GSL HFIP runs 2021

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GSL global modeling team

Overview

- Some explanation of wat we wanted to do and what we ended up doing
- Some results from HFIP
  - METexpress TC verification and grid to grid profile verification
  - Some general NWP scores and comparisons to RAOBS over CONUS
  - AOML website
- Bias and error comparison (grid to grid) from all runs at different levels
- What next..

Initial plans: 3 runs, starting at 00z, based on GFSFV3, but:

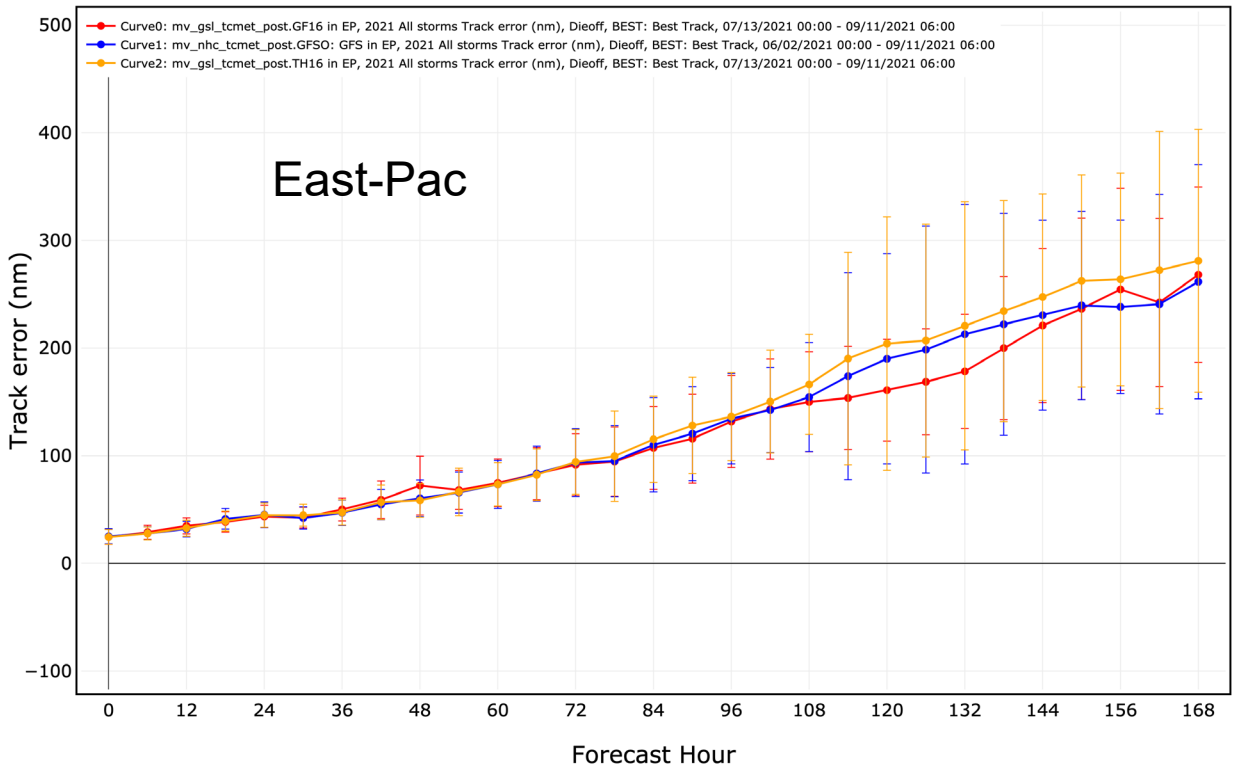
- Use GFS physics, but replace GFS PBL parameterization with GSL's MYNN EDMF scheme. Slightly improved version to improve intensity, but random hang-ups when initializing – runs are missing frequently
- Use GFS physics, but replace convective parameterization (SAS) with Grell-Freitas (GF) scheme
  - Initially we wanted to use the version with aerosol microphysics (possible impact of dust?)
  - The aero version was pulled after the first 2 weeks, since precipitation forecasts were deficient (significant decrease in precip rates) – will go back to that version (fixed a few things)
  - Since July 26 stable runs with expected results (similar to HFIP 2018, the last time we only changed one physics package at a time)
- Use GFS physics, but replace GFDL microphysics with Thompson-Eidhammer microphysics
  - The latest version of TH (from RRFS/HRRR), fixed TH aerosol climatology emissions, sub-cycling applied for stability
  - GFS physics produced large negative values of qv as well as hydrometeors – this caused TH runs to overproduce precipitation by 25% from clipping
    - we were not aware of this GFS-physics feature, does not happen with GSL physics. TH cannot take any very small negative moisture values, so it clips before going into the routine – usually with only very minor impact)
    - This is now fixed with a neg_adj routine, borrowing – really more stealing - from other layers – this may also not be a good solution (possible very diffusive impact)

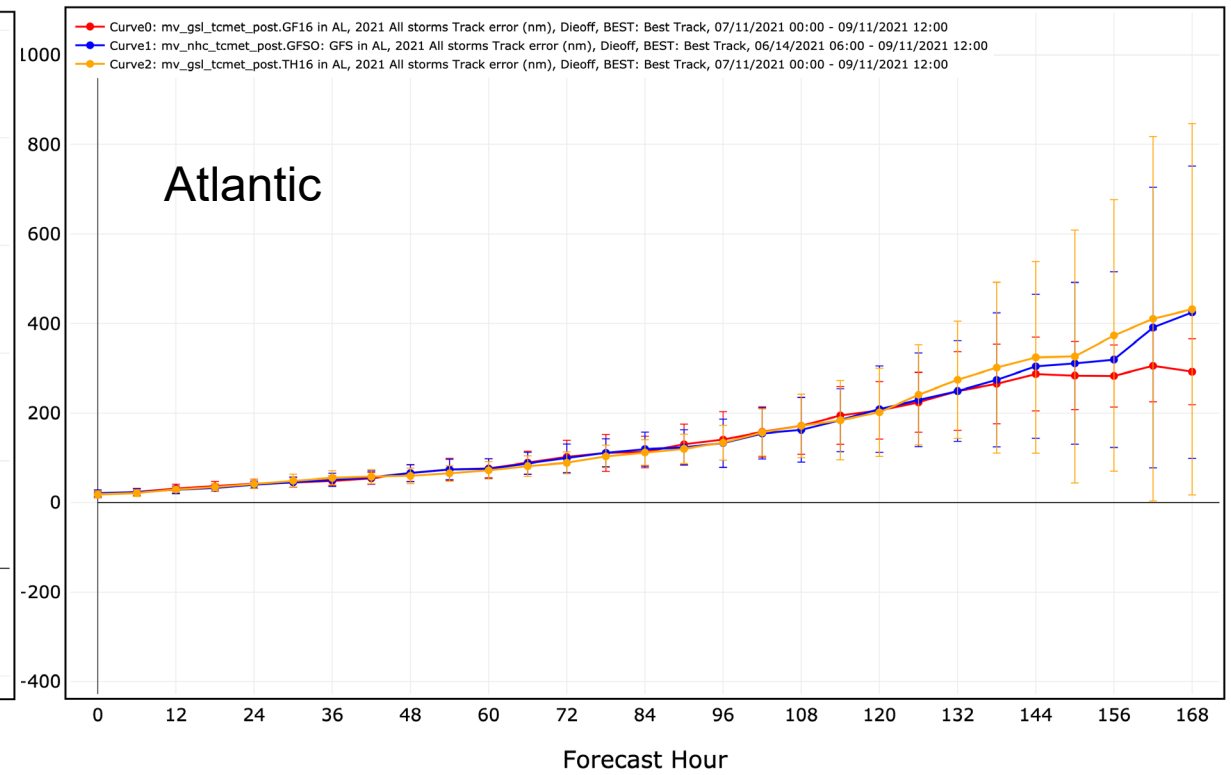
For best comparison to GFS, use C768 resolution, L127, GFS analysis for initial conditions

GSL runs are using CCPP for physics coupling, and an updated version of GFSFV3 (June 14 ufs-community develop branch)

Track errors – TH, GFS, GF

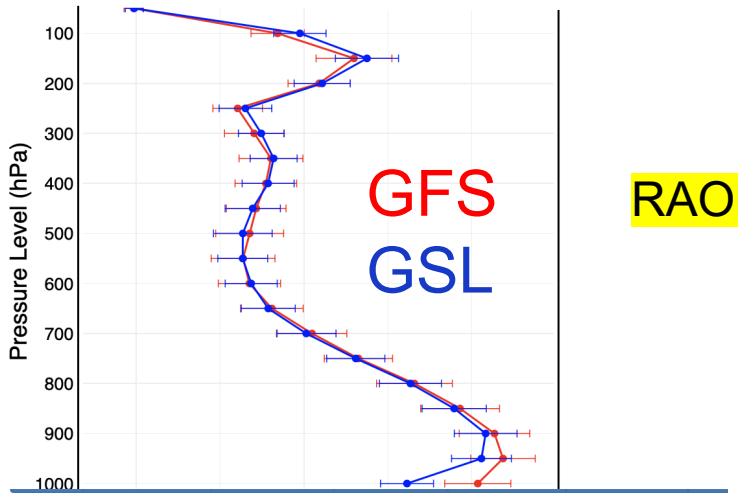
Note: these results are preliminary, amount of data is not sufficient to provide significance!!





Temperature Conus domain – Hr120 against 7/25 - 9/13/2021 RAOBS

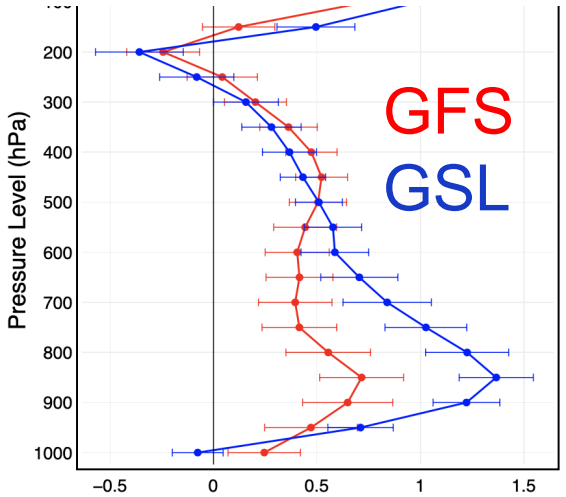
RMSE



MET Upper Air : Profile: no diffs MATCHED Close All Preview Windows

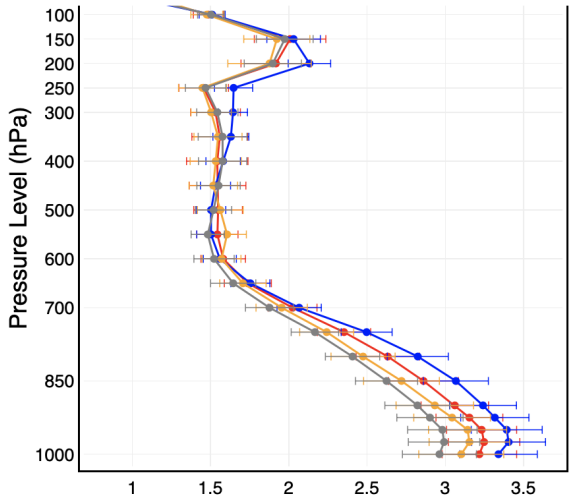
RAOBS

Bias



MET Upper Air : Profile: no diffs MATCHED Close All Preview Windows

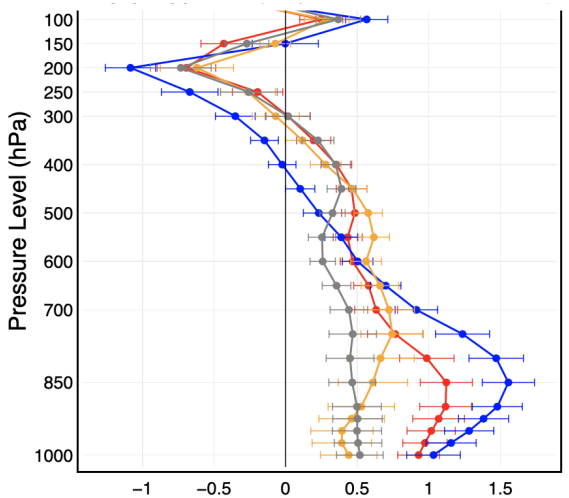
Note: GSL here is the whole GSL physics package, HFIP runs were not in our RAOBS verifications



