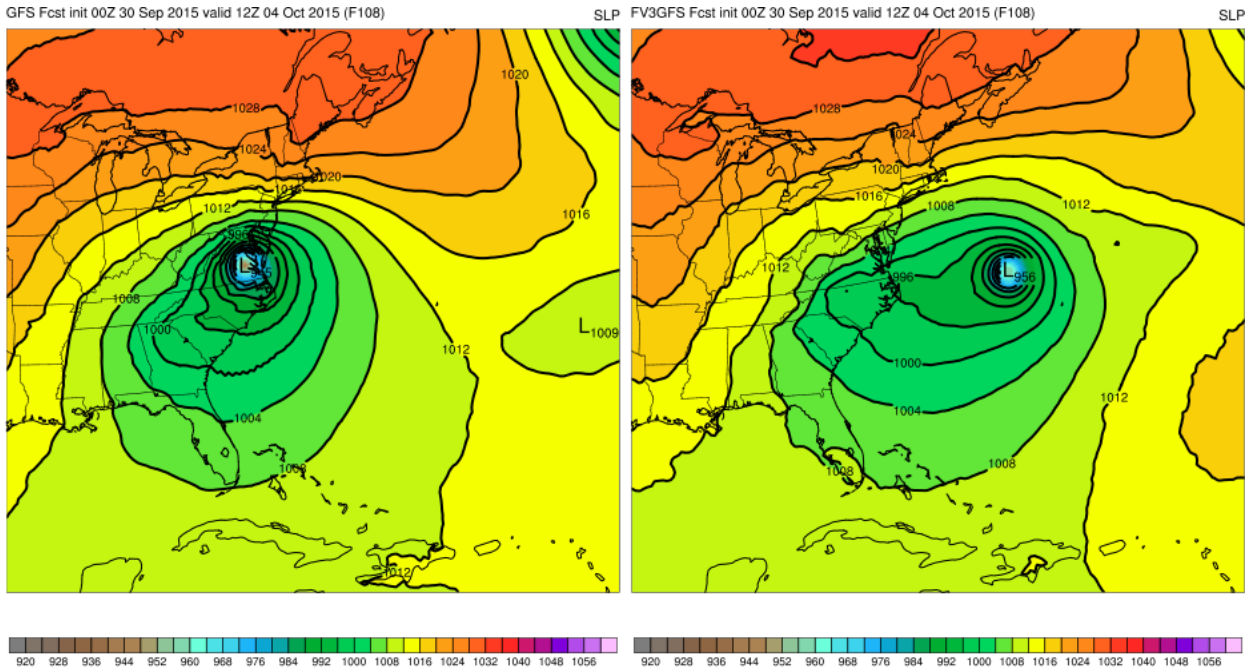
FV3GFS PERFORMANCE ON TROPICAL CYCLONES



Geoff Manikin, Alicia Bentley, Logan Dawson, Tracey Dorian

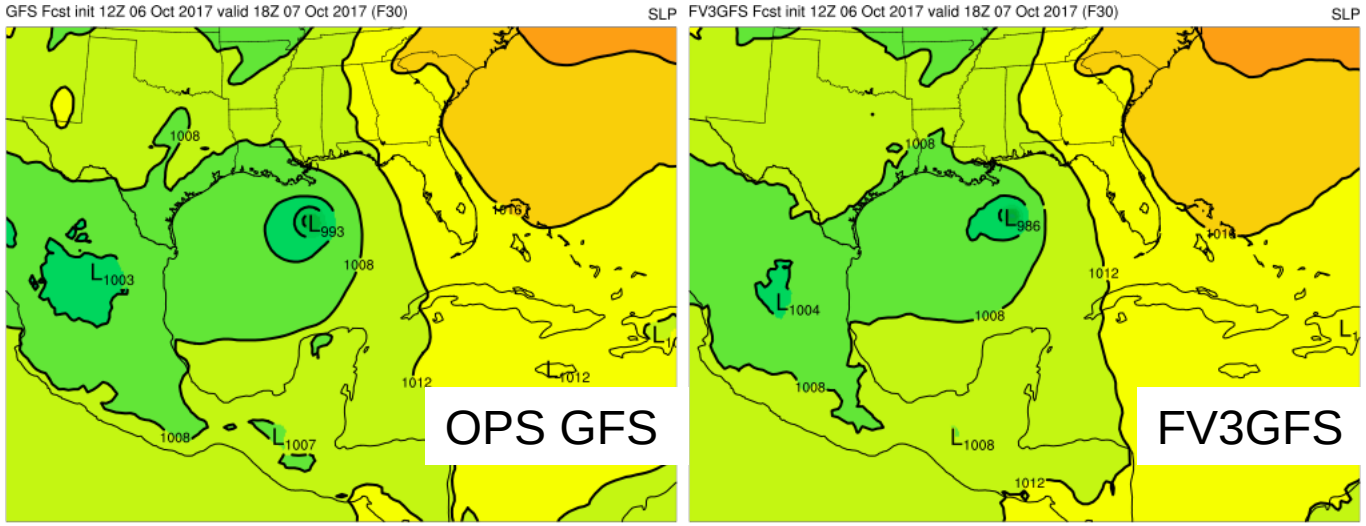
NCEP/EMC Model Evaluation Group

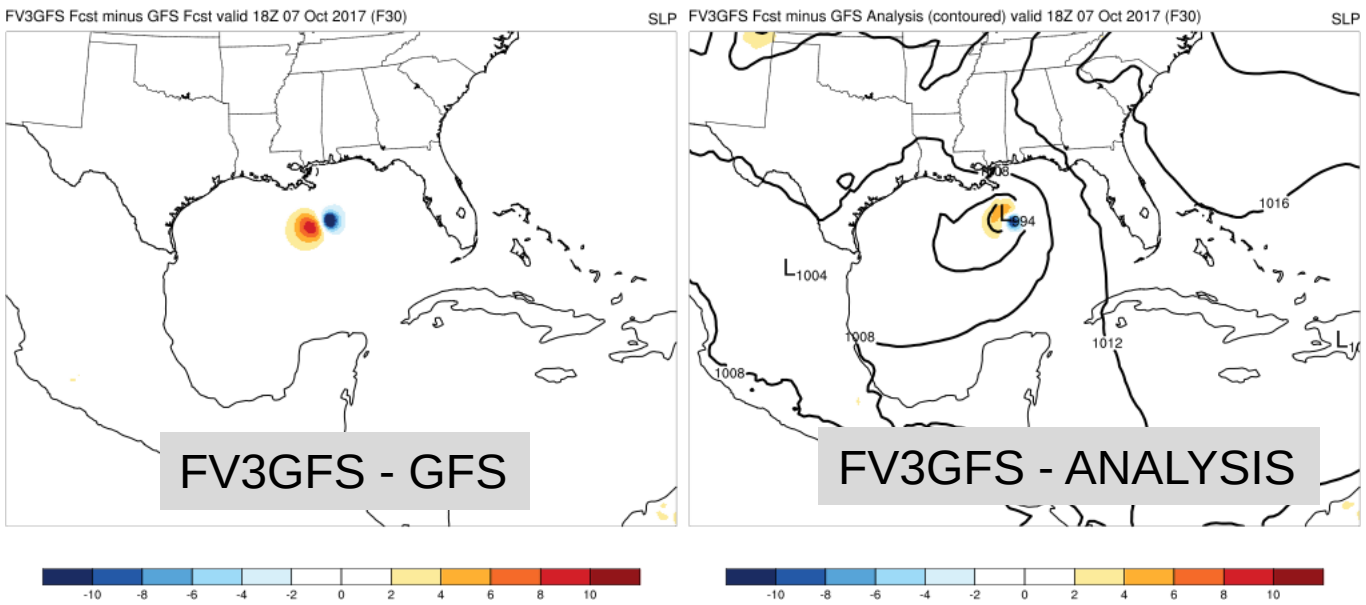
23 August 2018

Additional materials provided by Fanglin Yang, Vijay Tallapragada, Avichal Mehra

AN INITIAL LOOK AT CASES

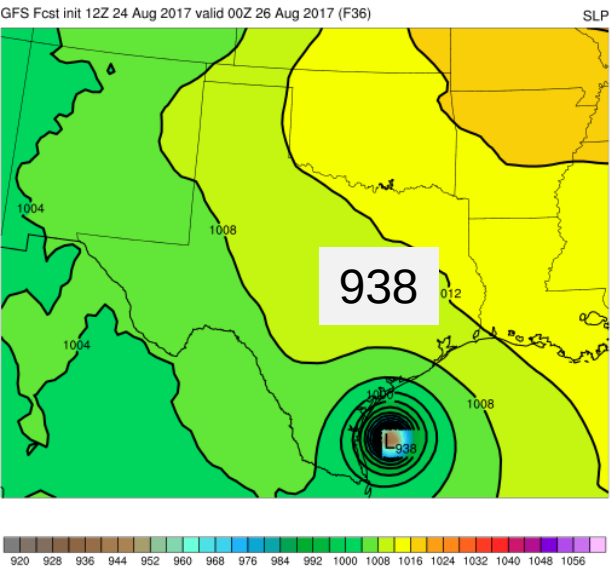
FORMAT OF SLIDES FOR THIS SECTION

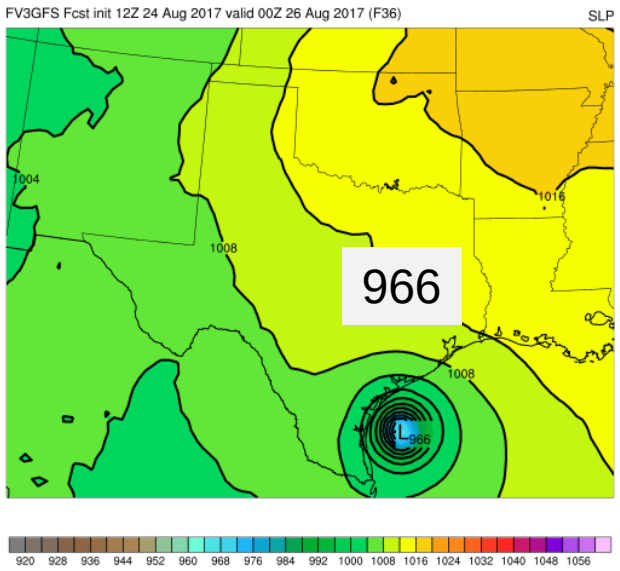


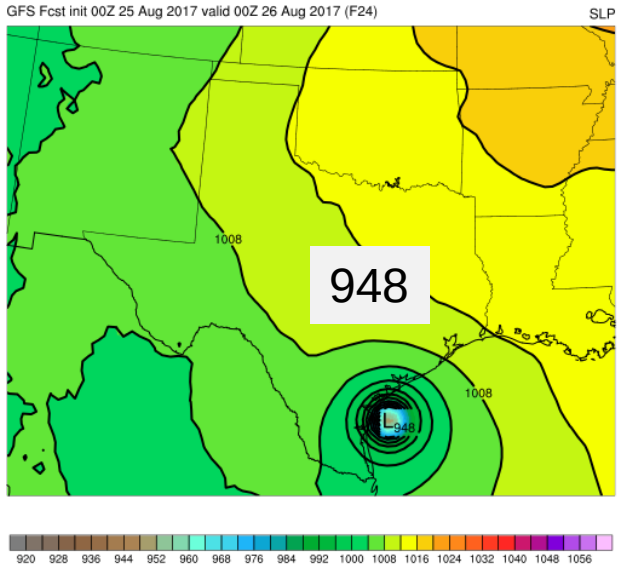


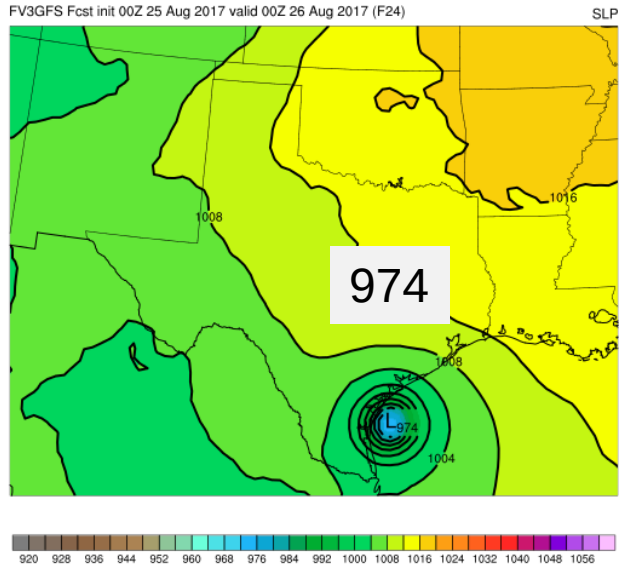
OPS GFS is used for analysis

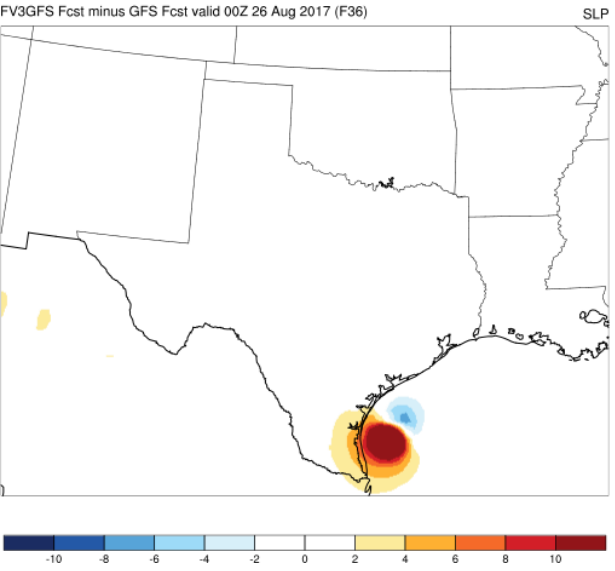
FV3GFS HARVEY RUNS CONSISTENTLY WEAKER THAN GFS

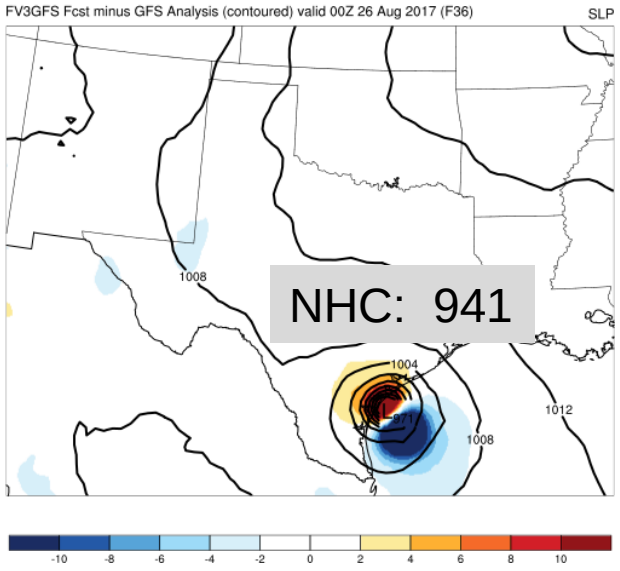


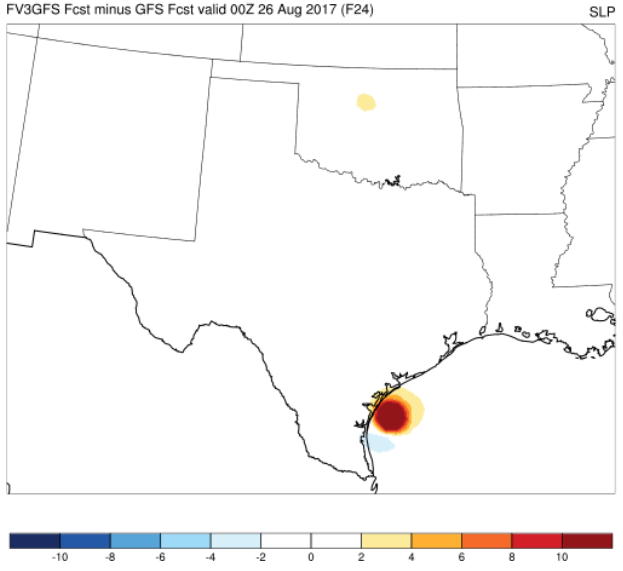


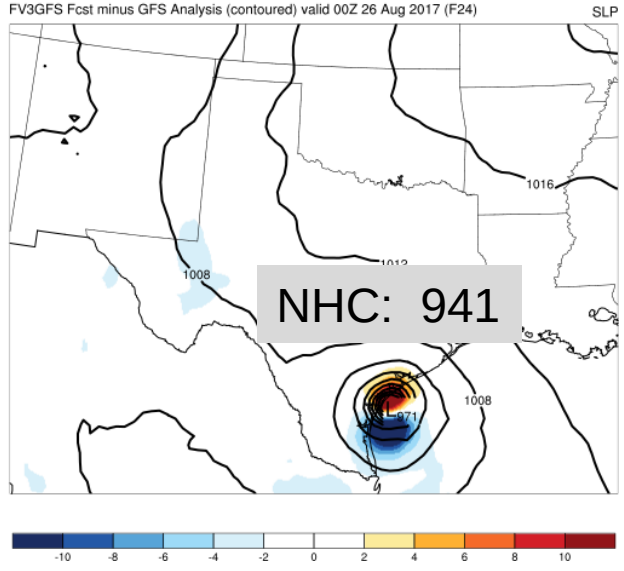




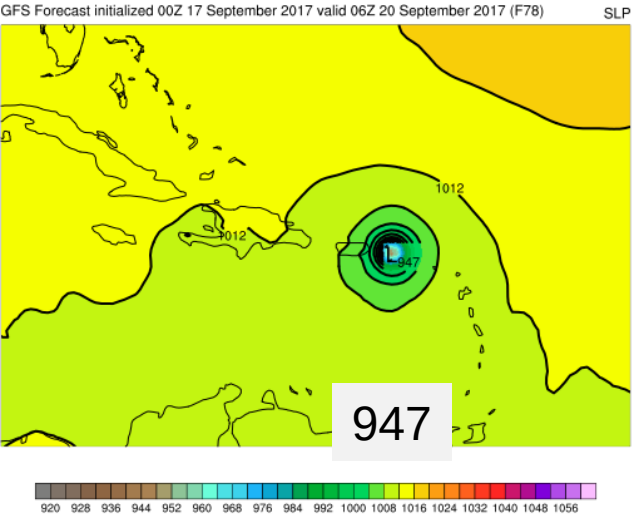


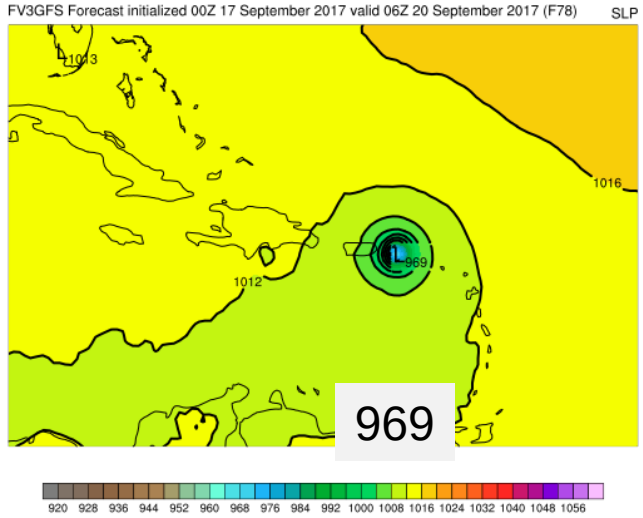


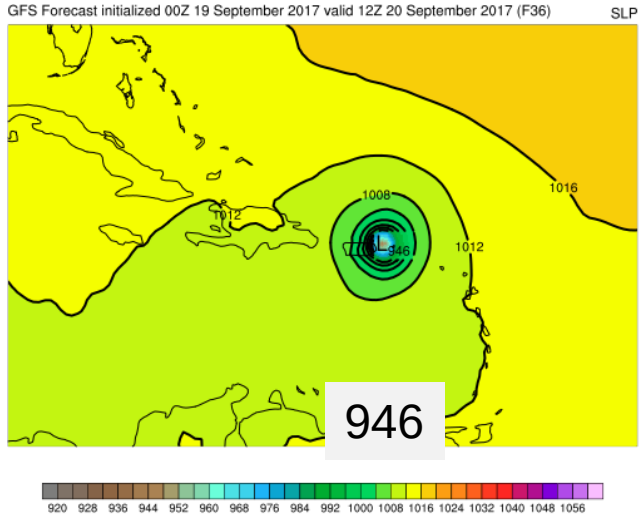


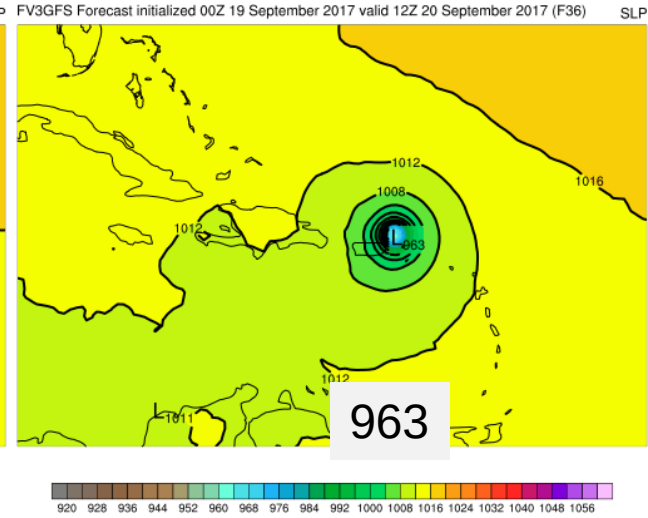


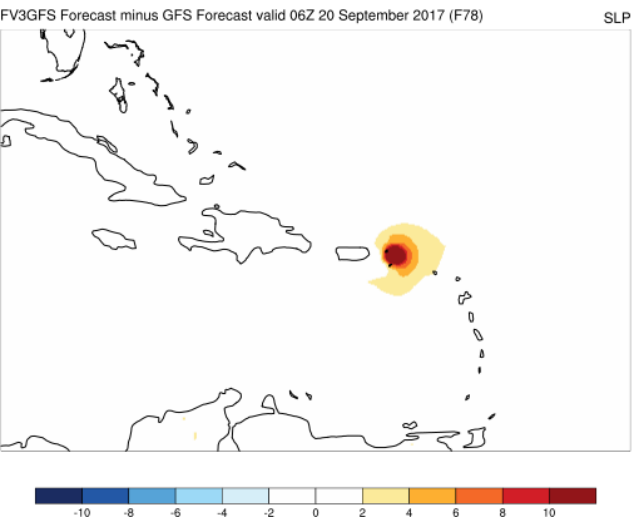
THE SAME WAS TRUE FOR MARIA

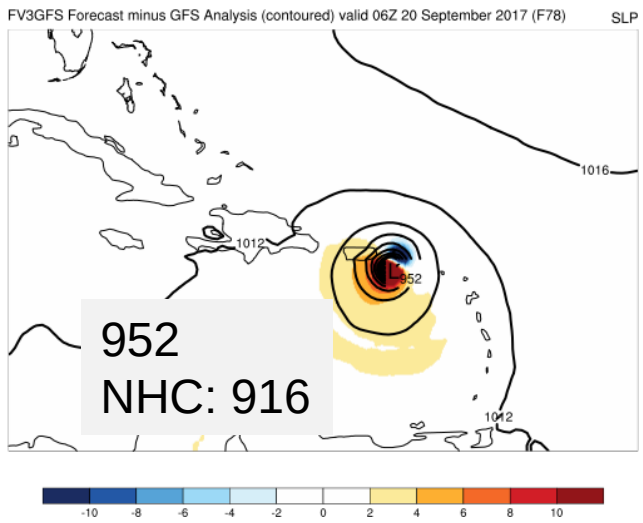


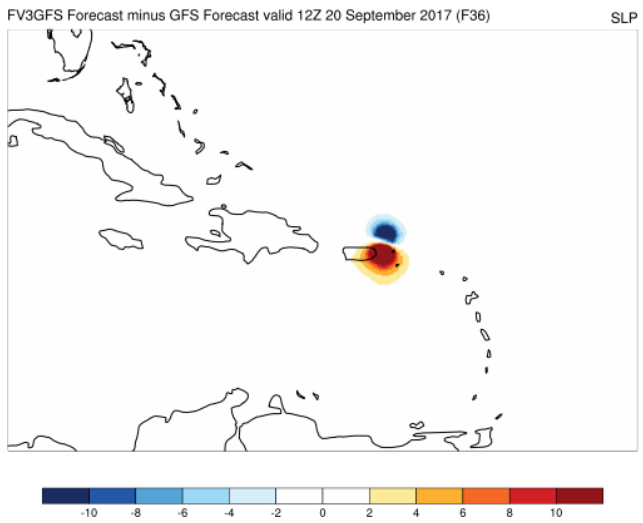


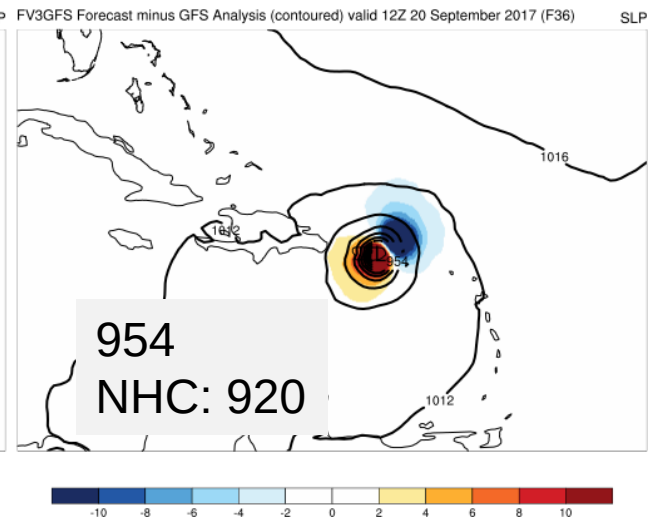


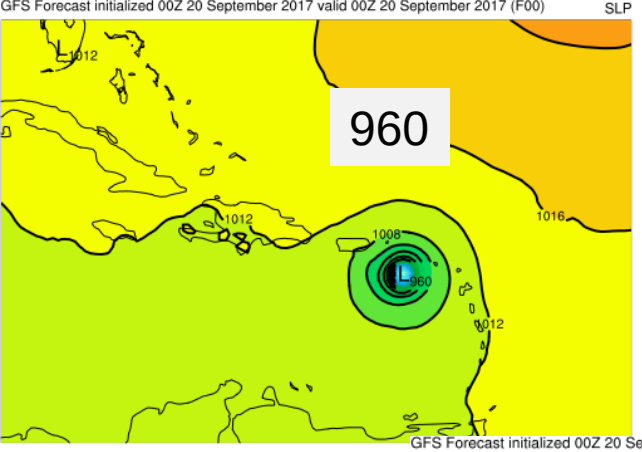


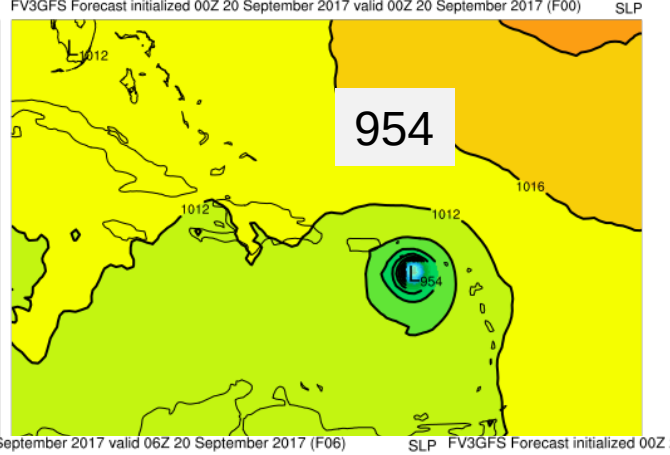




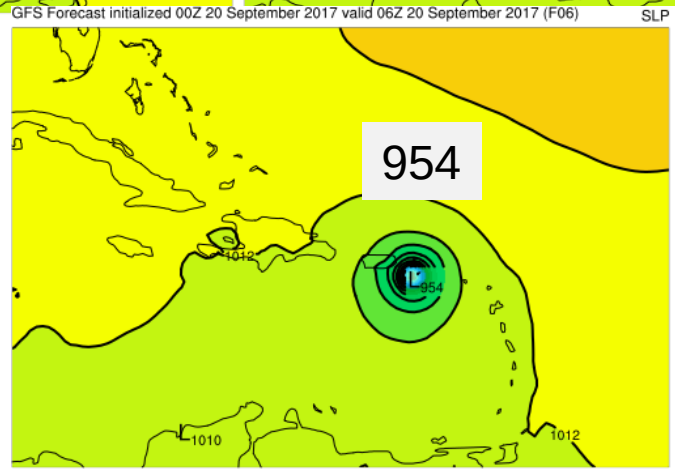


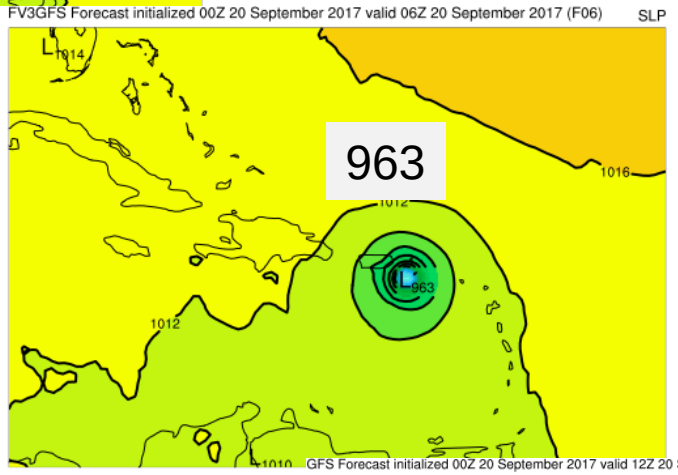




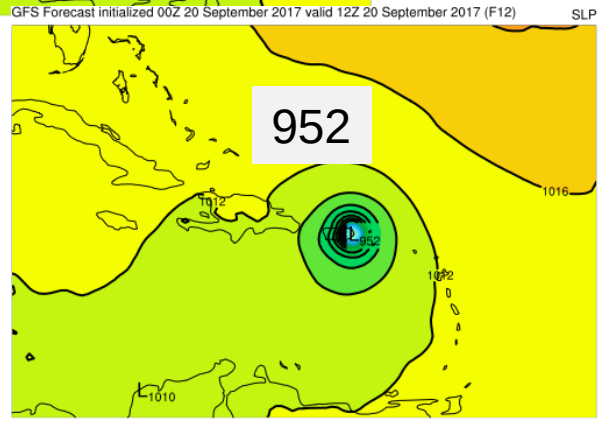


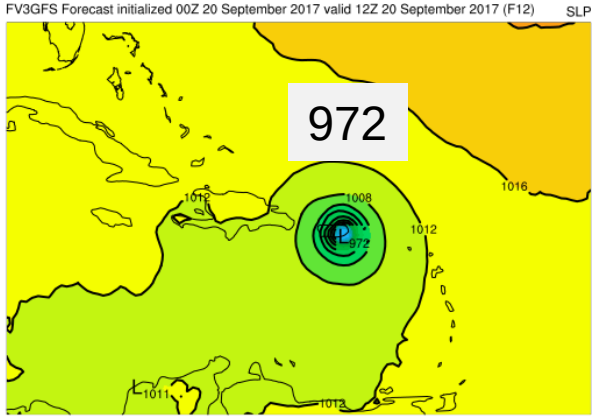
F00





F06

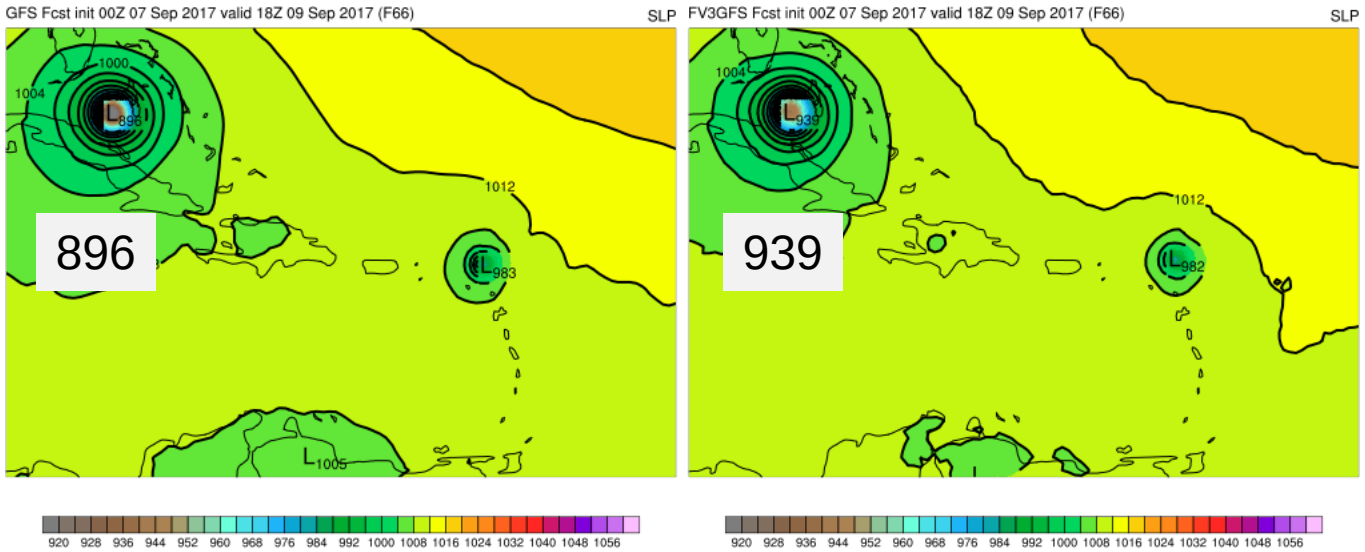


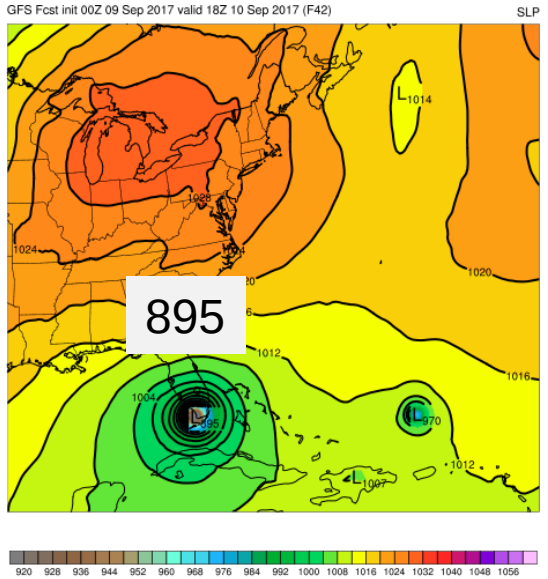


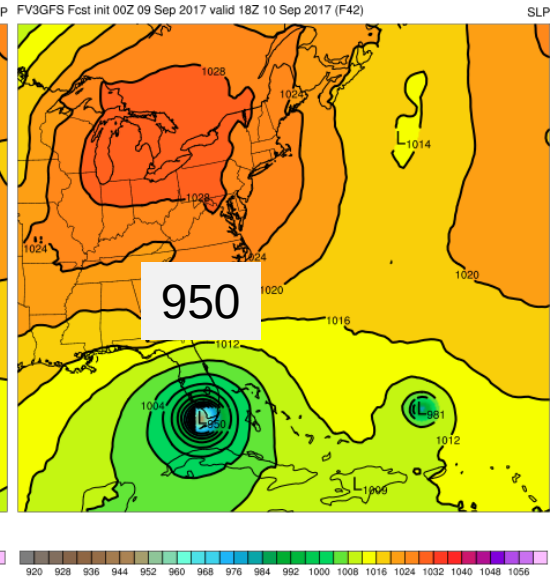
F12

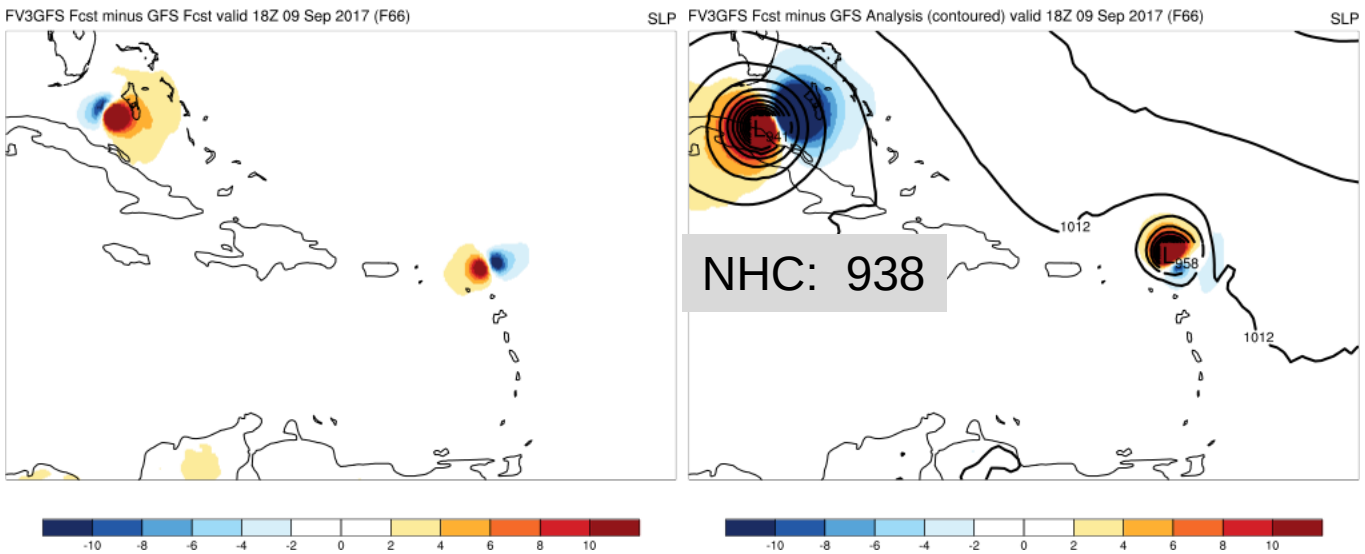
GFS intensifies Maria during first 12h
FV3GFS weakens Maria

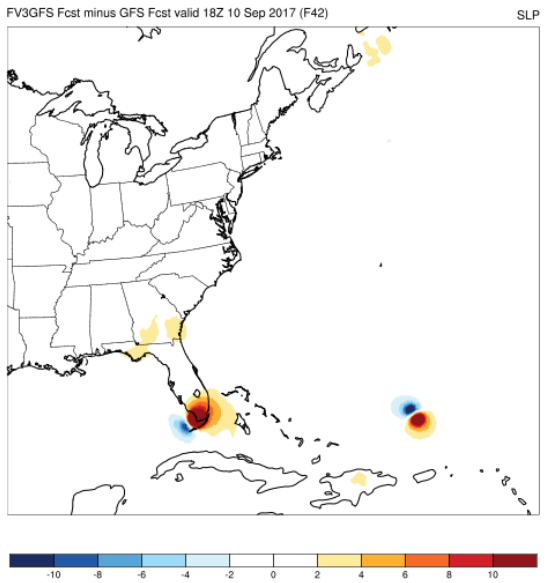
FV3GFS WAY WEAKER THAN GFS with IRMA, BUT OVERALL AN IMPROVEMENT DUE TO EXTREME GFS DEEPENING

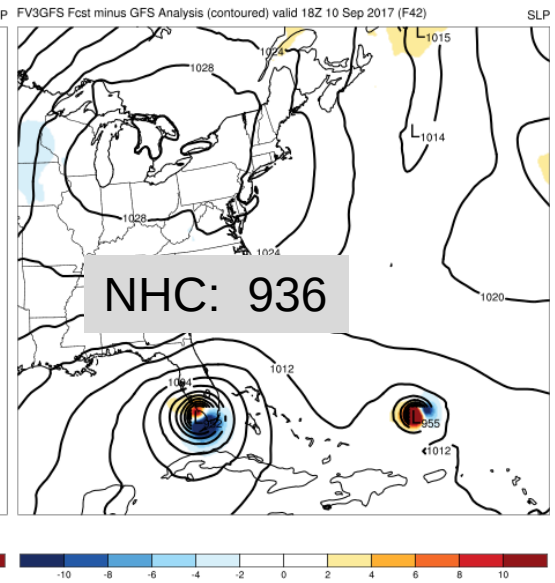






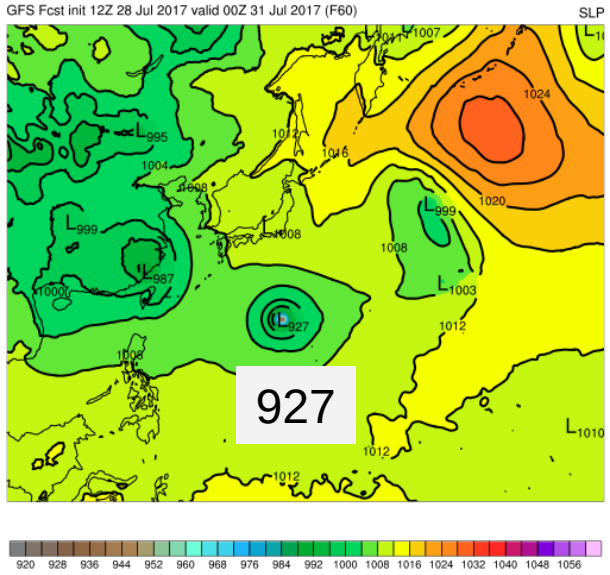


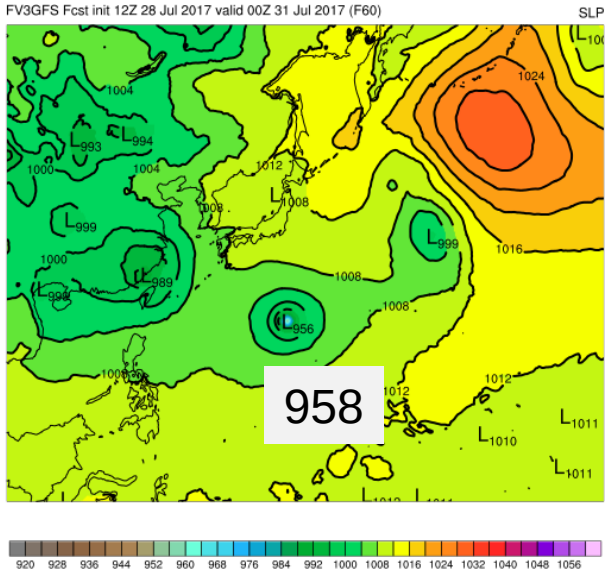


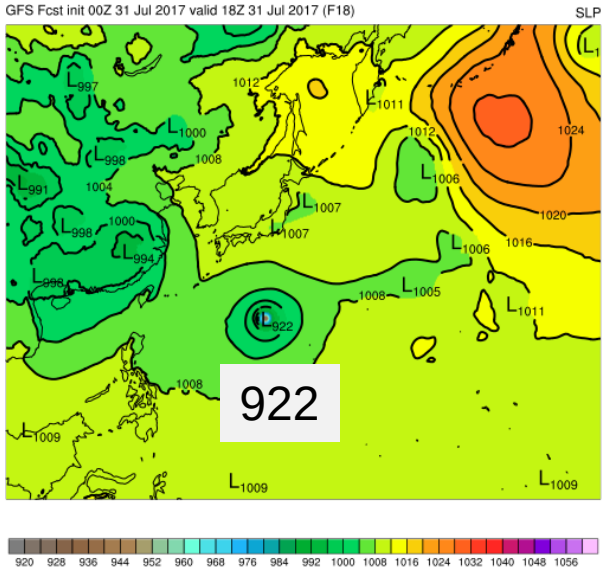


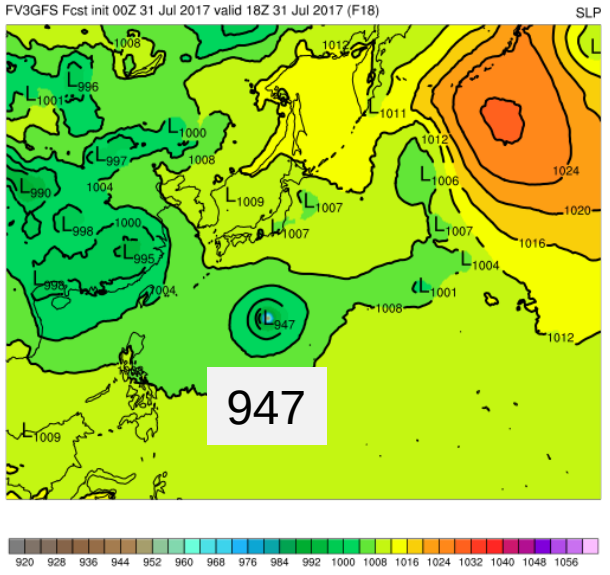
STILL, FV3GFS WEAKER THAN OBSERVED

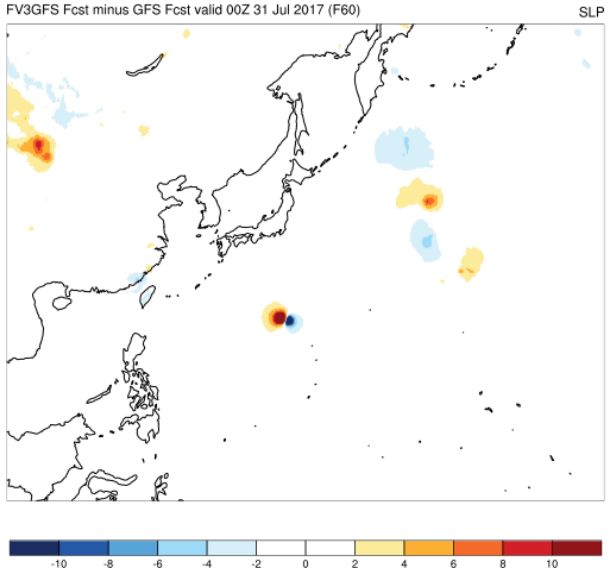
ISSUE OCCURRED IN ALL BASINS

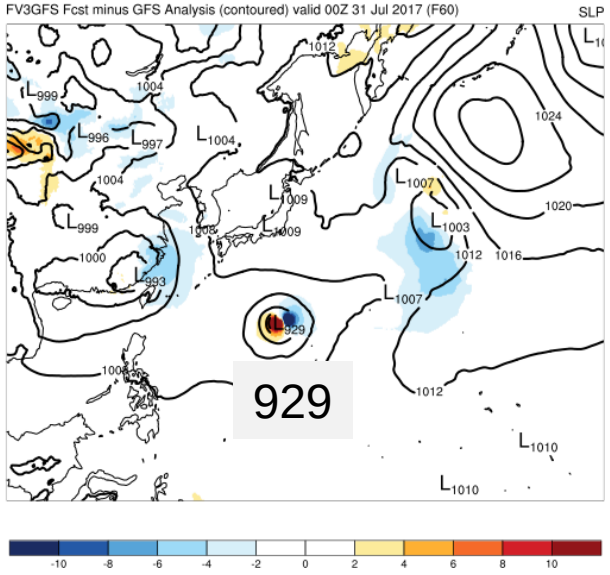


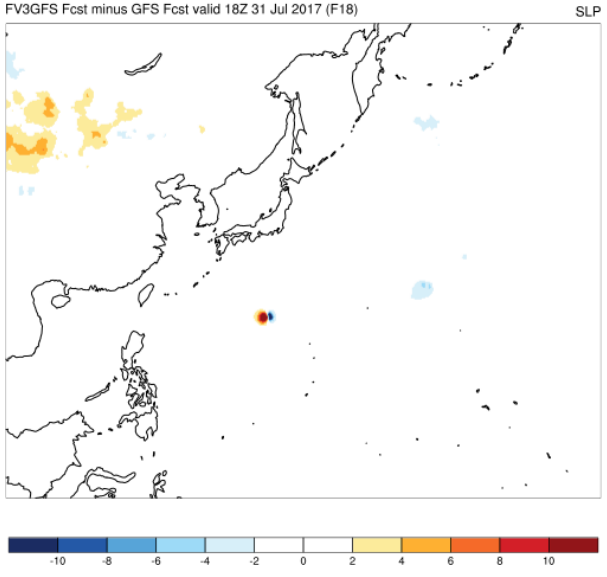


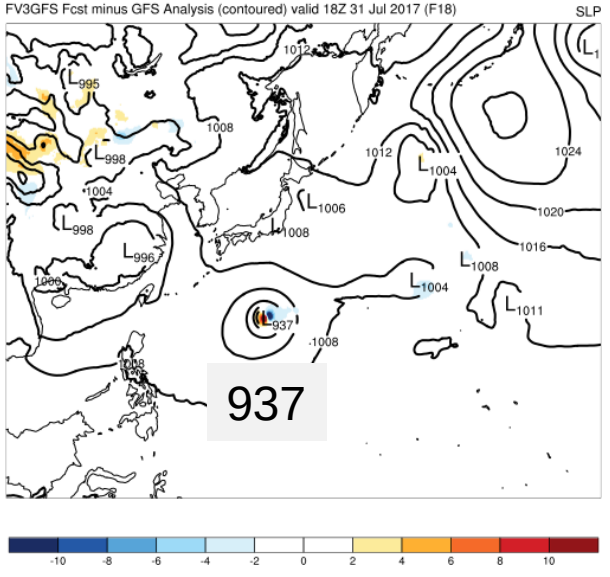






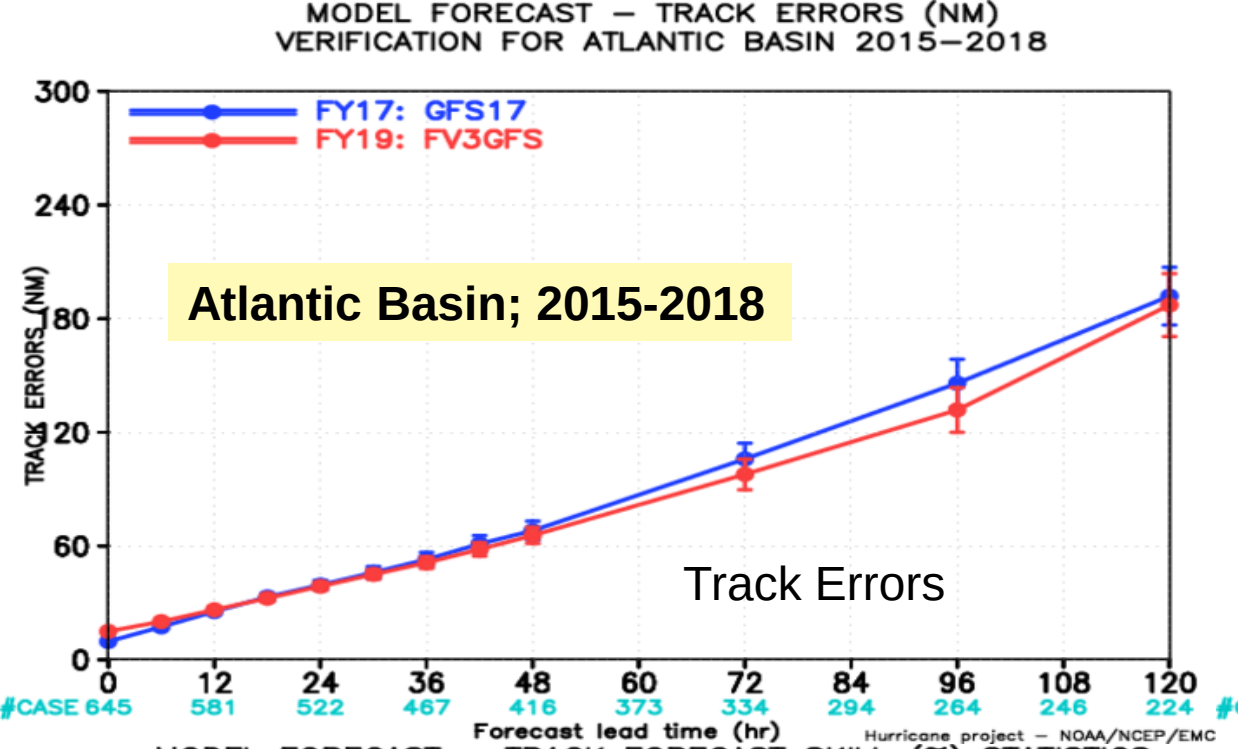


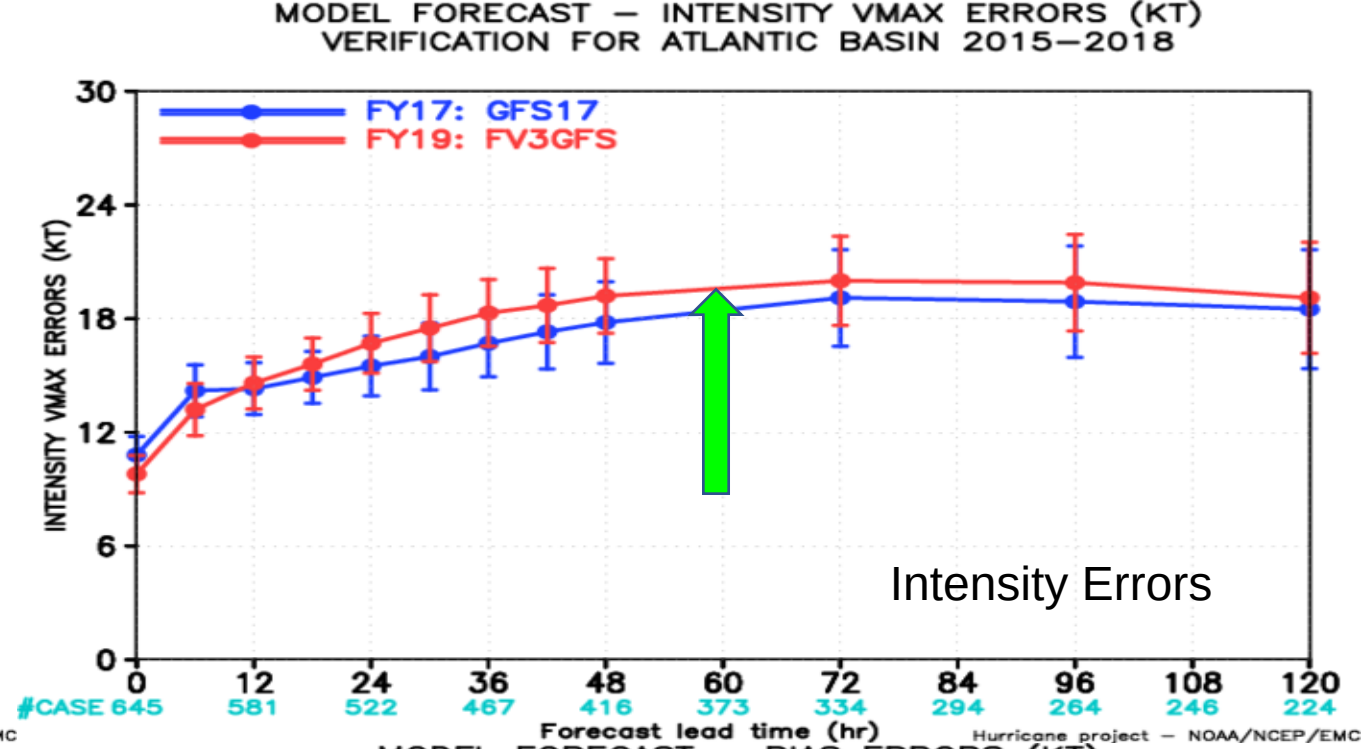


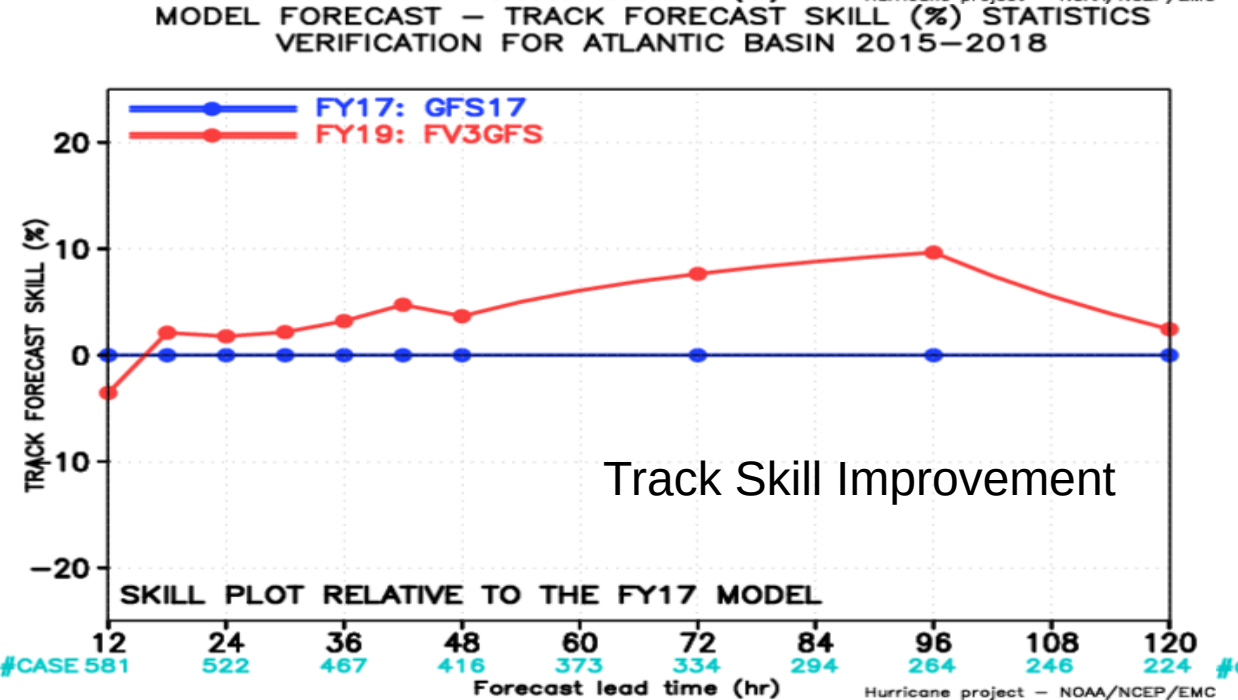


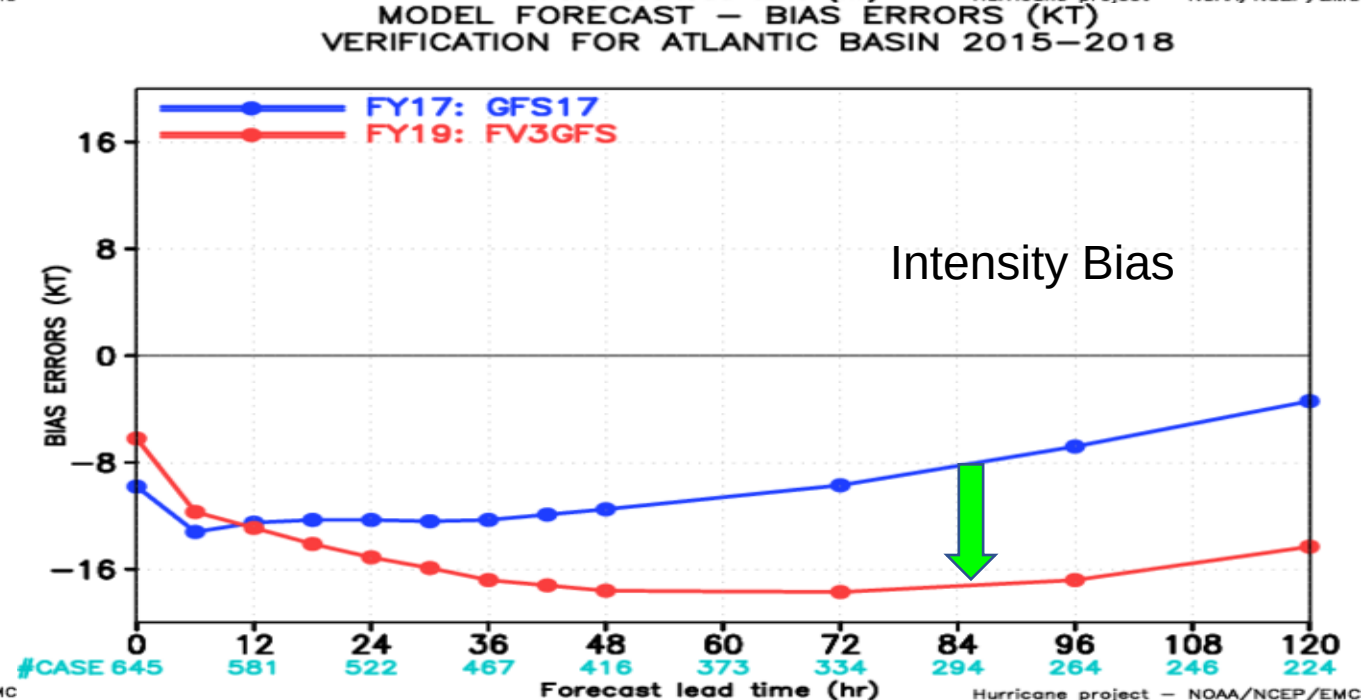
THE STATS CONFIRMED WHAT WAS SEEN IN THE CASES

