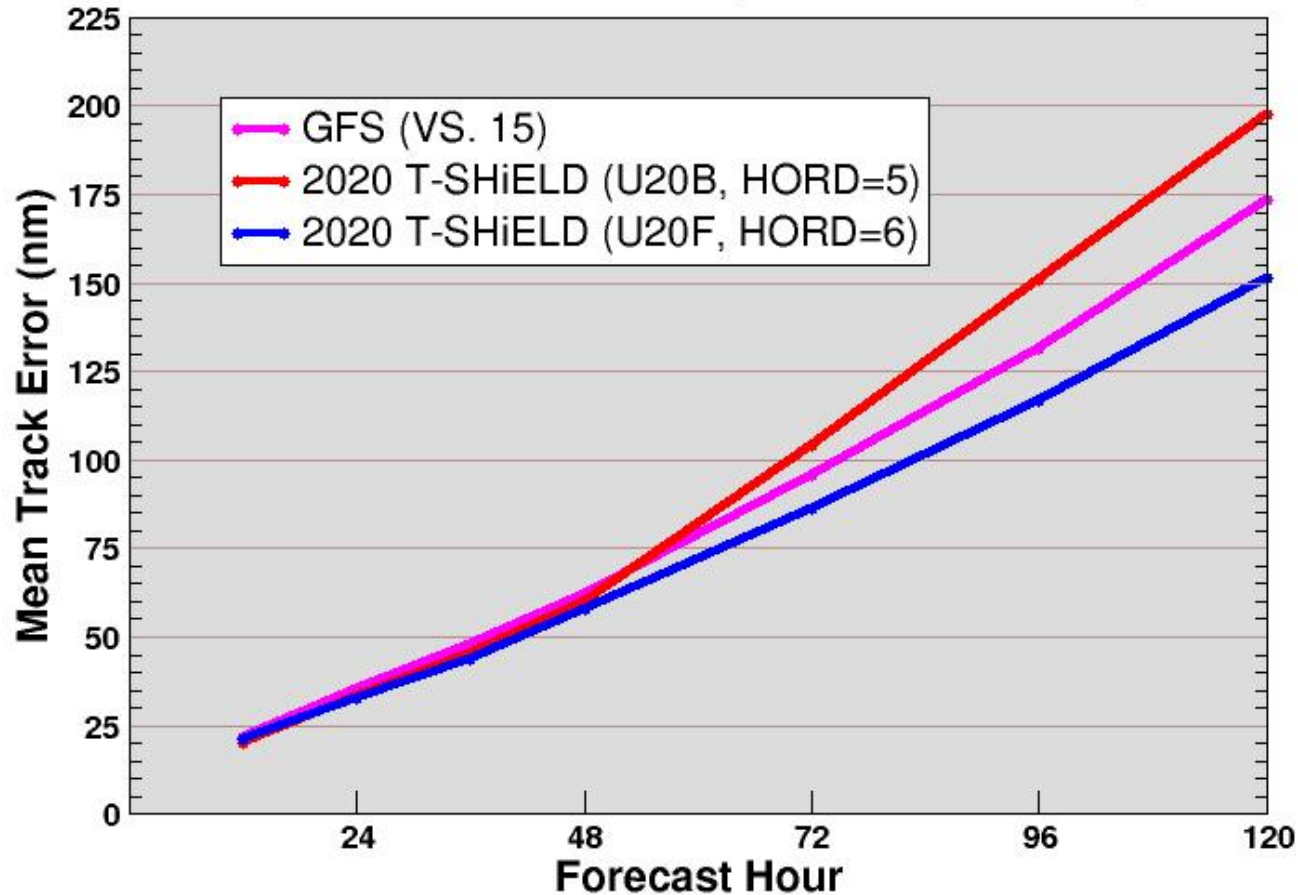
Comparisons will be shown comparing U20F with less diffusive advection scheme (ATCF-ID: “U20B”)

List of Storms Evaluated

- 2019 (0z and 12z): Dorian, Erin, Fernand, Gabrielle, Humberto, Jerry, Imelda, Karen, Lorenzo)**
- 2018 (September 1st-16th, 0z and 12z) : Florence, Gordon, Helene, Isaac, Joyce**
- 2017 (September 1st- 29th, 0z only) : Irma, Jose, Katia, Lee, Maria**

Average Track Error (nm)

