ADAPT/PSU EnKF Systems for Hurricane Joaquin (al112015)

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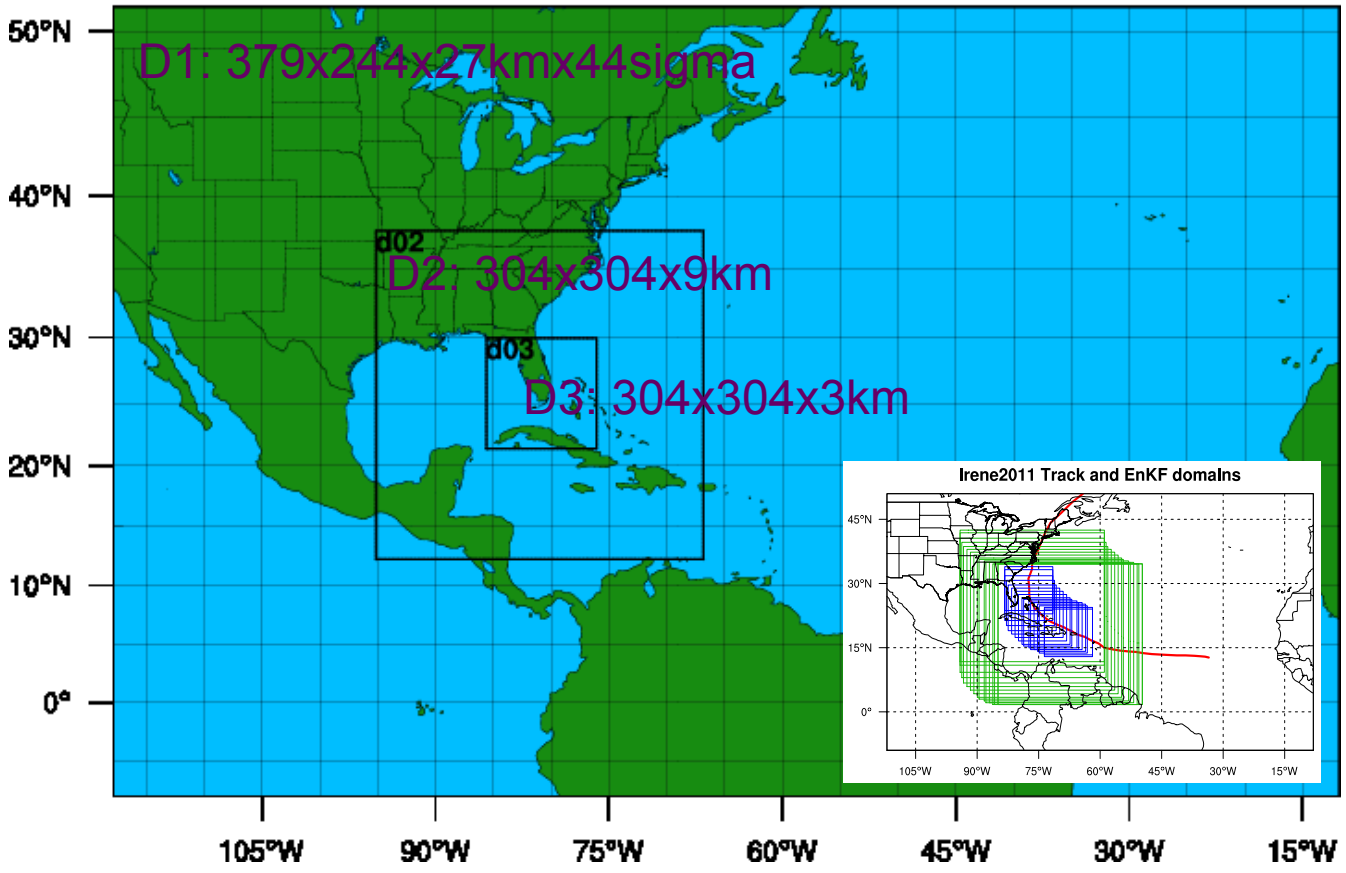
12/11/2015

ADAPT/PSU Hurricane Systems

- TWO systems in 2015
  - APSU: ARW-EnKF.
    - Operated in real-time since 2008: cold-start, only TDR;
    - Storm-life cycling since 2011: all conventional, Recon and satellite derived obs;
    - Developed into a unify system in 2014.
  - HPSU: HWRF-EnKF
    - Quasi-realtime in 2015.

APSU real-time configurations



ARW	V3.4.1
Cumulus	Grell-Devenyi ensemble (27 km domain only)
Microphysics	WSM 6-class graupel
PBL	YSU
Surface Layer	Monin-Obukov
Land Surface	thermal diffusion
Radiation	Rrtm / Dudhia
Air-sea flux	Green and Zhang
Ocean	1-D

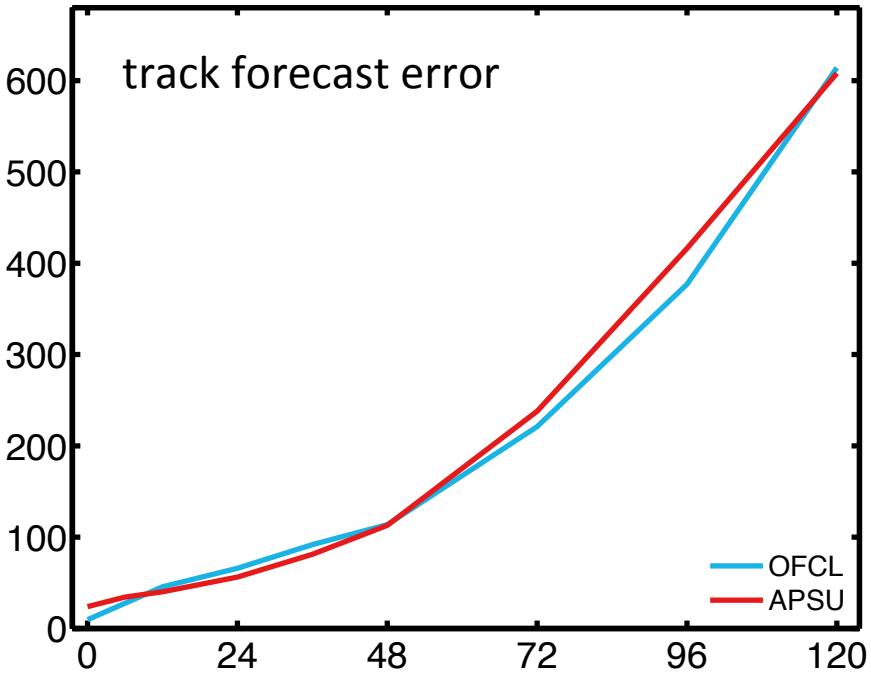
- 60-member ensemble
- Gaspairi & Cohn 99' covariance localization with varying RoI
- IC & BC: GFS using 3DVAR background uncertainty
- Hourly assimilation with TDR over all 3 domains

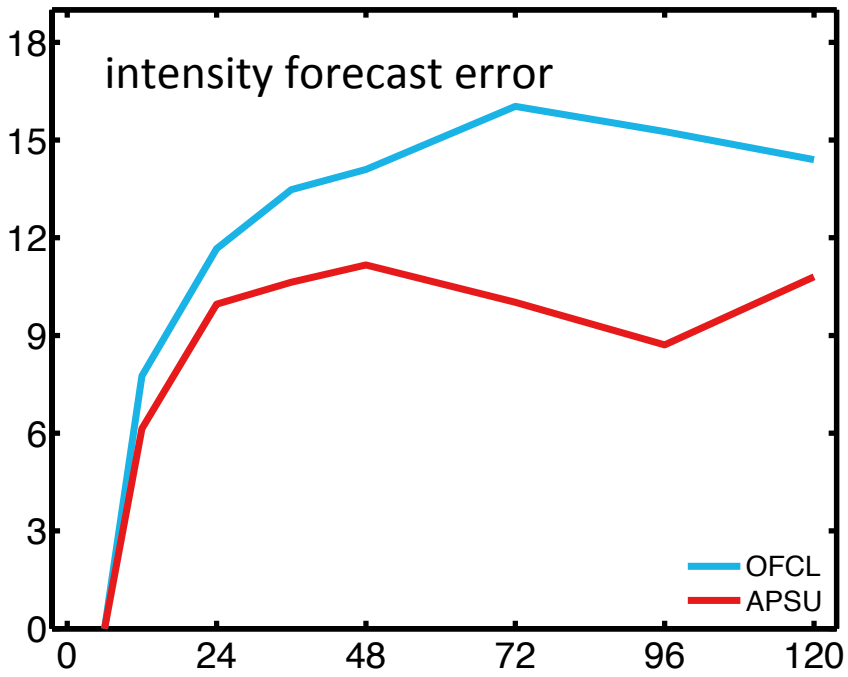
ATCF IDs:

APSU: stream 1.5, ARW 3-km deterministic forecast;

PS01-10: stream 2.0, ARW 3-km ensemble forecasts.

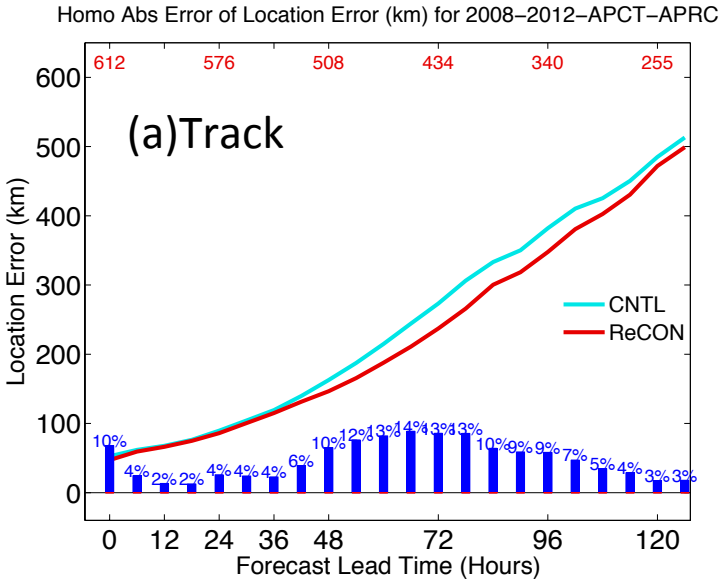
APSU Performance Verification over 2008-2012 all 112 NOAA TDR Cases with the 2012 Real-time System

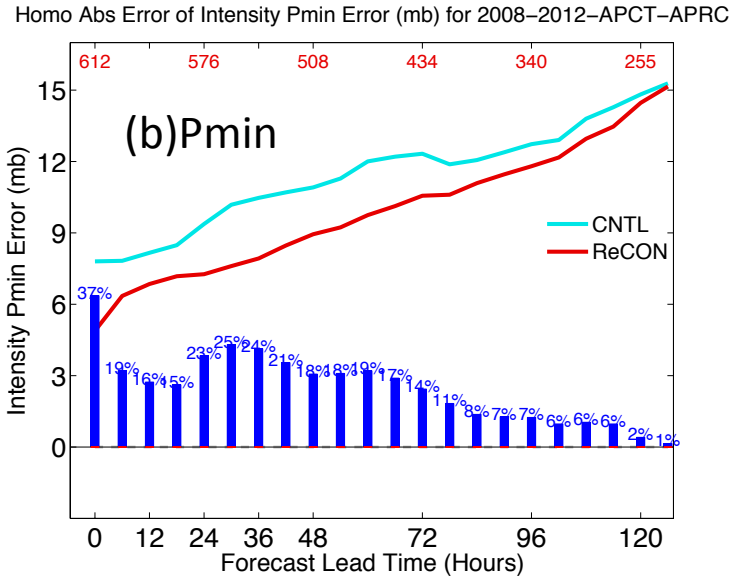




(Zhang and Weng, 2015 *BAMS*)

APSU with Recon Obs





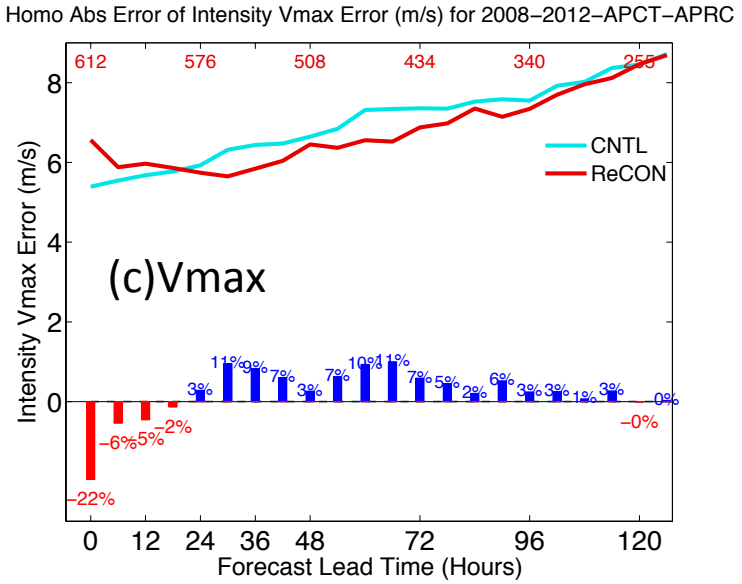
Mean absolute forecast error homogeneously averaged over all 636 APRC cases during 2008-2012 for APCT (cyan) and APRC (red) for:

(a) the track position error (km);

(b) minimum sea level pressure (mb) and;

(c) the 10-m maximum wind speed (m s^{-1}).