Edit chart »

Error Bars show 95% confidence

GFS Analysis

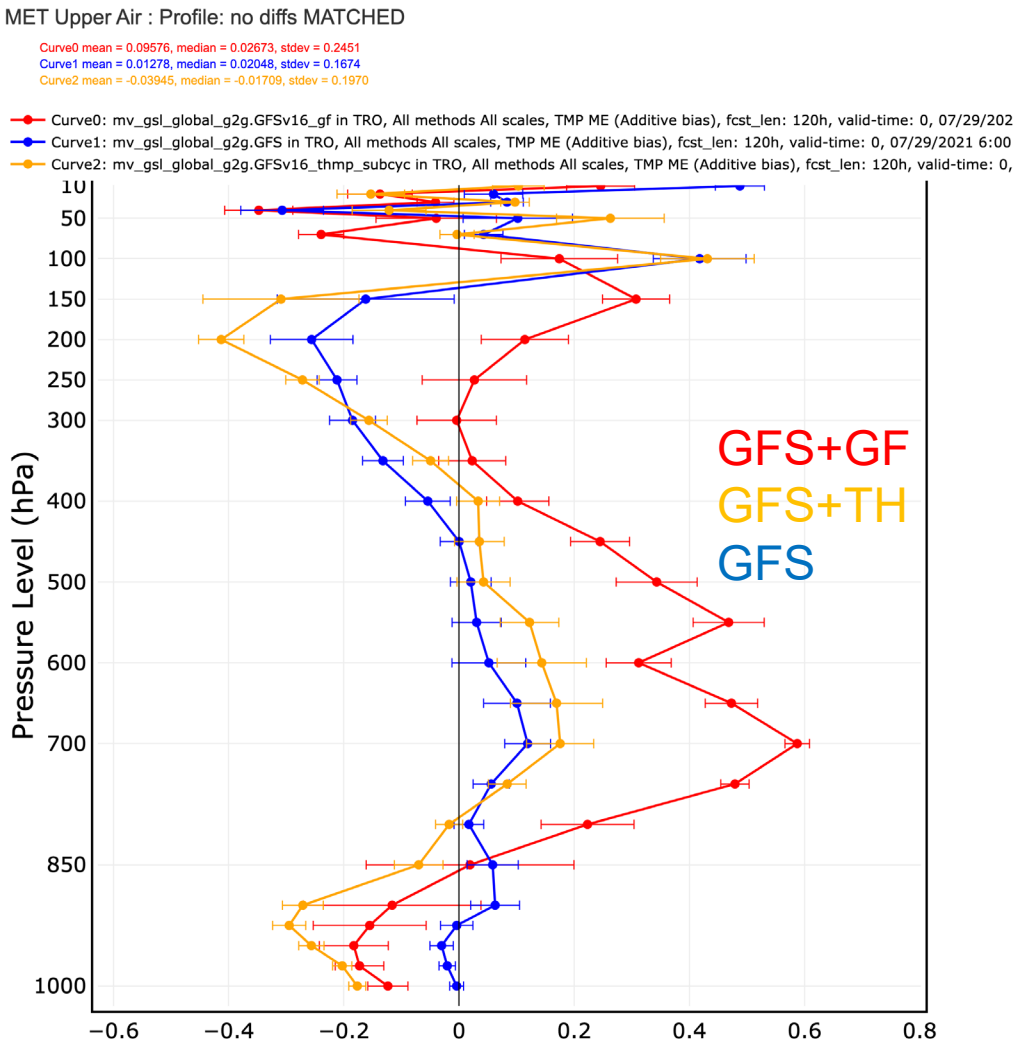


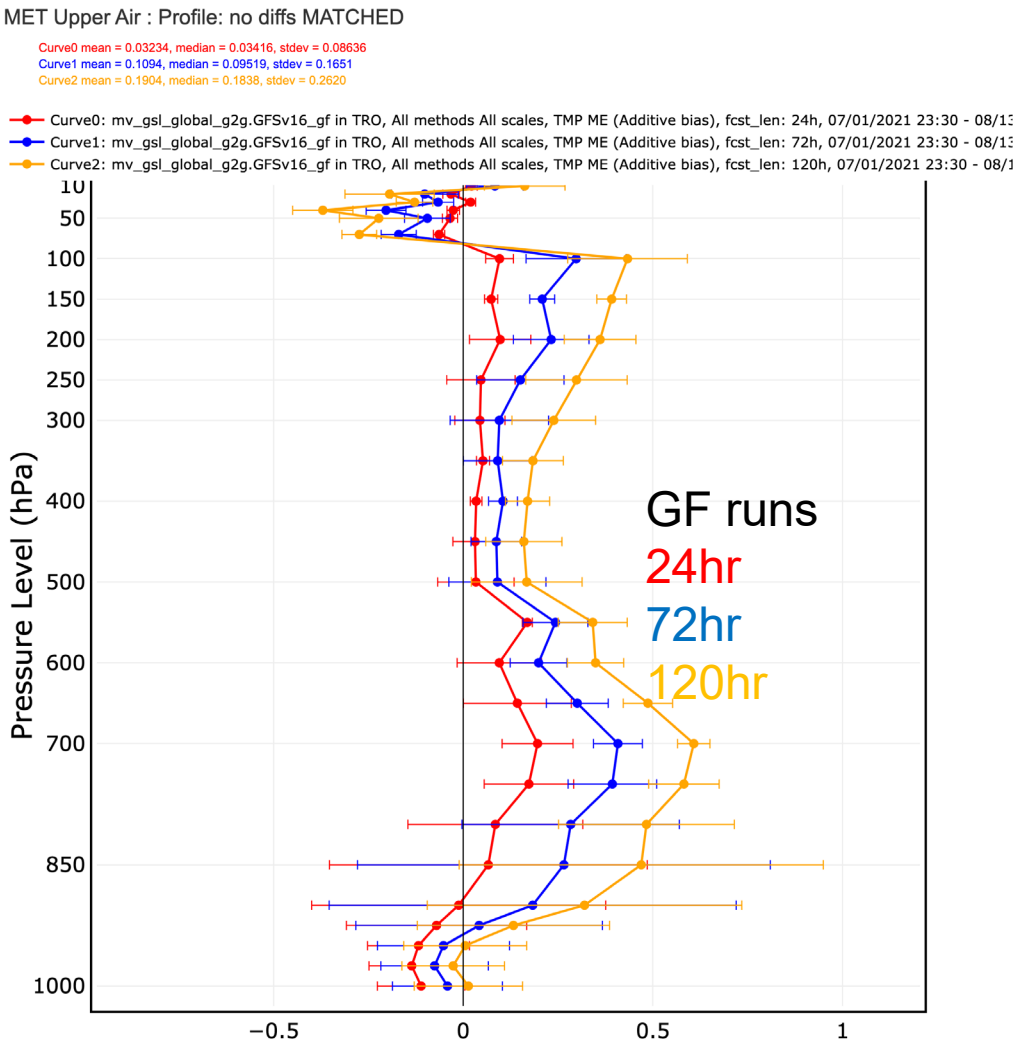
Edit chart »

Error Bars show 95% confidence

GFS
GSL
GFS+GF
GFS+THMP

Temperature bias in tropics for GF runs shows warm bias in mid levels – Comparing to GFS Analysis



