

Performance and Evaluation of HMON-based Ensemble Prediction System in 2018

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Outline

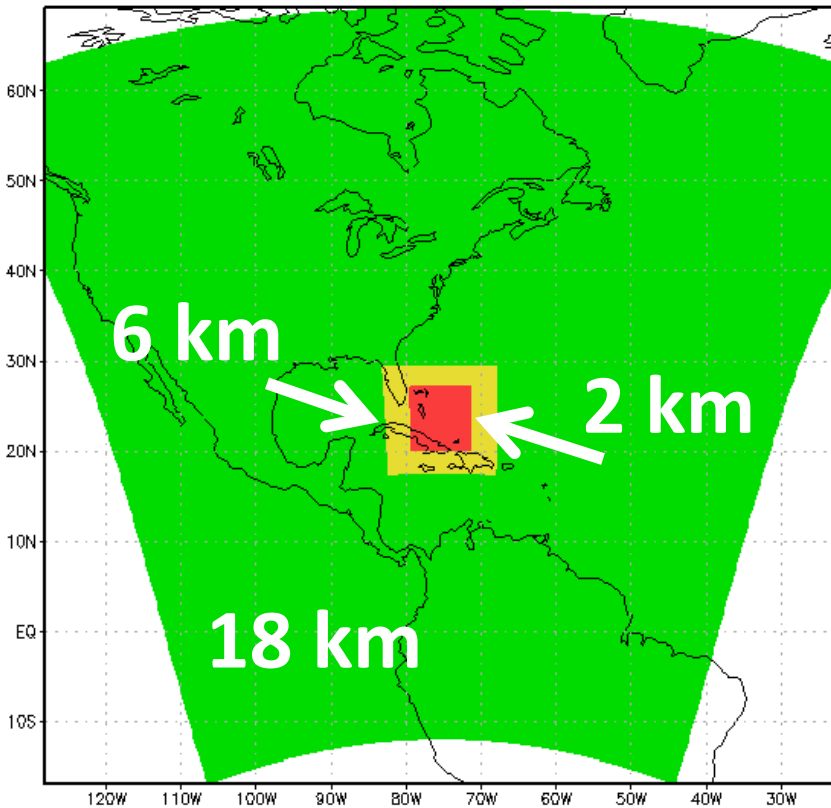
- HMON and configuration
- Comparisons of track and intensity
- Performance of RI forecasts
- Summary

HMON ENSEMBLE

- HMON ENS, 1 + 10
- Real time parallel for one AL(EP) storm
- Mean and uncertainty of track/intensity
- Provide results for multi-model ensembles

HMON

Hurricanes in a Multi-scale Ocean coupled Non-hydrostatic model



- Dynamic core: NMMB
- Coupled to HYCOM
- Vortex Initialization
- BC and IC from GFS
- 51 levels, 18-6-2km
- Three domains, two nests
- No DA yet
- D1: $\sim 65^\circ \times 65^\circ$
- D2: $\sim 12^\circ \times 12^\circ$
- D3: $\sim 7^\circ \times 7^\circ$

2018 HMON Ensemble Configuration

- Domain configuration: same as 2018 operational HMON model
 - 9 levels more than in 2017 HMON_ENS
 - 10% larger than 2017 HMON_ENS
 - HYCOM is cold started (warm started in operational HMON)

- IC/BC Perturbations (large scale): 10 member GEFS/FV3GFS.

- Random initial wind speed and position (TCVital) perturbations considering best track uncertainty

- Multi-phys Options in members:
 - Convection: BMJ, SAS, scale-aware SAS
 - PBL: GFSPBL, EDMFPBL
 - Land: SLAB, NOAH
 - Microphys: Fer_hires, WSM6
 - Surface layer: use different z0 and zt values (Cd,Ch)

- ~539 ujet nodes reserved (changed to tjet and xjet in Oct).

Configurations for HMON ensemble members

	Domains	CU	PBL	Land	Cd,Ch	MP
00	D1: 451x451 D2: 231x201 D3: 381x345 NZ=51 18 Km 6 Km 2 Km	Scale_SAS	EDMF	NOAH	ICOEF=10	Fer_hires
01		SAS	EDMF	NOAH	ICOEF=10	Fer_hires
02		BMJ	EDMF	NOAH	ICOEF=10	Fer_hires
03		Scale_SAS	GFSPBL	NOAH	ICOEF=10	Fer_hires
04		Scale_SAS	EDMF	SLAB	ICOEF=10	Fer_hires
05		Scale_SAS	EDMF	NOAH	ICOEF=10	WSM6
06		Scale_SAS	EDMF	NOAH	ICOEF=6	Fer_hires
07		Scale_SASumix	EDMF-A	NOAH	ICOEF=10	Fer_hires
08		Scale_SASumix	EDMF-A	NOAH	ICOEF=6	Fer_hires
09		SAS	EDMF	NOAH	ICOEF=10	WSM6
10 [#]	Scale_SAS	EDMF	NOAH	ICOEF=10	Fer_hires	

use FV3GFS for IC and BC,

Umix: momentum mixing due to convection

EDMF-A: wind-dependent K adjustment

Storms

	Start	END	# of cycles
NATL			
2018 04L DEBBY	2018080718	2018080912	8
2018 06L florence	2018083012	2018091606	68
2018 07L gordon	2018090218	2018090518	13
2018 09L isaac	2018090800	2018091612	33
2018 12L kirk	2018092212	2018092900	27
2018 14L michael	2018100700	2018101206	22
EPAC			
2018 10E Hector	2018080106	2018080806	29
2018 14E LANE	2018081612	2018082900	51