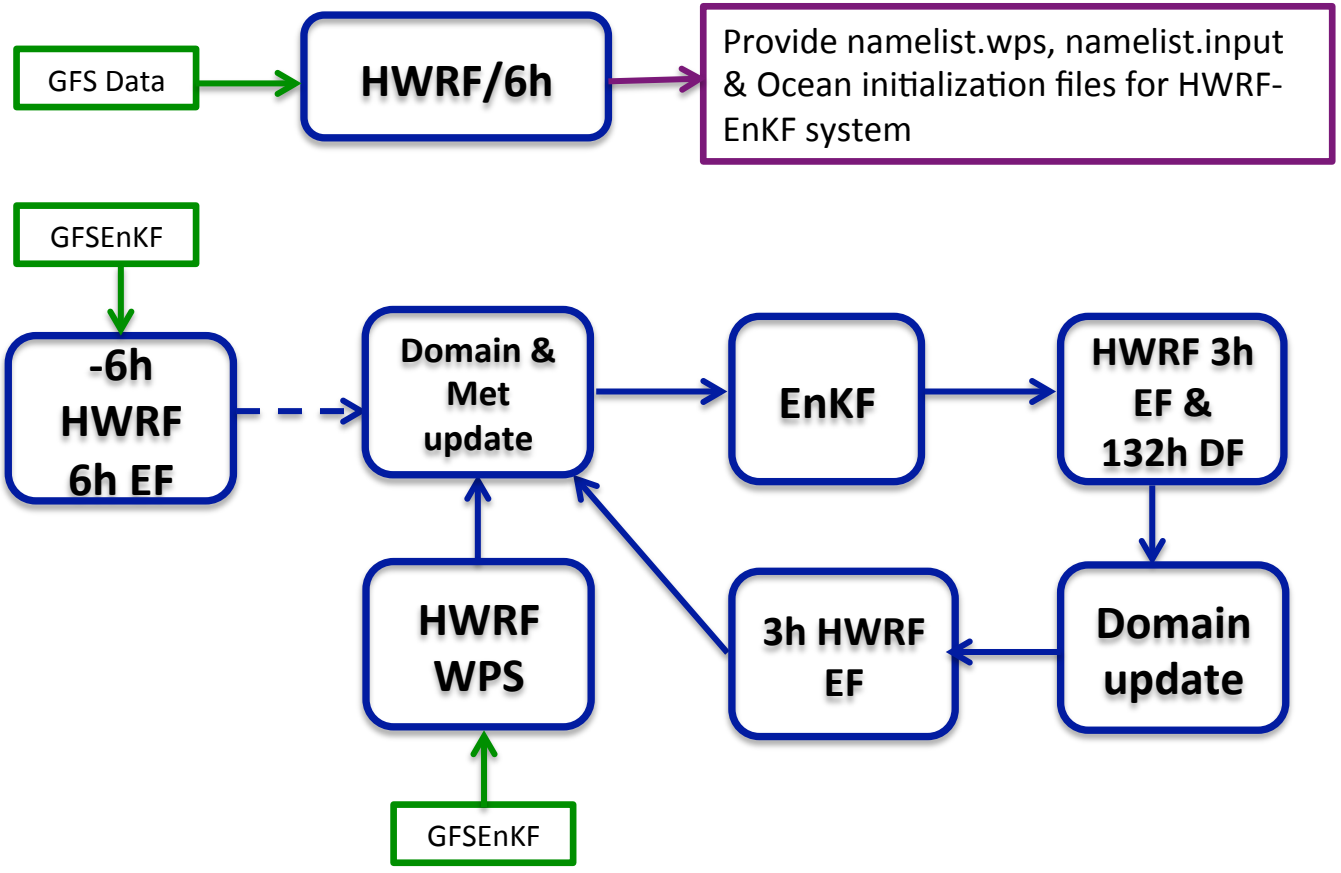
The blue bar on the bottom of each panel means the improvement of APRC in percent over APCT, while the red bar means APRC is worse than the APCT. The numbers of homogeneously samples are list on the top of each panel.



HPSU System

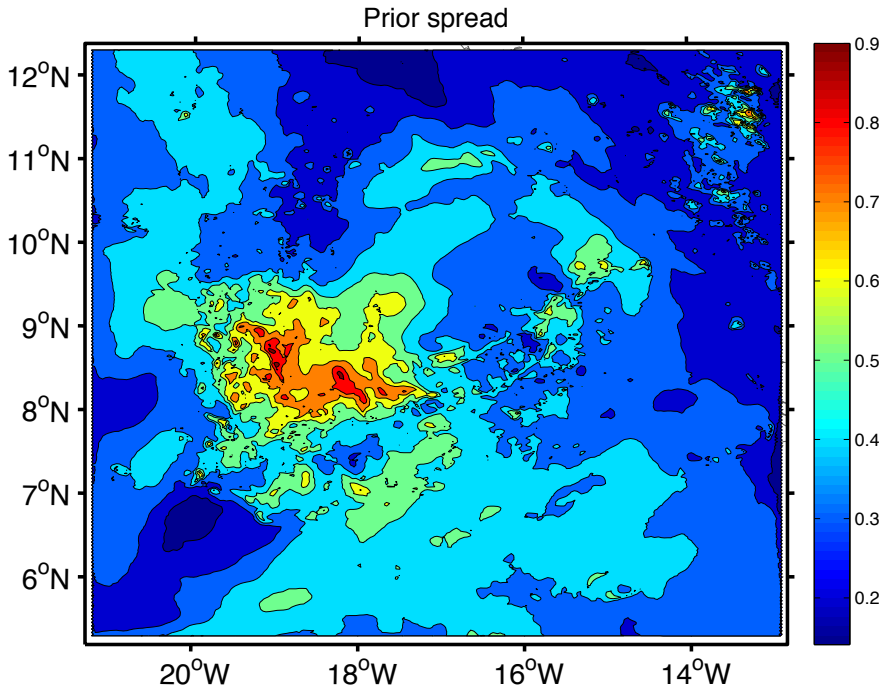
- Based on HWRF (or NMM)
  - No convert or interpolation from/to other map projection, coordinates and variables;
  - Can be started from any HWRF/NMM runs
    - w/ or w/o GSI; w/ or w/o ocean
- EnKF is fully functioned as PSU WRF-EnKF
  - Fully parallel, member+domain parallel;
  - Currently can digest GTS, Tcvitals, sat winds;
- Cycling system
  - The system will be initialized at the very begging of the storm, after spin-up, the system will run data assimilation every 3 hours till the end of the storm;
- Initialized with GDAS-EnKF 80 perturbations

HPSU Work Flow

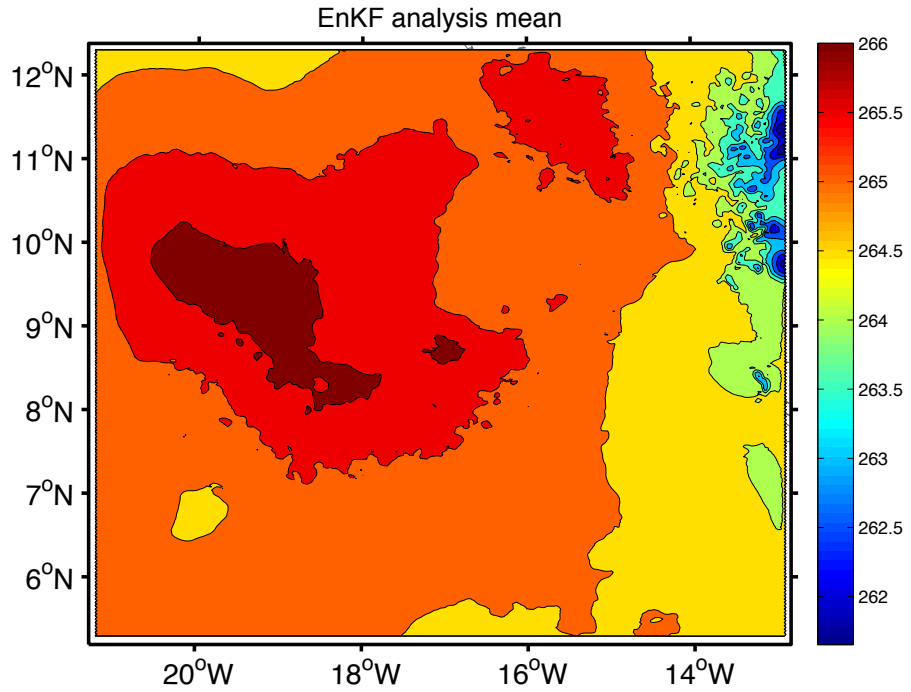


HWRF-EnKF analysis: 1 obs test

1 temperature obs
@ (9.1N;17.1W;500mb), in the inner domain (x=103.5; y=176; z=35.48)
To=265.1; O_err=0.42;
Tb=264.1; prior spread=0.42



Prior spread
T @ 35th sigma level



EnKF analysis
T @ 35th sigma level

HWRF-EnKF increments: 1 obs test

1 temperature obs
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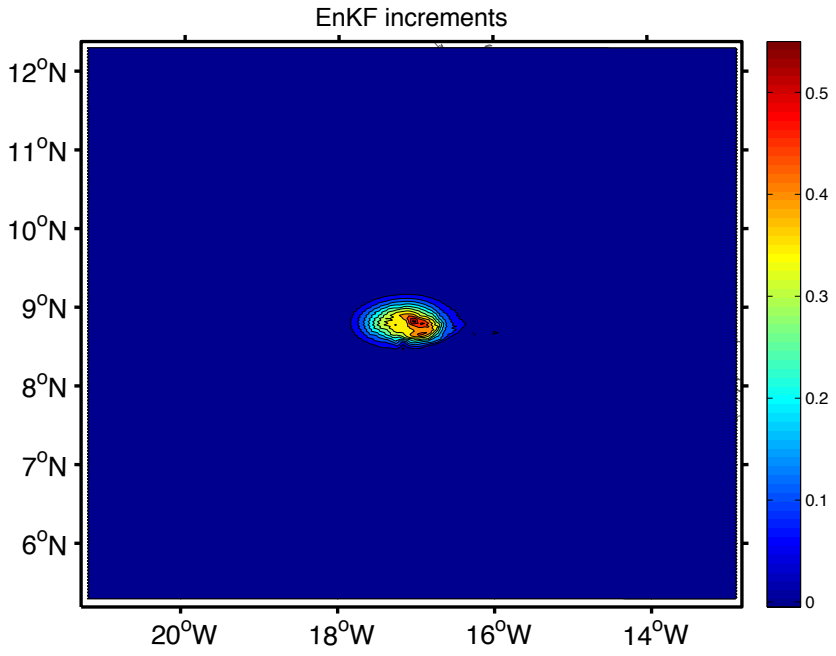
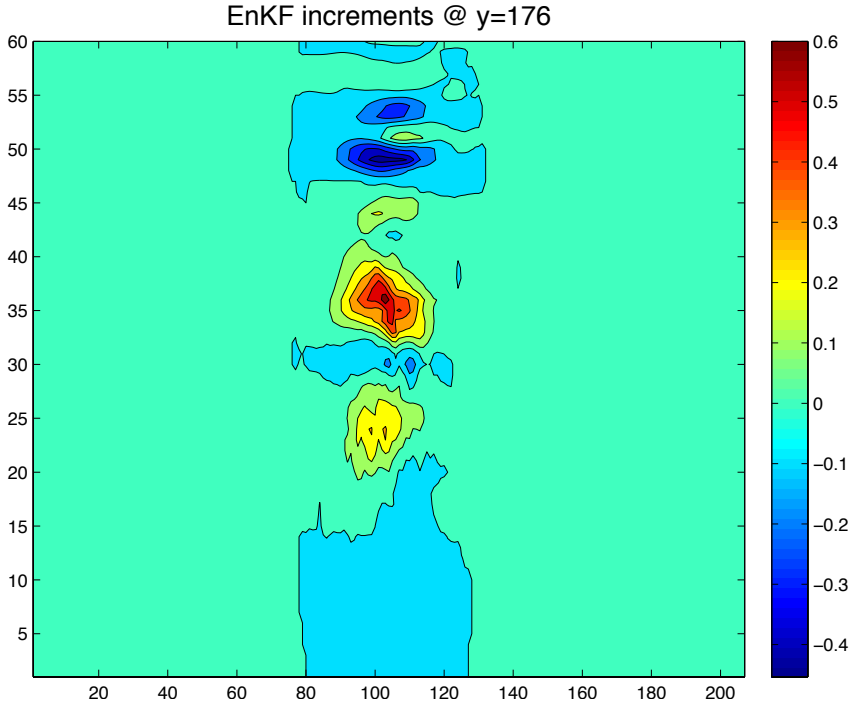
Tb=264.1; prior spread=0.42

