What do we get from FV3 so far?

- A close look of FV3GEFS performance

Yuejian Zhu
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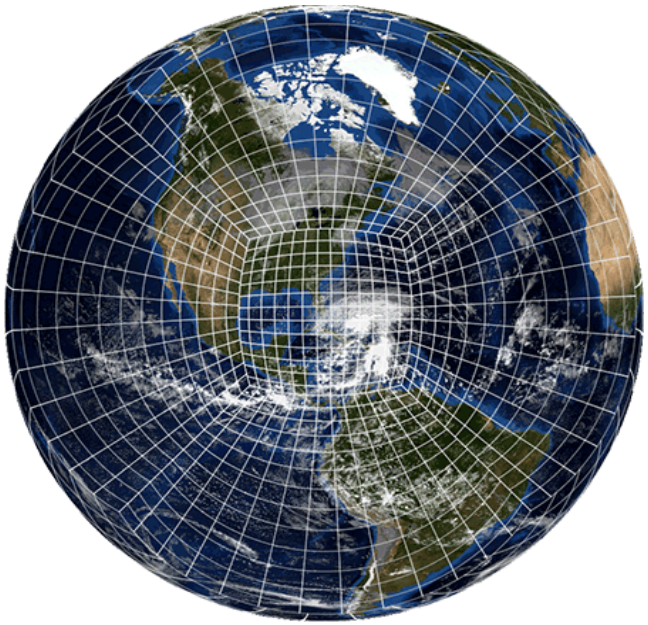
Yan Luo, Jiayi Peng, Alicia Bentley
All ensemble team members.

Update: August 9 2018

FV3 Dycore and Global Models

GFS (Deterministic)

- March 2018: Real Time FV3GFS Beta Version
  - C768L64 (~13km)
  - GFDL MP
- Q1-Q2 2019: Implement FV3GFS Beta Version



GEFS (Ensemble) v12

- Configuration
  - C384L64 (~25km)
  - 31 members, 4 cycles/day, out to 16 days
  - Extend 35 days forecast at 00UTC
- Q3FY18: Start to produce 20 years (1999-2018) reanalysis
- Q4FY18: Start to produce 30 years (1989-2018) reforecast
- Q2FY19: Start to produce retrospective runs (2.5 years)
- Q3FY19: Start users evaluation
- Q2FY20: Implement FV3GEFS operational version (v12)

FV3-GEFS experiments for weather

Bing Fu, Kate Zhou

- Resolution – C384 (~25km)
- **Lead time – 16 days**
- Ensemble members – 20 perturbed + 1 control
- Summer period:
  - Jun. 1 2017 – Aug. 6 2017 (67 cases)
- Winter period:
  - Dec. 1 2017 – Jan. 31 2018 (62 cases)
- Model and initial perturbations
  - Latest version with all bugs fixed
  - GFS physics with GFDL MP
  - NSST – assimilate diurnal variation
  - **EnKF f06 for ensemble initial perturbation (FV3 GFS retrospective)**
- Sciences
  - Three stochastic schemes (SKEB, SPPT and SHUM)
  - 2-tier SST
  - New SA convective parameterization scheme

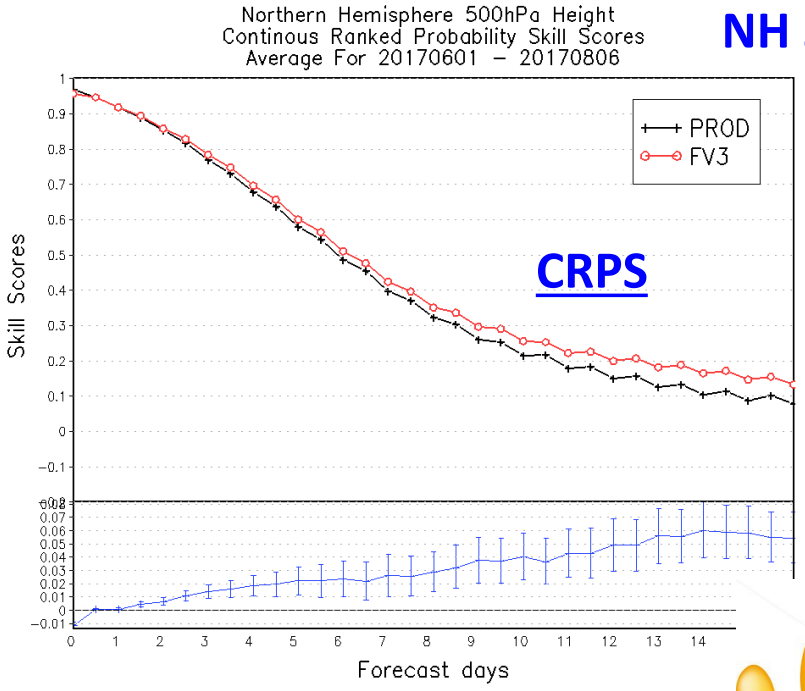
Summer Verification

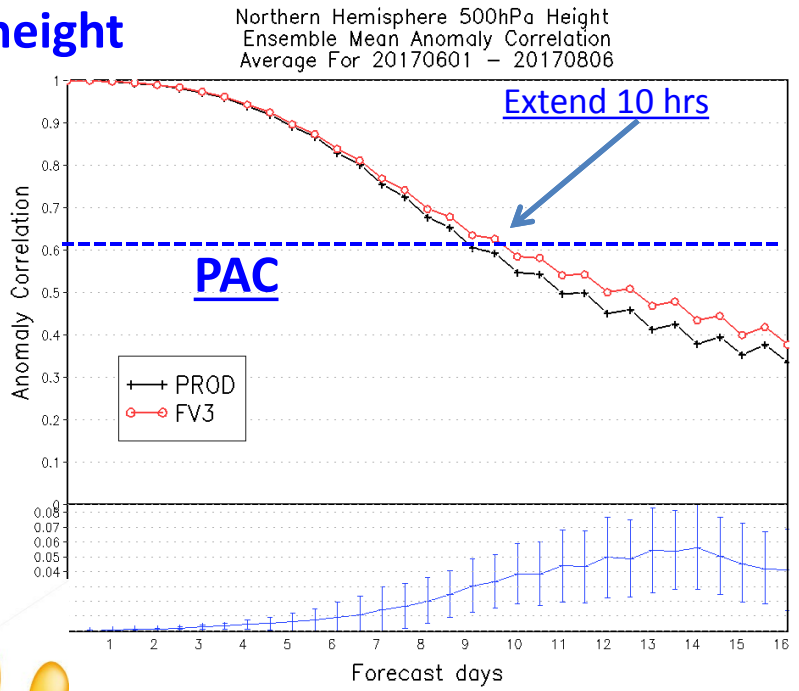
- Yan Luo (Jiayi Peng)

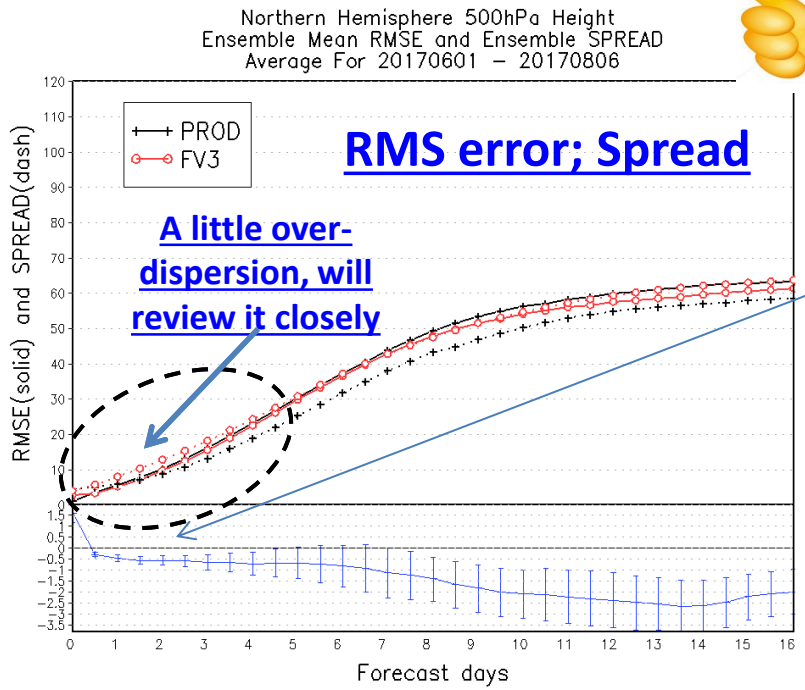
Upper air variables: own analysis at 2.5d