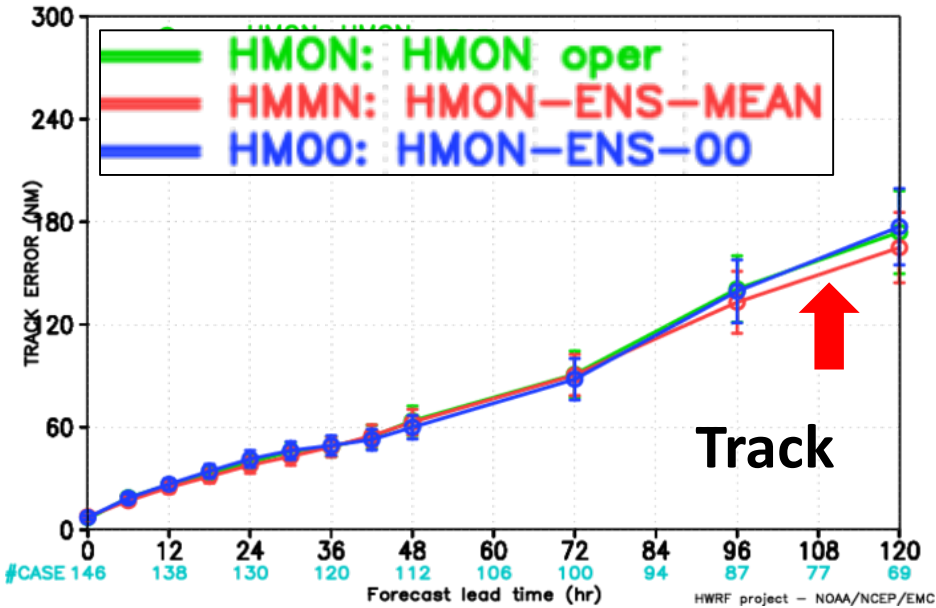
Performance of

Operational HMON

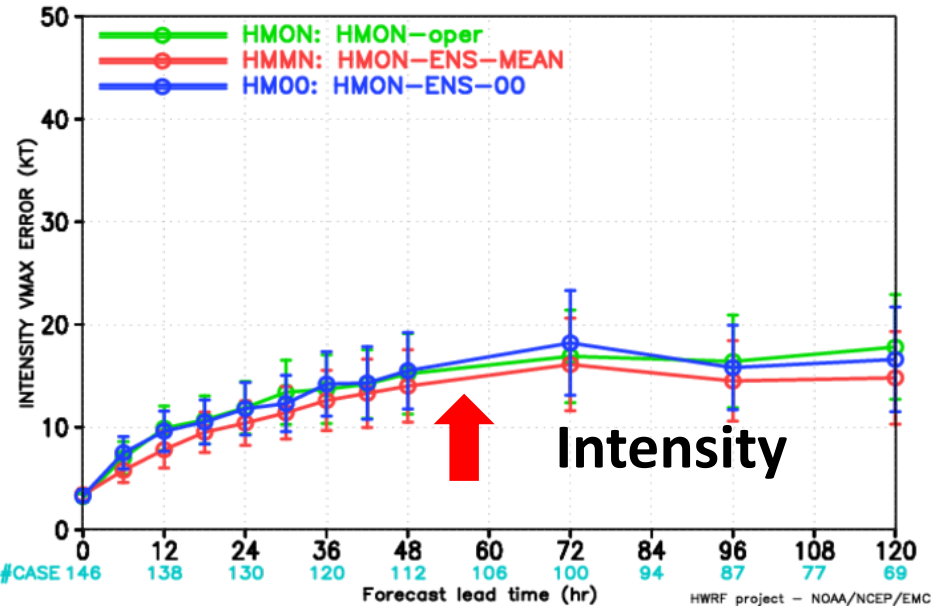
Control-00

ENS-mean

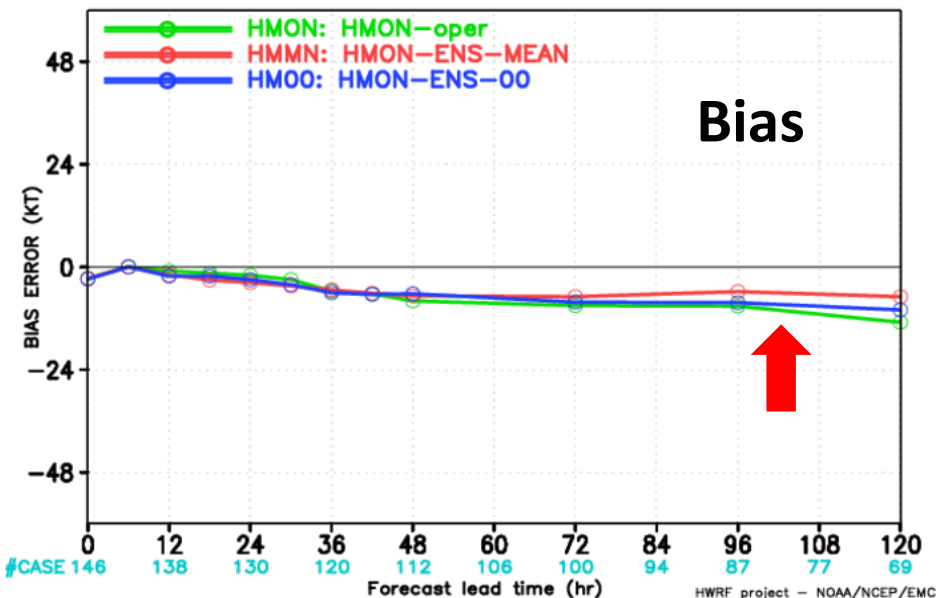
HWRP FORECAST – TRACK ERROR (NM) STATISTICS
HMON NATL VERIFICATION



HWRP FORECAST – INTENSITY VMAX ERROR (KT) STATISTICS
HMON NATL VERIFICATION



HWRP FORECAST – BIAS ERROR (KT) STATISTICS
HMON NATL VERIFICATION

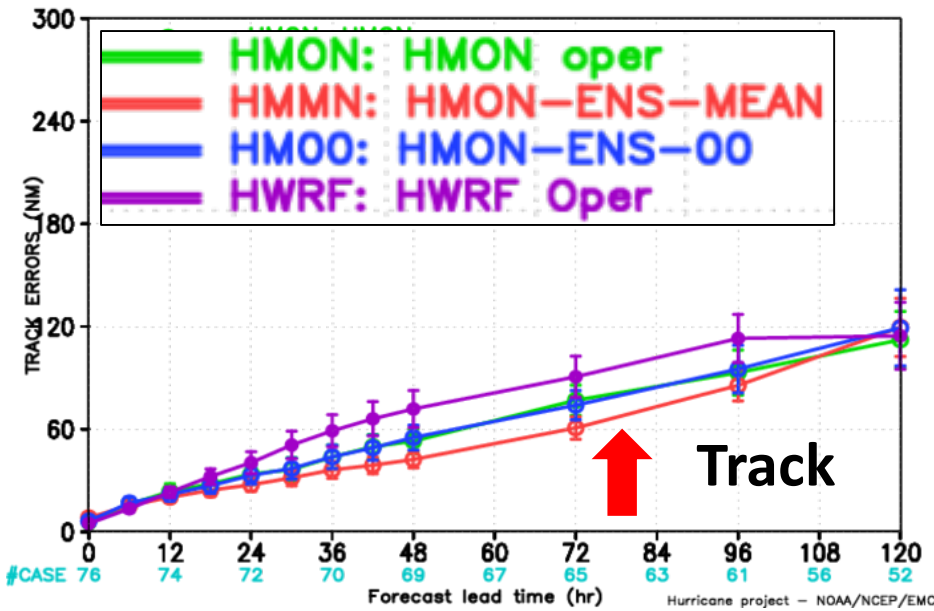


ATLANTIC Basin

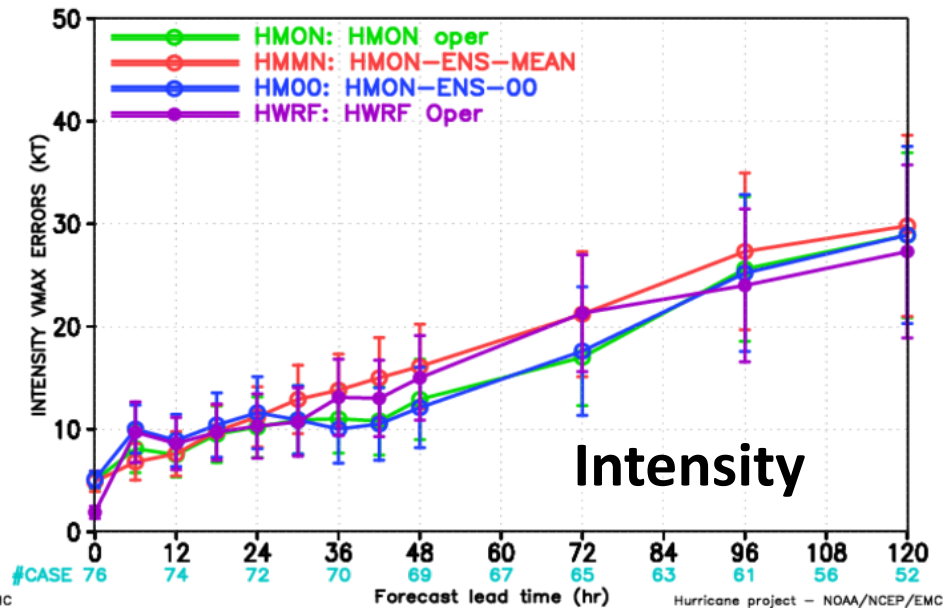
Figure 1. Comparison of track and intensity errors and bias from operational HMON (green), ensemble mean (red), and control member (blue).

- 148 cycles are verified.
- Control is close to oper HMON
- HMON-ENS: better/close track.
- HMON-ENS: better Intensity/bias.