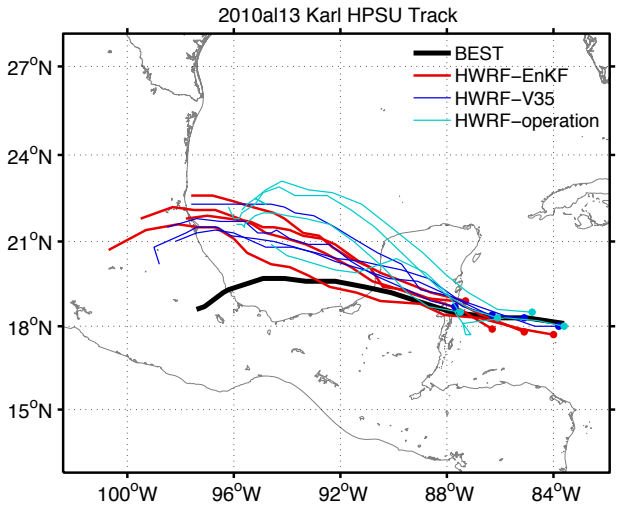


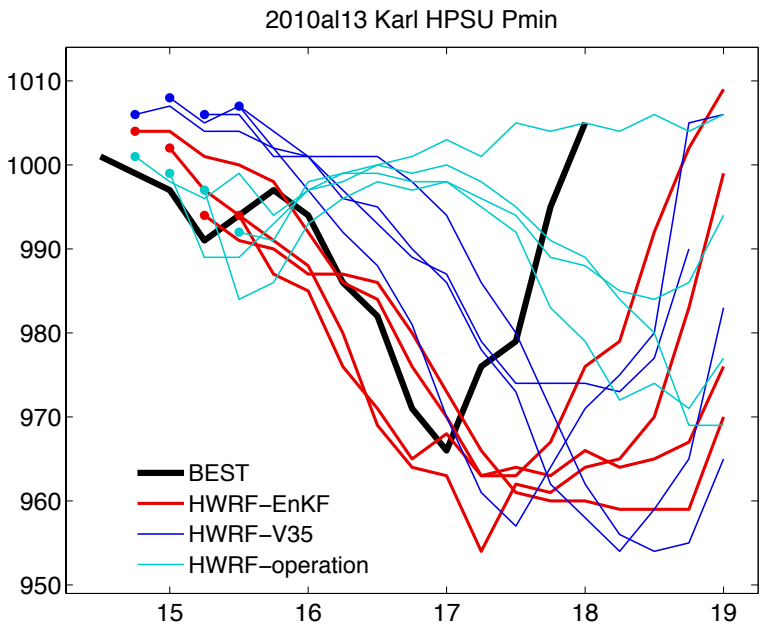
Horizontal increment
T @ 35th sigma level

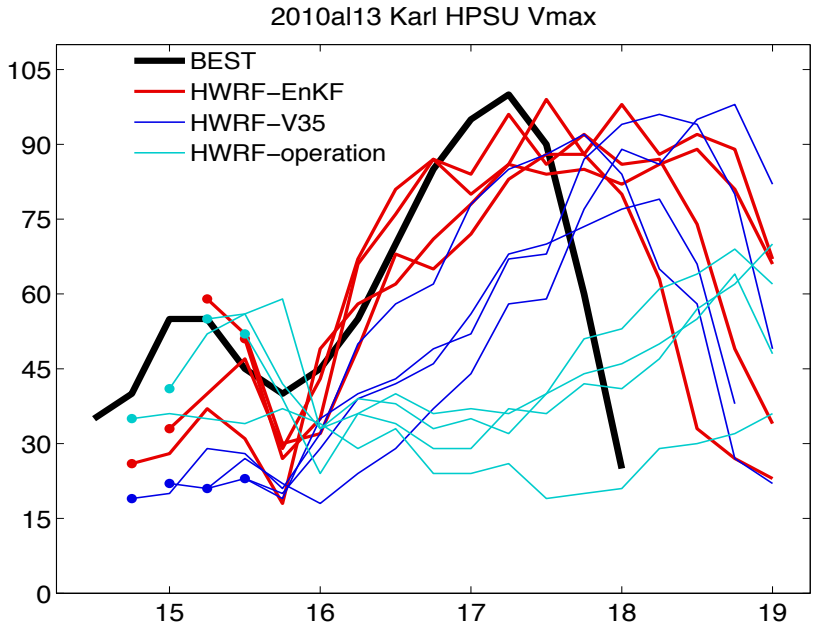


EnKF increments
T @ y=176

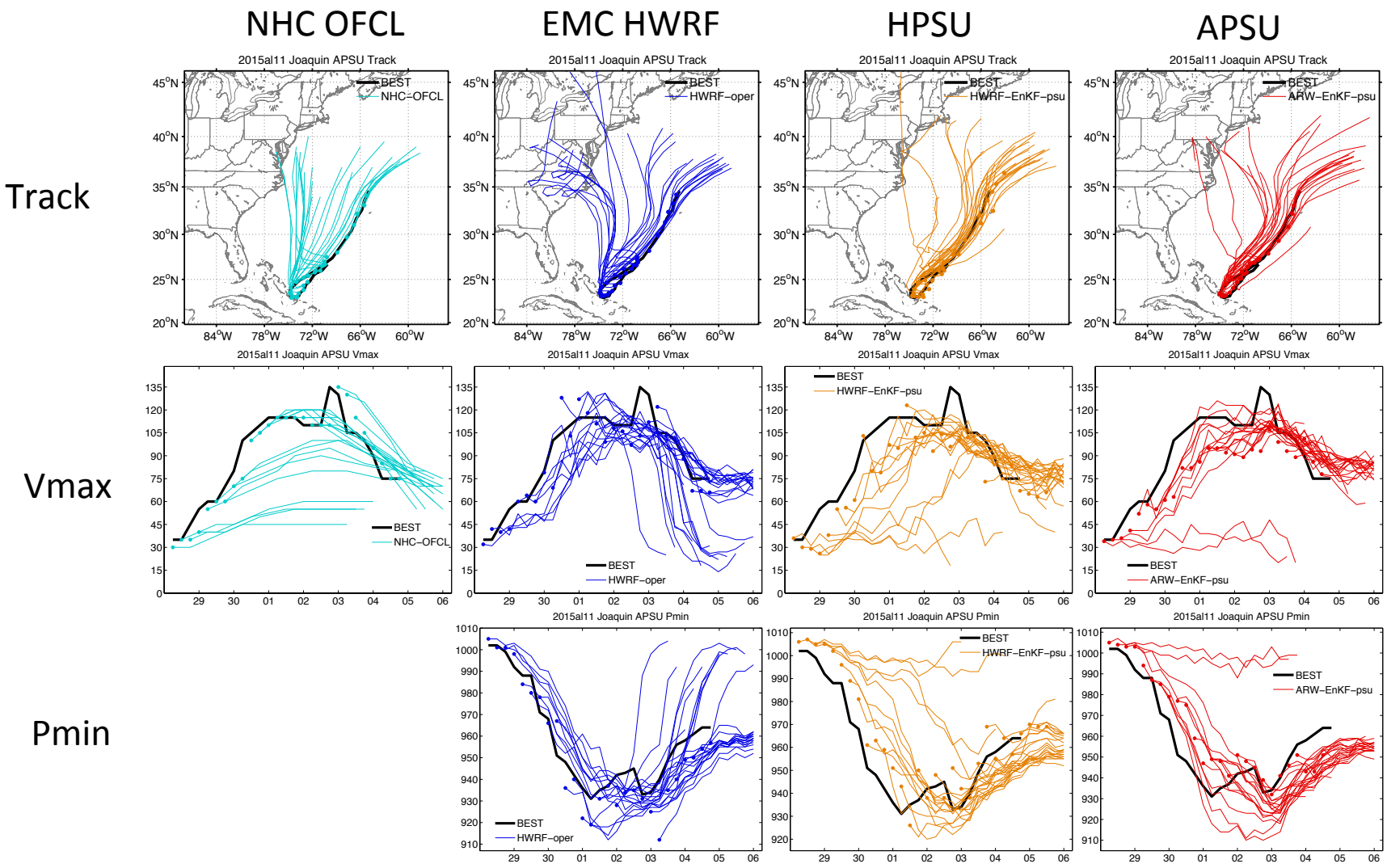
HWRF-EnKF Tests for Karl (2010)