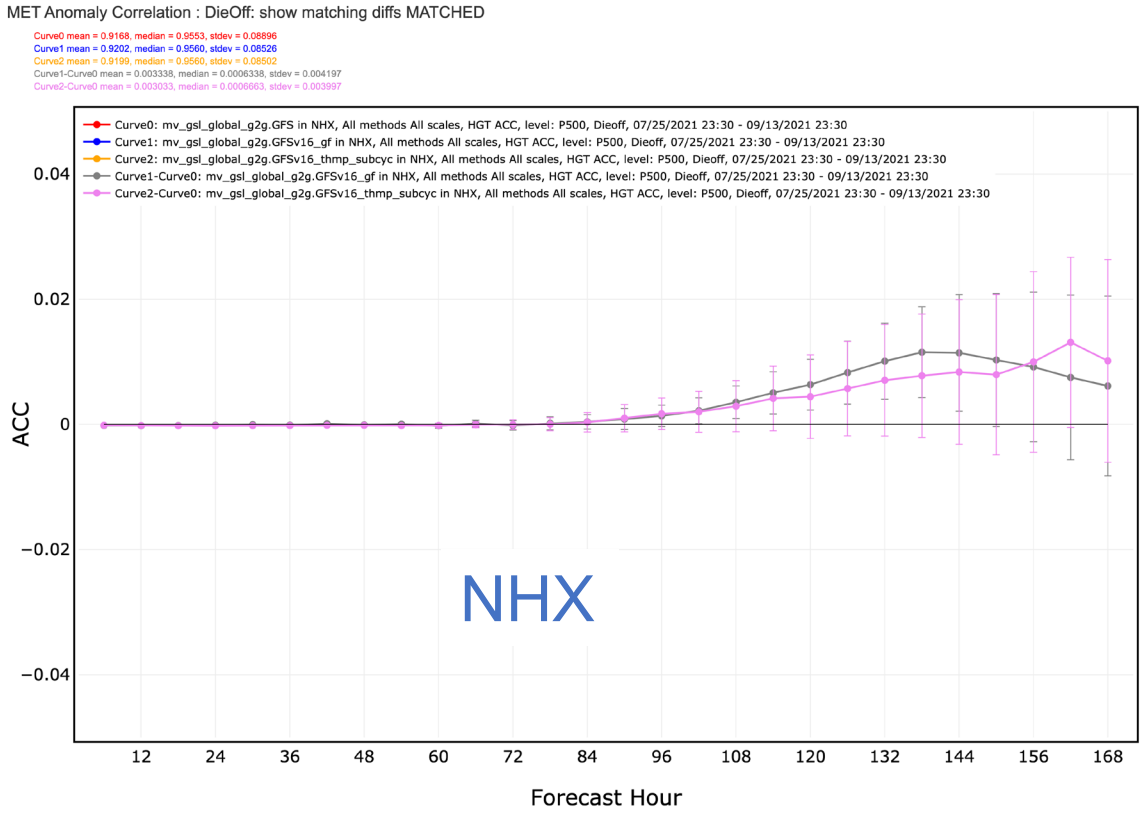


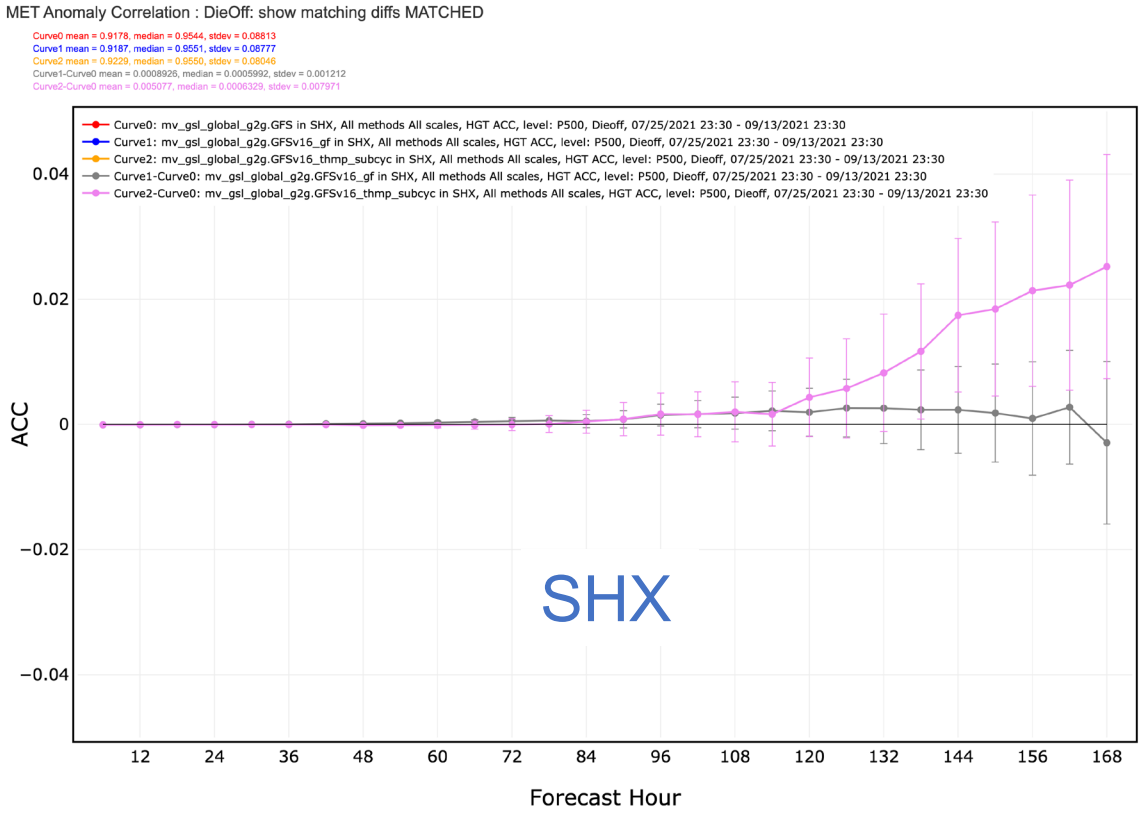
We saw a similar result when running GFS+GF for a whole year October 2019 – October 2020

By tuning the coupling to radiation and hydrometeor detrainment the bias can be removed or at least much improved, but we don't know how ACC scores react!

H500 ACC HFIP 7/25 – 9/13 2021

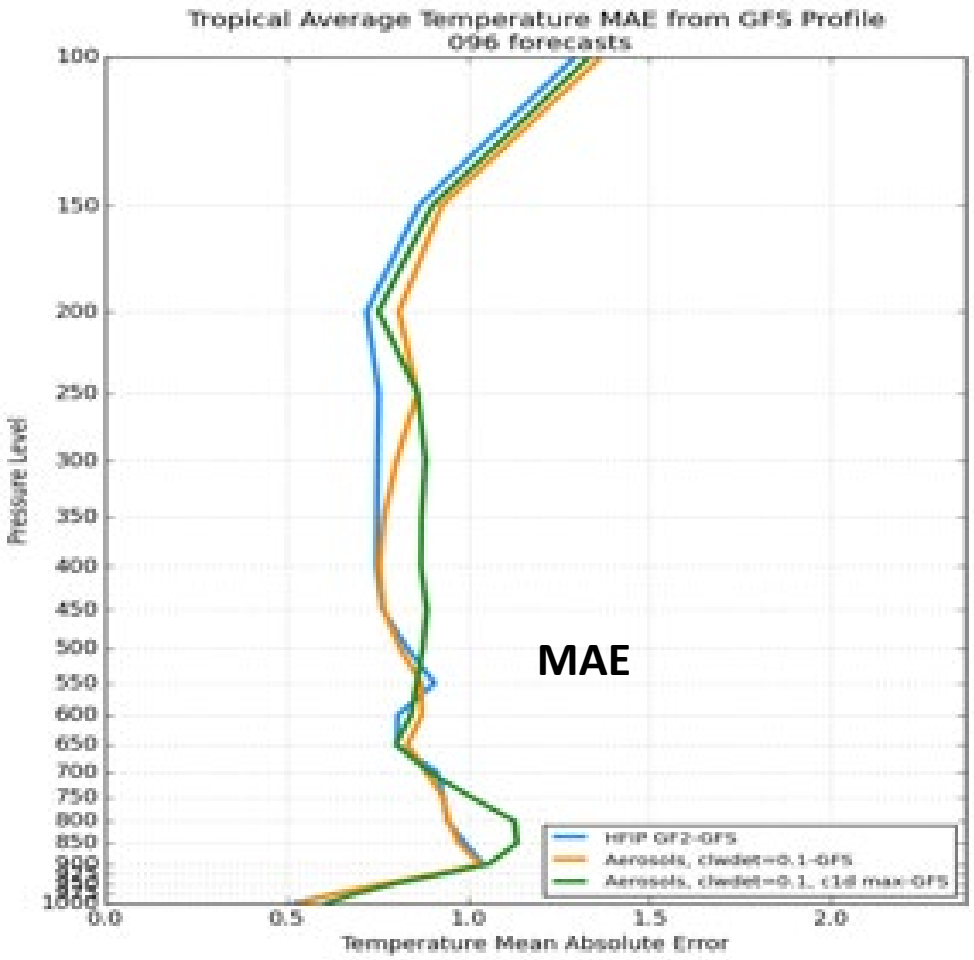
GFS+GF - GFS
GFS+THMP - GFS



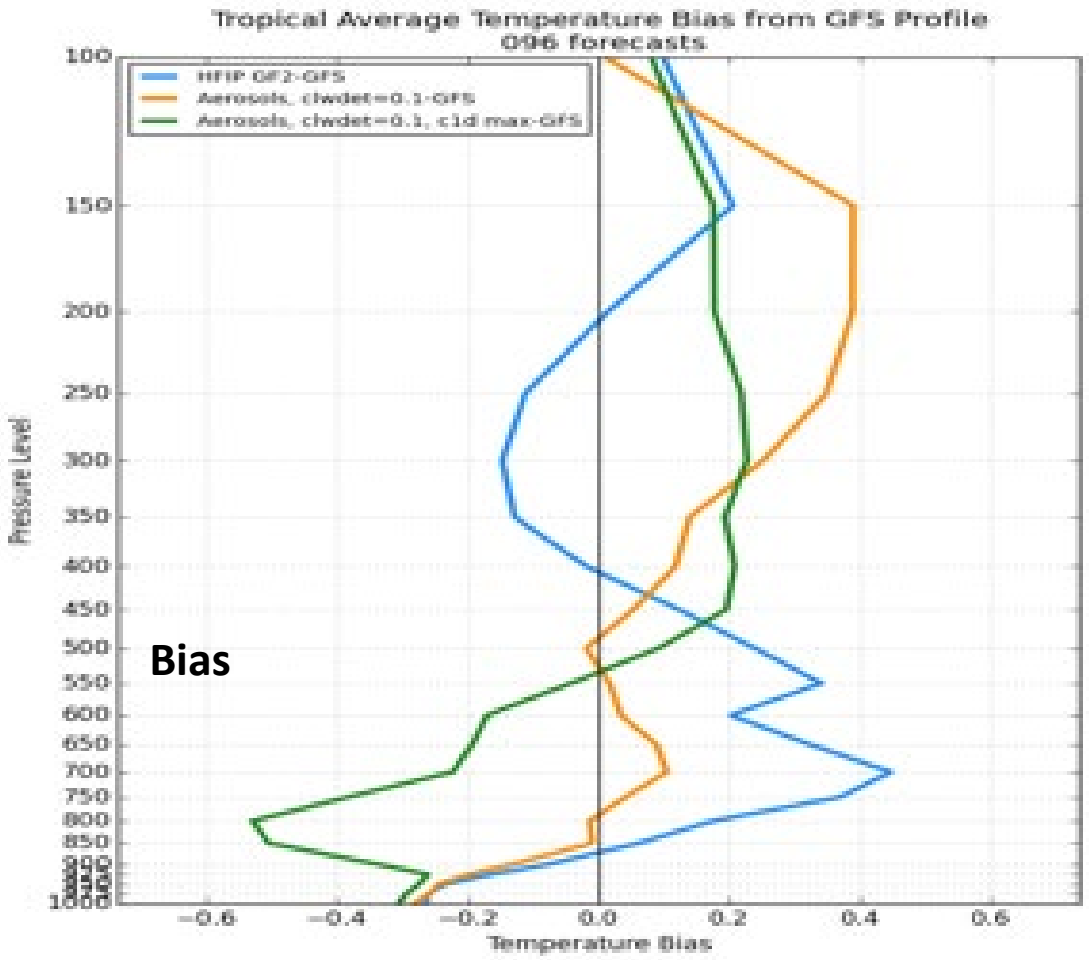


Again, not enough data for results to be significant, but for GF runs agreement to previous 1 year worth of runs as well as HFIP2018

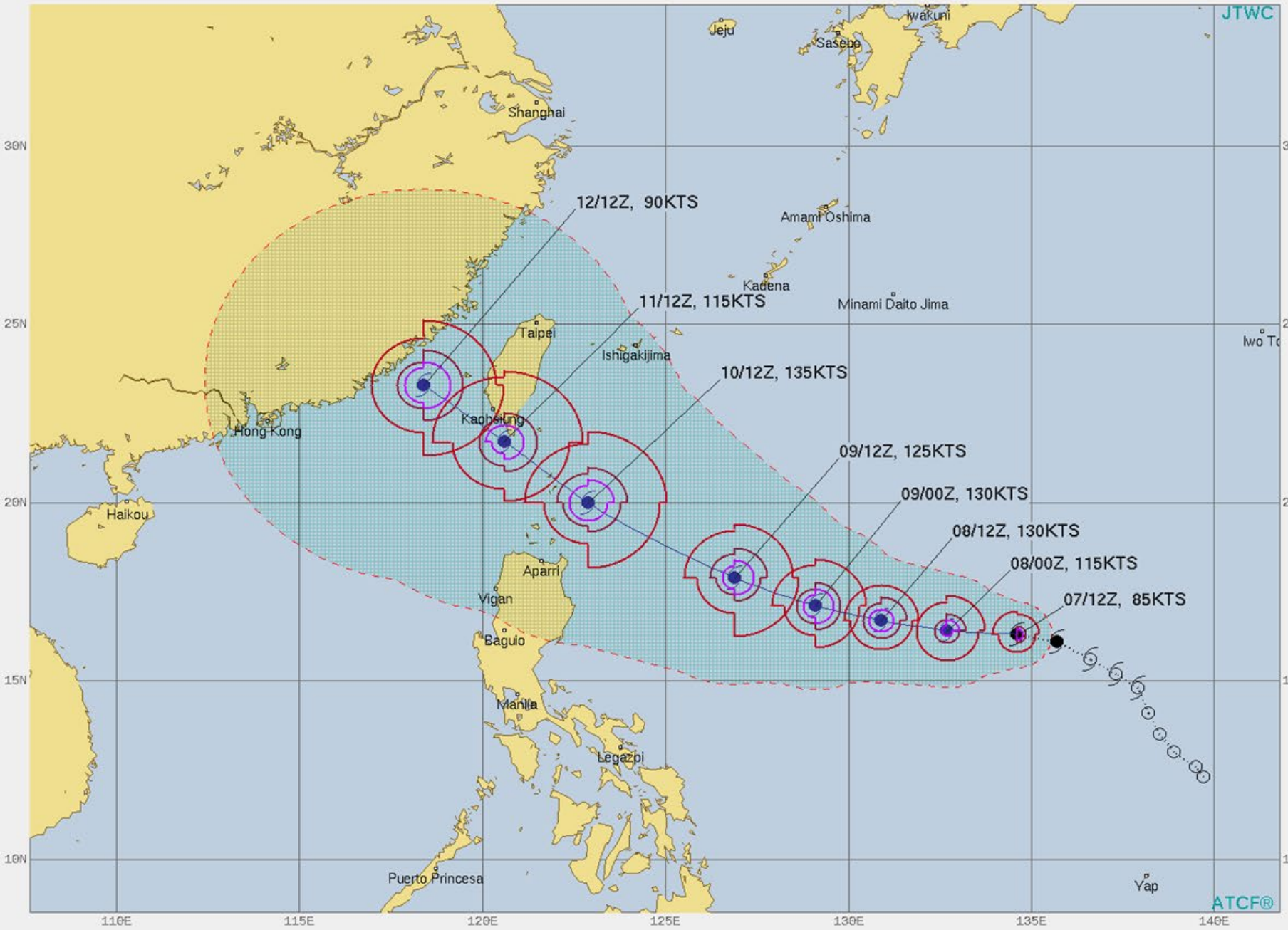
Improving temperature bias profiles



Tropics



- HFIP GF
- HFIP GF but increased hydrometeor detrainment
- HFIP GF as in (2), but increased hydrometeor detrainment in low levels (below max mass flux)