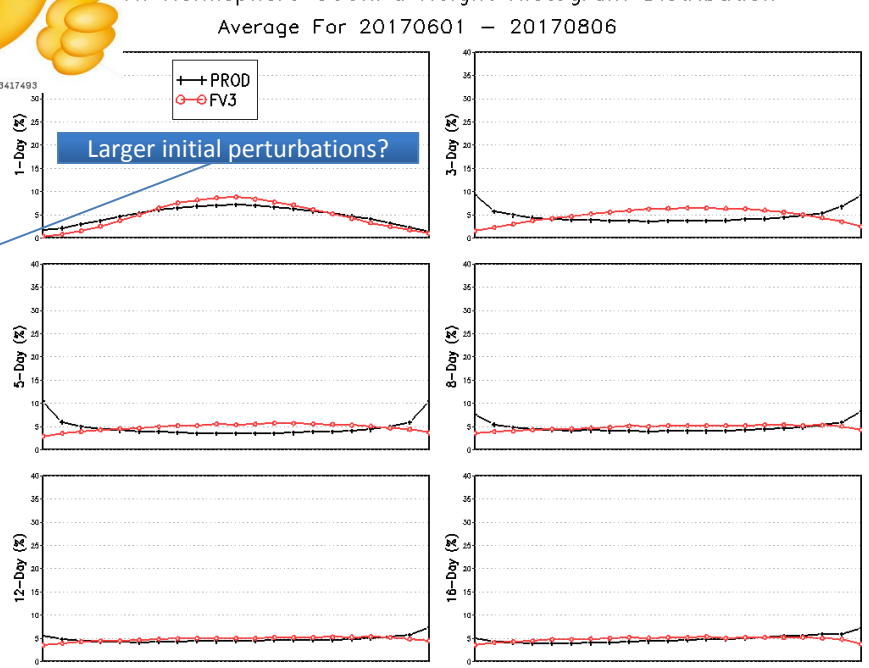
Precipitation: CCPA (CONUS) at 1.0

NH 500hPa height

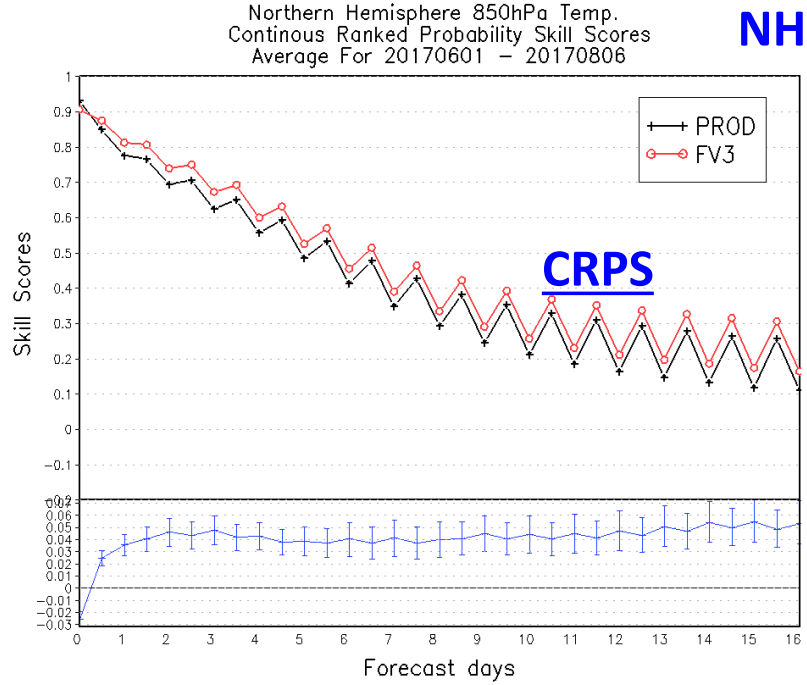


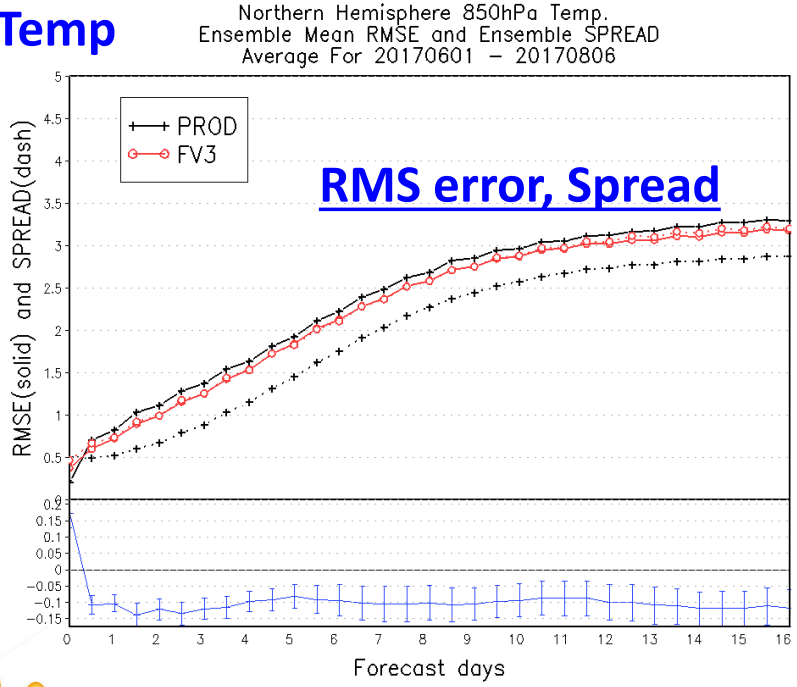


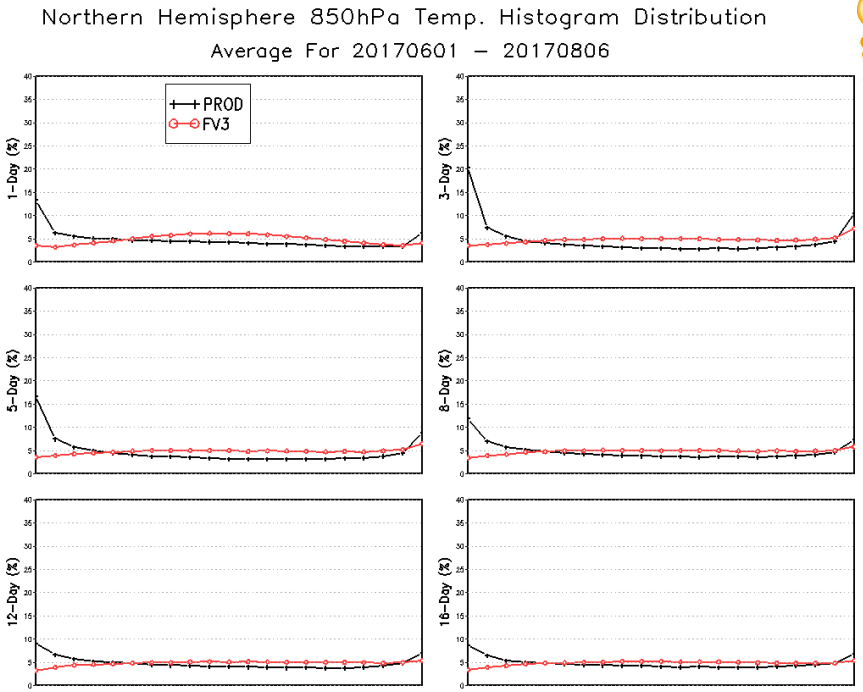


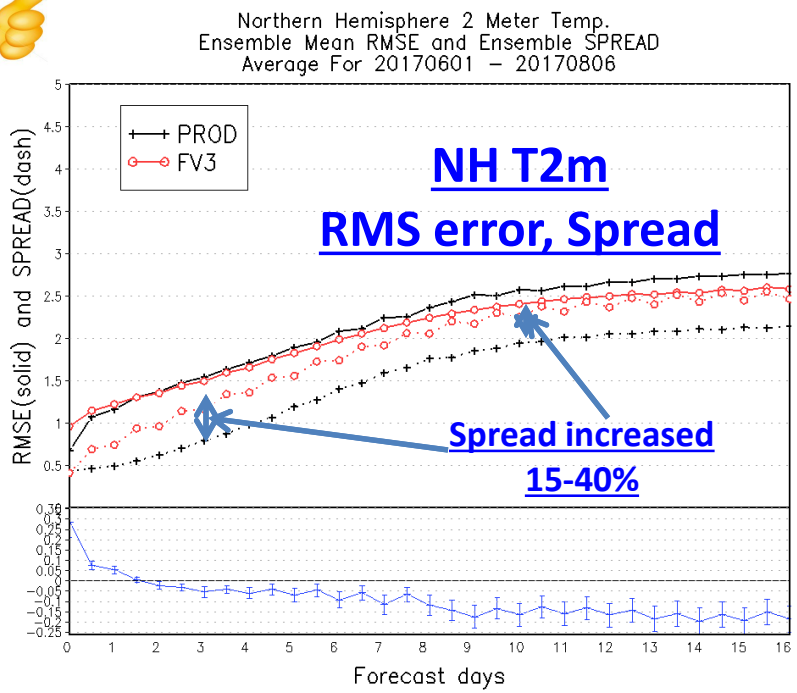


NH 850hPa Temp

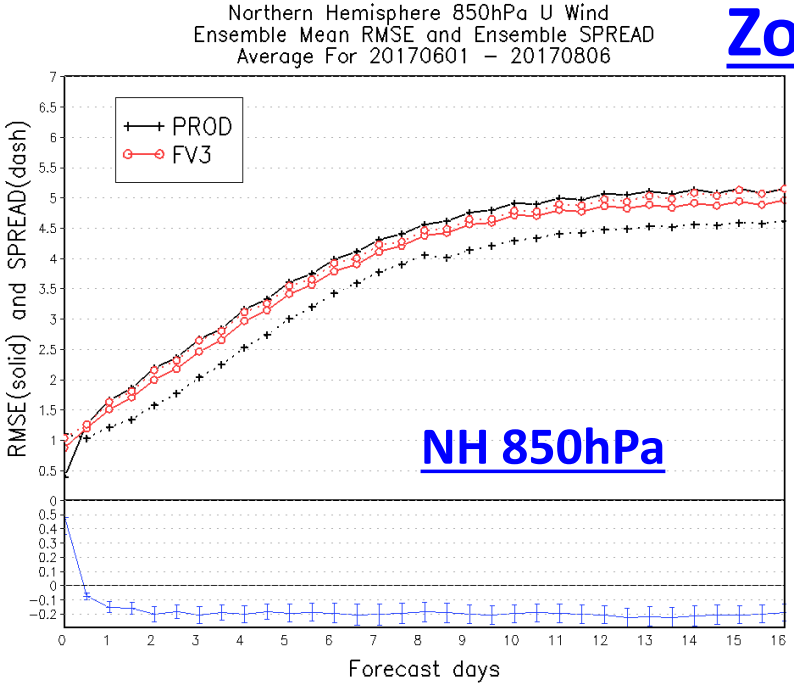


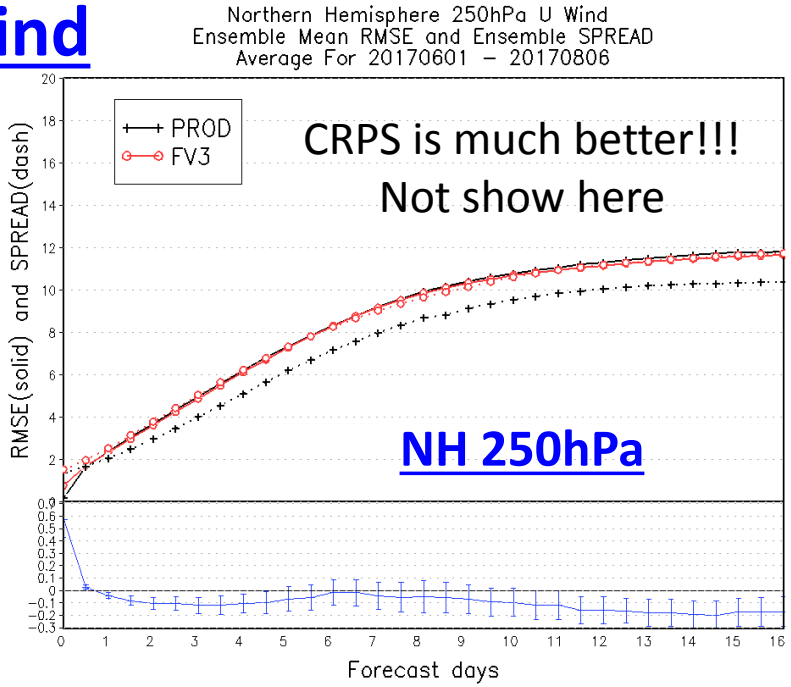


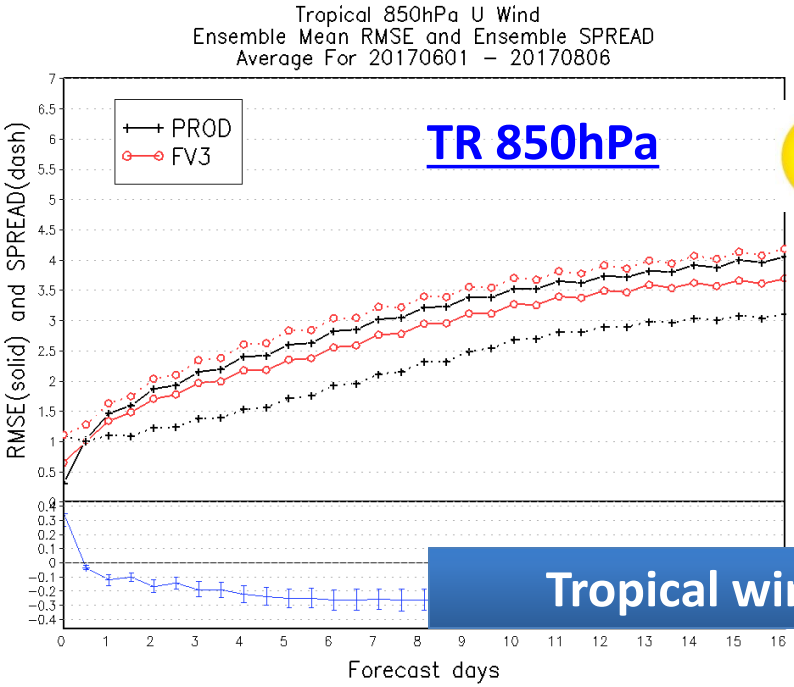


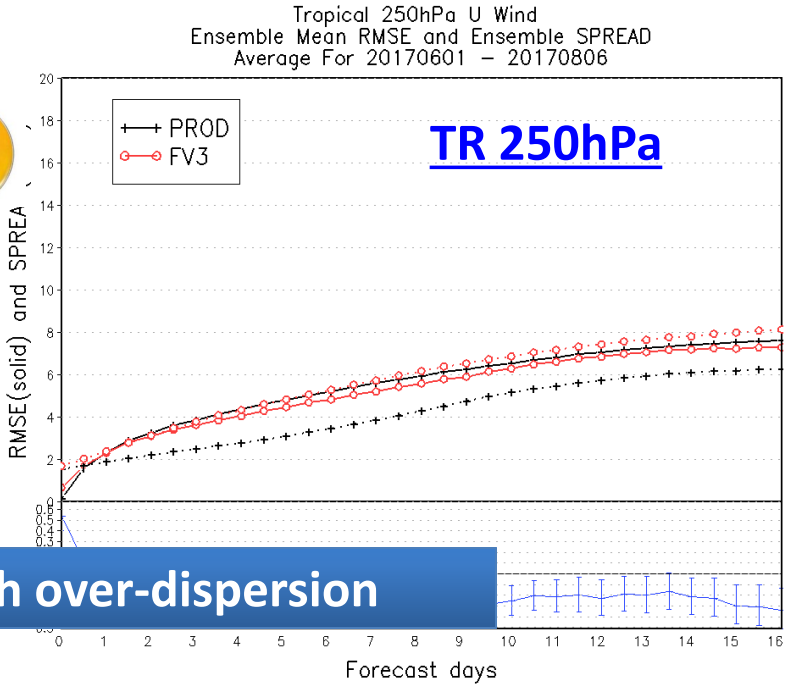


Zonal Wind



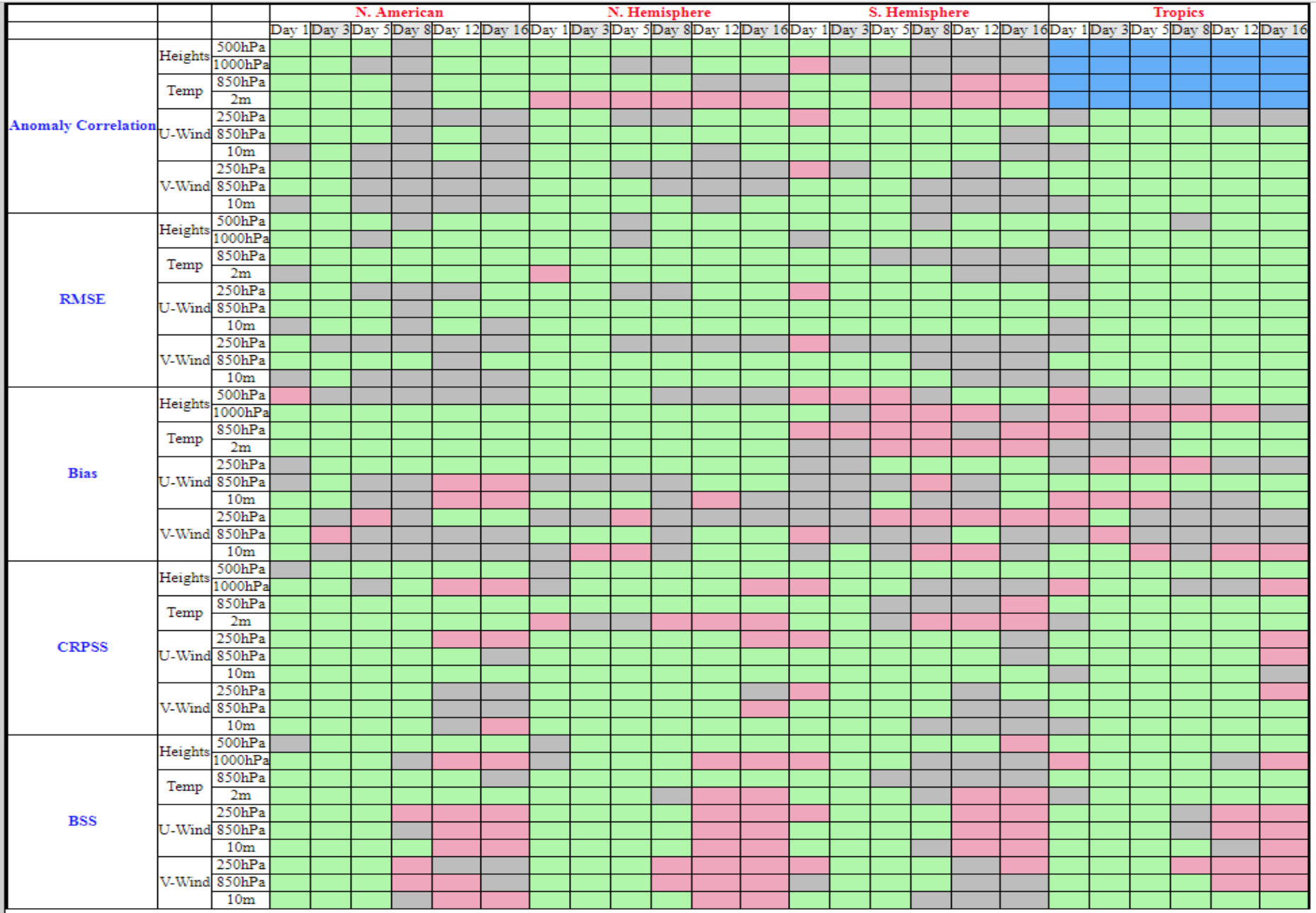


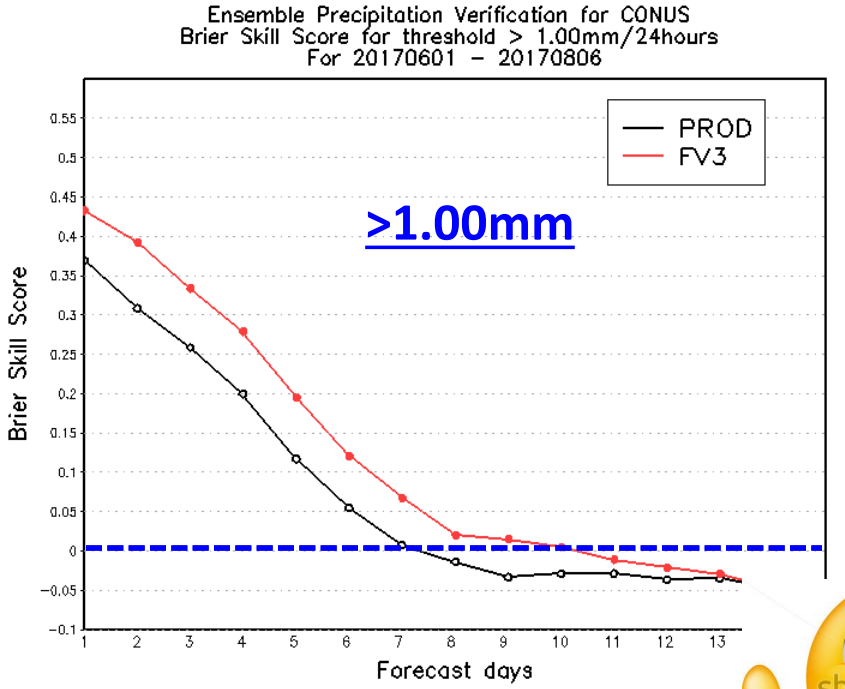


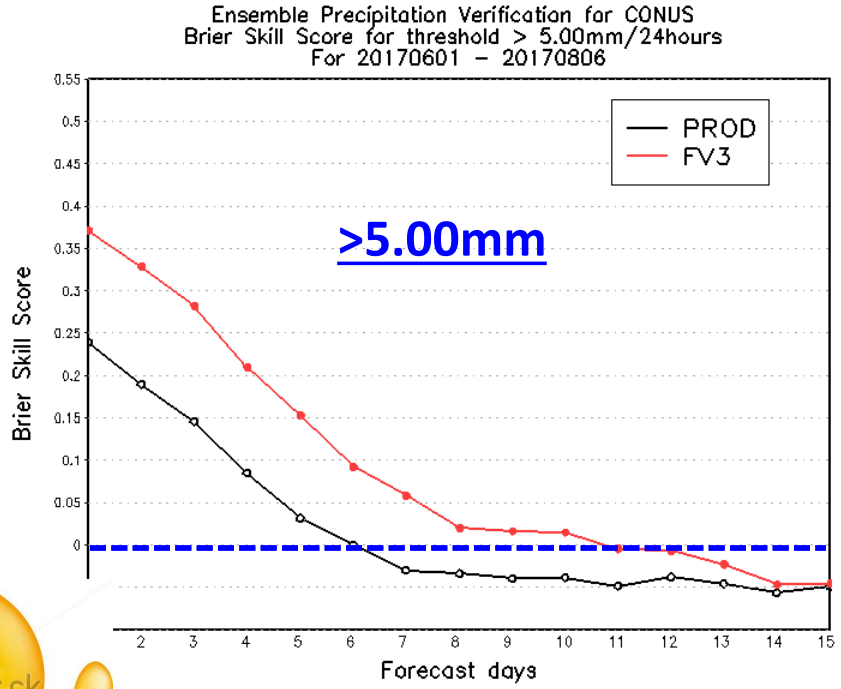


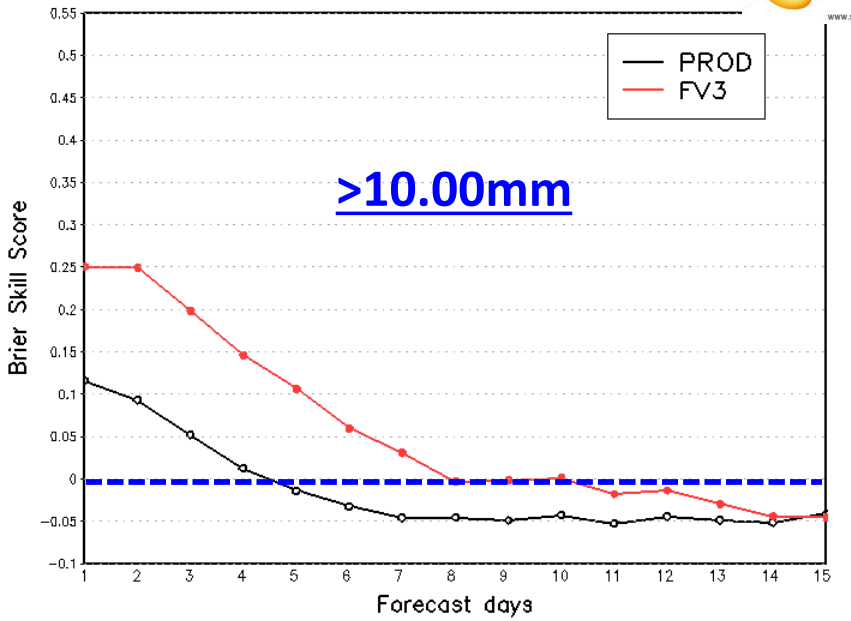
Tropical winds, much over-dispersion

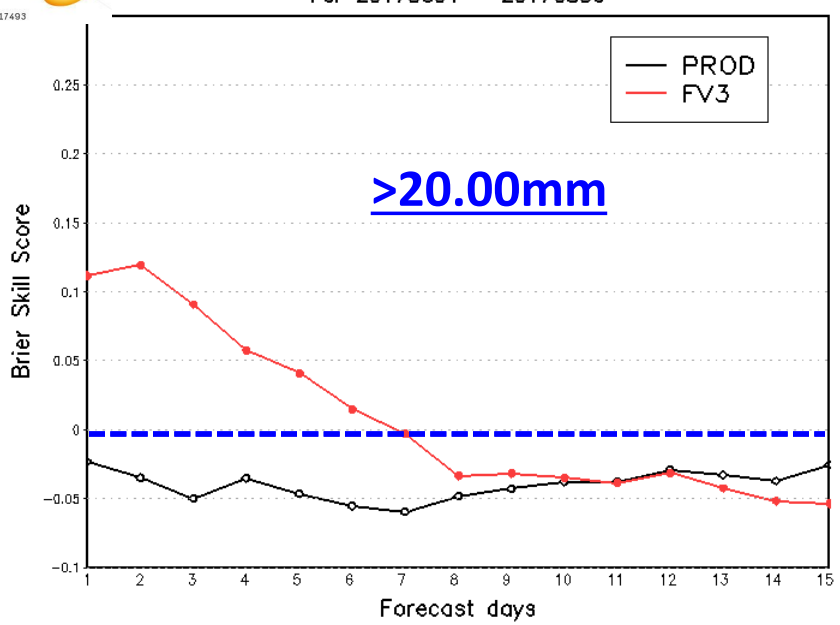
Summer Score Card – Period of June 1st – August 6 2017 (67 cases)




Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 1.00mm/24hours
For 20170601 - 20170806
PROD
FV3
>1.00mm
Brier Skill Score
Forecast days


Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 5.00mm/24hours
For 20170601 - 20170806
PROD
FV3
>5.00mm
Brier Skill Score
Forecast days


Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 10.0mm/24hours
For 20170601 - 20170806
PROD
FV3
>10.00mm
Brier Skill Score
Forecast days


Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 20.0mm/24hours
For 20170601 - 20170806
PROD
FV3
>20.00mm
Brier Skill Score
Forecast days

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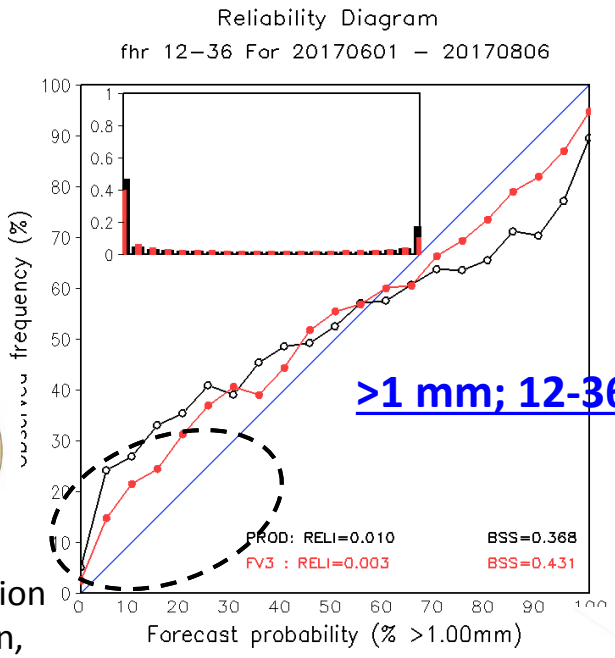
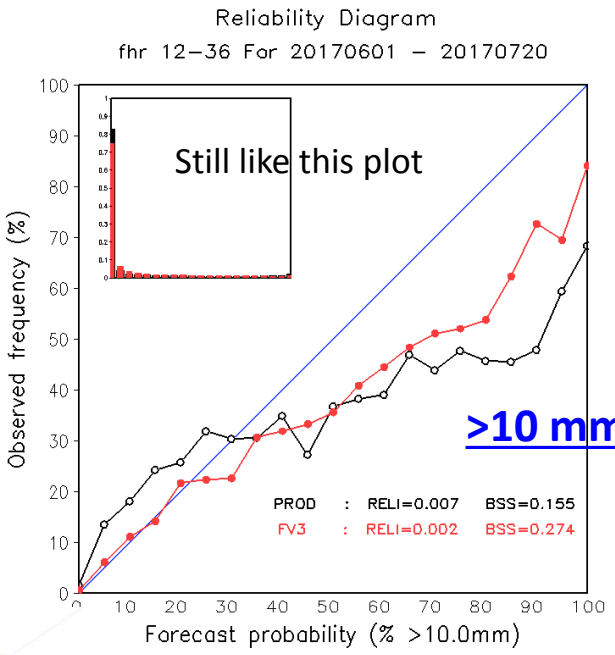
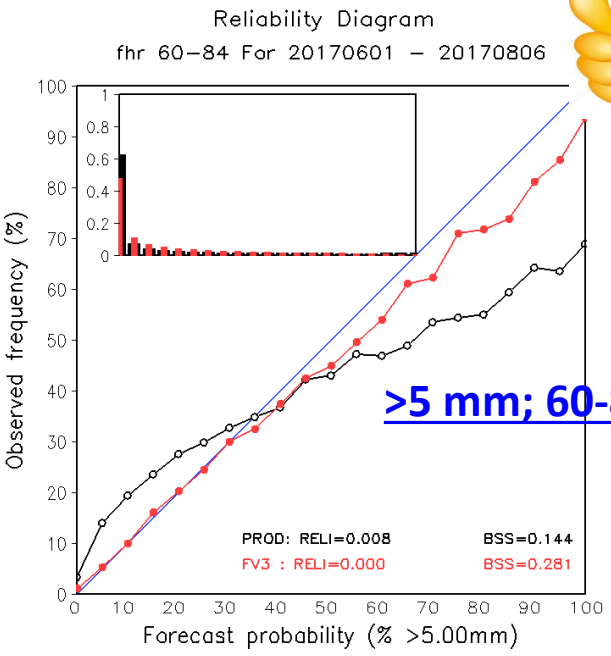
Less prediction of light rain, Less spread?



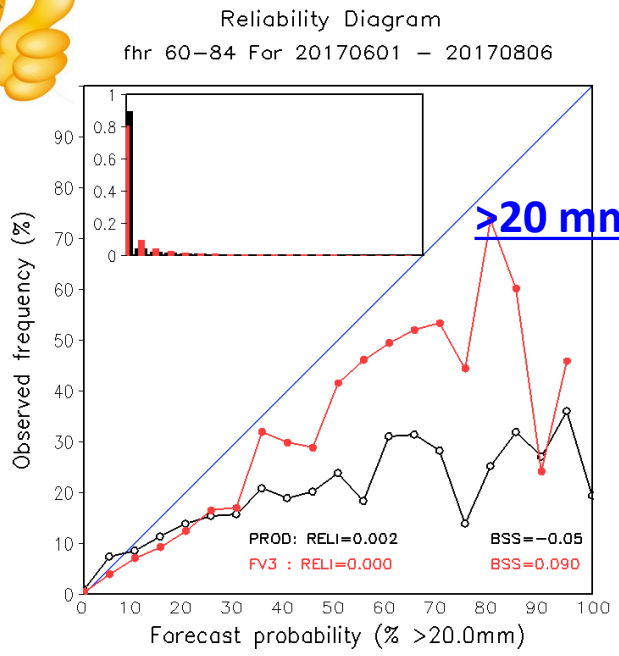
>1 mm; 12-36 hrs



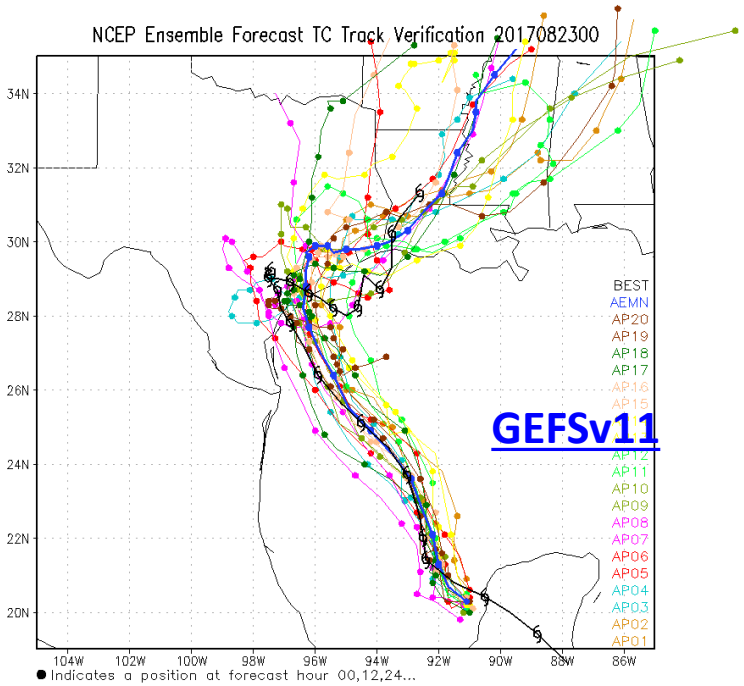
>10 mm; 12-36 hrs

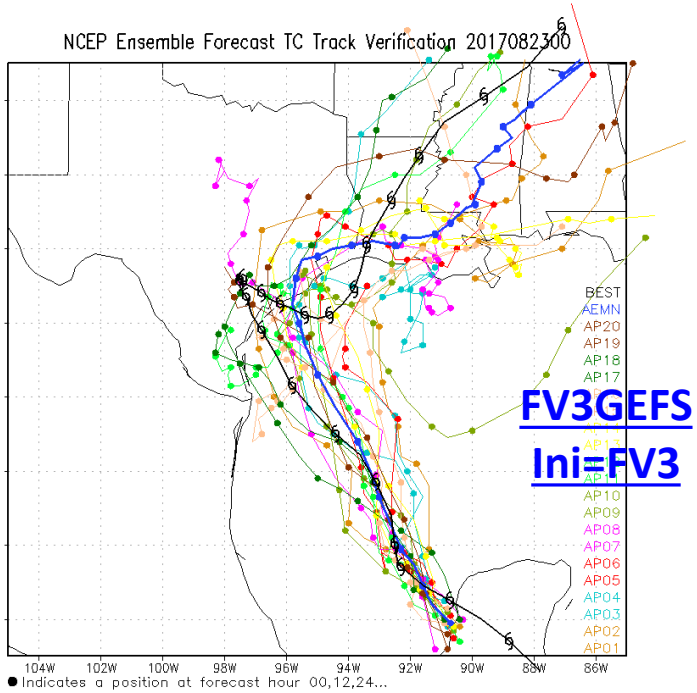


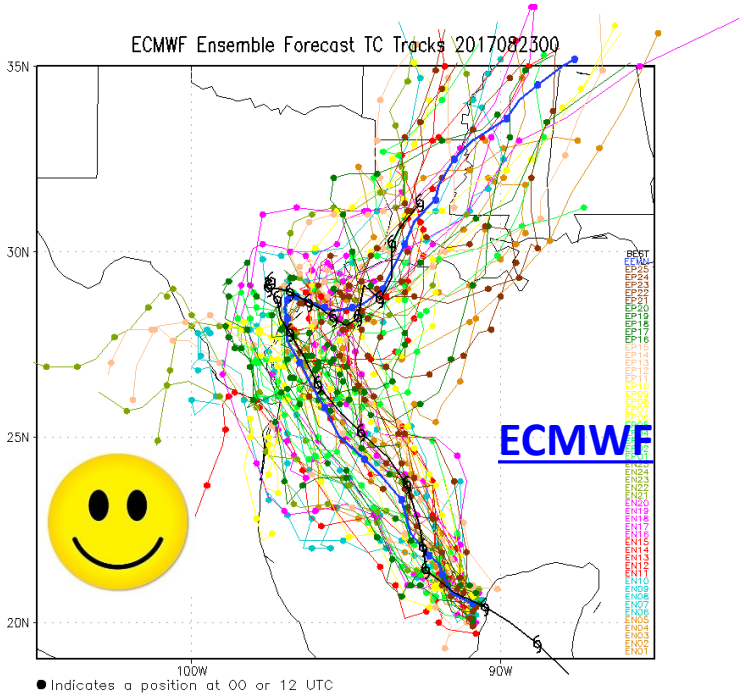
>5 mm; 60-84 hrs

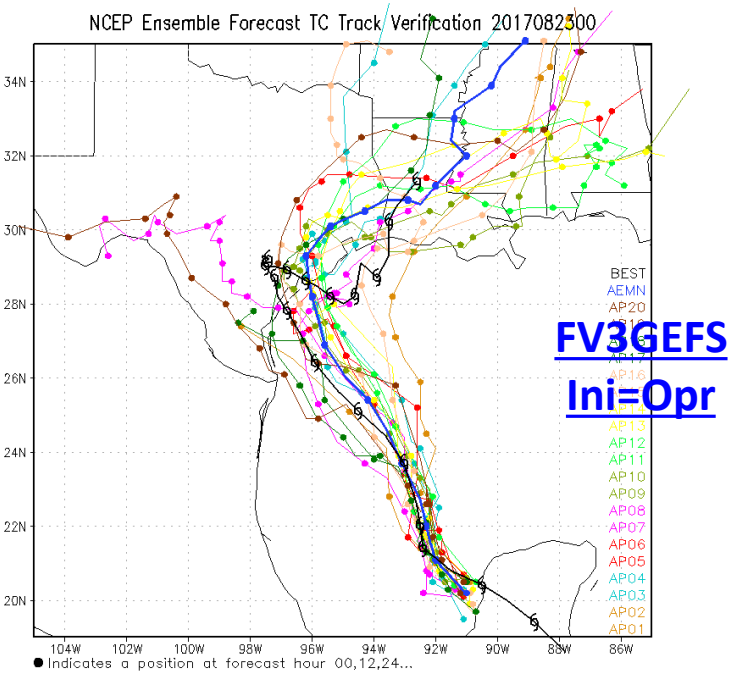


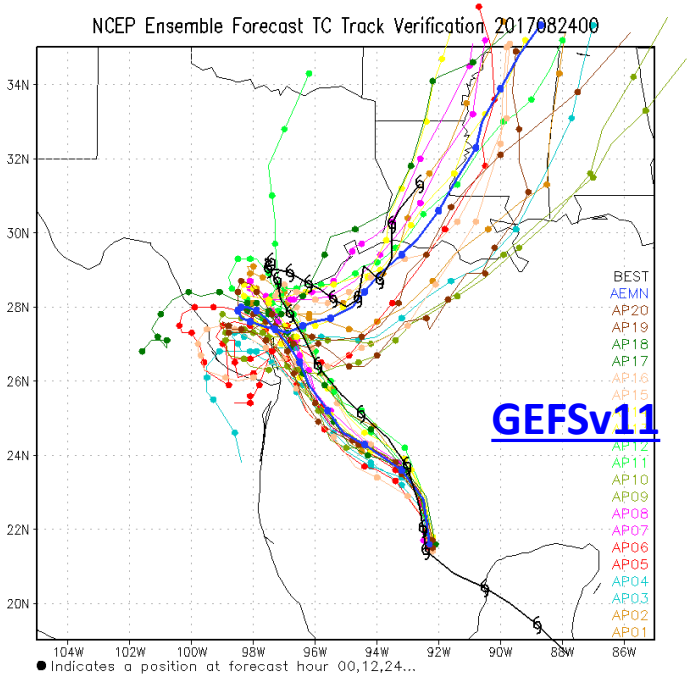
>20 mm; 60-84 hrs


NCEP Ensemble Forecast TC Track Verification 2017082300
BEST
AEMN
AP20
AP19
AP18
AP17
AP16
AP15
AP14
AP13
AP12
AP11
AP10
AP09
AP08
AP07
AP06
AP05
AP04
AP03
AP02
AP01
GEFSv11
Indicates a position at forecast hour 00,12,24...


NCEP Ensemble Forecast TC Track Verification 2017082300
BEST
AEMN
AP20
AP19
AP18
AP17
AP10
AP09
AP08
AP07
AP06
AP05
AP04
AP03
AP02
AP01
FV3GEFS
Ini=FV3
Indicates a position at forecast hour 00,12,24...


ECMWF Ensemble Forecast TC Tracks 2017082300
ECMWF
Indicates a position at 00 or 12 UTC


NCEP Ensemble Forecast TC Track Verification 2017082300
BEST
AEMN
AP20
AP12
AP11
AP10
AP09
AP08
AP07
AP06
AP05
AP04
AP03
AP02
AP01
FV3GEFS
Ini=Opr
Indicates a position at forecast hour 00,12,24...