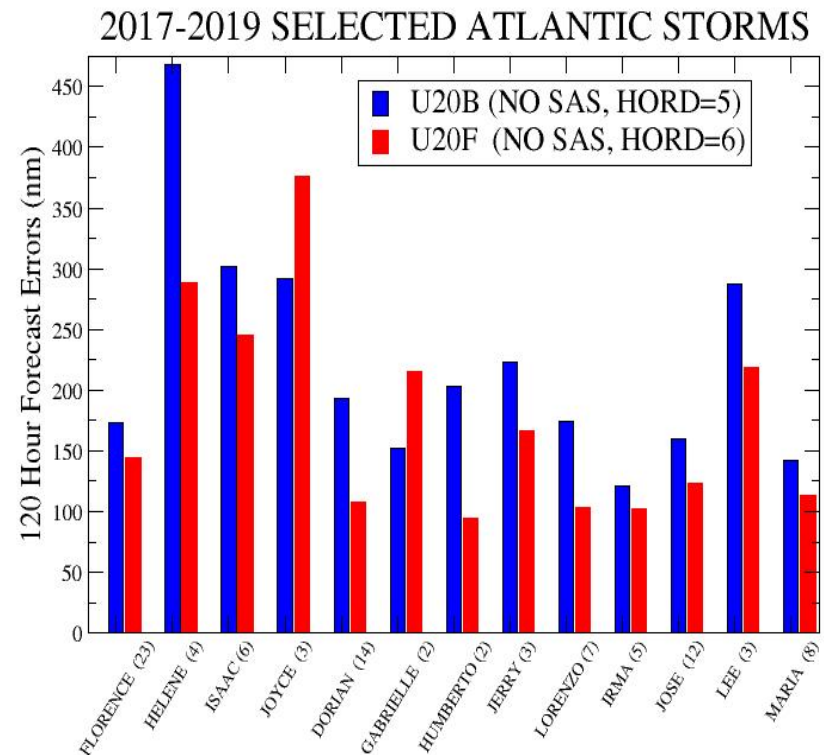
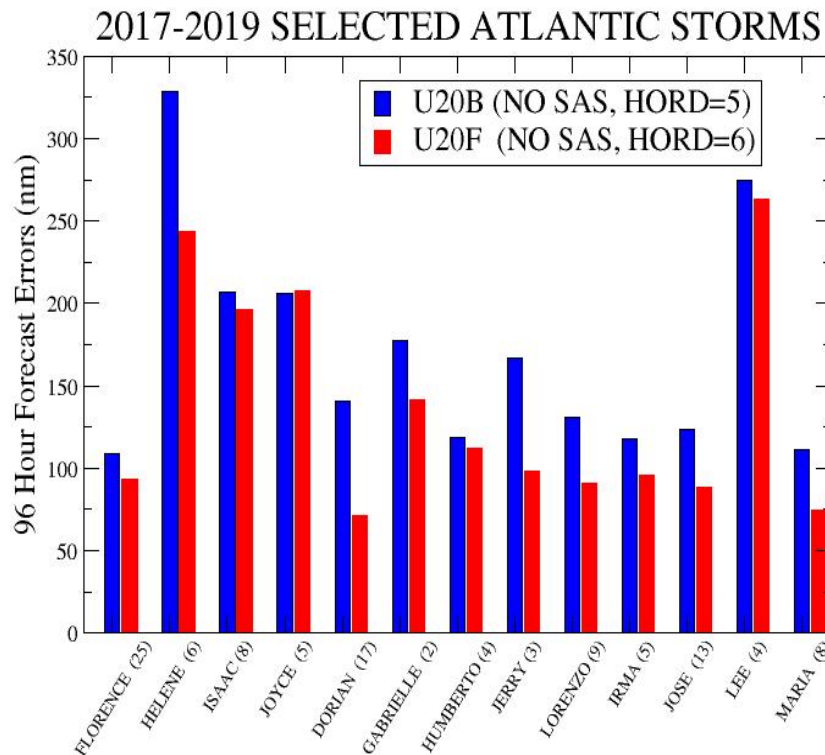
**COMPARISON of GFDL Models vs. OPERATIONAL GFS
2017 - 2019 SEASONS (SELECTED CASES)**



