Performance and Verification of HWRF/HMON Ensemble Prediction System in 2017 Real time Parallel Experiment

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HFIP Annual Review Meeting, November 8, 2017

Outline

- **Background**
  - Jet real time reservations for HWRF(1+20)/HMON(1+10) ENS
  - Real time parallel for one AL storm
  - Probabilistic guidance and mean track/intensity forecasts
  - Benefits from multi-model ensembles
- **HWRF-ENS**
- **HMON-ENS**
- **Multi-model ENS**
- **Example of ENS Products**
- **Future plans**

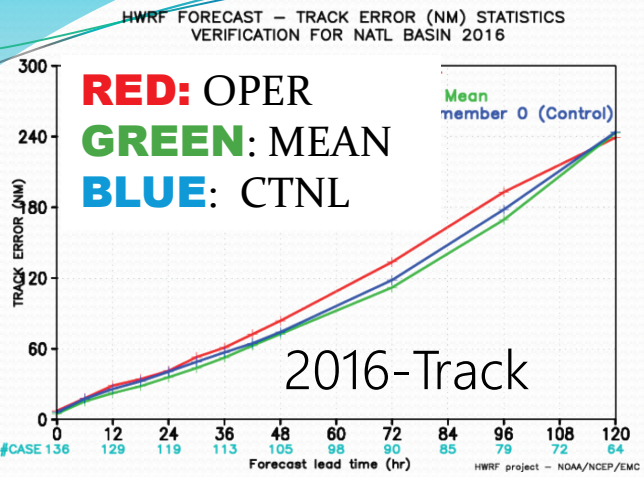
2017 HWRF Ensemble Configuration

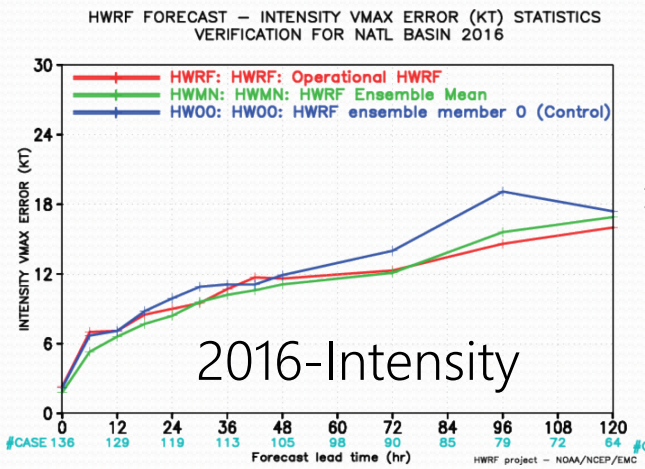
- Differences with 2017 HWRF operational configuration
  - Less horizontal resolution: 27/9/3km vs. 18/6/2km
  - Less vertical resolution: L43 vs. L75;
  - No GSI due to lack of GDAS data

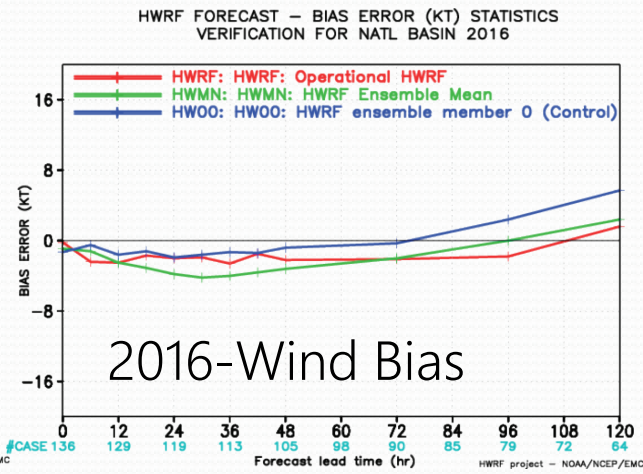
- IC/BC Perturbations (large scale): 20 member GEFS.