NCEP Ensemble Forecast TC Track Verification 2017082400
BEST
AEMN
AP20
AP19
AP18
AP17
AP16
AP15
AP14
AP13
AP12
AP11
AP10
AP09
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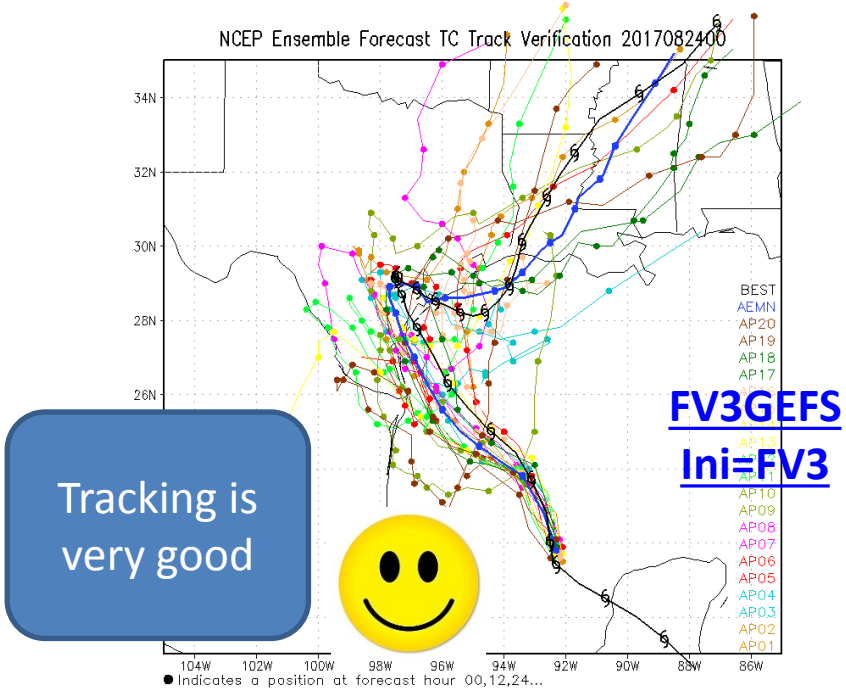
AP07
AP06
AP05
AP04
AP03
AP02
AP01
GEFSv11
Indicates a position at forecast hour 00,12,24...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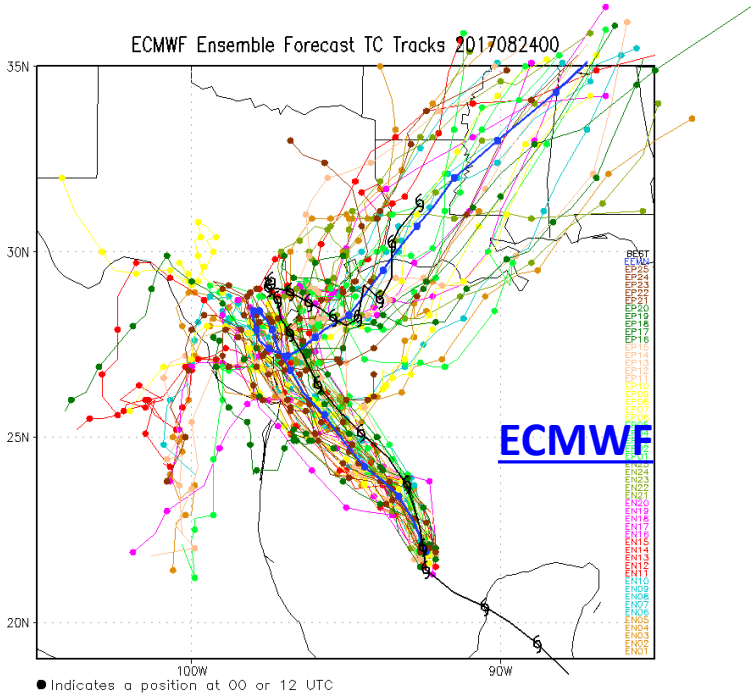
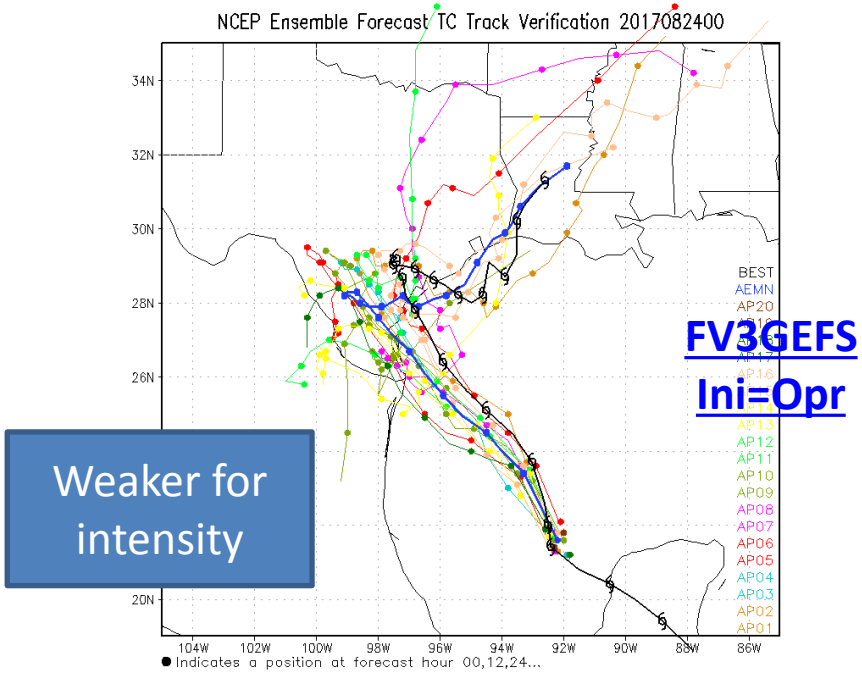
AEMN
AP20
AP19
AP18
AP17
AP10
AP09
AP08
AP07
AP06
AP05
AP04
AP03
AP02
AP01
FV3GEFS
Ini=FV3
Tracking is very good
Indicates a position at forecast hour 00,12,24...


ECMWF Ensemble Forecast TC Tracks 2017082400
ECMWF
Indicates a position at 00 or 12 UTC


NCEP Ensemble Forecast TC Track Verification 2017082400
BEST
AEMN
AP20
AP13
AP12
AP11
AP10
AP09
AP08
AP07
AP06
AP05
AP04
AP03
AP02
AP01
FV3GEFS
Ini=Opr
Weaker for intensity
Indicates a position at forecast hour 00,12,24...

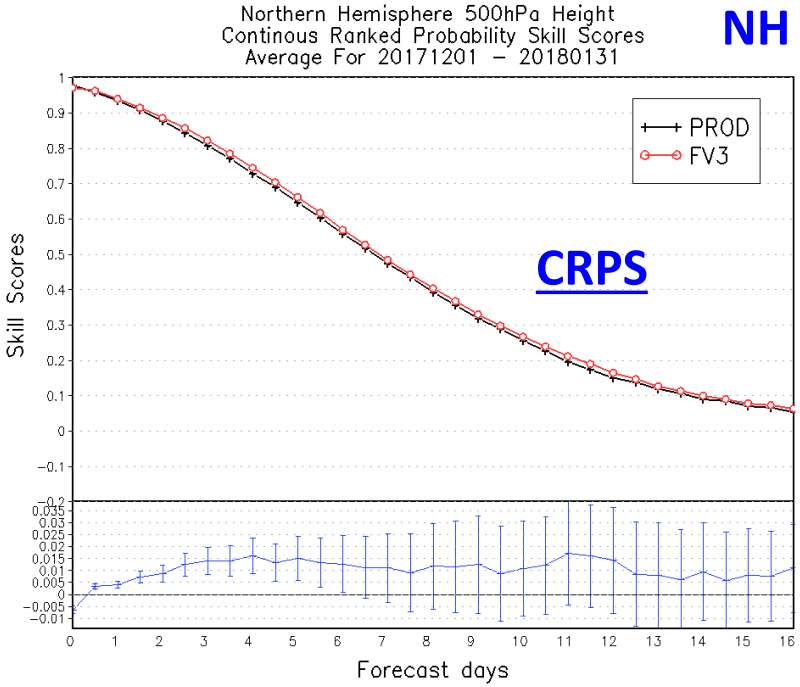
Winter Verification

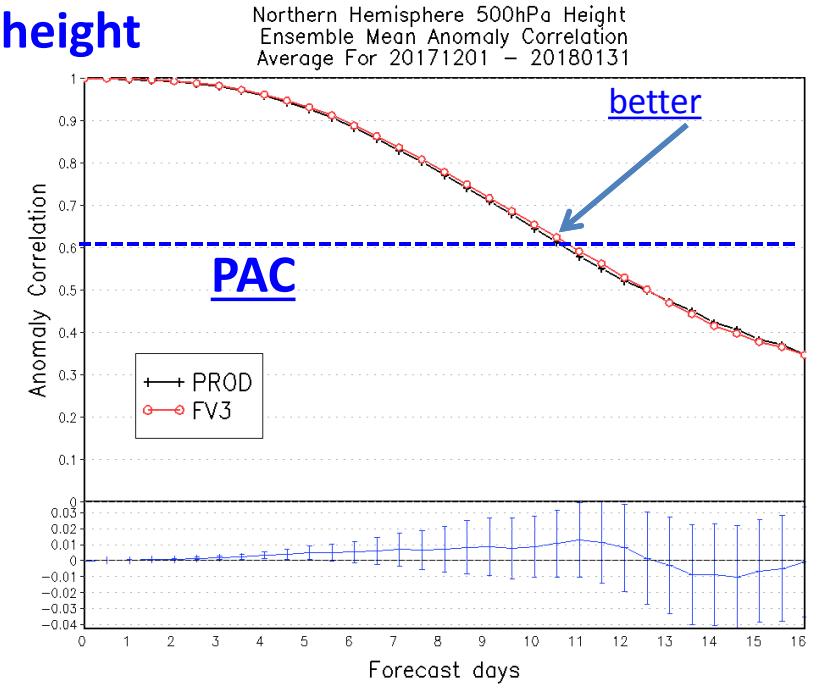
- Yan Luo (Bing Fu)

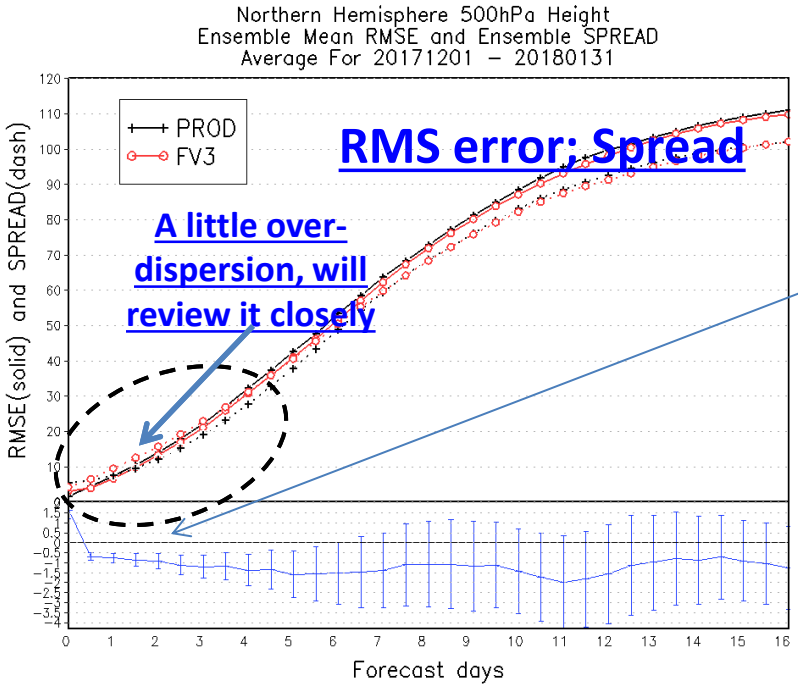
Upper air variables: own analysis at 2.5d