NUMBER OF CASES	171	148	129	110	91
% U20F/U20B IMPR	2%	3%	17%	23%	23%

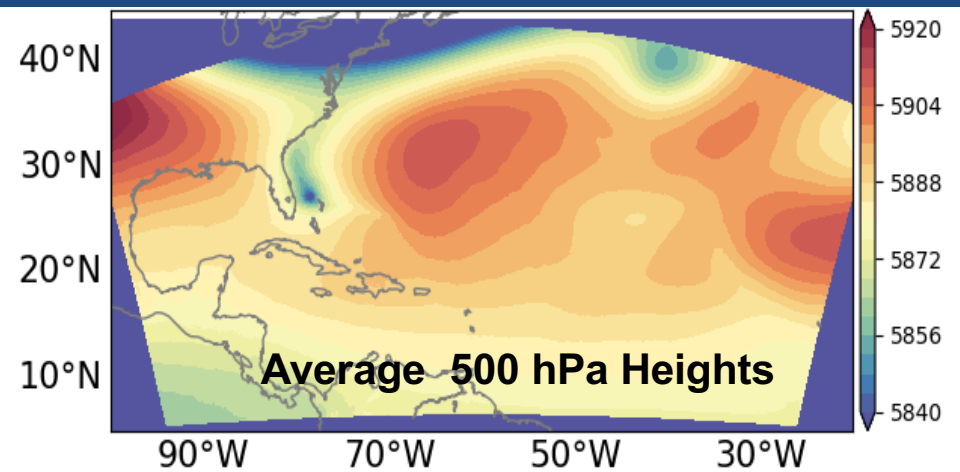
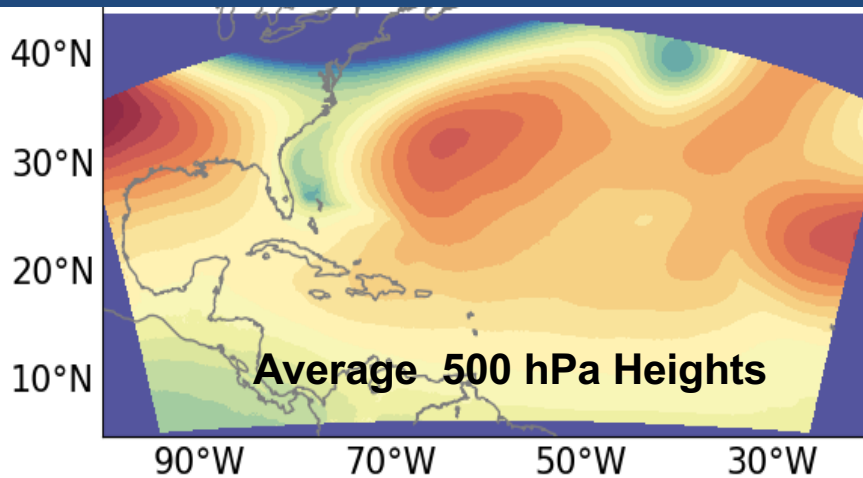
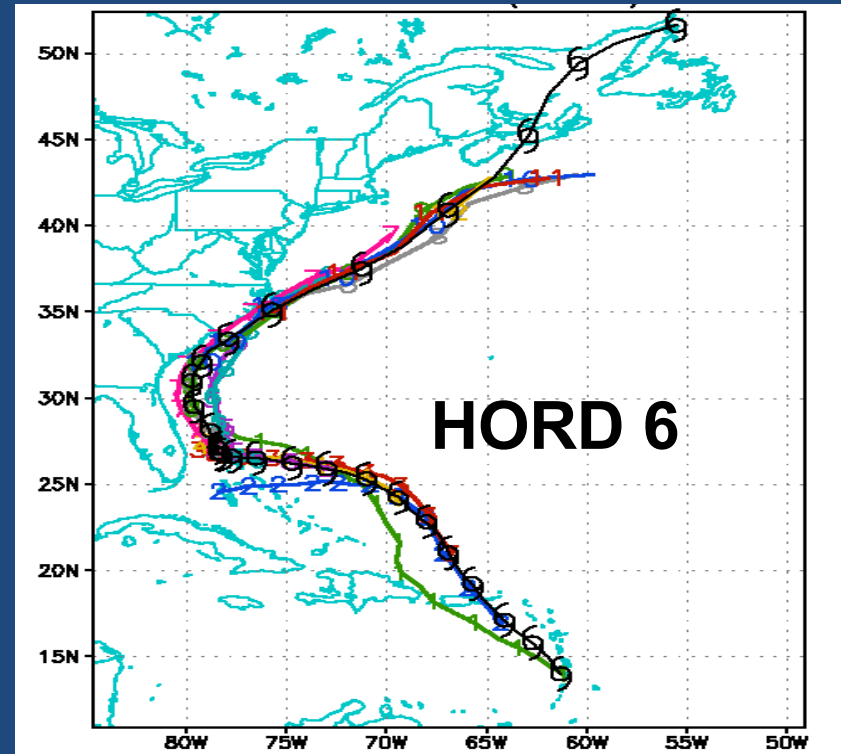
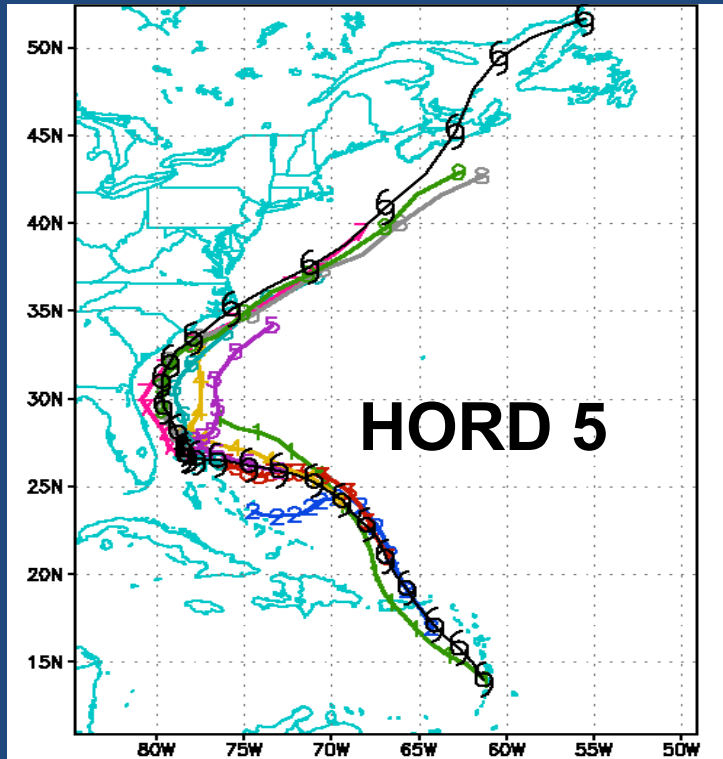
**2020 Atlantic T-SHiELD Track Skill is Better than the GFS with Hord=6
BUT Significantly Degraded with Hord=5 !!!**