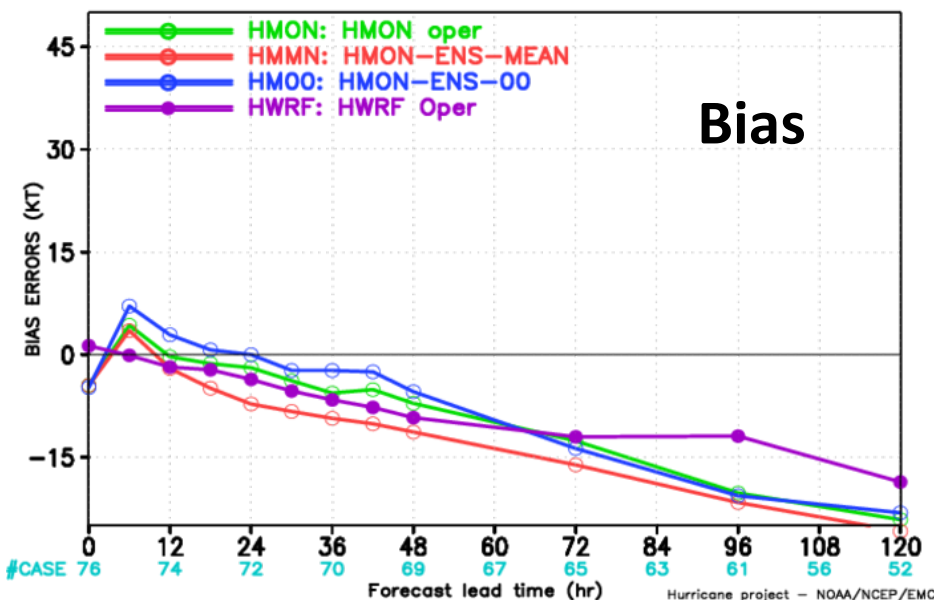
MODEL FORECAST – TRACK ERRORS (NM)
VERIFICATION FOR EASTERN PACIFIC BASIN 2018



MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
VERIFICATION FOR EASTERN PACIFIC BASIN 2018



MODEL FORECAST – BIAS ERRORS (KT)
VERIFICATION FOR EASTERN PACIFIC BASIN 2018



East Pacific Basin

Figure 2. As Fig 1 except for East Pac Basin.

- Control is close to operational HMON
- HMON-ENS gives better track than oper HMON and control.
- Intensity/bias, worse.

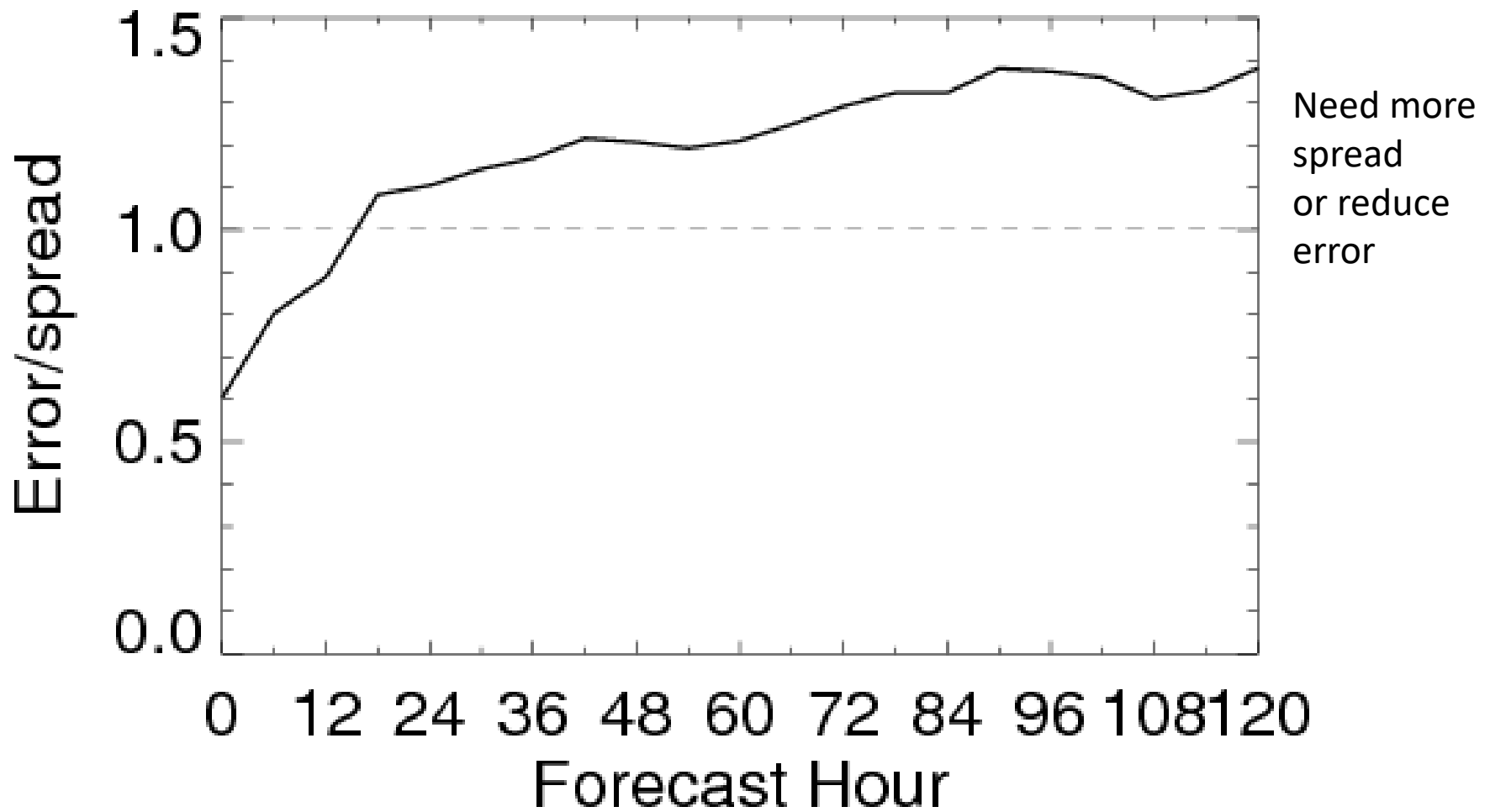


Figure 3. Ratio of error in mean intensity and spread of members.

Rapid Intensification (RI)