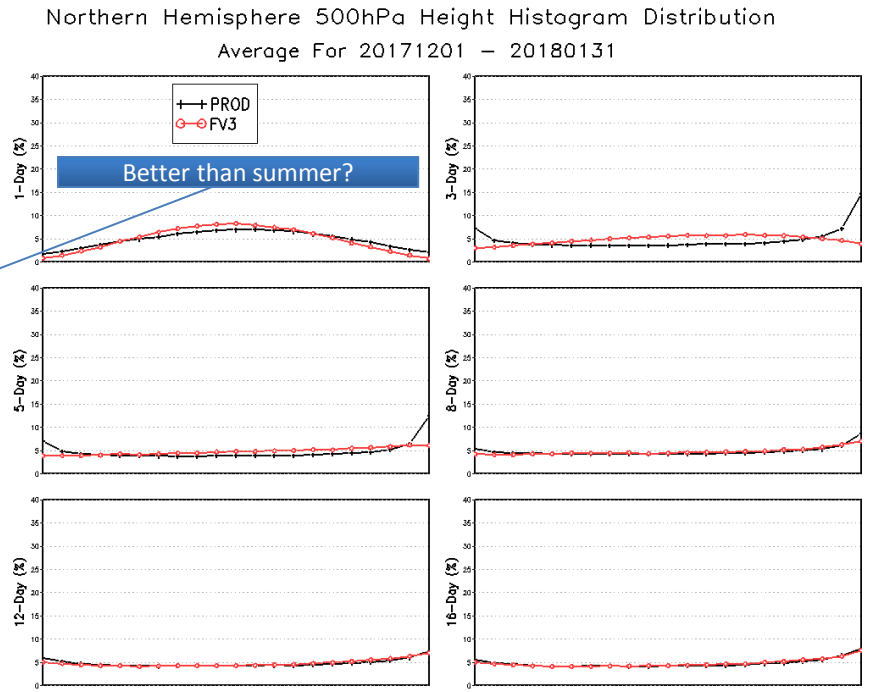
Precipitation: CCPA (CONUS) at 1.0

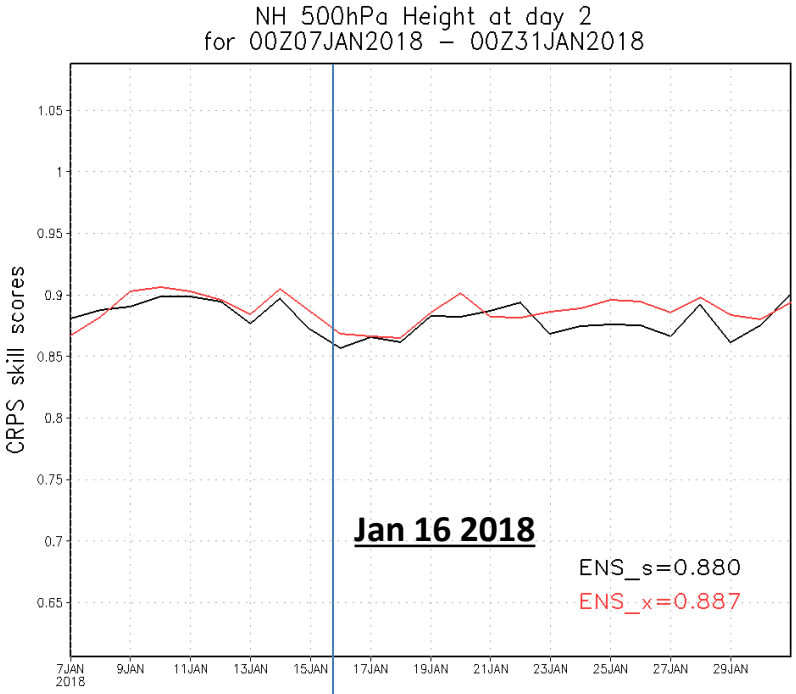
NH 500hPa height

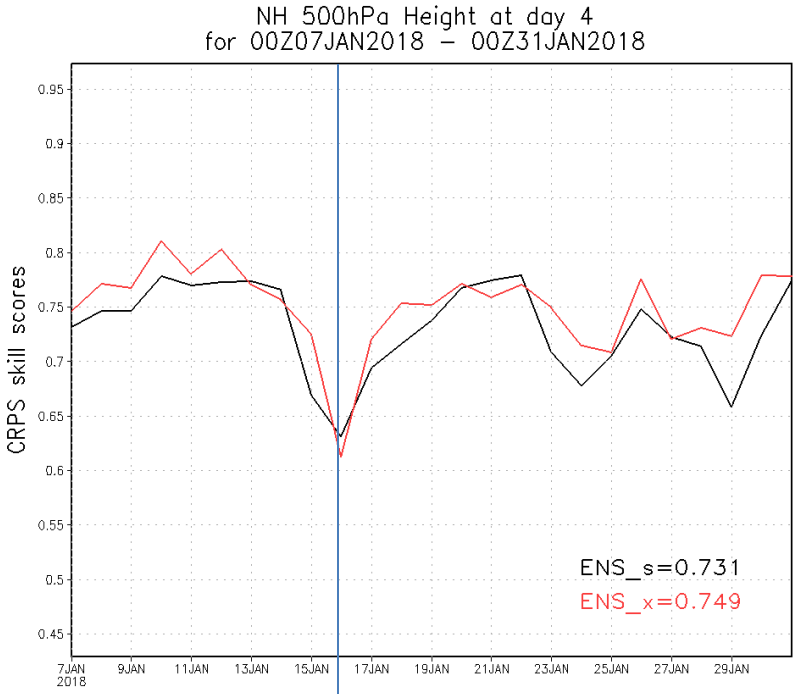


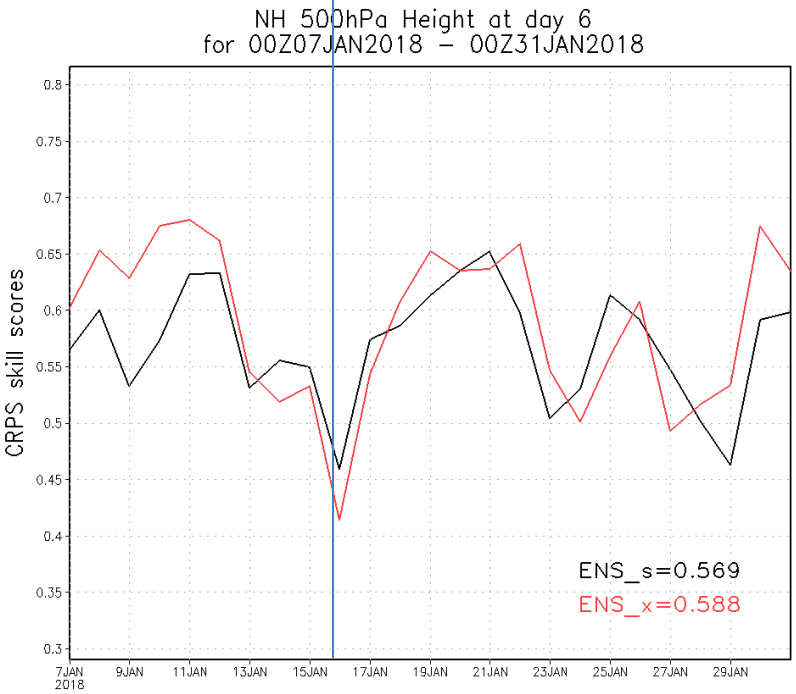


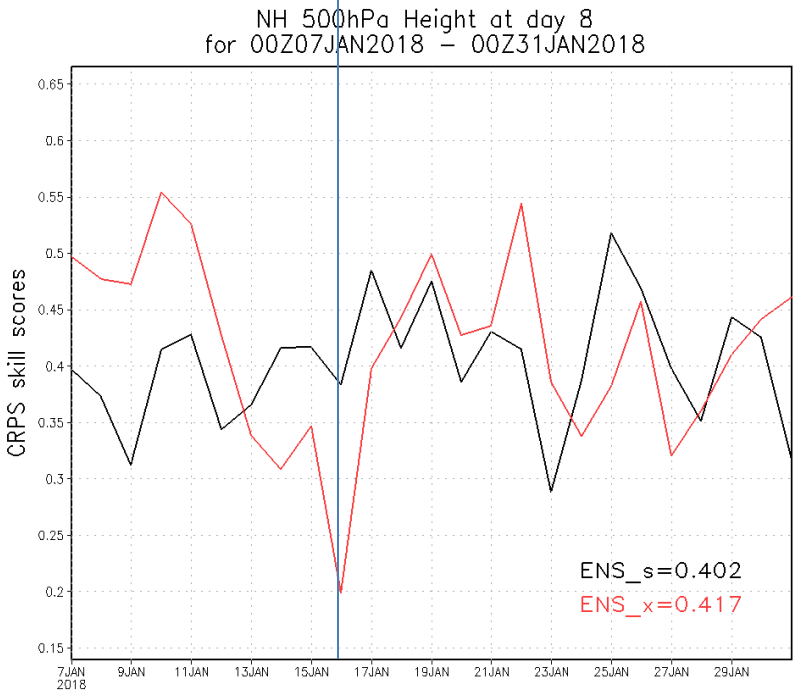


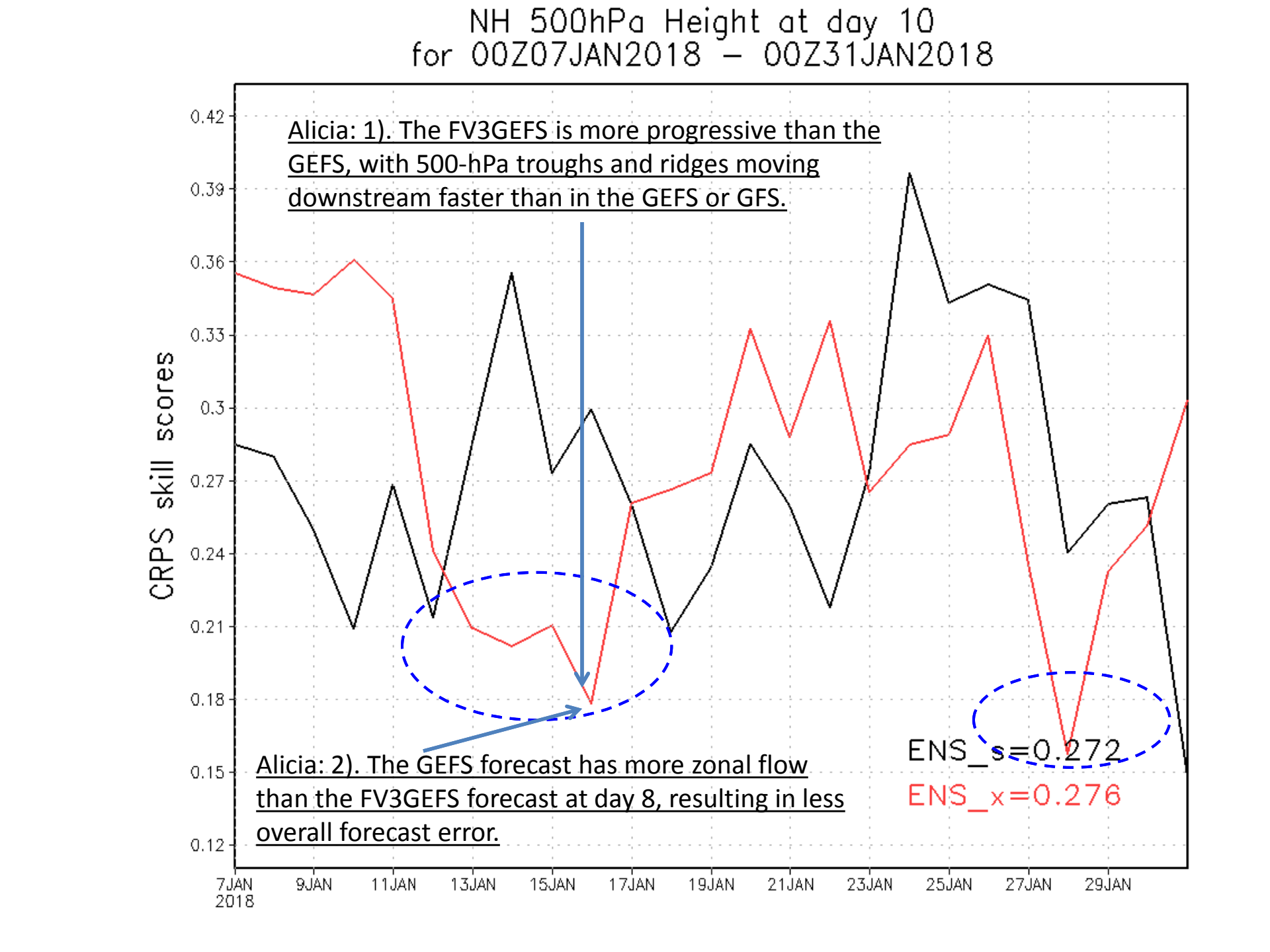


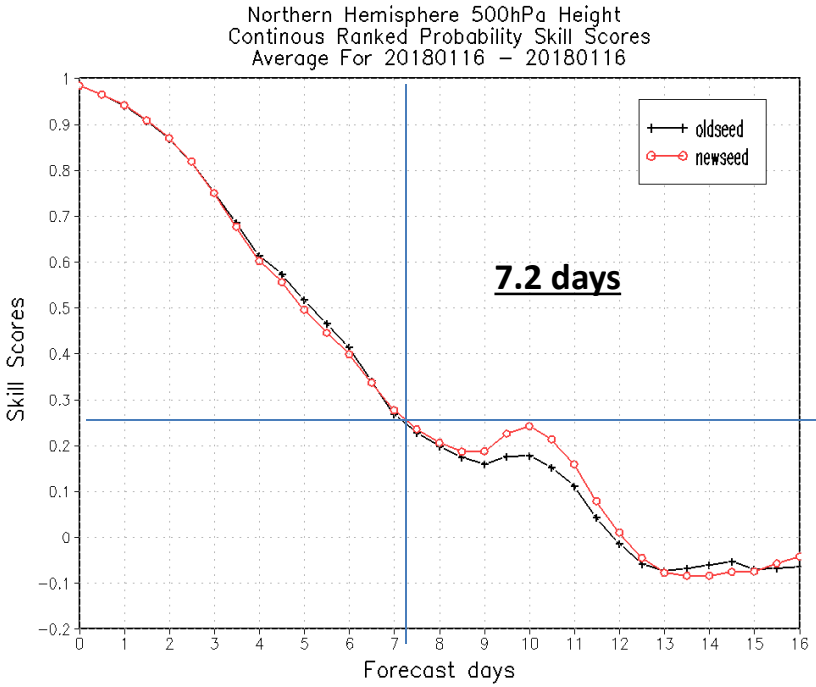

NH 500hPa Height at day 2
for 00Z07JAN2018 – 00Z31JAN2018
CRPS skill scores
Jan 16 2018
ENS_s=0.880
ENS_x=0.887
7JAN 2018
9JAN
11JAN
13JAN
15JAN
17JAN
19JAN
21JAN
23JAN
25JAN
27JAN
29JAN

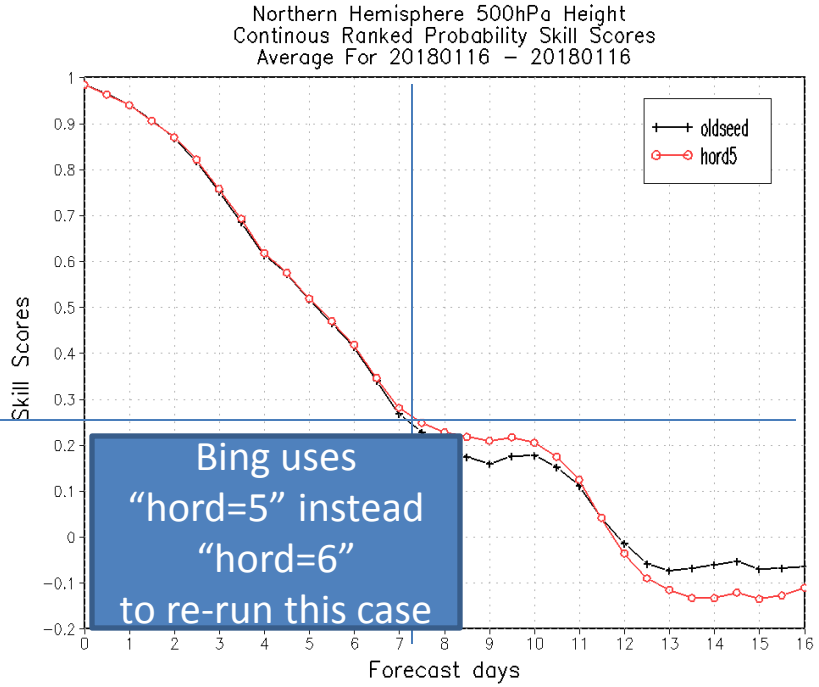

NH 500hPa Height at day 4
for 00Z07JAN2018 – 00Z31JAN2018
CRPS skill scores
ENS_s=0.731
ENS_x=0.749
7JAN 2018
9JAN
11JAN
13JAN
15JAN
17JAN
19JAN
21JAN
23JAN
25JAN
27JAN
29JAN

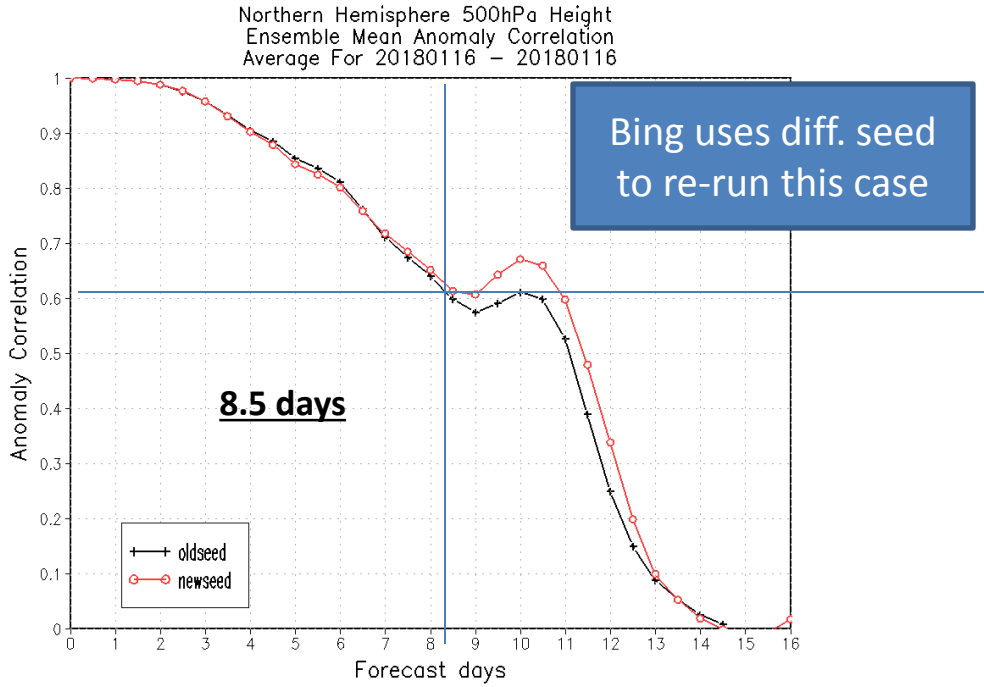

NH 500hPa Height at day 6
for 00Z07JAN2018 – 00Z31JAN2018
CRPS skill scores
ENS_s=0.569
ENS_x=0.588
7JAN 2018
9JAN
11JAN
13JAN
15JAN
17JAN
19JAN
21JAN
23JAN
25JAN
27JAN
29JAN

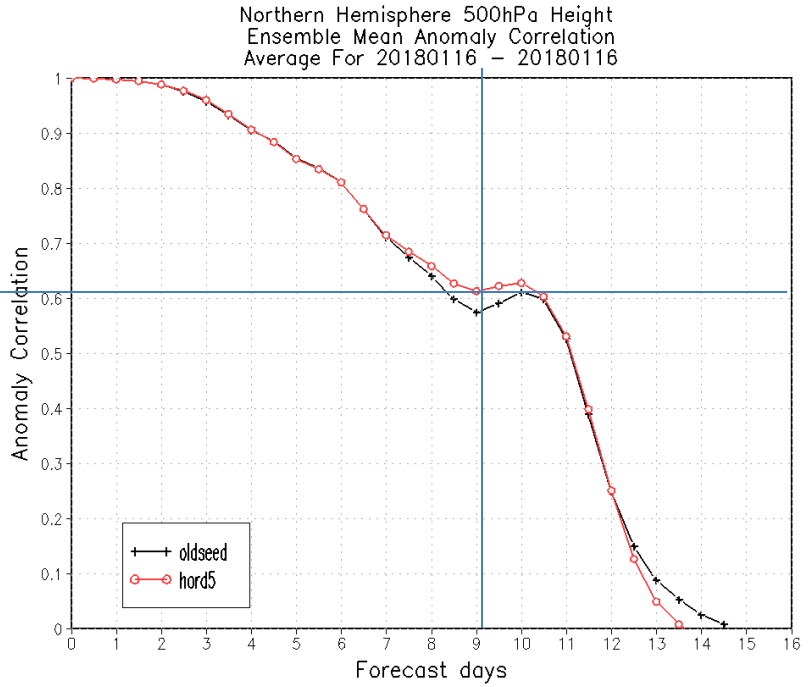

NH 500hPa Height at day 8
for 00Z07JAN2018 – 00Z31JAN2018
CRPS skill scores
ENS_s=0.402
ENS_x=0.417
7JAN 2018
9JAN
11JAN
13JAN
15JAN
17JAN
19JAN
21JAN
23JAN
25JAN
27JAN
29JAN


NH 500hPa Height at day 10
for 00Z07JAN2018 – 00Z31JAN2018
Alicia: 1). The FV3GEFS is more progressive than the GEFS, with 500-hPa troughs and ridges moving downstream faster than in the GEFS or GFS.
Alicia: 2). The GEFS forecast has more zonal flow than the FV3GEFS forecast at day 8, resulting in less overall forecast error.
ENS_s=0.272
ENS_x=0.276
CRPS skill scores
0.42
0.39
0.36
0.33
0.3
0.27
0.24
0.21
0.18
0.15
0.12
7JAN 2018
9JAN
11JAN
13JAN
15JAN
17JAN
19JAN
21JAN
23JAN
25JAN
27JAN
29JAN