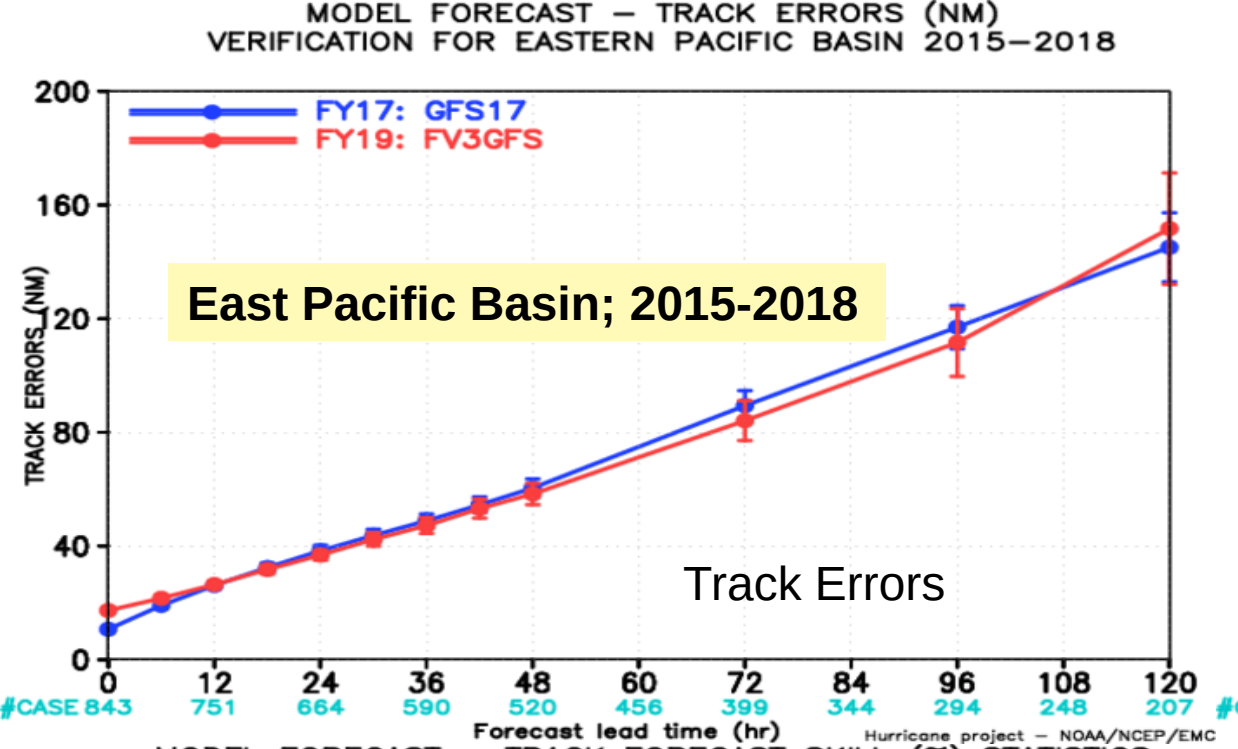
In the next 5 plots, BLUE is ops GFS
RED is original FV3GFS configuration

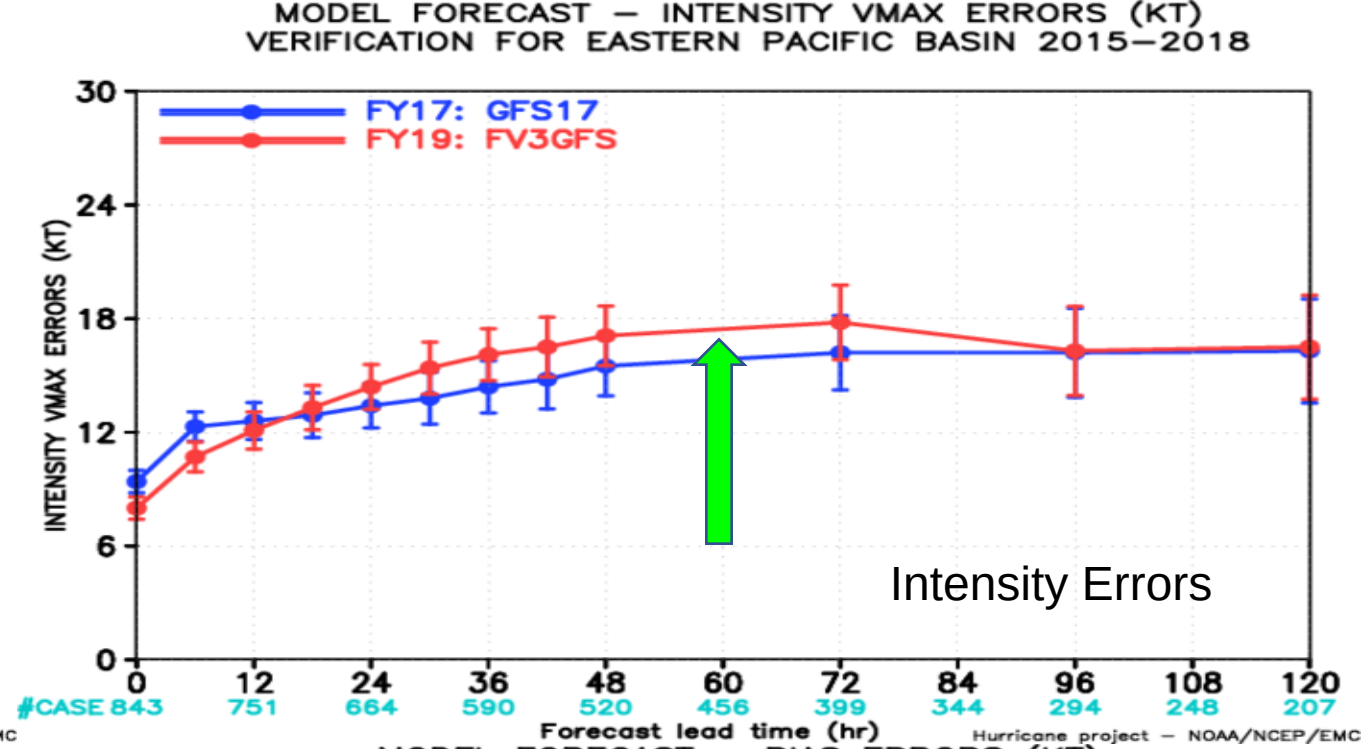

MODEL FORECAST – TRACK ERRORS (NM)
VERIFICATION FOR ATLANTIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
TRACK ERRORS (NM)
Atlantic Basin; 2015-2018
Track Errors
#CASE 645 581 522 467 416 373 334 294 264 246 224
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

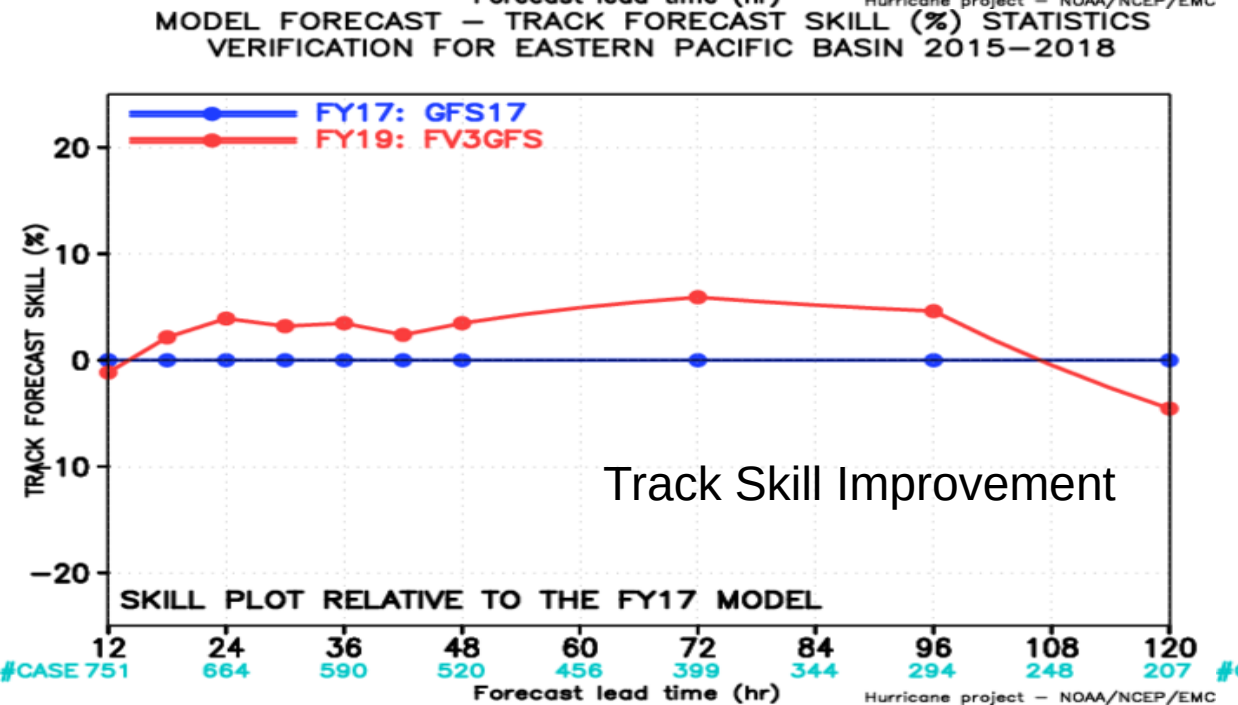

MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
VERIFICATION FOR ATLANTIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
INTENSITY VMAX ERRORS (KT)
Intensity Errors
#CASE 645 581 522 467 416 373 334 294 264 246 224
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

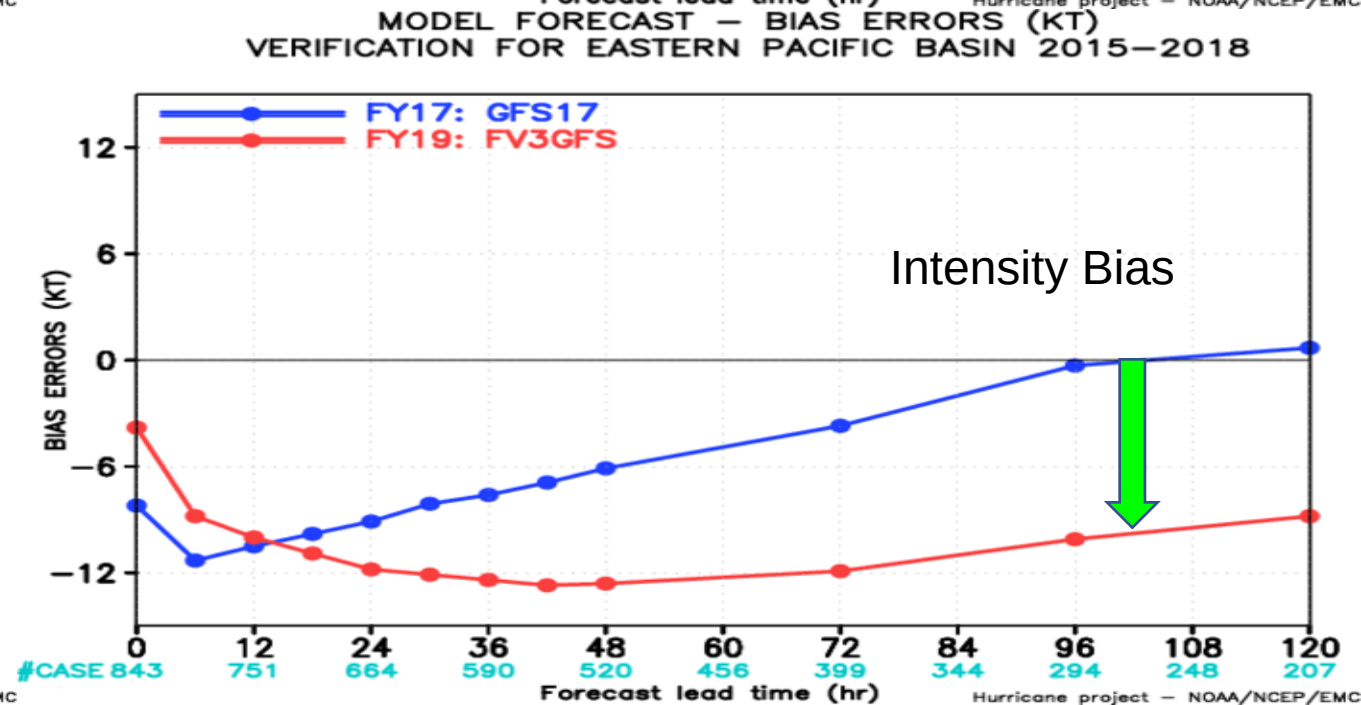

MODEL FORECAST – TRACK FORECAST SKILL (%) STATISTICS
VERIFICATION FOR ATLANTIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
TRACK FORECAST SKILL (%)
Track Skill Improvement
SKILL PLOT RELATIVE TO THE FY17 MODEL
#CASE 581 522 467 416 373 334 294 264 246 224
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

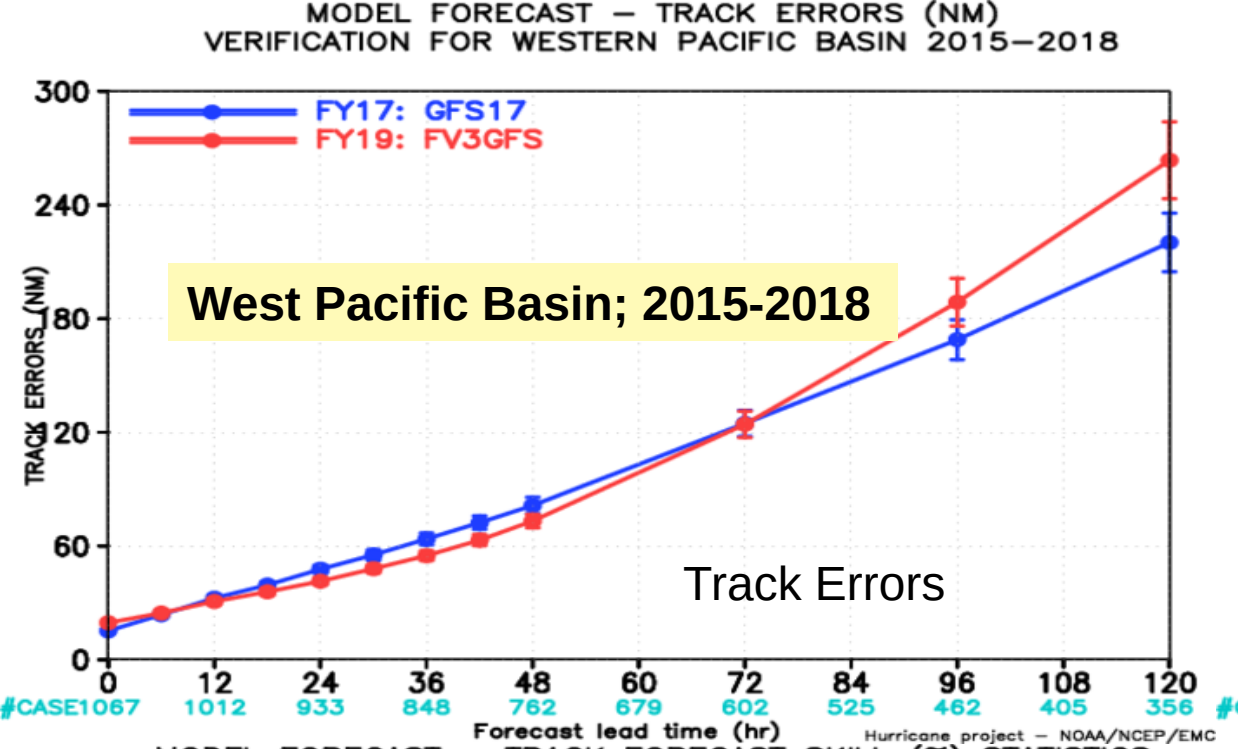

MODEL FORECAST – BIAS ERRORS (KT)
VERIFICATION FOR ATLANTIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
BIAS ERRORS (KT)
Intensity Bias
#CASE 645 581 522 467 416 373 334 294 264 246 224
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

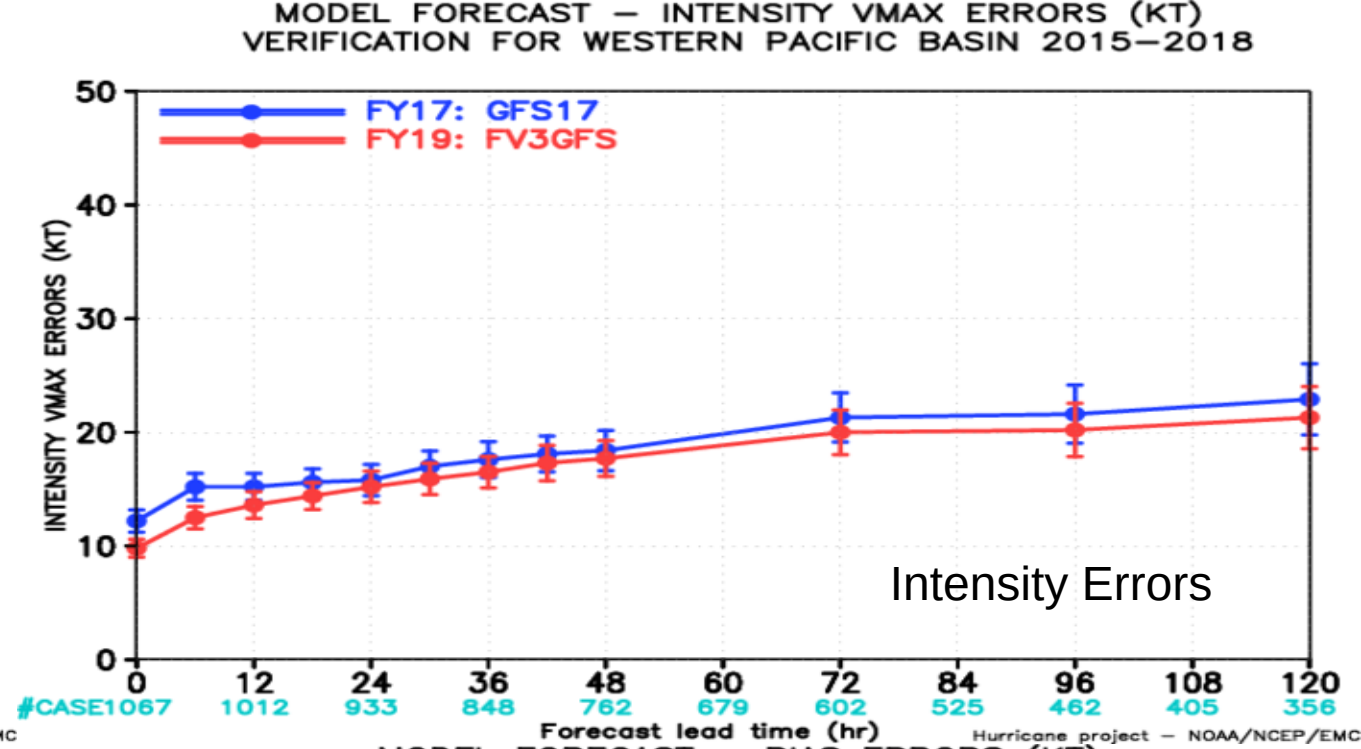

MODEL FORECAST – TRACK ERRORS (NM)
VERIFICATION FOR EASTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
East Pacific Basin; 2015-2018
Track Errors
TRACK ERRORS (NM)
#CASE 843 751 664 590 520 456 399 344 294 248 207
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

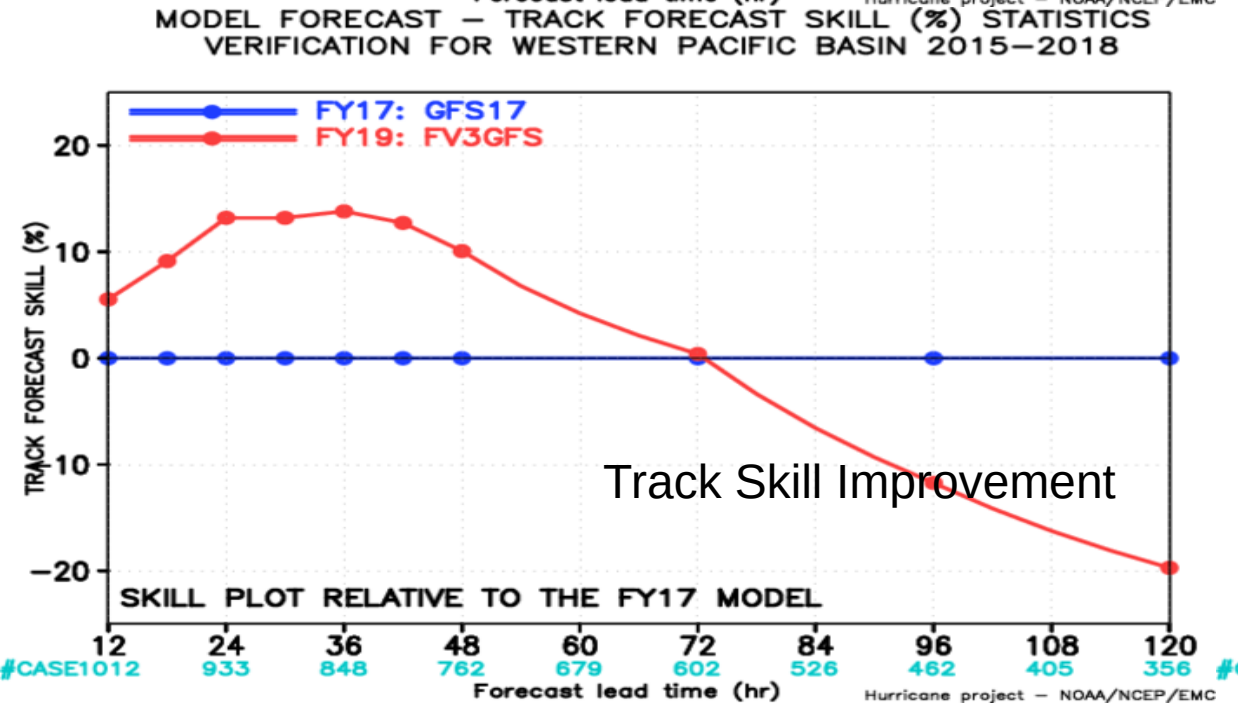

MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
VERIFICATION FOR EASTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
Intensity Errors
INTENSITY VMAX ERRORS (KT)
#CASE 843 751 664 590 520 456 399 344 294 248 207
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

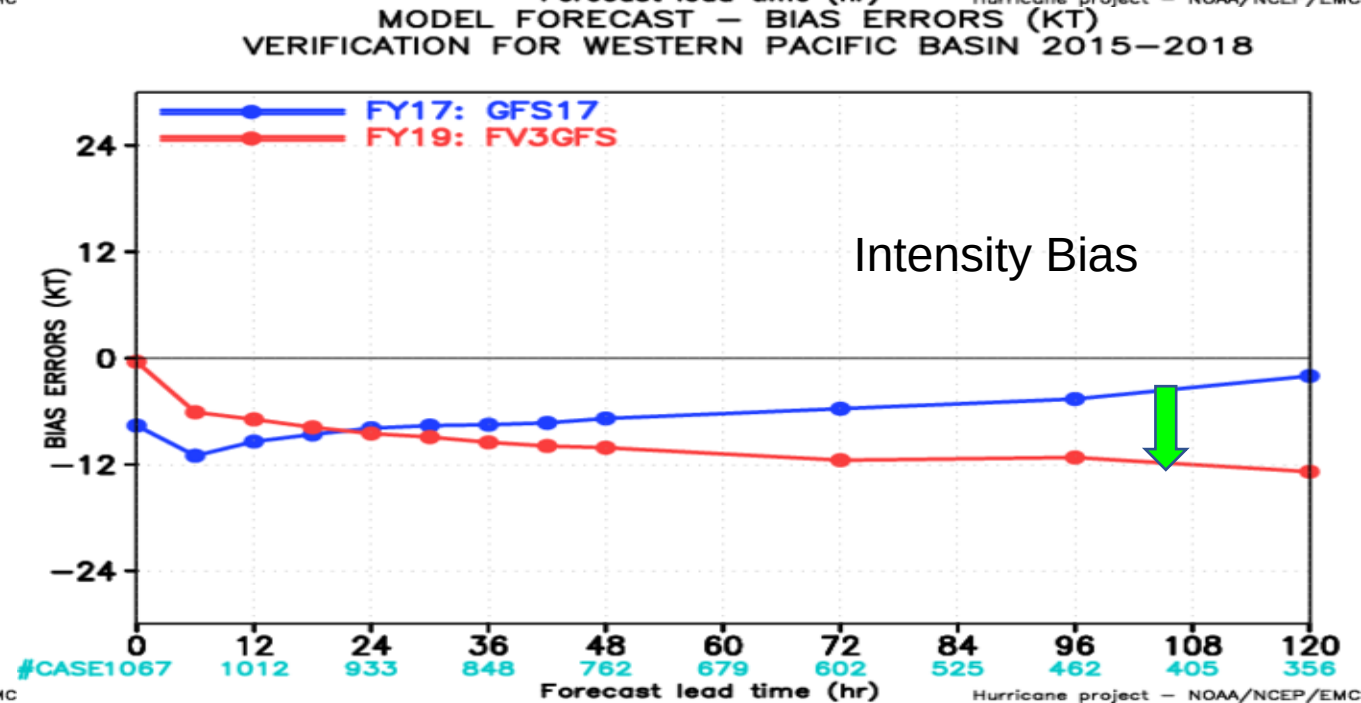

MODEL FORECAST – TRACK FORECAST SKILL (%) STATISTICS
VERIFICATION FOR EASTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
Track Skill Improvement
SKILL PLOT RELATIVE TO THE FY17 MODEL
TRACK FORECAST SKILL (%)
#CASE 751 664 590 520 456 399 344 294 248 207
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

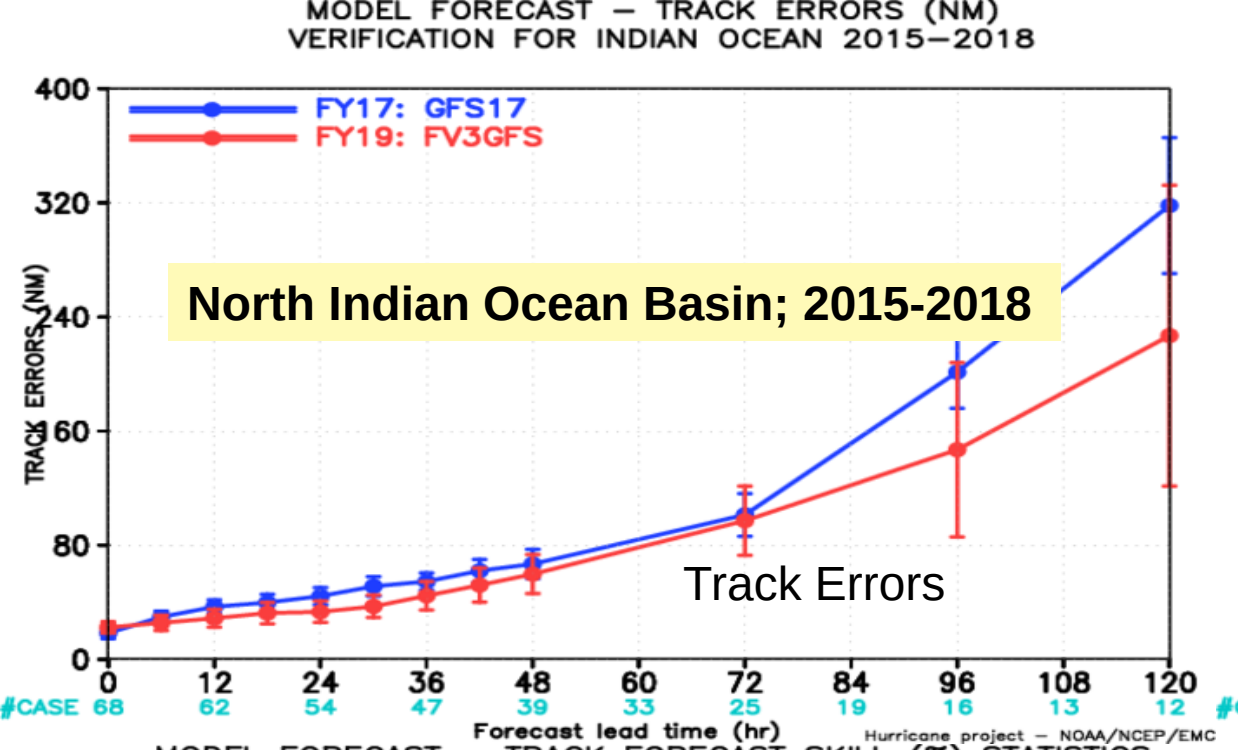

MODEL FORECAST – BIAS ERRORS (KT)
VERIFICATION FOR EASTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
Intensity Bias
BIAS ERRORS (KT)
#CASE 843 751 664 590 520 456 399 344 294 248 207
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

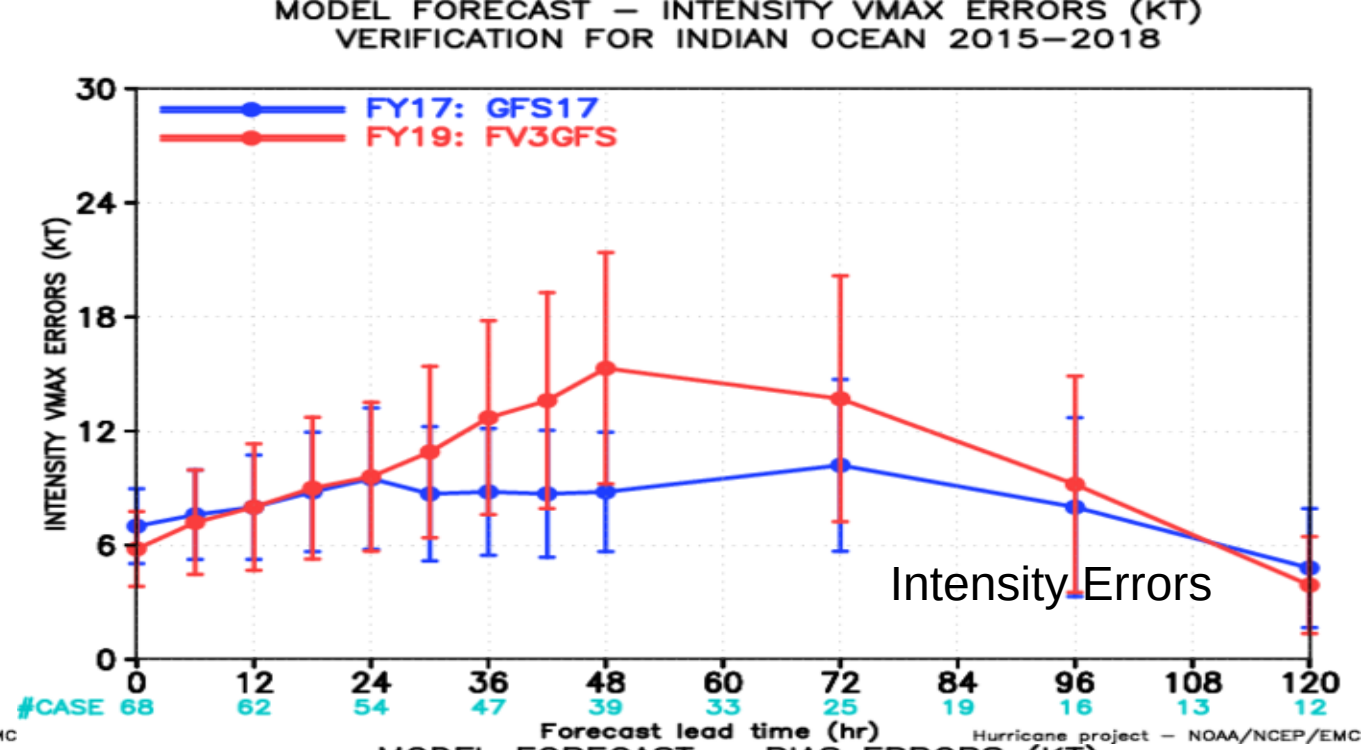

MODEL FORECAST – TRACK ERRORS (NM)
VERIFICATION FOR WESTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
TRACK ERRORS (NM)
West Pacific Basin; 2015-2018
Track Errors
#CASE1067
1012
933
848
762
679
602
525
462
405
356
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

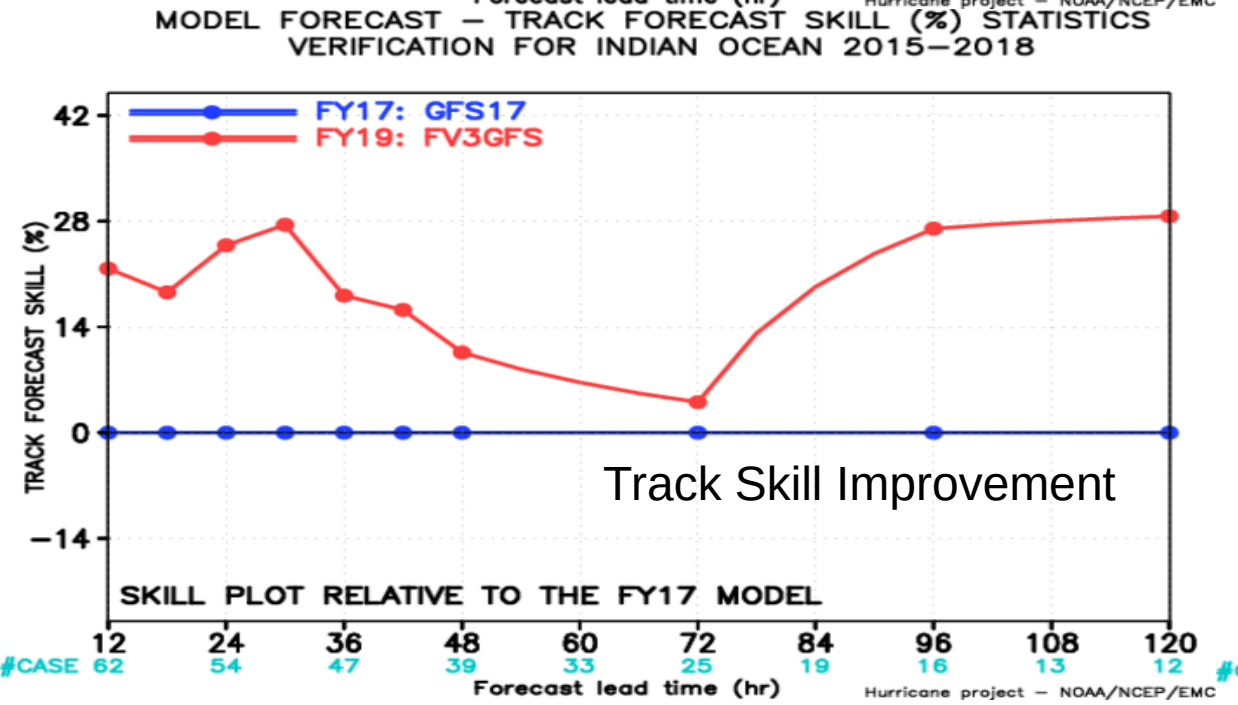

MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
VERIFICATION FOR WESTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
INTENSITY VMAX ERRORS (KT)
Intensity Errors
#CASE1067
1012
933
848
762
679
602
525
462
405
356
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

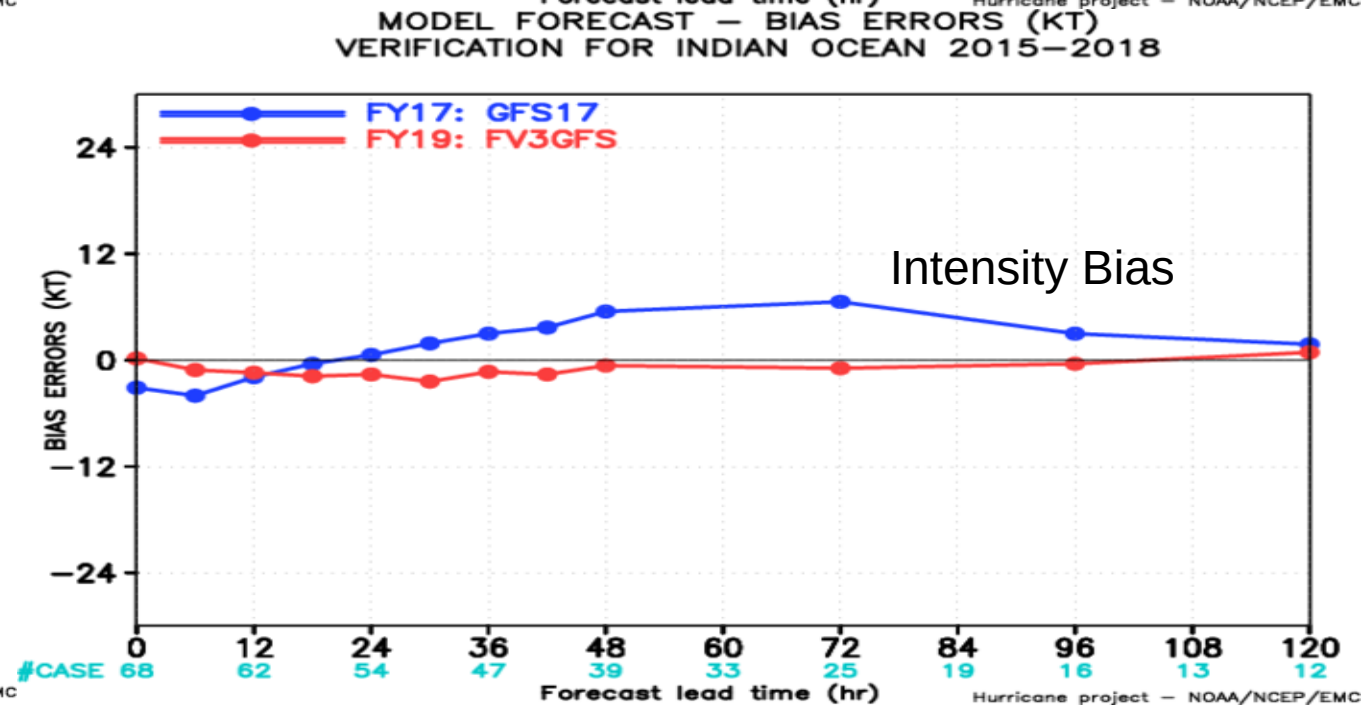

MODEL FORECAST – TRACK FORECAST SKILL (%) STATISTICS
VERIFICATION FOR WESTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
TRACK FORECAST SKILL (%)
Track Skill Improvement
SKILL PLOT RELATIVE TO THE FY17 MODEL
#CASE1012
933
848
762
679
602
526
462
405
356
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

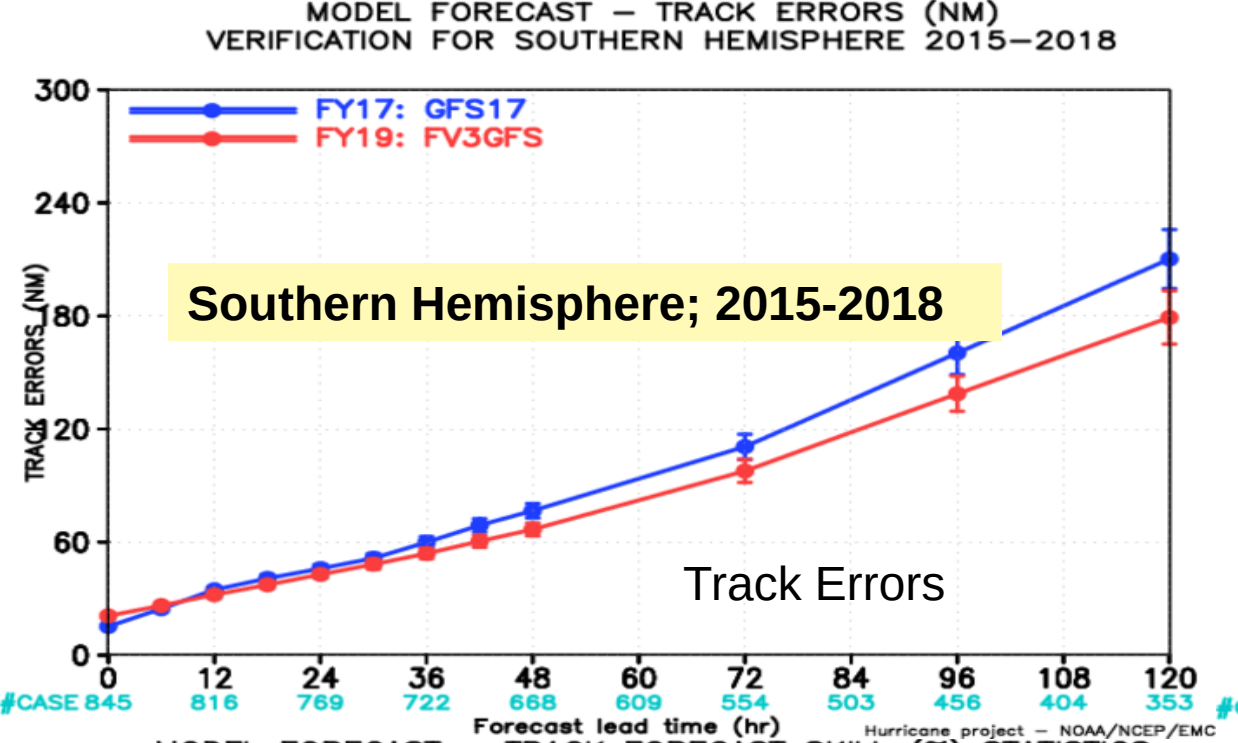

MODEL FORECAST – BIAS ERRORS (KT)
VERIFICATION FOR WESTERN PACIFIC BASIN 2015–2018
FY17: GFS17
FY19: FV3GFS
BIAS ERRORS (KT)
Intensity Bias
#CASE1067
1012
933
848
762
679
602
525
462
405
356
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

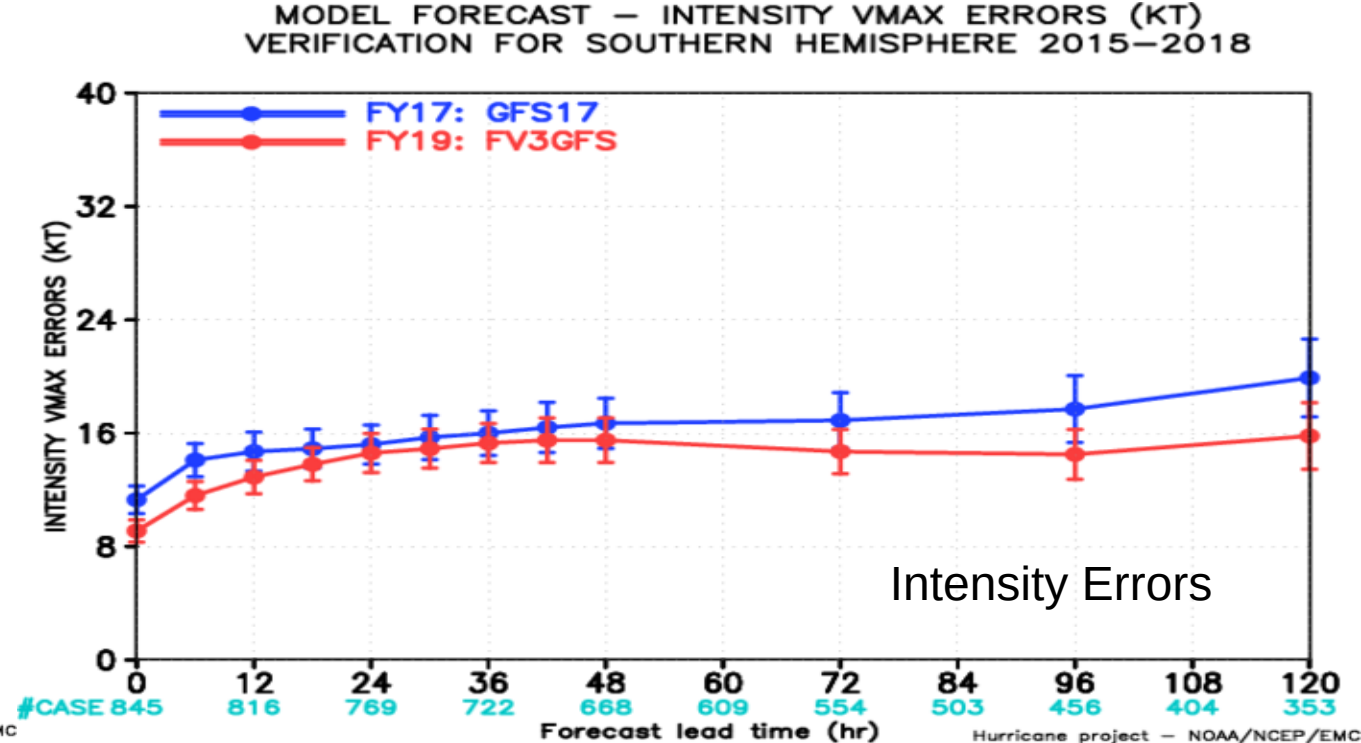

MODEL FORECAST – TRACK ERRORS (NM)
VERIFICATION FOR INDIAN OCEAN 2015–2018
FY17: GFS17
FY19: FV3GFS
TRACK ERRORS (NM)
400
320
240
160
80
0
North Indian Ocean Basin; 2015-2018
Track Errors
0 12 24 36 48 60 72 84 96 108 120
#CASE 68 62 54 47 39 33 25 19 16 13 12
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