Average Track Error (nm) for Individual Storms



Most Storm 4 and 5 day track errors were significantly reduced with the more diffusive advection scheme (Hord=6)

Hurricane Dorian

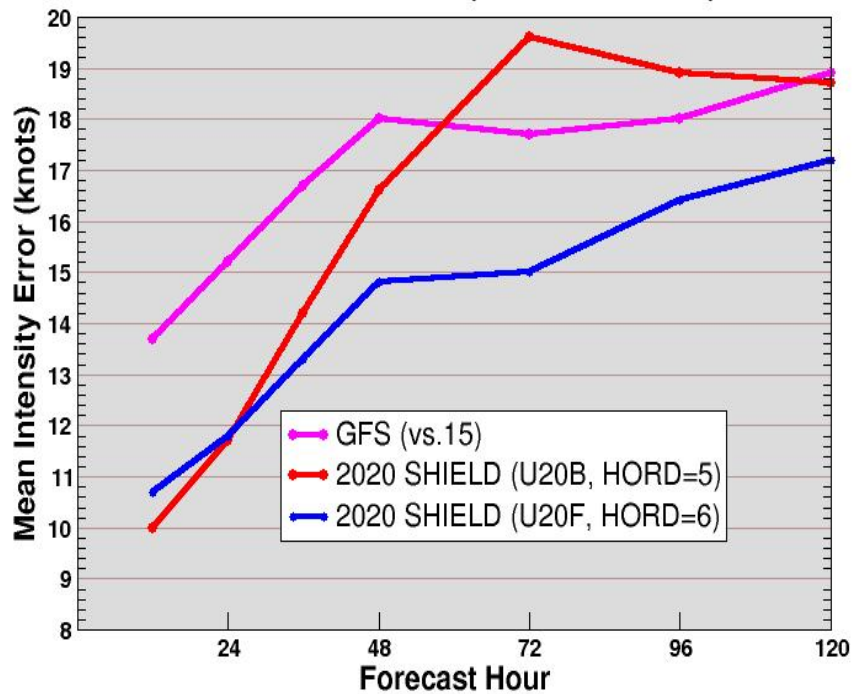


2020 Atlantic T-SHiELD Intensity Errors & Bias

Intensity Error (Knots)