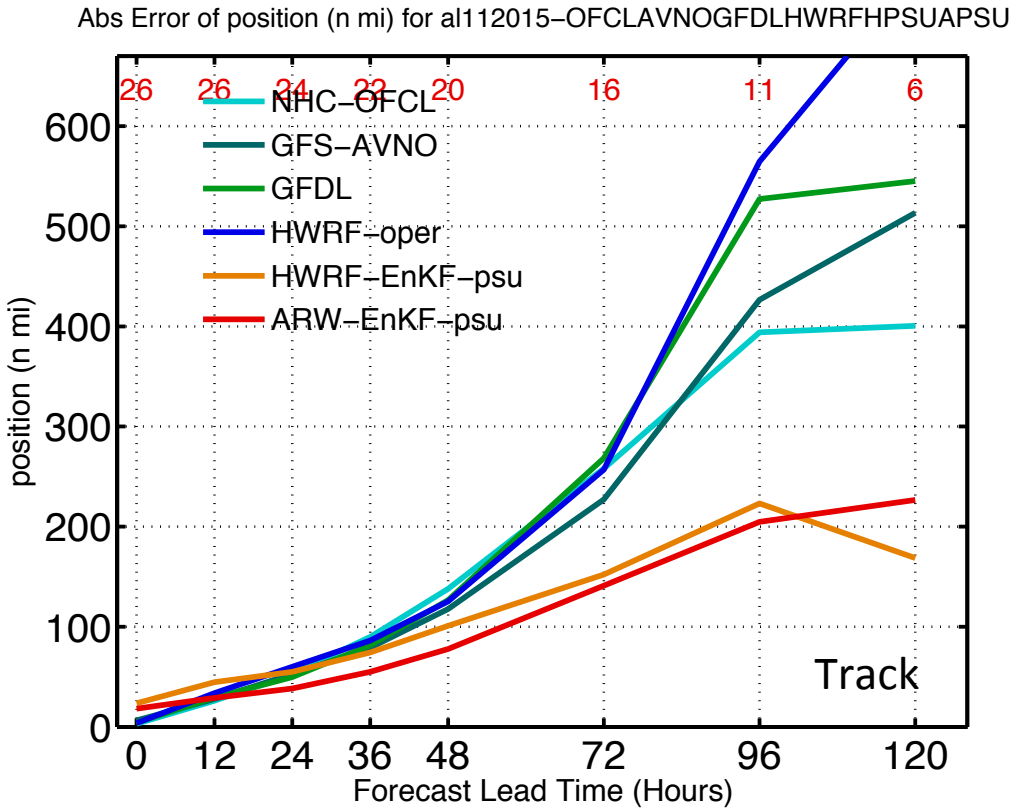


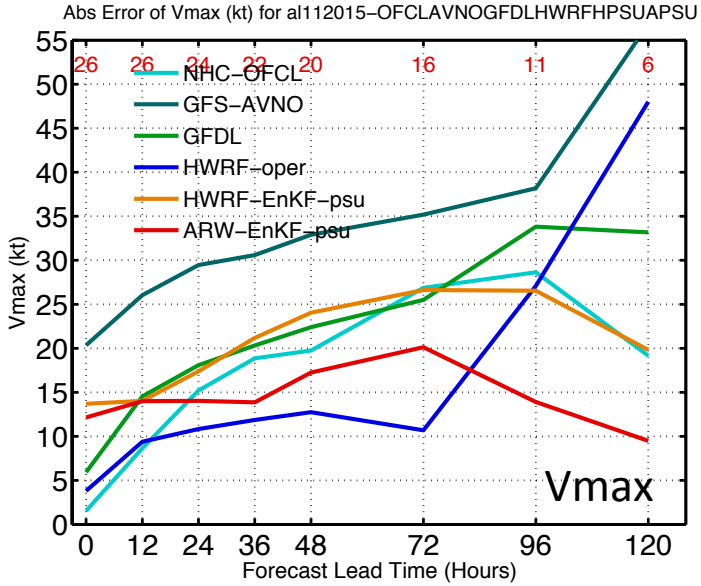
Realtime for Joaquin: track & intensity

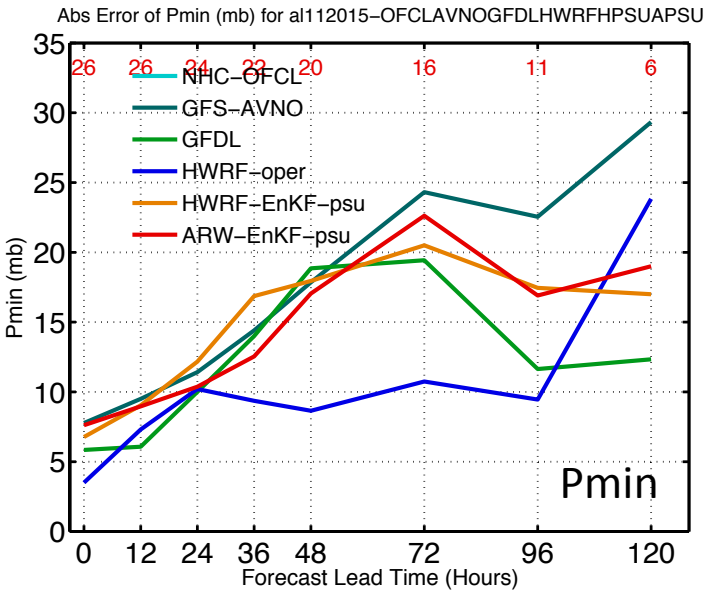


- Initialized at 12Z Sep. 28, 2015 with GDAS analysis and its 80 perturbations;
- Cycling every 6h started at 18Z Sep. 28 and ended at 00Z Oct. 6;
- All conventional observations including Recon, satellite derived winds were assimilated.

HWRF-EnKF realtime for Joaquin： errors

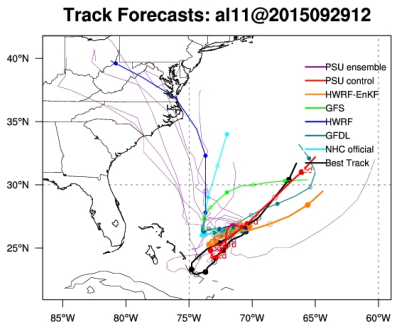


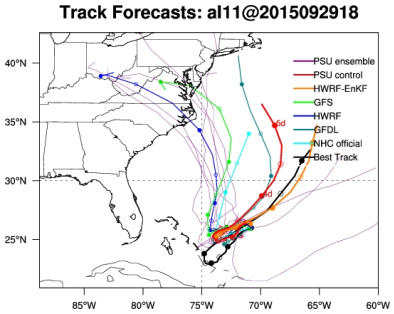


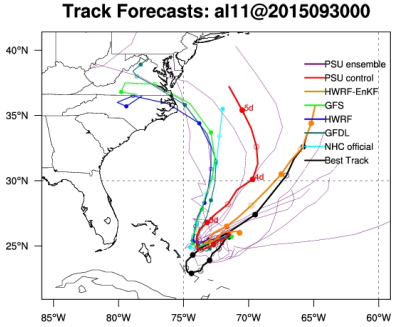


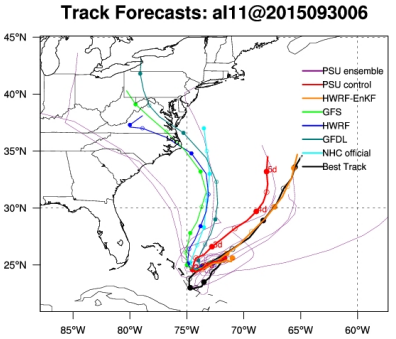
Realtime products for Joaquin

Track









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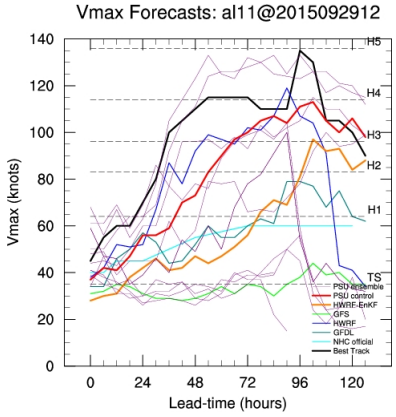

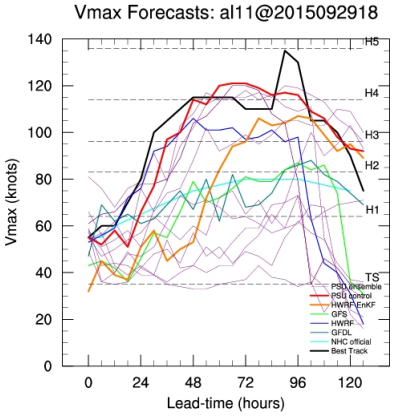

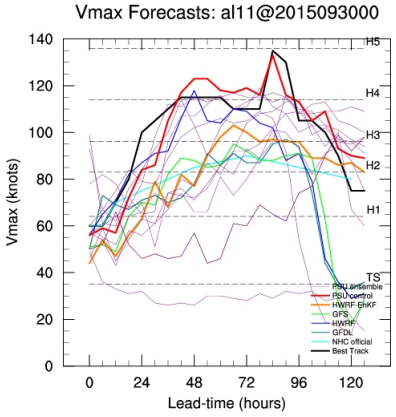

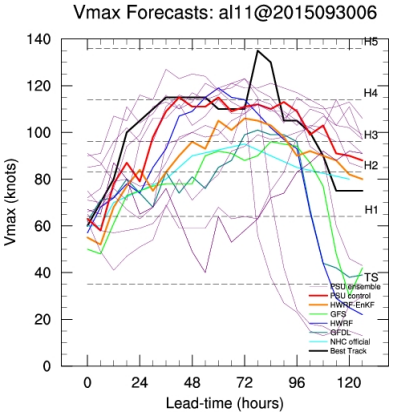

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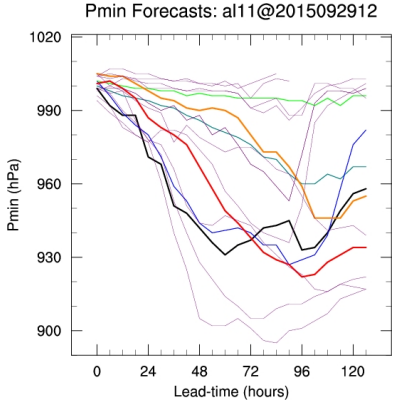

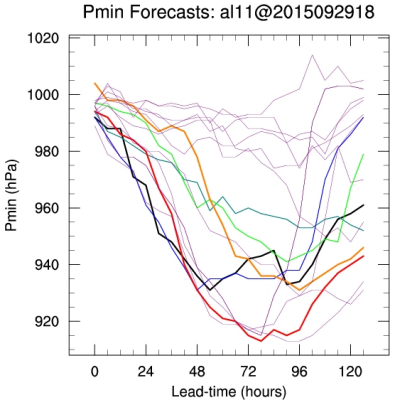

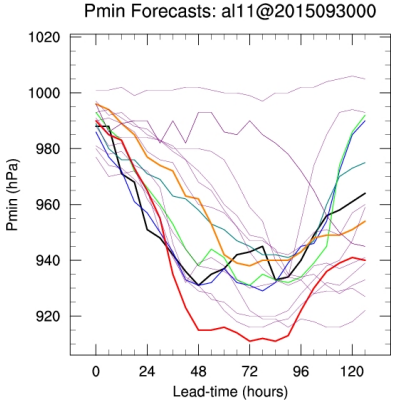

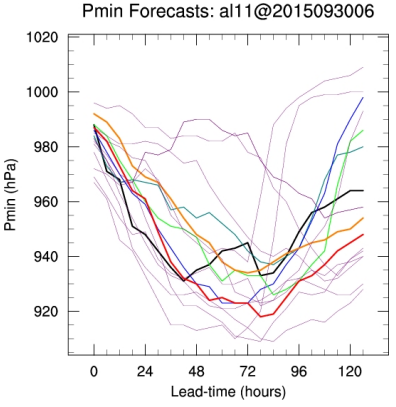

http://hfip.psu.edu/realtime/AL2015/forecast_track.html

Ensembles at 12Z 29 Sept.

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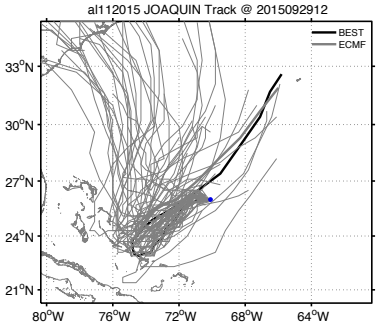
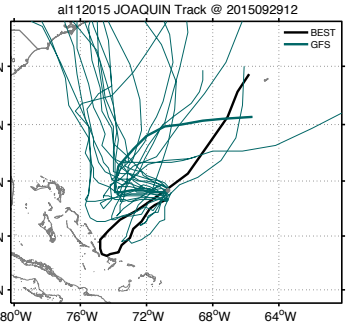
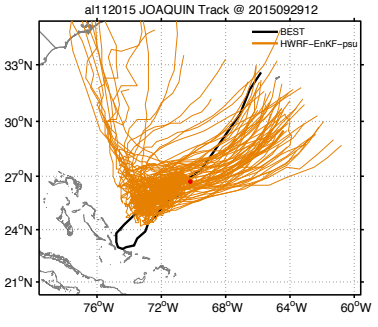
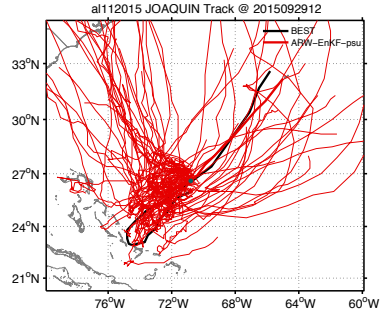
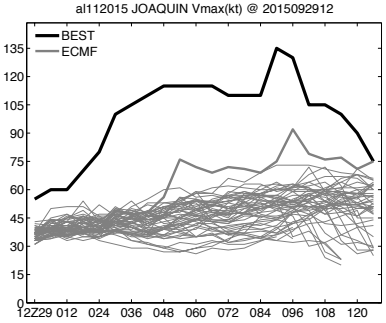
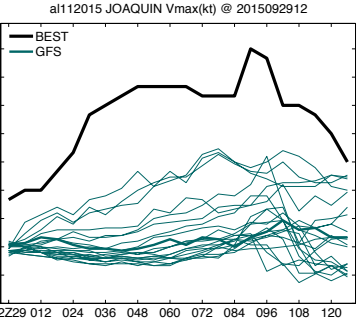
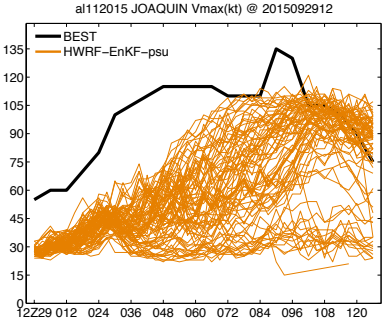
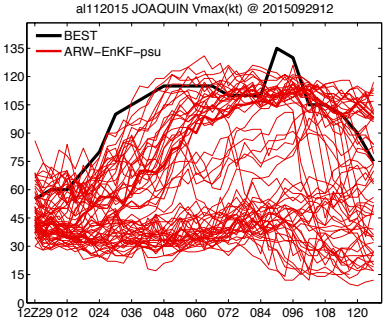
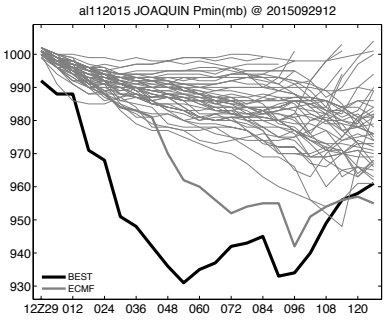
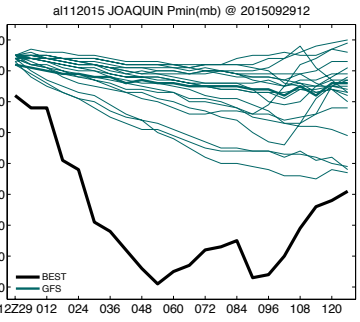
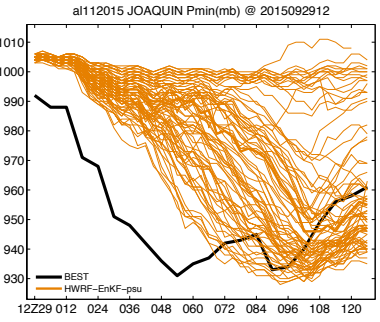
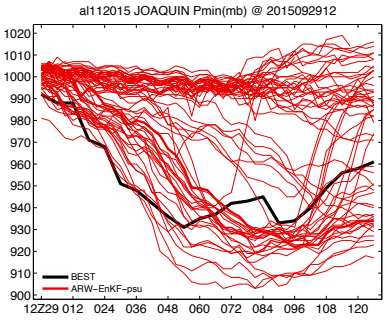
Track				
Vmax				
Pmin				

Ensembles at 00Z 30 Sept.