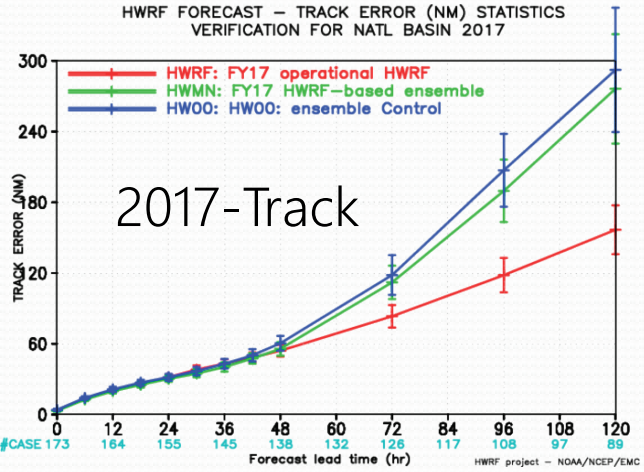
- Model Physics Perturbations (vortex scale):
  - Stochastic Convective Trigger Perturbations in SAS: -50hPa to + 50hPa white noise ;
  - Stochastic boundary layer height perturbations in PBL scheme, -20% to +20%;
  - Stochastic Cd perturbation;
  - Stochastic initial wind speed and position (TCVital) perturbations considering best track uncertainty;

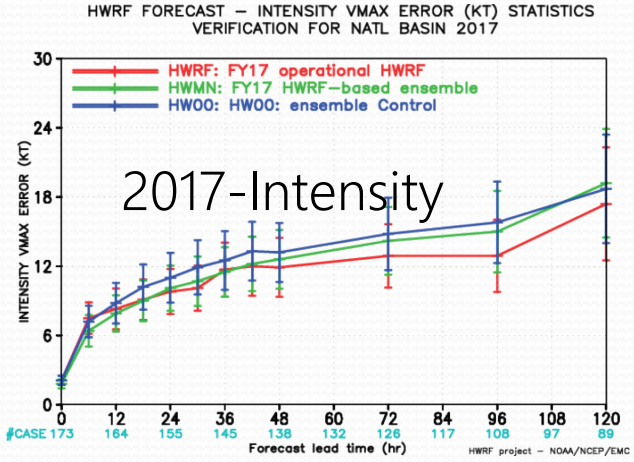
Verification: HWRF-EPS vs Deterministic HWRF at AL

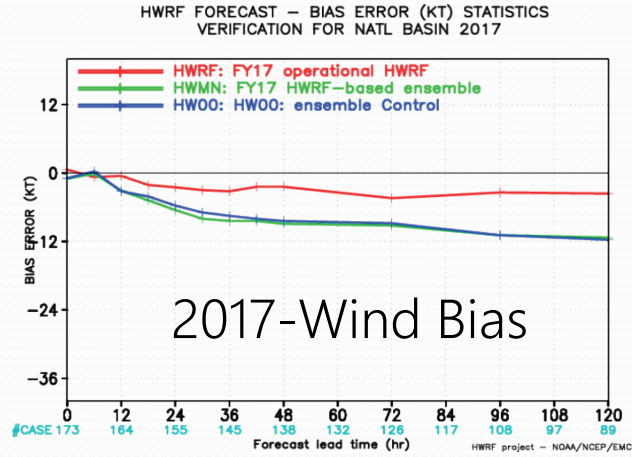












1. In the past years, HWRF EPS (at lowres) outperformed the deterministic operational model (at hires), but this year, the results are reversed;
2. As always, HWRF EPS produces better ensemble mean track/intensity forecasts than its own deterministic (control) system;

2017 HWRF Ensemble Configuration

Conclusions

- The operational 2017 HWRF performed very well due to vertical resolution increase, data assimilation upgrades, and physics upgrades;

- Different results from HWRF EPS with 2017 season which had many more cycles with stronger storms (**97/191** > 64 kts, **61/191** > 94 kts) as compared to the 2016 season;

- In future, need to run ensembles at similar resolutions as the operational configuration.