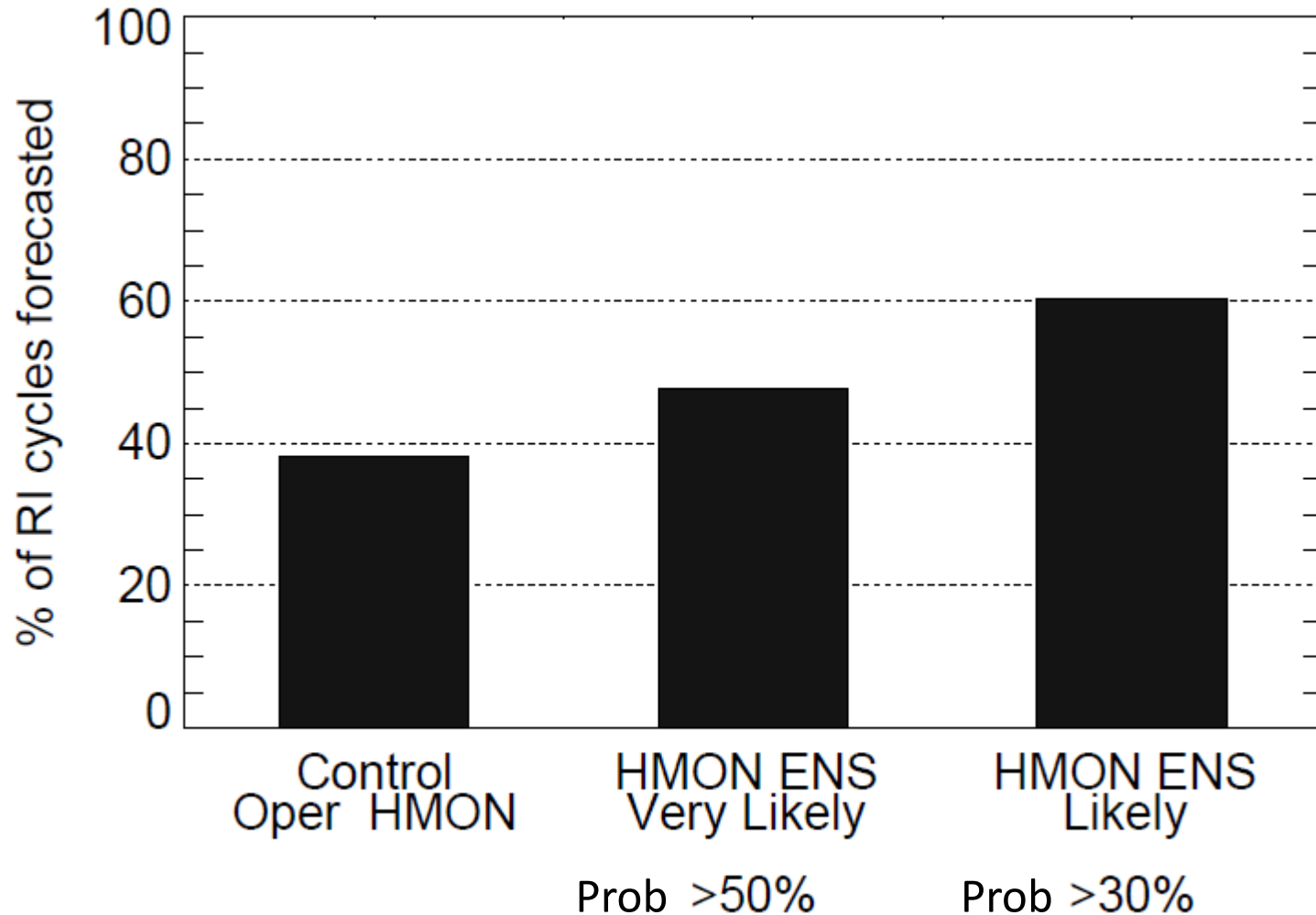


Figure 4. Comparison of percentage of rapid intensification cycles forecasted successfully by Oper HMON/control and ensemble system.

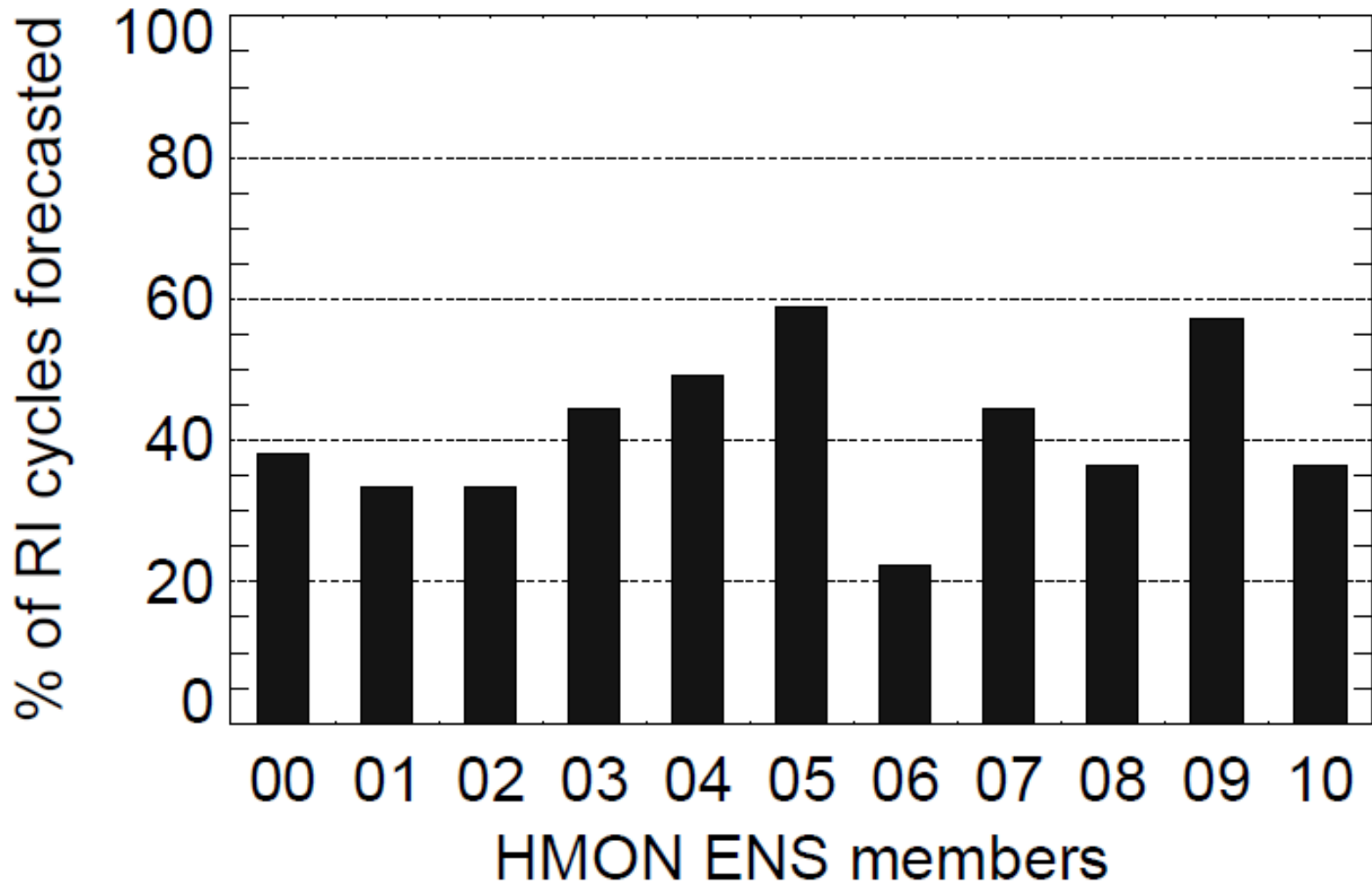


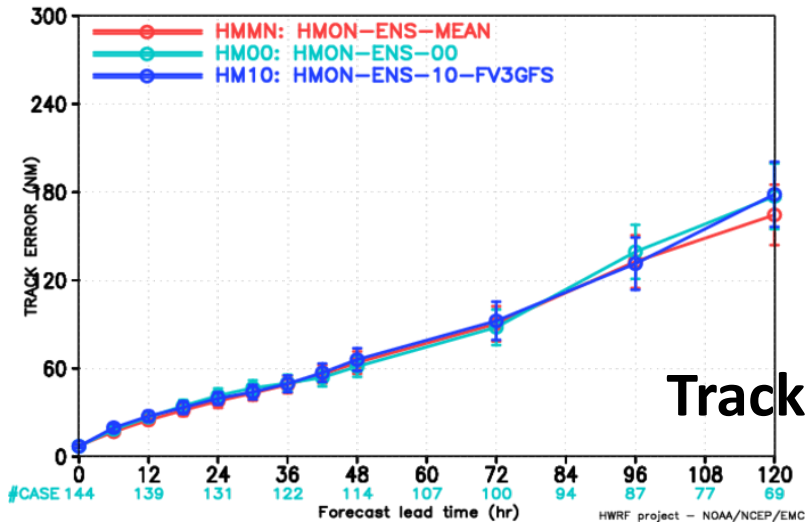
Figure 5. Comparison of percentage of rapid intensification cycles forecasted successfully by individual members.

Summary

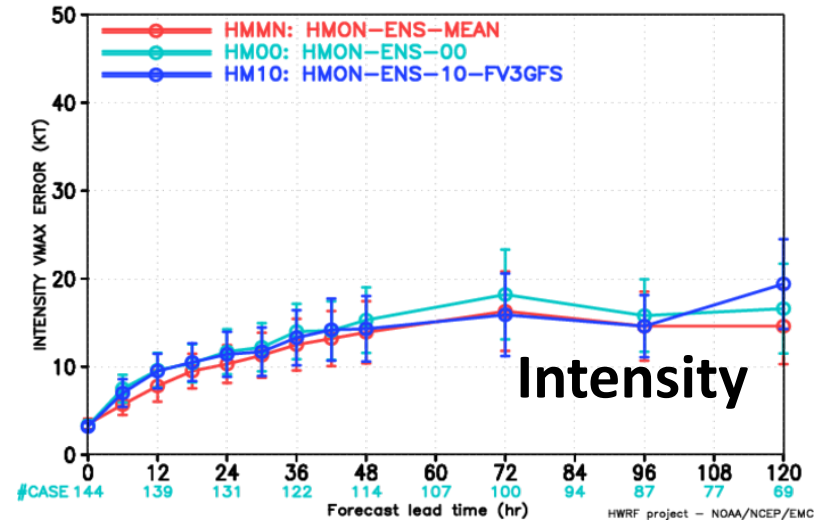
- For **NATL storms**, HMON-based ENS forecasted mean track, intensity, and bias better than operational HMON does.
- For **EPAC storms**, HMON-based ENS forecasted mean track better than operational HMON, but gave worse intensity.
- HMON-based ENS improved RI forecasts.
- Further analyses of HMON-ENS performance are being done to improve the system.