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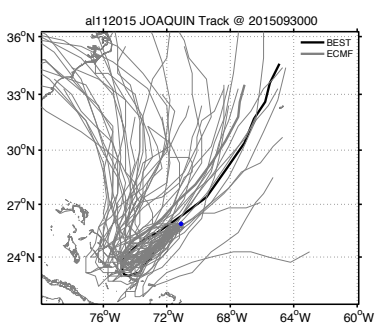
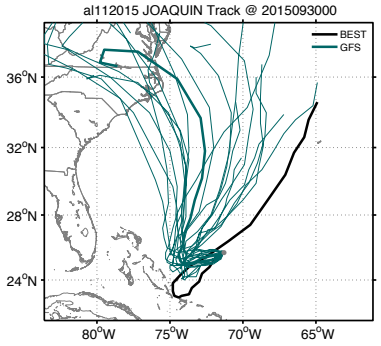
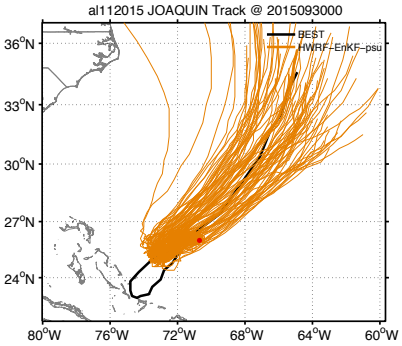
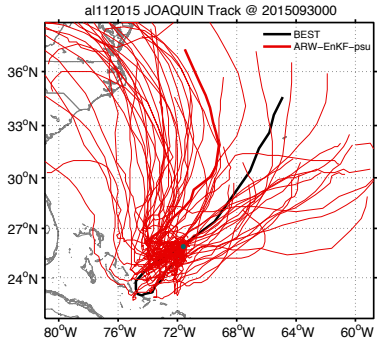
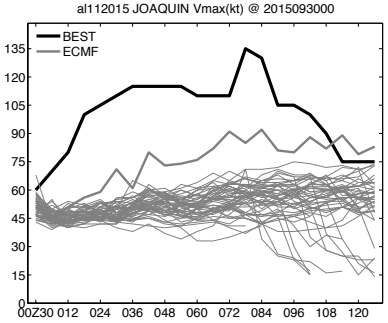
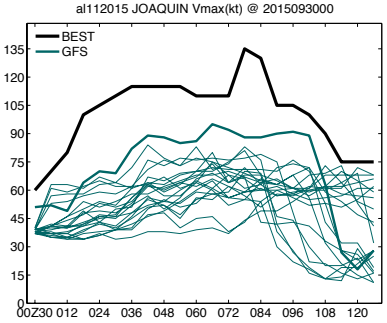
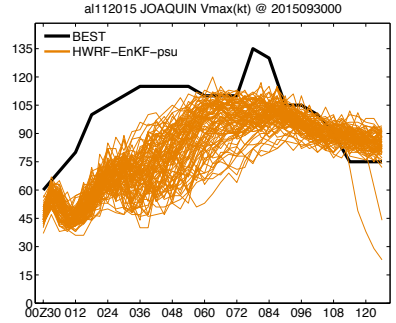
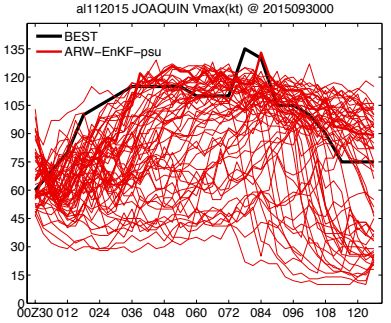
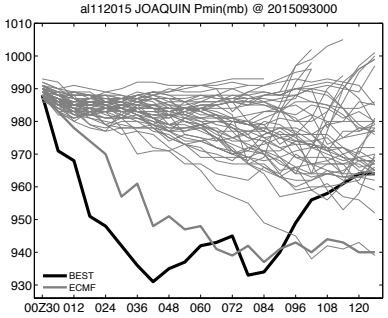
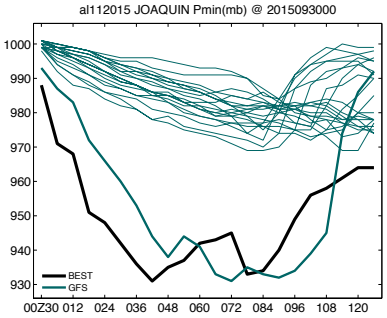
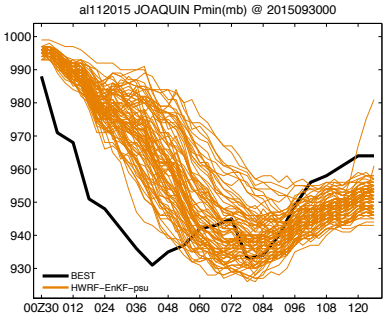
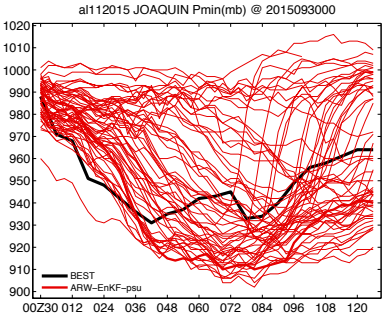
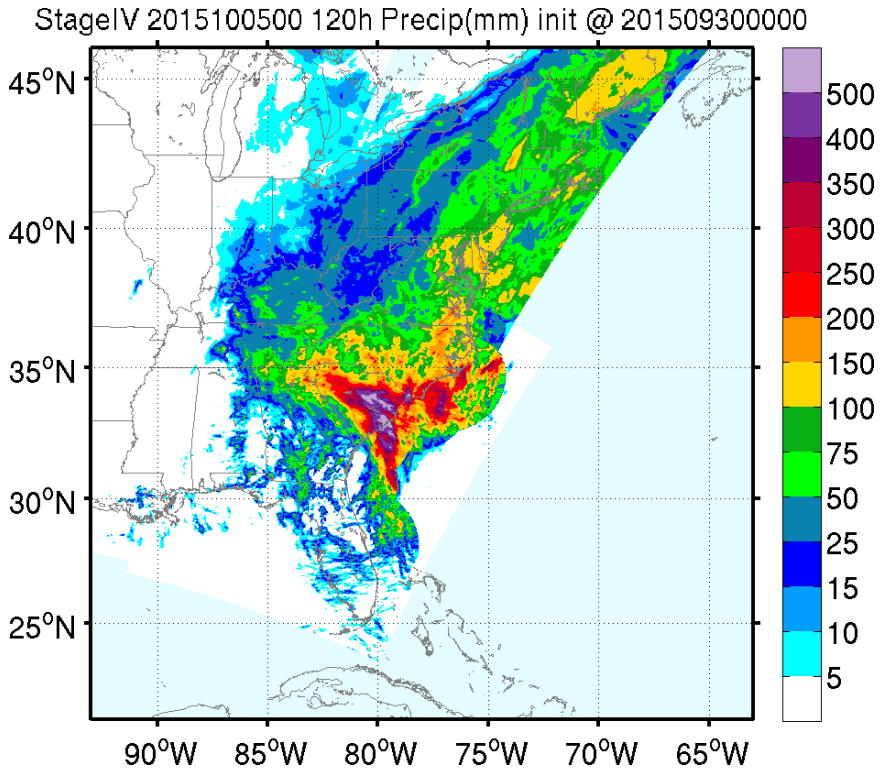
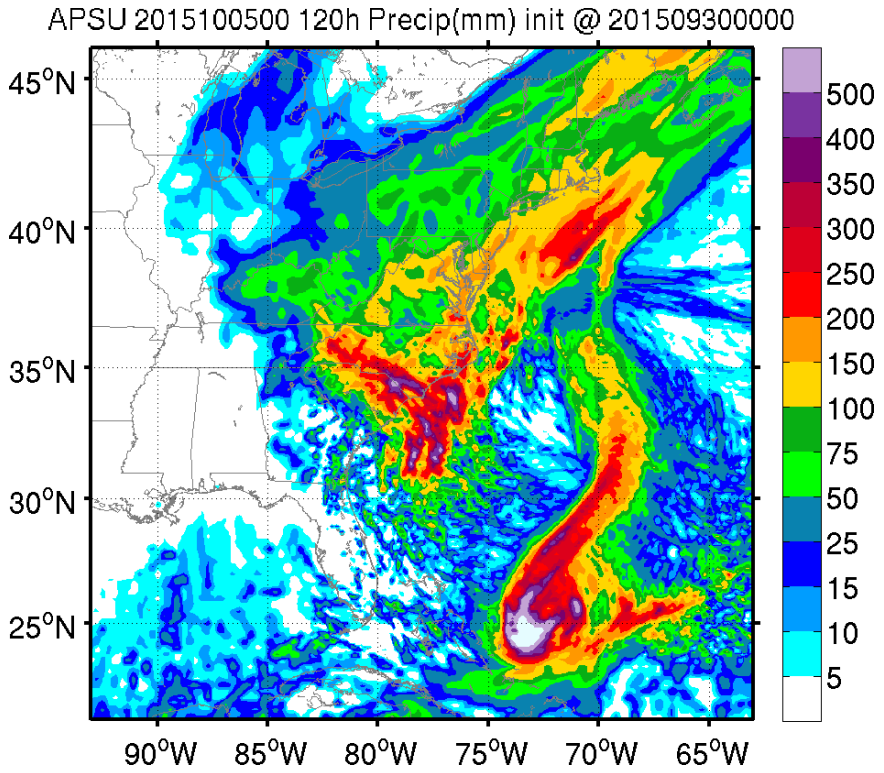
Track				
Vmax				
Pmin				

APSU Precipitation Forecast





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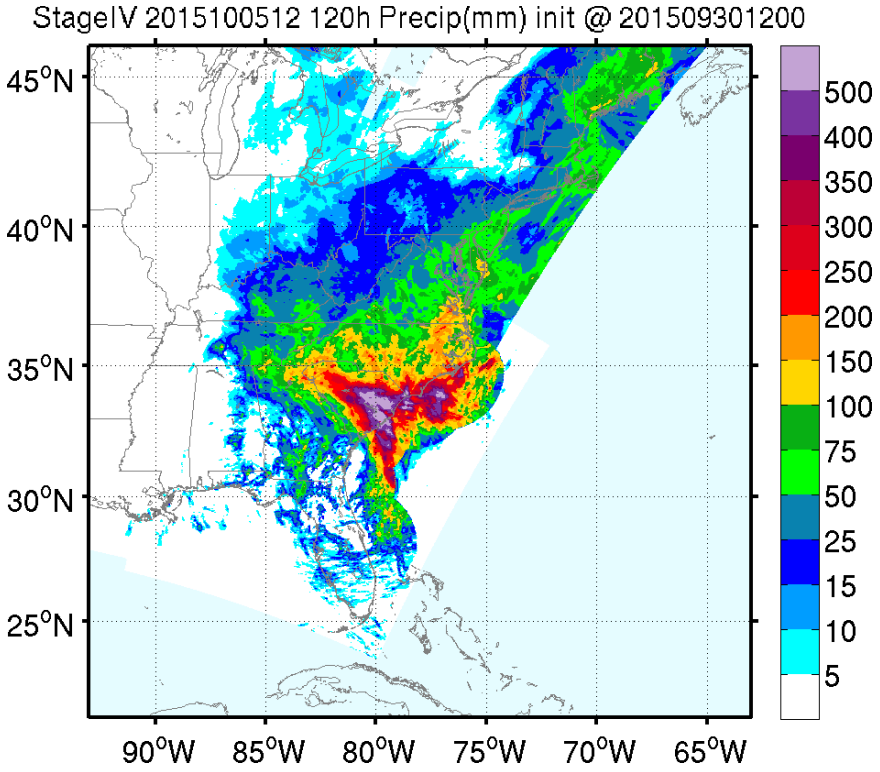