2017 HMON Ensemble Configuration

- Differences with the 2017 operational deterministic HMON model:
  - 8% smaller domains to fit Jet runtime window
  - Coupled to HYCOM ocean model

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

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

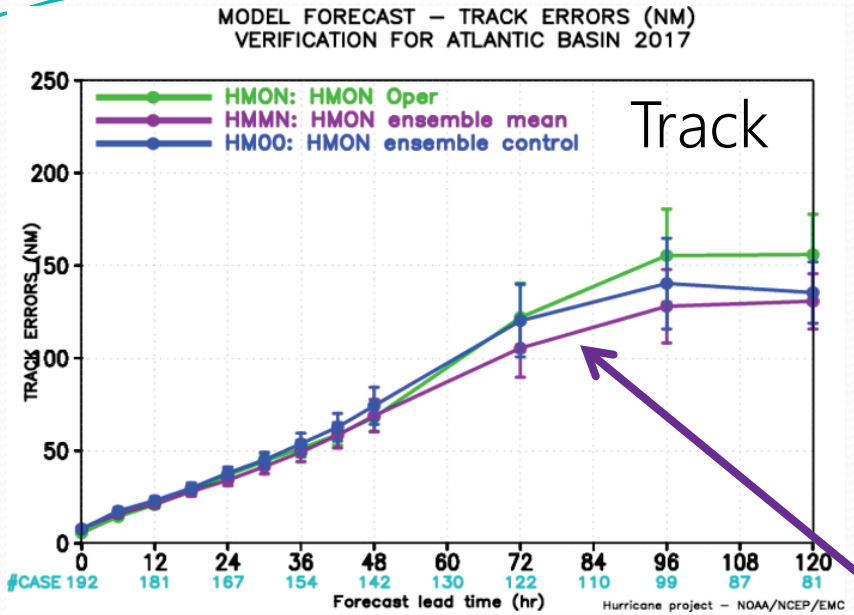
- Multi-phys Options in members:
  - Convection: BMJ, SAS, scale-aware SAS
  - PBL: GFSPBL, EDMFPBL
  - Land: GFDL, NOAH
  - Microphys: Fer_hires, WSM6
  - Surface layer: use different z0 and zt values (Cd,Ch)

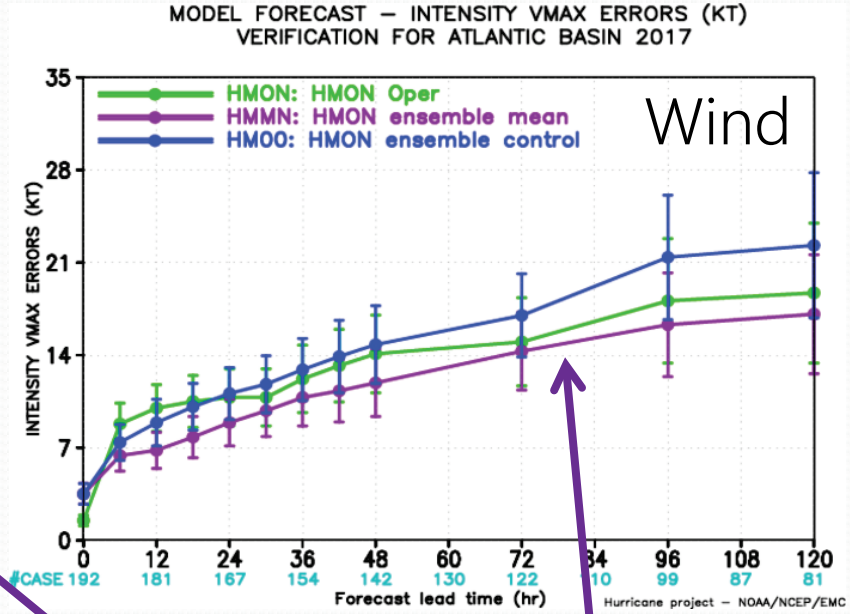
Physics options for coupled HMON ensemble members