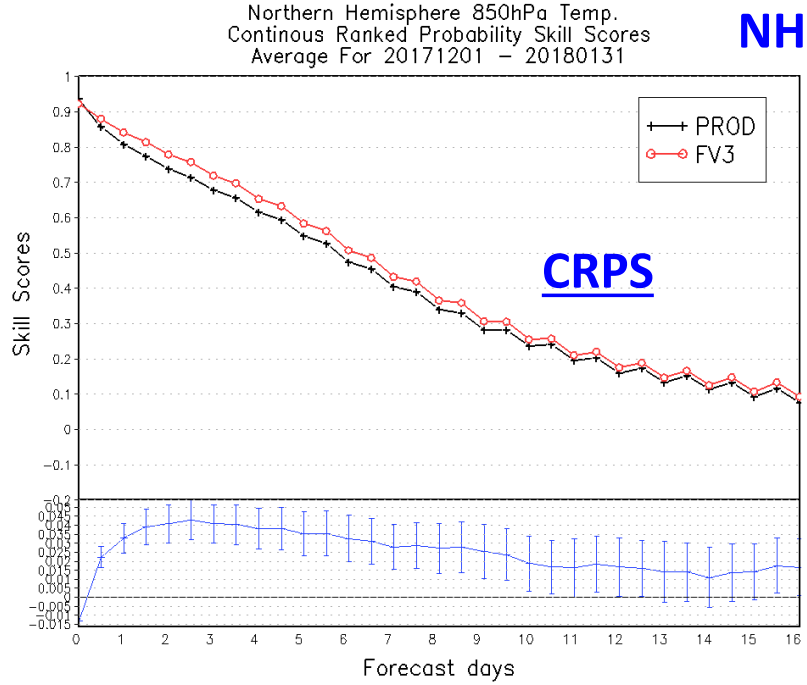

Northern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20180116 – 20180116
oldseed
newseed
7.2 days
Skill Scores
Forecast days

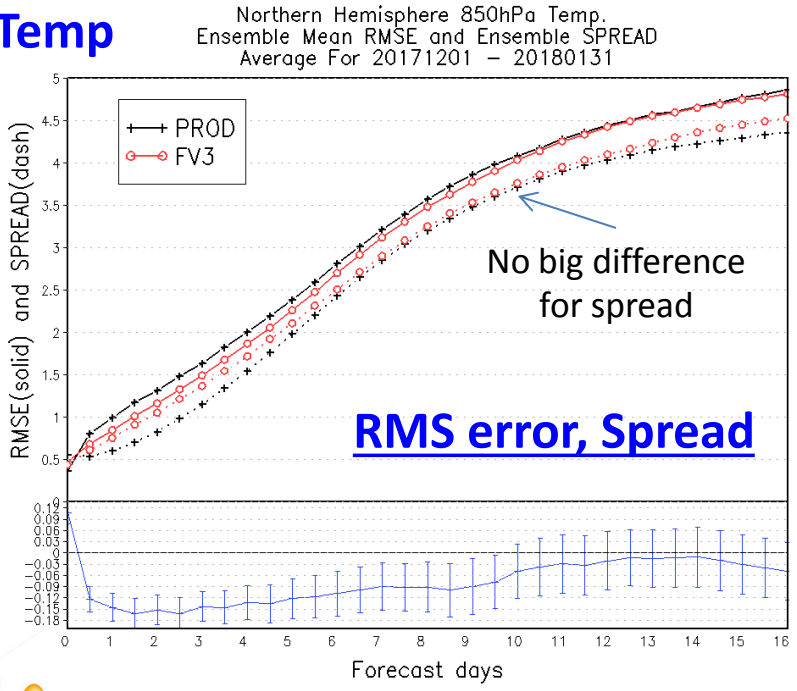

Northern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20180116 – 20180116
oldseed
hord5
Bing uses
“hord=5” instead
“hord=6”
to re-run this case
Skill Scores
Forecast days

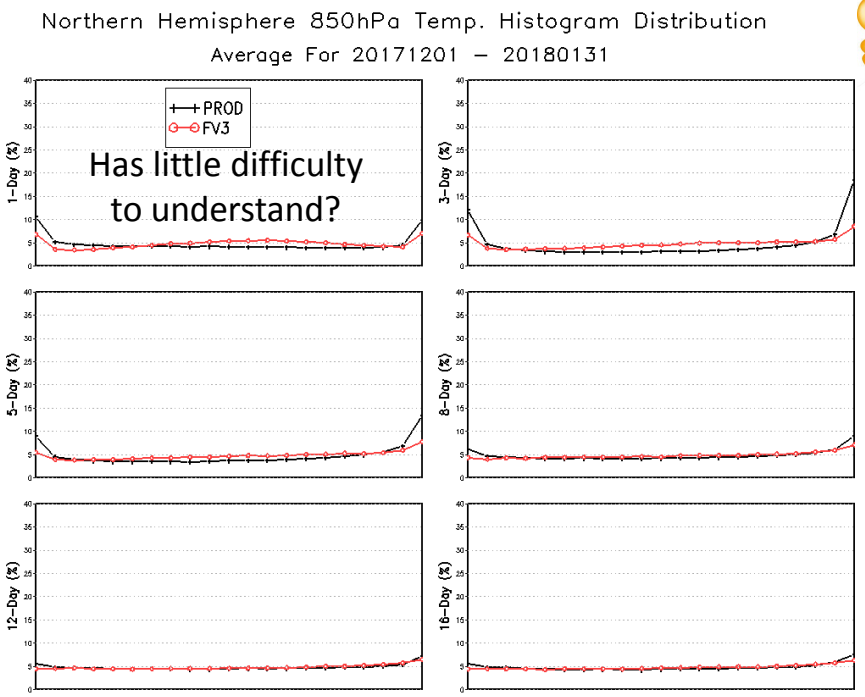

Northern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20180116 – 20180116
Bing uses diff. seed
to re-run this case
8.5 days
oldseed
newseed
Anomaly Correlation
Forecast days

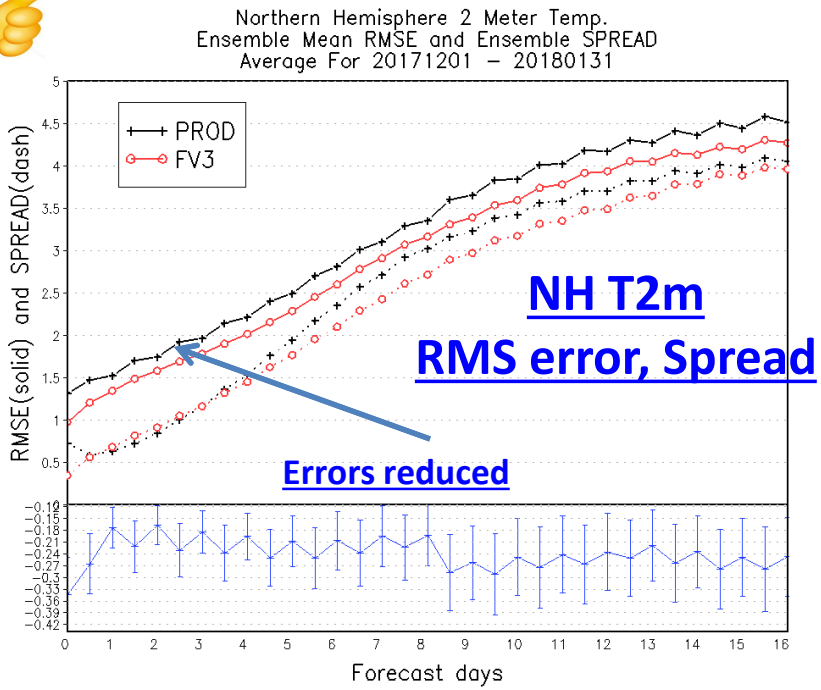

Northern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20180116 – 20180116
oldseed
hord5
Anomaly Correlation
Forecast days