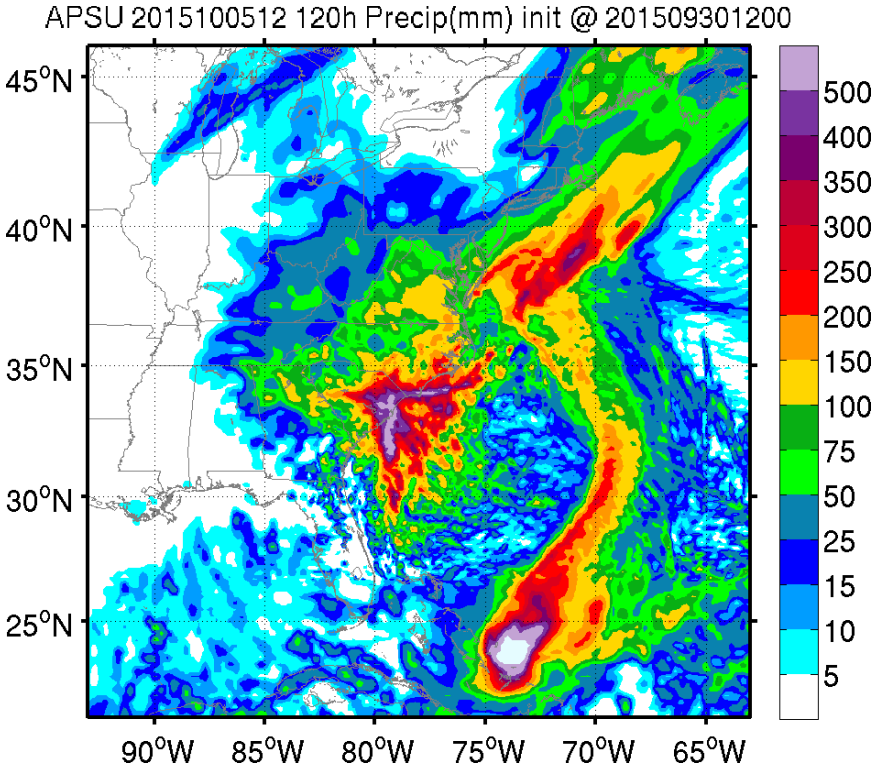

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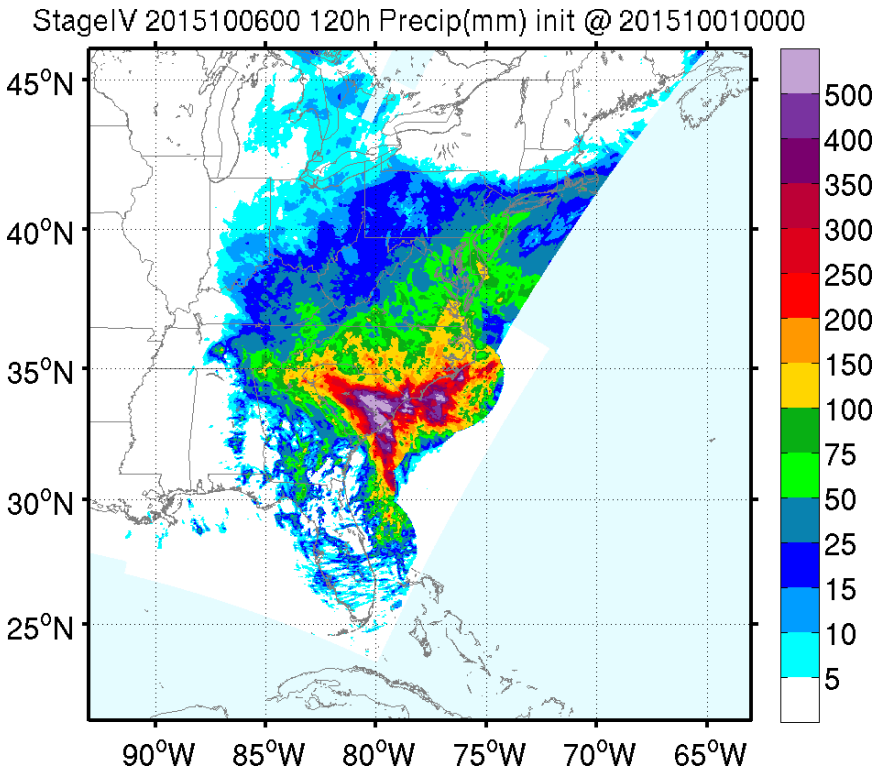

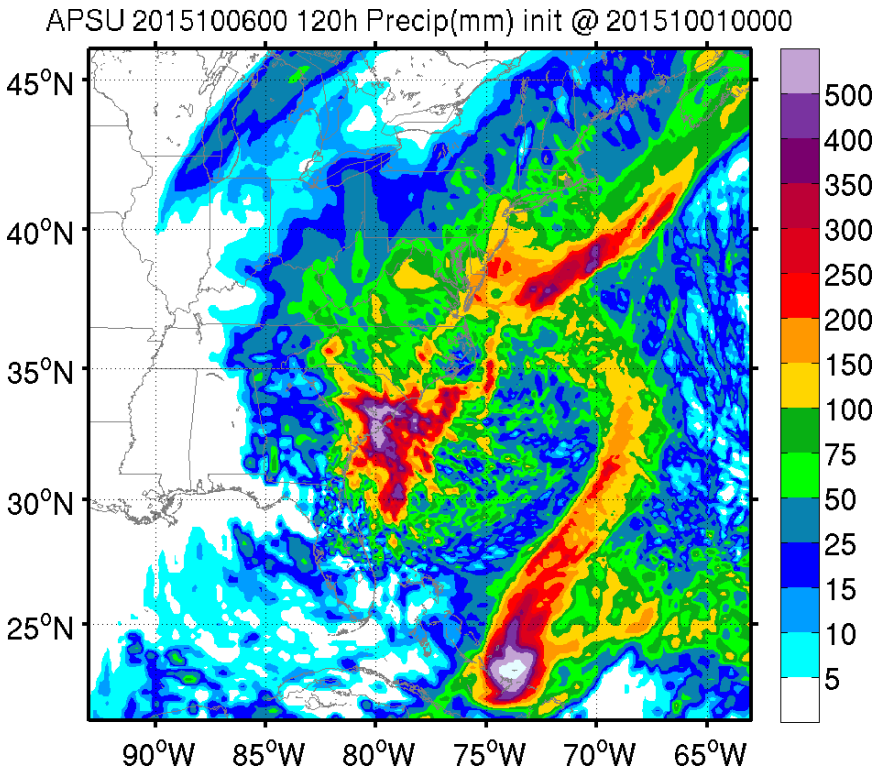

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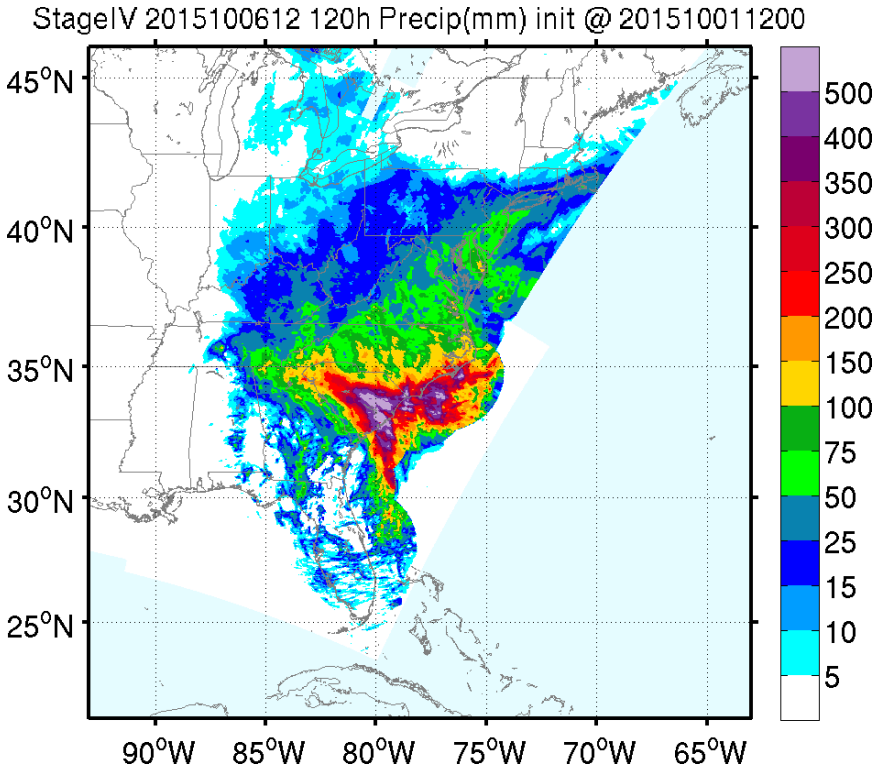

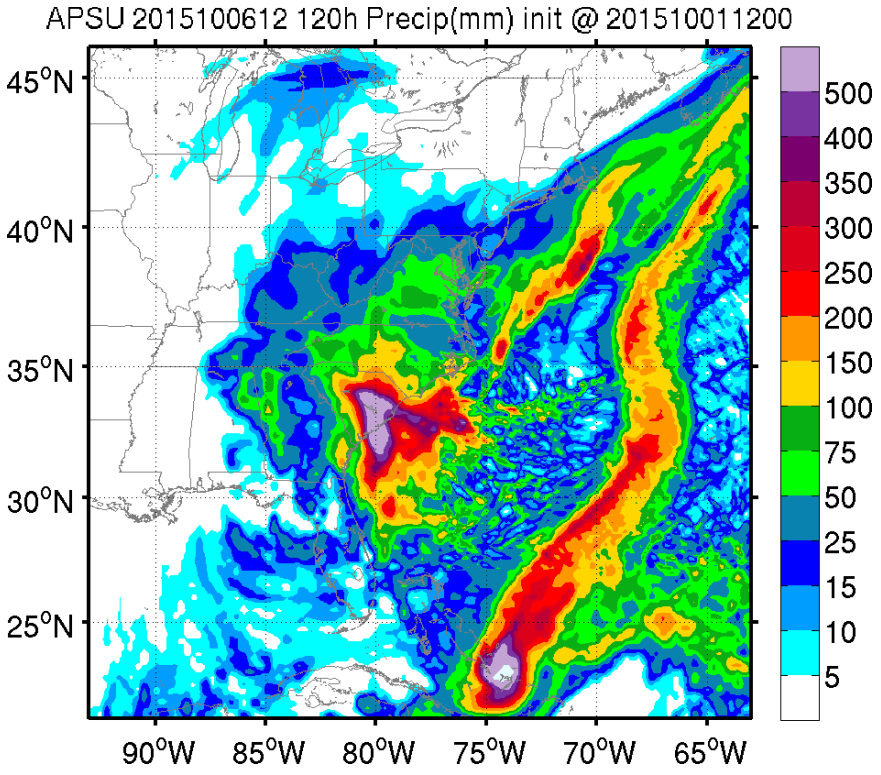

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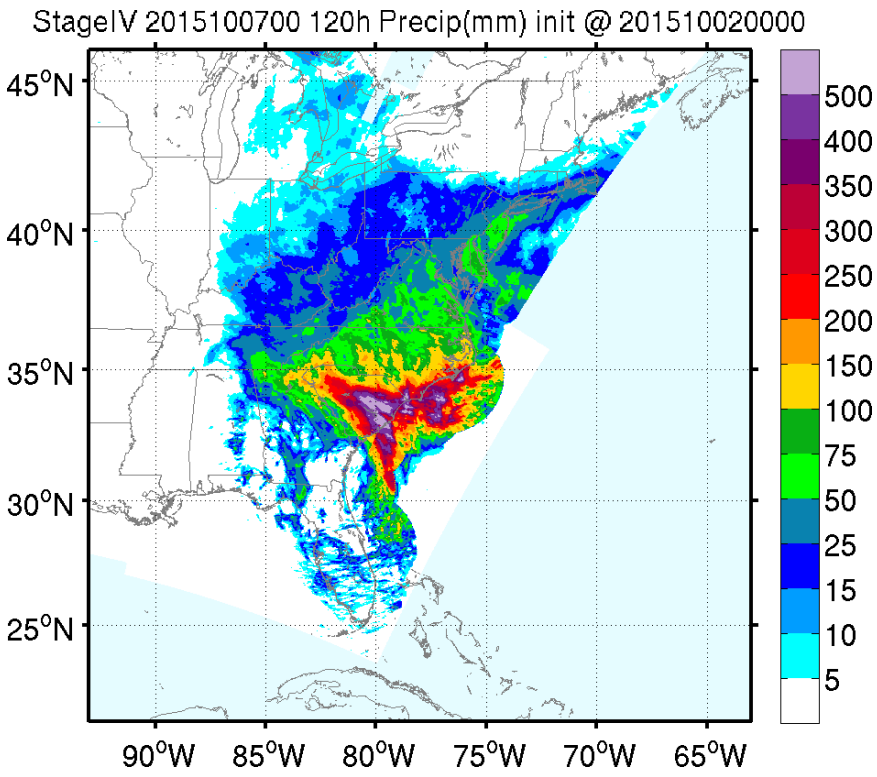