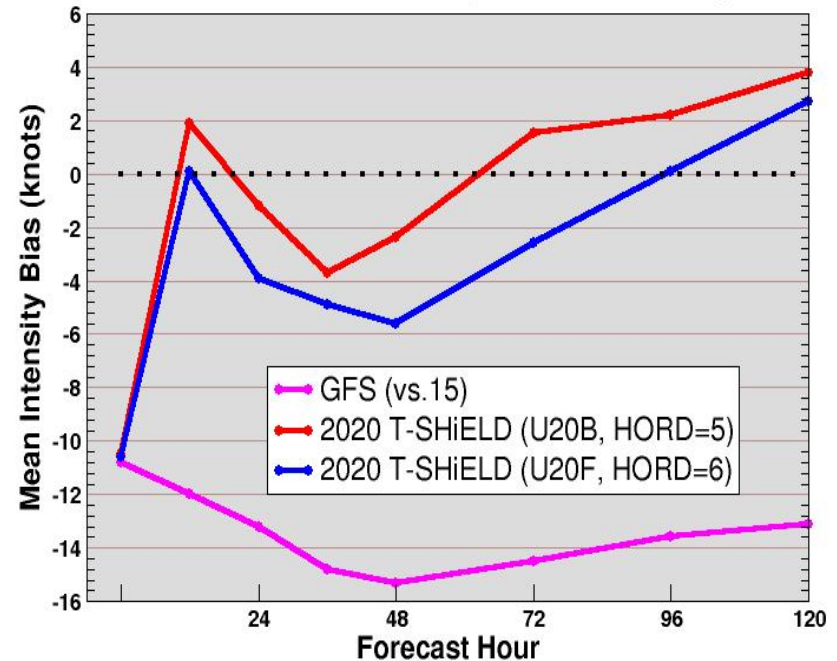
Intensity Bias (Knots)

COMPARISON of GFDL MODELS vs. OPERATIONAL GFS
2017 - 2019 SEASONS (SELECTED CASES)