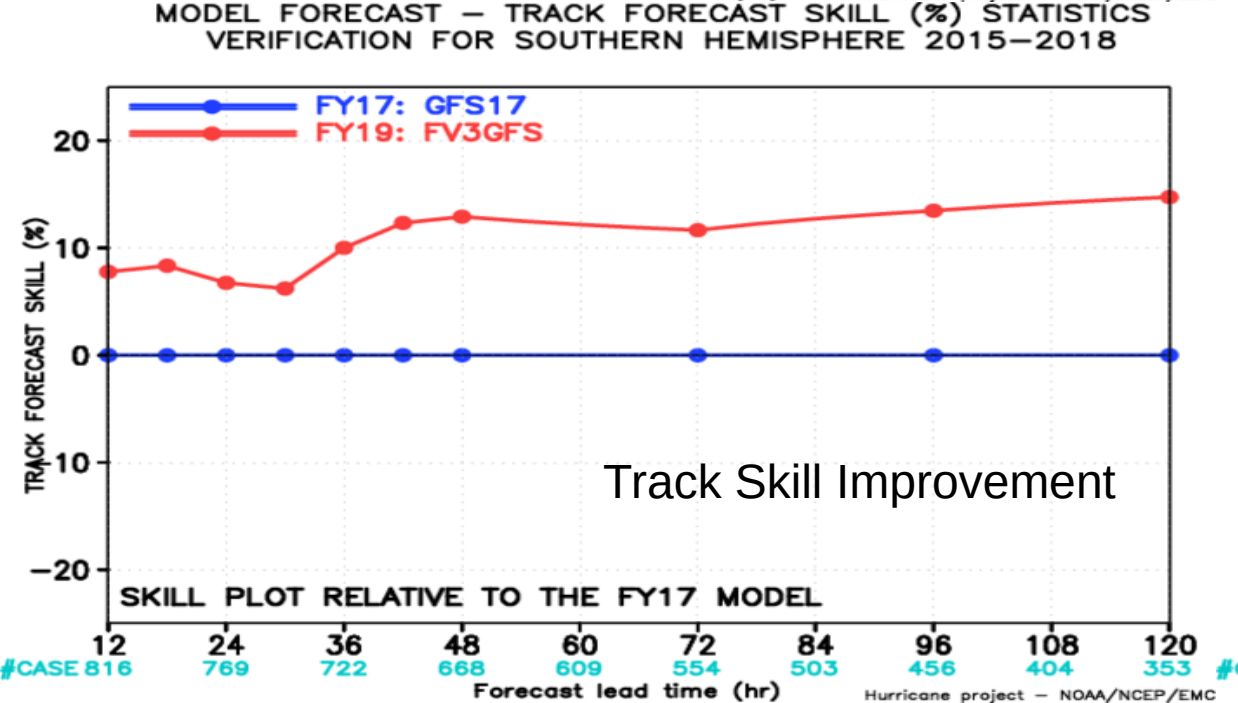

MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
VERIFICATION FOR INDIAN OCEAN 2015–2018
FY17: GFS17
FY19: FV3GFS
INTENSITY VMAX ERRORS (KT)
30
24
18
12
6
0
Intensity Errors
0 12 24 36 48 60 72 84 96 108 120
#CASE 68 62 54 47 39 33 25 19 16 13 12
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

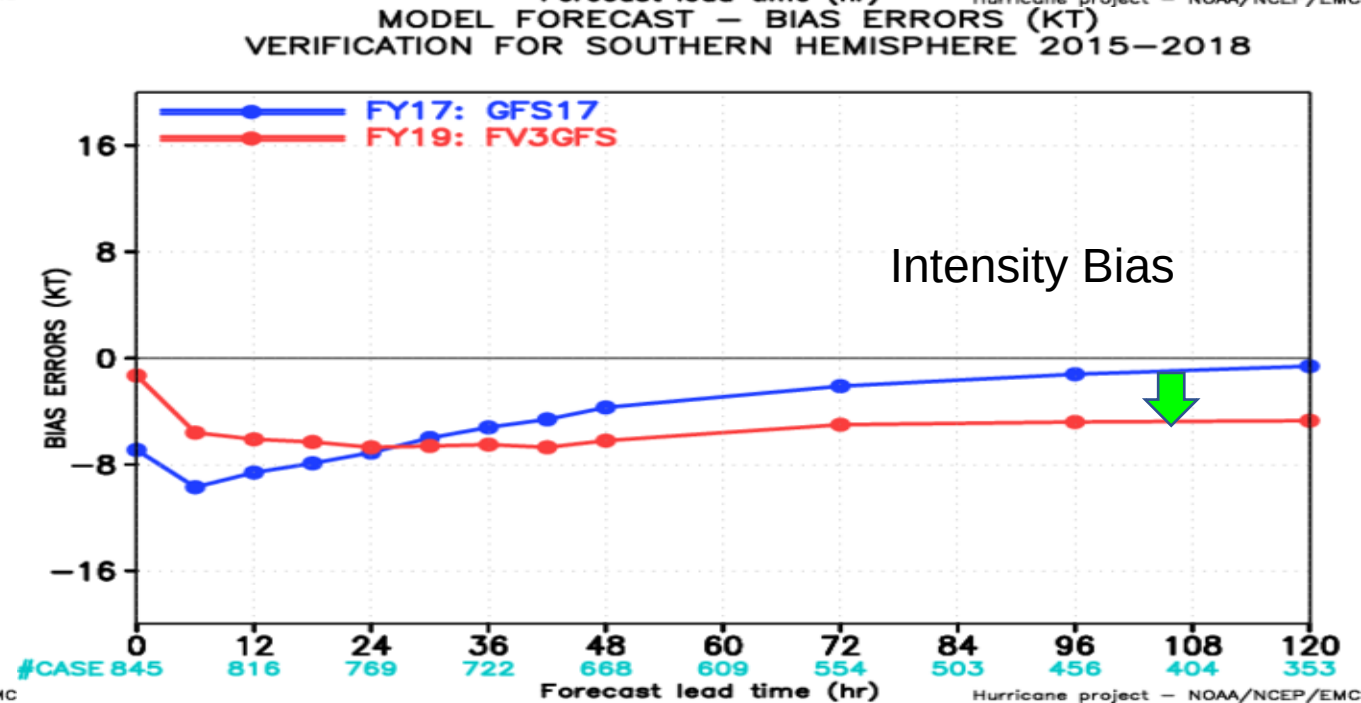

MODEL FORECAST – TRACK FORECAST SKILL (%) STATISTICS
VERIFICATION FOR INDIAN OCEAN 2015–2018
FY17: GFS17
FY19: FV3GFS
TRACK FORECAST SKILL (%)
42
28
14
0
−14
Track Skill Improvement
SKILL PLOT RELATIVE TO THE FY17 MODEL
12 24 36 48 60 72 84 96 108 120
#CASE 62 54 47 39 33 25 19 16 13 12
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC


MODEL FORECAST – BIAS ERRORS (KT)
VERIFICATION FOR INDIAN OCEAN 2015–2018
FY17: GFS17
FY19: FV3GFS
BIAS ERRORS (KT)
24
12
0
−12
−24
Intensity Bias
0 12 24 36 48 60 72 84 96 108 120
#CASE 68 62 54 47 39 33 25 19 16 13 12
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC


MODEL FORECAST – TRACK ERRORS (NM)
VERIFICATION FOR SOUTHERN HEMISPHERE 2015–2018
FY17: GFS17
FY19: FV3GFS
Southern Hemisphere; 2015-2018
TRACK ERRORS (NM)
Track Errors
#CASE 845 816 769 722 668 609 554 503 456 404 353
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC


MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
VERIFICATION FOR SOUTHERN HEMISPHERE 2015–2018
FY17: GFS17
FY19: FV3GFS
INTENSITY VMAX ERRORS (KT)
Intensity Errors
#CASE 845 816 769 722 668 609 554 503 456 404 353
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC


MODEL FORECAST – TRACK FORECAST SKILL (%) STATISTICS
VERIFICATION FOR SOUTHERN HEMISPHERE 2015–2018
FY17: GFS17
FY19: FV3GFS
TRACK FORECAST SKILL (%)
Track Skill Improvement
SKILL PLOT RELATIVE TO THE FY17 MODEL
#CASE 816 769 722 668 609 554 503 456 404 353
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC


MODEL FORECAST – BIAS ERRORS (KT)
VERIFICATION FOR SOUTHERN HEMISPHERE 2015–2018
FY17: GFS17
FY19: FV3GFS
BIAS ERRORS (KT)
Intensity Bias
#CASE 845 816 769 722 668 609 554 503 456 404 353
Forecast lead time (hr)
Hurricane project – NOAA/NCEP/EMC

Comparing initial FV3GFS with current operational GFS:

- Large-scale verification stats were improved, including ACC and precip ETS scores
- Hurricane tracks were improved over Atlantic and Eastern Pacific basins.
- Hurricane intensity was too weak

Actions Taken:

- Consulted with GFDL. SJ-Lin stated that using the advection scheme hord=6 gives better ACC scores but weaker storms, while using hord=5 gives better storm intensity but lower ACC.

- Hord=5: Unlimited Colella and Woodward (1984) Piecewise-parabolic method, using Hunyh's second constraint to enforce monotonicity
- Hord=6: unlimited "fifth-order" PPM. This option may be useful for 4D-DA.

- SJ Lin recommended to run GDAS cycle with hord=6, and GFS forecast with hord=5

Actions taken to address hurricane intensity issue:

- Hurricane intensity is too weak in FV3GFS parallels. A new forecast-only experiment was set up to run for all hurricane seasons with an alternate advection scheme (hord=5), which is less diffusive. Preliminary results showed that hurricane intensity was improved. Hurricane track did not change. Large-scale skill scores are similar to that of the original experiment with hord=6.

- Concerns were raised about the impact of this change on winter storms.

- HWRF and HMON will use these reruns with hord=5 to perform fv3gfs downstream evaluation.

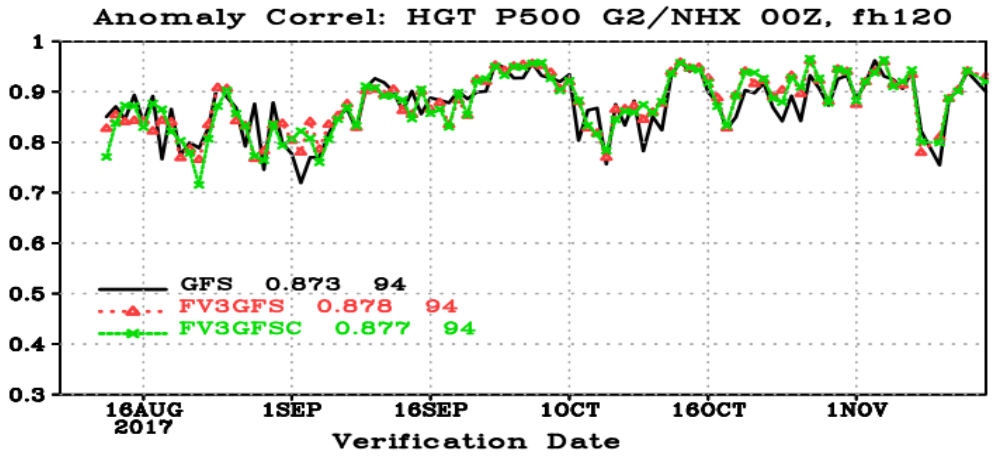
- Set up another forecast-only experiment to cover the 2017/18 winter/spring season to investigate the impact of hord=5 on cold season forecast skill scores and individual winter storms.

1. FV3GFS Comparison of hord=5 with hord=6

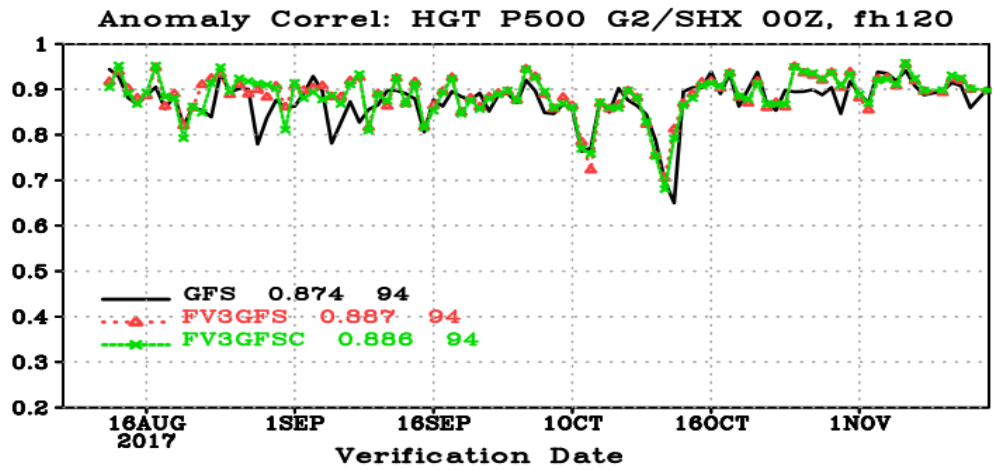
http://www.emc.ncep.noaa.gov/gmb/emc.glopara/vsdb/fv3q2fy19retro2c/

500 hPa HGT ACC
DURING 2017 TROPICAL SEASON

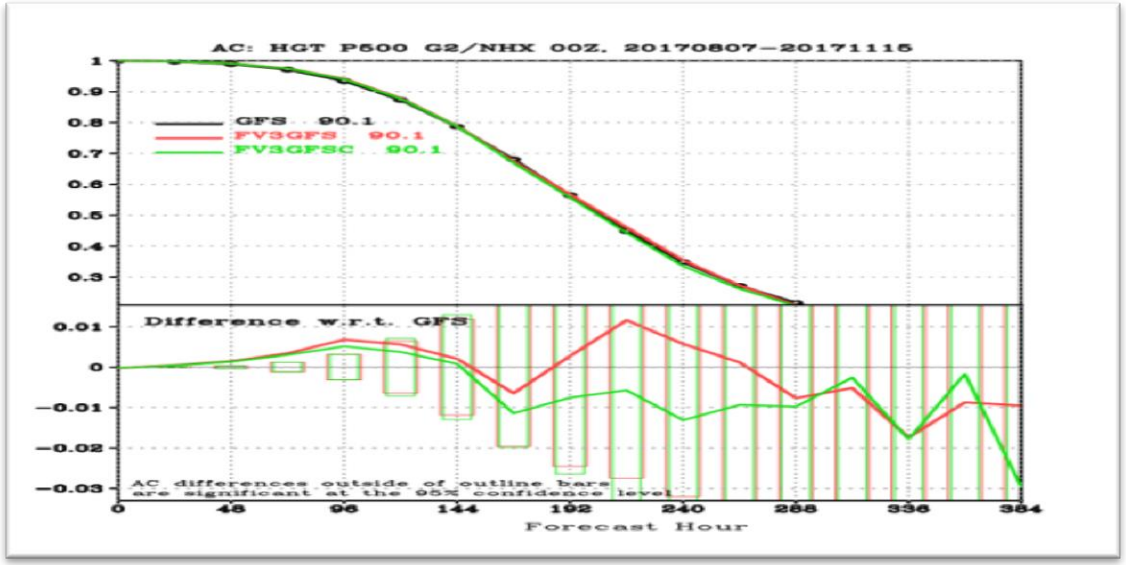
Black: ops GFS; Red: fv3gfs, hord=6; green: fv3gfsc, hord=5



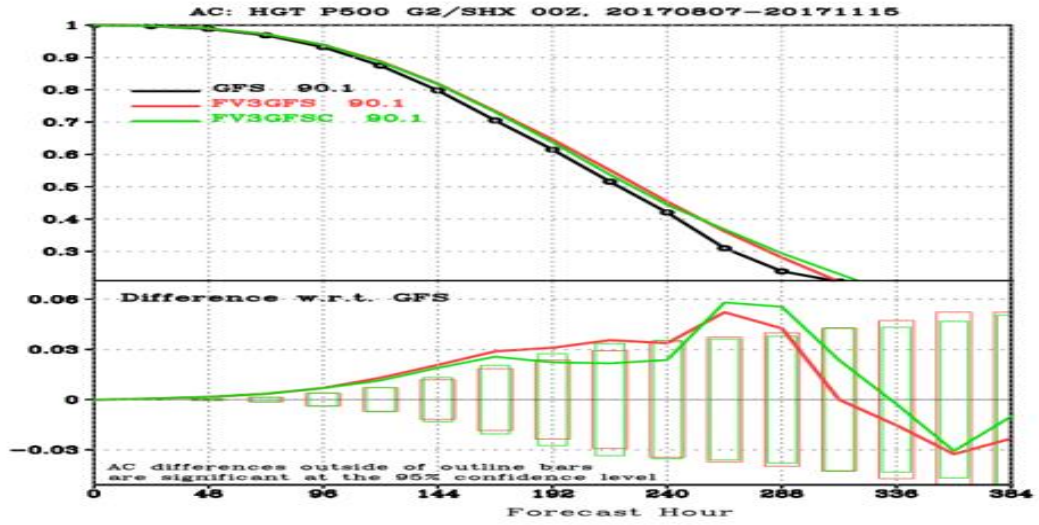
NH



SH

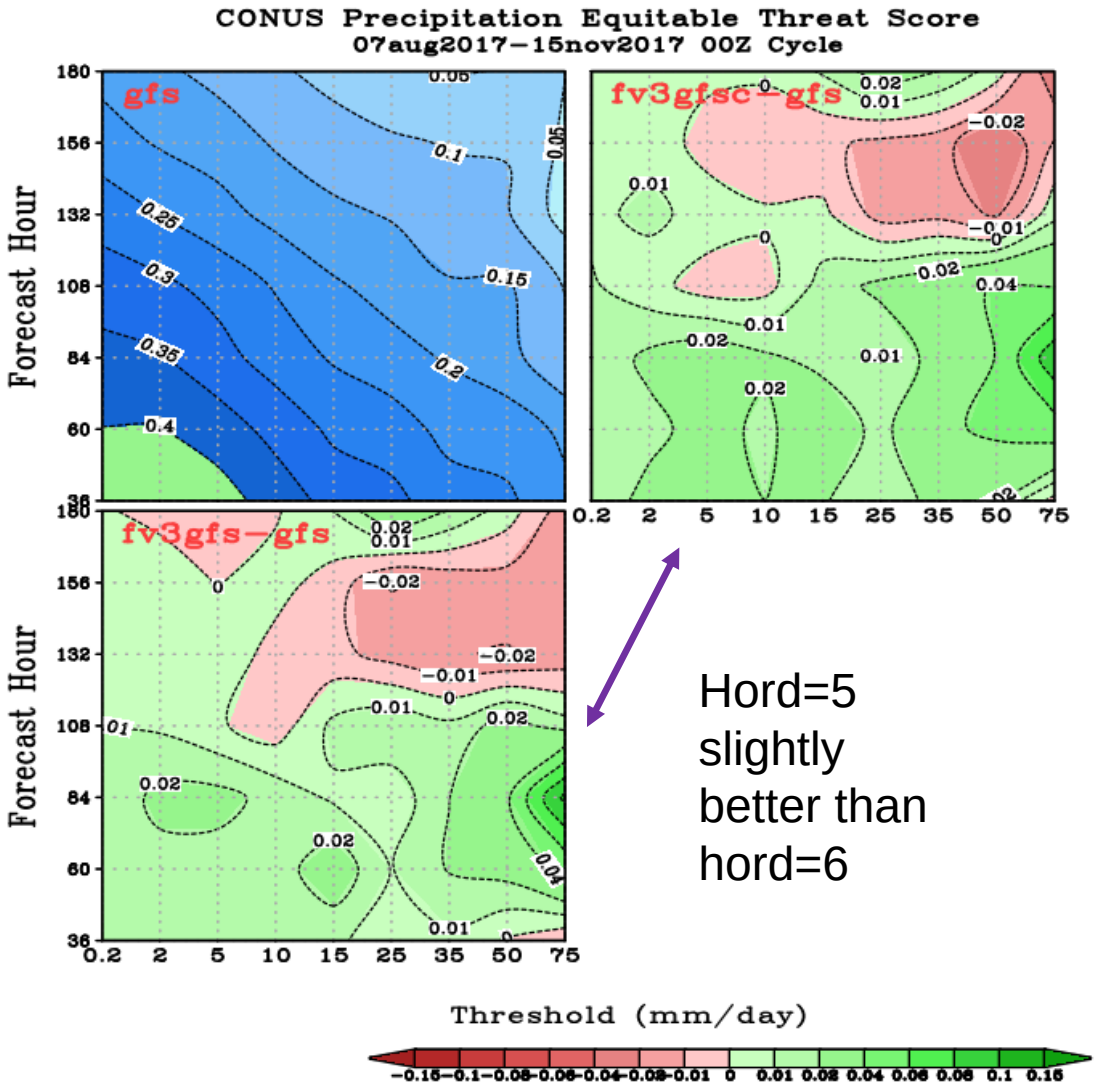


Slightly worse ACC, not significant

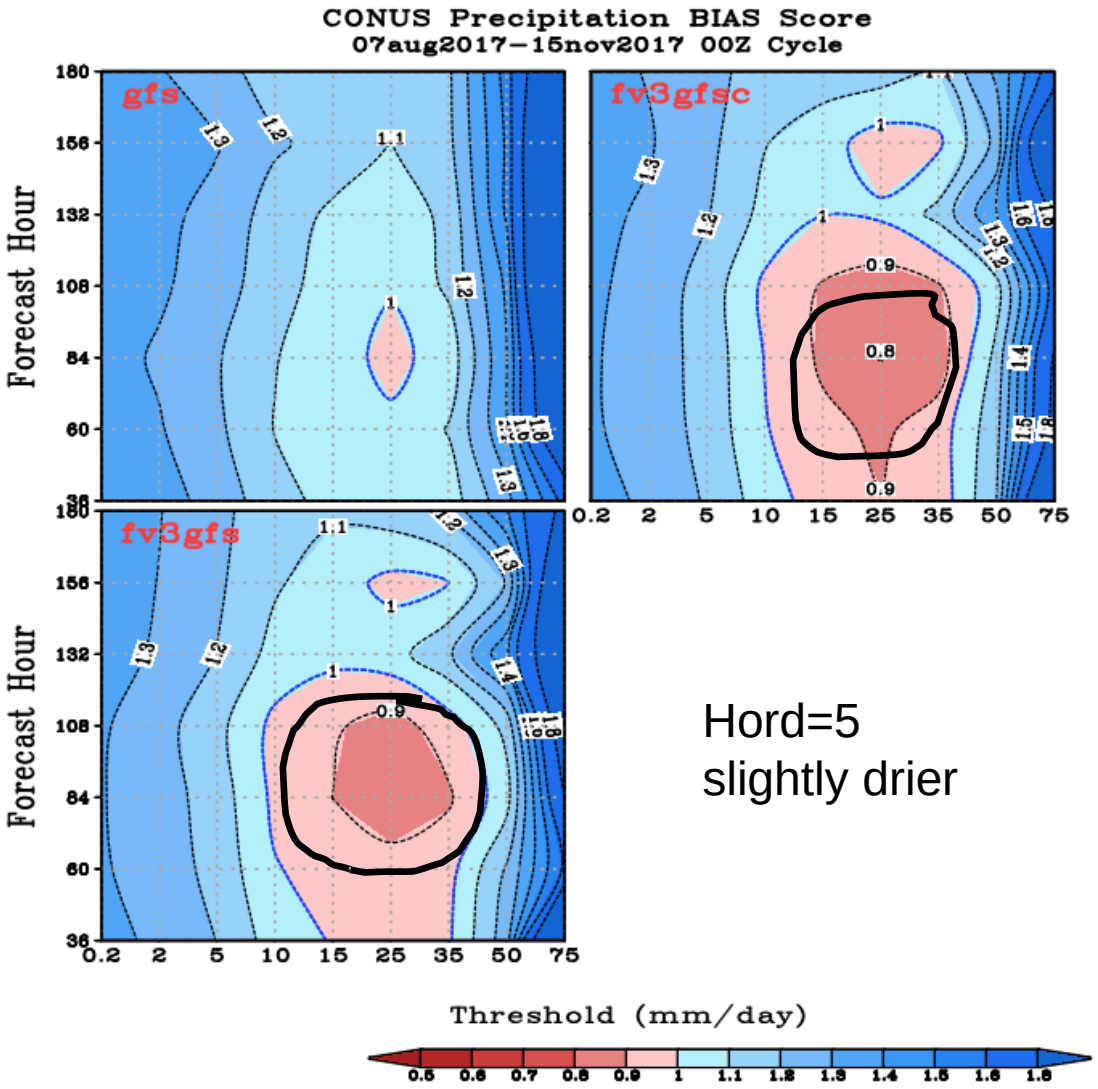


No difference

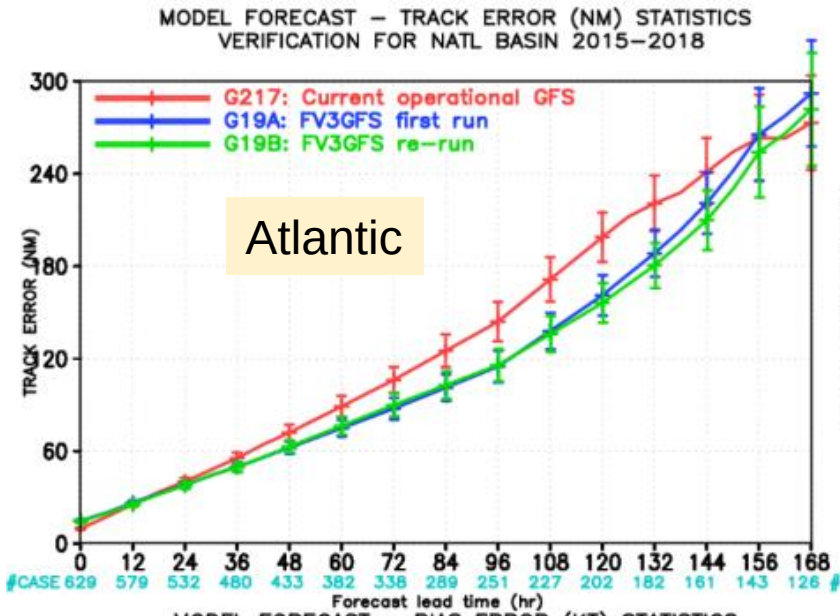
CONUS PRECIP ETS and BIAS Scores

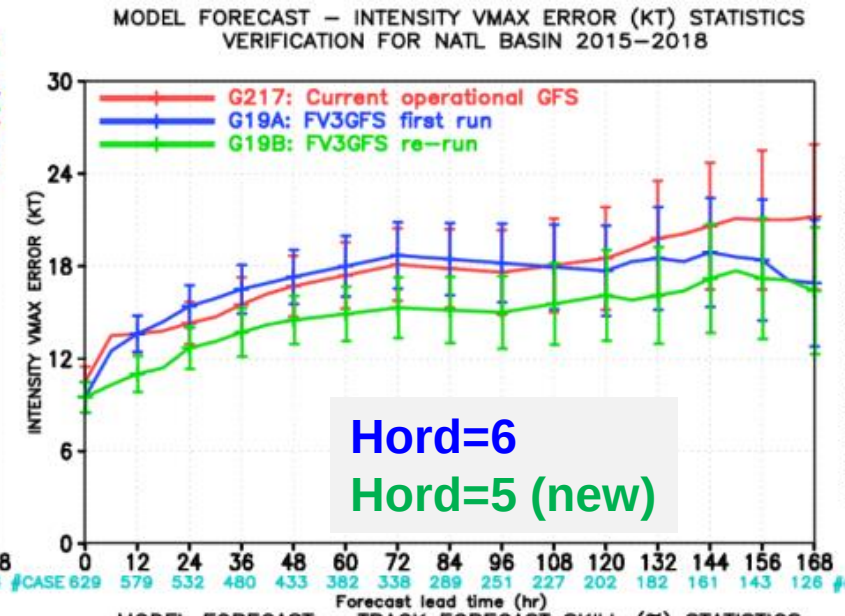


Hord=5
slightly
better than
hord=6

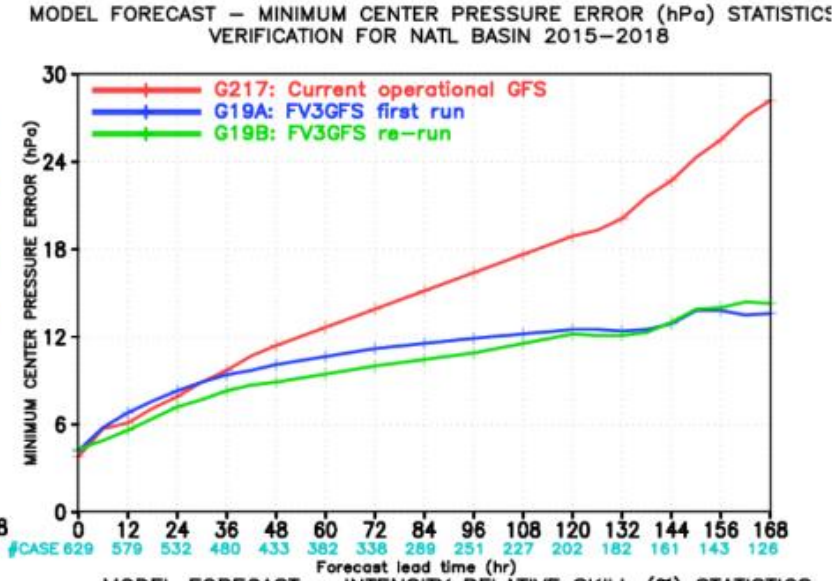


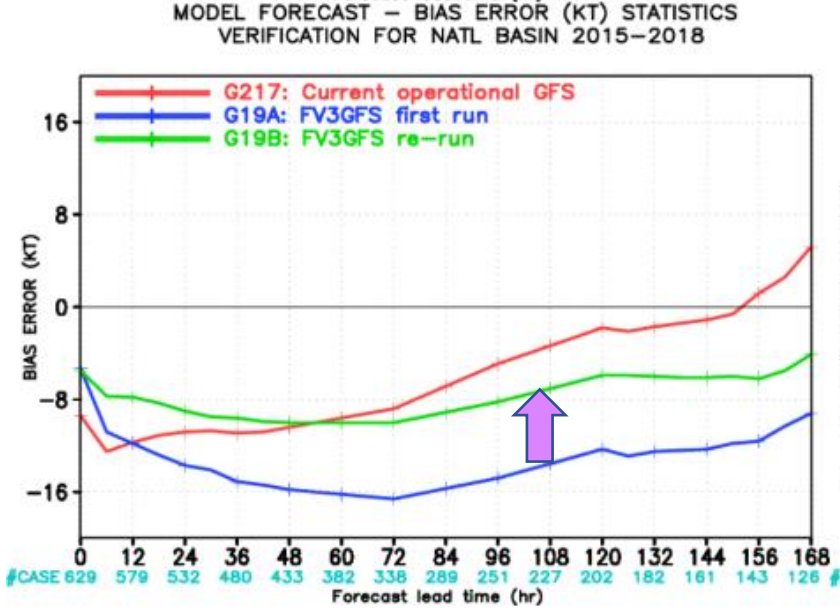
Hord=5
slightly drier

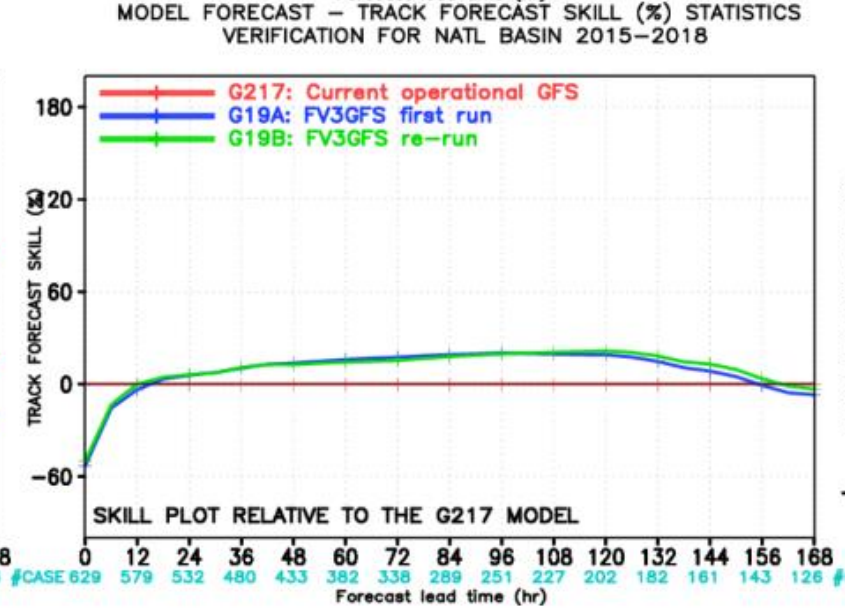


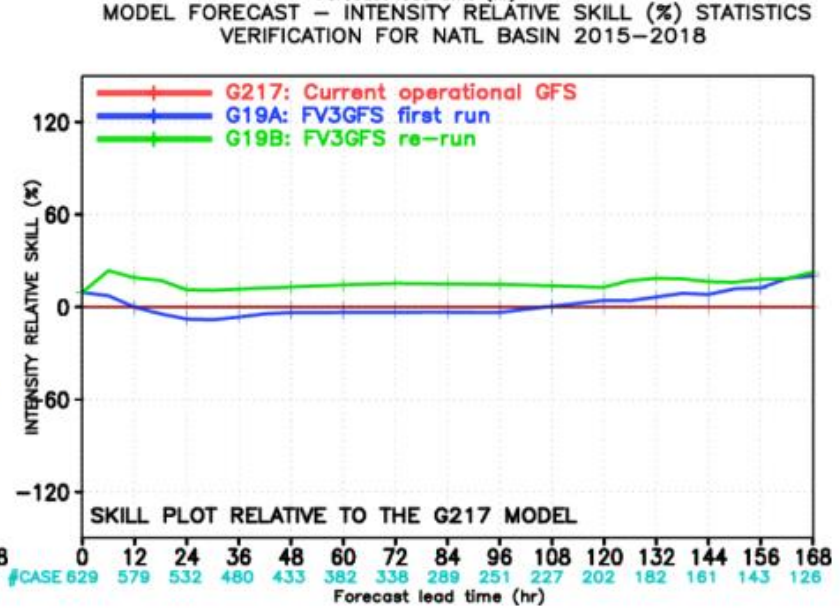


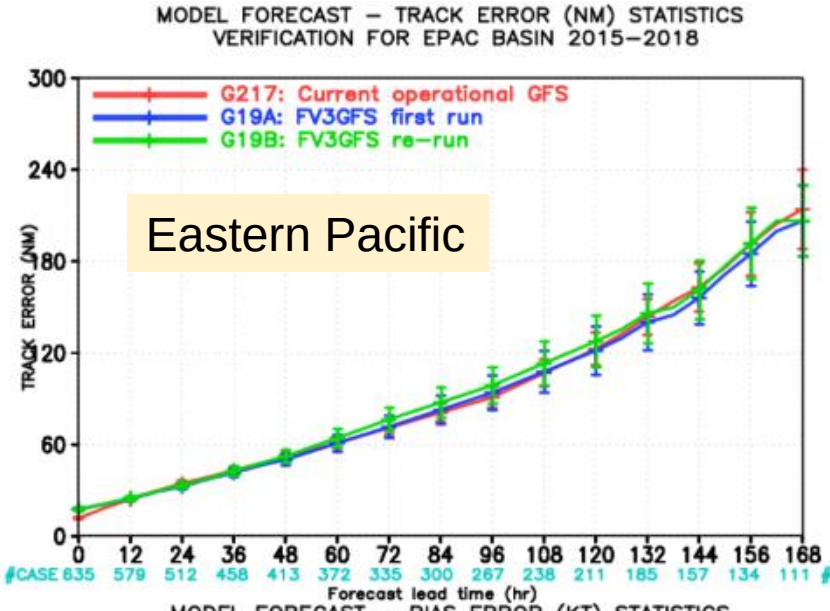
Hord=6
Hord=5 (new)

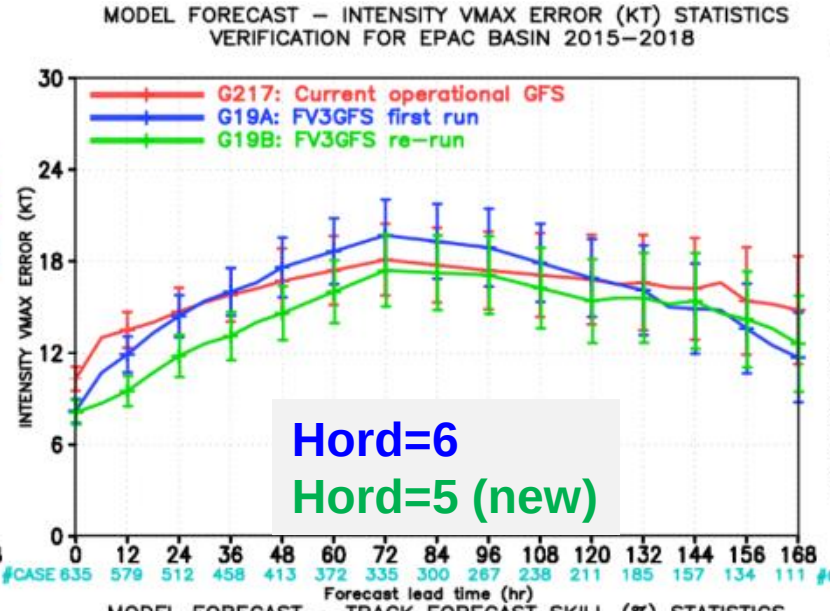


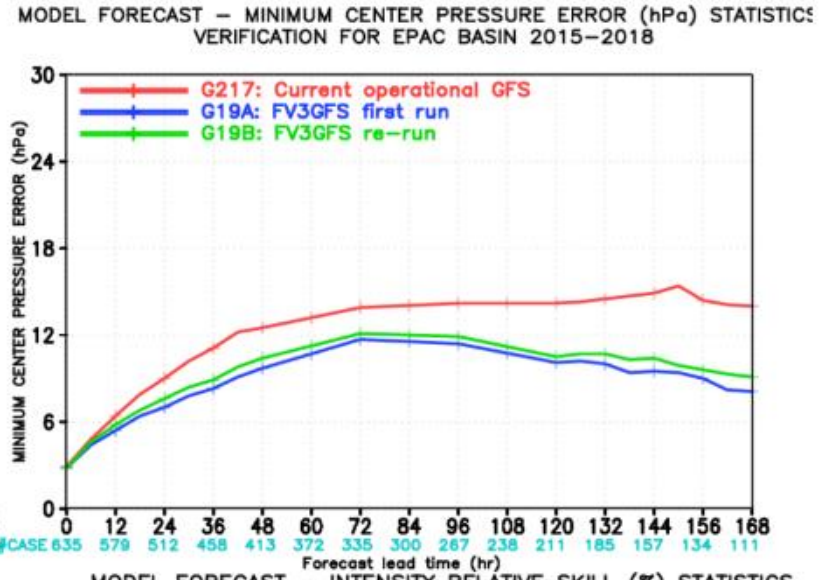


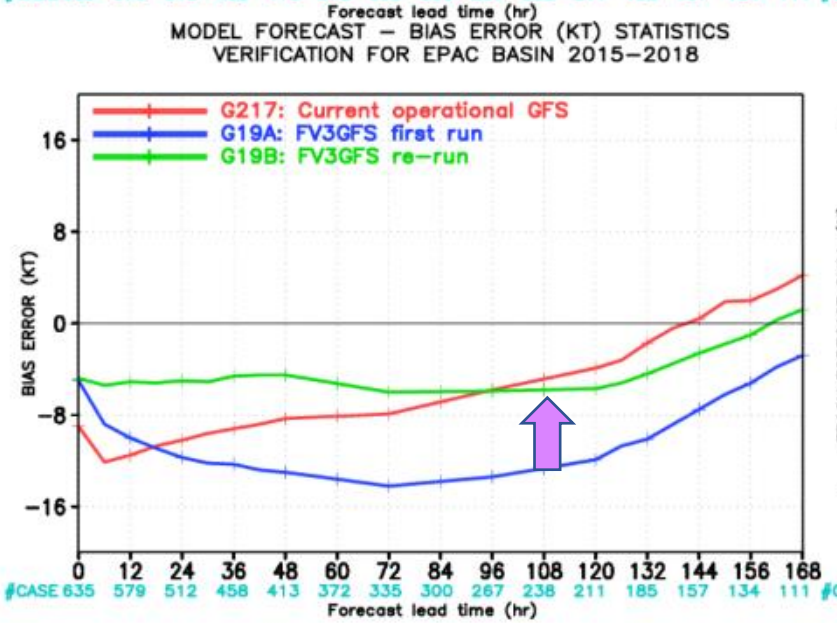


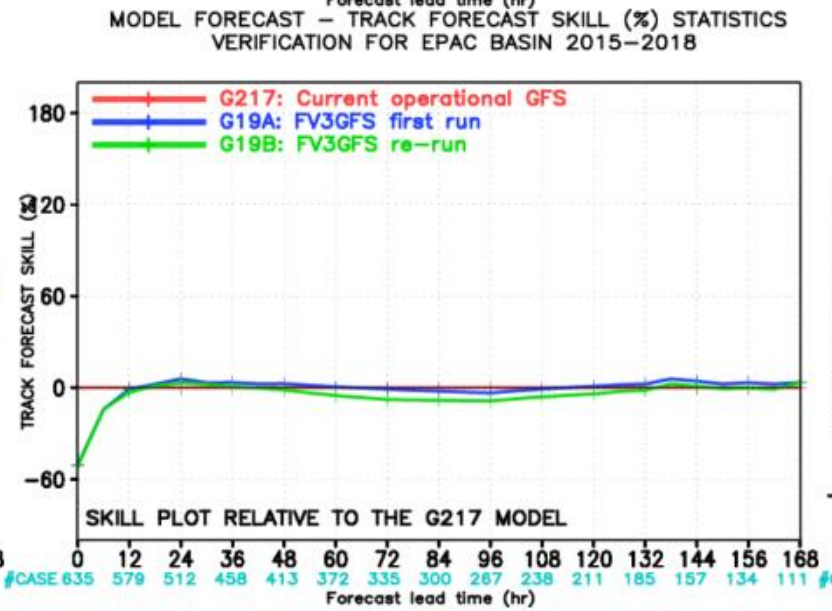


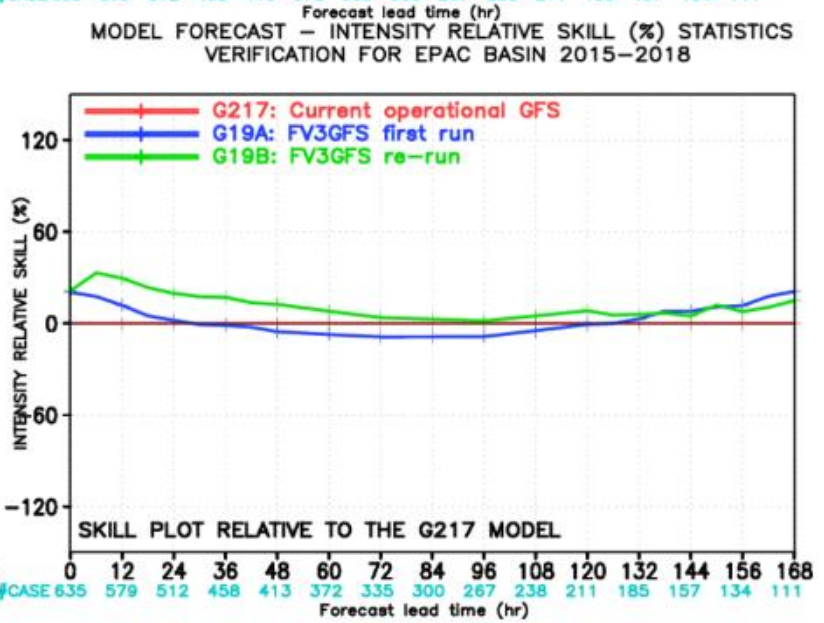

MODEL FORECAST – TRACK ERROR (NM) STATISTICS
VERIFICATION FOR EPAC BASIN 2015–2018
G217: Current operational GFS
G19A: FV3GFS first run
G19B: FV3GFS re–run
Eastern Pacific
TRACK ERROR (NM)
Forecast lead time (hr)
#CASE 635 579 512 458 413 372 335 300 267 238 211 185 157 134 111

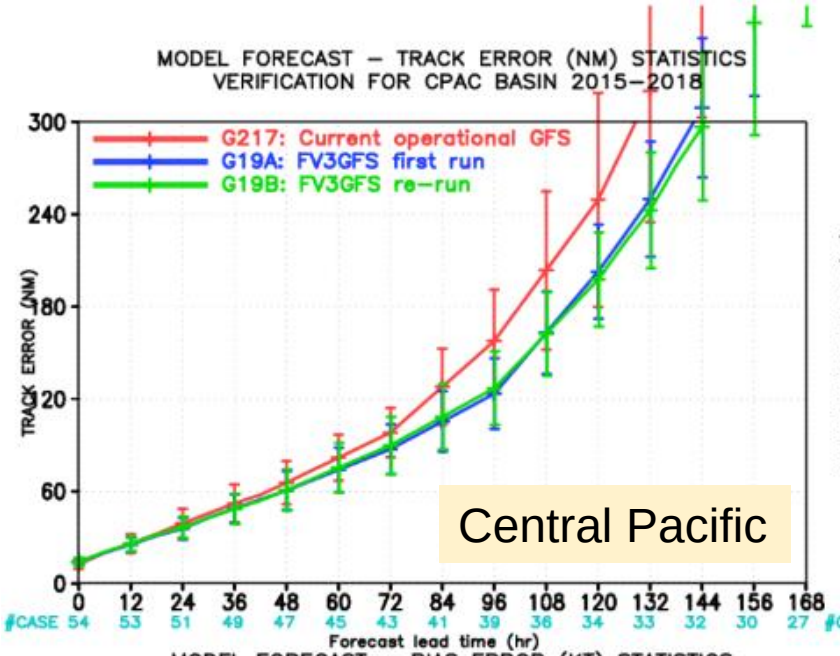

MODEL FORECAST – INTENSITY VMAX ERROR (KT) STATISTICS
VERIFICATION FOR EPAC BASIN 2015–2018
G217: Current operational GFS
G19A: FV3GFS first run
G19B: FV3GFS re–run
Hord=6
Hord=5 (new)
INTENSITY VMAX ERROR (KT)
Forecast lead time (hr)
#CASE 635 579 512 458 413 372 335 300 267 238 211 185 157 134 111


MODEL FORECAST – MINIMUM CENTER PRESSURE ERROR (hPa) STATISTICS
VERIFICATION FOR EPAC BASIN 2015–2018
G217: Current operational GFS
G19A: FV3GFS first run
G19B: FV3GFS re–run
MINIMUM CENTER PRESSURE ERROR (hPa)
Forecast lead time (hr)
#CASE 635 579 512 458 413 372 335 300 267 238 211 185 157 134 111

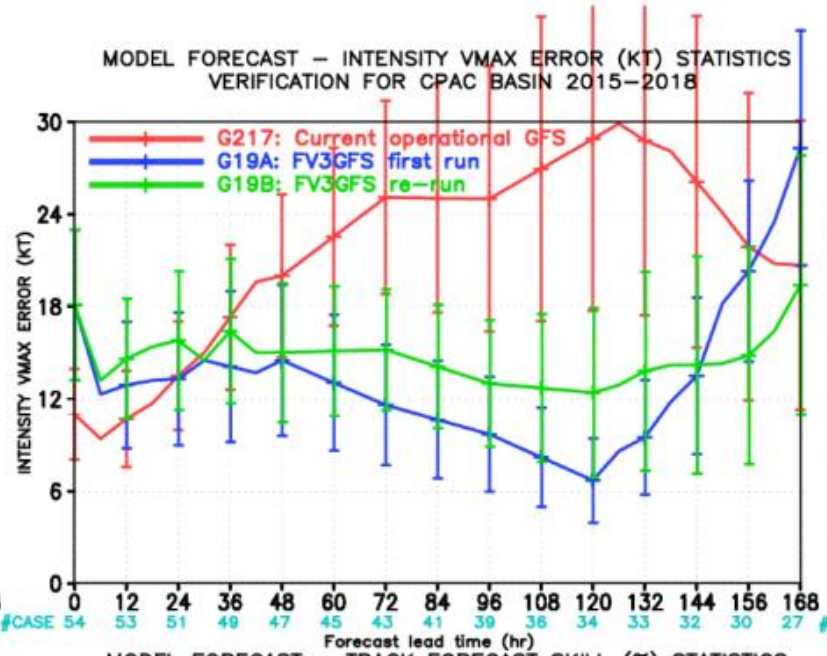

MODEL FORECAST – BIAS ERROR (KT) STATISTICS
VERIFICATION FOR EPAC BASIN 2015–2018
G217: Current operational GFS
G19A: FV3GFS first run
G19B: FV3GFS re–run
BIAS ERROR (KT)
Forecast lead time (hr)
#CASE 635 579 512 458 413 372 335 300 267 238 211 185 157 134 111

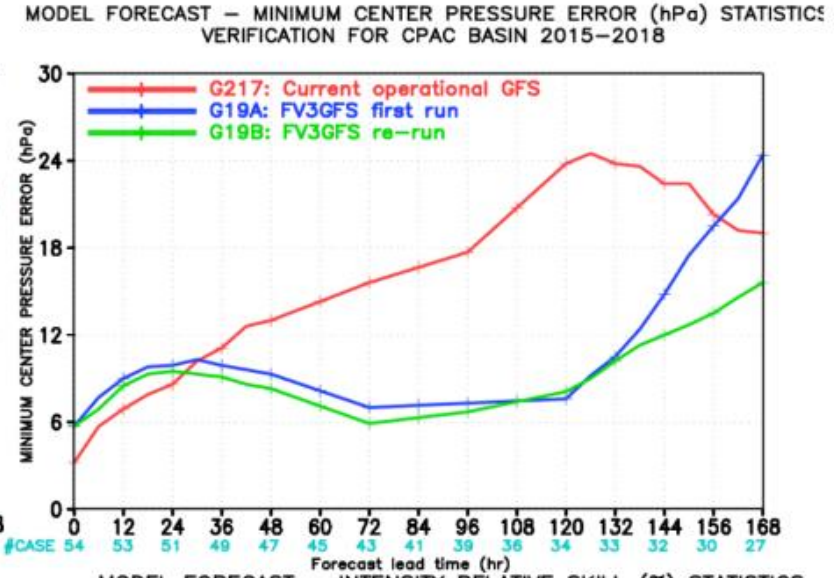

MODEL FORECAST – TRACK FORECAST SKILL (%) STATISTICS
VERIFICATION FOR EPAC BASIN 2015–2018
G217: Current operational GFS
G19A: FV3GFS first run
G19B: FV3GFS re–run
TRACK FORECAST SKILL (%)
SKILL PLOT RELATIVE TO THE G217 MODEL
Forecast lead time (hr)
#CASE 635 579 512 458 413 372 335 300 267 238 211 185 157 134 111

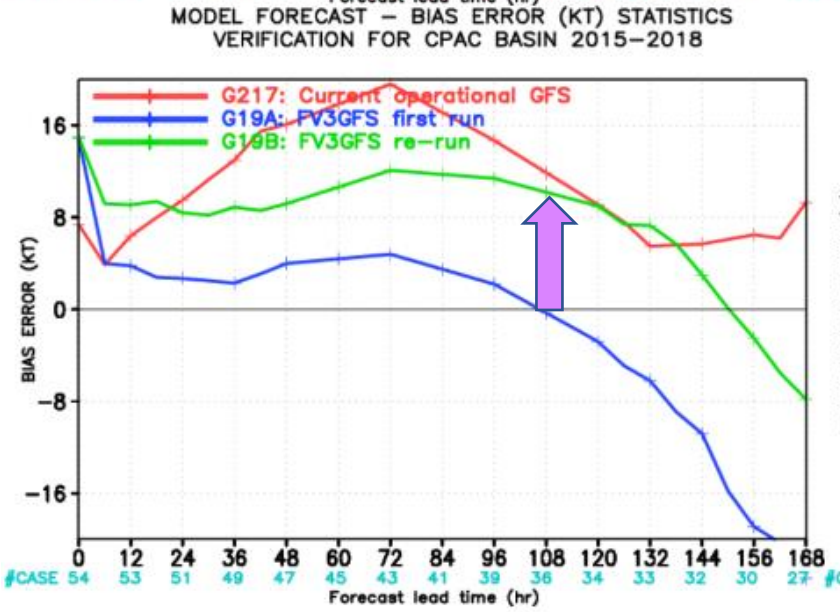

MODEL FORECAST – INTENSITY RELATIVE SKILL (%) STATISTICS
VERIFICATION FOR EPAC BASIN 2015–2018
G217: Current operational GFS
G19A: FV3GFS first run
G19B: FV3GFS re–run
INTENSITY RELATIVE SKILL (%)
SKILL PLOT RELATIVE TO THE G217 MODEL
Forecast lead time (hr)
#CASE 635 579 512 458 413 372 335 300 267 238 211 185 157 134 111