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TYPHOON 19W (CHANTHU) WARNING #6A
*** AMENDED ***
WTPN32 PGTW 071500 AMD
071200Z POSIT: NEAR 16.3N 134.6E
MOVING 280 DEGREES TRUE AT 11 KNOTS
MAXIMUM SIGNIFICANT WAVE HEIGHT: 28 FEET
07/12Z, WINDS 085 KTS, GUSTS TO 105 KTS
08/00Z, WINDS 115 KTS, GUSTS TO 140 KTS
08/12Z, WINDS 130 KTS, GUSTS TO 160 KTS
09/00Z, WINDS 130 KTS, GUSTS TO 160 KTS
09/12Z, WINDS 125 KTS, GUSTS TO 150 KTS
10/12Z, WINDS 135 KTS, GUSTS TO 165 KTS
11/12Z, WINDS 115 KTS, GUSTS TO 140 KTS
12/12Z, WINDS 090 KTS, GUSTS TO 110 KTS
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CPA TO:	NM	DTG
MANILA	333	09/10/05Z
CLARK_AB	314	09/10/08Z
SUBIC_BAY	347	09/10/09Z
KAOHSIUNG	32	09/11/19Z
TAIPEI	190	09/12/02Z
HONG_KONG	240	09/12/12Z

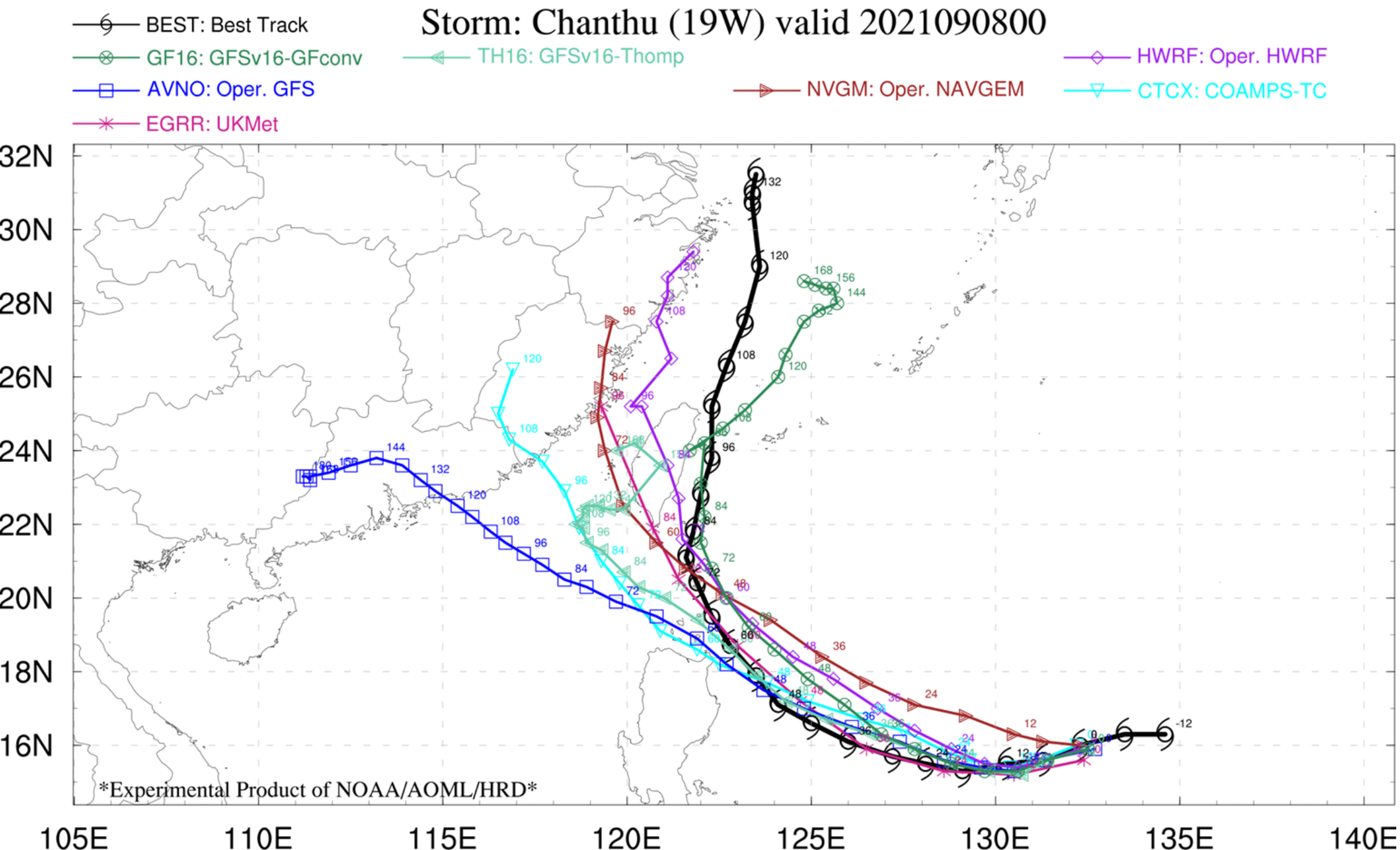
LESS THAN 34 KNOTS
34-63 KNOTS
MORE THAN 63 KNOTS
FORECAST CYCLONE TRACK
PAST CYCLONE TRACK
DENOTES 34 KNOT WIND DANGER AREA/USN SHIP AVOIDANCE AREA
FORECAST 34/50/64 KNOT WIND RADII (WINDS VALID OVER OPEN OCEAN ONLY)

Super Typhoon Chanthu**, from AOML website**

JTWC forecast from 15z/7 Sep

Late Track Guidance

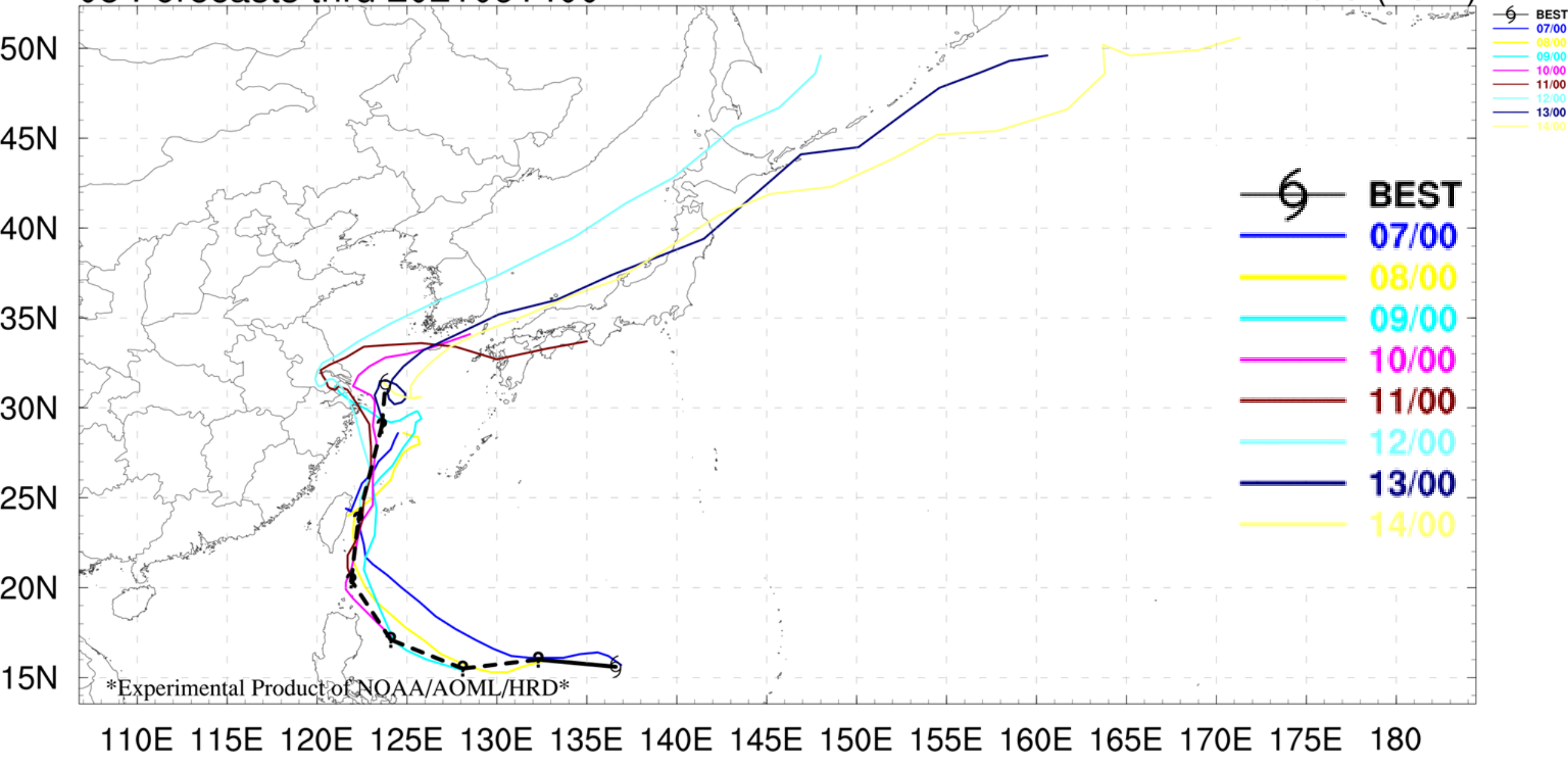
Storm: Chanthu (19W) valid 2021090800



GF16 Lifetime Track Forecasts

08 Forecasts thru 2021091400

Chanthu (19W)