NUMBER OF CASES	171	148	129	110	91
% U20F/U20B IMPR	-1%	11%	23%	13%	8%

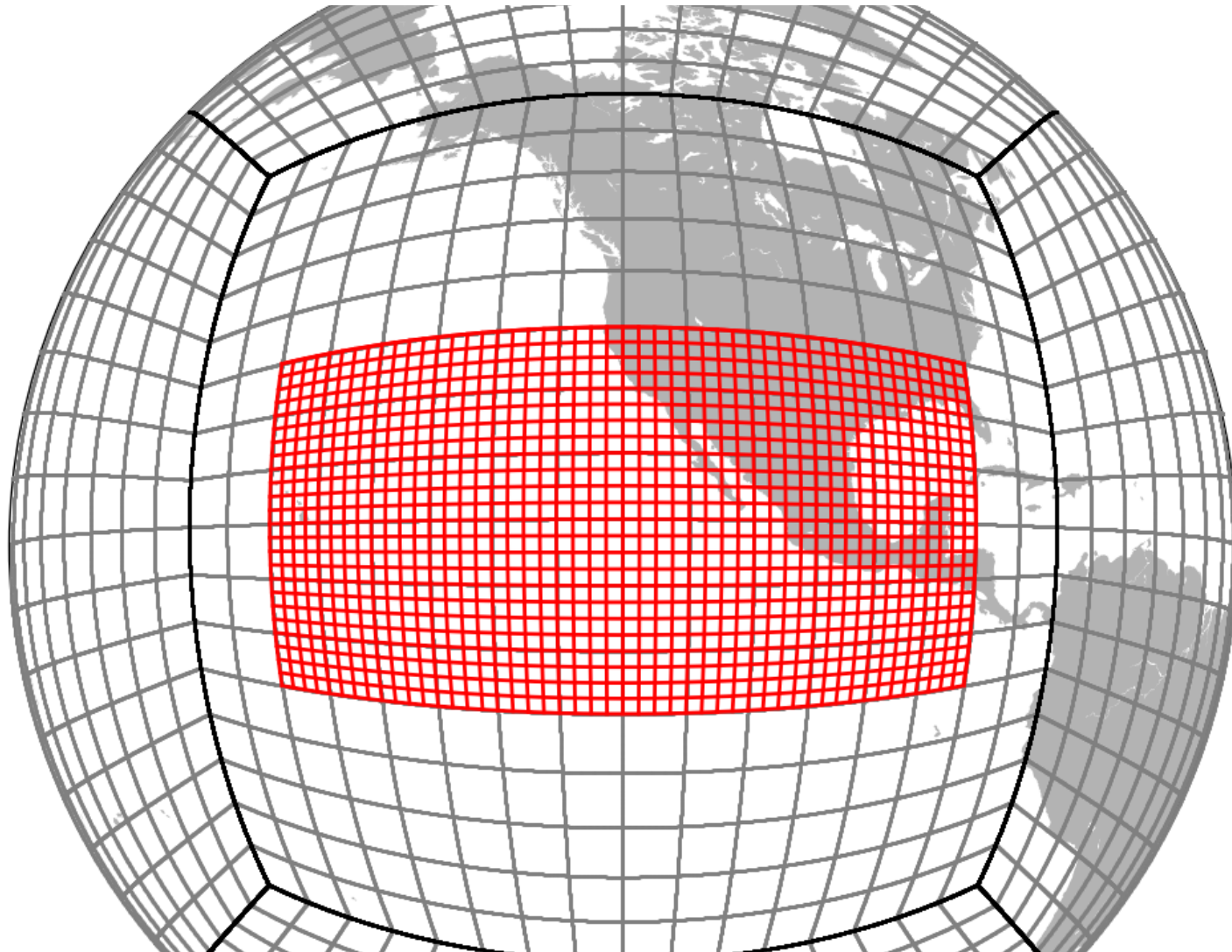
COMPARISON of GFDL Models vs. OPERATIONAL GFS
2017 - 2019 SEASONS (SELECTED CASES)



NUMBER OF CASES:	171	148	129	110	91
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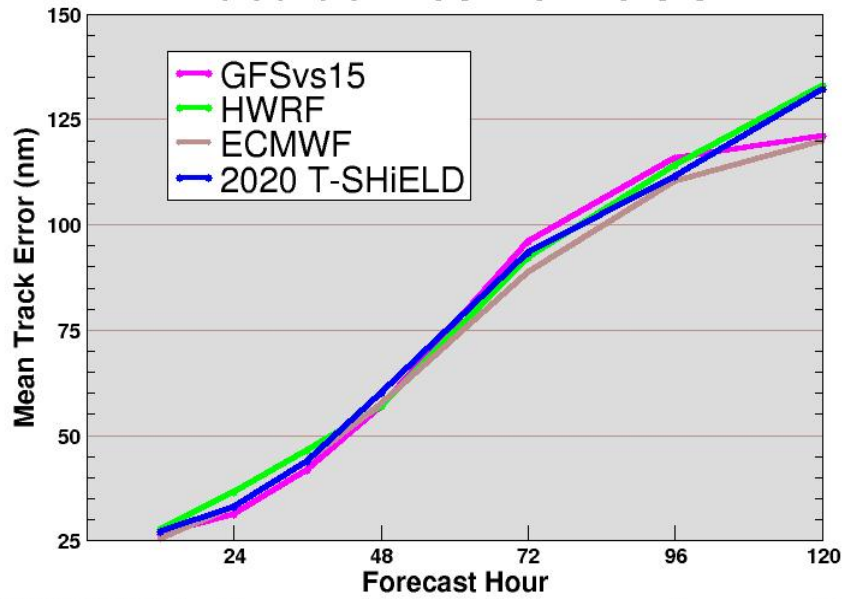
Intensity Errors were also significantly reduced with Hord=6 at most all forecast lead times