Performance of Members

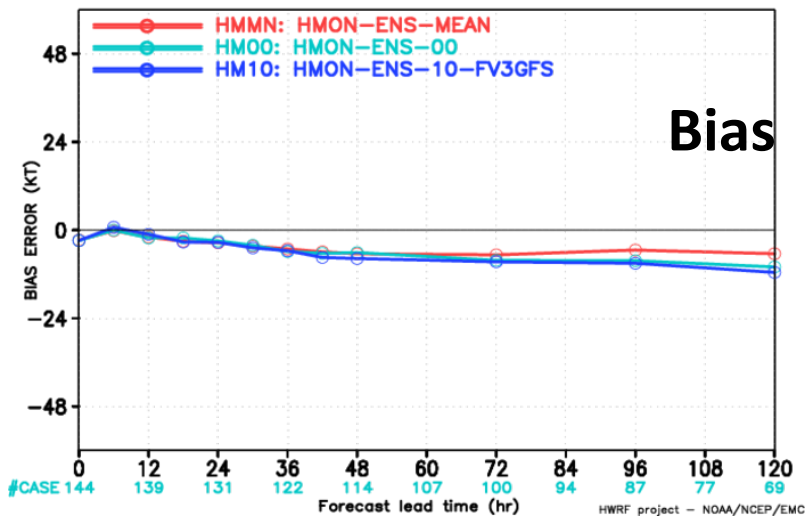
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HMON NATL VERIFICATION



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HMON NATL VERIFICATION



HWRP FORECAST – BIAS ERROR (KT) STATISTICS
HMON NATL VERIFICATION



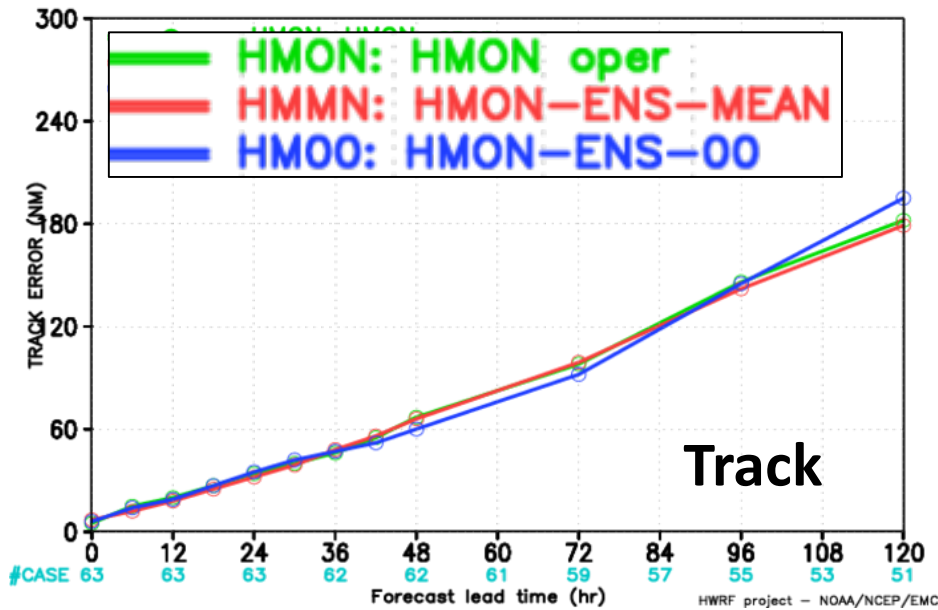
Global Data

GEFS

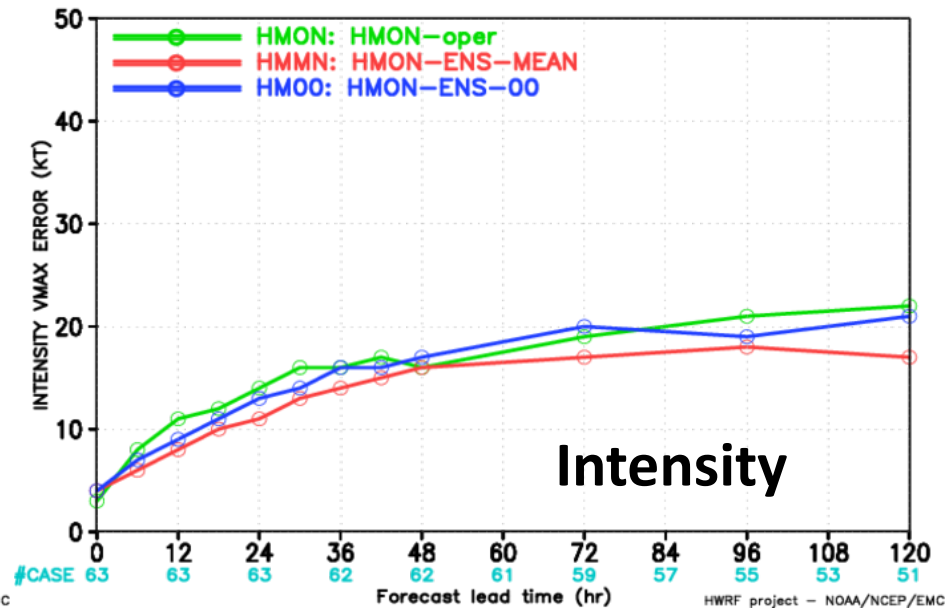
FV3GFS

With FV3GFS, a little better track and intensity

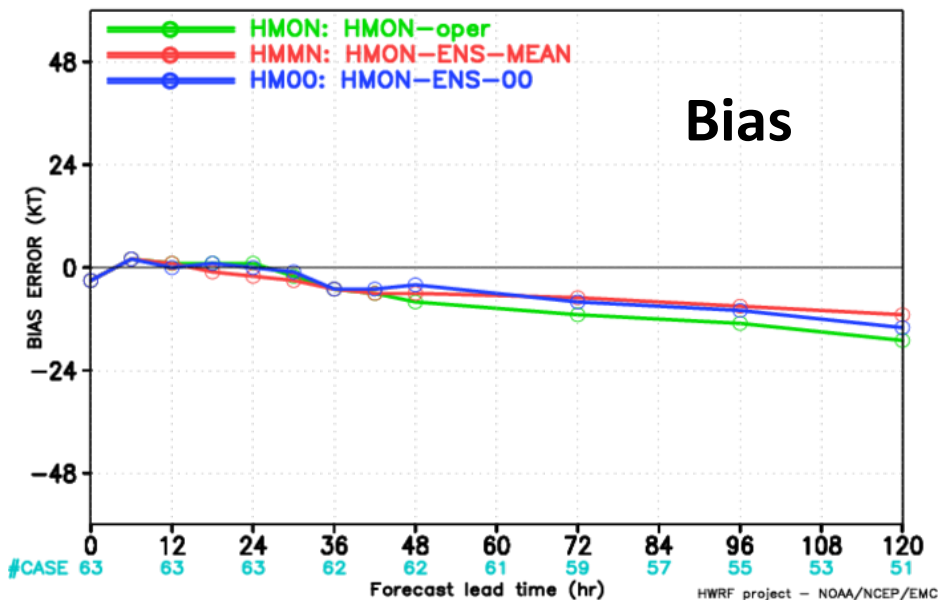
HWRP FORECAST – TRACK ERROR (NM) STATISTICS
STATISTICS FOR A SINGLE CASE – a1062018_FLORENCE