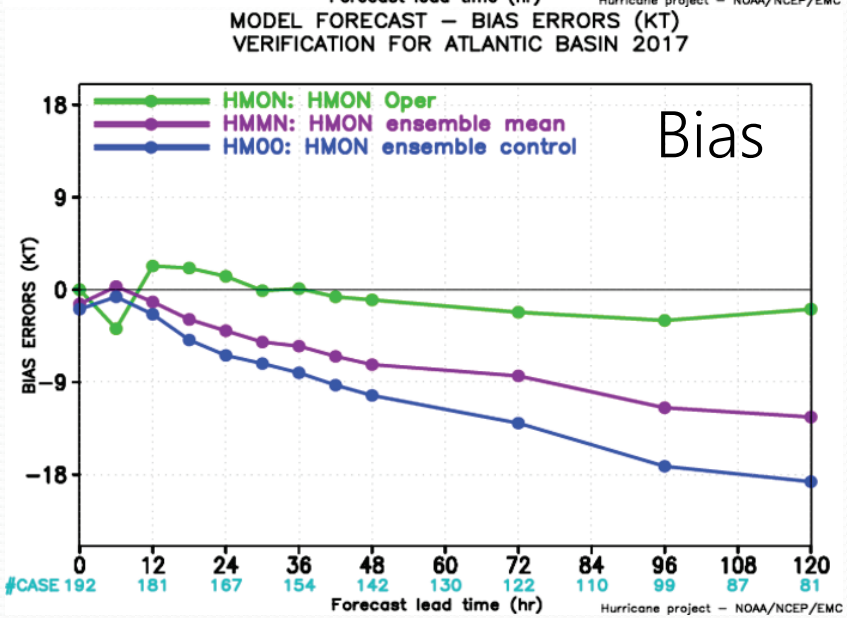
	Domains	CU	PBL	Land	Cd,Ch	MP	Spec_adv
00	D1: 431x431 D2: 219x191 D3: 361x327 NZ=42 18 Km 6 Km 2 Km	SAS	GFSPBL	NOAH	ICOEF=2	Fer_hires	No
01		Scale SAS	GFSPBL	NOAH	ICOEF=2	Fer_hires	No
02		BMJ	GFSPBL	NOAH	ICOEF=2	Fer_hires	No
03		BMJ	GFSPBL	GFDL	ICOEF=2	Fer_hires	Yes
04		SAS	GFSPBL	NOAH	ICOEF=2	WSM6	No
05		BMJ	EDMF	NOAH	ICOEF=2	Fer_hires	No
06		Scale_SAS	EDMF	GFDL	ICOEF=2	Fer_hires	
07		BMJ	EDMF	NOAH	ICOEF=2	WSM6	
08		Scale_SAS	EDMF	NOAH	ICOEF=2	Fer_hires	No
09		Scale_SAS	GFSPBL	NOAH	ICOEF=6	Fer_hires	Yes
10		SAS	GFSPBL	NOAH	ICOEF=6	Fer_hires	No

- All ensemble members are ocean-coupled while the operational HMON is uncoupled in the NATL basin