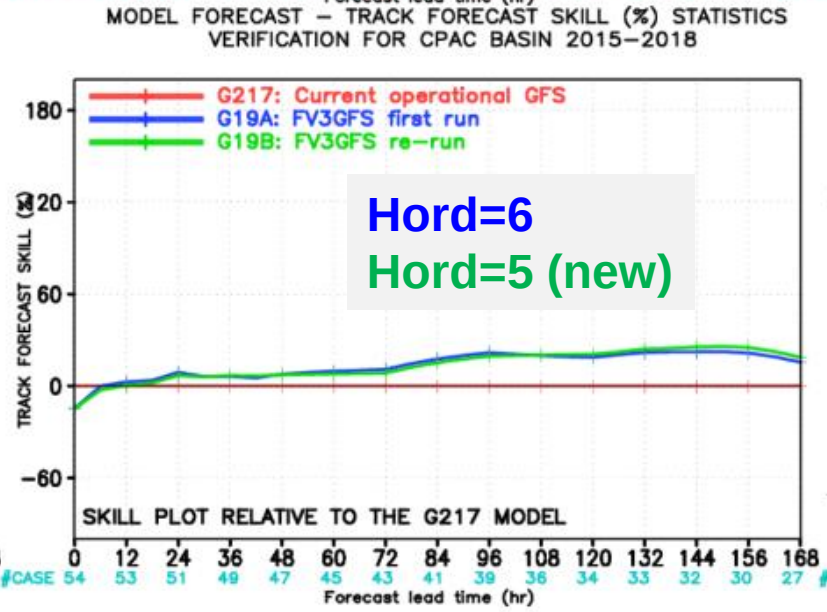


Central Pacific

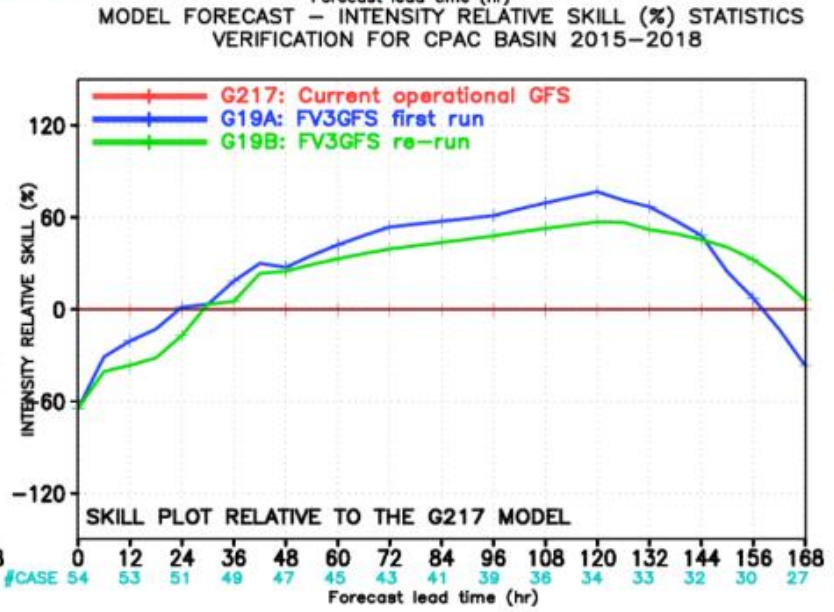


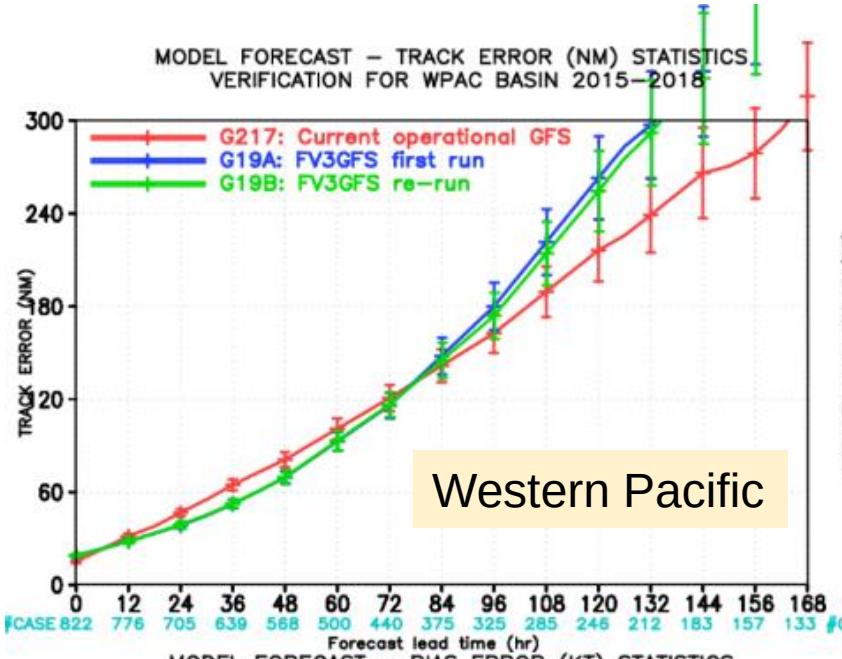




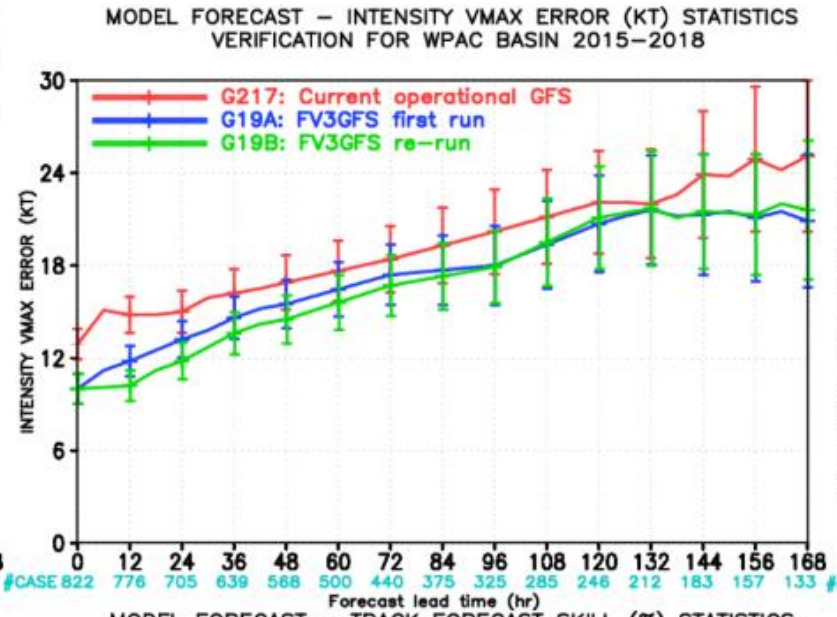


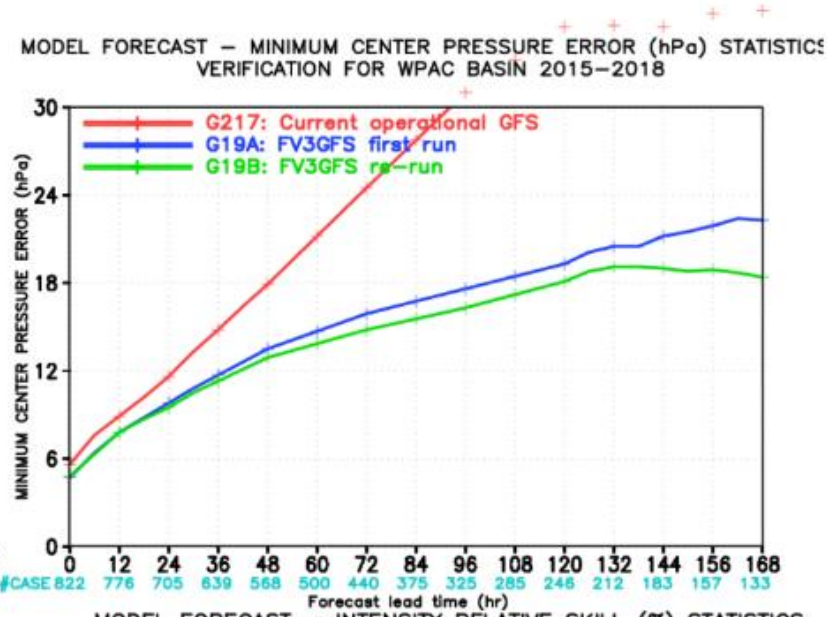
Hord=6
Hord=5 (new)

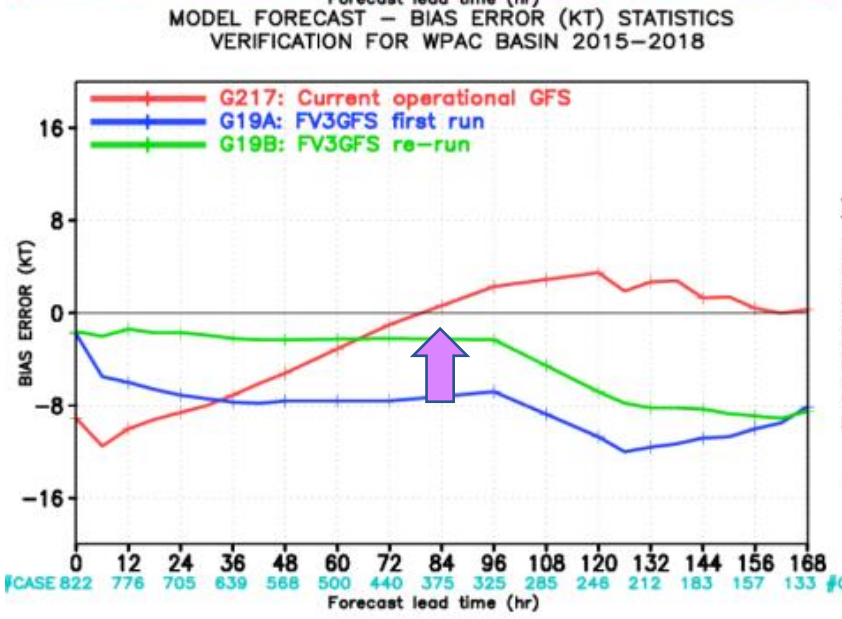


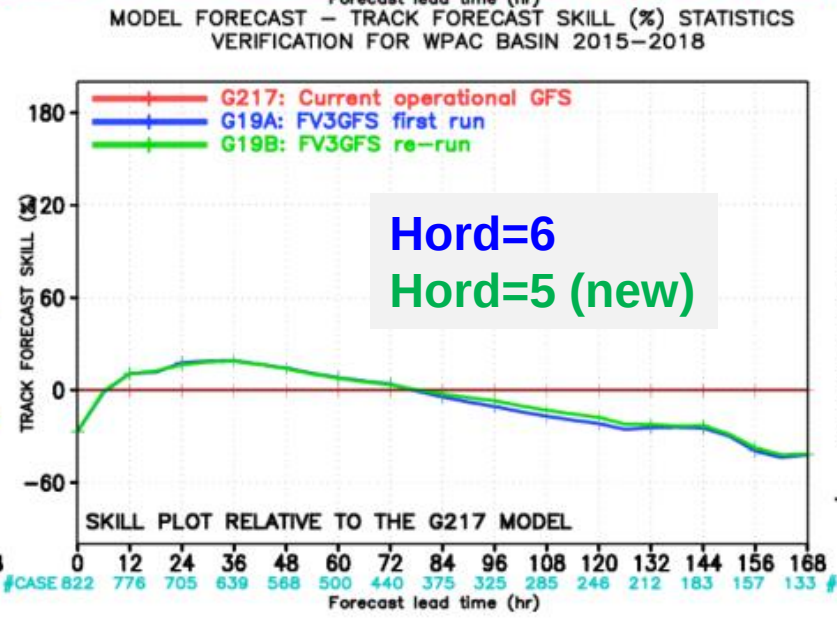


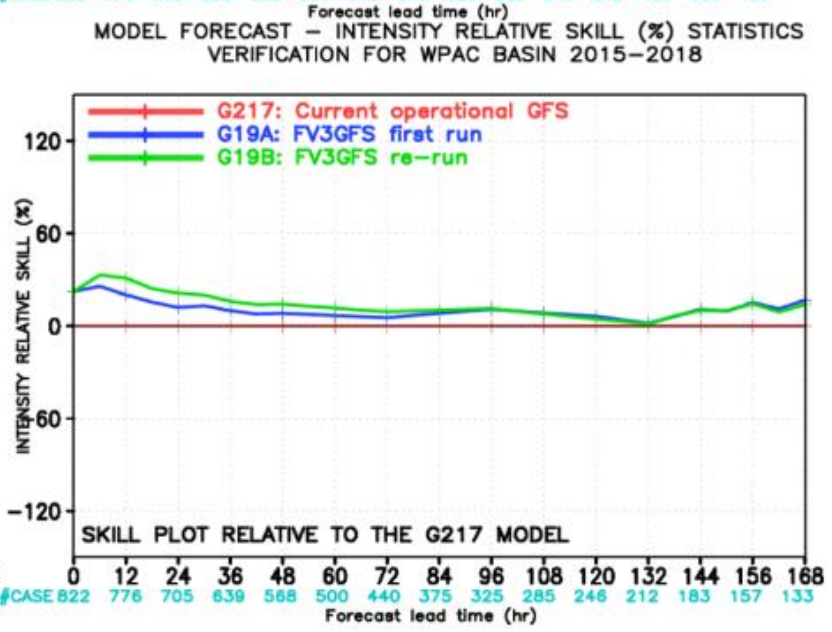
Western Pacific

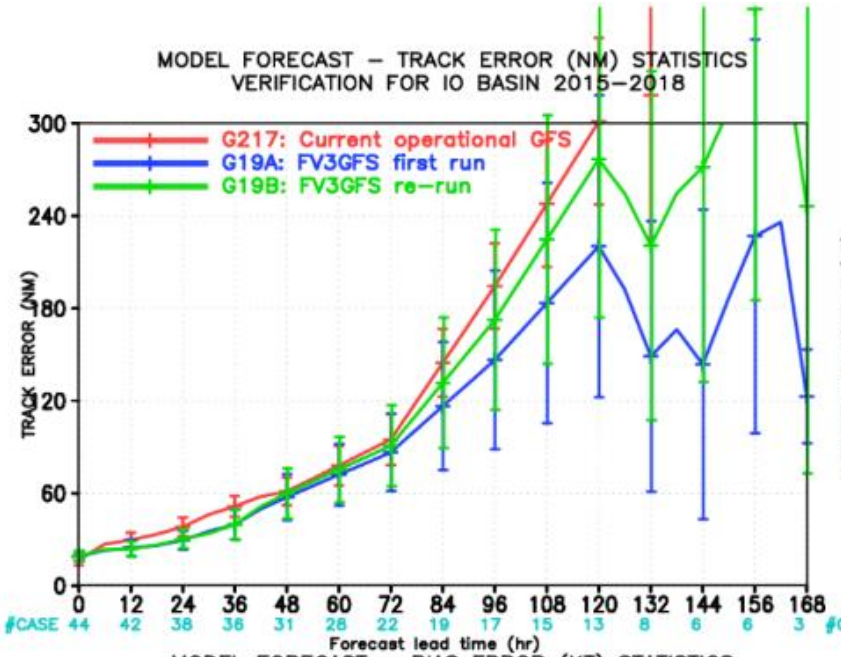


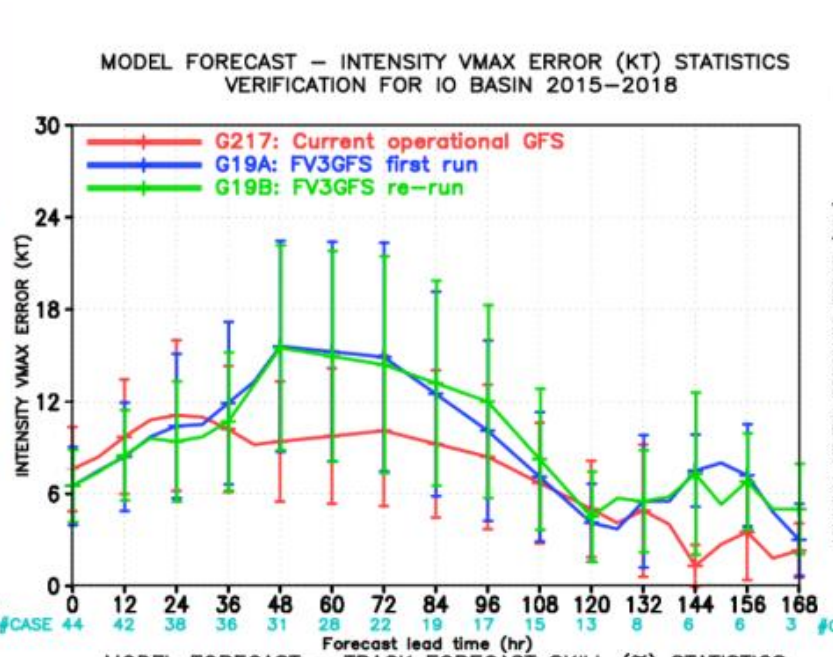


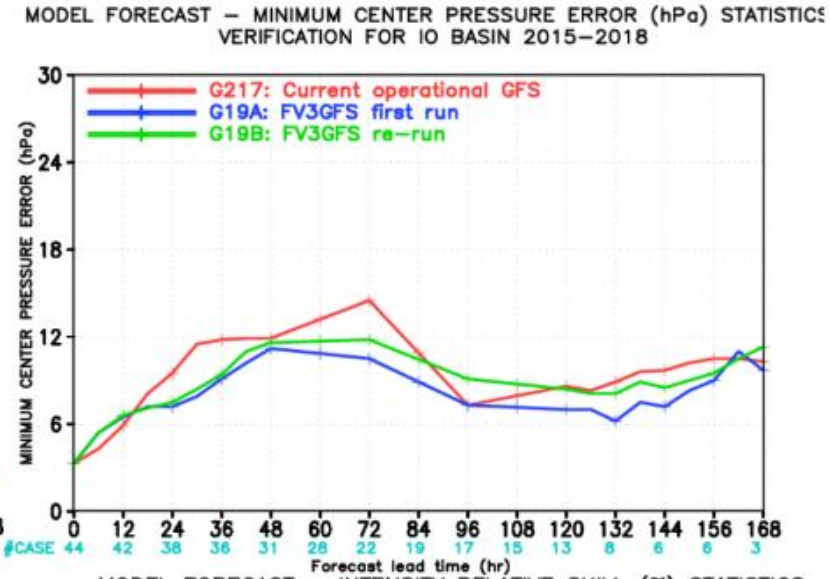


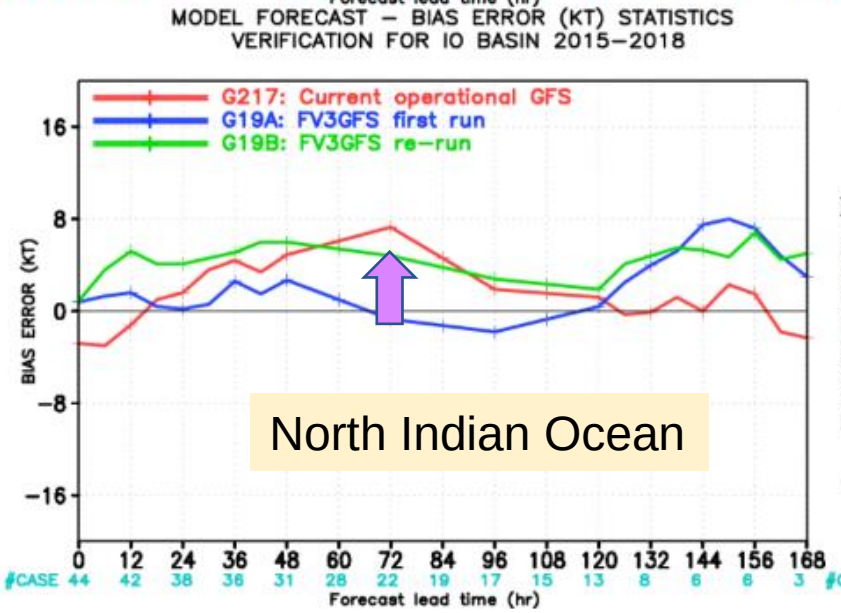




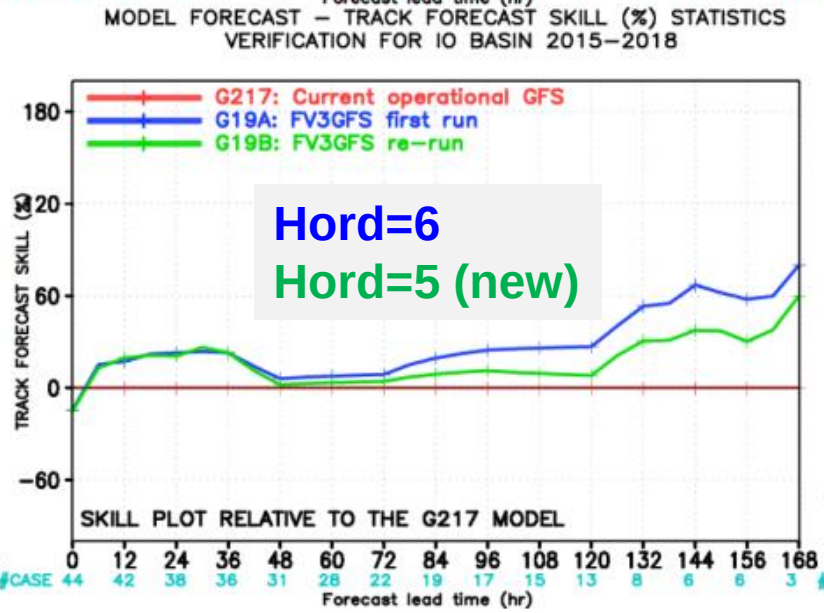




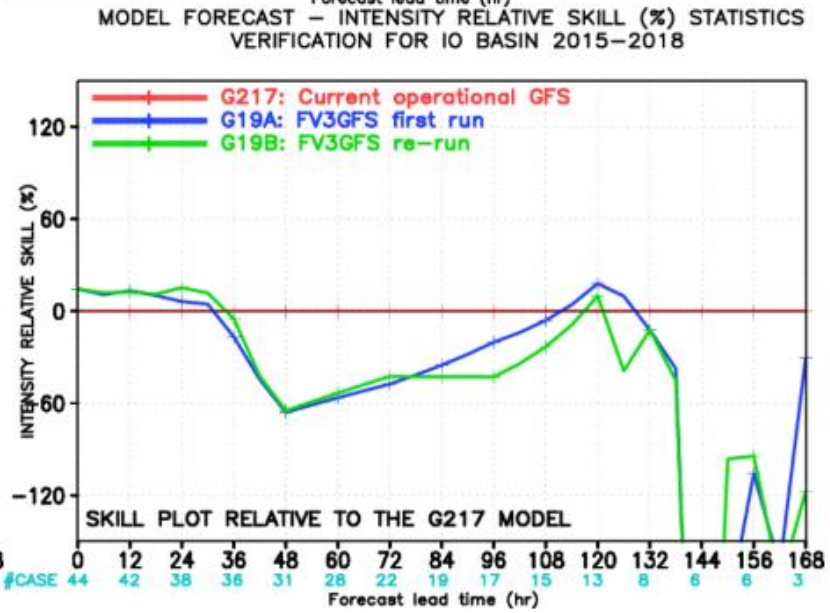


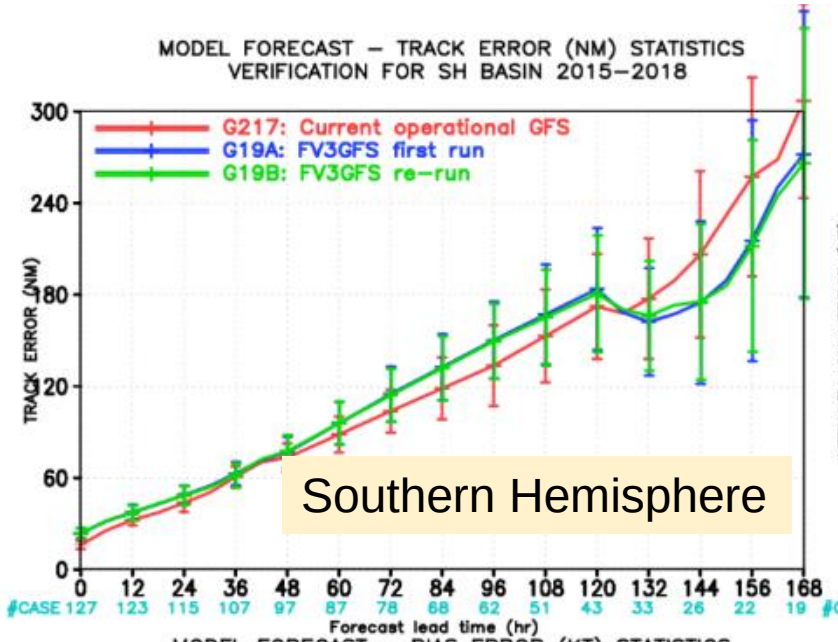


North Indian Ocean

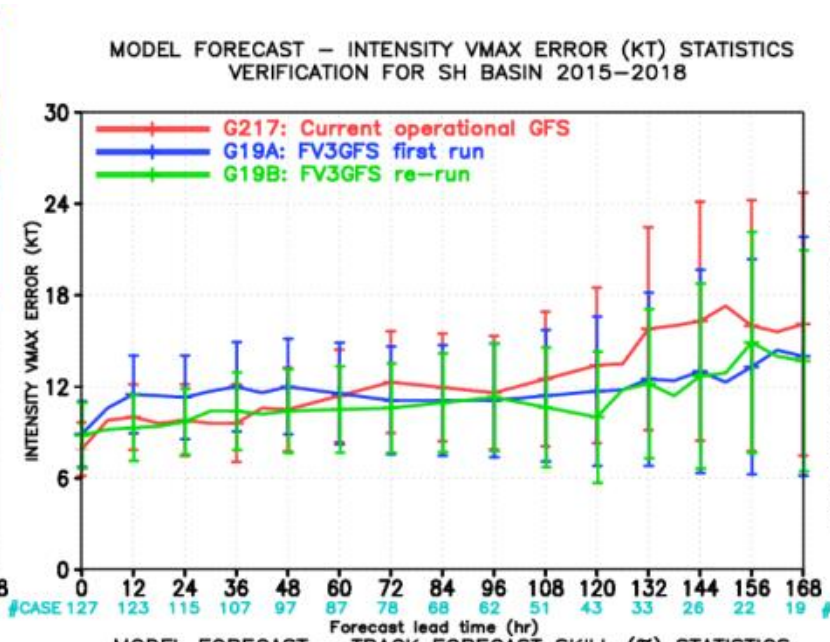


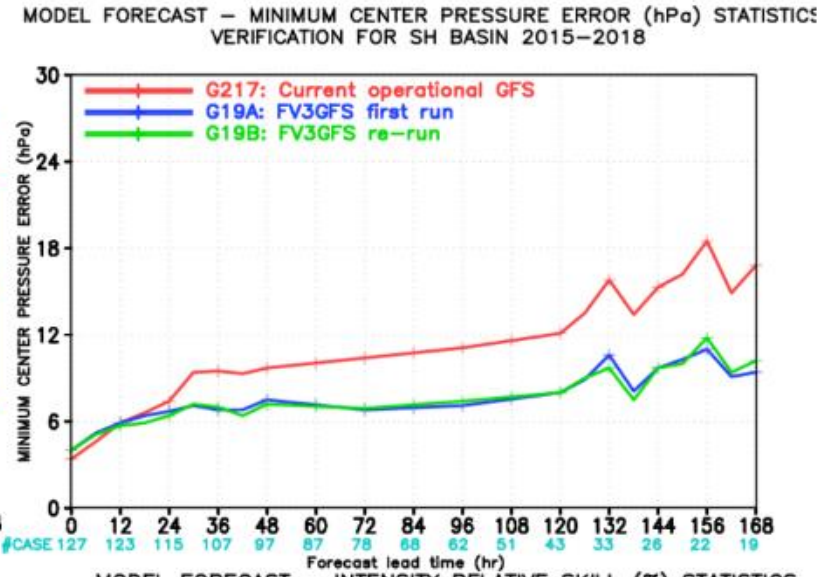
Hord=6
Hord=5 (new)

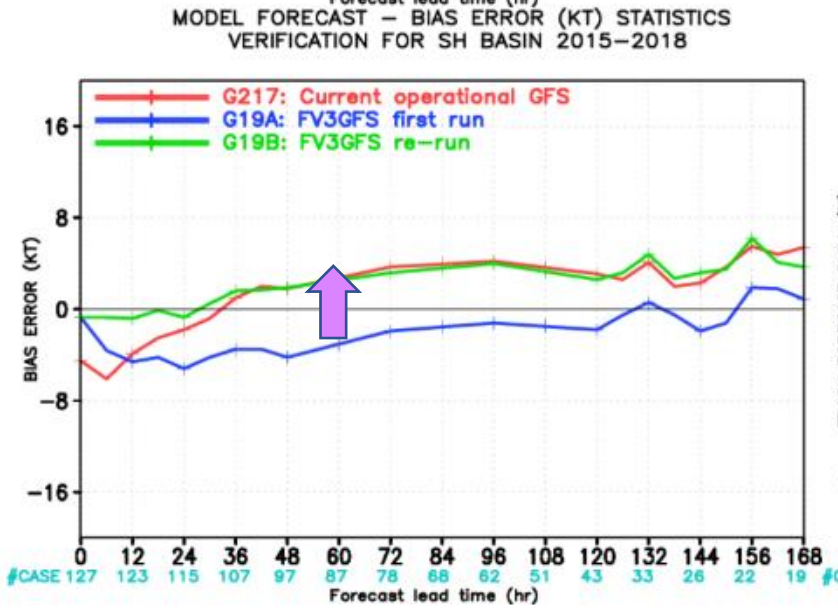


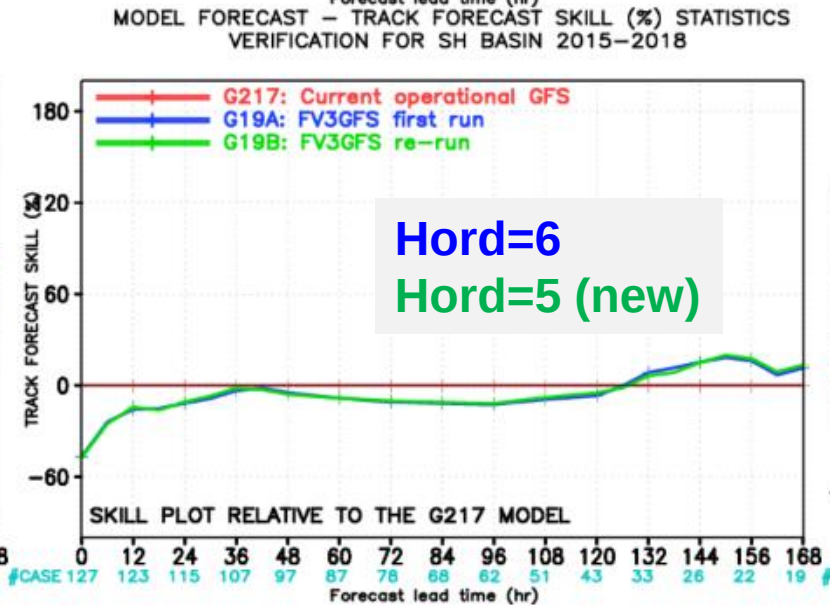


Southern Hemisphere

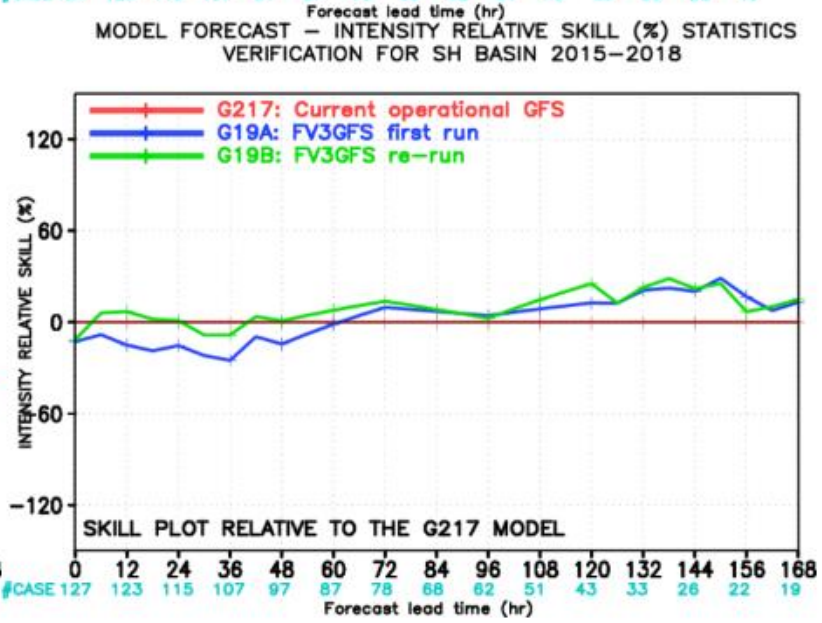






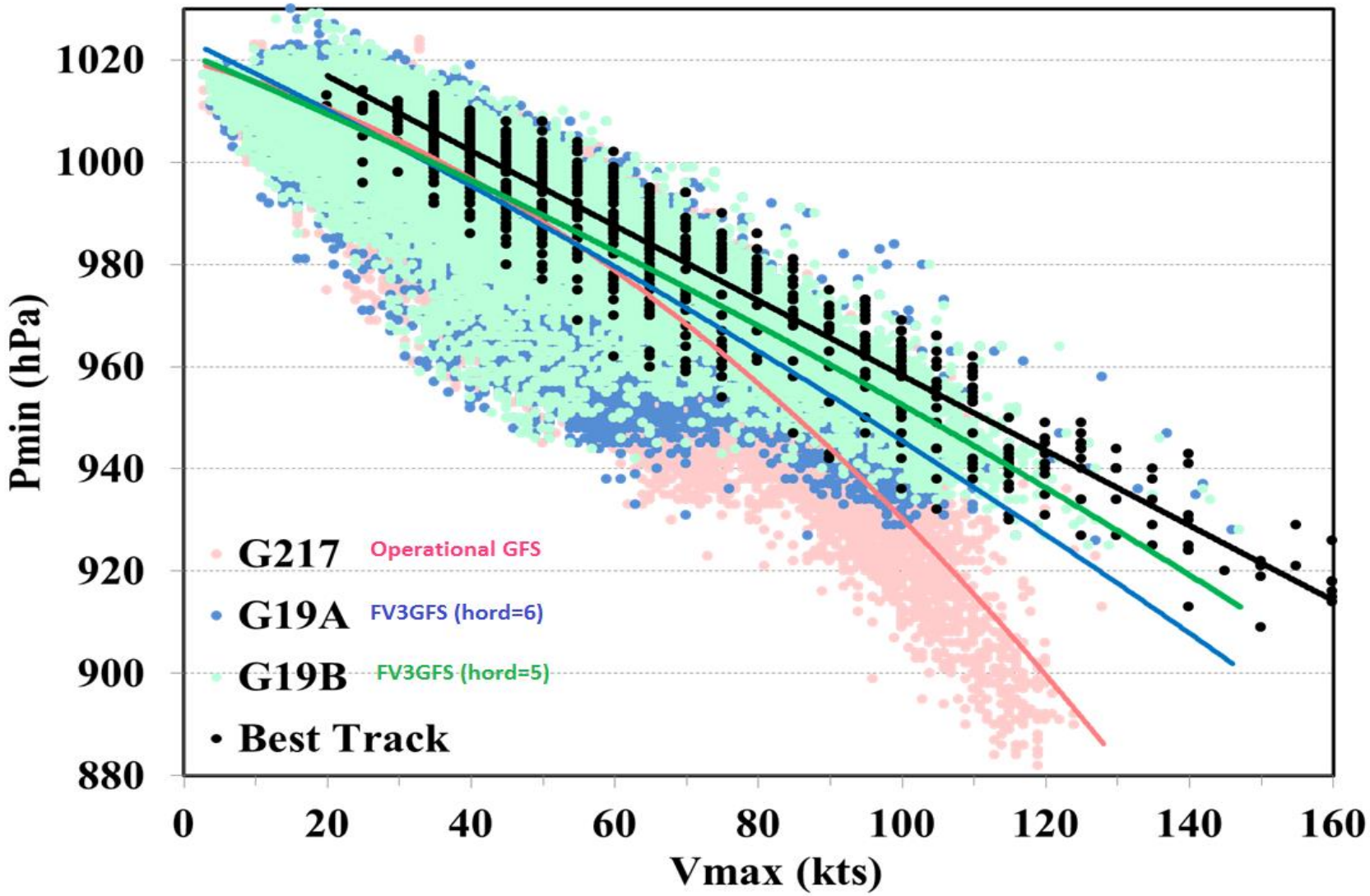


Hord=6
Hord=5 (new)



Wind-Pressure Relationship

Much improved W-P relationship with FV3GFS (hord=5) compared to operational GFS and older runs of FV3GFS (hord=6)



Statistical Summary:
Comparing hord=5 (new) with hord=6 (old):

- There are no significant differences in ACC, RMSE, and precip skill scores for the warm season

- Running FV3GFS with hord5 significantly improves hurricane intensity in the Atlantic, EPAC and WPAC.

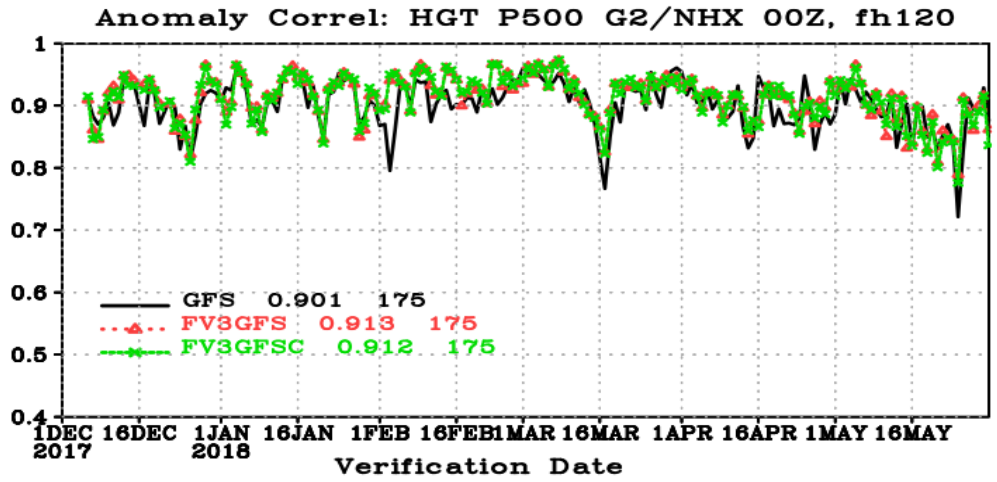
- Has slightly positive impact on hurricane track.

2. 2017/18 cold season – Compare hord=5 with hord=6 (20171201 ~ 20180531)

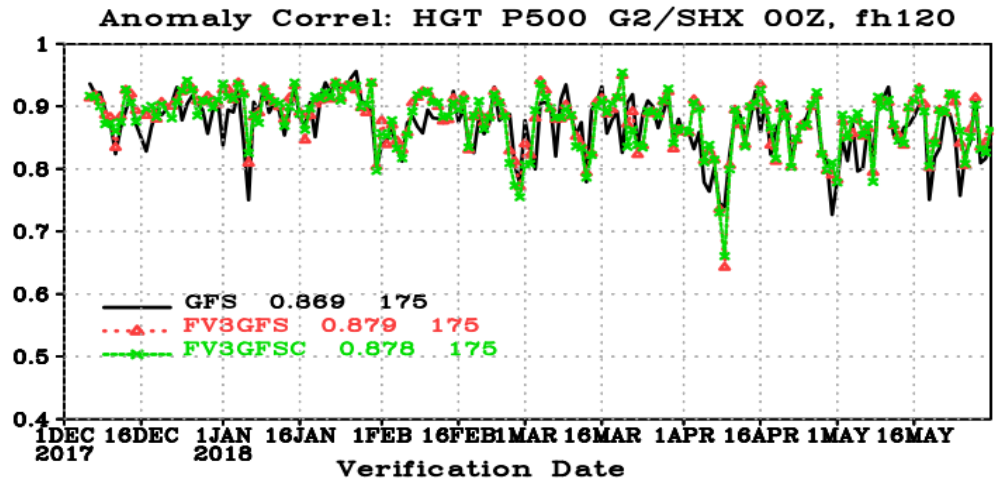
http://www.emc.ncep.noaa.gov/gmb/emc.glopara/vsdb/fv3q2fy19retro1c/

500 hPa HGT ACC

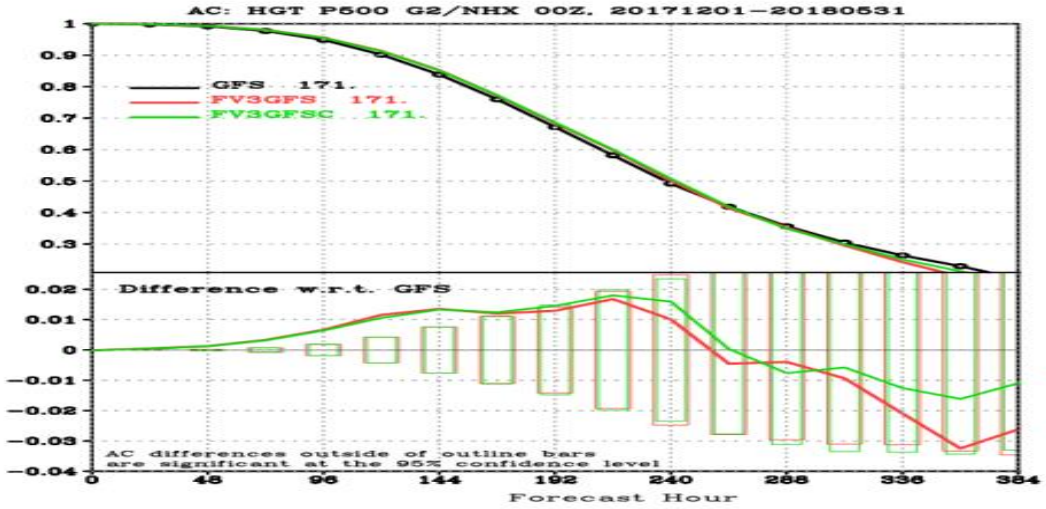
Black: ops GFS; Red: fv3gfs, hord=6; green: fv3gfsc, hord=5



NH



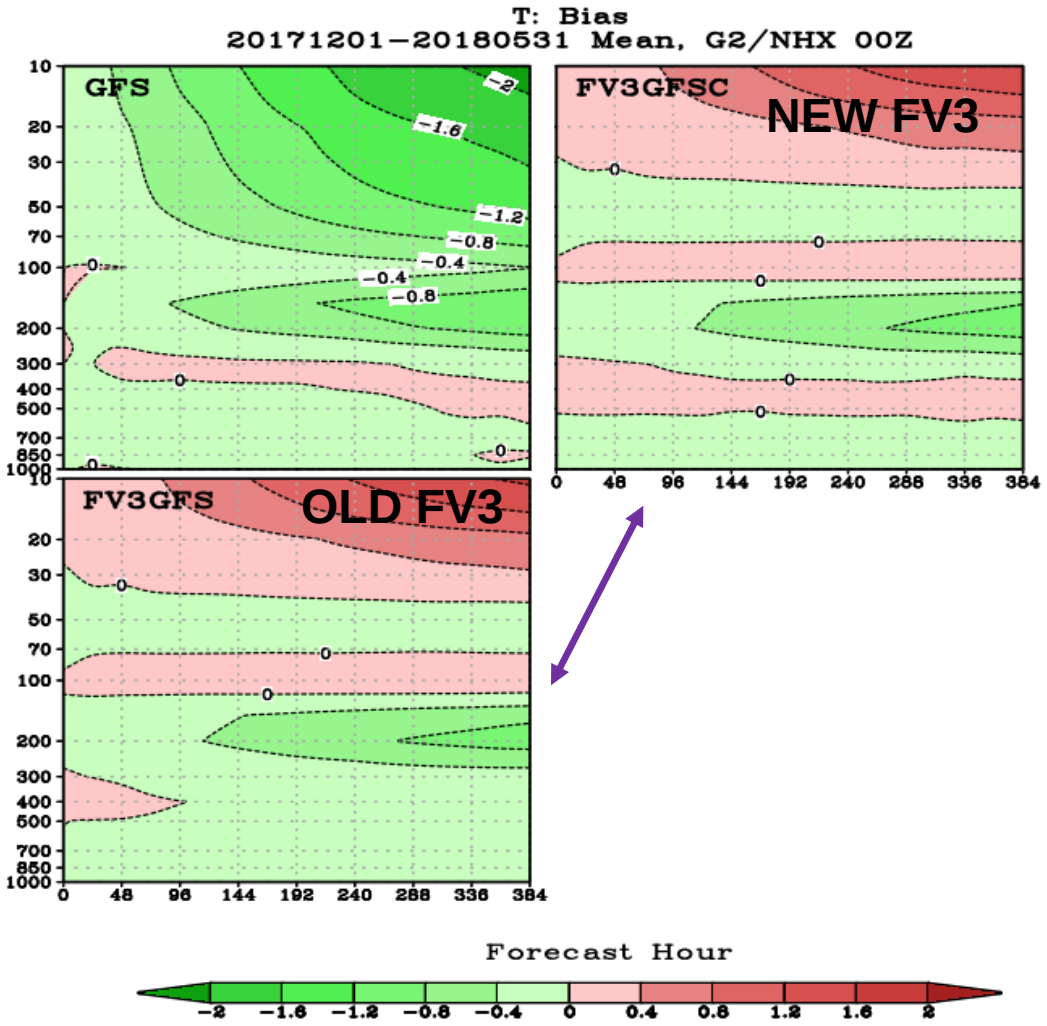
SH



No difference

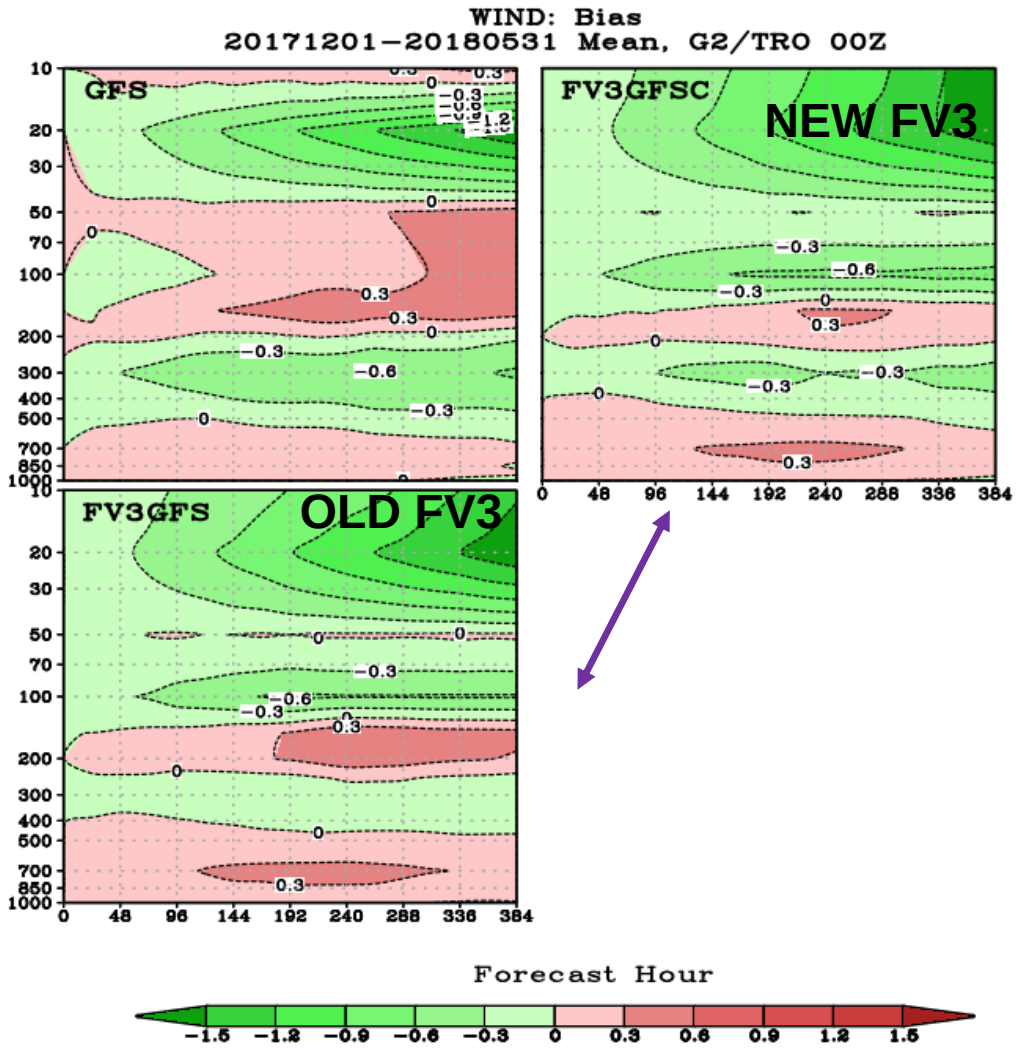
No difference

NH Temperature Bias



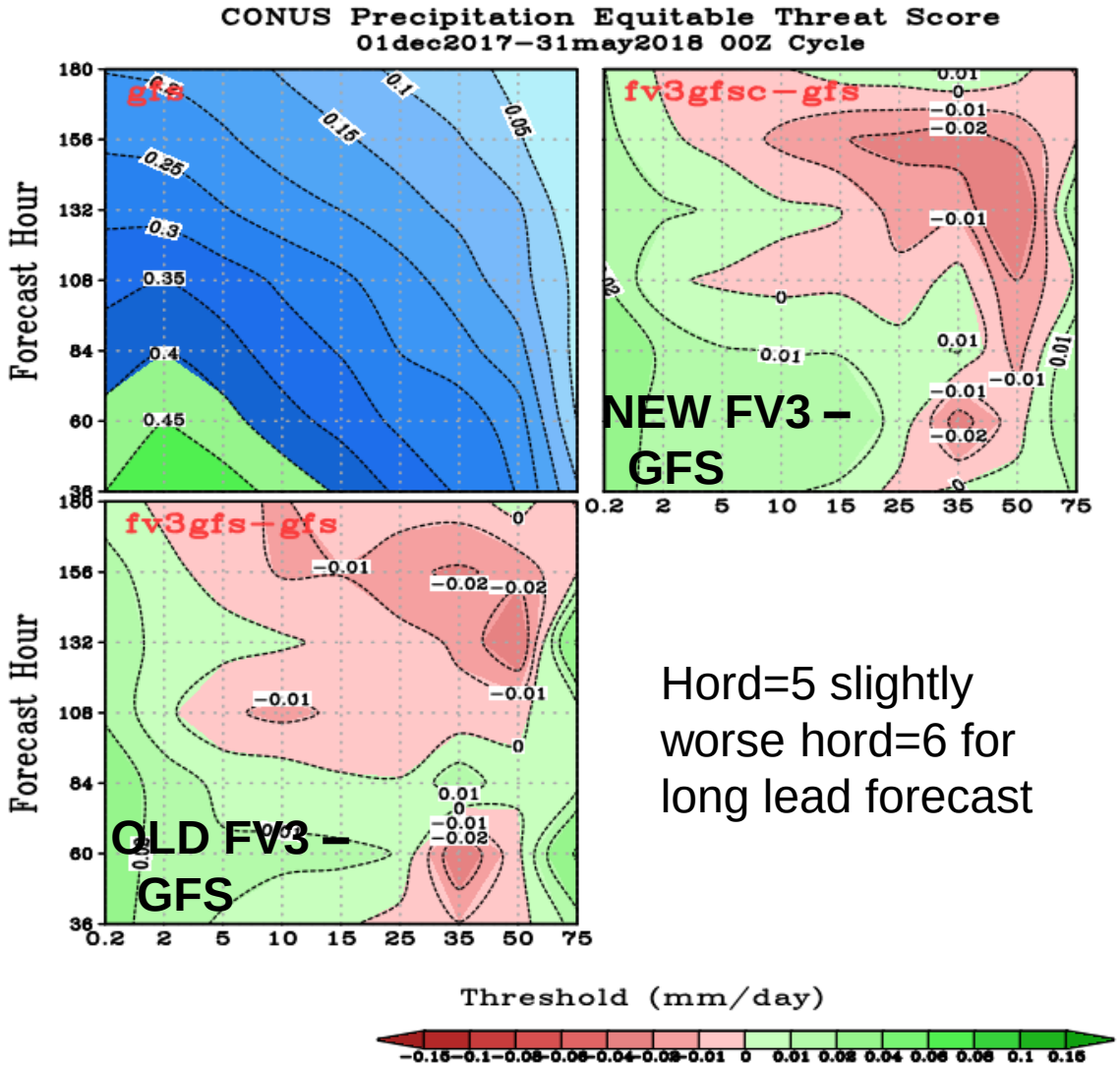
No difference

NH Wind Bias

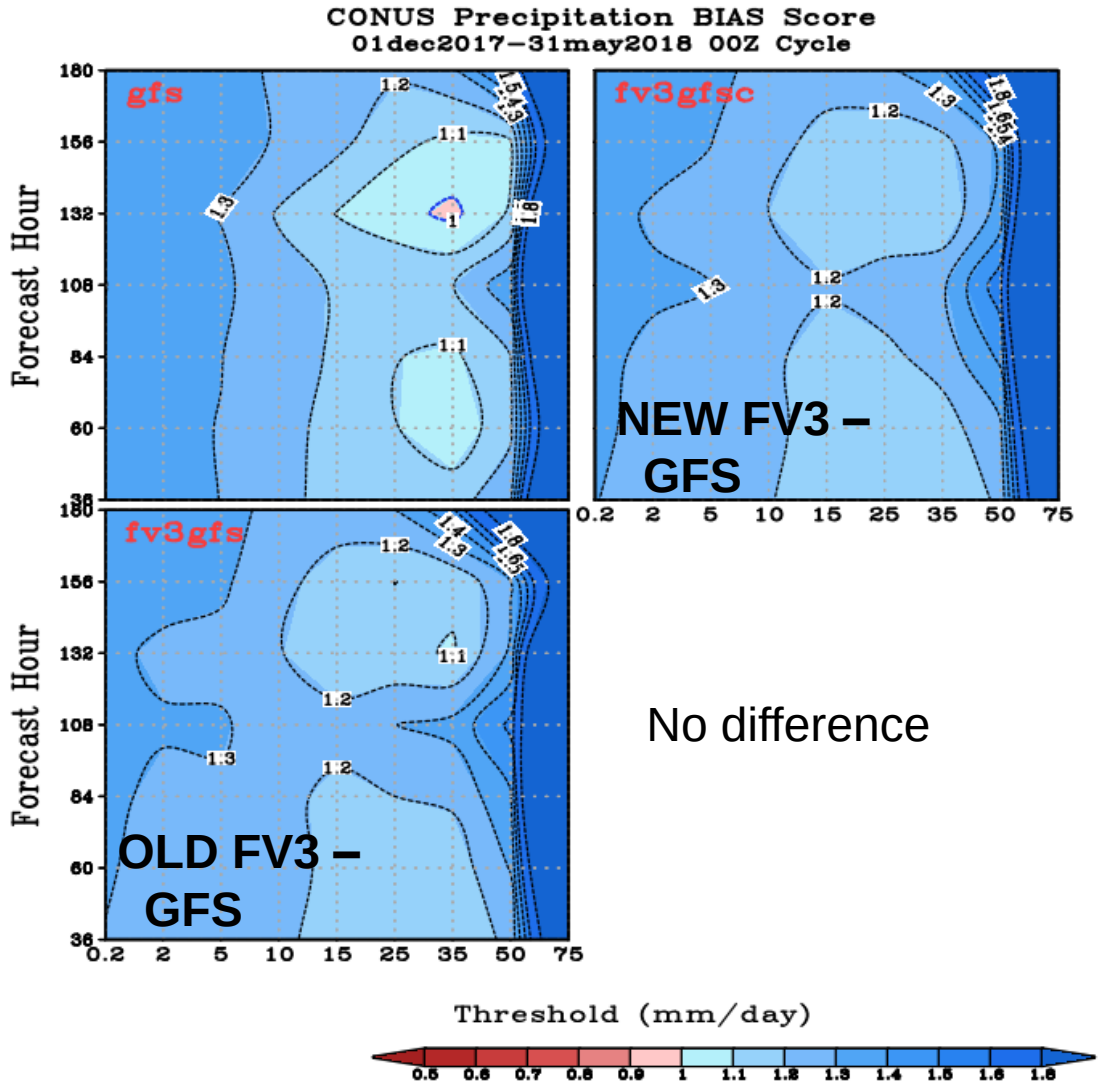


No difference

CONUS PRECIP ETS and BIAS Scores



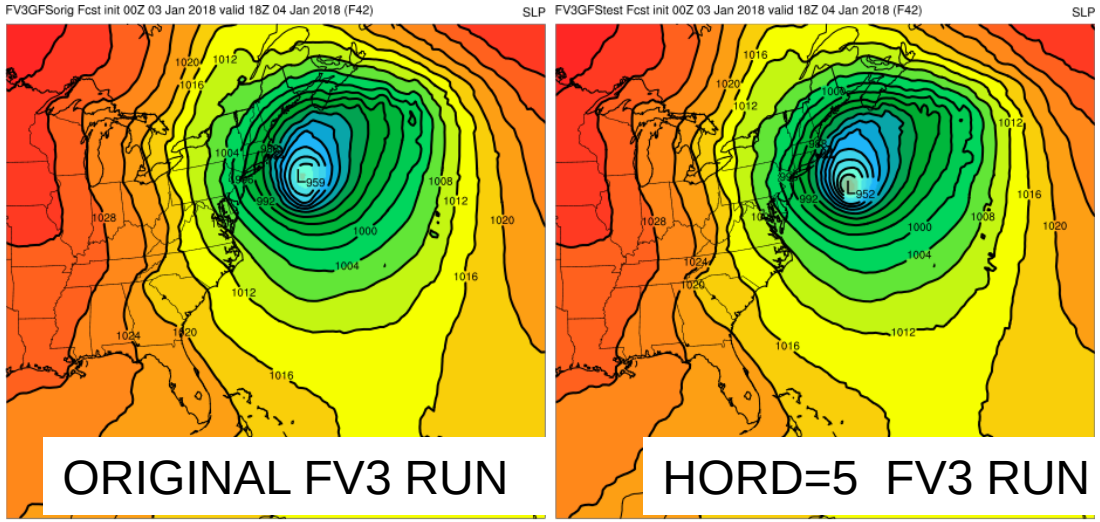
Hord=5 slightly worse hord=6 for long lead forecast