HWRP FORECAST – INTENSITY VMAX ERROR (KT) STATISTICS
STATISTICS FOR A SINGLE CASE – a1062018_FLORENCE



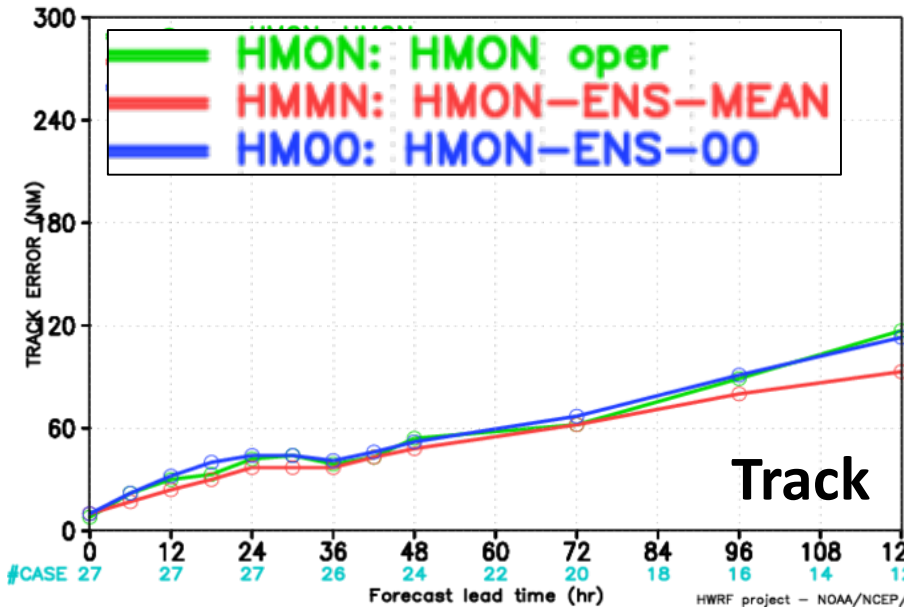
HWRP FORECAST – BIAS ERROR (KT) STATISTICS
STATISTICS FOR A SINGLE CASE – a1062018_FLORENCE



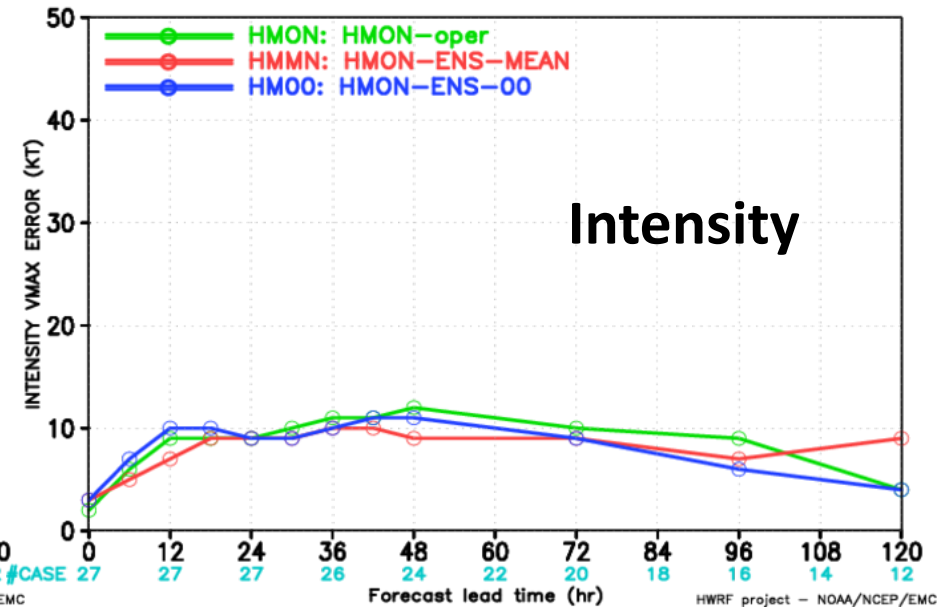
FLORENCE 06L

- Control is close to oper HMON
- HMON-ENS gives better track and intensity/bias

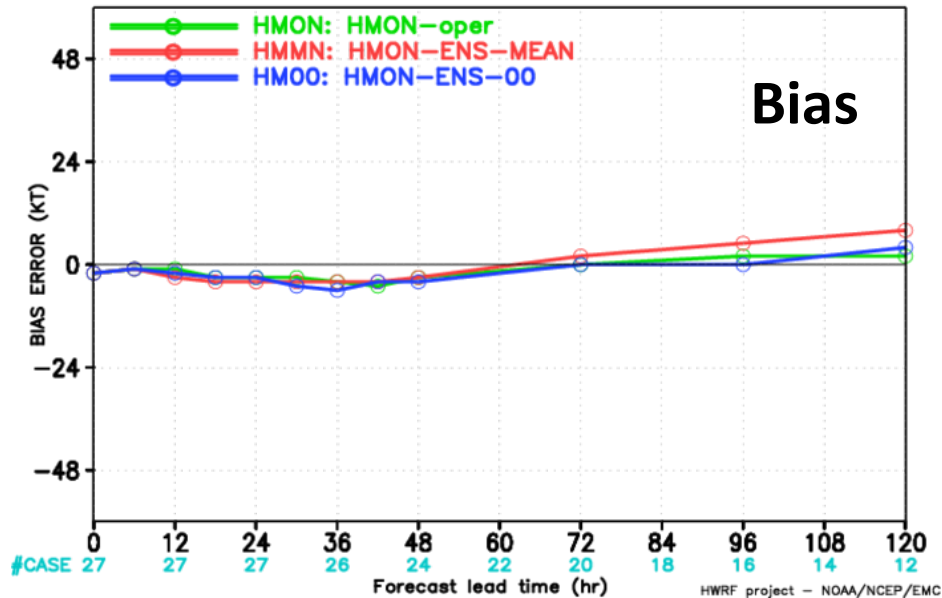
HWRP FORECAST – TRACK ERROR (NM) STATISTICS
 STATISTICS FOR A SINGLE CASE – aI092018_ISAAC



HWRP FORECAST – INTENSITY VMAX ERROR (KT) STATISTICS
 STATISTICS FOR A SINGLE CASE – aI092018_ISAAC



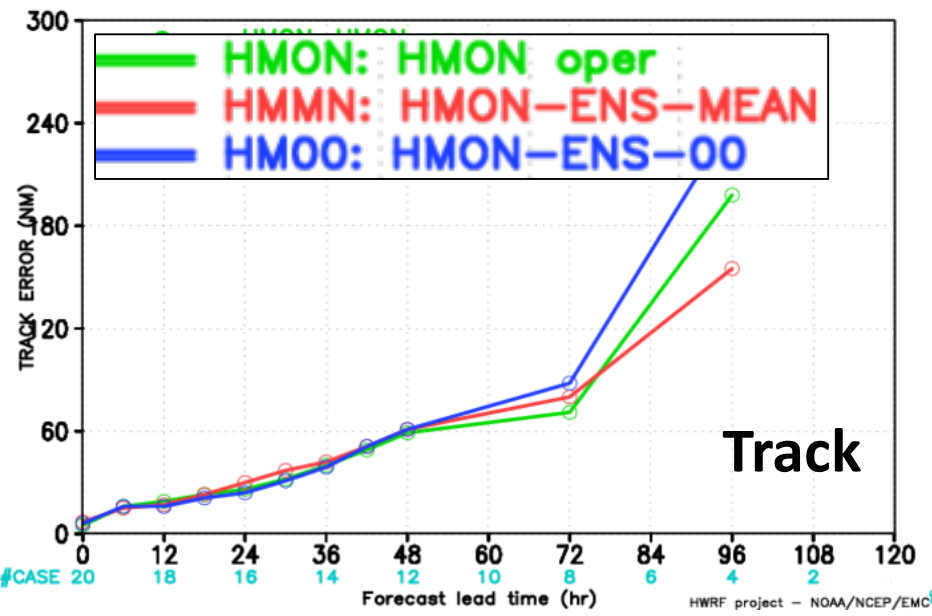
HWRP FORECAST – BIAS ERROR (KT) STATISTICS
 STATISTICS FOR A SINGLE CASE – aI092018_ISAAC