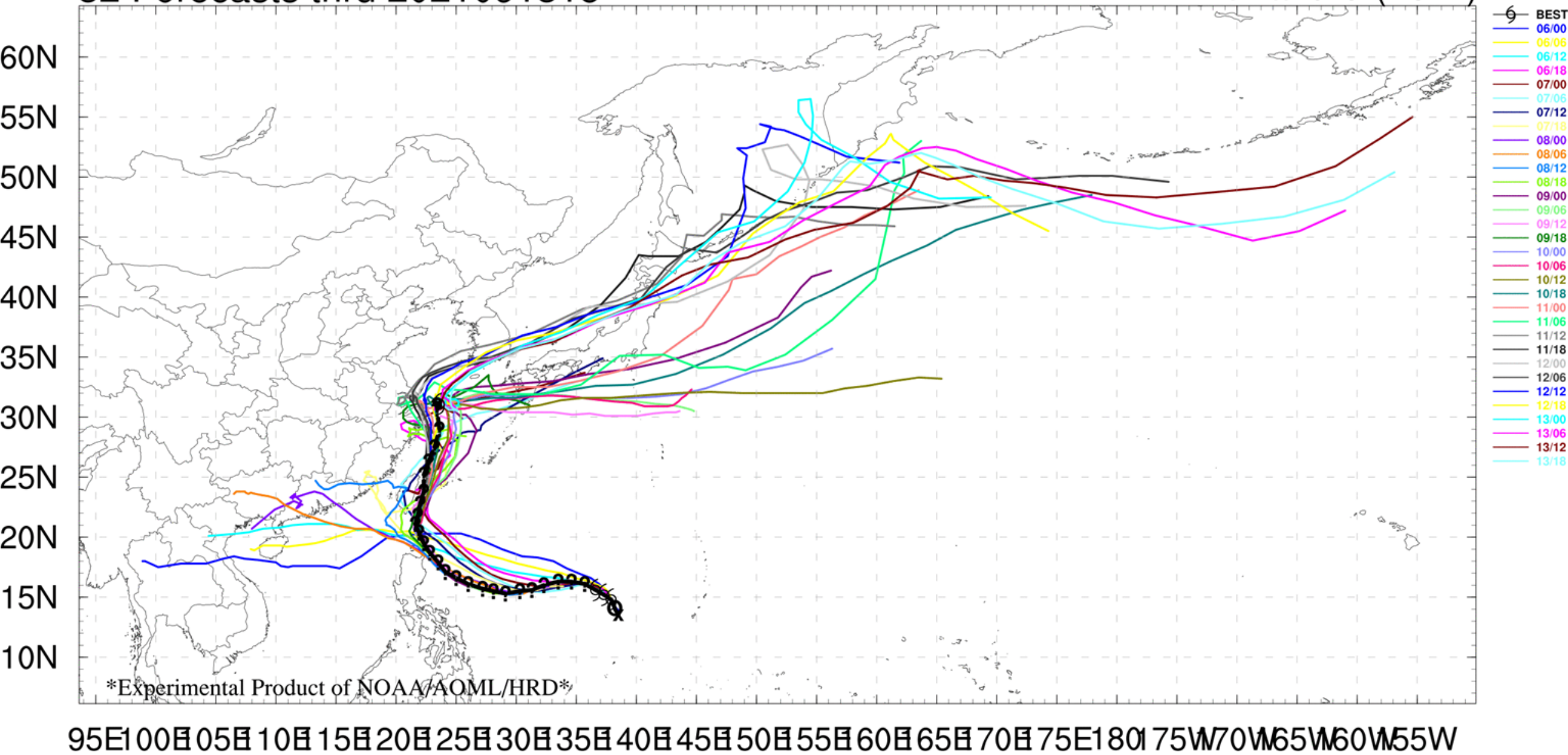


The GF had the most consistent track forecasts, keeping all forecast tracks east of Taiwan.

AVNO Lifetime Track Forecasts

32 Forecasts thru 2021091318

Chanthu (19W)

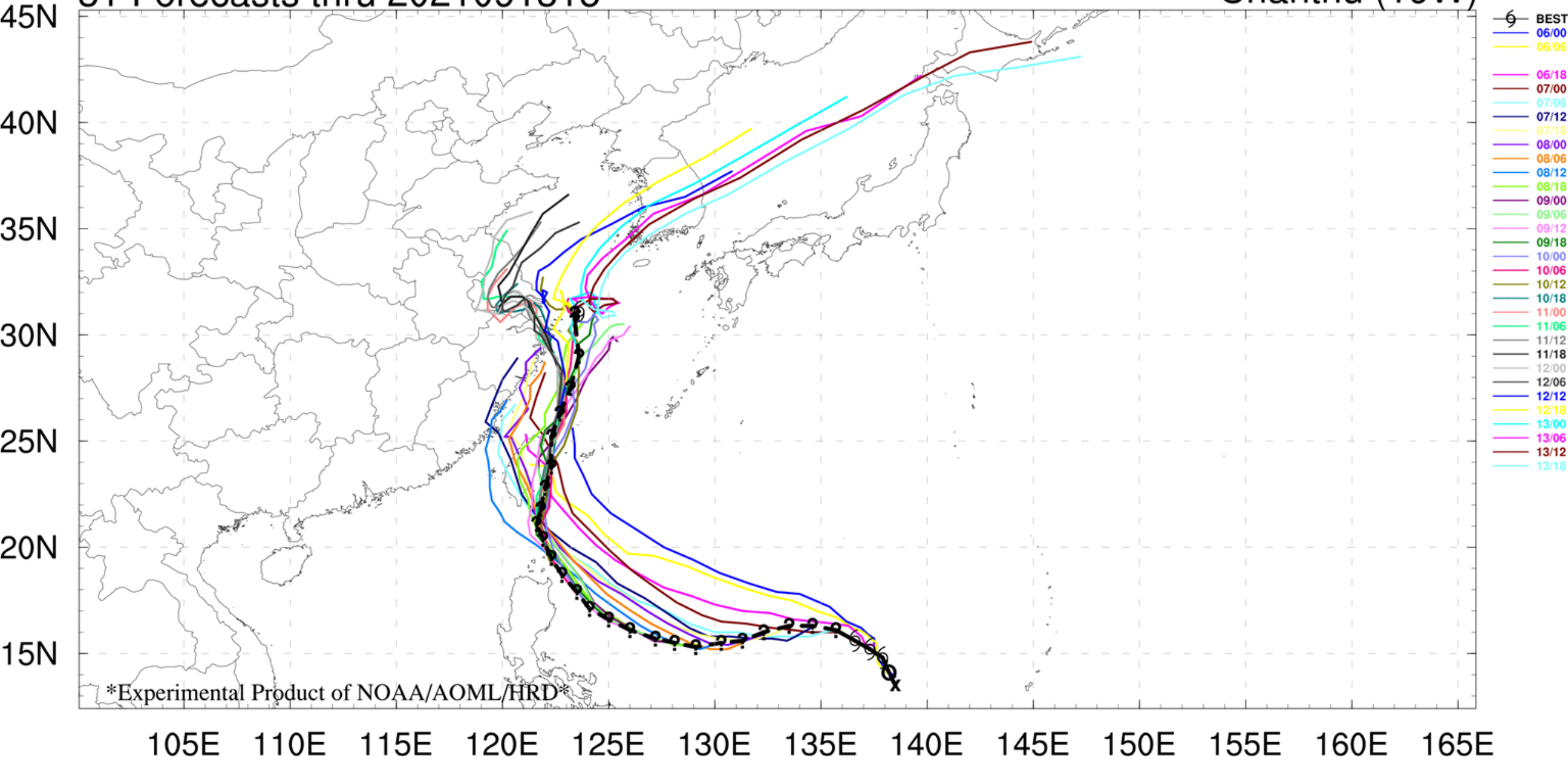


These are all the GFS forecasts.

HWRF Lifetime Track Forecasts

31 Forecasts thru 2021091318

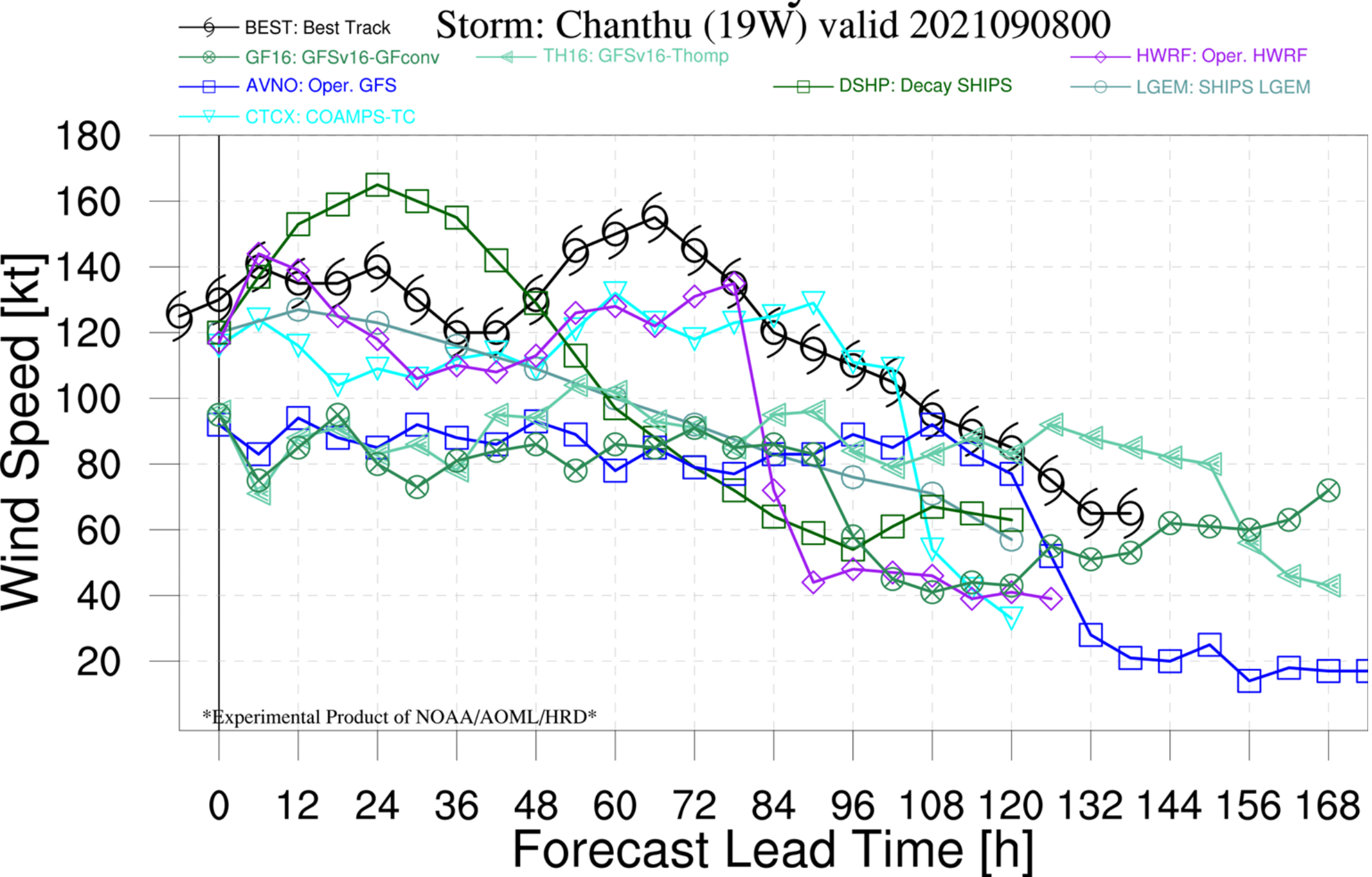
Chanthu (19W)



These are all the HWRF forecasts; the HWRF did not move the storm as much to the west but did hit Taiwan on some runs.

Late Intensity Guidance

Storm: Chanthu (19W) valid 2021090800

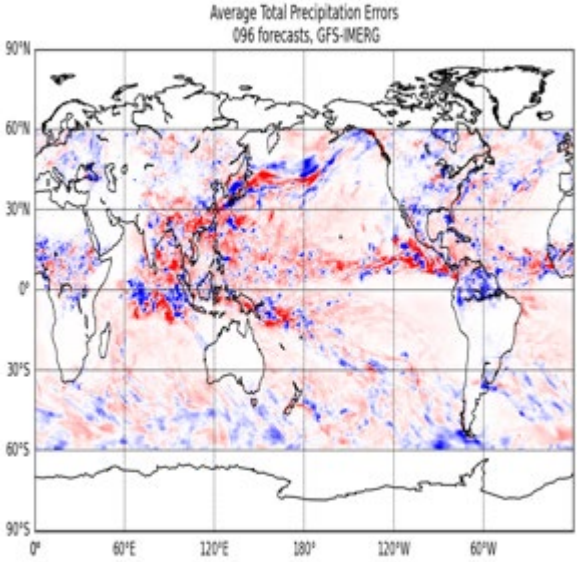


A second intensification occurs after 48-h out. Some increase in TH forecast winds as well as HWRF.