Verification: HMON-EPS vs Deterministic HMON at AL

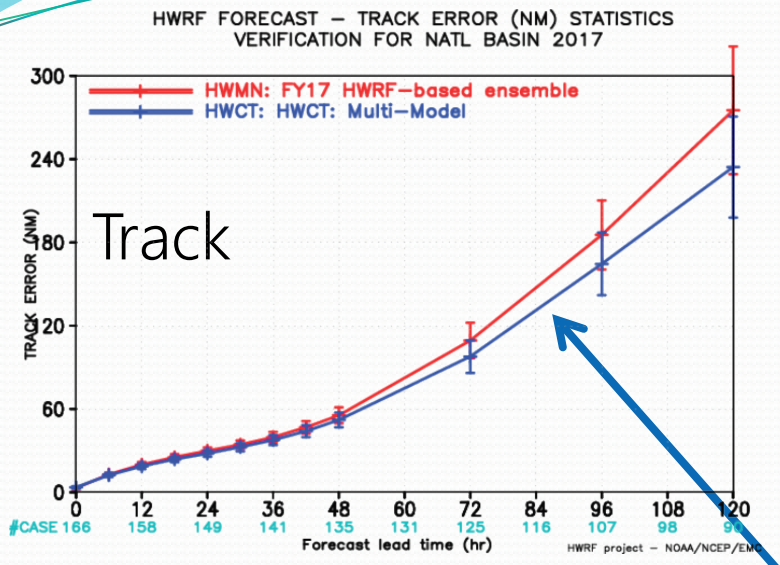


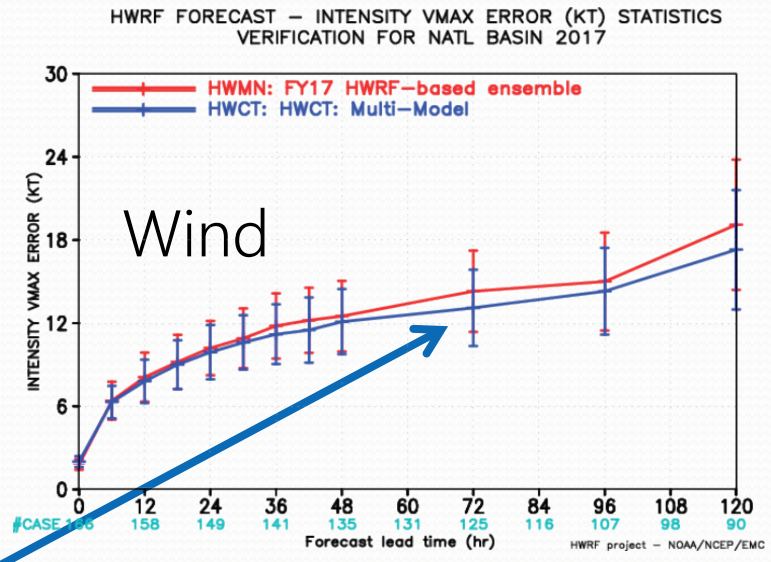




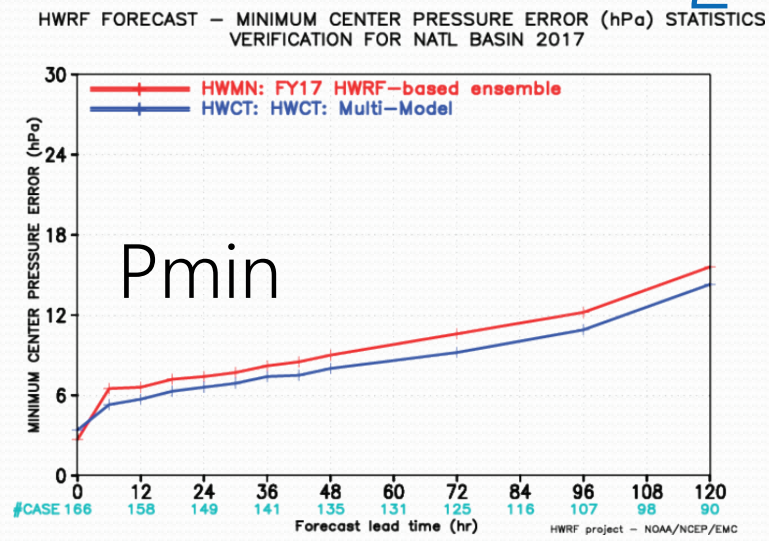
Ensemble mean

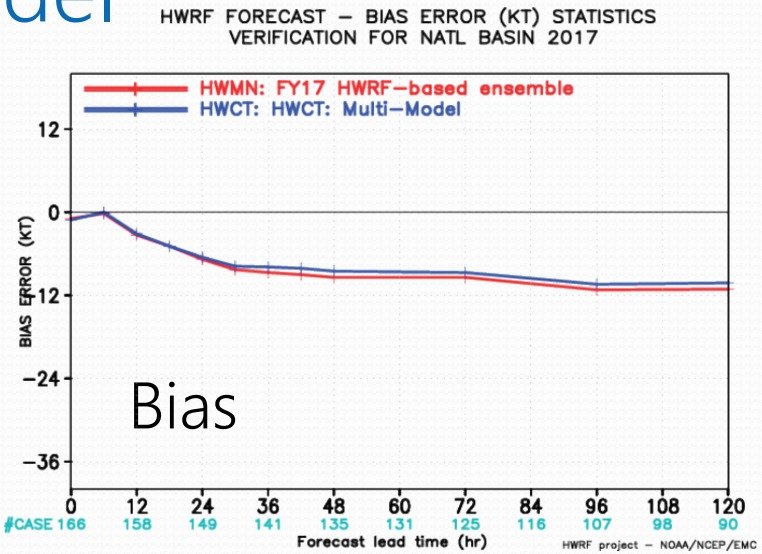
Multi-Model EPS (HWMN+CTMN)