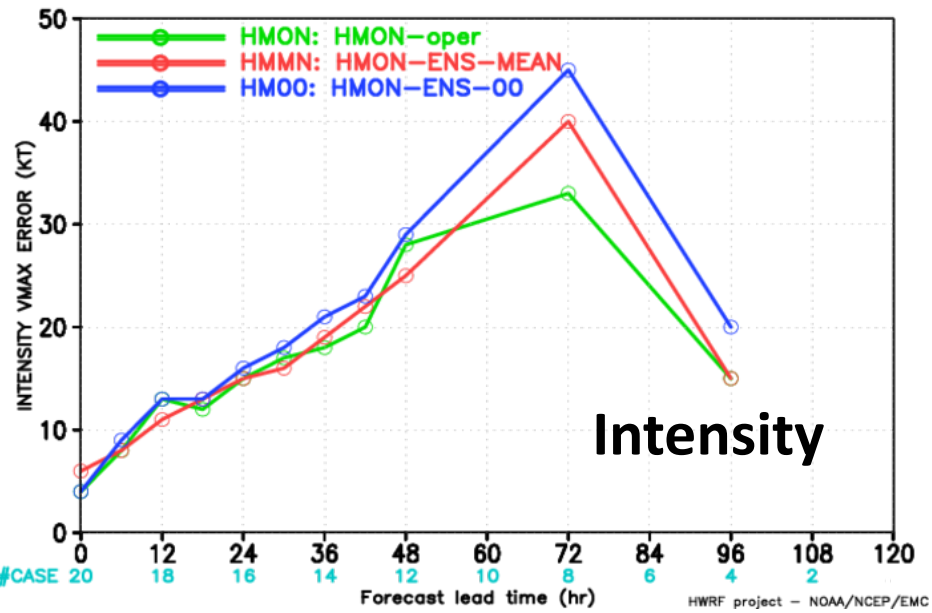
ISAAC 09L

- Control is close to oper HMON
- HMON-ENS gives better track than HMON and control.
- Intensity/bias, close.

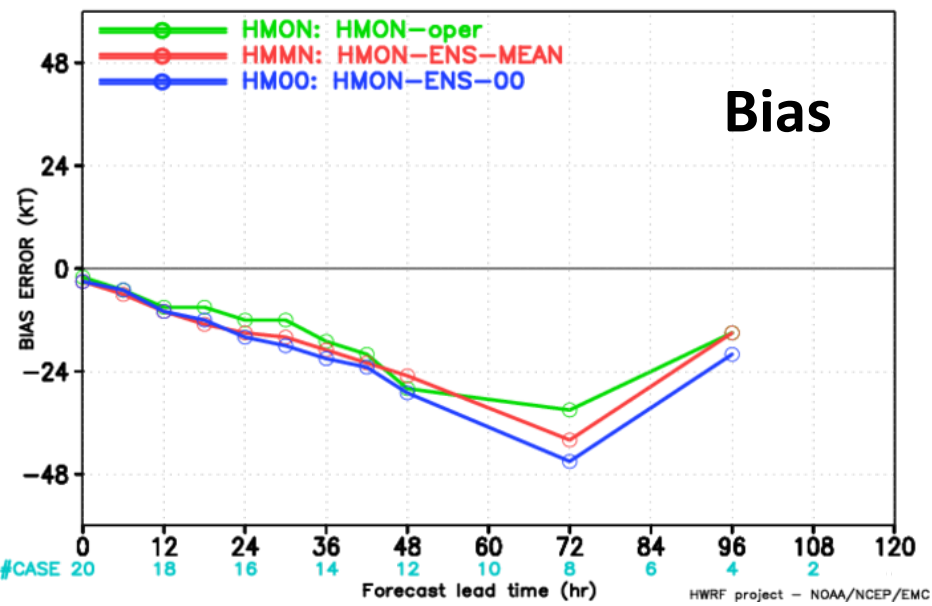
HWRP FORECAST – TRACK ERROR (NM) STATISTICS
 STATISTICS FOR A SINGLE CASE – a1142018_MICHAEL



HWRP FORECAST – INTENSITY VMAX ERROR (KT) STATISTICS
 STATISTICS FOR A SINGLE CASE – a1142018_MICHAEL



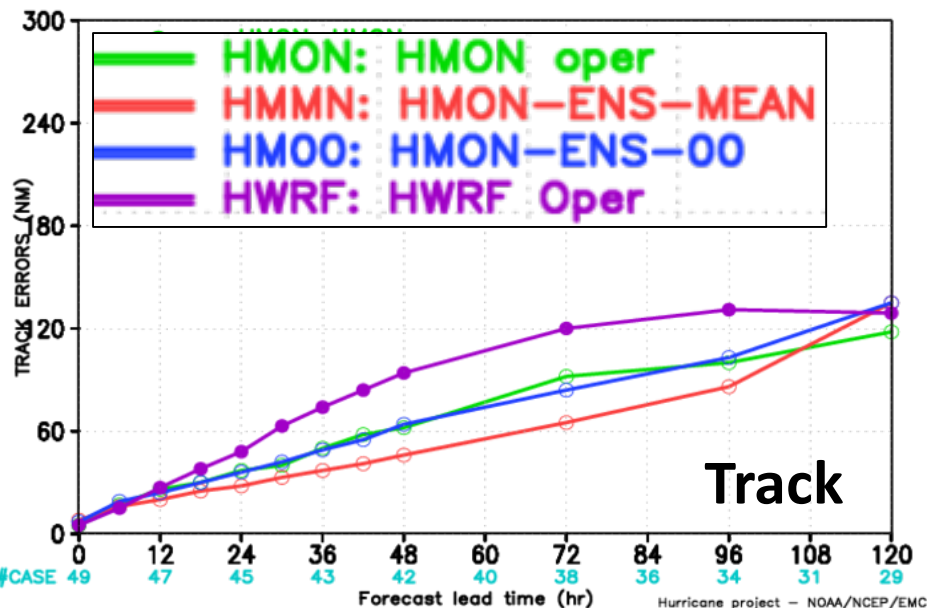
HWRP FORECAST – BIAS ERROR (KT) STATISTICS
 STATISTICS FOR A SINGLE CASE – a1142018_MICHAEL



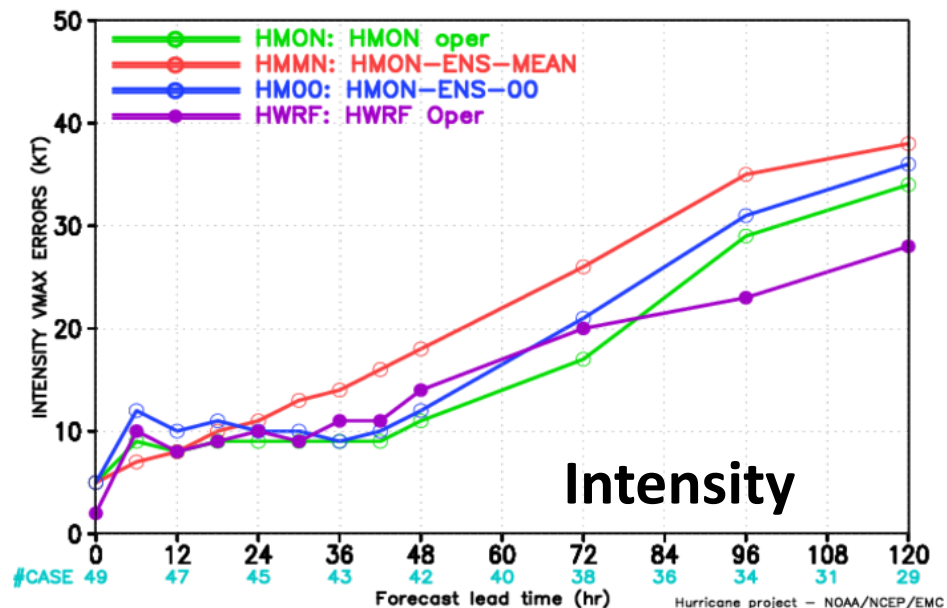
MICHAEL 14L

- oper HMON is better than control
- HMON-ENS gives better track than HMON and control.
- Intensity/bias: Oper HMON is best