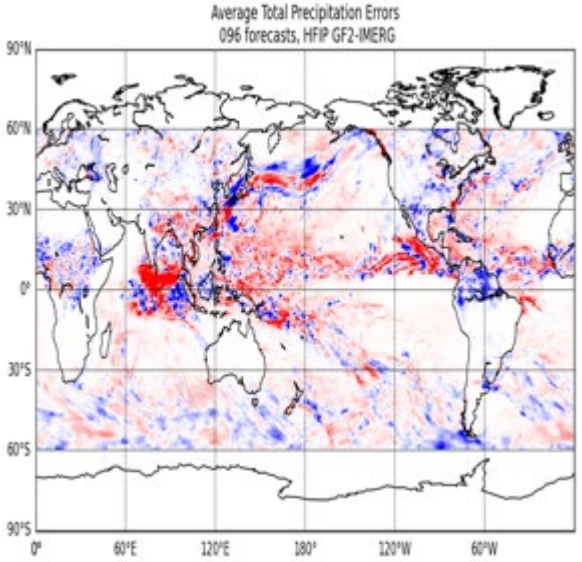
Total Precipitation Errors and Differences

GFS
HFIP GF2
HFIP MYNN
HFIP THMP
IMERG

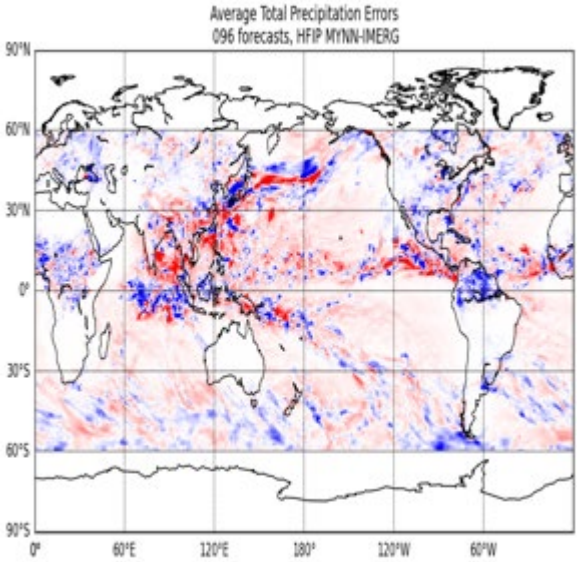
GFS – IMERG



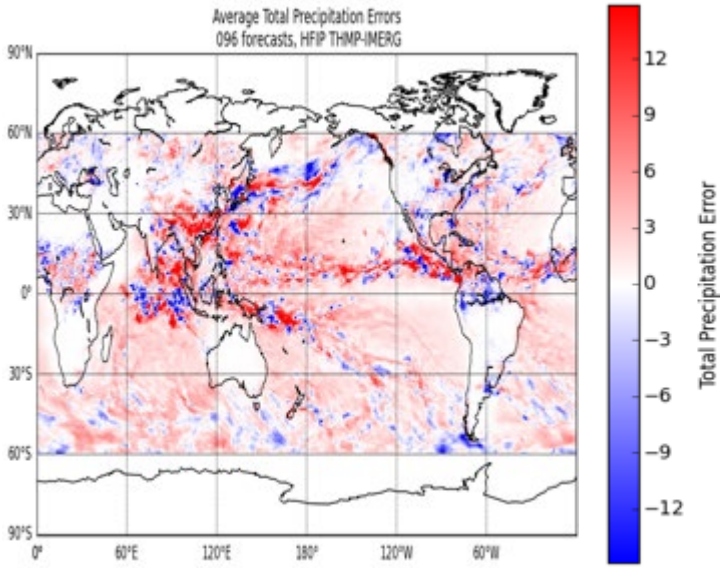
HFIP GF2 – IMERG



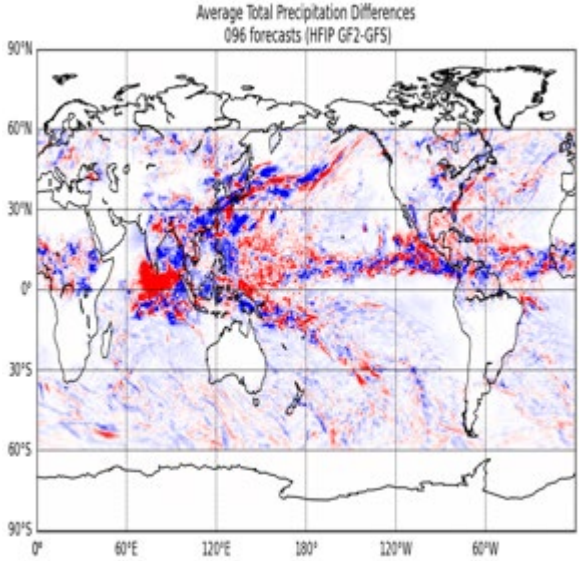
HFIP MYNN – IMERG



HFIP THMP – IMERG



HFIP GF2 – GFS



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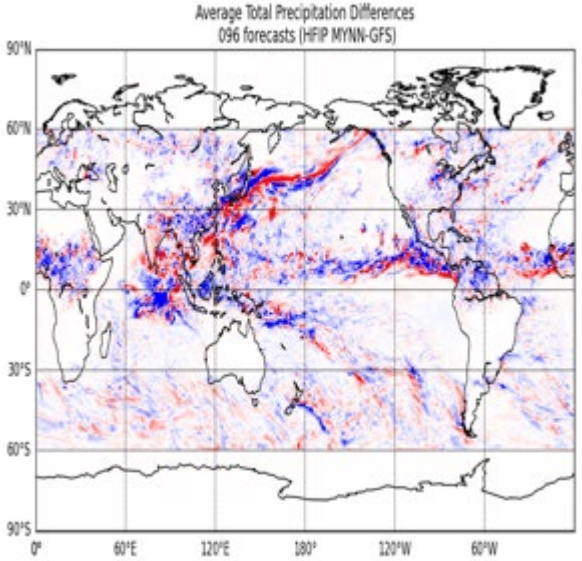
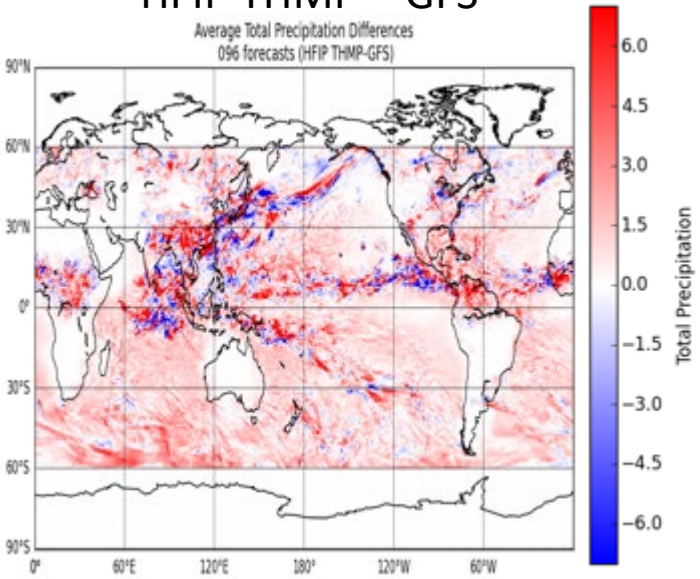
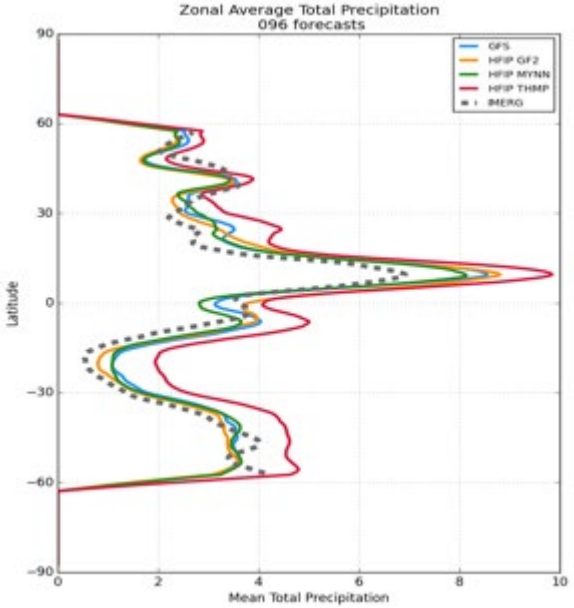


HFIP THMP – GFS

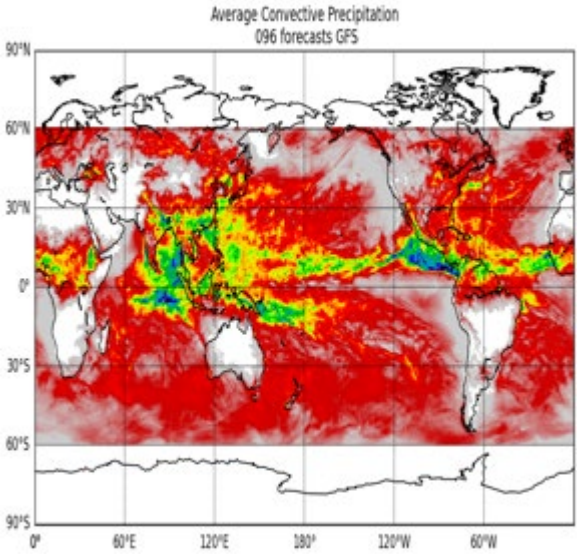




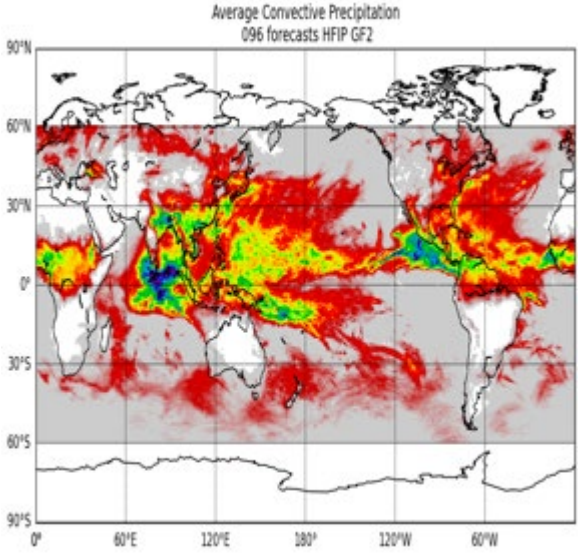
Convective Precipitation and Differences