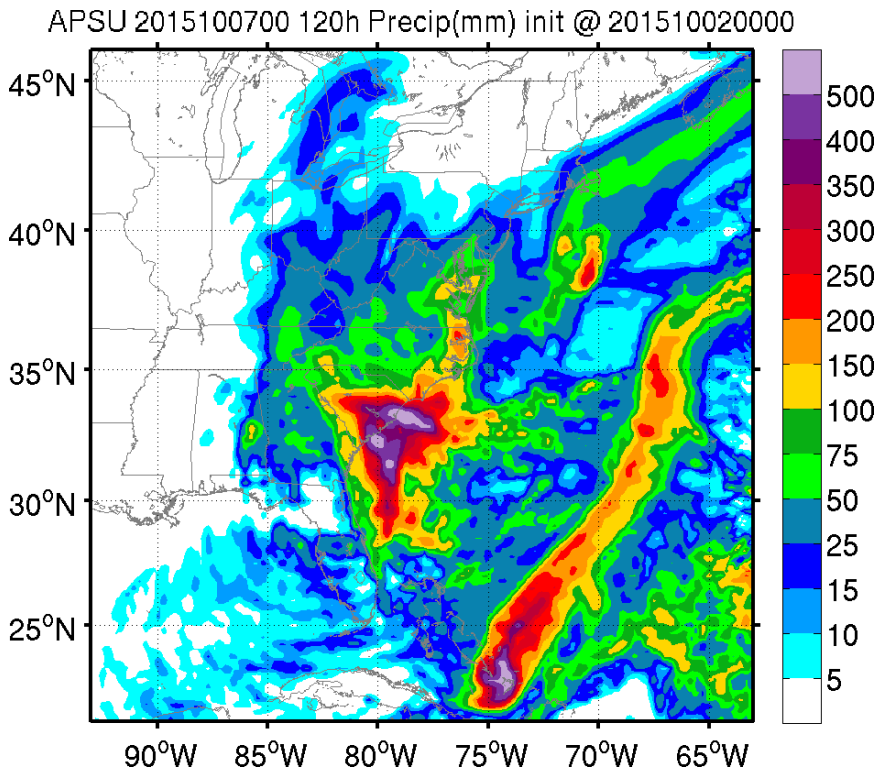

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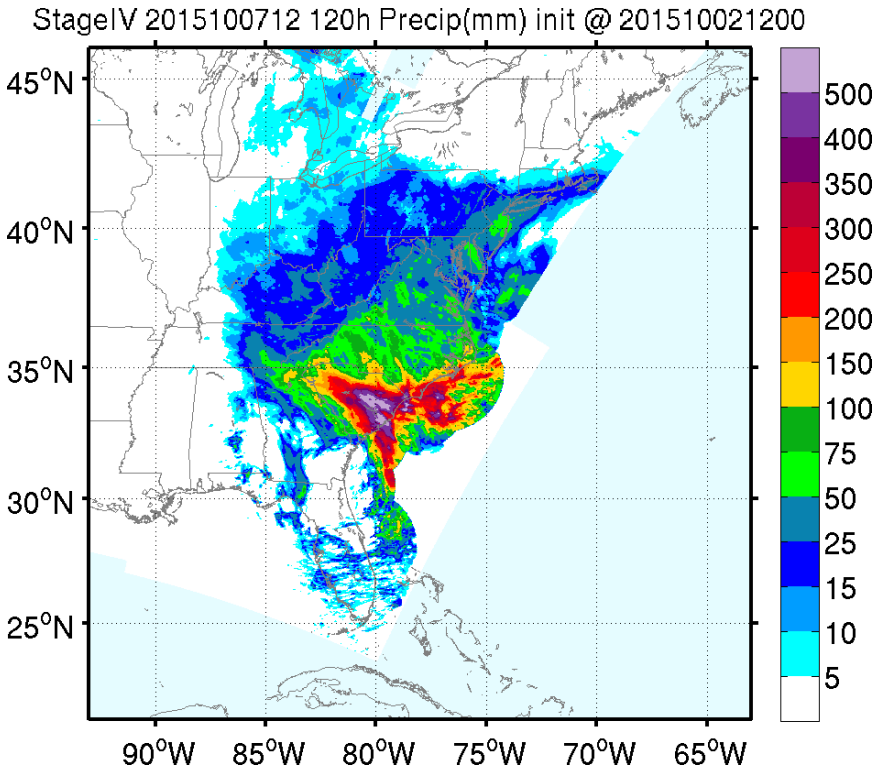

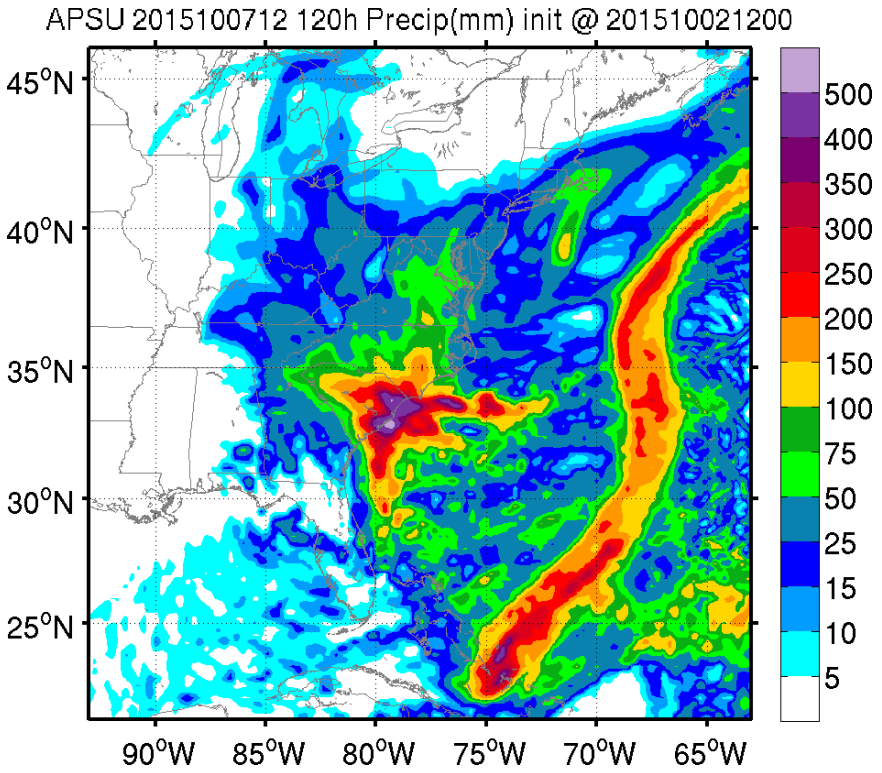

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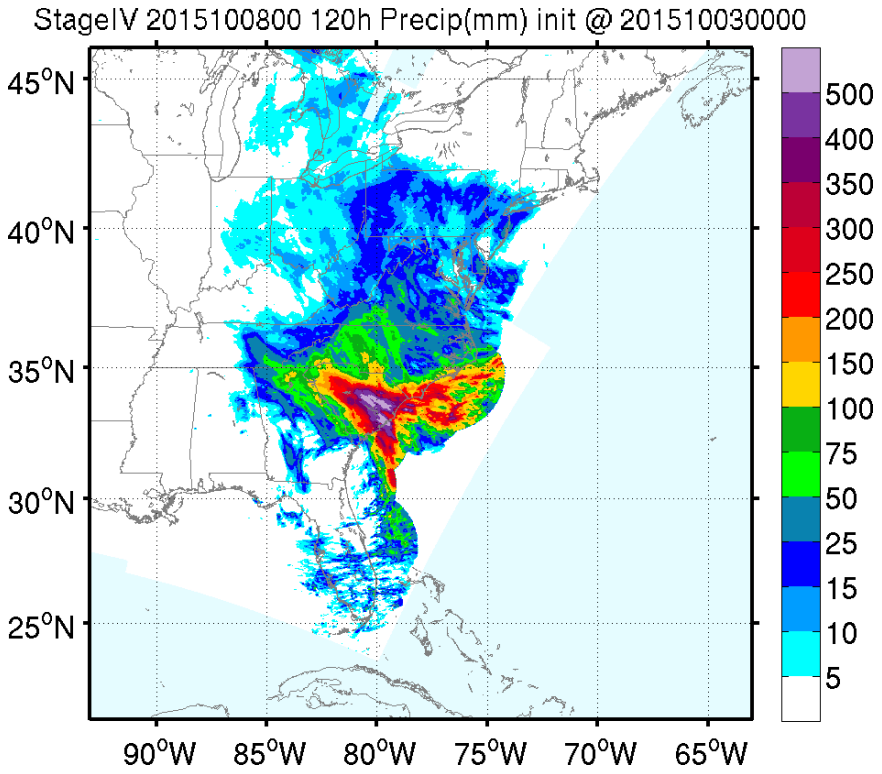

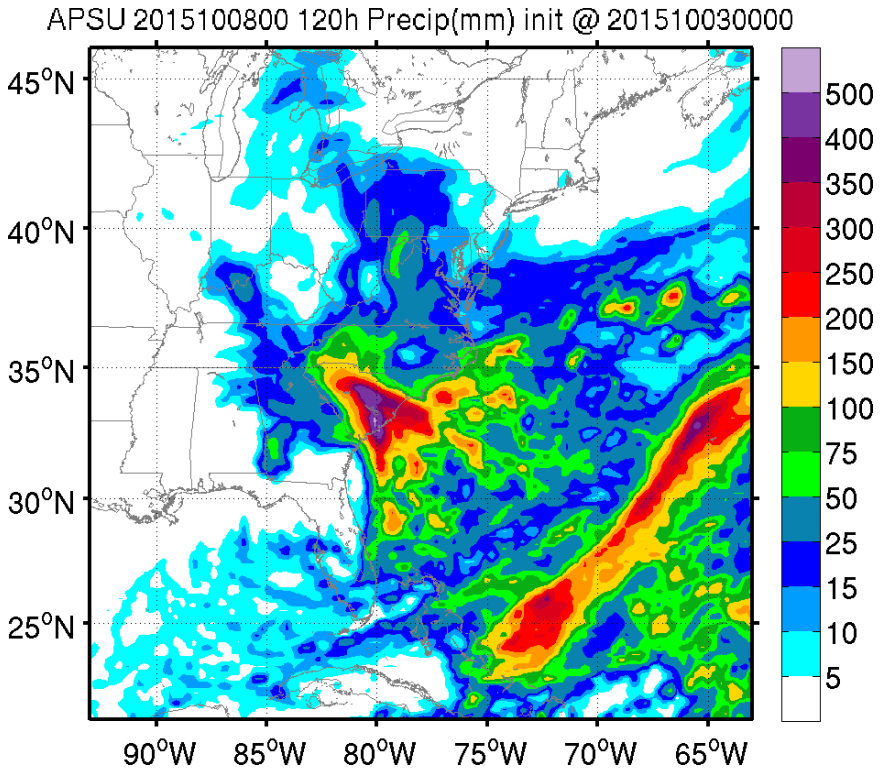

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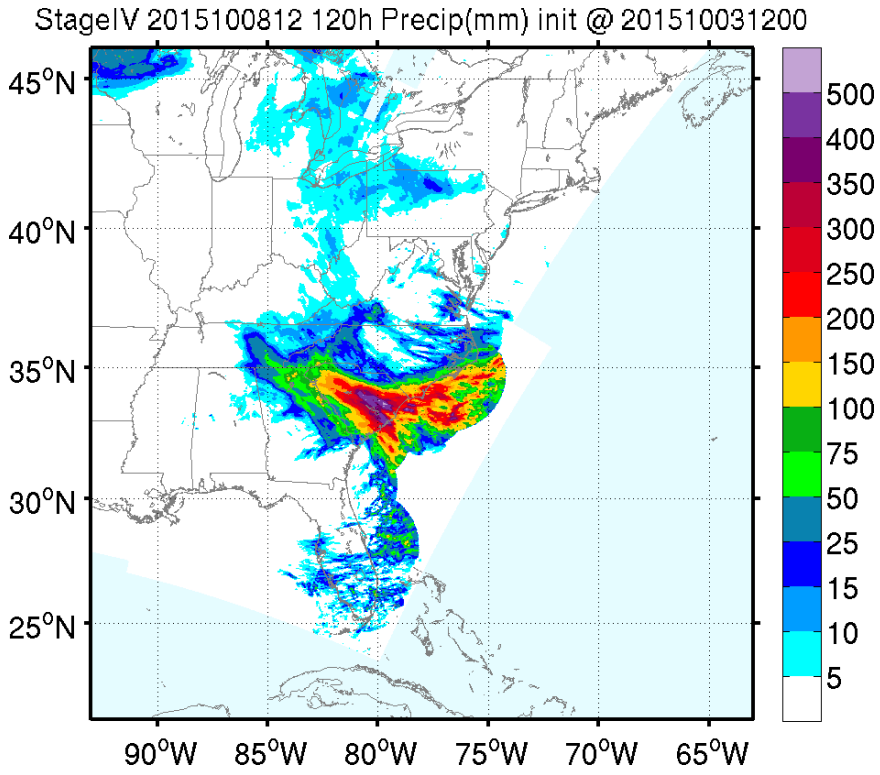