2020 East Pacific T-SHiELD Domain



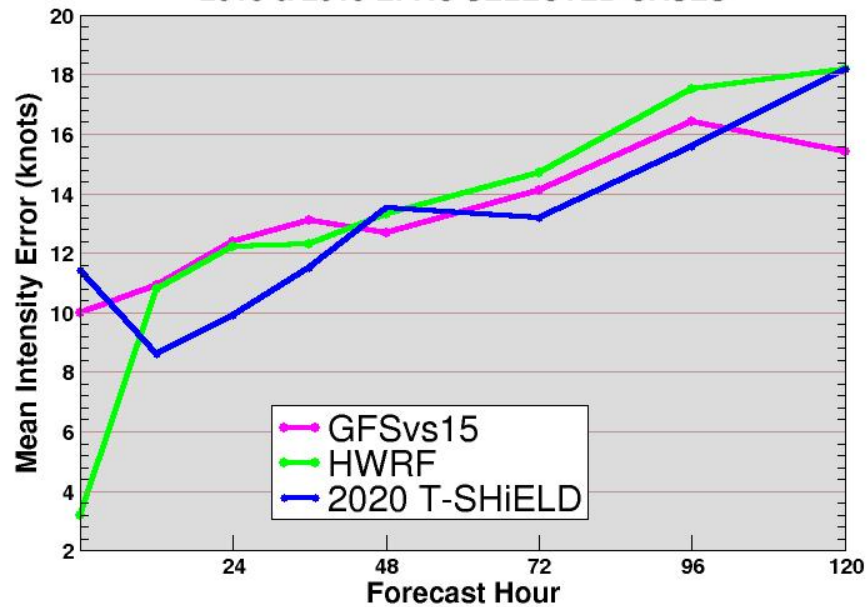
2020 EPAC T-SHiELD will be run when machine resources are available

**COMPARISON of 2020 T-SHiELD vs. OPERATIONAL MODELS
2018 & 2019 EPAC SELECTED CASES**

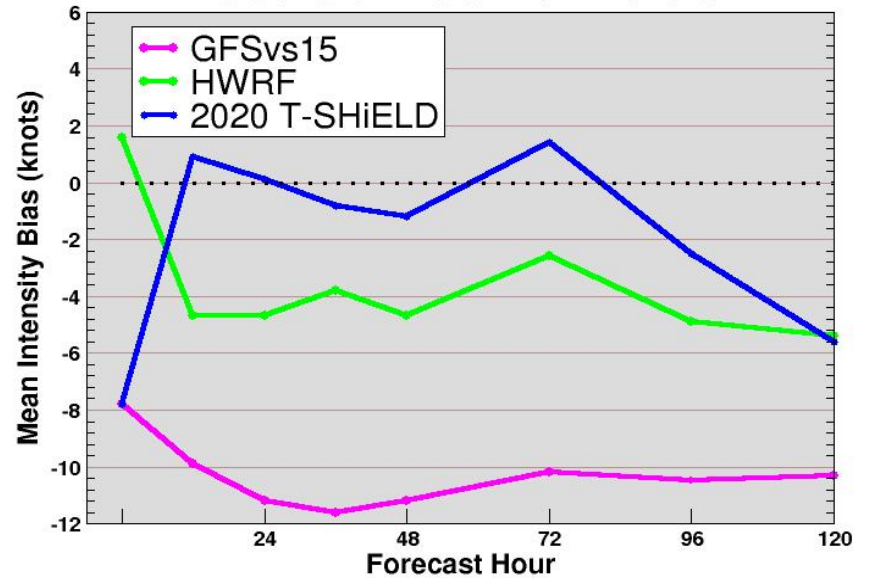


2020 T-SHiELD Eastern Pacific Verifications

**COMPARISON of 2020 T-SHiELD VS. OPERATIONAL MODELS
2018 & 2019 EPAC SELECTED CASES**



**COMPARISON of 2020 T-SHiELD VS. OPERATIONAL MODELS
2018 & 2019 EPAC SELECTED CASES**



NUMBER OF CASES: 75 64 56 48 39

NUMBER OF CASES: 75 64 56 48 39

Summary

- **Expansion of gale wind radii observed in 3-km FV3 HAFS appears to result from a vortex adjustment process during the first 6-10 hours of the forecast.**
- **Expansion of gale wind radii in most 3-km FV3 HAFS models demonstrates that the development of a proper vortex DA system in HAFS needs to remain a high priority.**
- **2020 3-km GFDL T-SHiELD track skill is significantly improved with selection of hord=6 advection scheme but degraded over 20% using the less diffusive scheme (hord=5).**
- **2020 3-km GFDL T-SHiELD intensity skill is also significantly improved at all 2-5 day forecast lead times, with hord=6, with 10-23% reduced intensity errors.**