GFS
HFIP GF2
HFIP MYNN
HFIP THMP

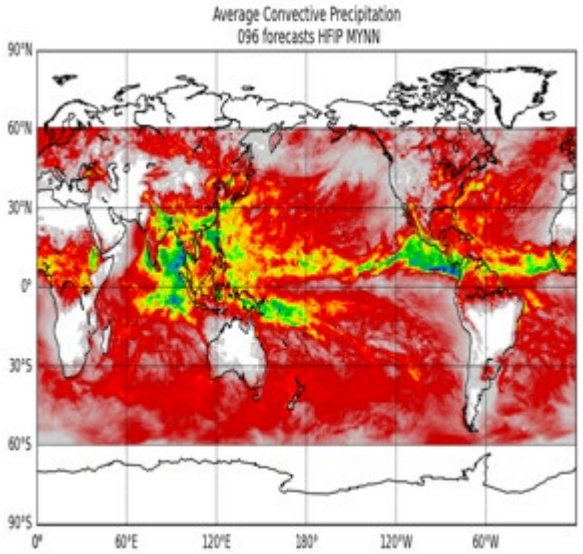
GFS



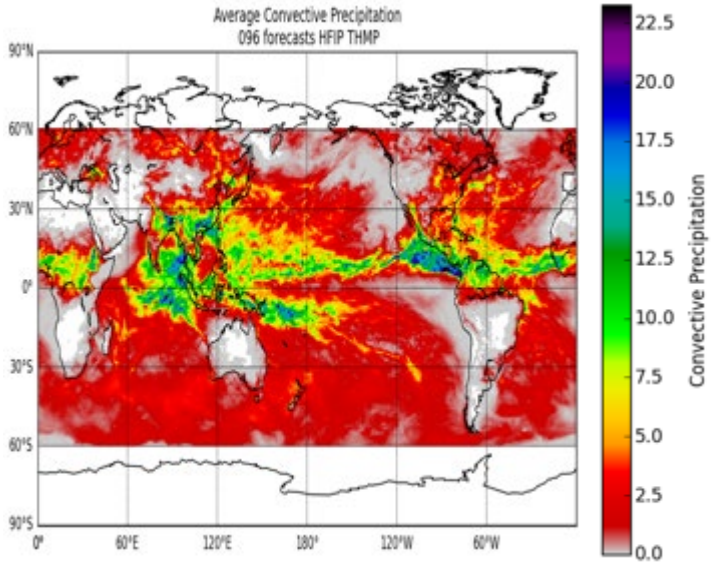
HFIP GF2



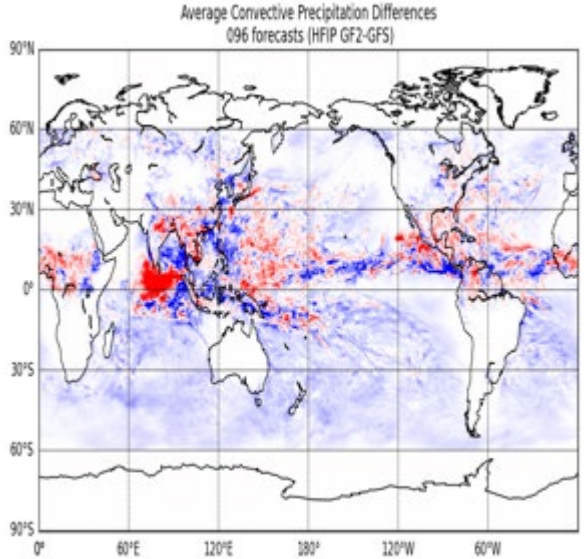
HFIP MYNN



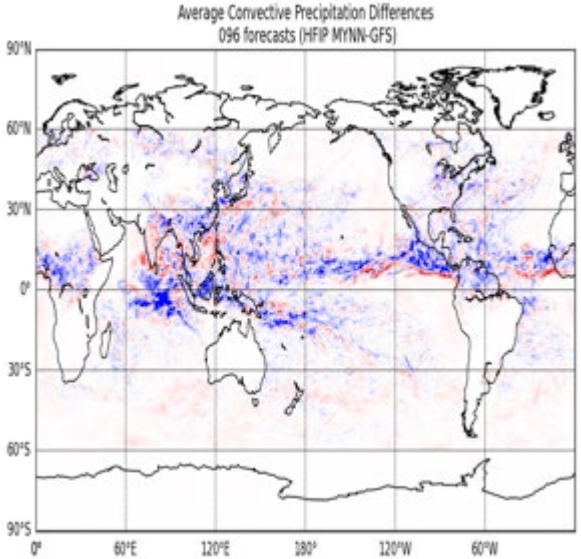
HFIP THMP



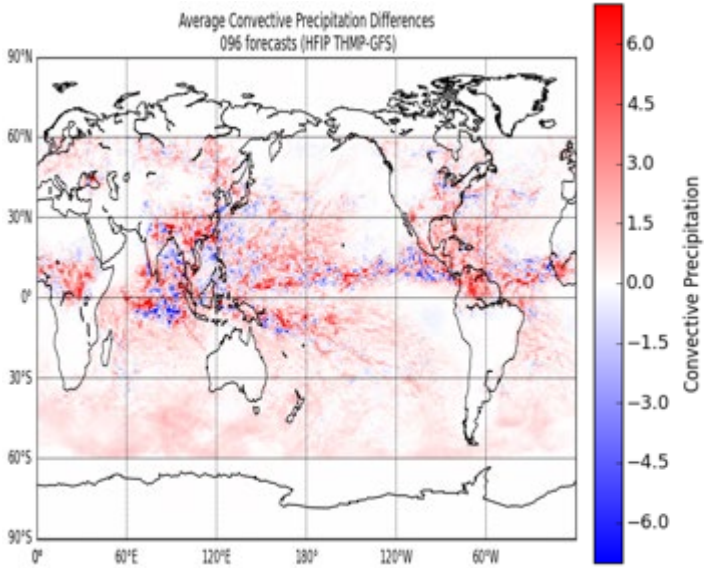
HFIP GF2 – GFS

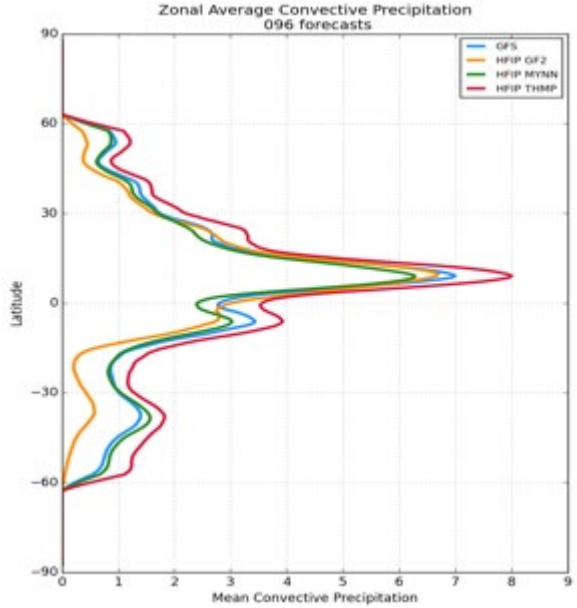


HFIP MYNN – GFS



HFIP THMP – GFS

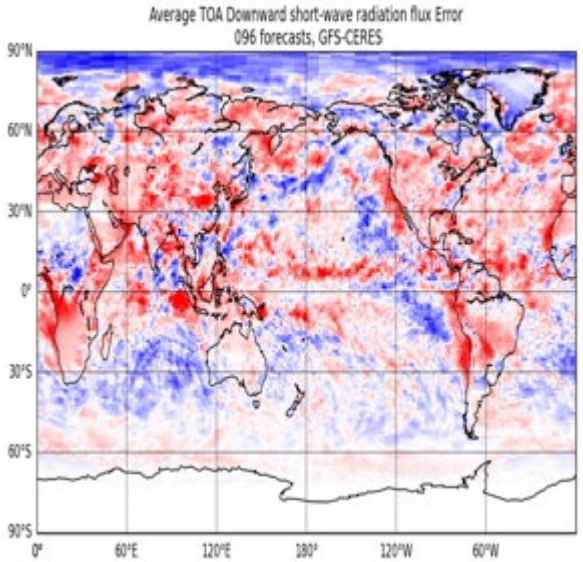




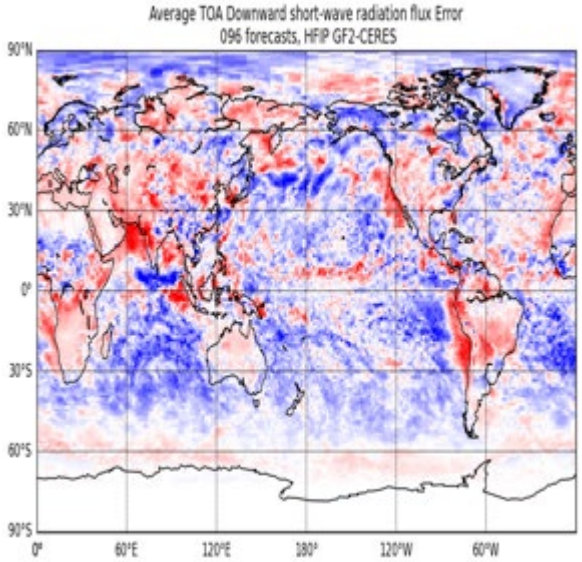
SFC Downward Short-Wave Radiative Flux Errors and Differences