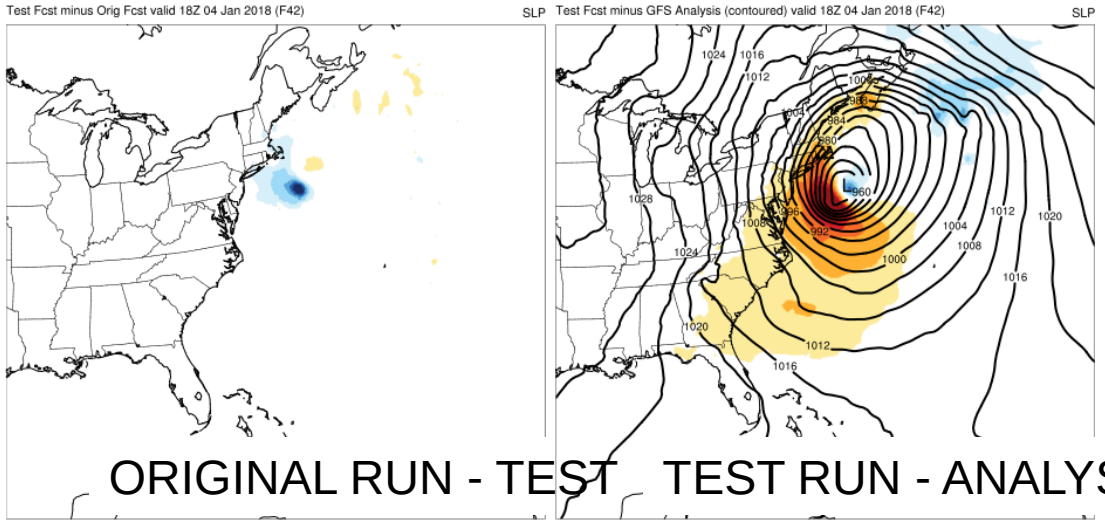


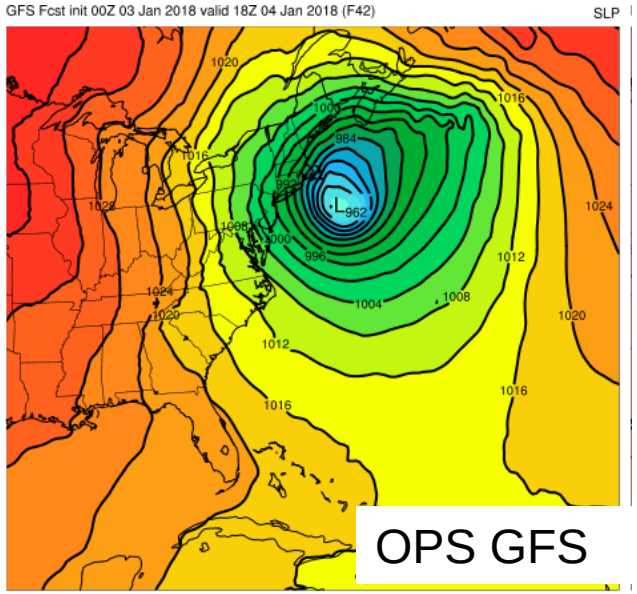
No difference

IMPACT OF HORD=5 TEST CASES

FORMAT OF SLIDES

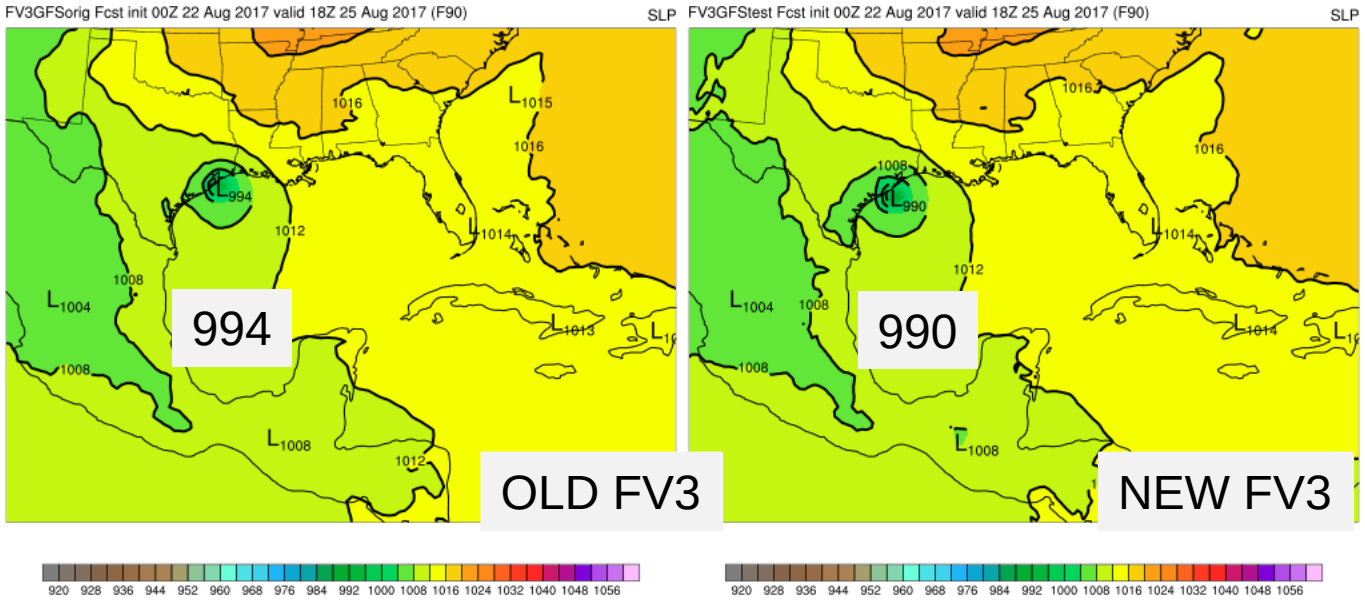


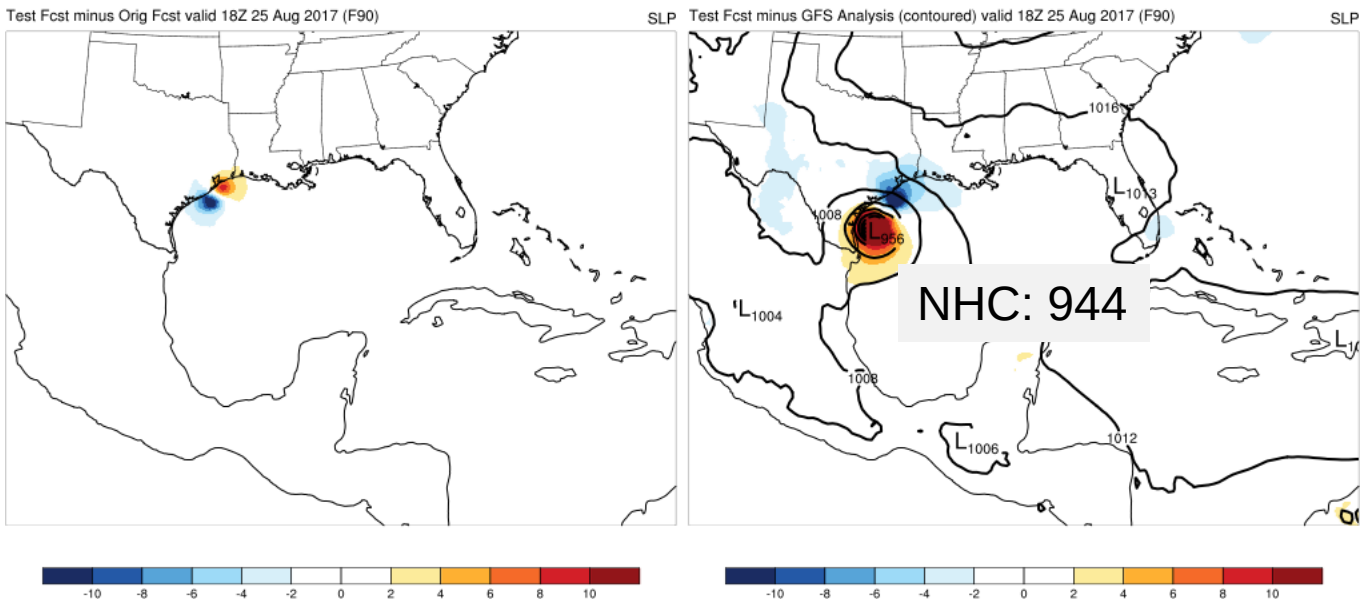




OPS GFS is used for analysis
WPC/NHC intensity used when needed

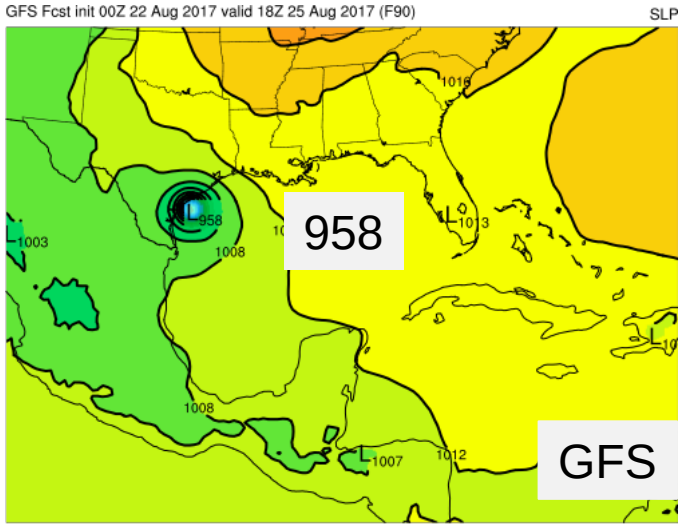
HARVEY



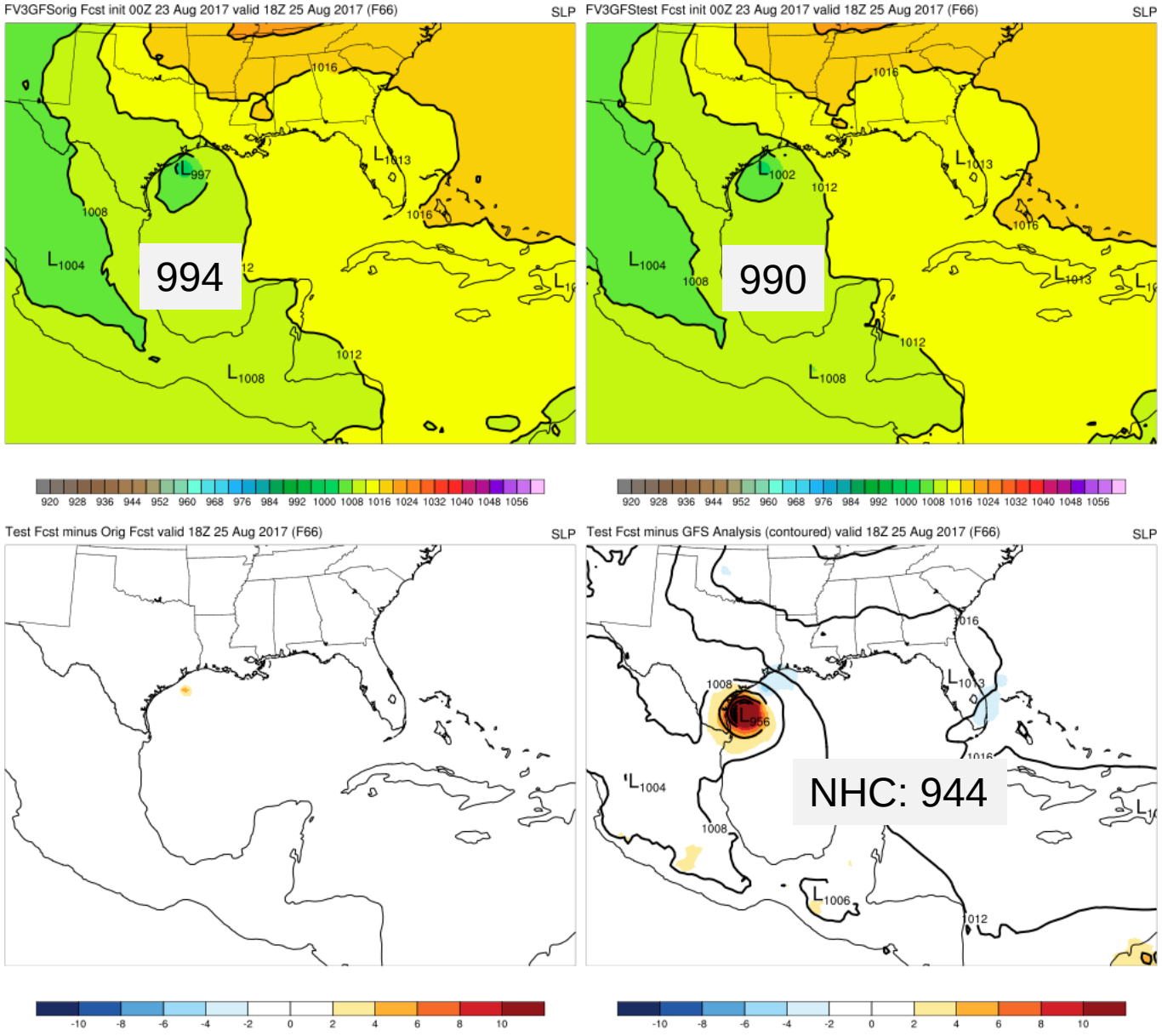


HARVEY

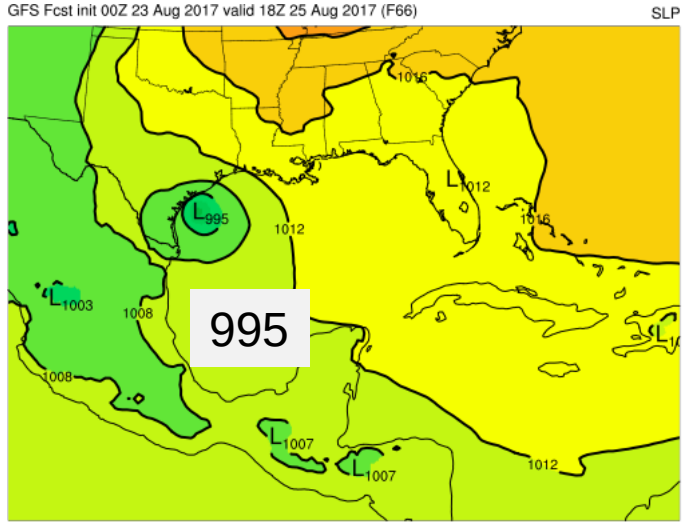
00z 8/22/17 CYCLE
F90



TEST RUN ~5 mb deeper, but both FV3 cycles are too far north with landfall

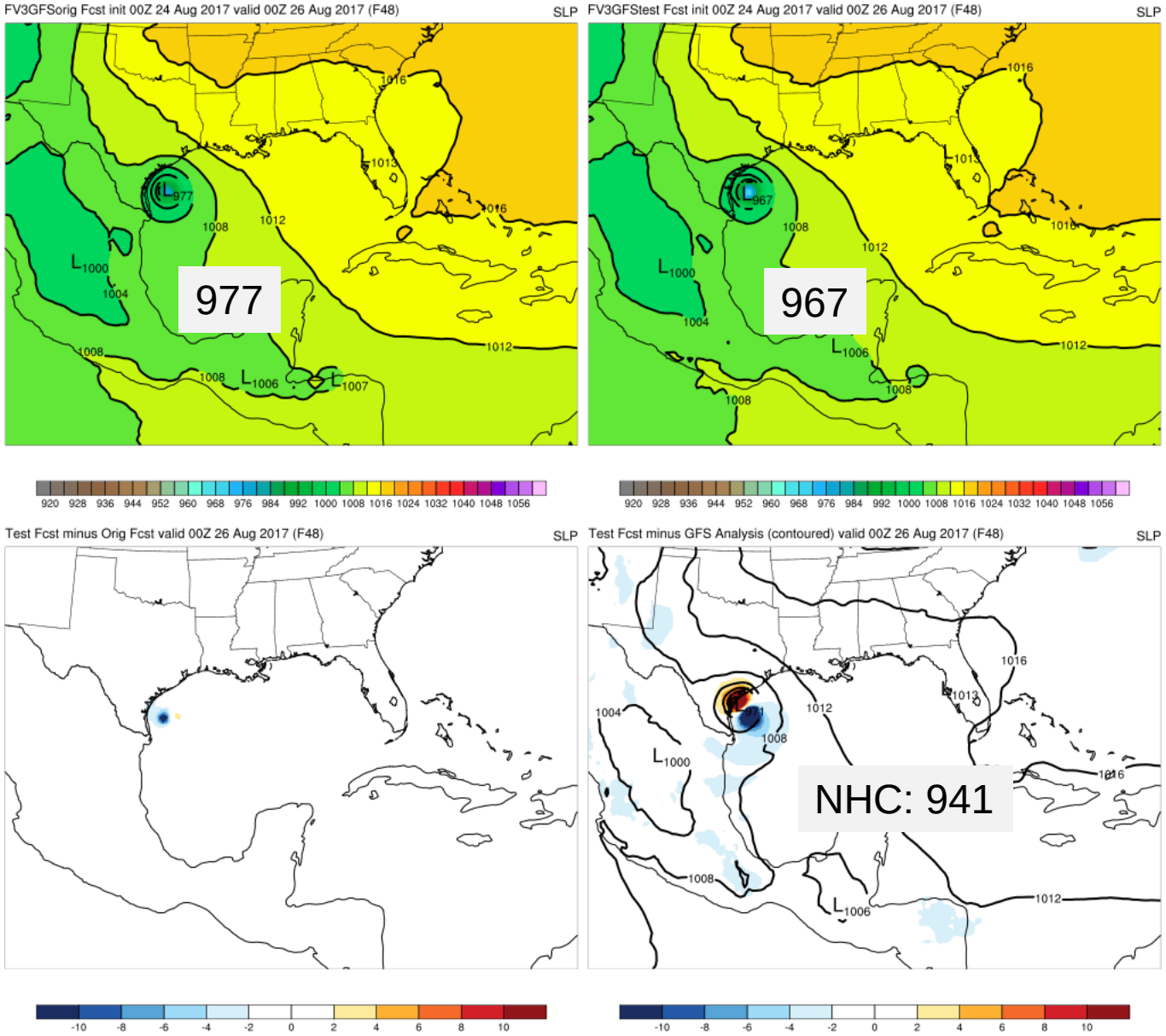


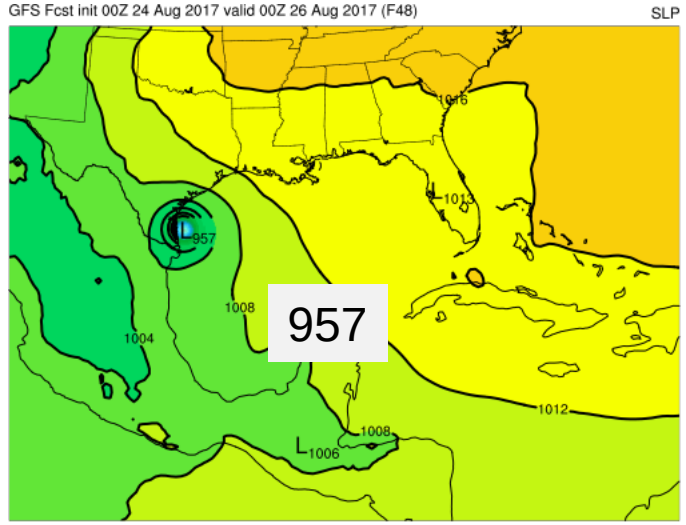
00z 8/23/17 CYCLE
F66



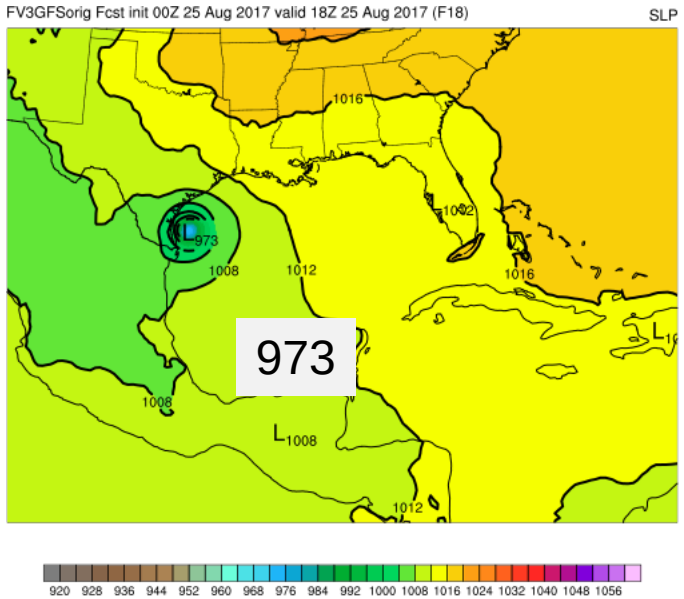
TEST RUN ~5 mb weaker; both FV3 cycles are too far north with landfall

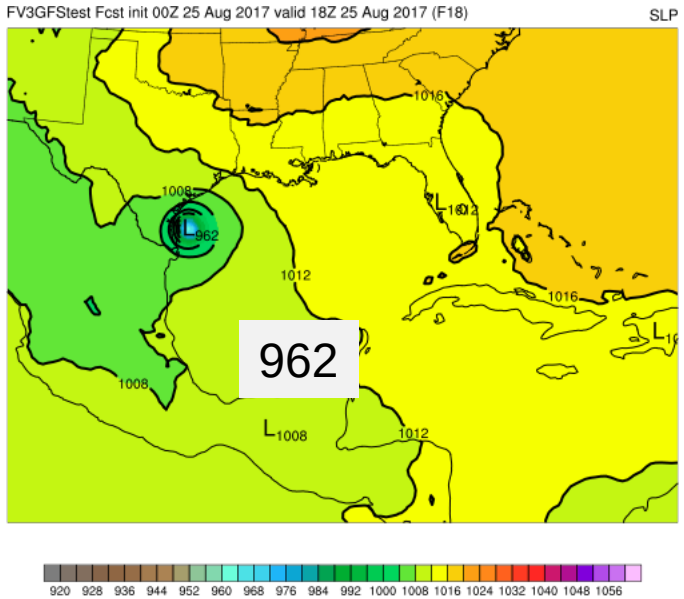
00z 8/24/17 CYCLE
F48

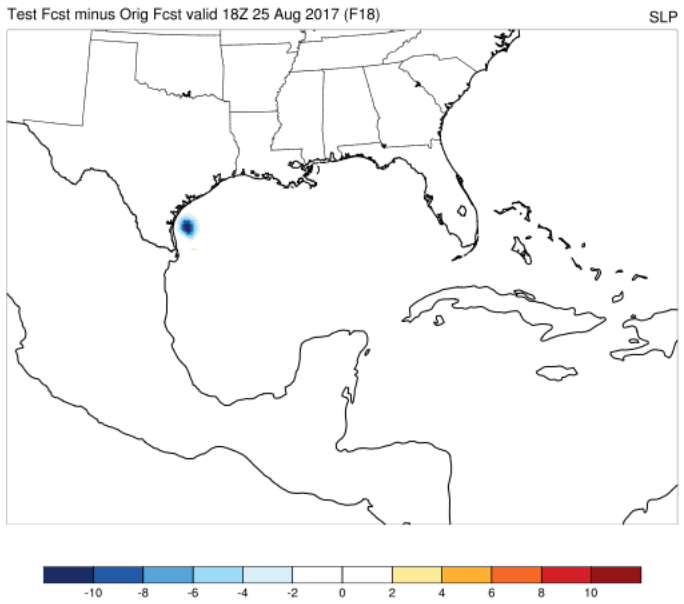


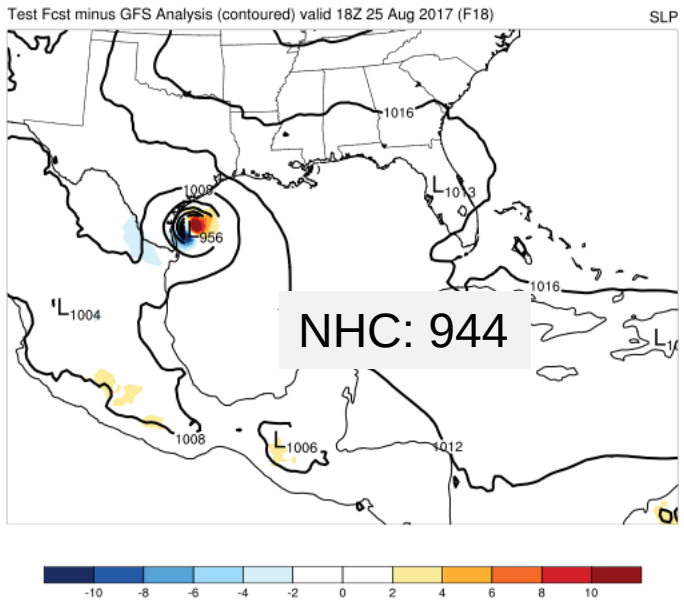


TEST RUN ~10 mb deeper, much closer to GFS intensity

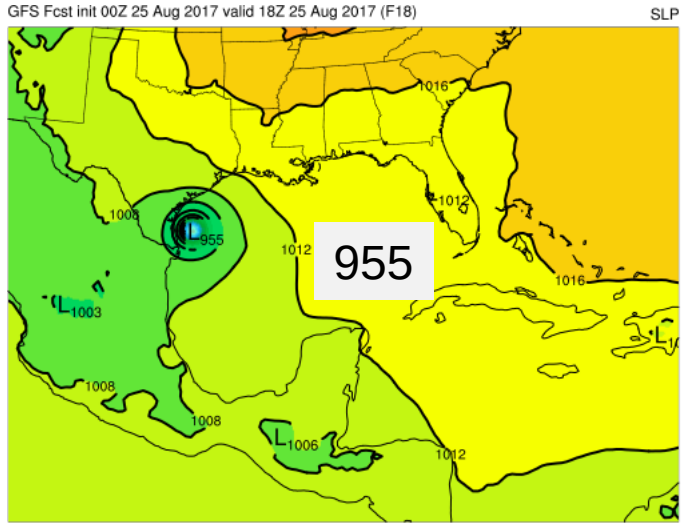








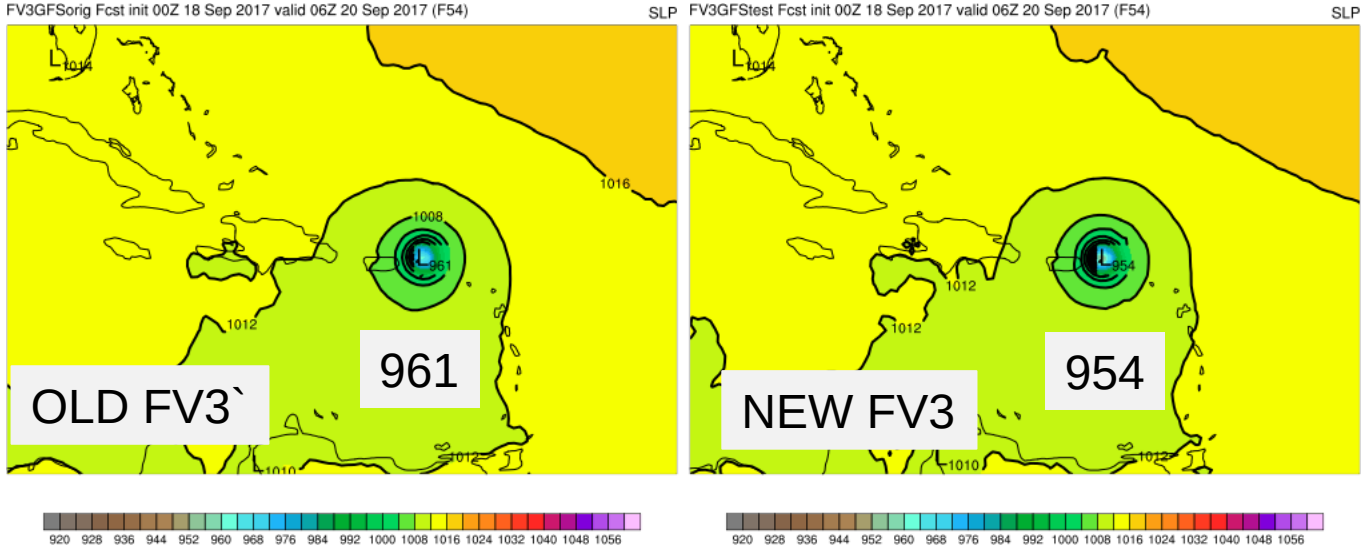
00z 8/25/17 CYCLE
F18

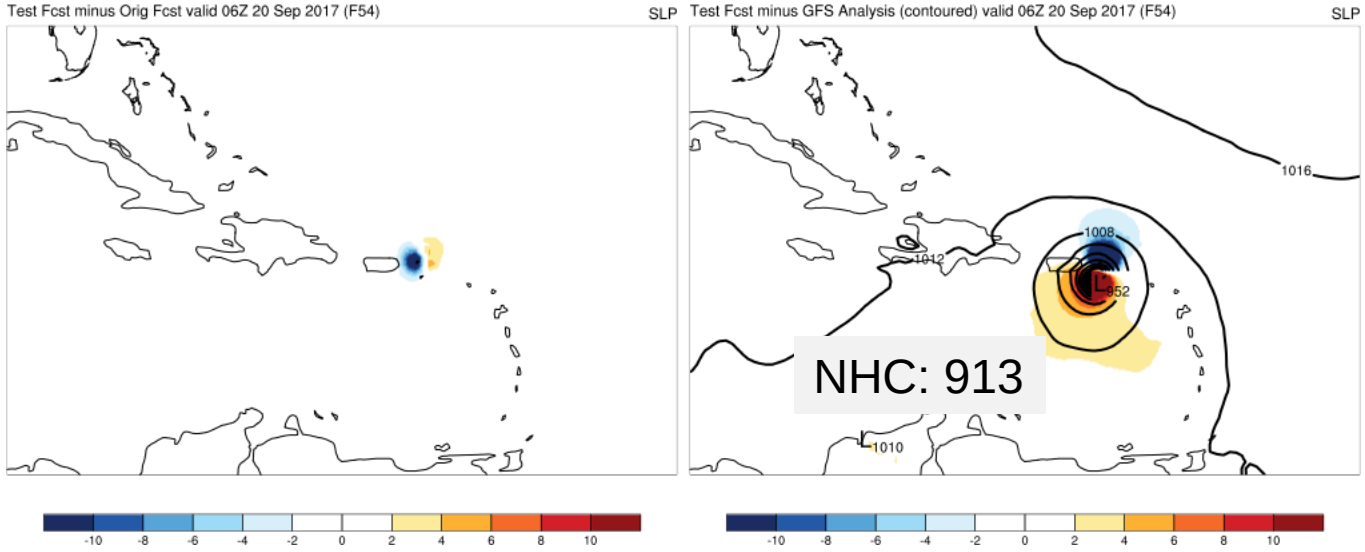


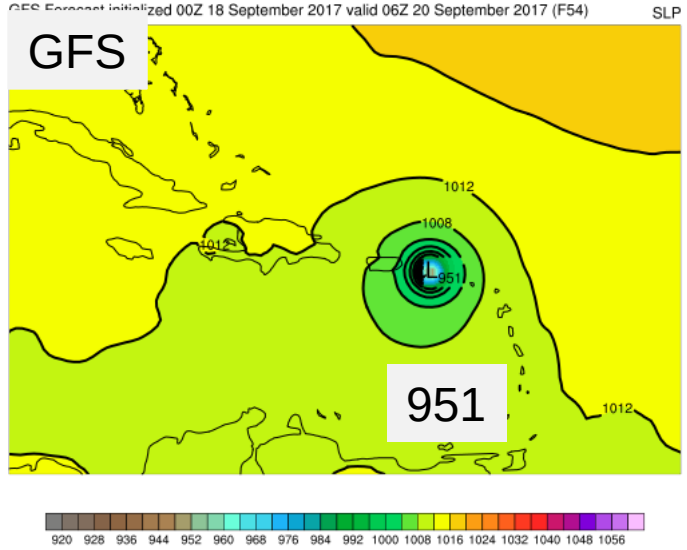
TEST RUN ~10 mb deeper, although still not as strong as GFS

MARIA

00z 9/18/17 CYCLE
F54

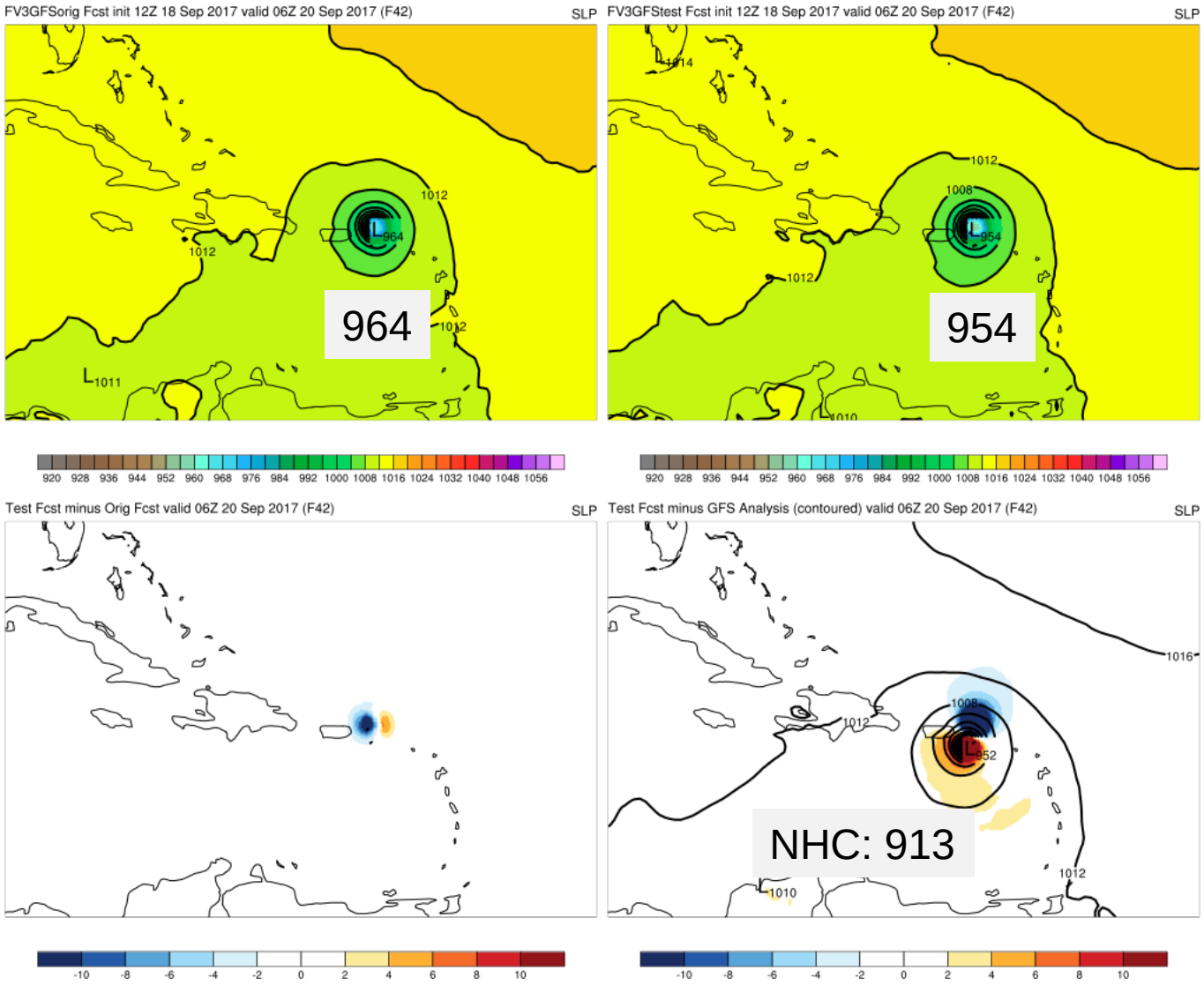


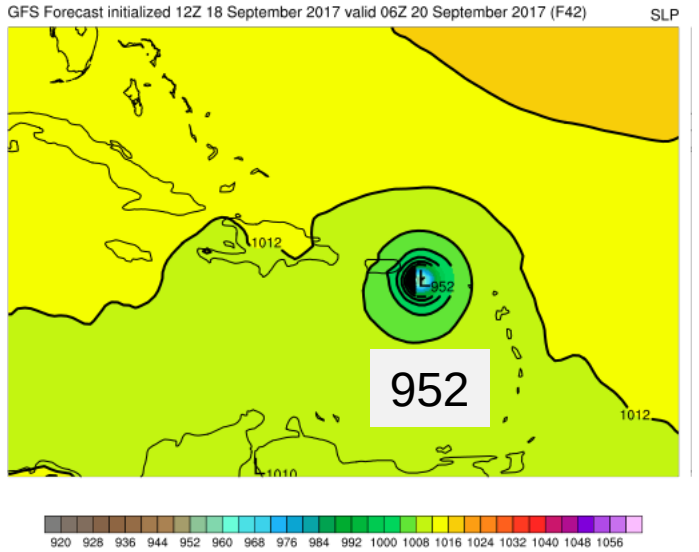




All runs too far east; TEST RUN much closer to ops GFS - original FV3 run weaker (extreme intensification not likely to be captured by global model)

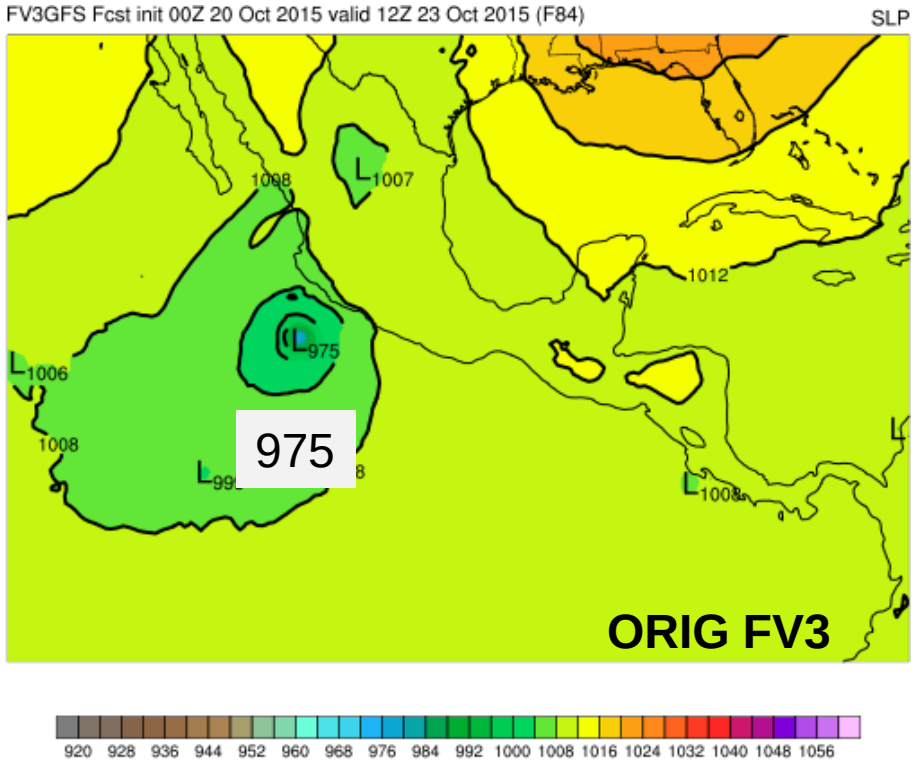
12z 9/18/17 CYCLE
F48

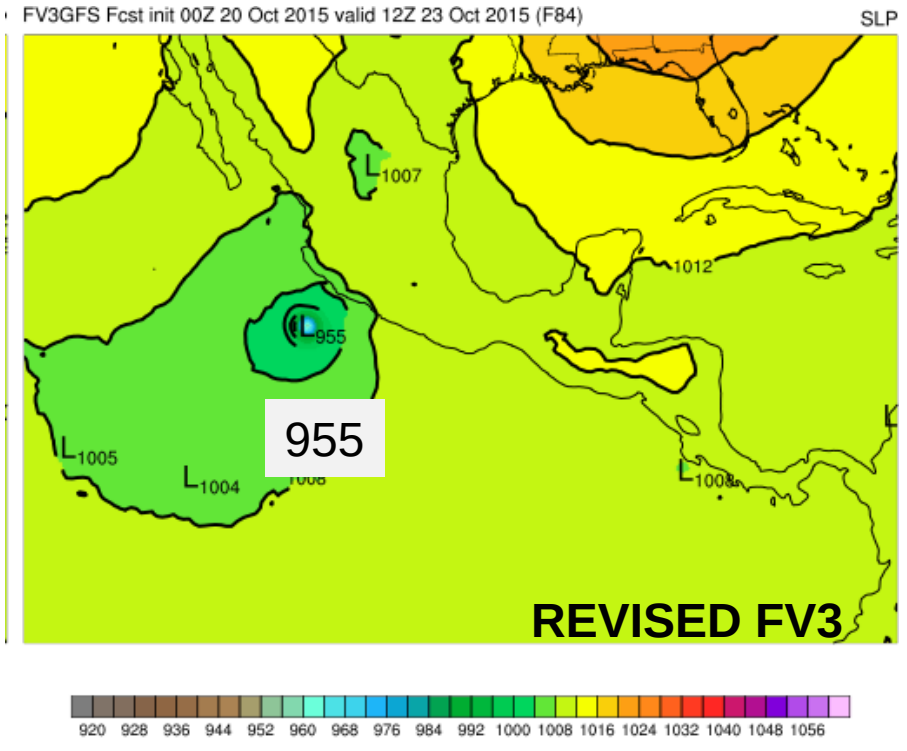




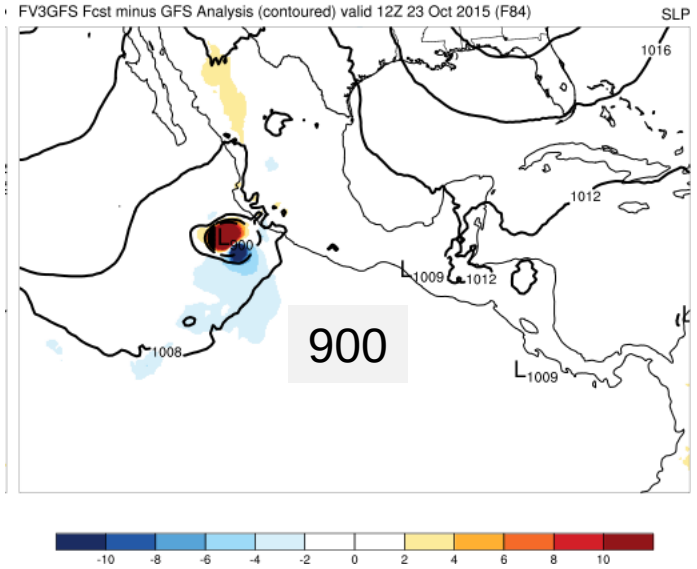
Both FV3 cycles too fast, but TEST RUN is closer in intensity to GFS