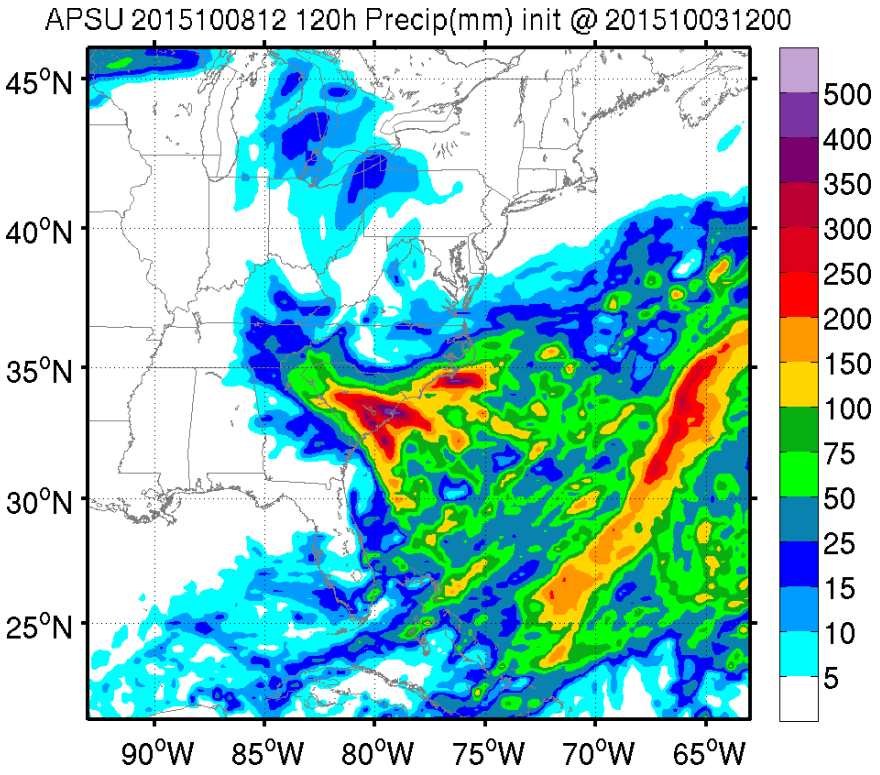

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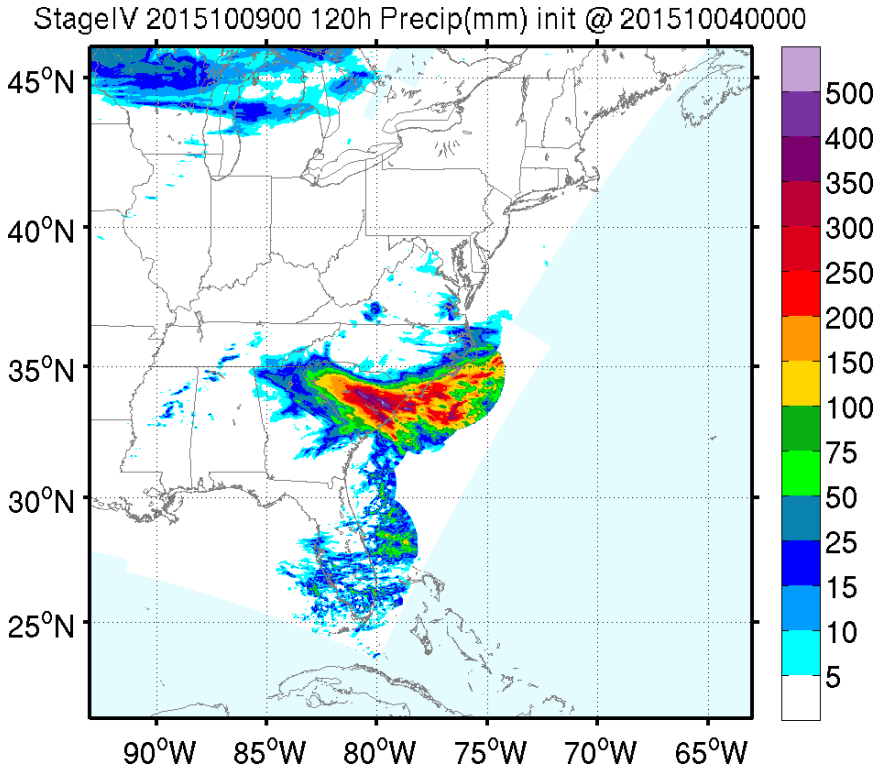

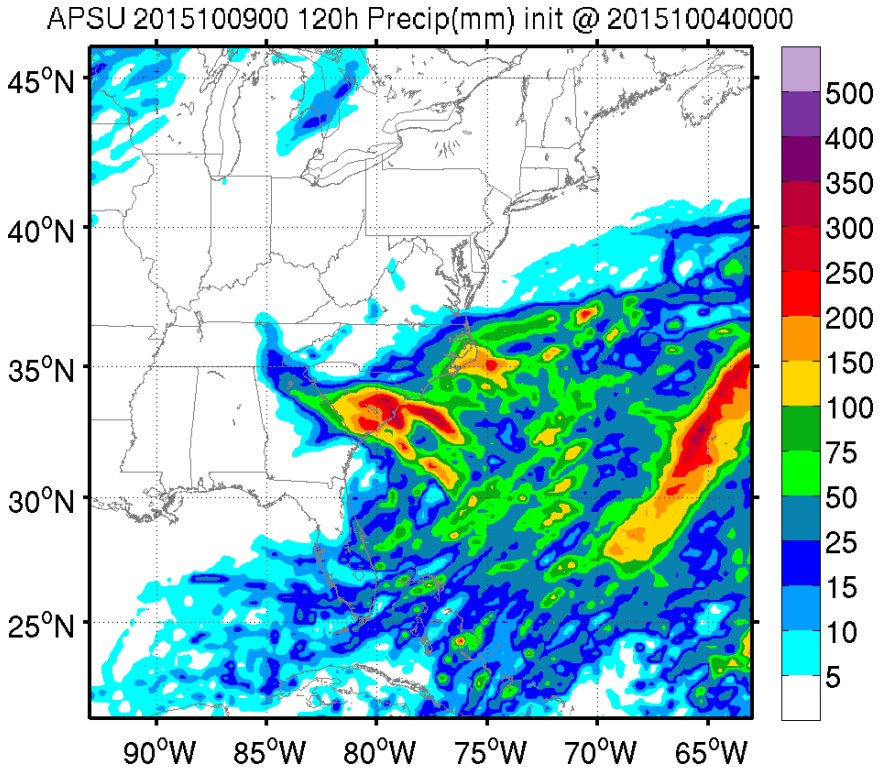

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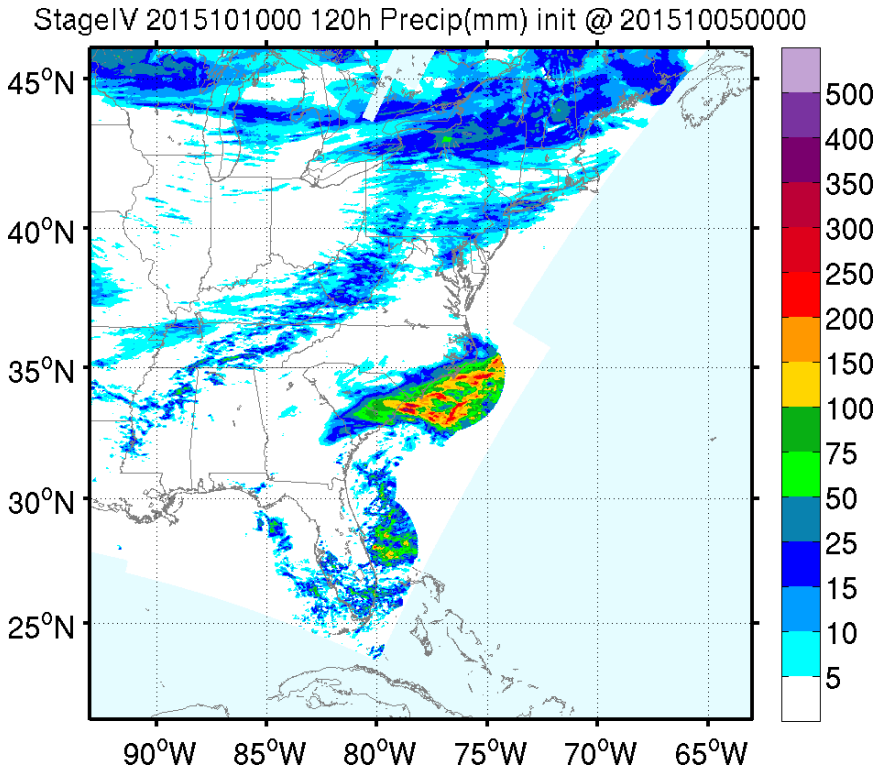

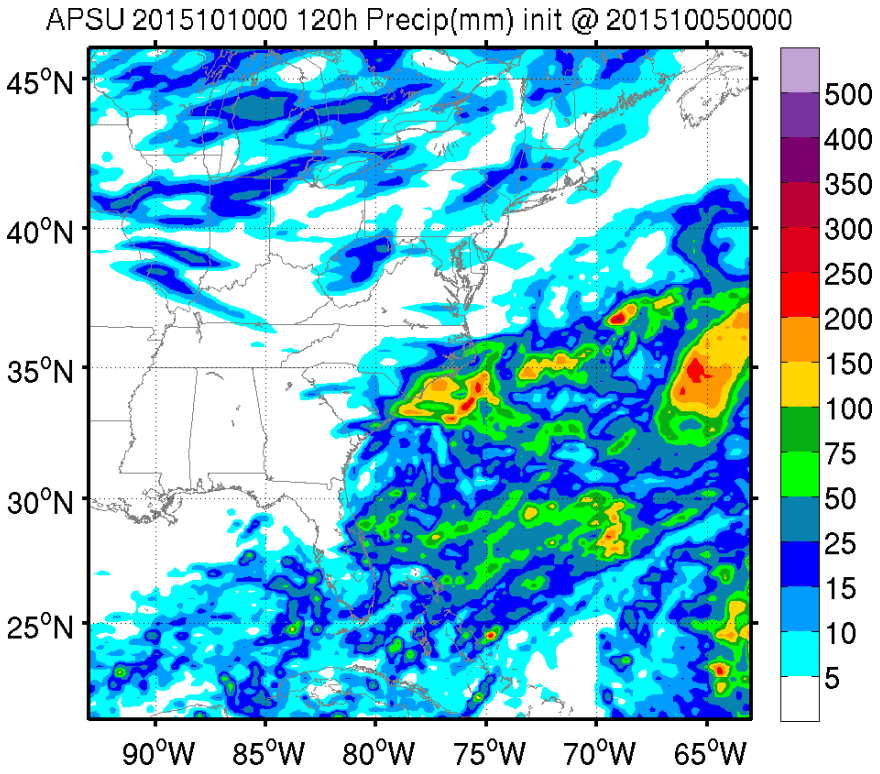

Ongoing and Future Works

- Satellite;
- Satellite radiance;
- Satellite radiance into APSU;
- Satellite radiance into HPSU;
- ……