NH 850hPa Temp

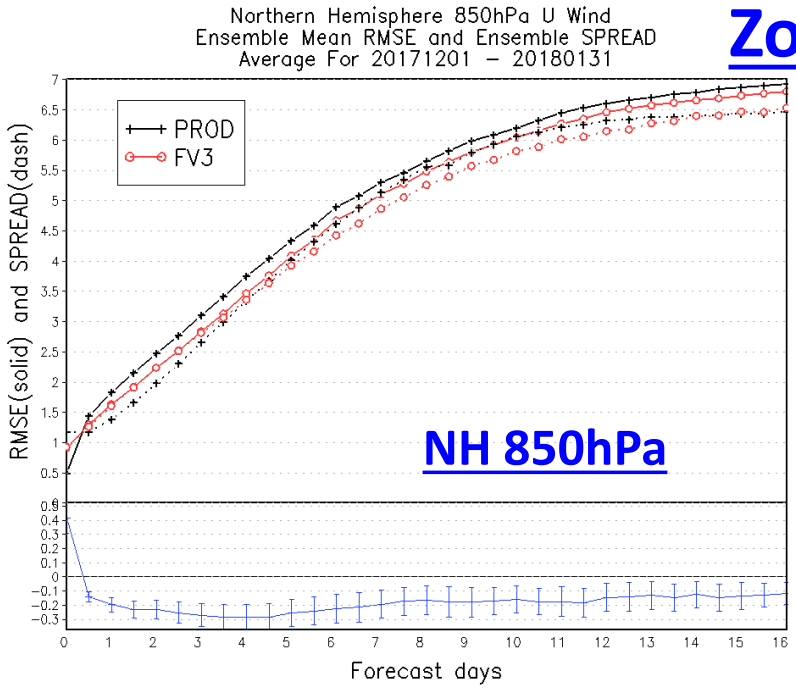


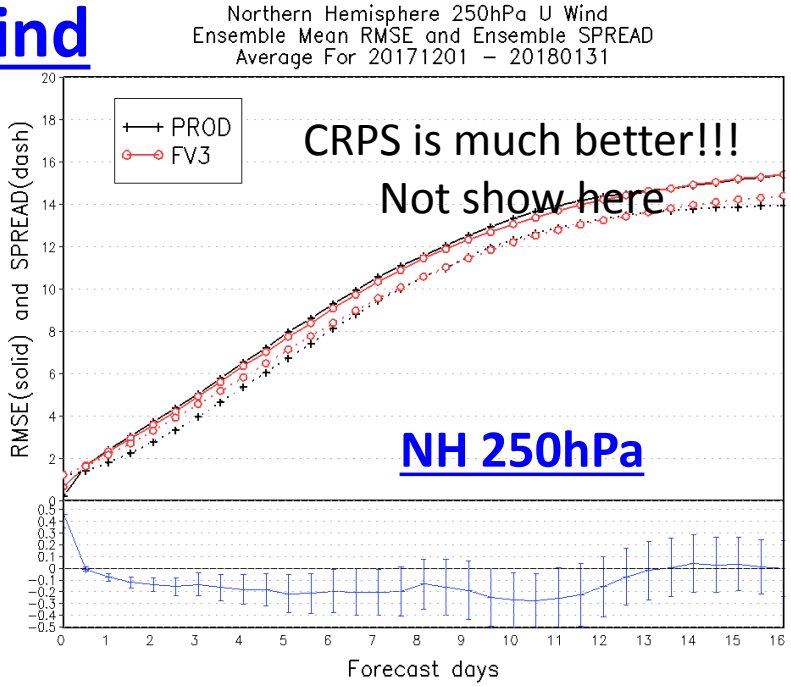


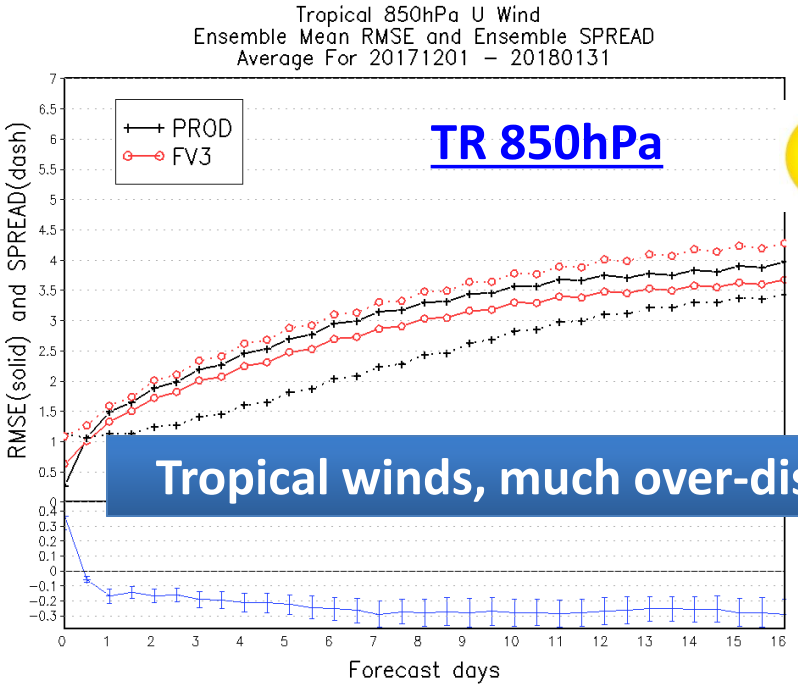


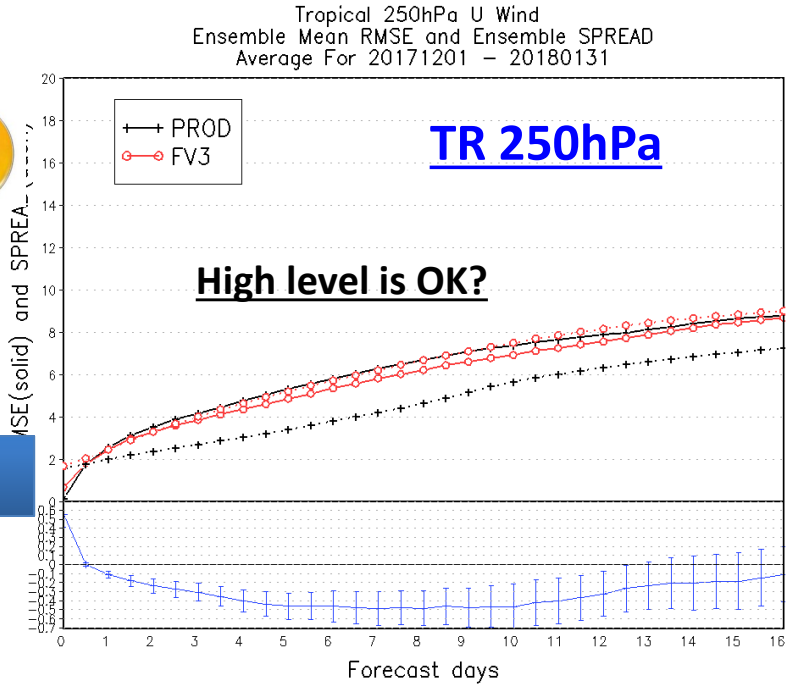


Zonal Wind



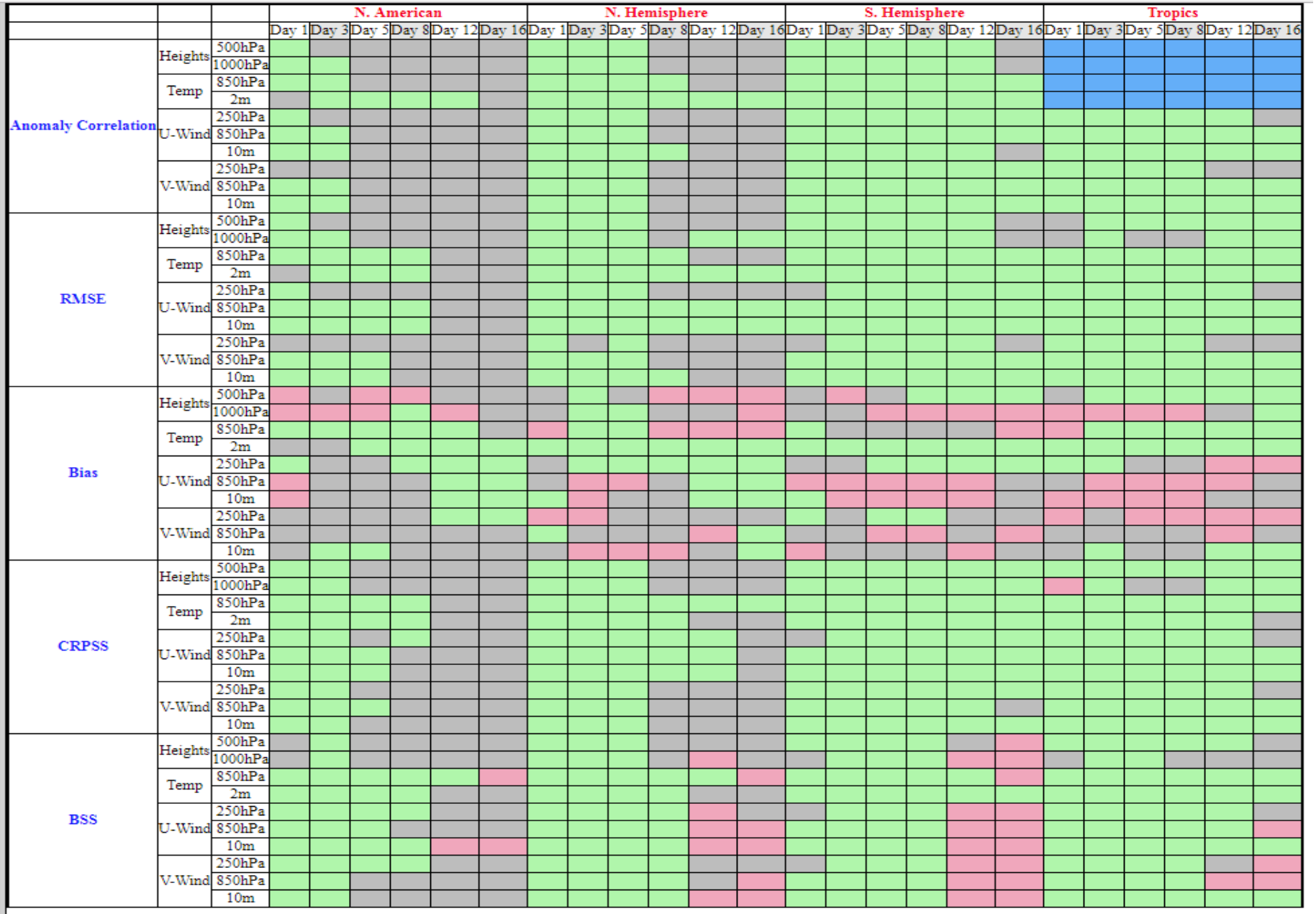


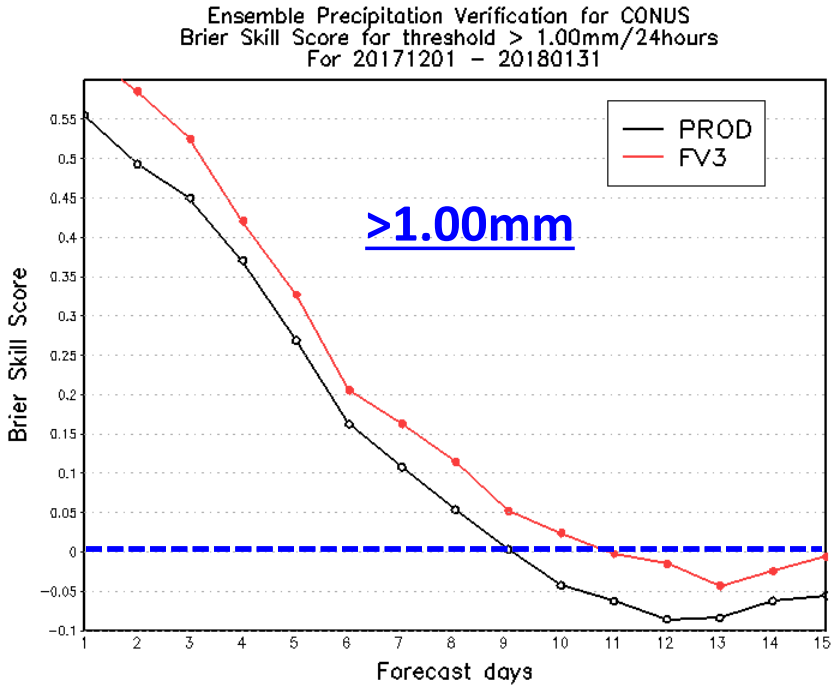


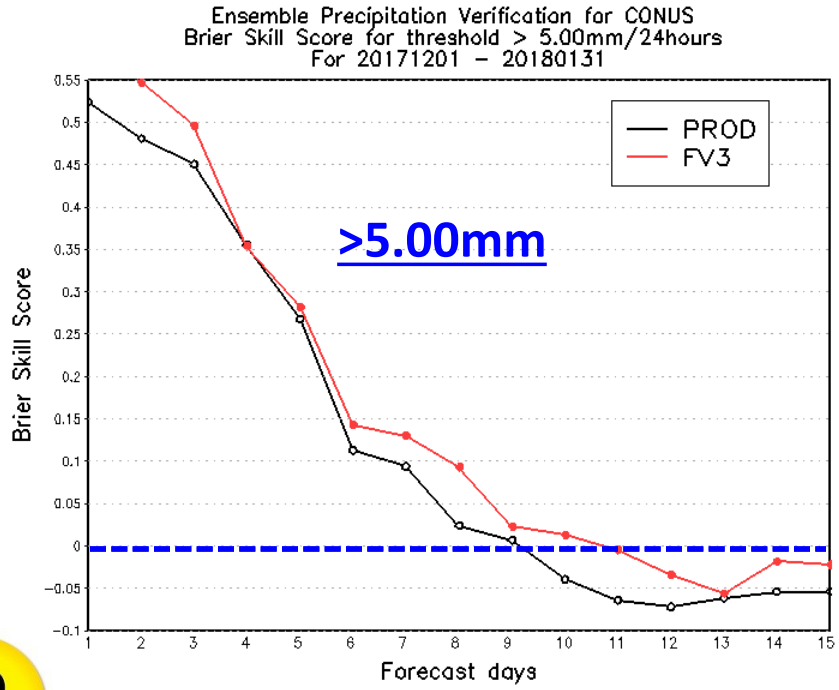


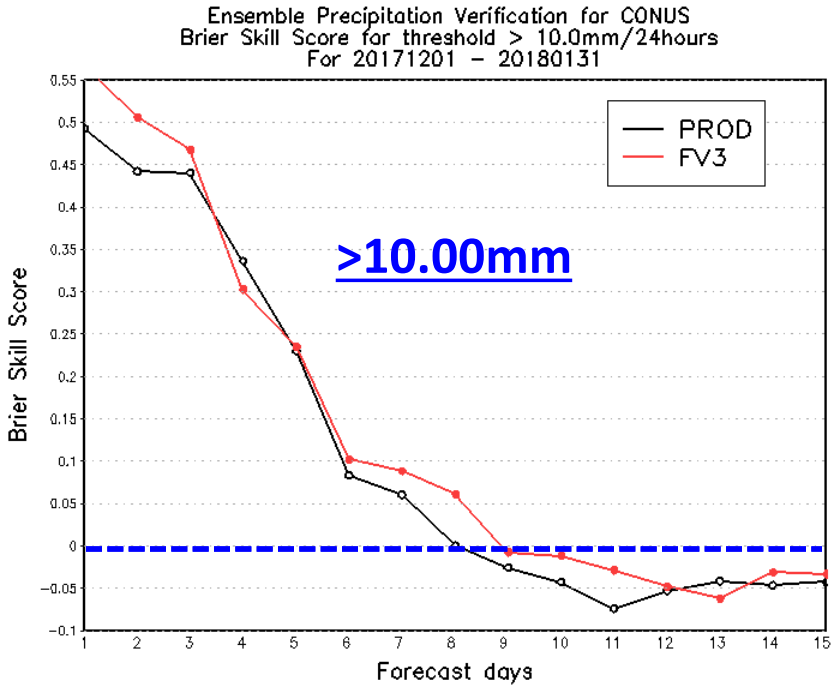
Tropical winds, much over-dispersion

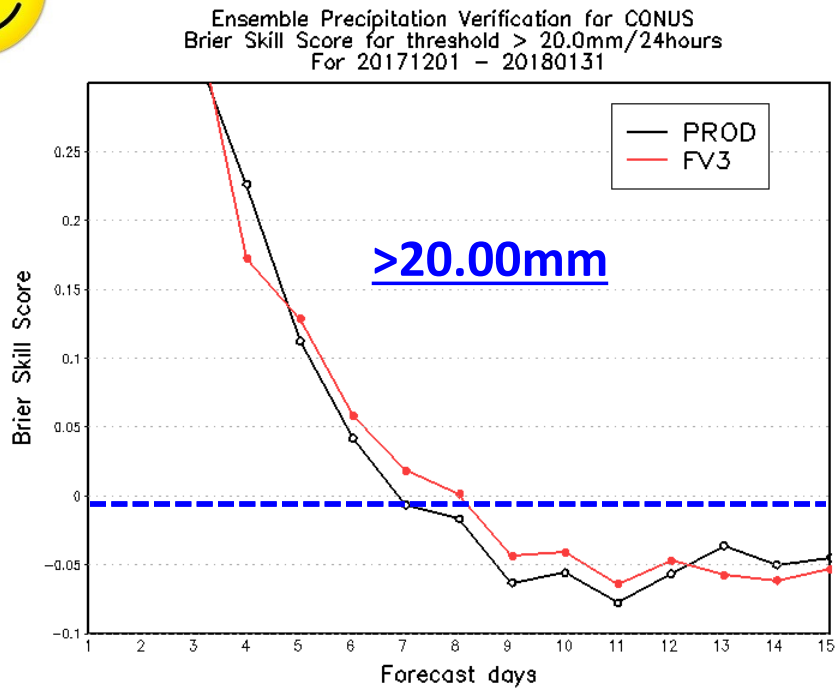
Summer Score Card – Period of Dec. 1st 2017 – Jan. 31 2018 (62 cases)



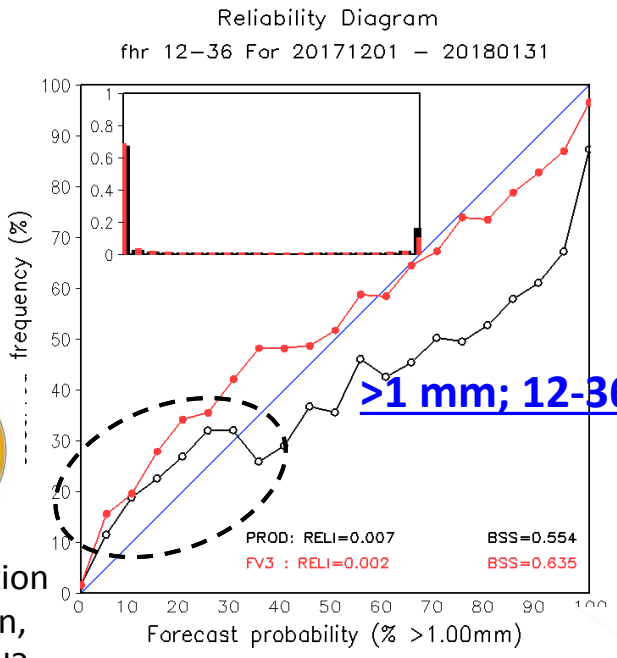

Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 1.00mm/24hours
For 20171201 - 20180131
PROD
FV3
>1.00mm
Brier Skill Score
Forecast days


Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 5.00mm/24hours
For 20171201 - 20180131
PROD
FV3
>5.00mm
Brier Skill Score
Forecast days

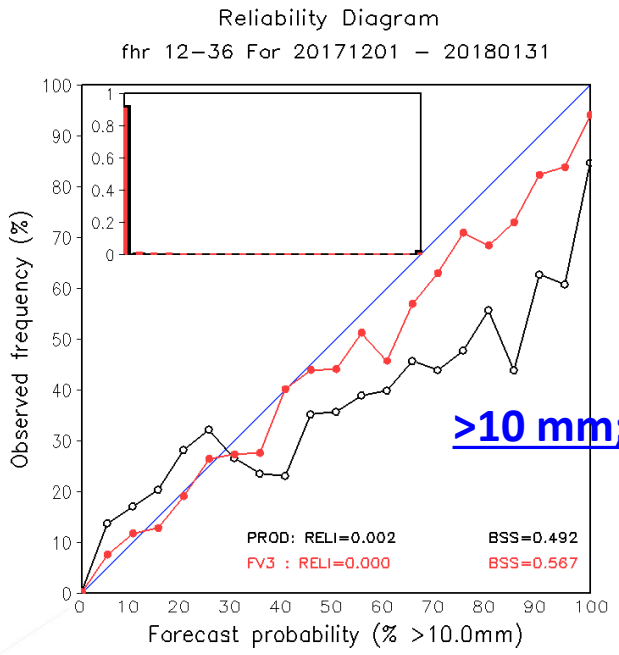

Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 10.0mm/24hours
For 20171201 - 20180131
PROD
FV3
>10.00mm
Brier Skill Score
Forecast days


Ensemble Precipitation Verification for CONUS
Brier Skill Score for threshold > 20.0mm/24hours
For 20171201 - 20180131
PROD
FV3
>20.00mm
Brier Skill Score
Forecast days

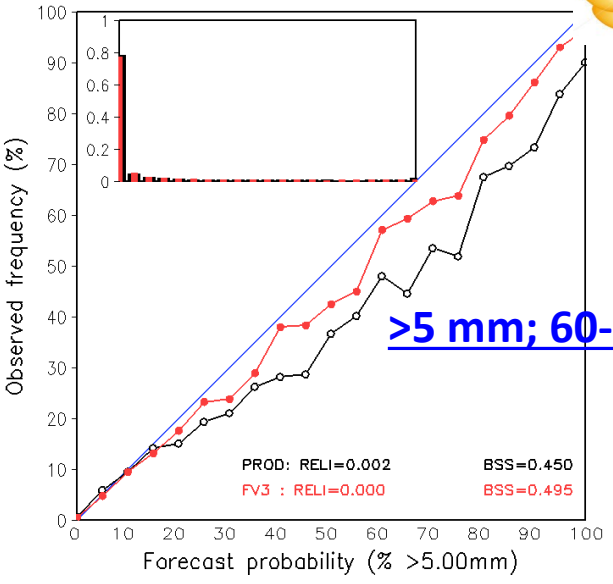
Less prediction of light rain, less spread?



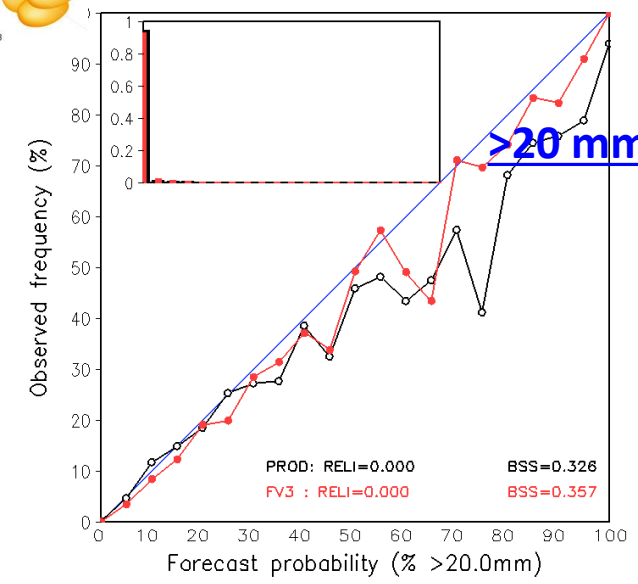
>1 mm; 12-36 hrs



>10 mm; 12-36 hrs



>5 mm; 60-84 hrs



>20 mm; 60-84 hrs

Summary (8/8/2018)

- Summer 2+ months (67 cases) full testing (6/1 – 8/6/2017) for 16 days forecast, after full fixed all bugs we have found.
- NH 500hPa height
  - Good for all lead time, and week-2 as well, especially for CRPS
  - Good spread (and distribution), but question for day-1 Talagrand
- NH 850hPa temperature
  - It is good for all lead-time in terms of skills, spread, and uncertainty distribution, and bias.
- NH zonal winds (850hPa and 250hPa)
  - It is very good
- Tropical zonal winds (850hPa and 250hPa)
  - It is good in terms of error
  - **Concern : large spread or over-dispersion for lower level (mainly).**
- **Precipitation**
  - **It has supper improvement from current operation.**
  - **Especially for reliability – much enhanced spread**
  - **Due to "new stochastic scheme", GFDL MP and others (?)**
- Hurricane tracks
  - One case (Harvey) only, it is better than initialized through operation analysis
  - Good track prediction on 8/23/2018 ooUTC

Summary (8/8/2018)