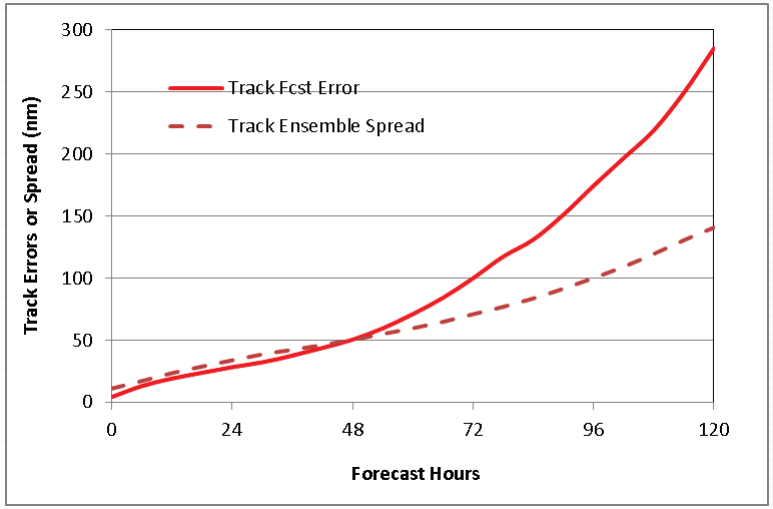


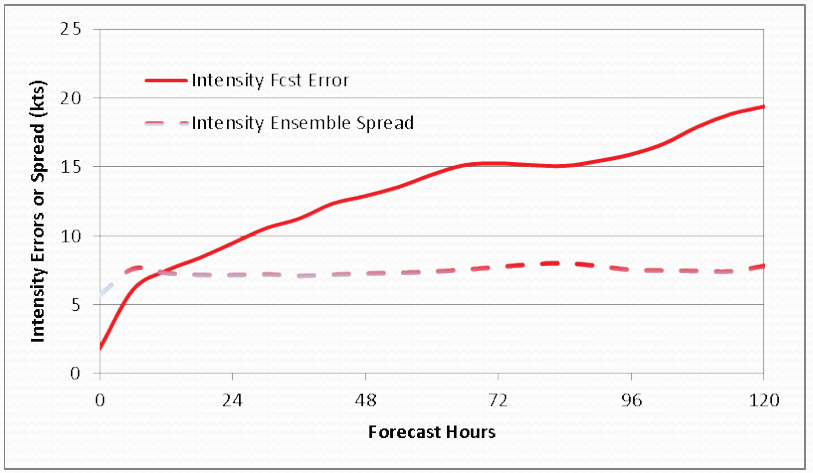
2-model

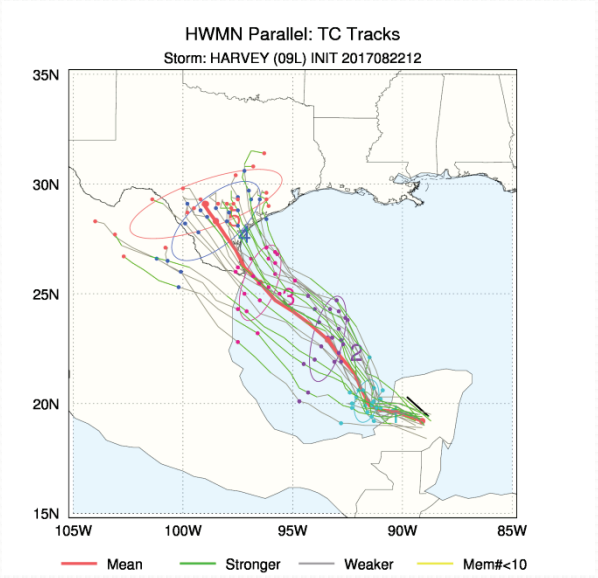


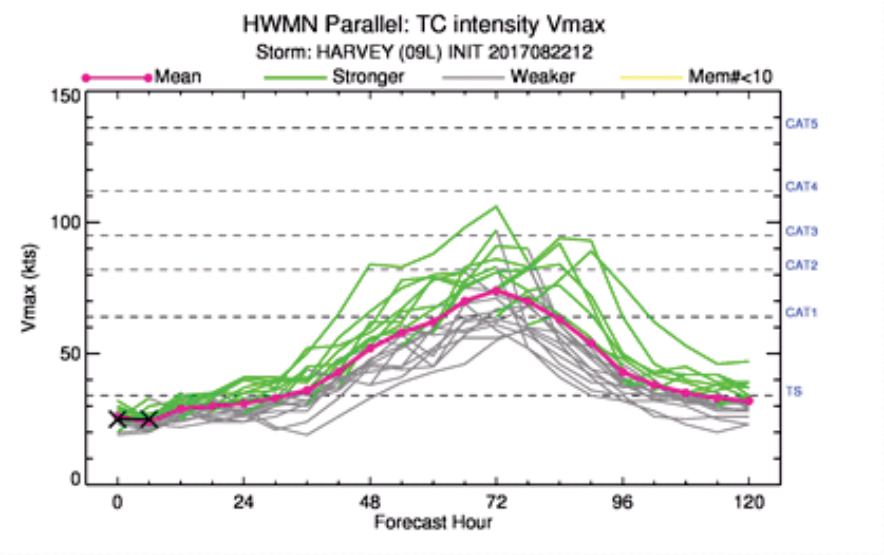