PATRICIA





00z
10/20/15
CYCLE

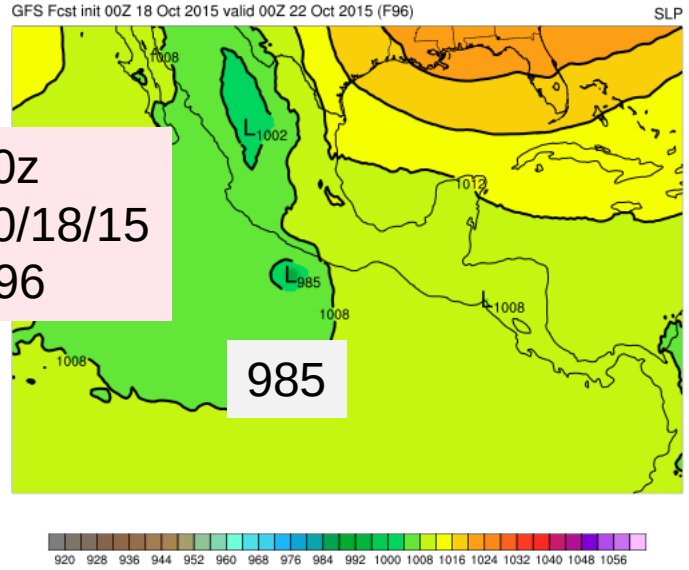


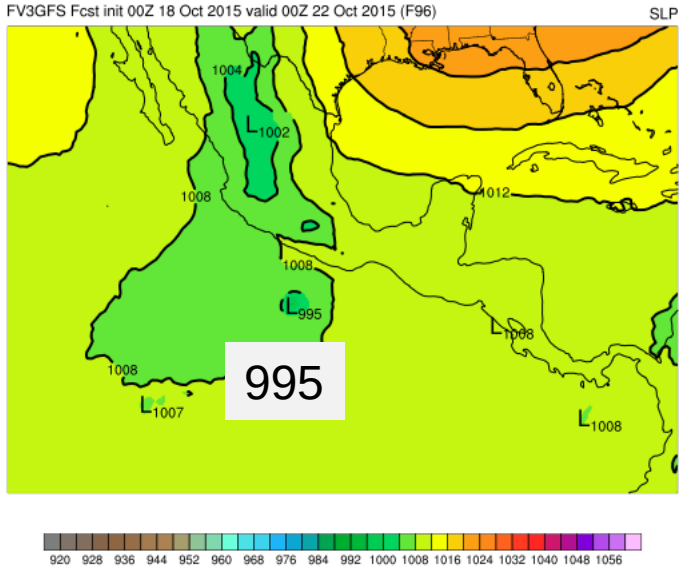
GFS

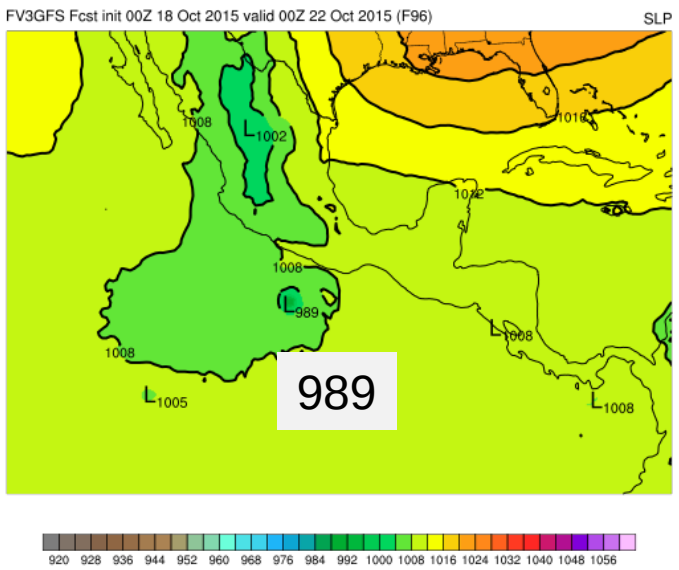
ORIG FV3

REVISED FV3

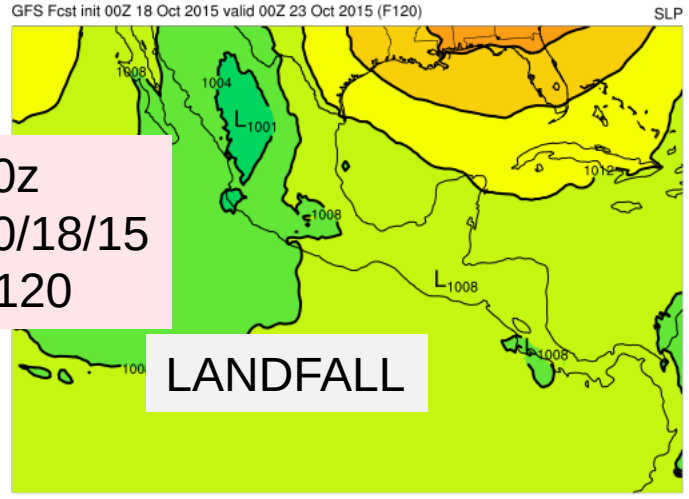
24h intensification

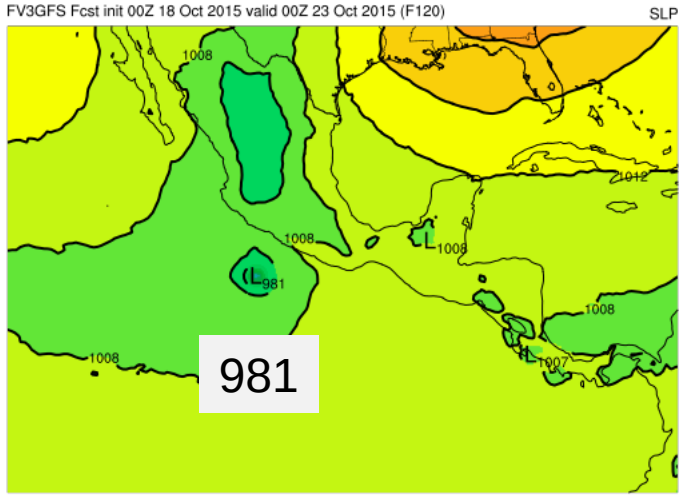


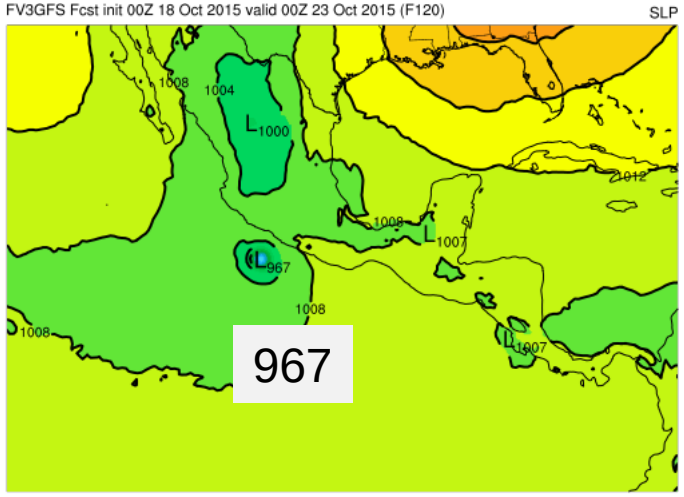




00z 10/18/15 F96



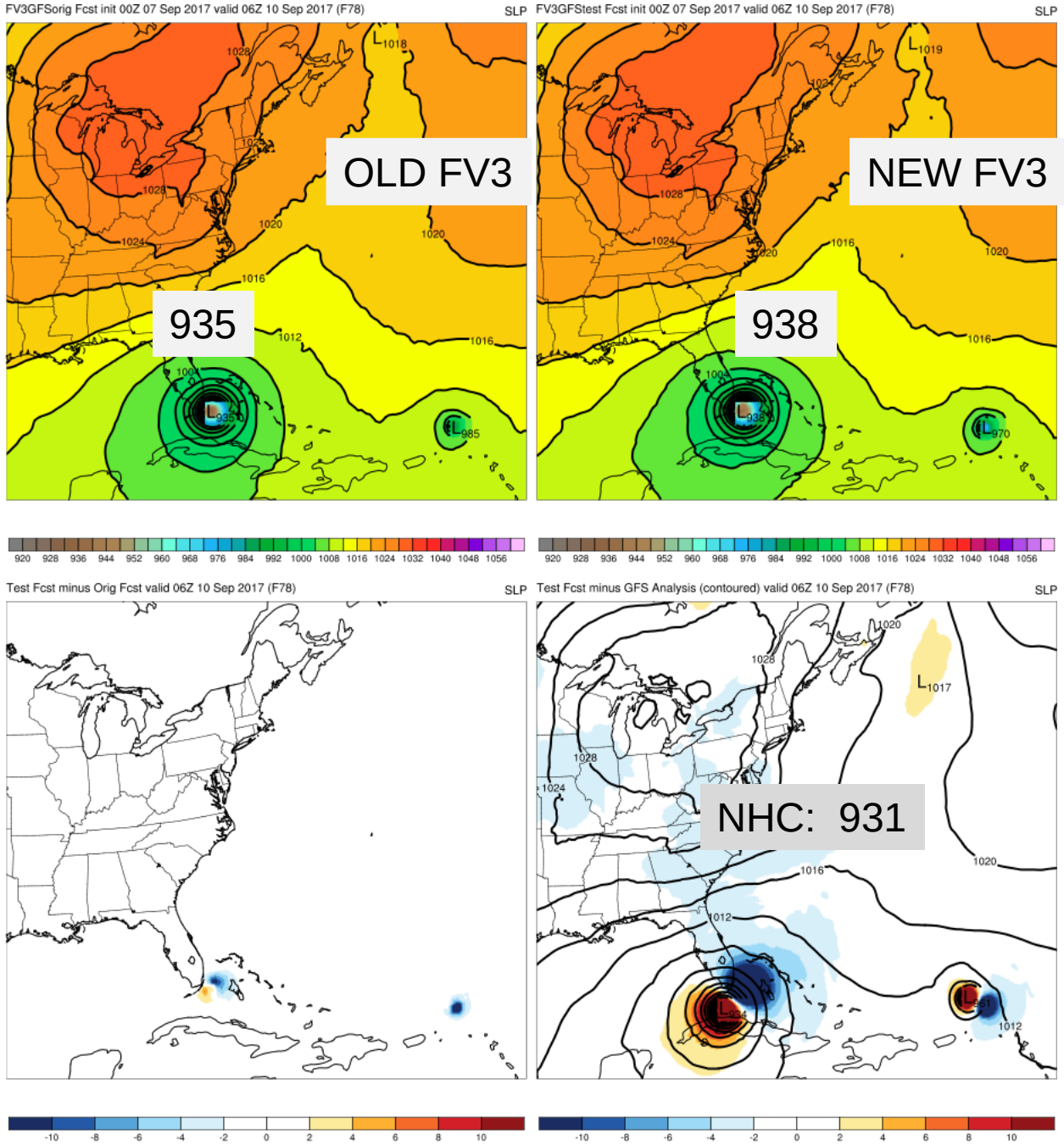


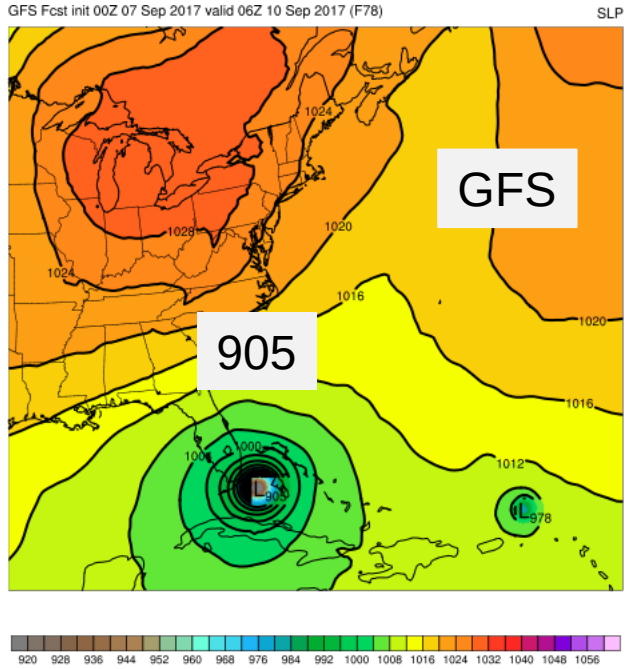


00z 10/18/15 F120

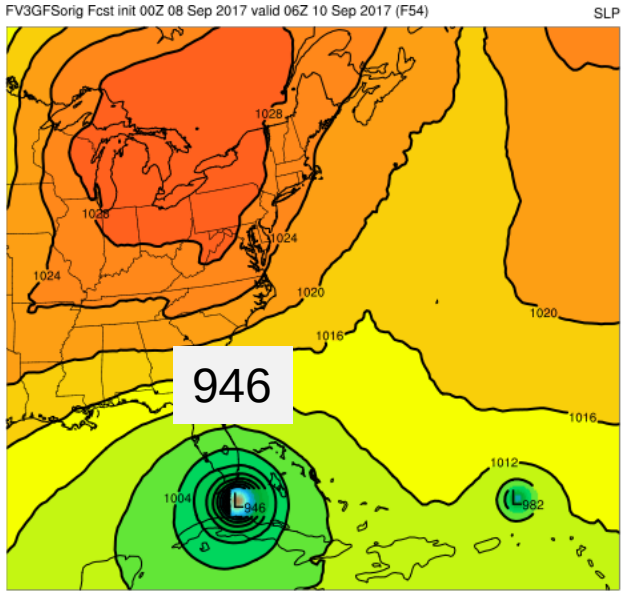
REVISED FV3GFS BETTER SHOWED POTENTIAL FOR RAPID DEEPENING

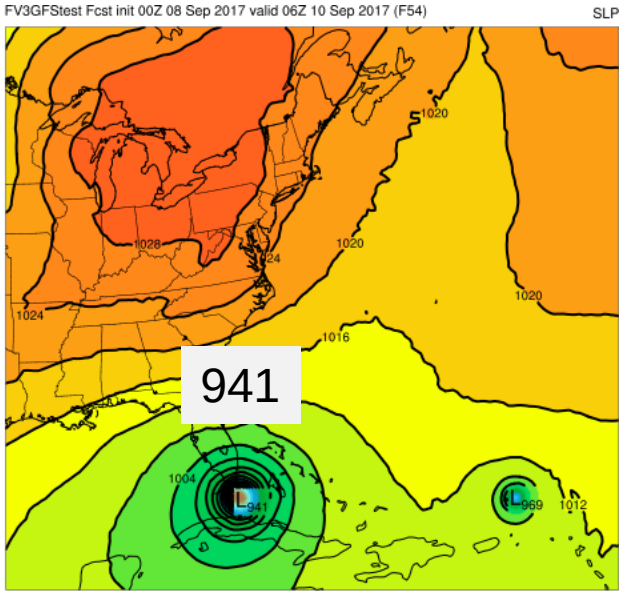
IRMA

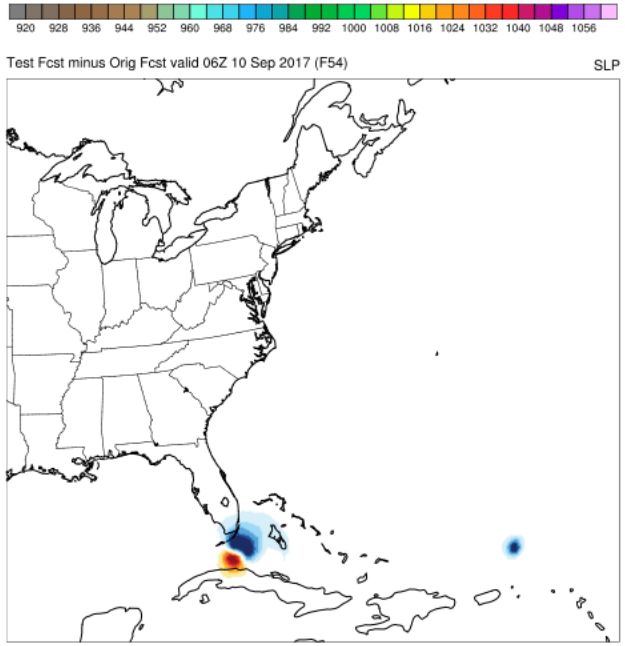

FV3GFSorig Fcst init 00Z 07 Sep 2017 valid 06Z 10 Sep 2017 (F78)
SLP
OLD FV3
935
FV3GFStest Fcst init 00Z 07 Sep 2017 valid 06Z 10 Sep 2017 (F78)
SLP
NEW FV3
938
920 928 936 944 952 960 968 976 984 992 1000 1008 1016 1024 1032 1040 1048 1056
Test Fcst minus Orig Fcst valid 06Z 10 Sep 2017 (F78)
SLP
Test Fcst minus GFS Analysis (contoured) valid 06Z 10 Sep 2017 (F78)
SLP
NHC: 931
-10 -8 -6 -4 -2 0 2 4 6 8 10

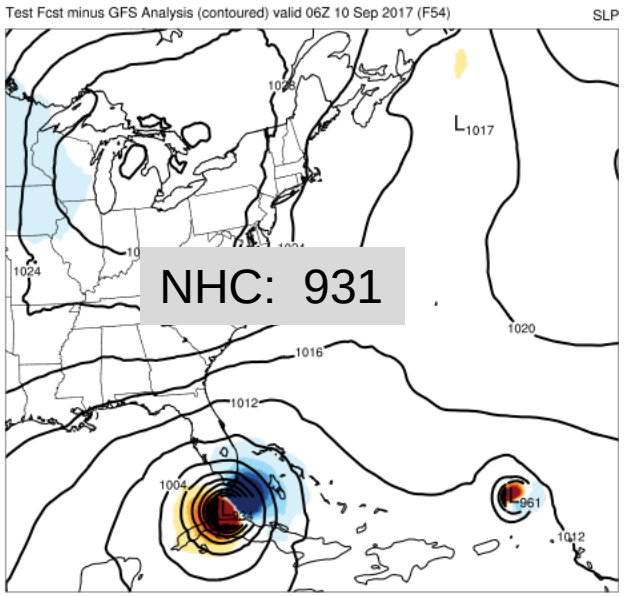

GFS Fcst init 00Z 07 Sep 2017 valid 06Z 10 Sep 2017 (F78)
SLP
GFS
905
920 928 936 944 952 960 968 976 984 992 1000 1008 1016 1024 1032 1040 1048 1056

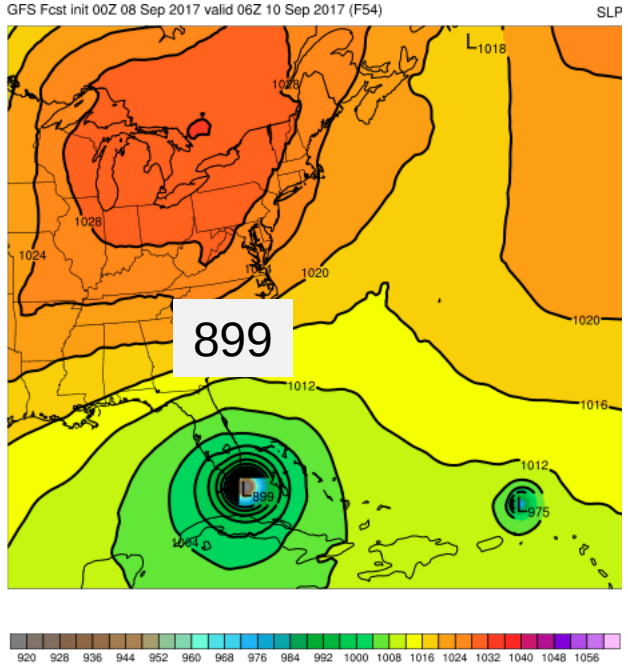
00z 9/7/17 F78


FV3GFSorig Fcst init 00Z 08 Sep 2017 valid 06Z 10 Sep 2017 (F54)
SLP
946


FV3GFStest Fcst init 00Z 08 Sep 2017 valid 06Z 10 Sep 2017 (F54)
SLP
941


Test Fcst minus Orig Fcst valid 06Z 10 Sep 2017 (F54)
SLP

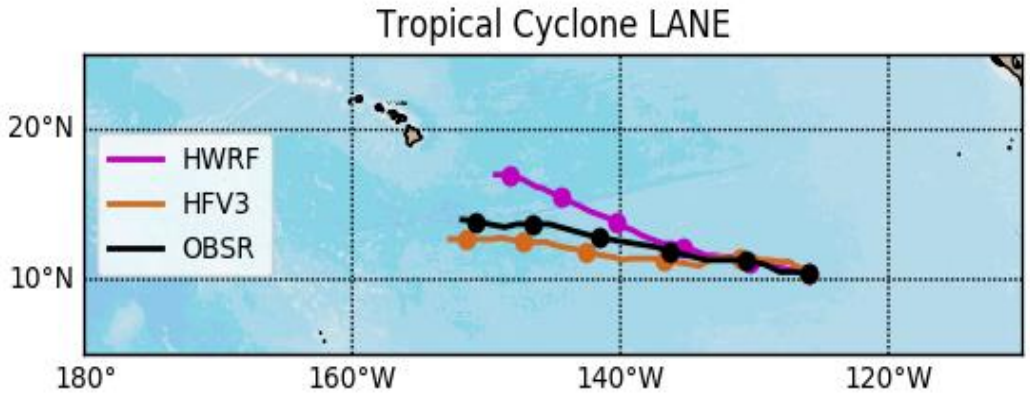

Test Fcst minus GFS Analysis (contoured) valid 06Z 10 Sep 2017 (F54)
SLP
NHC: 931

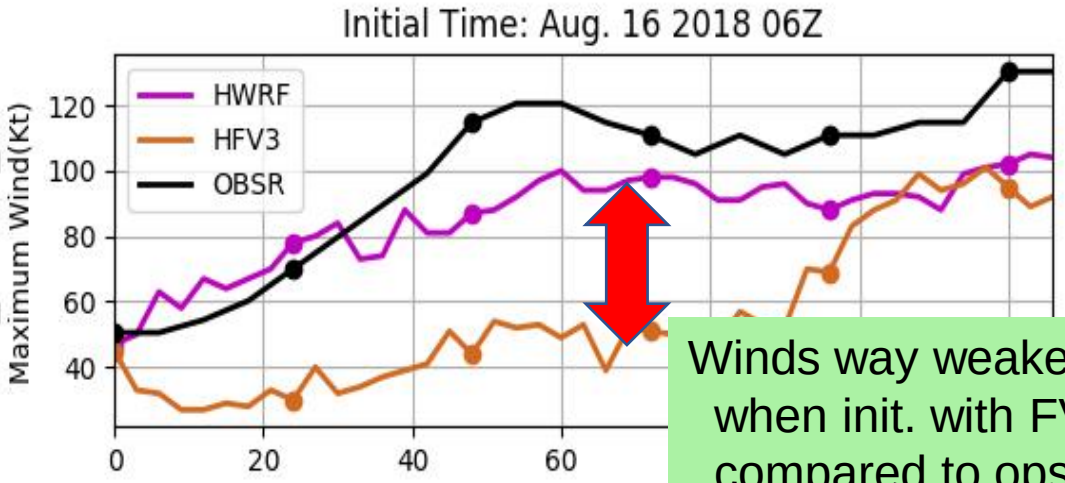

GFS Fcst init 00Z 08 Sep 2017 valid 06Z 10 Sep 2017 (F54)
SLP
899

00z 9/8/17 F54

IMPACT of CHANGE on HWRF RUNS INITIALIZED w FV3GFS

HURRICANE LANE

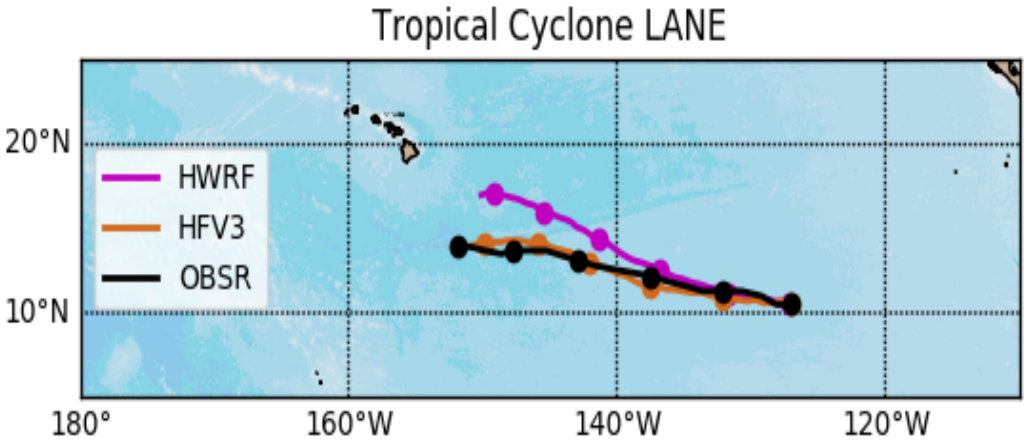


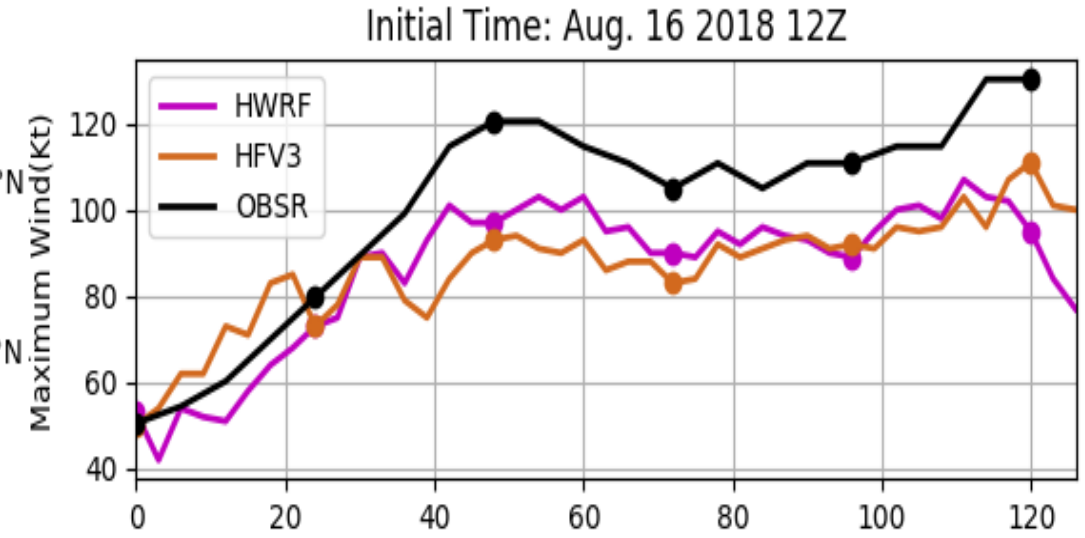


6z 8/16 cycle (hord=6)

Winds way weaker when init. with FV3GFS, compared to ops GFS

CHANGE MADE TO FV3GFS AFTER THAT CYCLE

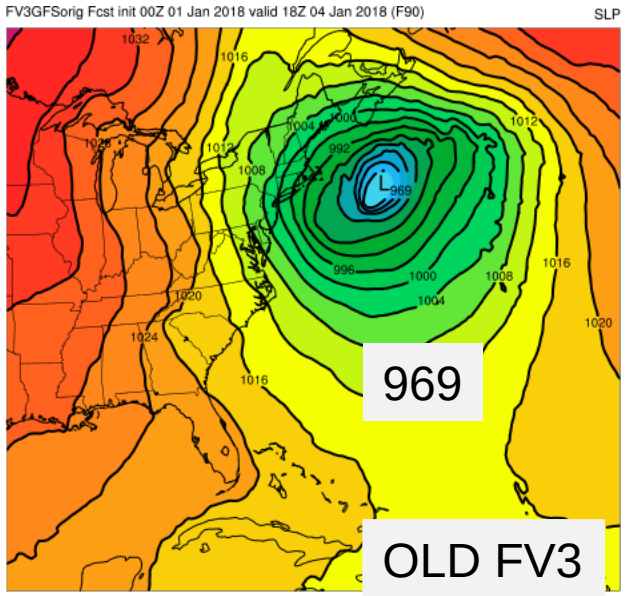


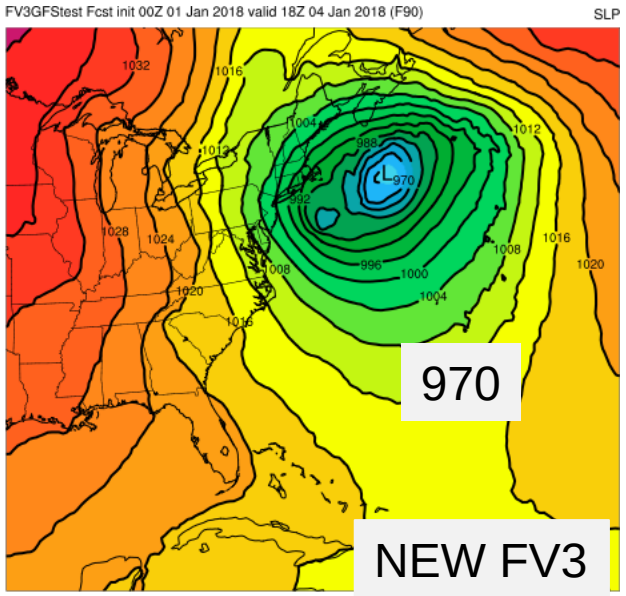


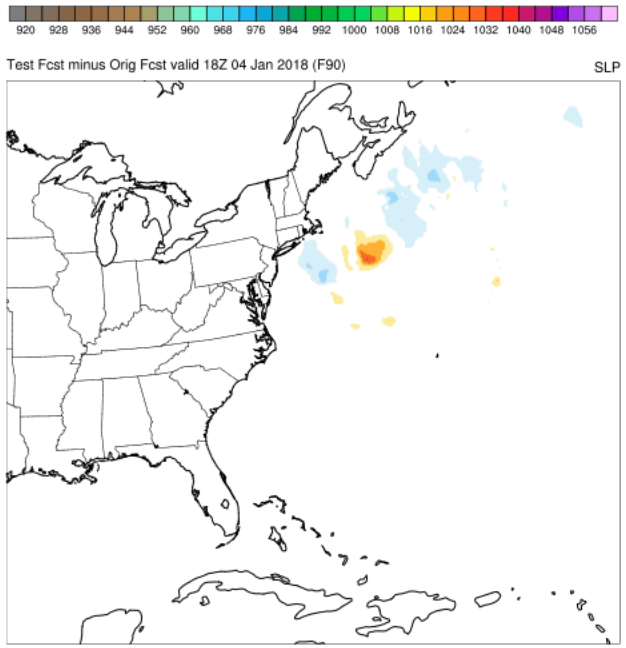
12z 8/16 cycle (hord=5)

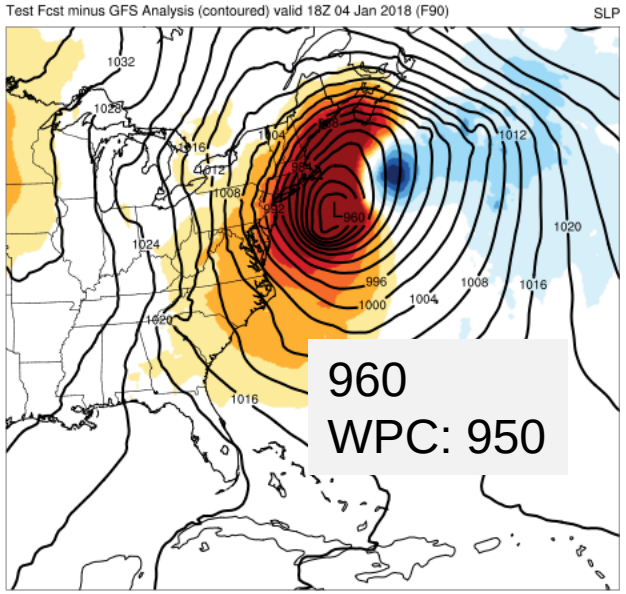
WINTER CASES

JANUARY 2018 BOMB CYCLONE

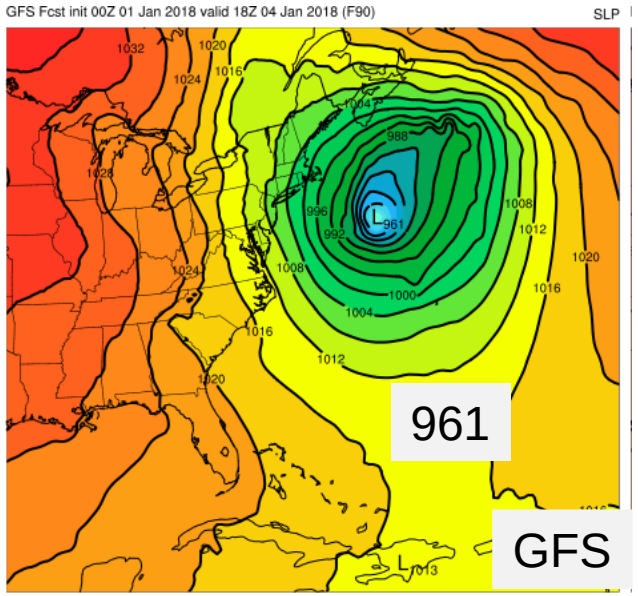




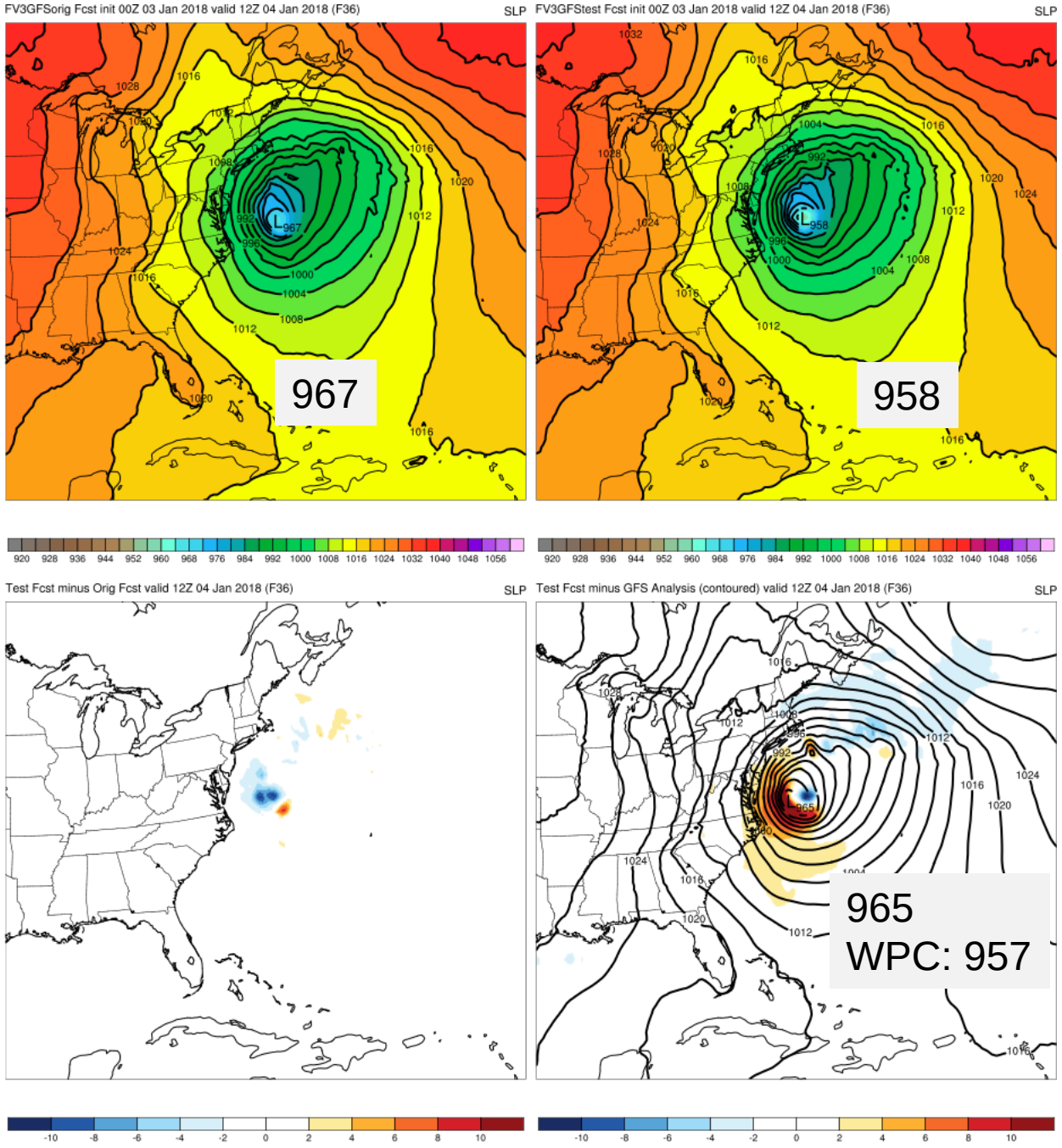




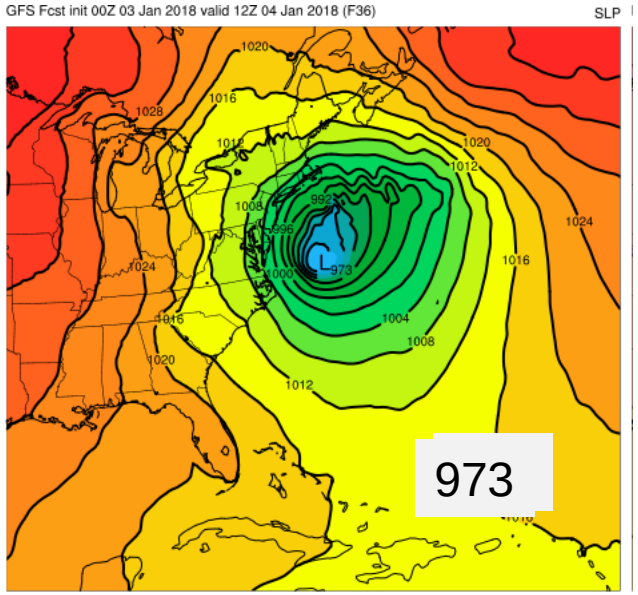
1/1/18 00z F90



TEST RUN similar in intensity to original FV3 run – both are weaker than GFS and analysis; TEST RUN has a well-defined and apparently erroneous secondary center

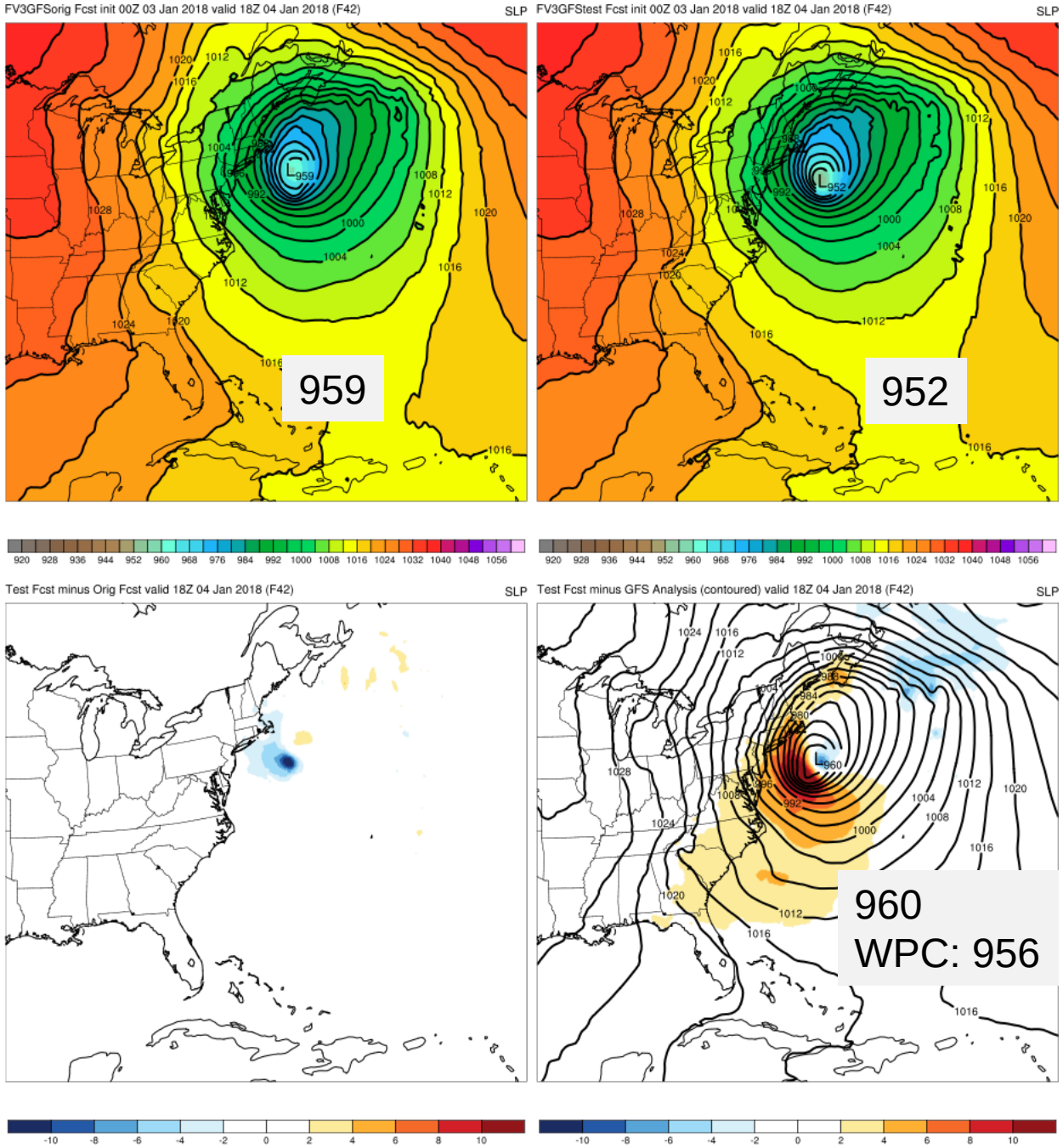


1/3/18 00z F36

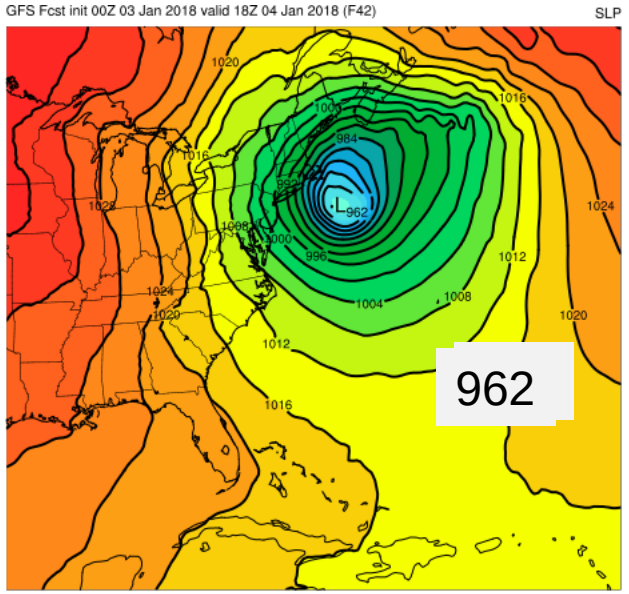


TEST RUN ~10 mb deeper than original and 15 mb deeper than GFS; better matches WPC intensity

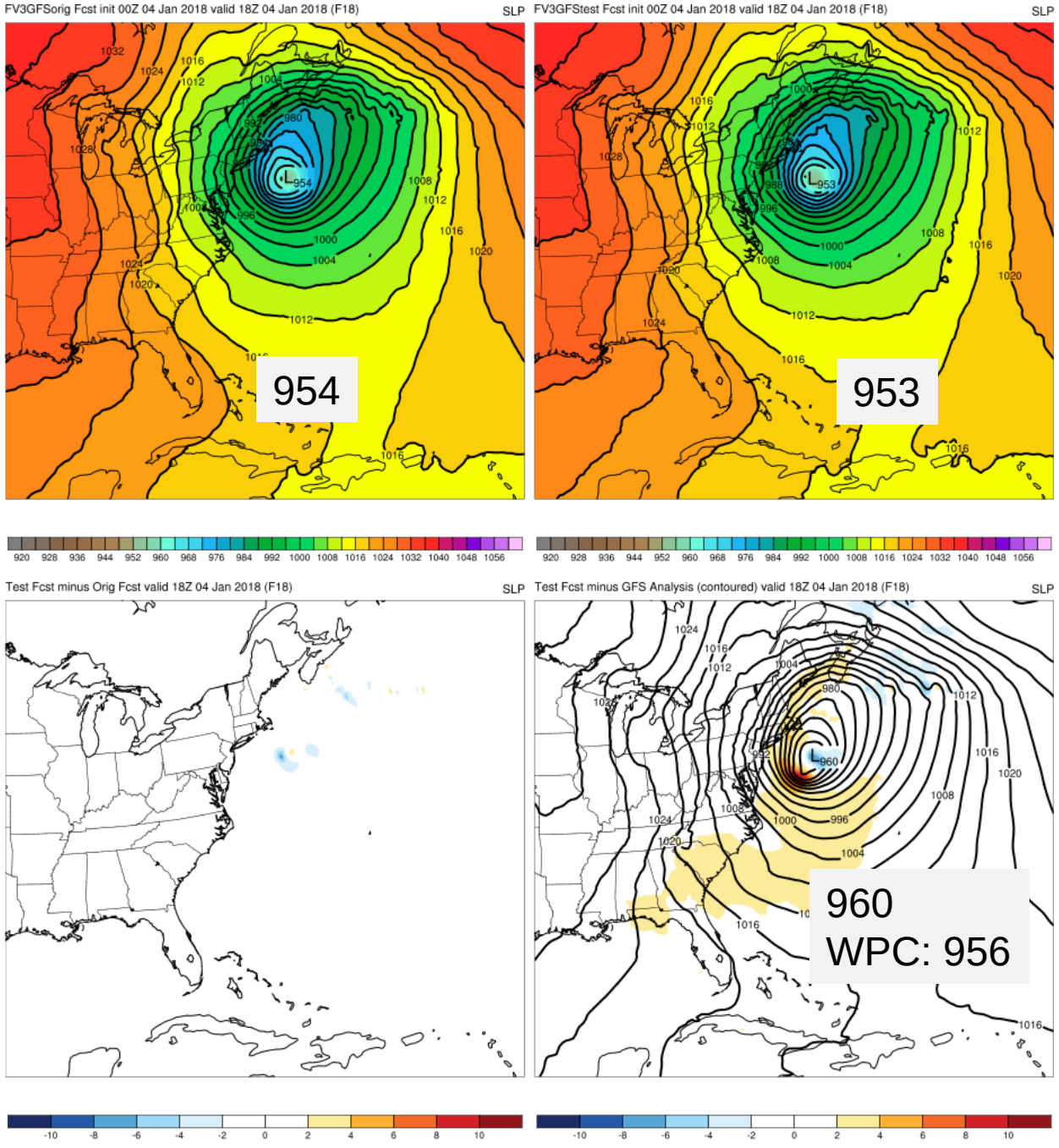
TEST RUN is noisier with SLP field than original run



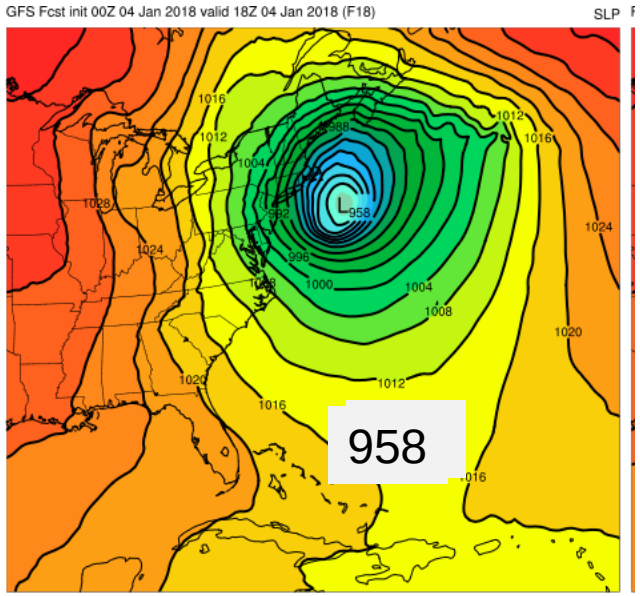
1/3/18 00z F42



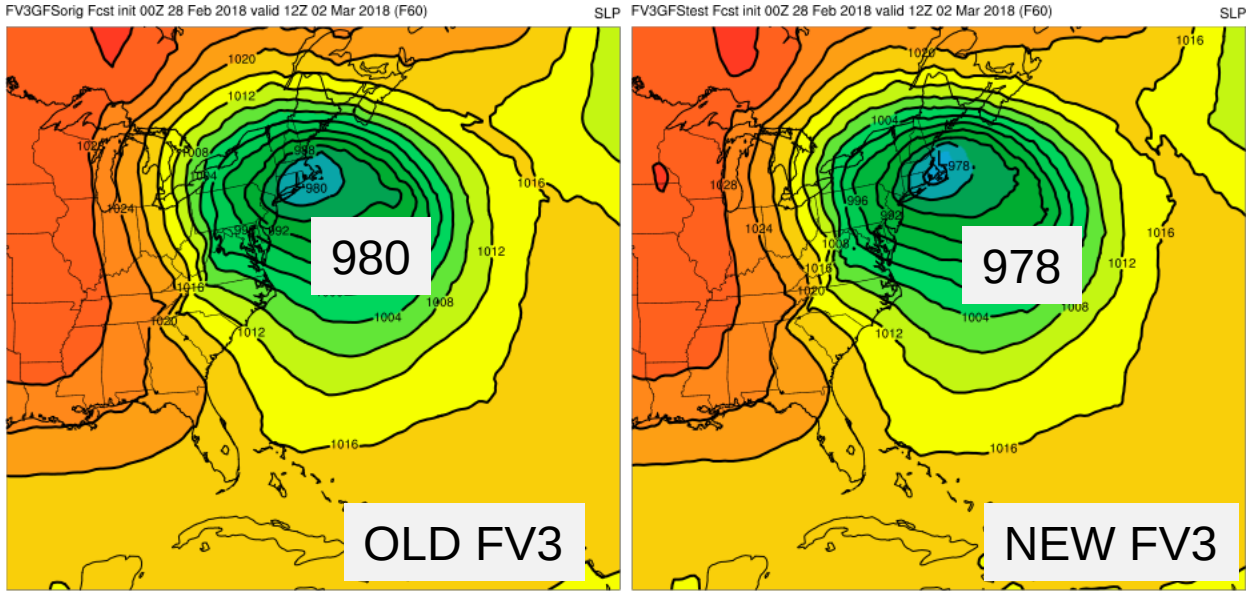
TEST RUN ~7 mb deeper than original run and GFS; too deep compared to analysis

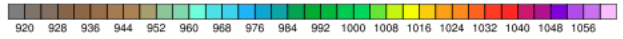


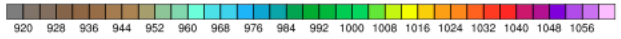
1/4/18 00z F18

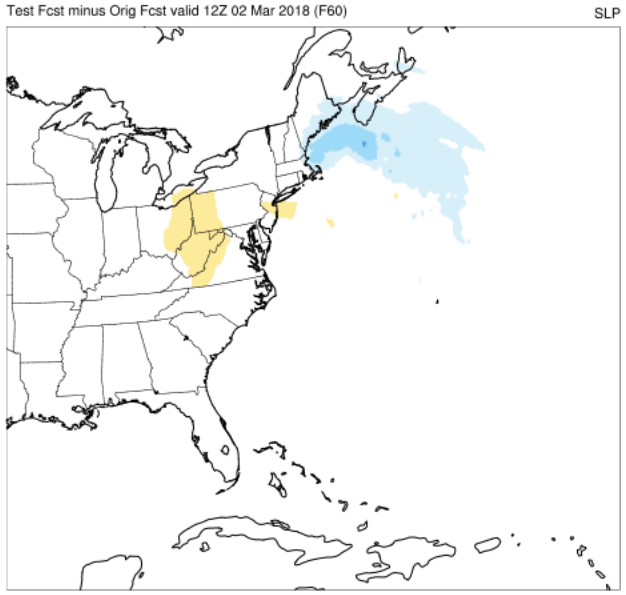


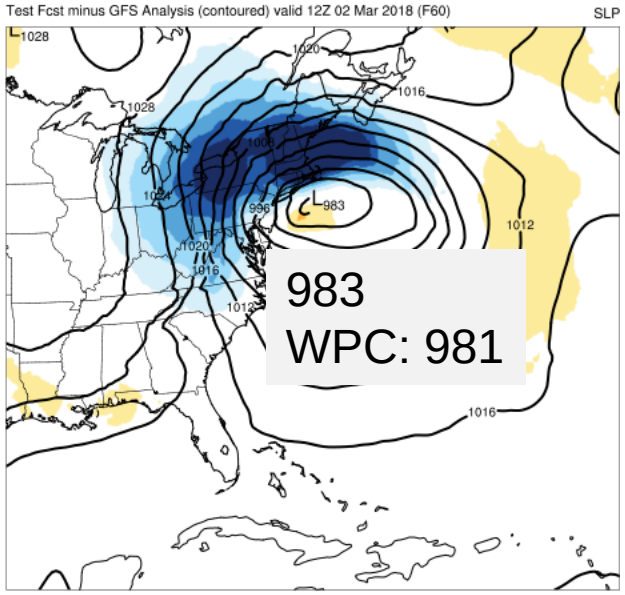
TEST RUN similar to original run;
both close to WPC intensity

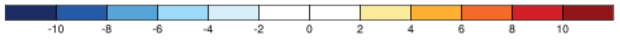


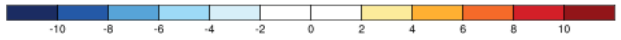












MARCH 2018 NOR'EASTER
2/28/18 00z F60

TEST RUN slightly stronger than original FV3 configuration

JUSTFICATION FOR HORD=5 CHANGE

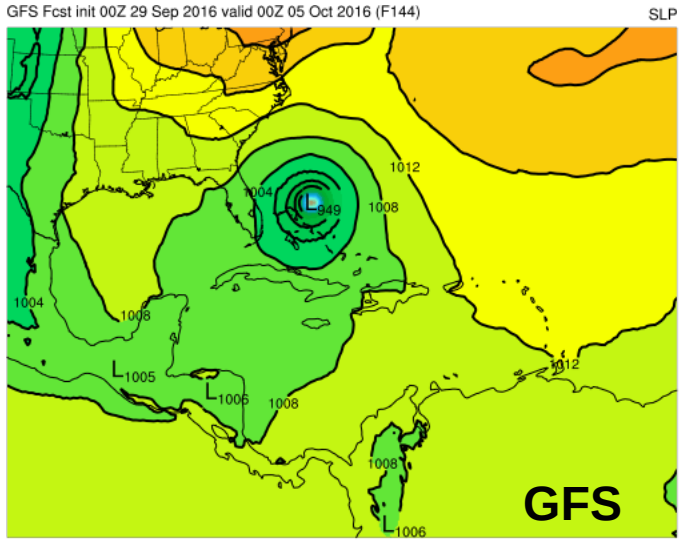
- Clear improvement with regard to tropical cyclone intensity – almost always yields a stronger storm than HORD=6 run, and it's usually in the right direction with its forecast of a stronger storm
- Some concern about overdeepening of winter storms but overall impact is far less than on tropical cyclones
- Stats indicate little change on the synoptic scale with this change in any time of year
- NCEP Director Approved changing hord=6 to hord=5 starting with 18Z on August 15th for real-time parallel.