GFS-CERES
HFIP GF2-CERES
HFIP MYNN-CERES
HFIP THMP-CERES

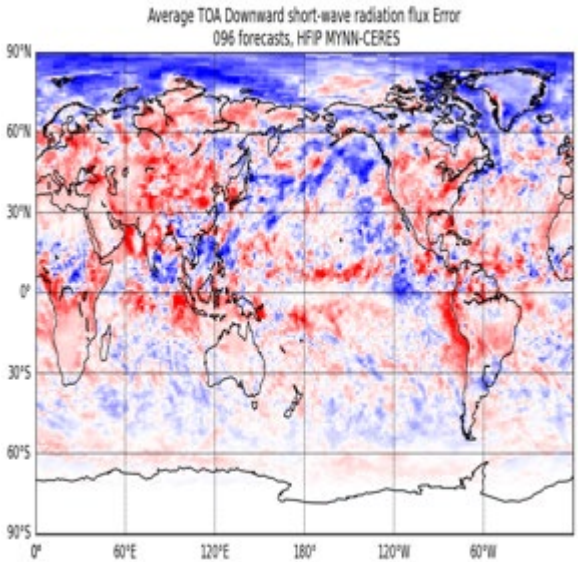
GFS – CERES



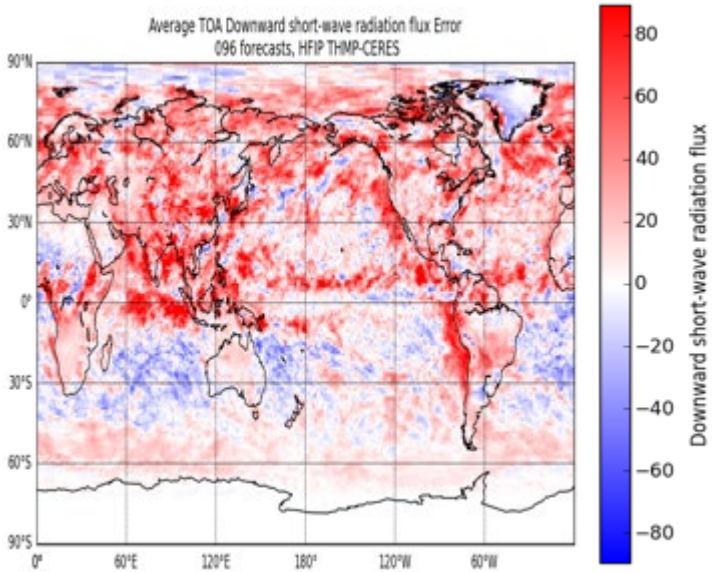
HFIP GF2 – CERES



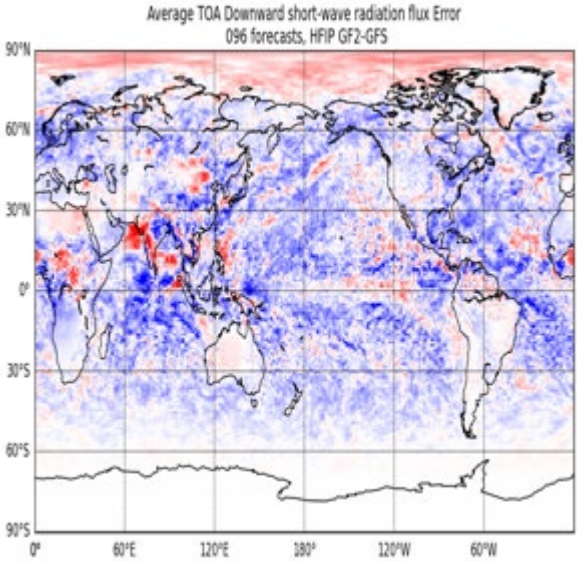
HFIP MYNN – CERES



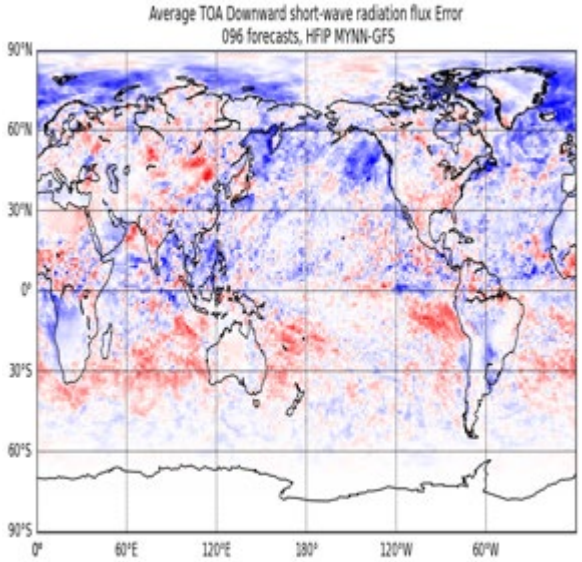
HFIP THMP – CERES



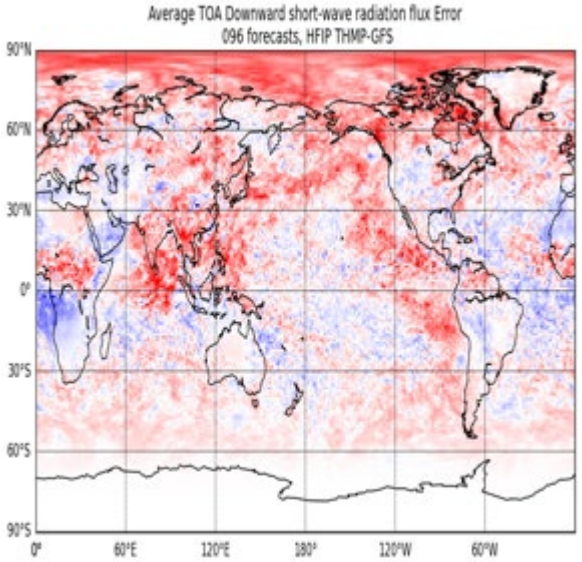
HFIP GF2 – GFS

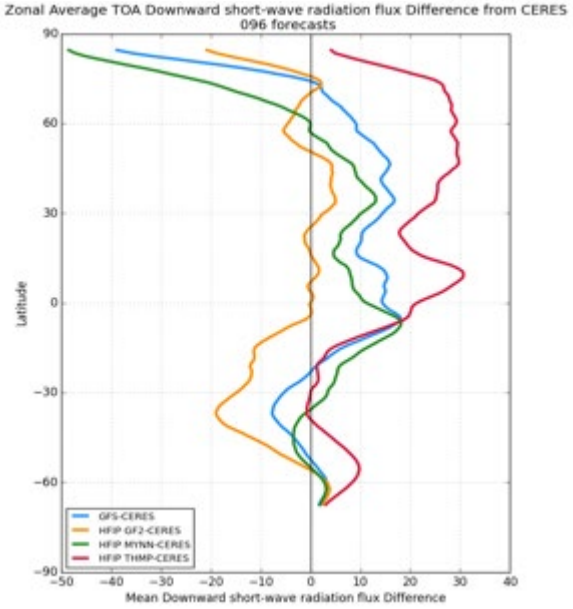


HFIP MYNN – GFS



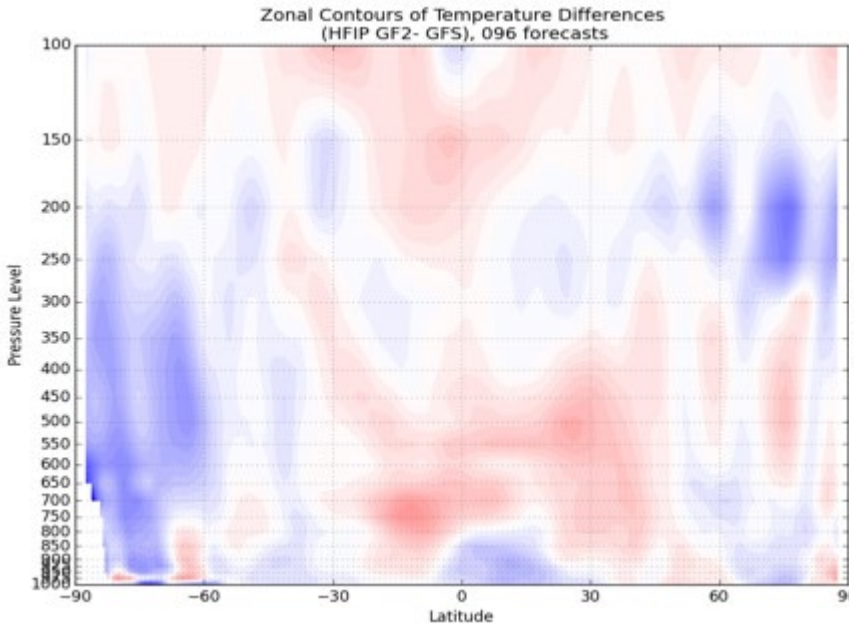
HFIP THMP – GFS



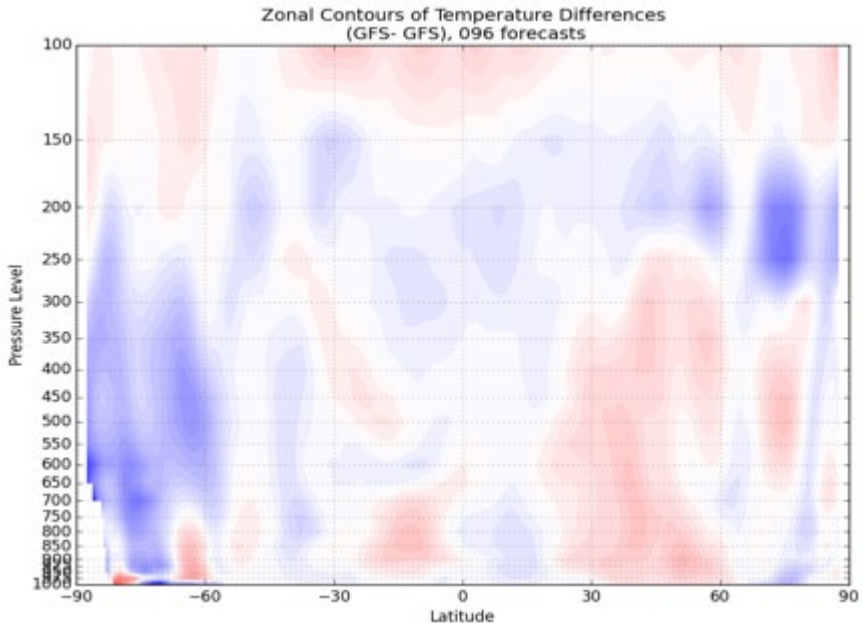


Zonal – Height Temperature Error Contours

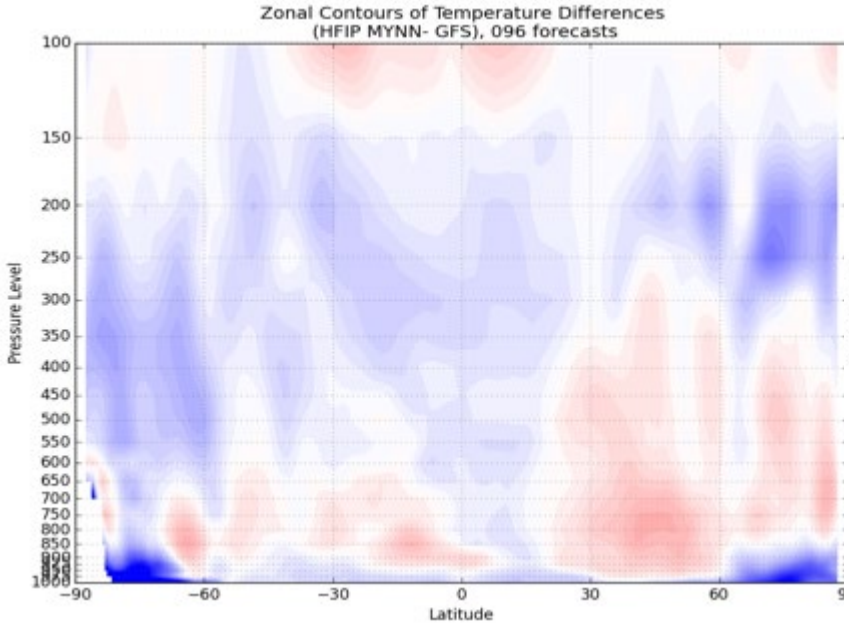
GFS – GFS Analysis



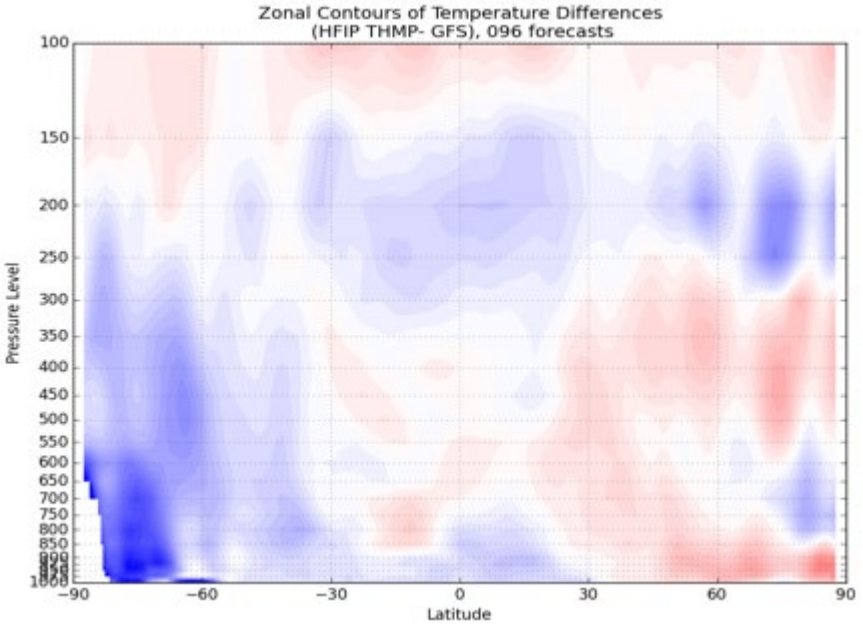
HFIP GF2 – GFS Analysis

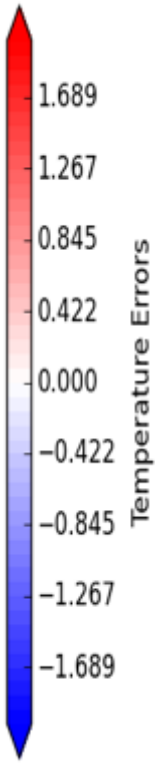


HFIP MYNN – GFS Analysis



HFIP THMP – GFS Analysis





Summary

- Negative mixing ratios from GFS physics
  - Impact the Thompson runs very significantly
  - Probably also impact GF runs slightly (maybe impacting the aero version more?)
- Initial results for track error look promising for GF runs, not enough data for any significance yet
- ACC scores look improved, but again, more verification data are needed
- Compared to GFS analysis, GF runs have a significant warm bias in the tropics the upper levels, but improved bias over CONUS, also compared to RAOBS
- Warm bias can be improved with tuning
- Work still in progress to find out why MYNN run hangs randomly with initialization
- Exchanging one scheme at a time can lead to very different radiation balances
  - Tuning especially the coupling with radiation is important for future
- Can we learn something from the fact – caused by having to clip large negative mix ratios - for TH runs, acc scores as well as biases are improved, yet radiation balances are worse, precipitation is over forecast ?