Products: HWRF-EPS Ensemble Spread



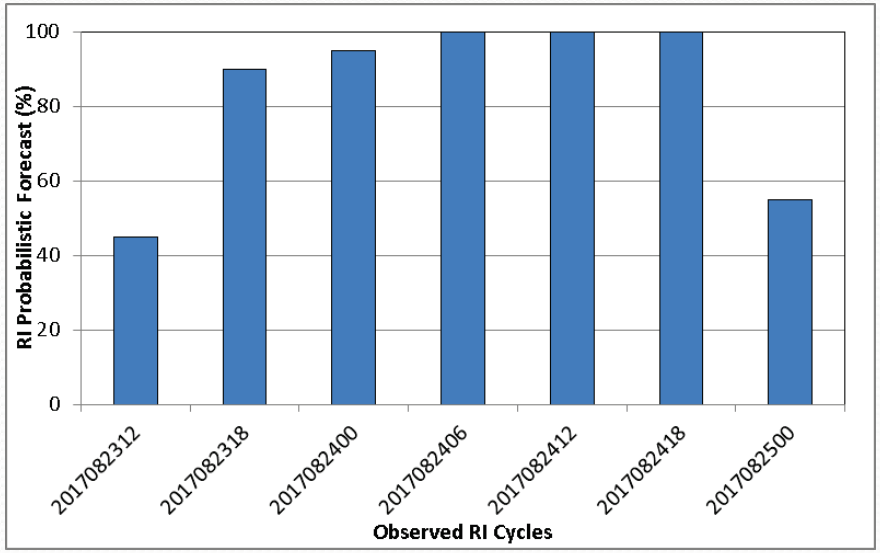






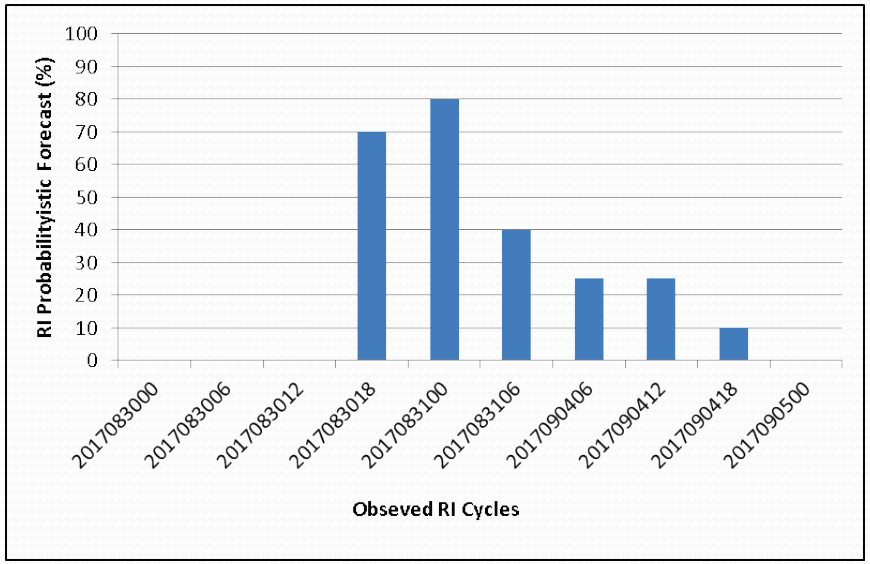
Products: HWRF-EPS Probabilistic Prediction