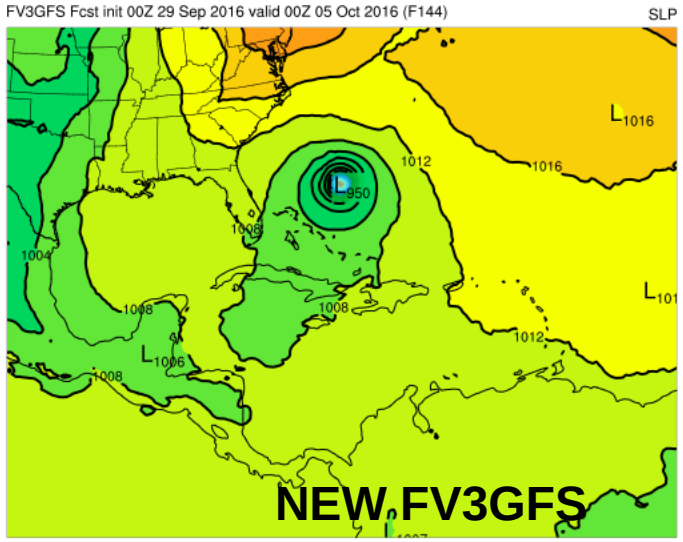
OTHER TROPICAL CASES OF NOTE

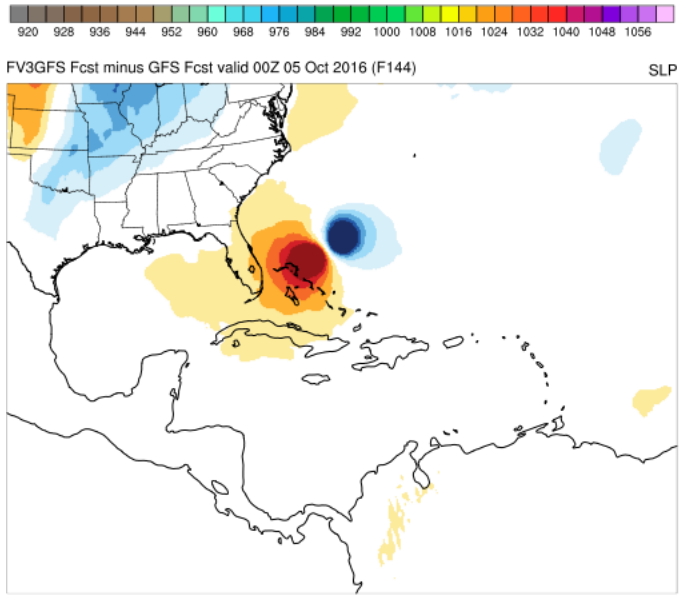
In these plots, the FV3GFS run is the NEW configuration of the model

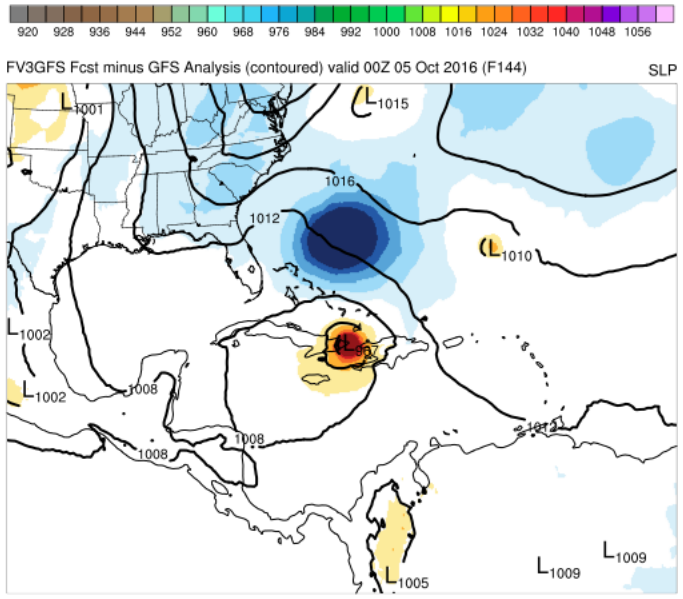
MATTHEW

9/29/16 00z F144

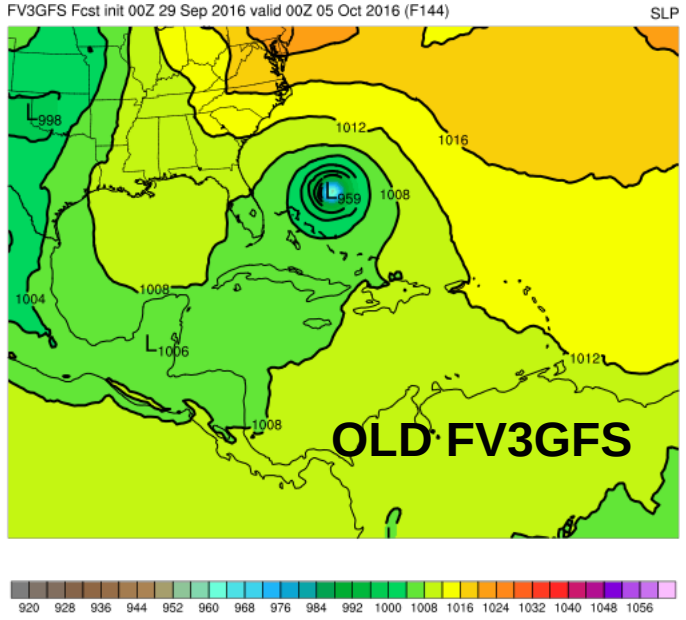






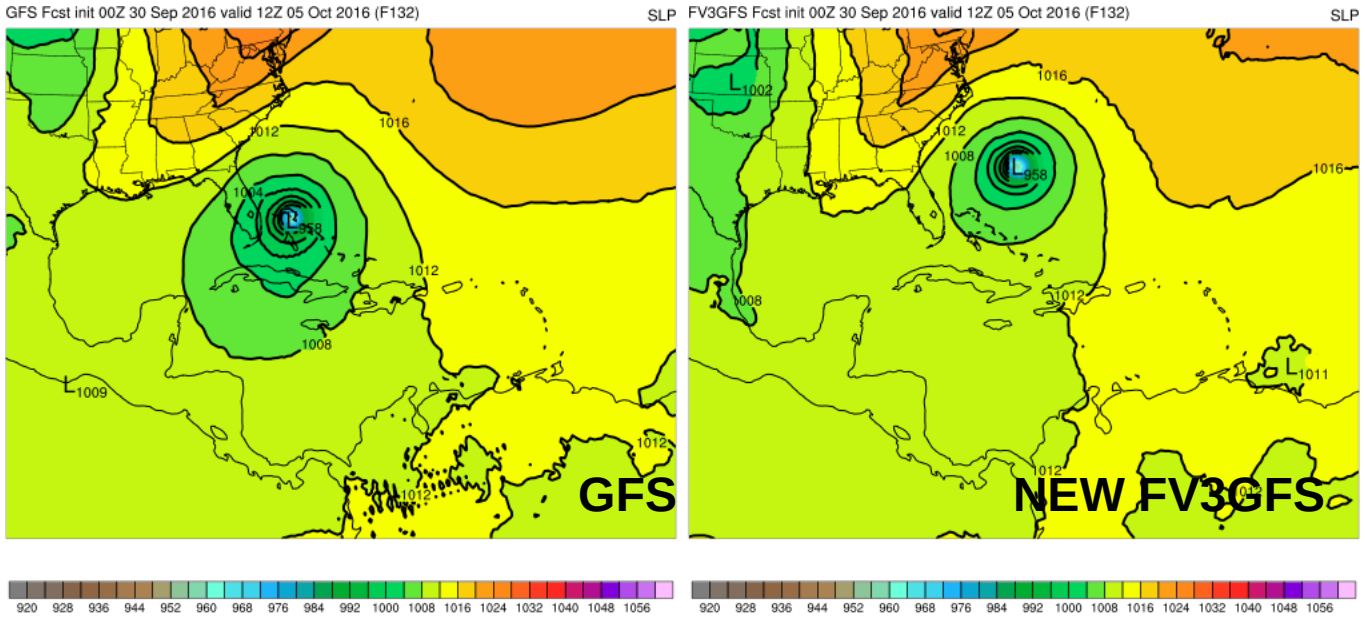


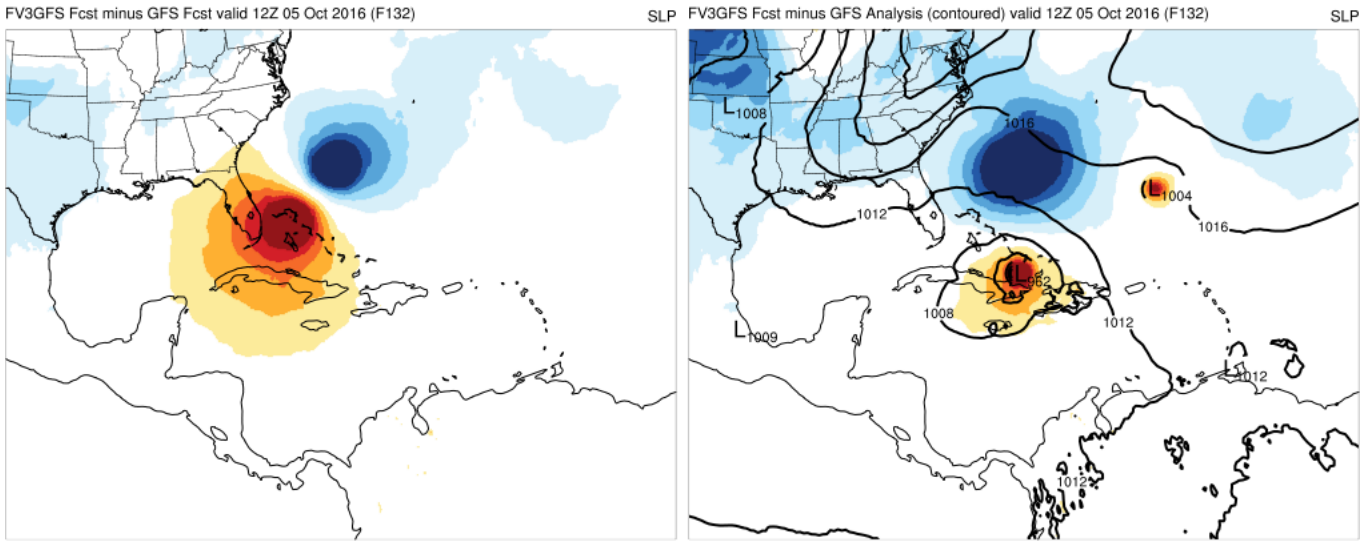
GFS and BOTH FV3GFS RUNS TOO FAST AND TOO FAR EAST, ALTHOUGH NEW FV3GFS IS STRONGER

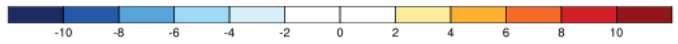


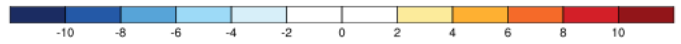
BUT FV3GFS RUNS ARE CONSISTENTLY FURTHER EAST

9/30/16 12z F132



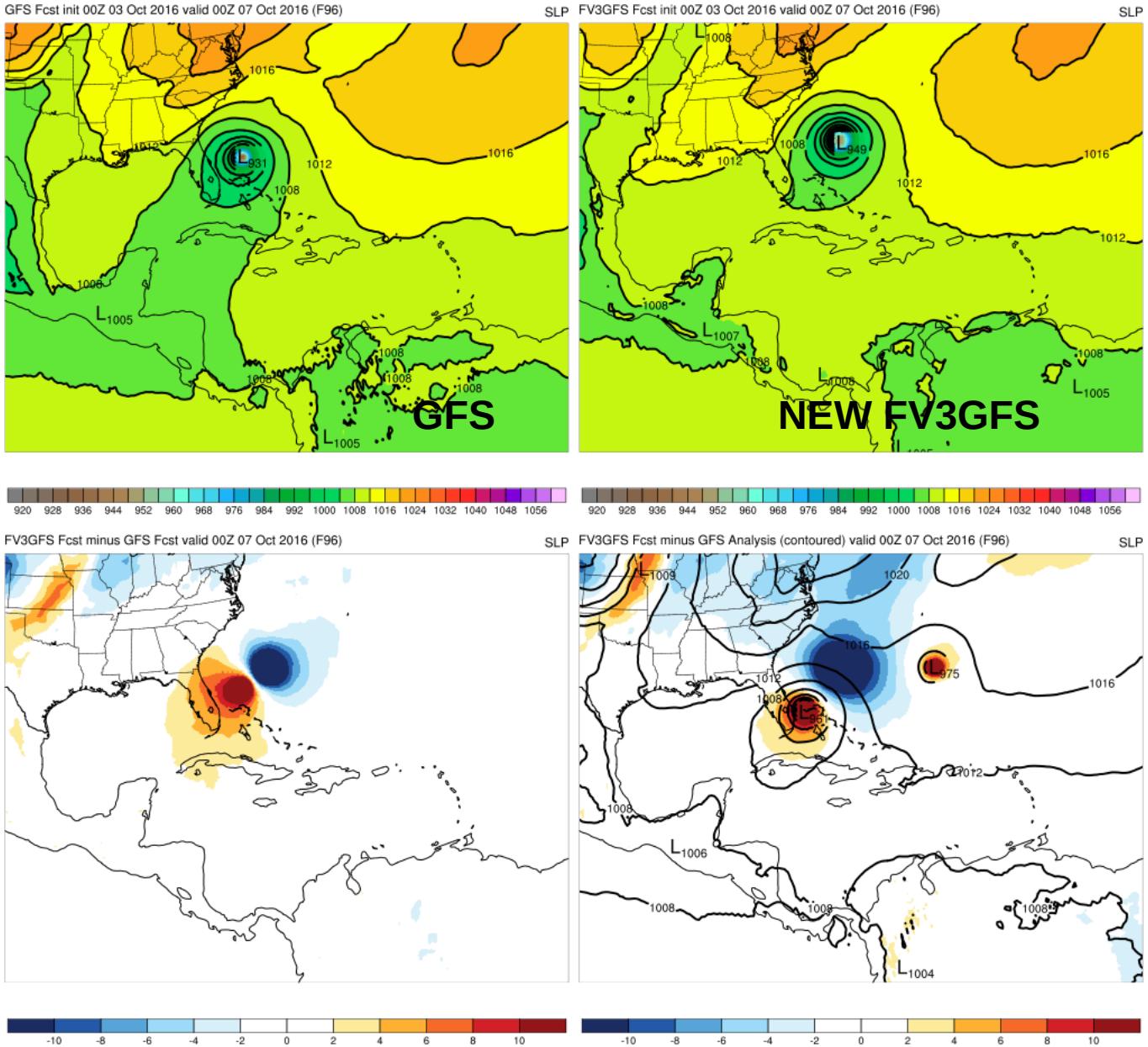




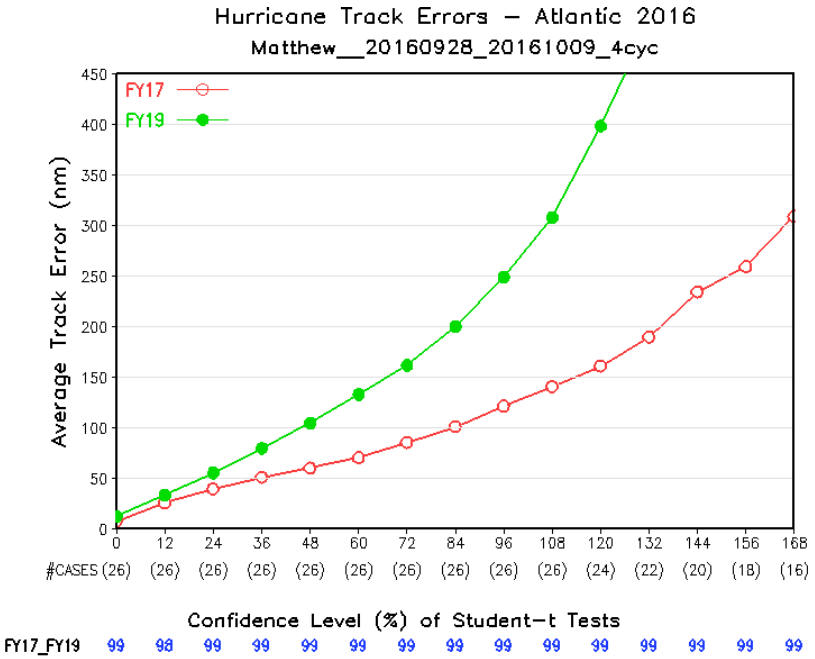


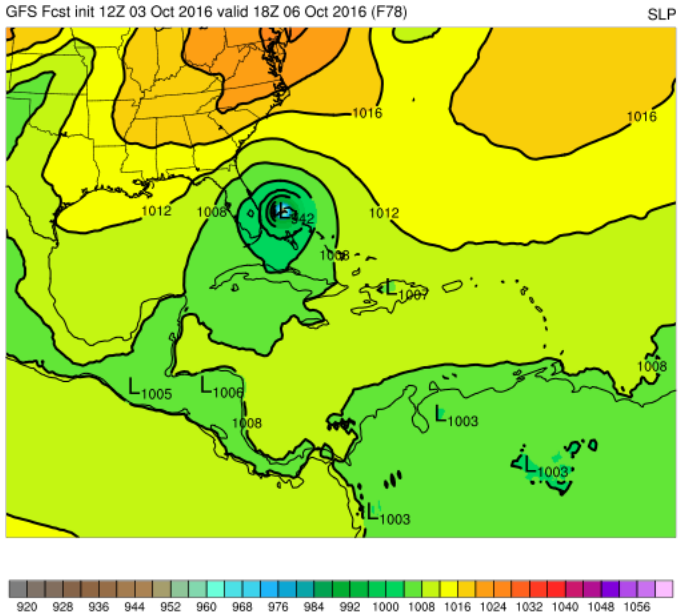
FV3GFS FASTER and TOO FAR EAST WITH TRACK

10/3/16 00z F96

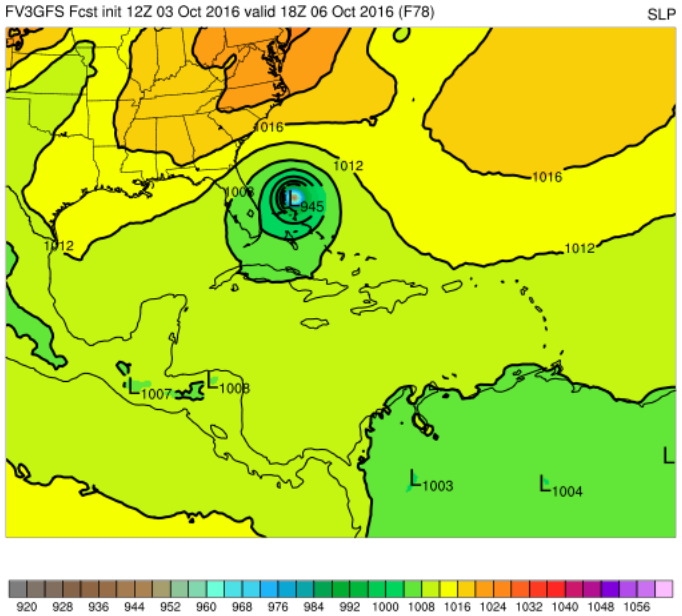


FV3GFS CONSISTENTLY TOO FAR EAST (FURTHER EAST THAN OPS GFS); VERY CLEAR IN TRACK ERRORS

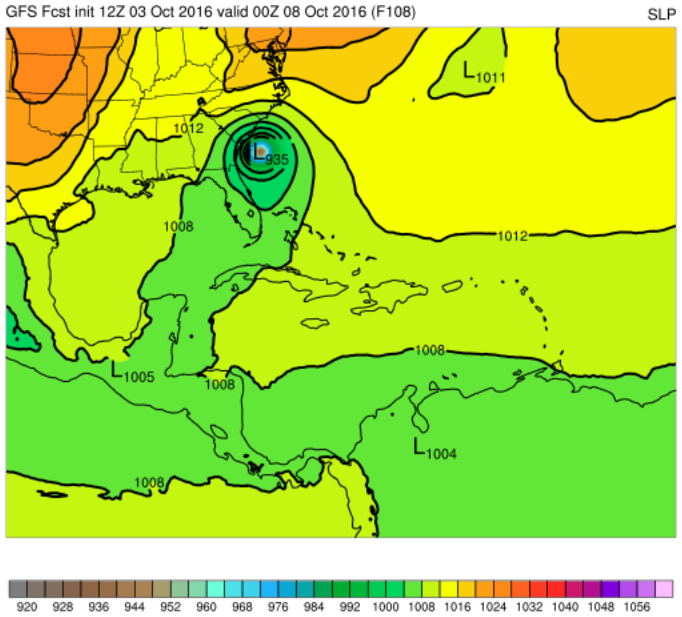


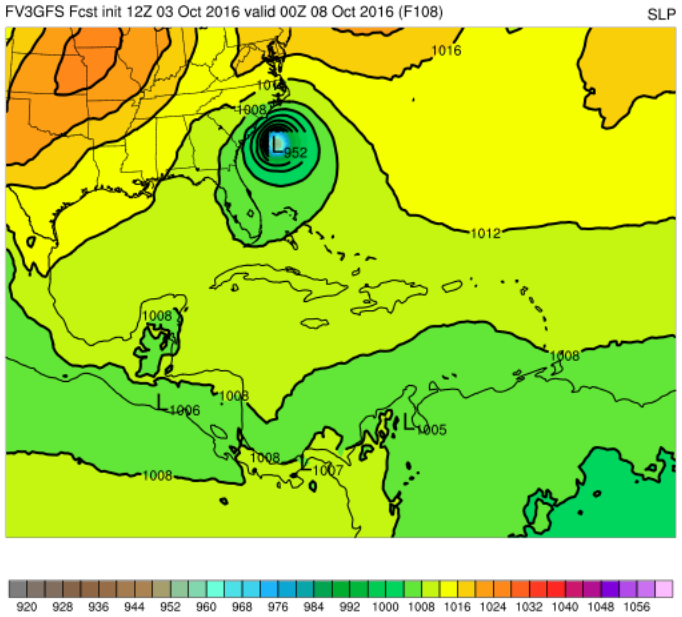


GFS



NEW FV3GFS



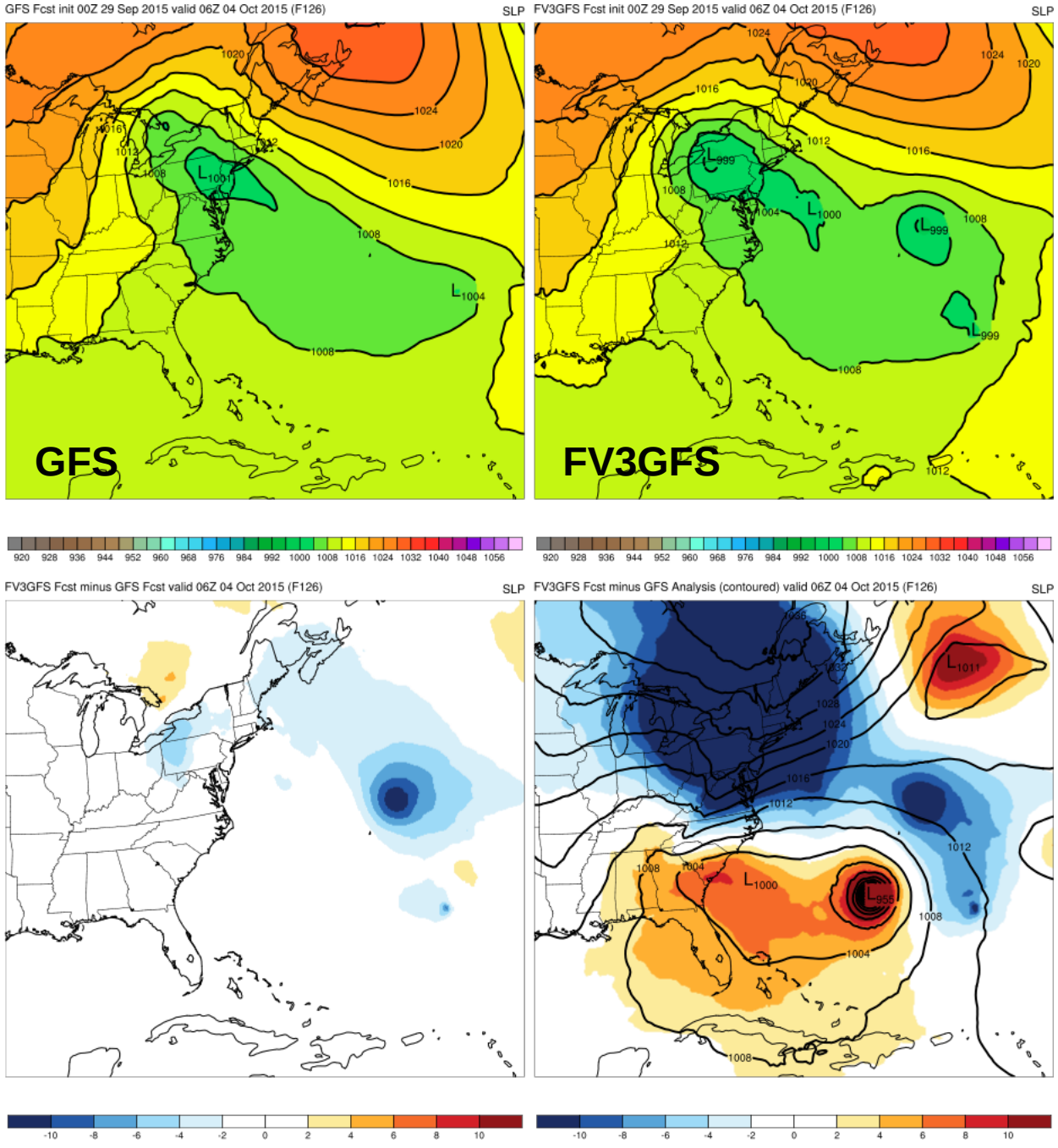


10/3/16 12z F78 + F108

LATER FV3GFS RUNS WERE TOO FAR EAST NEAR FL BUT DID BRING MATTHEW CLOSER TO CAROLINA COAST

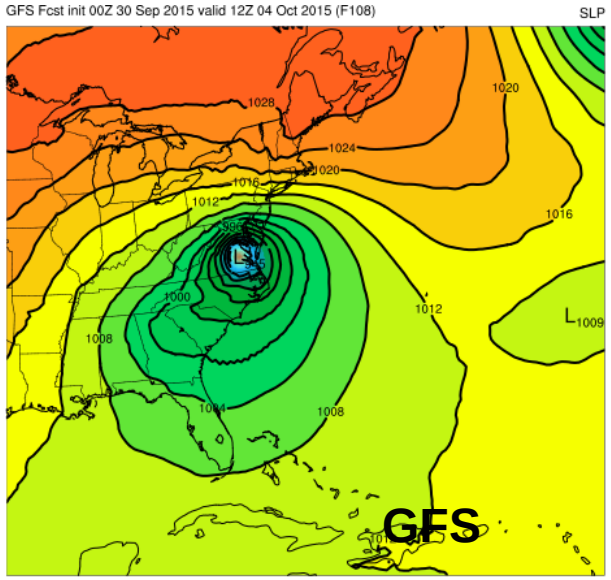
JOAQUIN

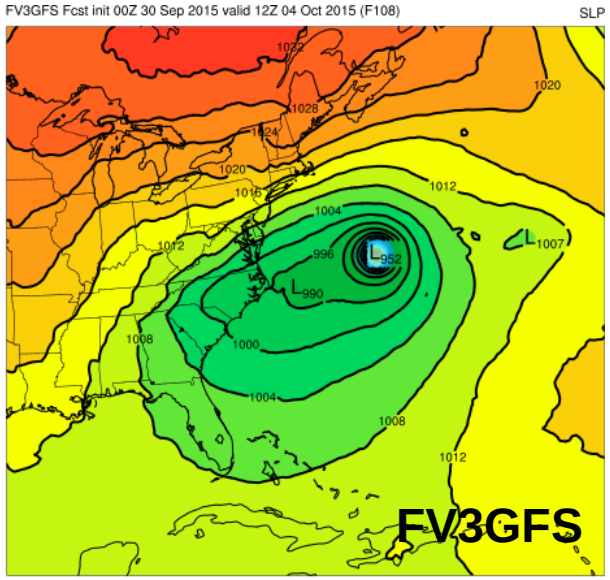
00z 9/29 F126

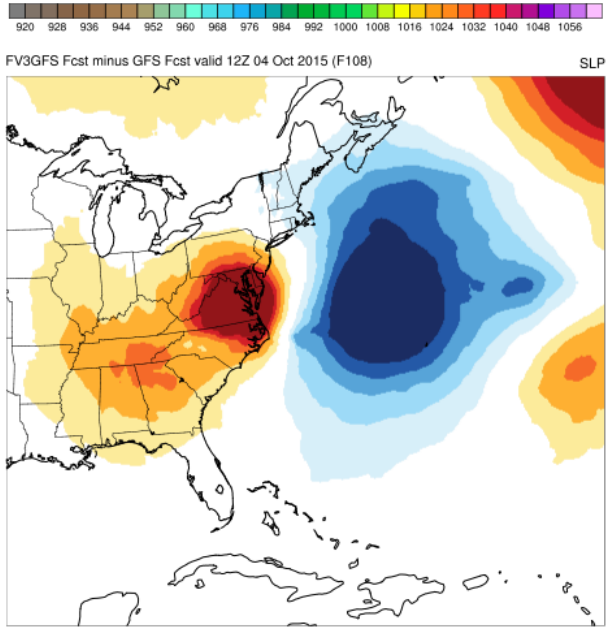


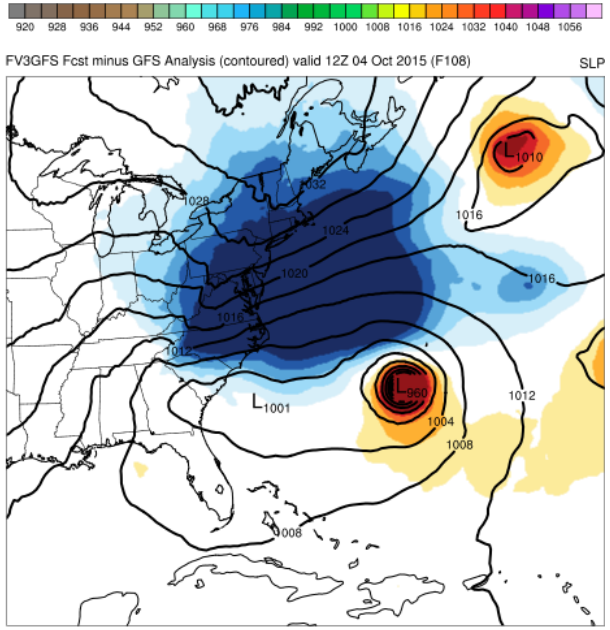
GFS and FV3GFS both have a system impacting the mid-Atlantic

00z 9/30 F108

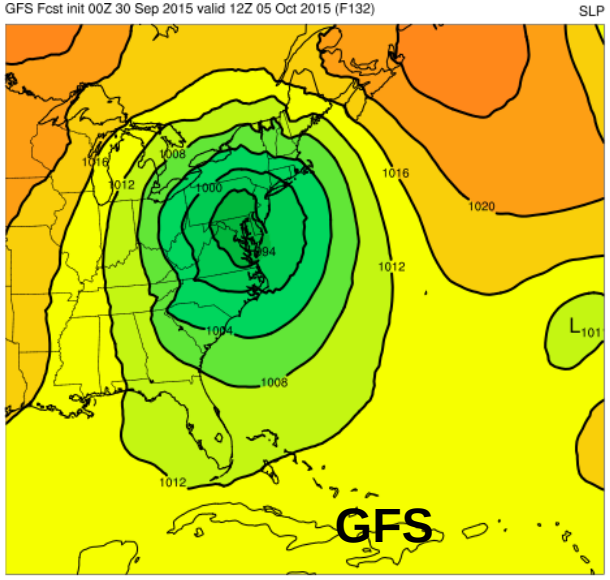


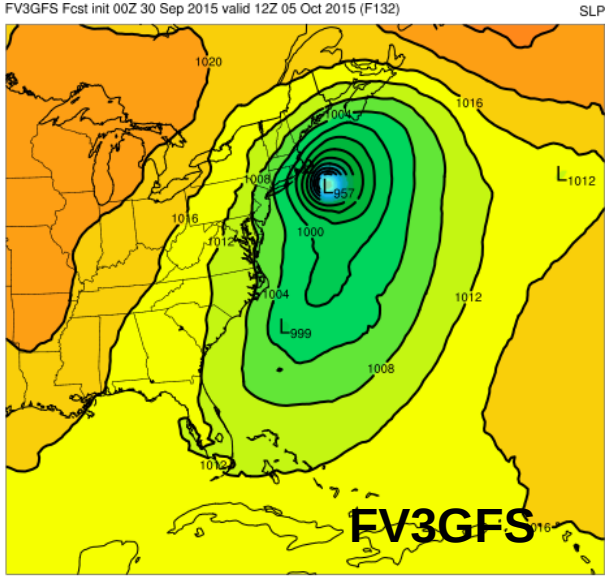


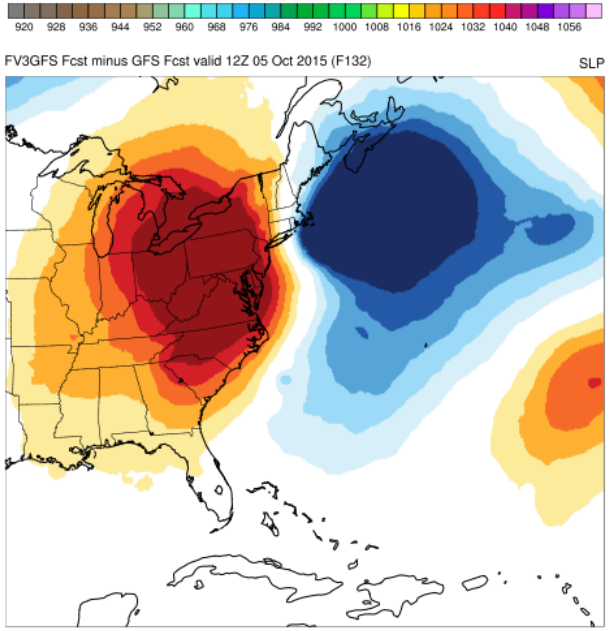


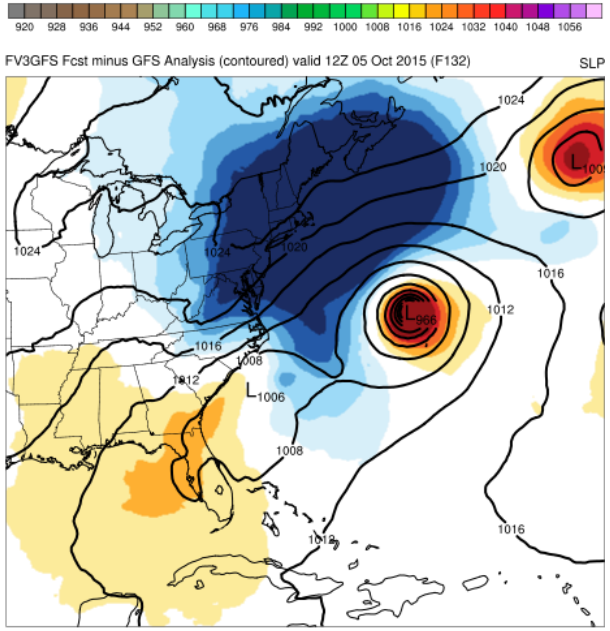


00z 9/30 F132



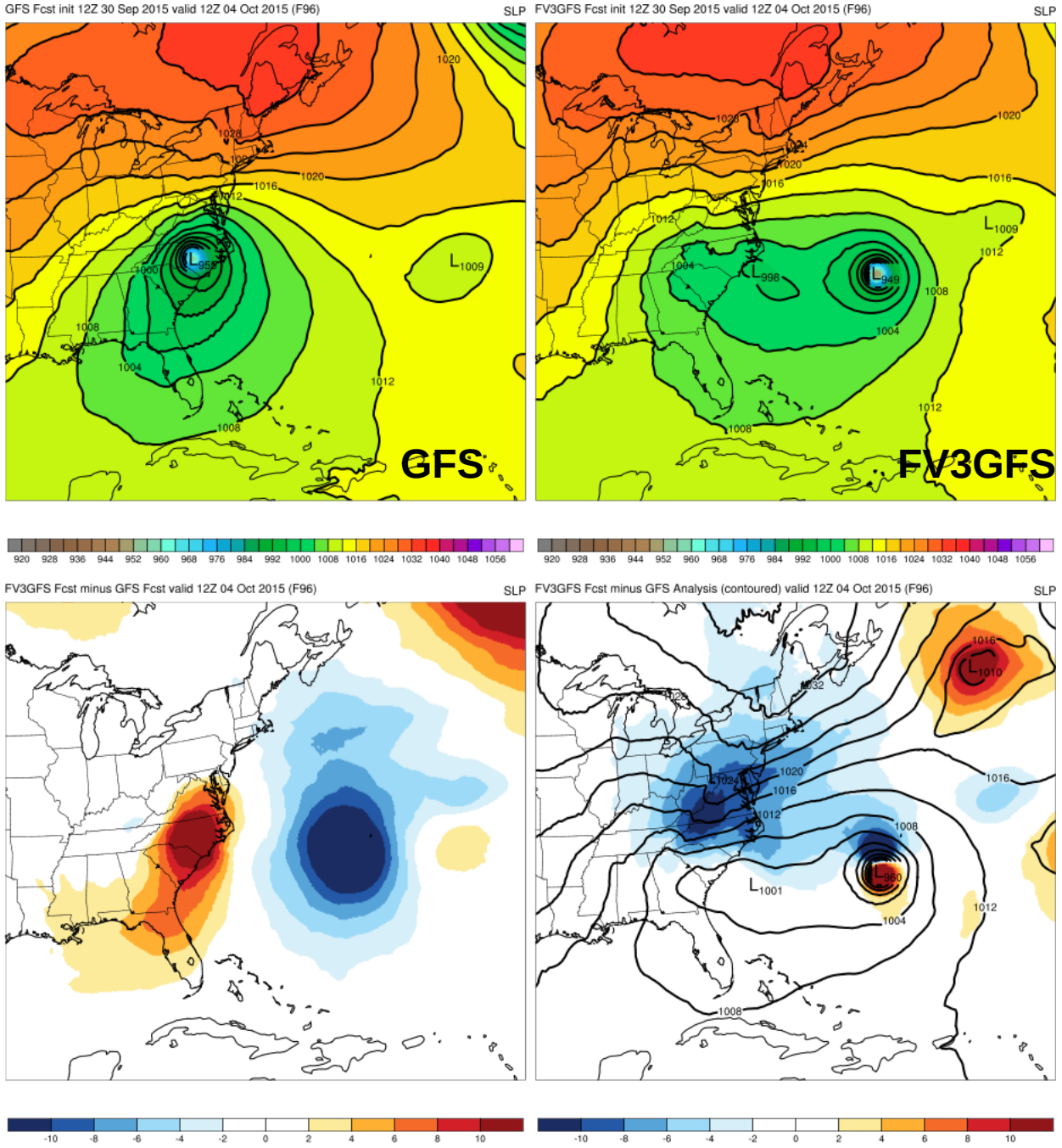






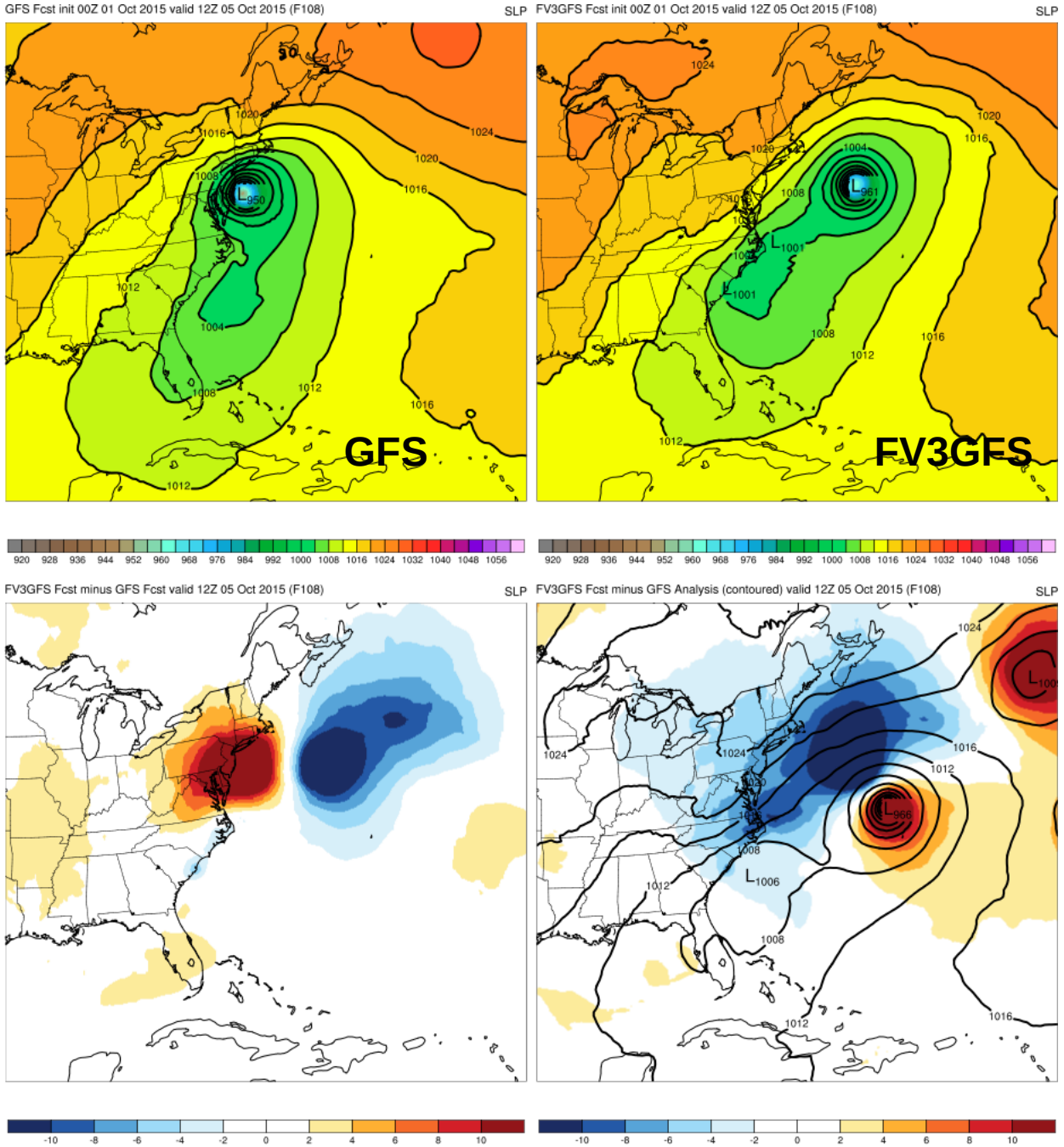
BIG IMPROVEMENT AVOIDING MID-ATLANTIC LANDALL, BUT STILL GETS CLOSE TO NEW ENGLAND AND TOO FAST

12z 9/30 F96



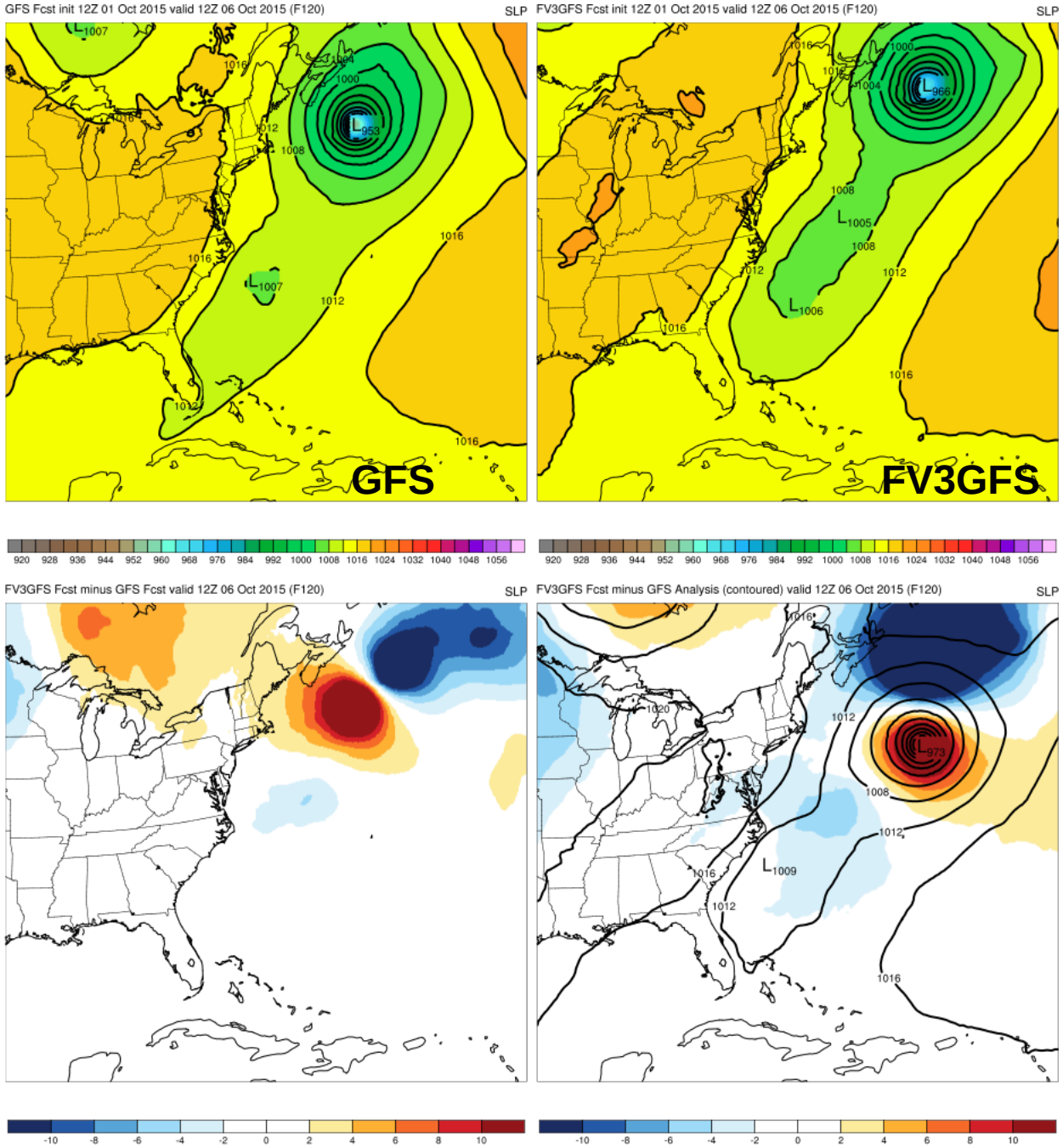
MASSIVE IMPROVEMENT IN FV3GFS

00z 10/1 F108



FV3GFS STILL MUCH BETTER THAN OPS GFS BUT TOO FAR NORTHWEST AND TOO FAST

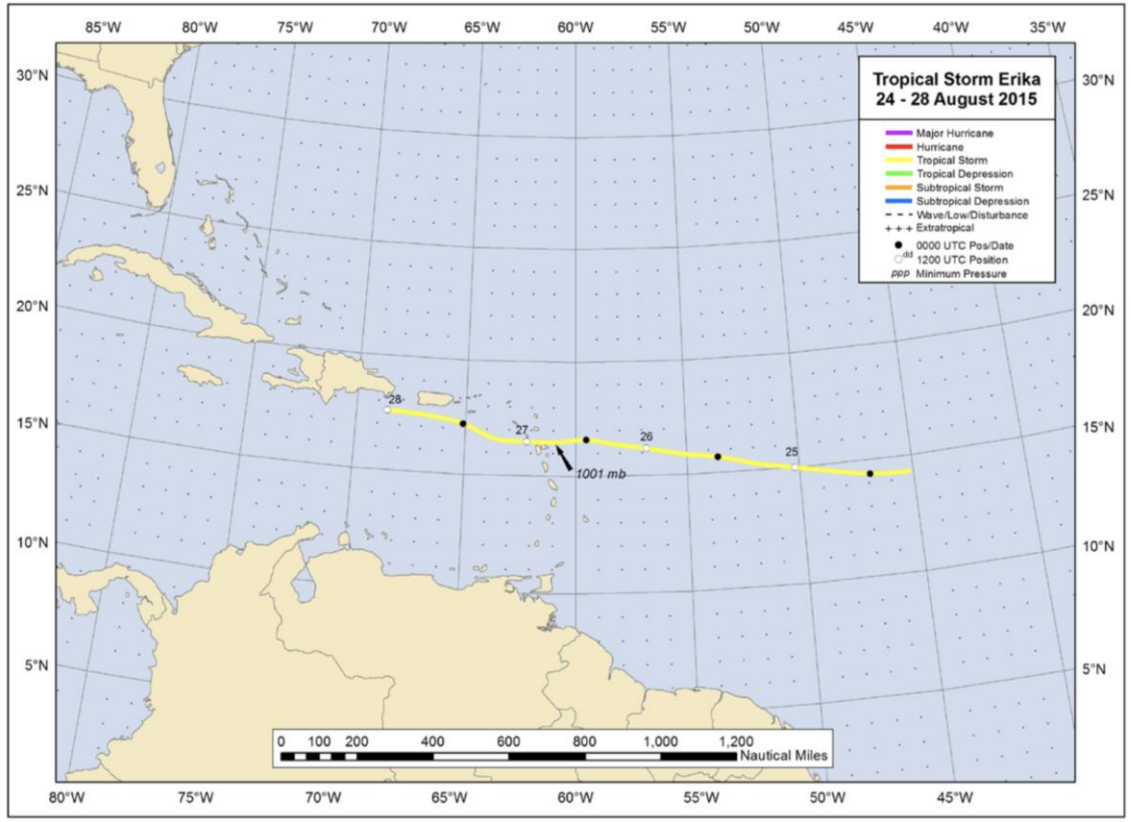
12z 10/1 F108



BOTH RUNS AVOID U.S. LANDFALL, BUT FV3GFS IS TOO FAST

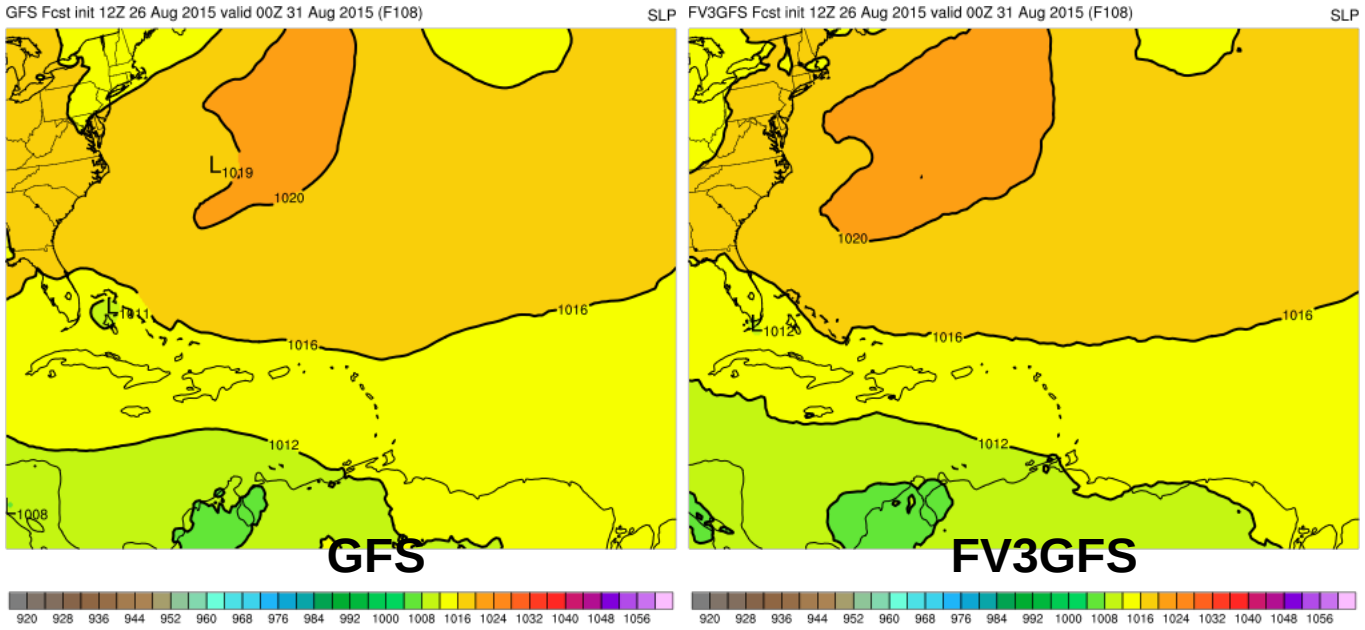
OVERALL, IMPRESSIVE IMPROVEMENT BY FV3GFS FOR JOAQUIN

ERIKA

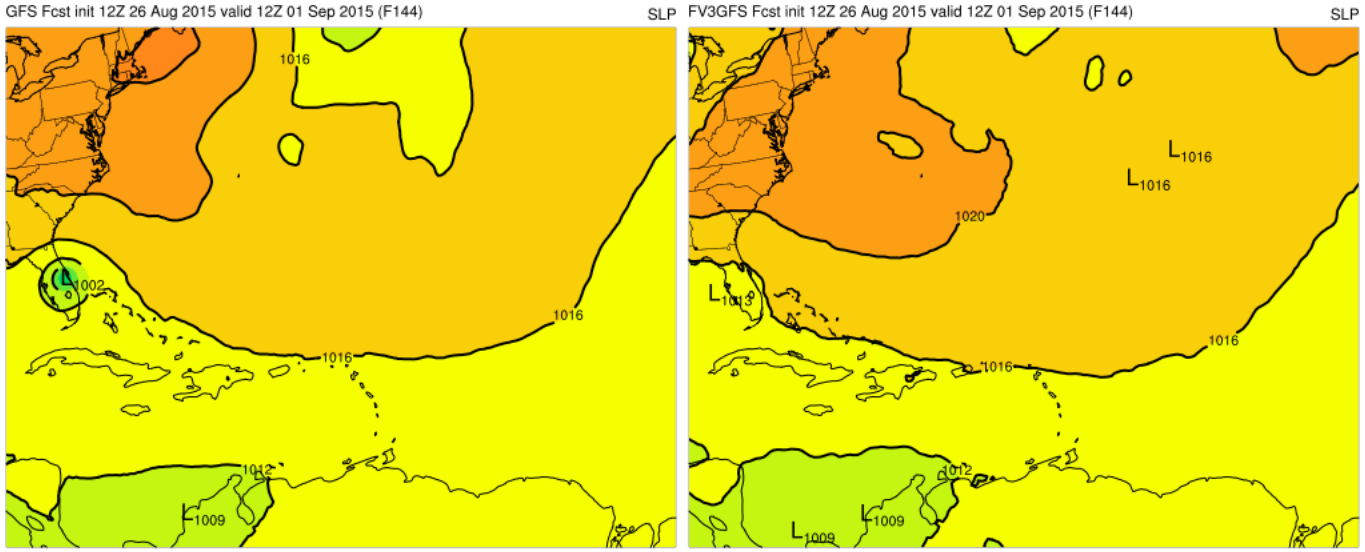


Best track positions for Tropical Storm Erika, 24-28 August 2015.