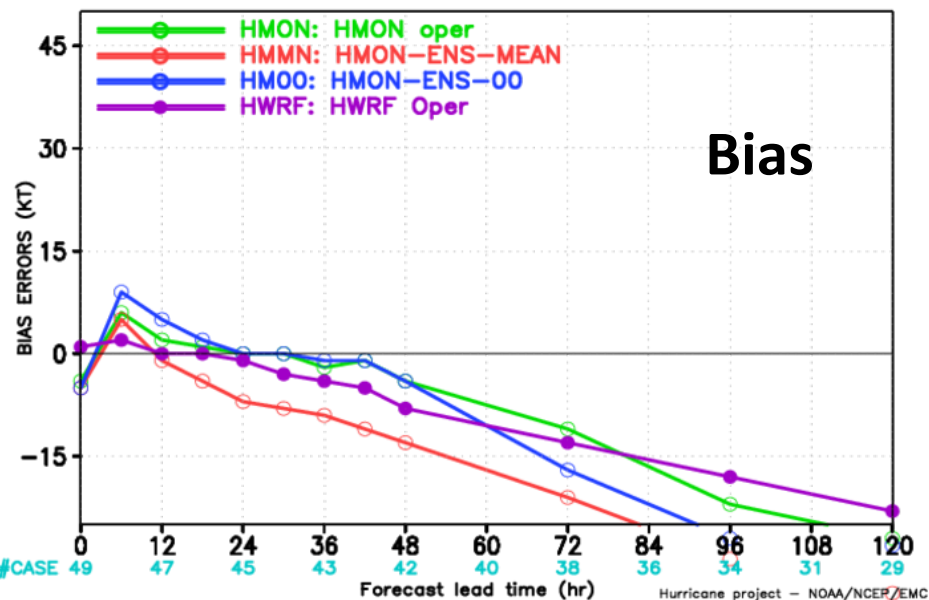
MODEL FORECAST – TRACK ERRORS (NM)
STATISTICS FOR A SINGLE STORM – ep142018_LANE



MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
STATISTICS FOR A SINGLE STORM – ep142018_LANE



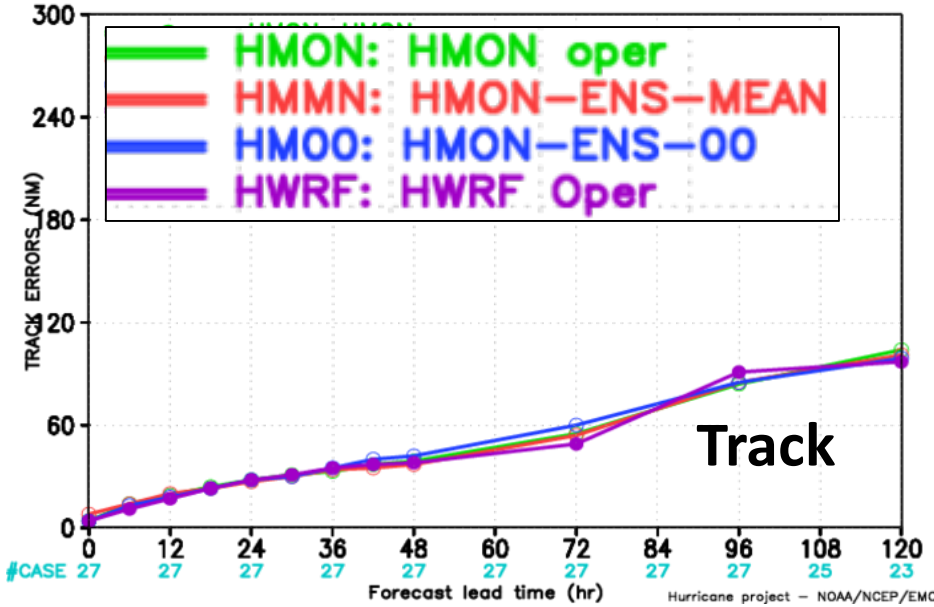
MODEL FORECAST – BIAS ERRORS (KT)
STATISTICS FOR A SINGLE STORM – ep142018_LANE



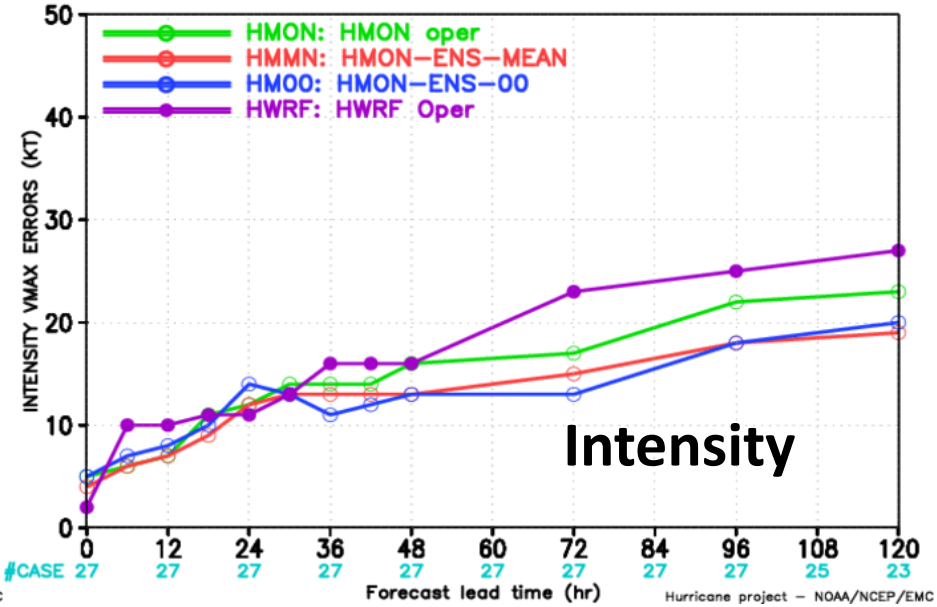
LANE, 14E

- Control is close to oper HMON
- HMON-ENS gives better track than HMON and control, HWRF.
- Intensity/bias, worse.

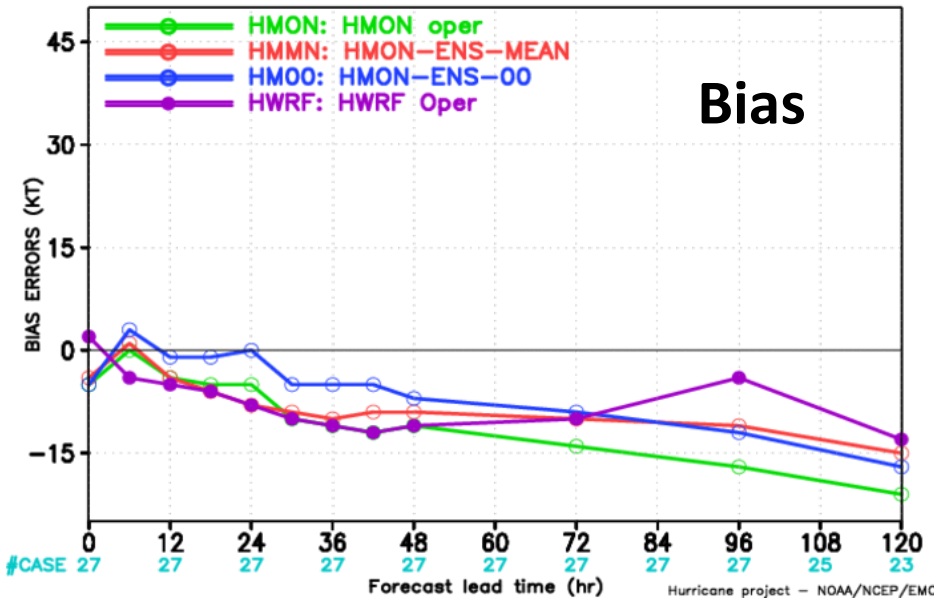
MODEL FORECAST – TRACK ERRORS (NM)
STATISTICS FOR A SINGLE STORM – ep102018_HECTOR



MODEL FORECAST – INTENSITY VMAX ERRORS (KT)
STATISTICS FOR A SINGLE STORM – ep102018_HECTOR



MODEL FORECAST – BIAS ERRORS (KT)
STATISTICS FOR A SINGLE STORM – ep102018_HECTOR



HECTOR, 10E

- Intensity/bias:
 - Control is better than oper HMON
 - ENS is close to control
- Track:
 - all are close