Harvey 09L



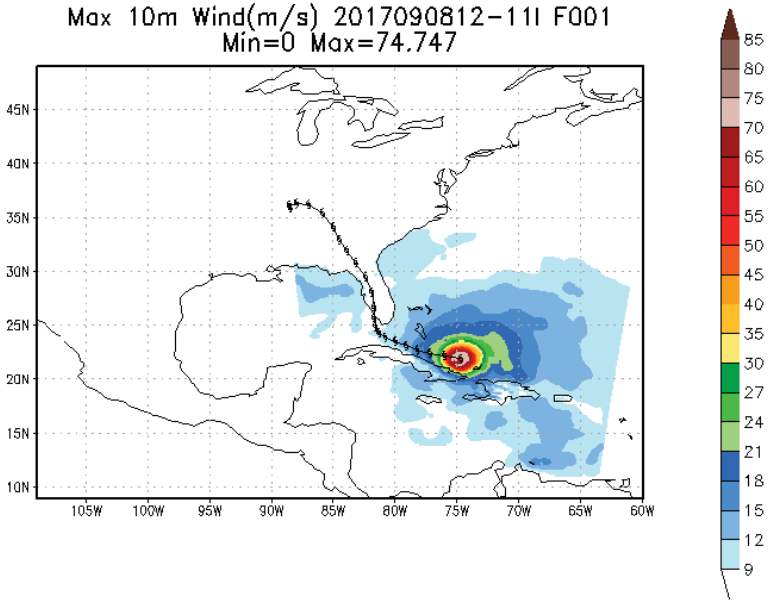
RI probability

Irma 11L

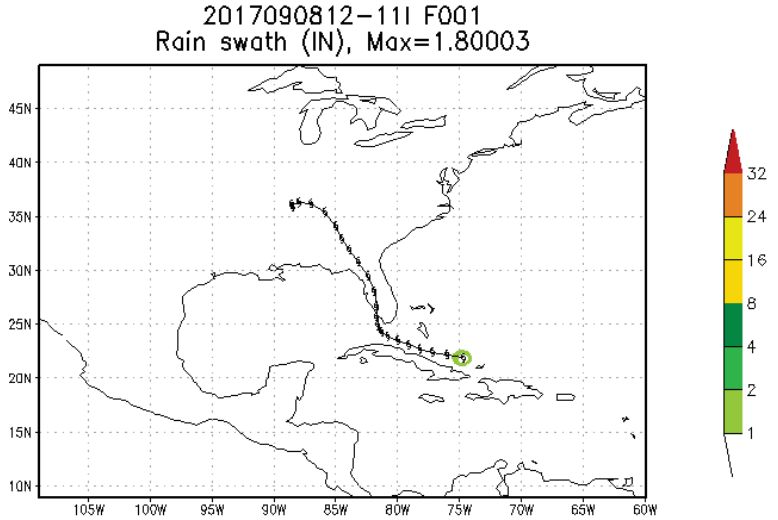


Products: HWRF-EPS Swath plots

Wind Speed at 10m



Rainfall Swath



Future Plans
HWRF/HMON based Ensemble Prediction System

- Use higher resolutions (same as deterministic model);
- Include data assimilation in ensembles;
- Improve representation of HWRF/HMON model error and initial uncertainties (SST);
- Develop more post-processed deterministic products: including median value of track/intensity, select best member to represent EPS;

Future Plans
HWRF/HMON based Ensemble Prediction System

- Develop more probabilistic products, visualization of model variable uncertainty fields;
- Continue HWRF/HMON EPS real time demo, distribute track/intensity forecasts via a-deck files;
- Combined HWRF/HMON/COAMPS-TC multi ensemble system;
- Run 10 member HMON/HWRF-based EPS operationally in 2019