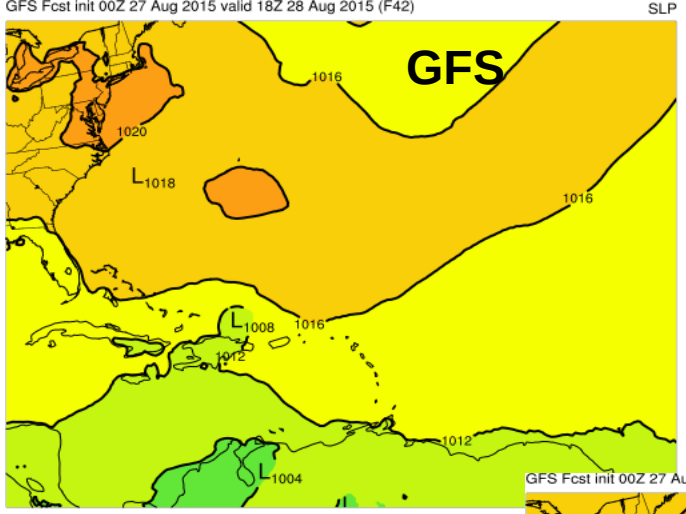
12z
8/26/15
F108

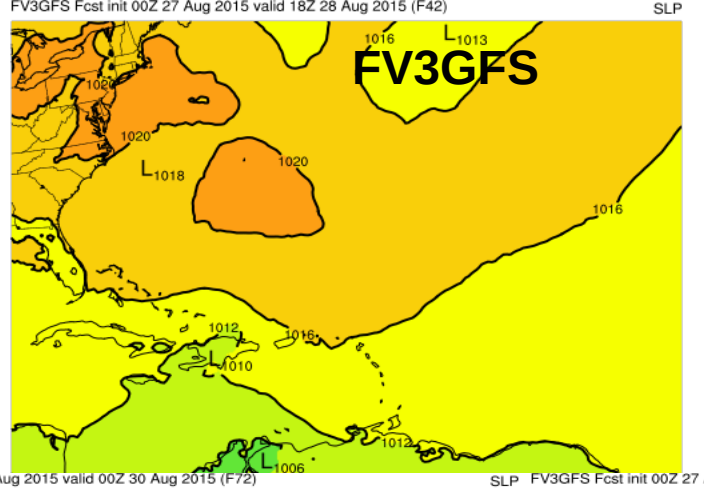


12z
8/26/15
F144



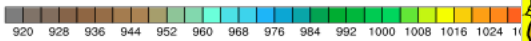
GFS keeps Erika alive after passing through the Caribbean and shows landfall of a modestly-organized storm in FL, while the FV3GFS has a more disorganized storm

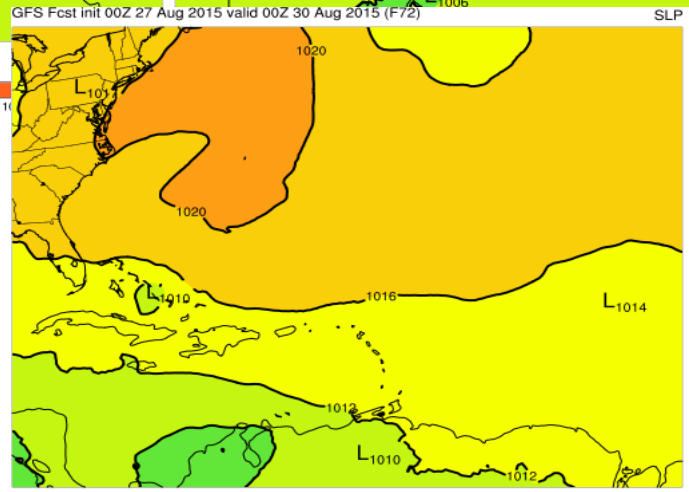


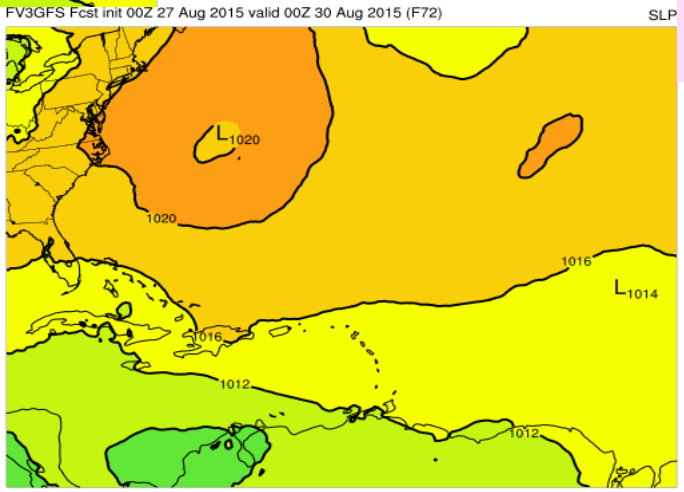


00z
8/27/15
F42

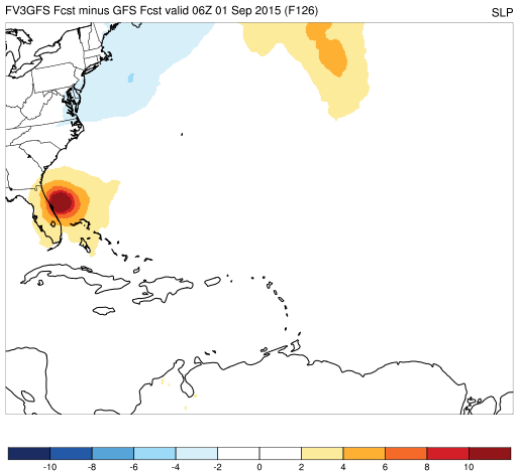
GFS KEEPS ERIKA ALIVE AND STRENGTHENS THE STORM ON AN APPROACH TO FL; FV3GFS CORRECTLY LOSES THE SYSTEM







00z
8/27/15
F72



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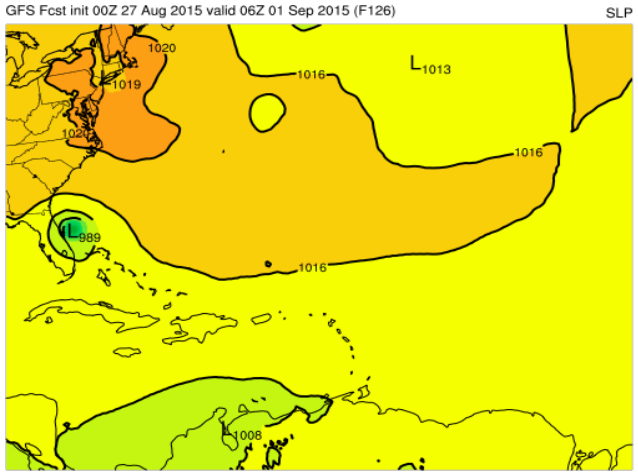
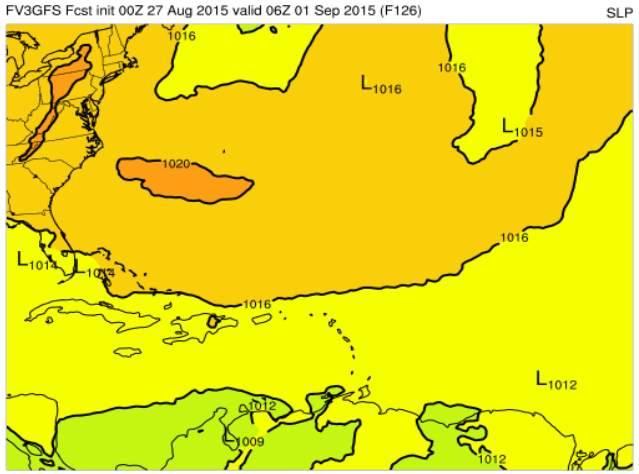
8/27/15
F126





NATE

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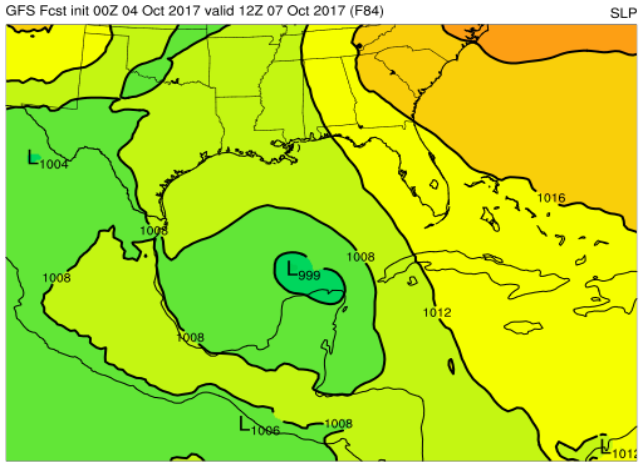
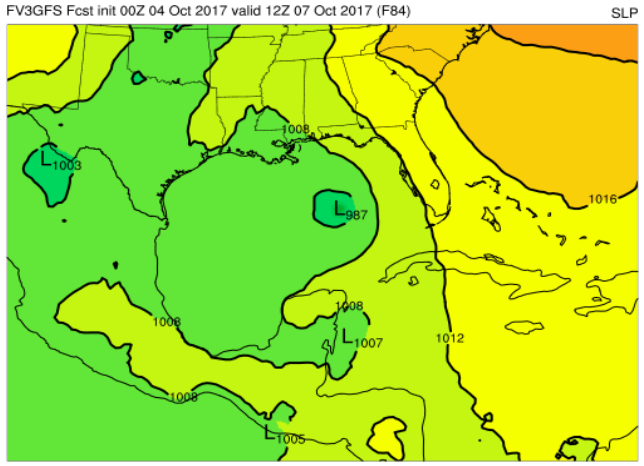
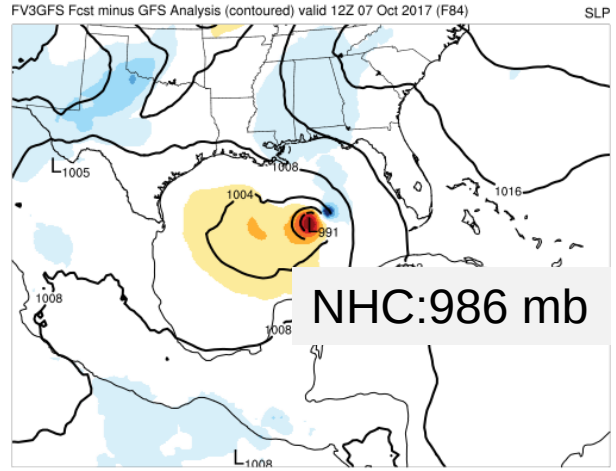
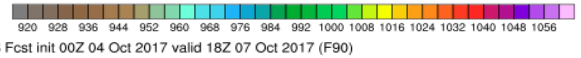
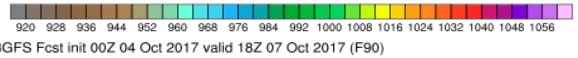
10/4/17
CYCLE

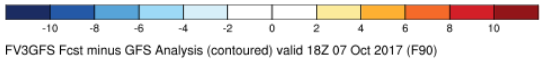


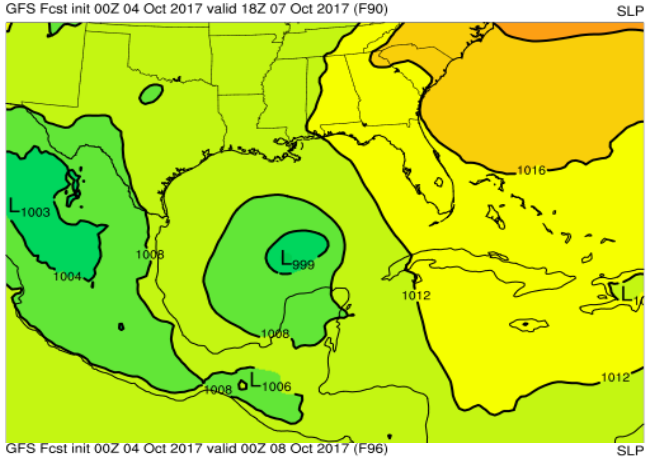


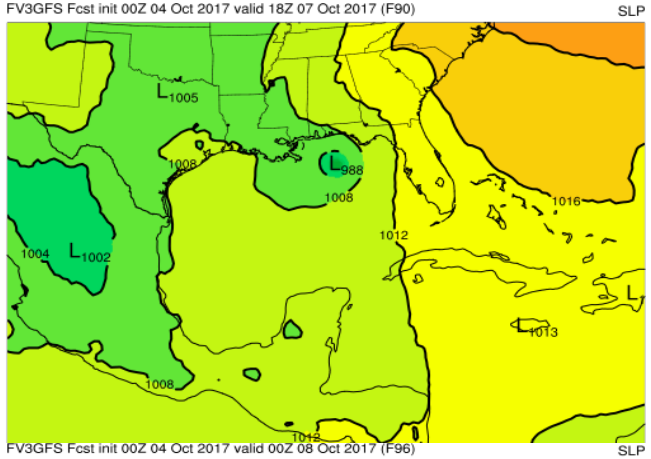


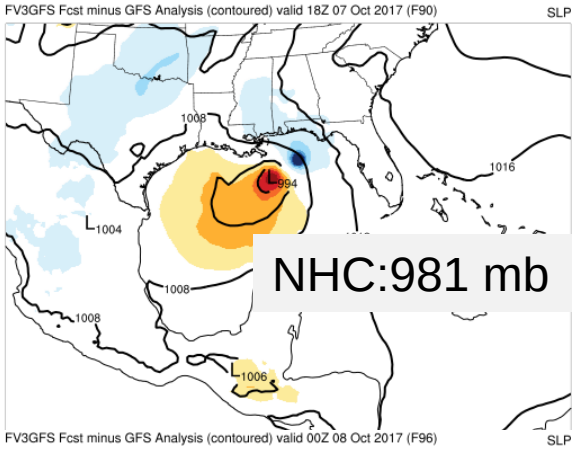


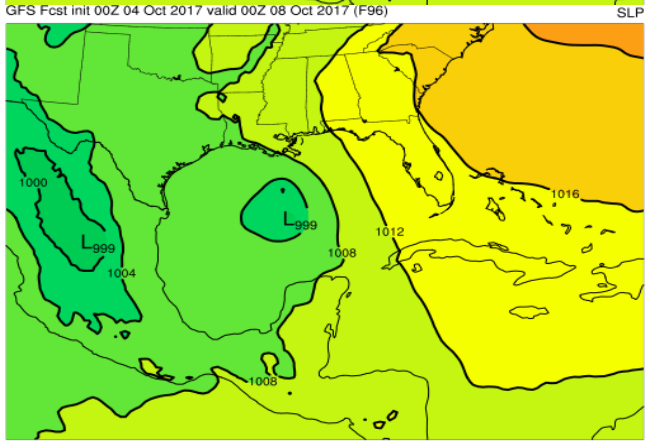


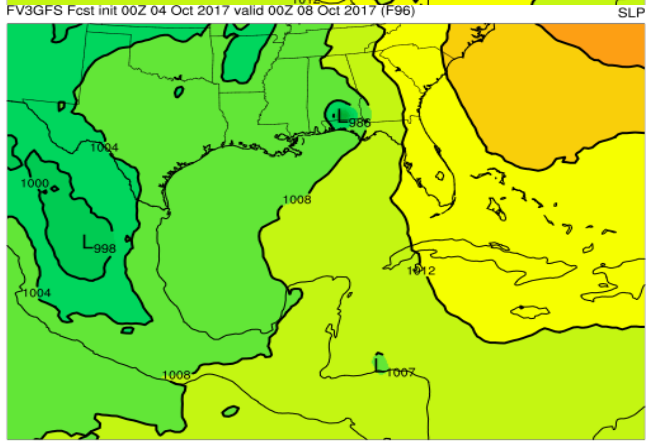


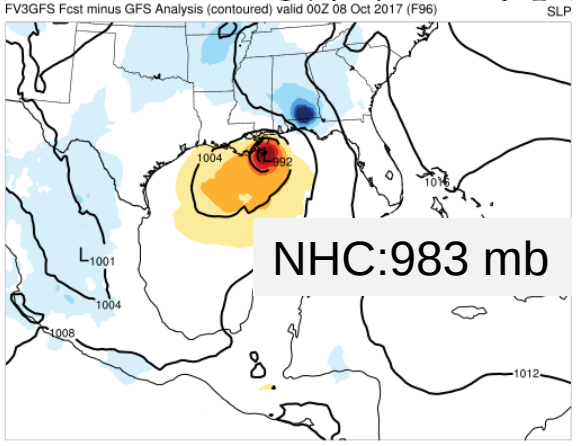






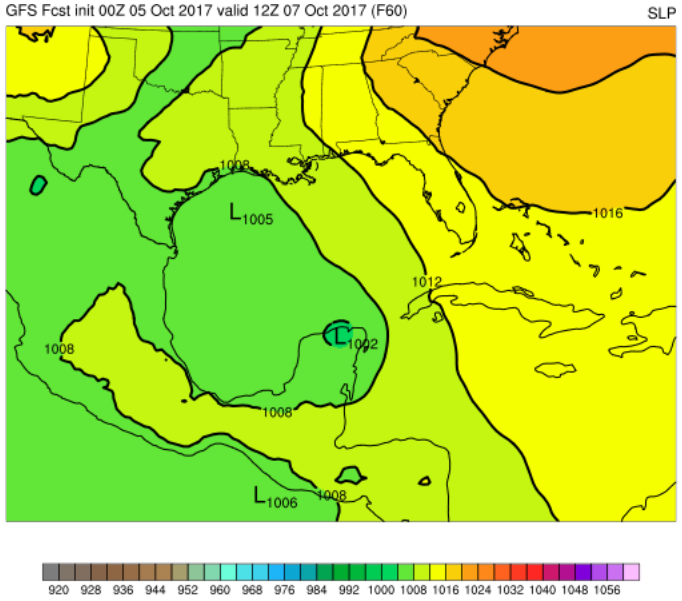


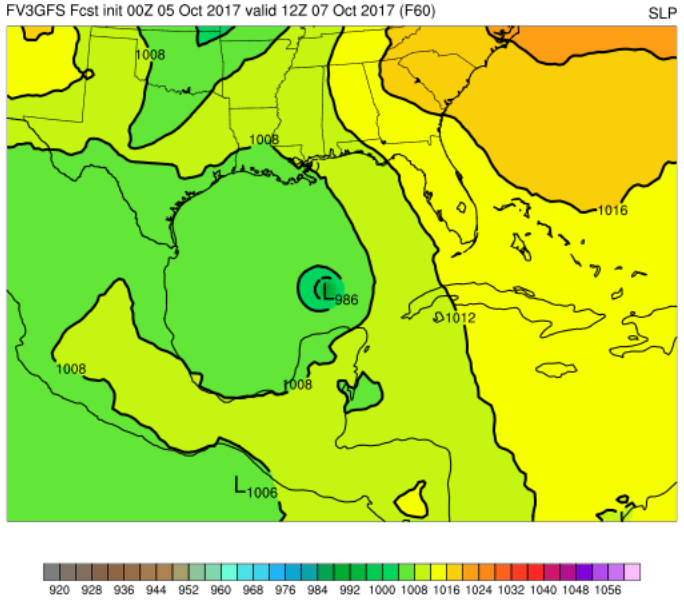




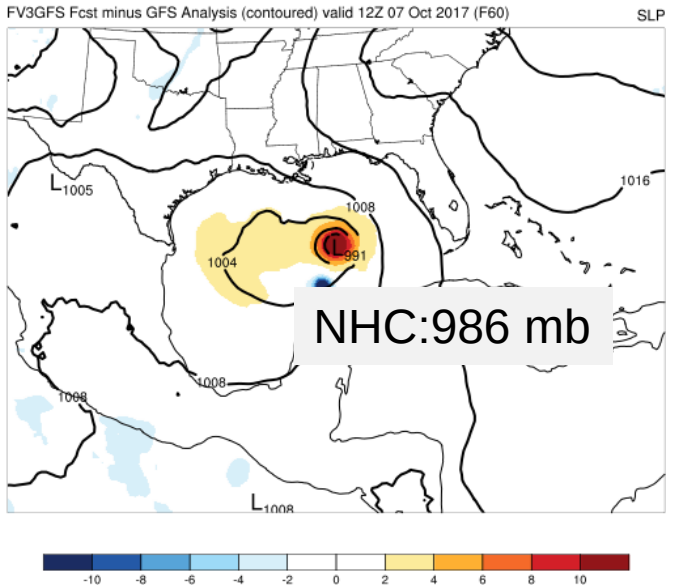
00z
10/5/17
CYCLE

F60

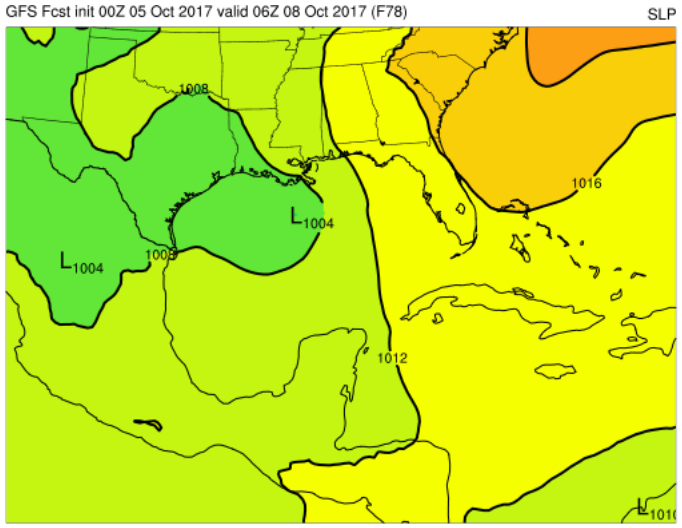


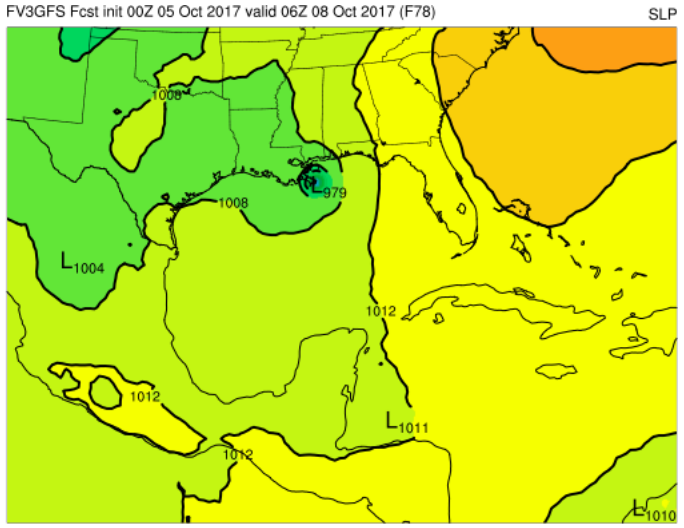


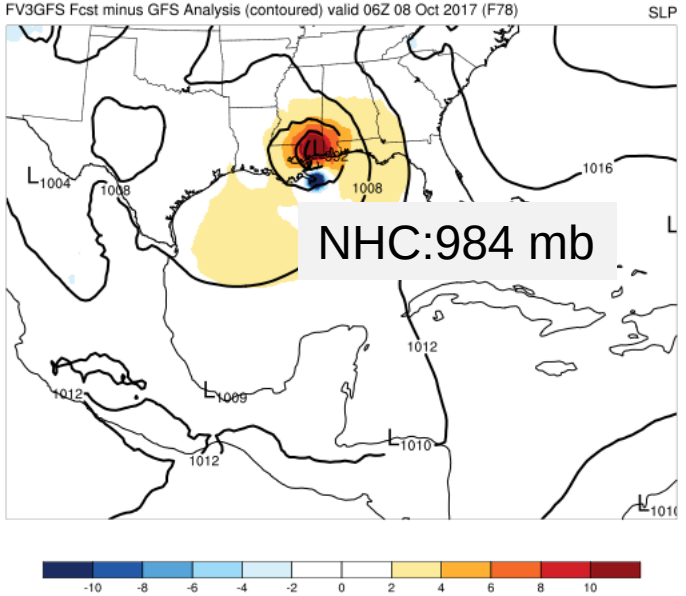
GFS **FV3GFS**



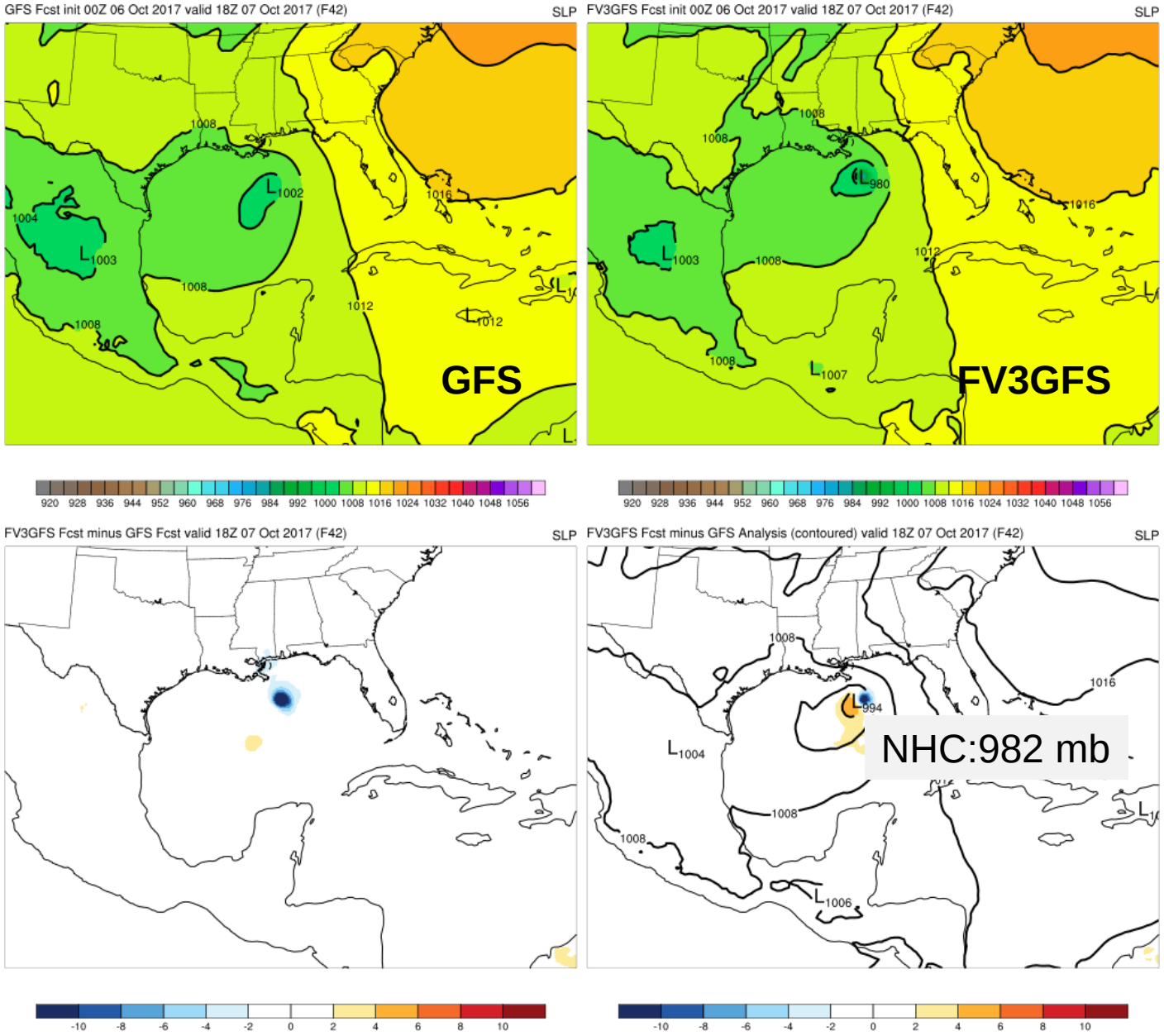
F78



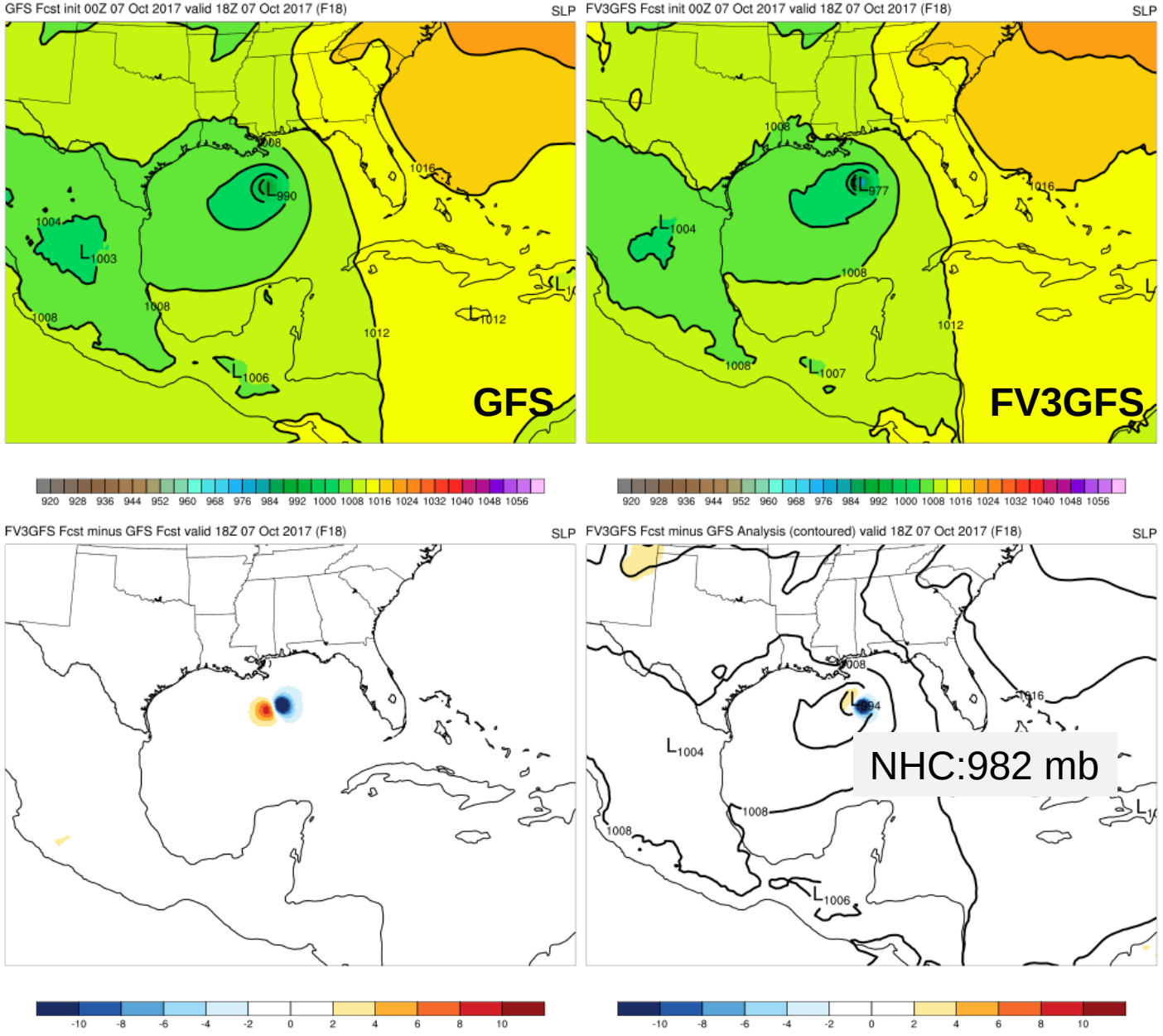


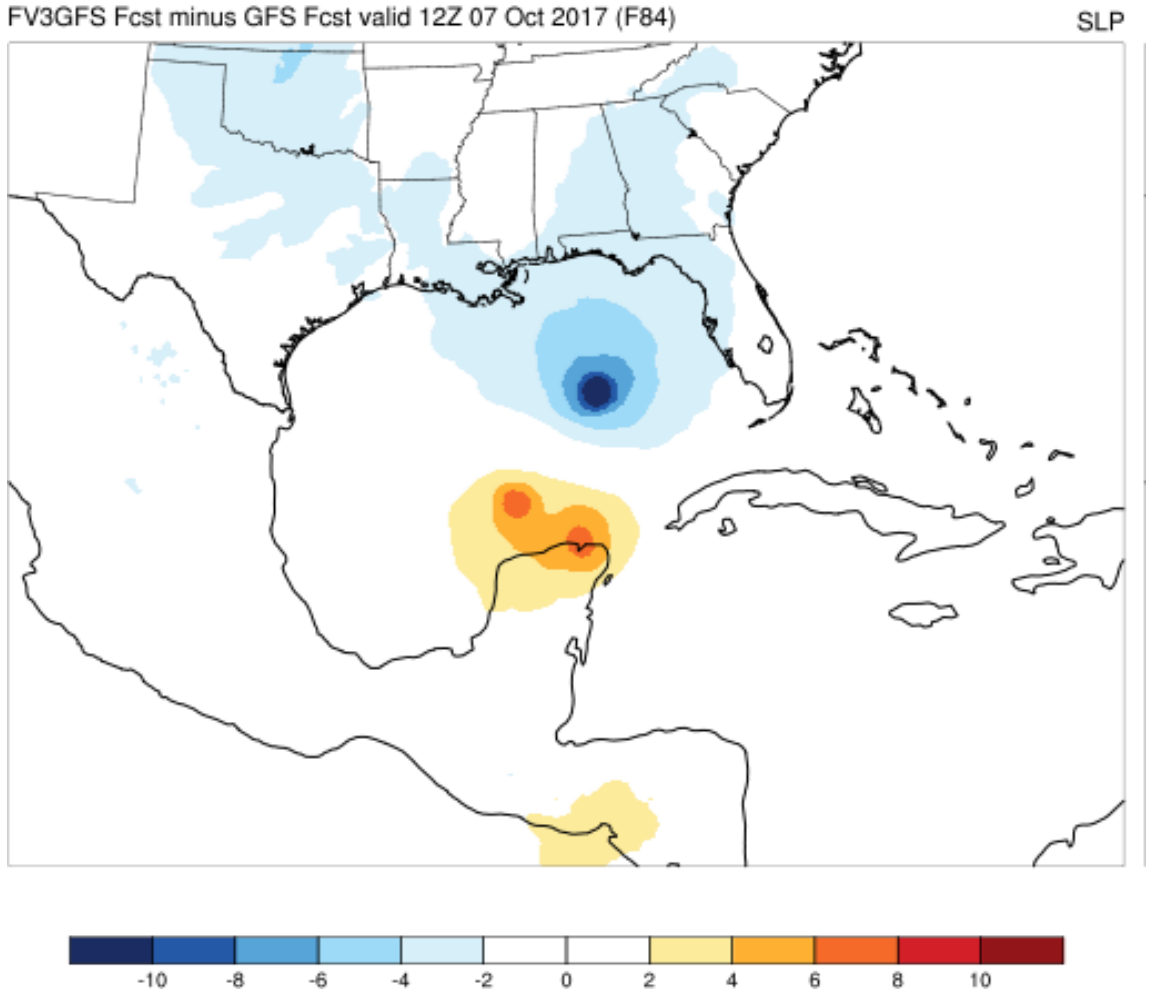


00z
10/6/17
CYCLE



00z
10/7/17
CYCLE





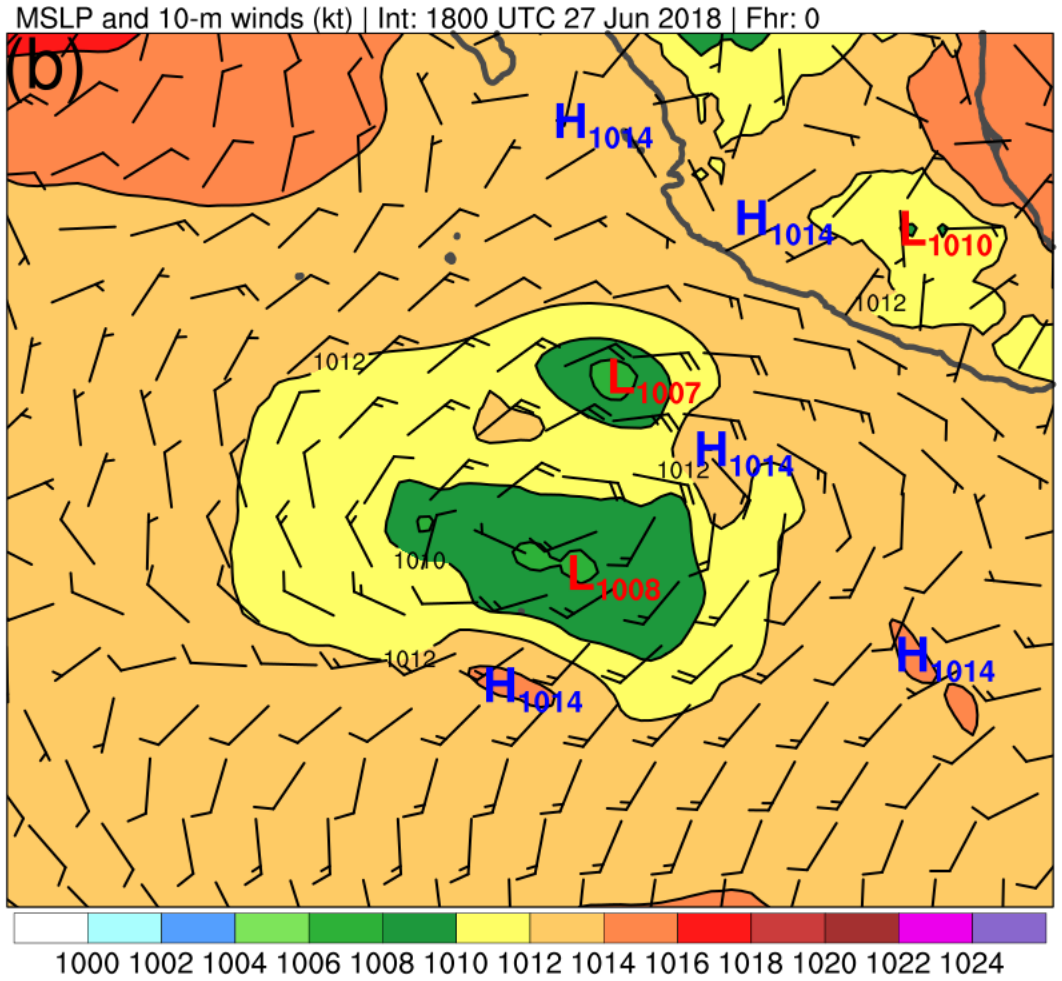
THIS FV3GFS-GFS SLP DIFFERENCE PLOT SUMS UP MULTIPLE CYCLES OF THE NATE CASE NICELY:

1) FV3GFS STRONGER THAN GFS (correct)
2) FV3GFS FASTER THAN GFS (too fast)
3) GFS HAD PROBLEMS WITH DOUBLE LOW STRUCTURE THAT WERE MUCH LESS PREVALENT IN FV3GFS (correct)

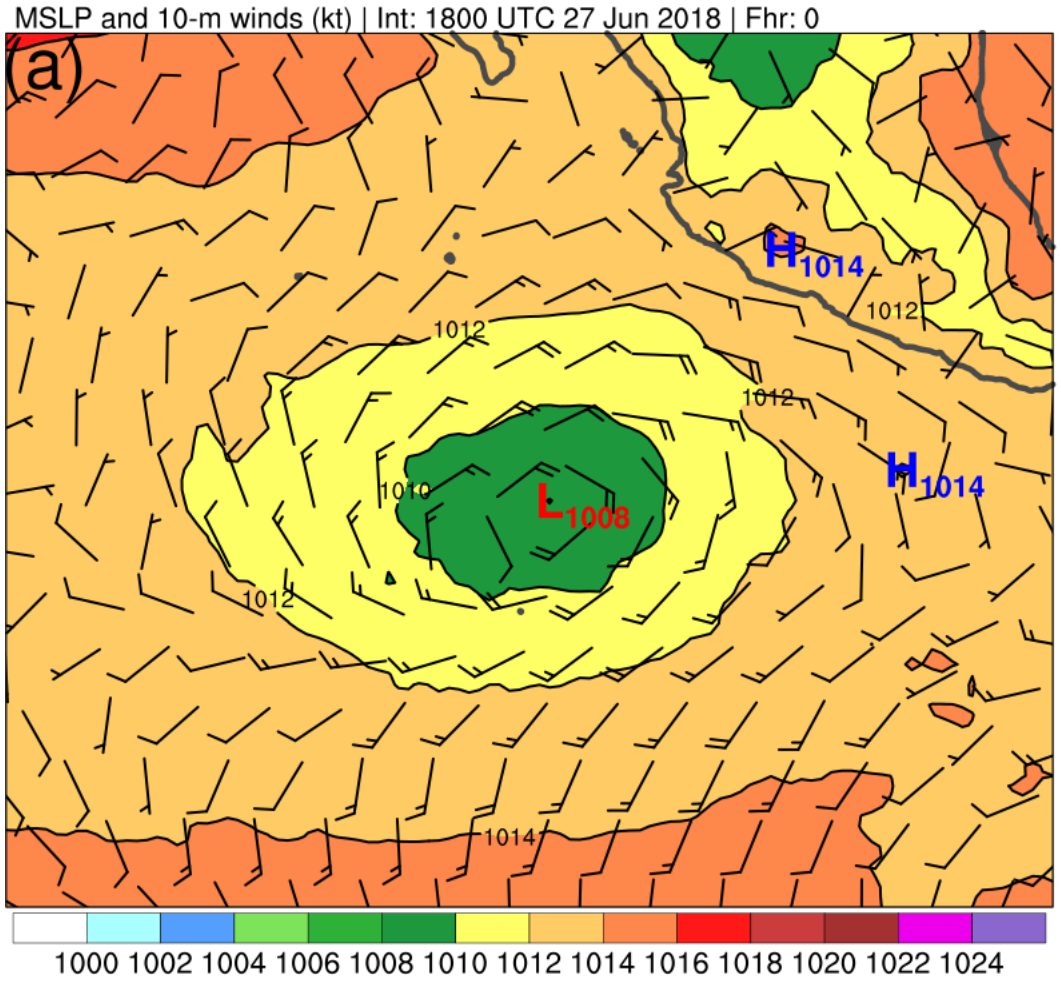
IMPROVED INITIALIZIATIONS

6/27/18 18z F00

GFS

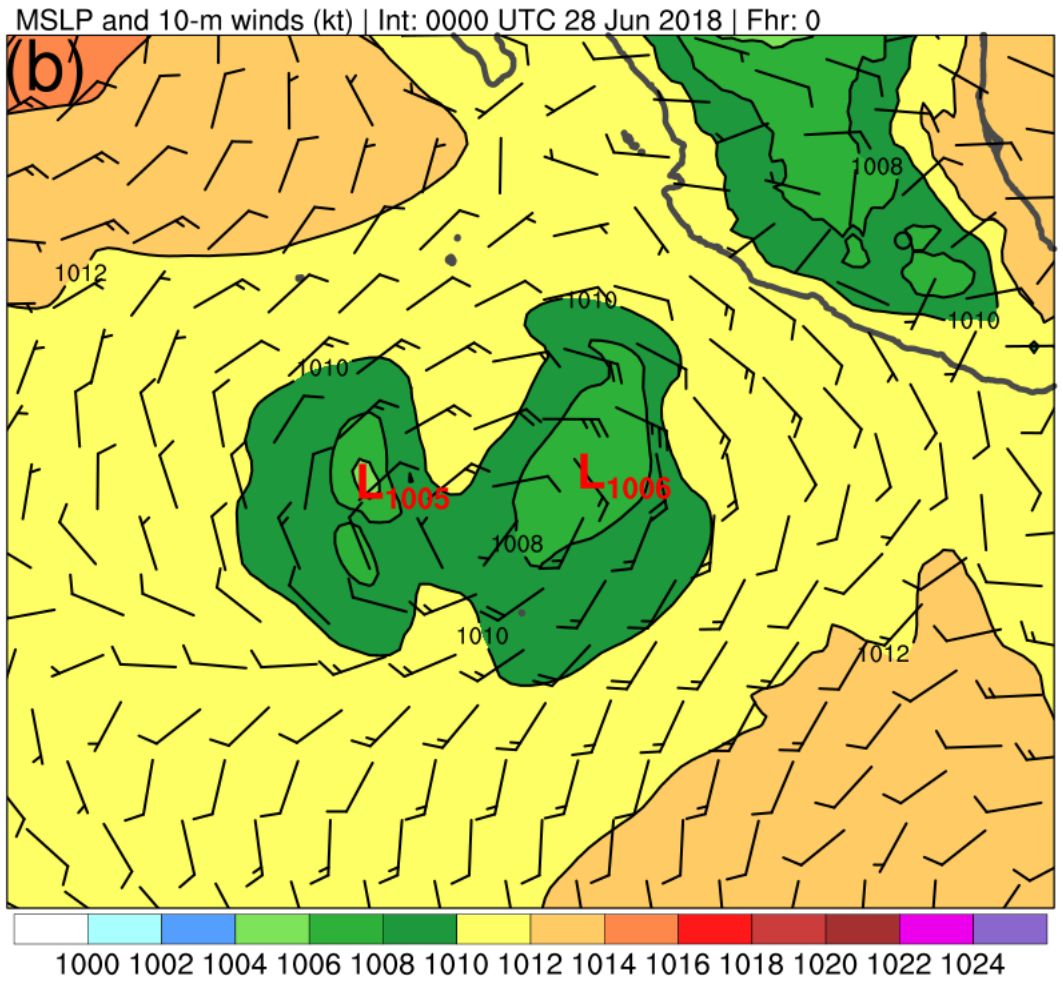


FV3



6/28/18 00z F00

GFS



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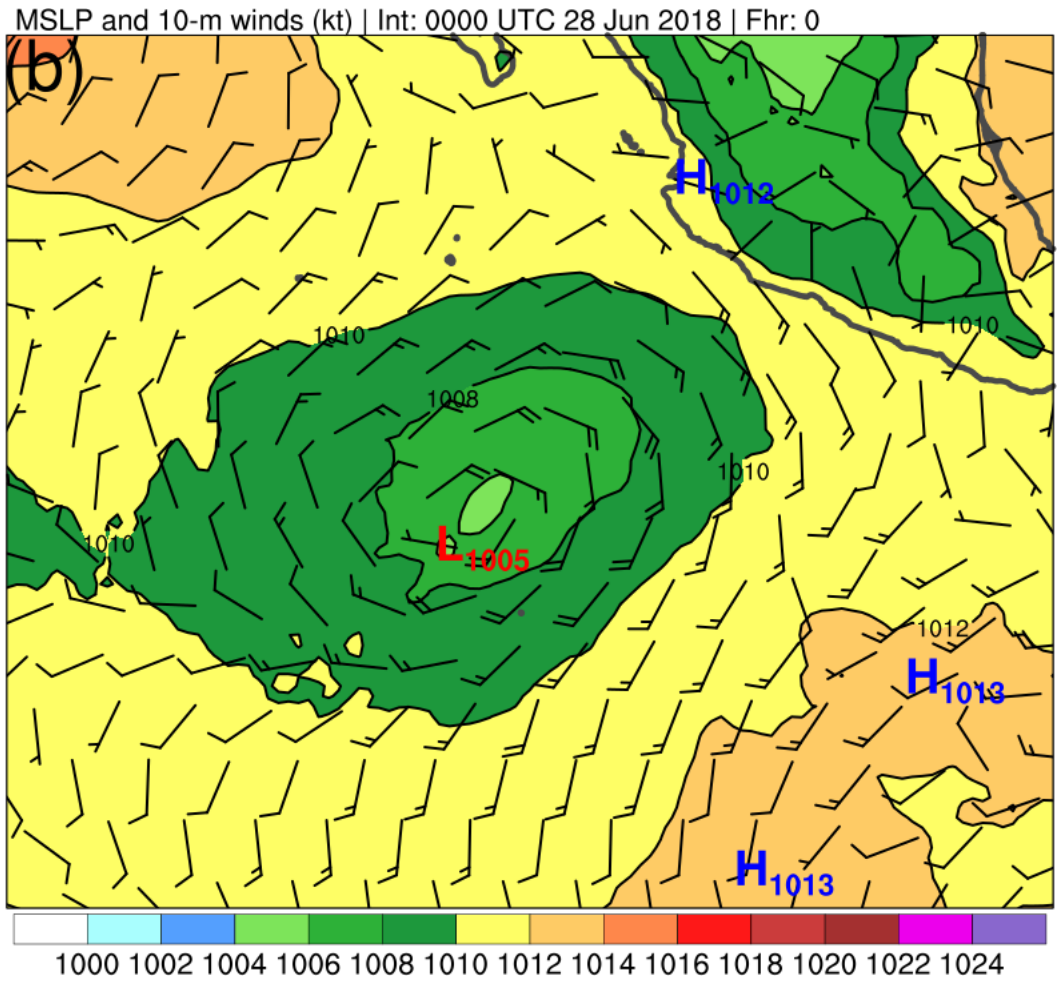
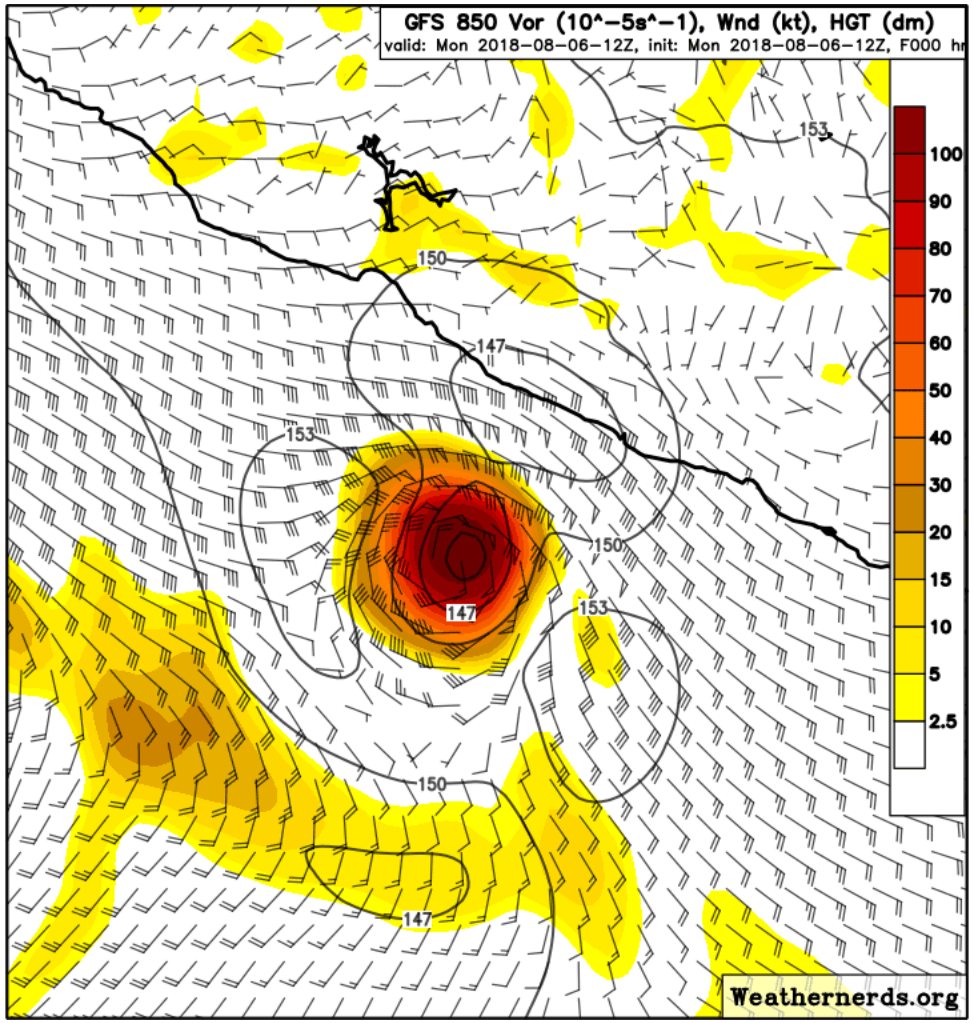


8/6/18 12z F00

GFS



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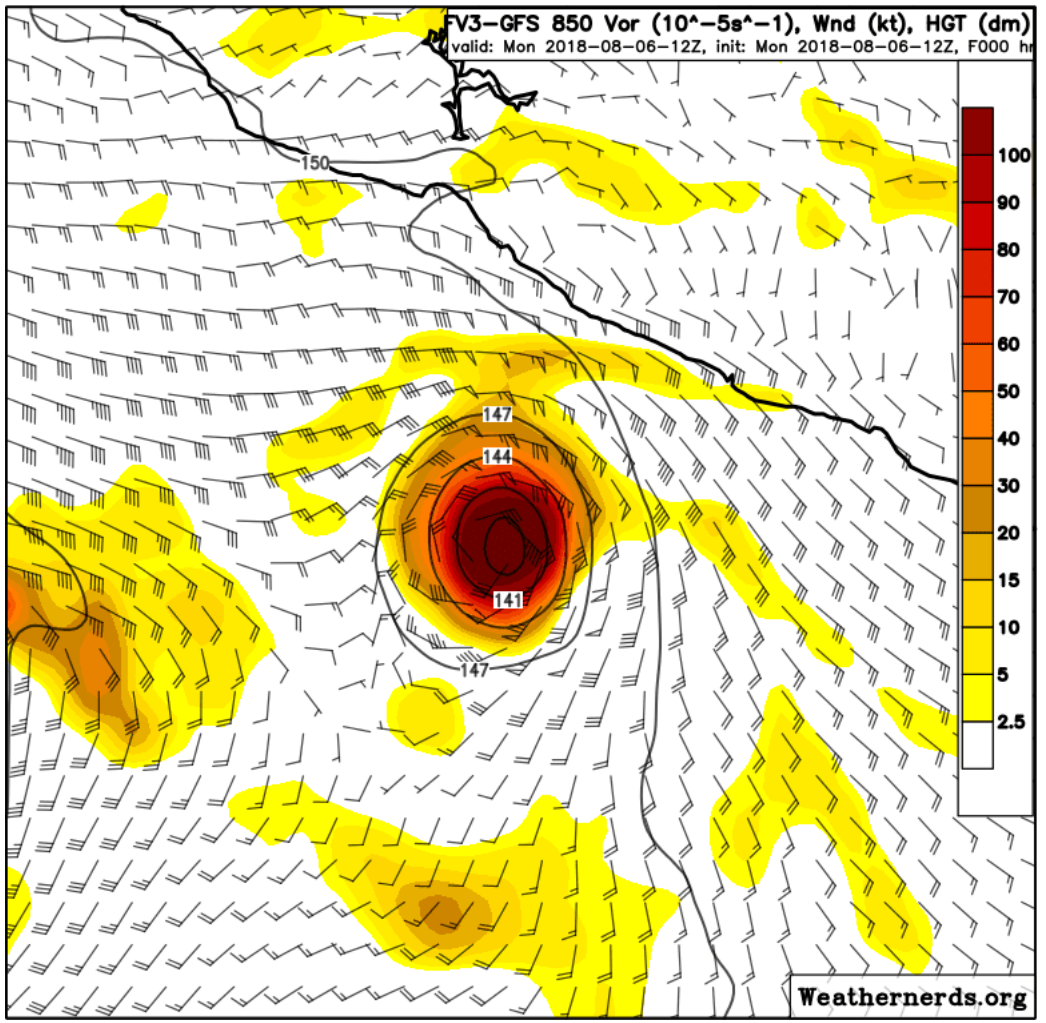

FINAL THOUGHTS

- There was a clear issue with FV3GFS tropical cyclone intensity
- The advection scheme setting change seems to improve intensity with minimal degradation to overall synoptic performance
- We do not see the extreme deepening in the FV3GFS that we saw last year in the ops GFS
- Wind-pressure relationship appears significantly improved in FV3GFS
- Matthew track is worse in FV3GFS; Joaquin track is a major improvement
- FV3GFS subjectively did better than GFS with Nate, Erika, and Patricia
- Some suggestion that FV3GFS is too fast with TC motion
- FV3GFS appears to avoid GFS initialization issues with multiple centers
- Overall track/intensity performance of FV3GFS (relative to GFS) seems acceptable