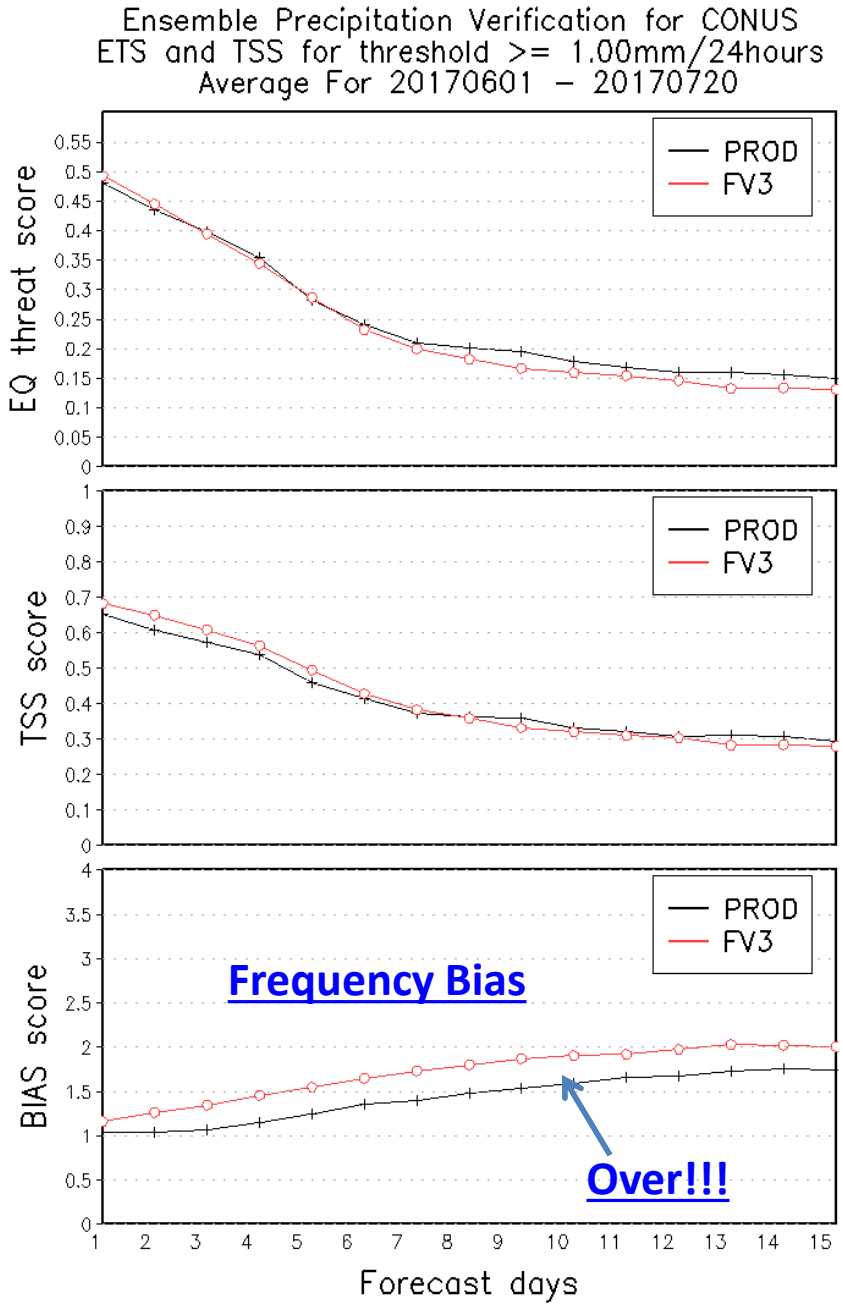
- Winter 2 months (62 cases) full testing (12/1/2017 – 1/31/2018) for 16 days forecast, after full fixed all bugs we have found.
- NH 500hPa height
  - Good for all lead time, and week-2 as well, especially for CRPS
  - Significant better than opr for 1st week, but not as good as summer, especially for week-2
- NH 850hPa temperature
  - It is good for all lead-time in terms of skills, spread, and uncertainty distribution, and bias. Less significant for week-2
- NH zonal winds (850hPa and 250hPa)
  - It is very good
- Tropical zonal winds (850hPa and 250hPa)
  - It is good in terms of error
  - **Concern : large spread or over-dispersion for lower level (mainly).**
- **Precipitation**
  - **It is much better than current operation, but not as good as summer**
  - **Especially for reliability – much enhanced spread**
  - **Due to "new stochastic scheme", GFDL MP and others (?)**
- Drop out case
  - Jan 16 2018 00UTC – much degraded skill score after 3-4 days. This score (and previous couple of days) greatly impact week-2

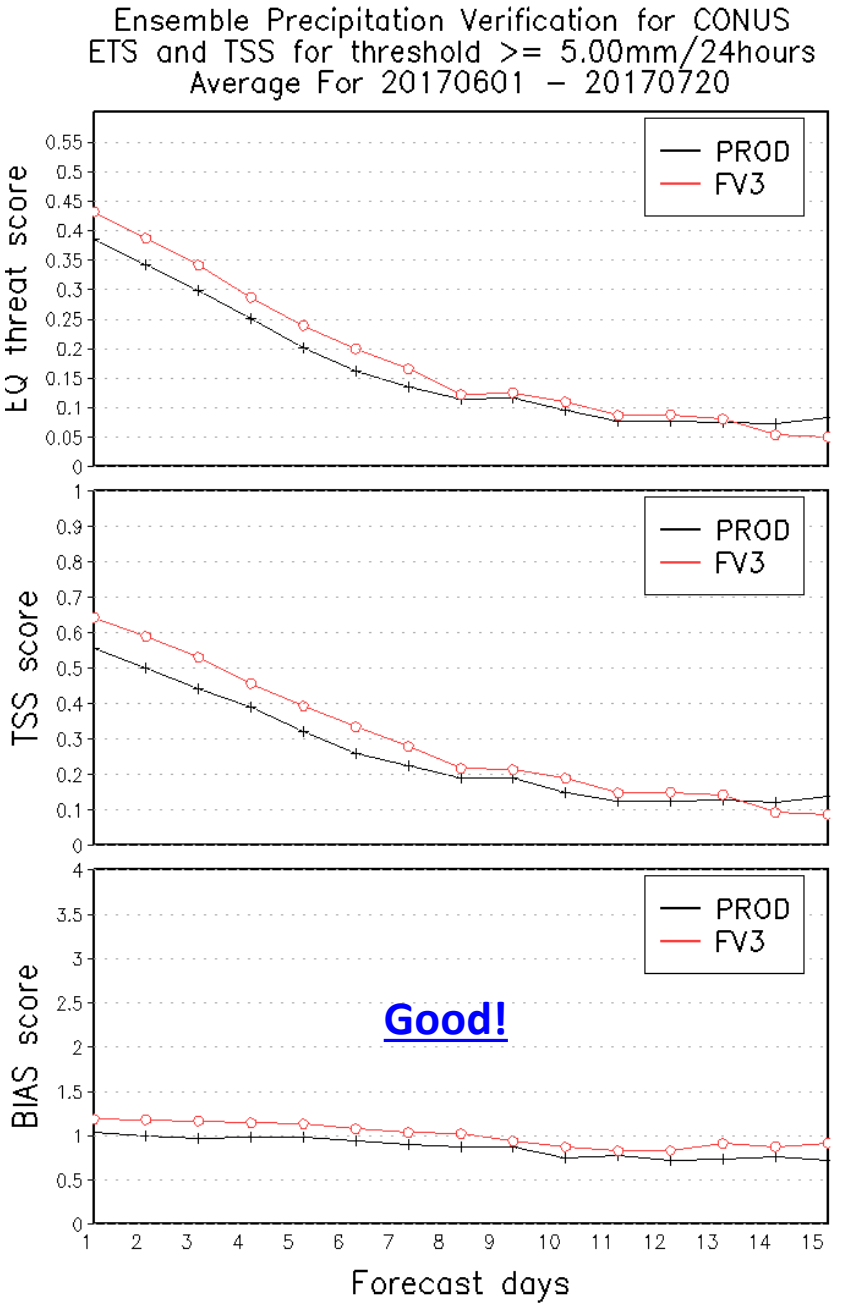
Concerns and/or Issues

- **Tropical over-dispersion for winds**
  - Indicated for all vertical levels, lower level has more, and high level has less
  - Walter has run experiments on thiea (without 2-tiered SST, and not use FV3 retrospective analysis) which shows the similar conclusion.
  - Walter experiments indicate that either reduces 20% SPPT or turn out SHUM will limit over-dispersion for tropical without significant impact for extra-tropical area, but will look at the impact of the precipitation and tropical storm (later).
- **Stability of GEFS**
  - Bing Fu has fund another re-produced crash case for C384 GEFS – one member failed after nearly 16 days integration
  - It happens after previous bug fixed (Jongil)
  - Looks there is a different issue – no clear clue yet
  - Bing Fu can not reproduce this failed case on thiea, therefore, Phil will not be able to jump
  - **Good news - No more crashed case since last one**
- **Precipitation forecast**
  - For >1.0 mm (all precipitation categories), looks both of summer and winter are less biased, but it still has spread issue
  - For >5mm and greater threads, both of spread and bias are much better.

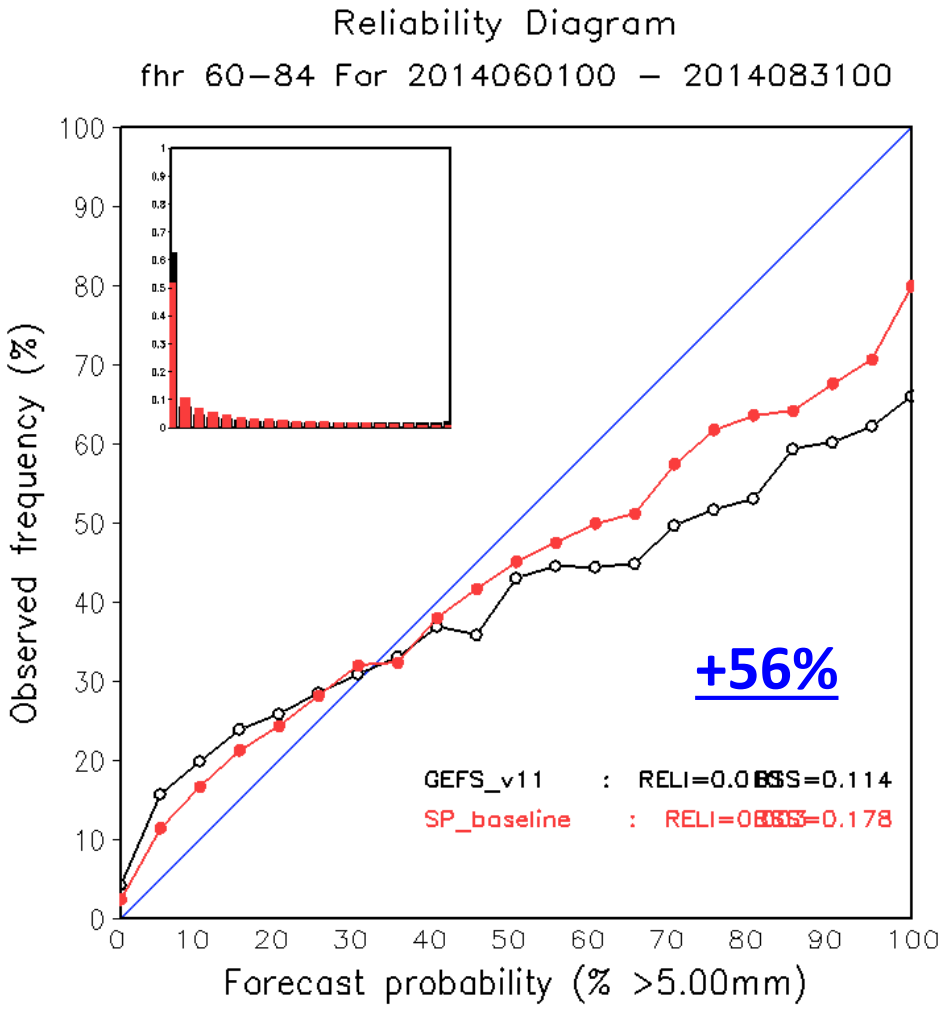
Extra Slides

Ensemble mean verification for FV3 GEFSv12 experiments

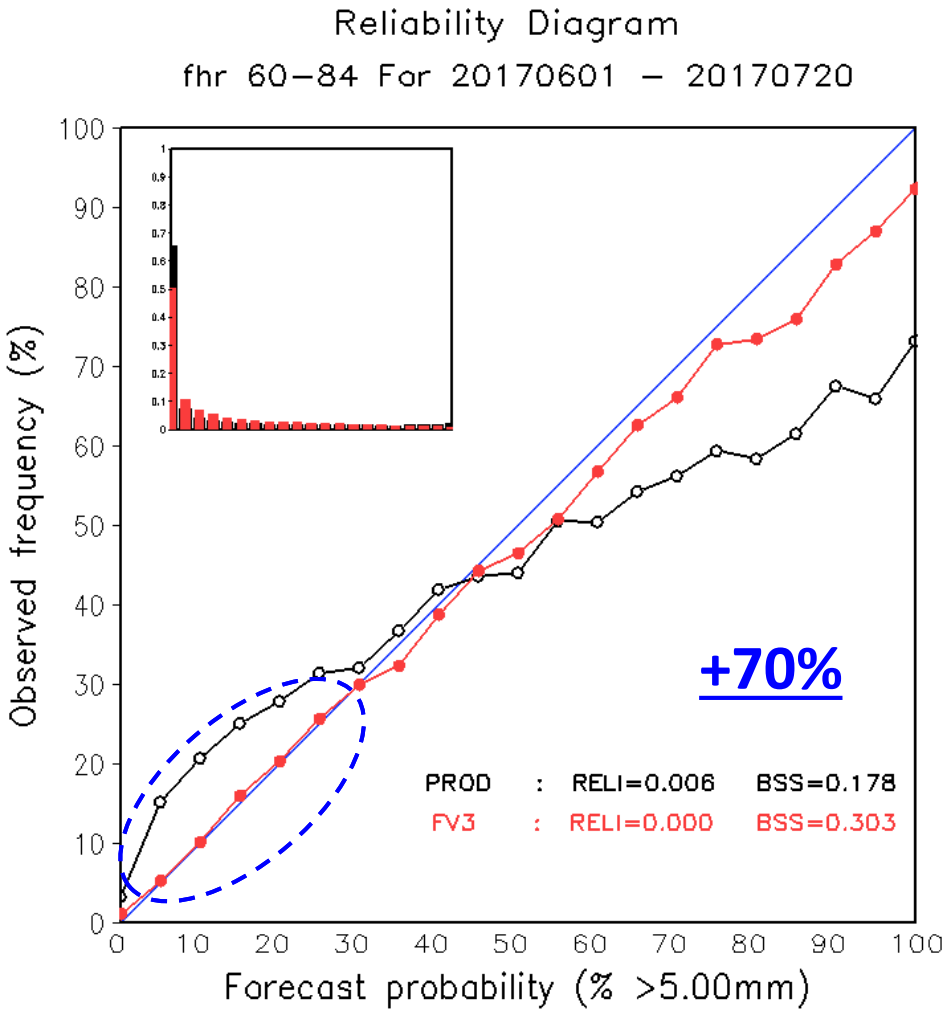




Comparison of GEFSv11 and GEFSv12 with/without new SPs

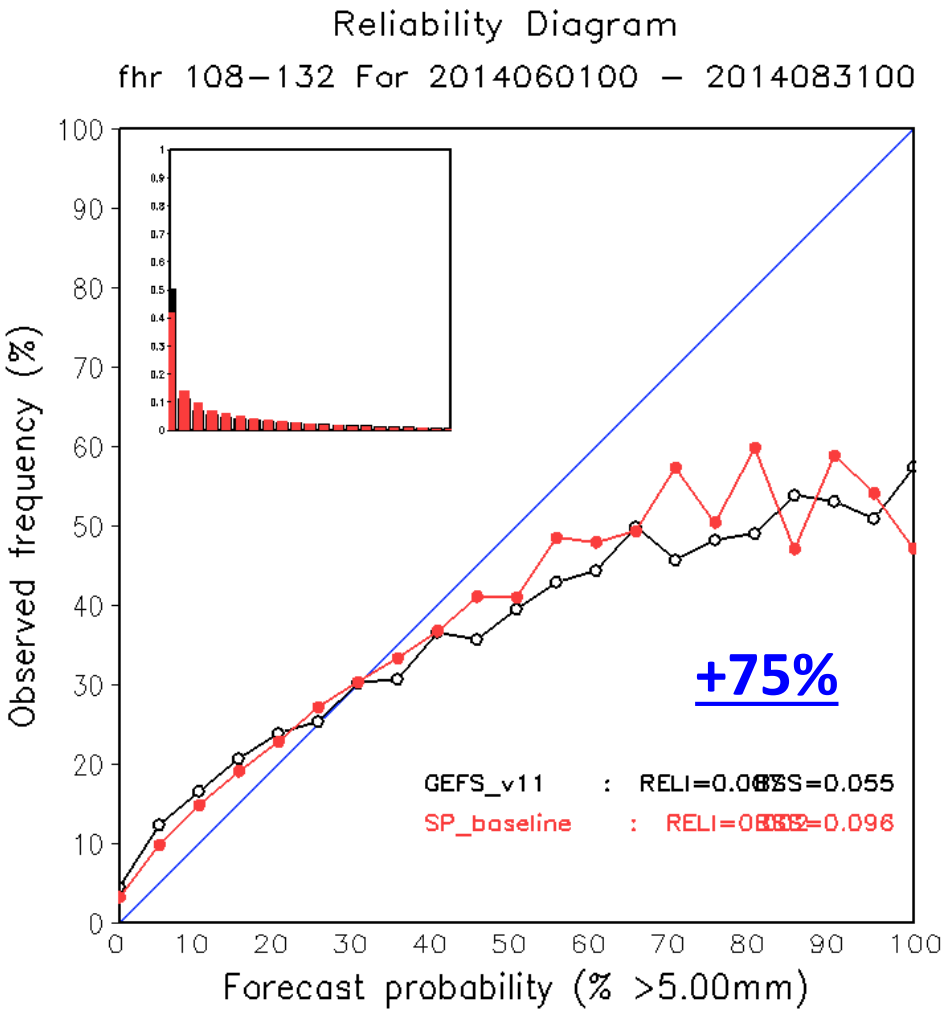


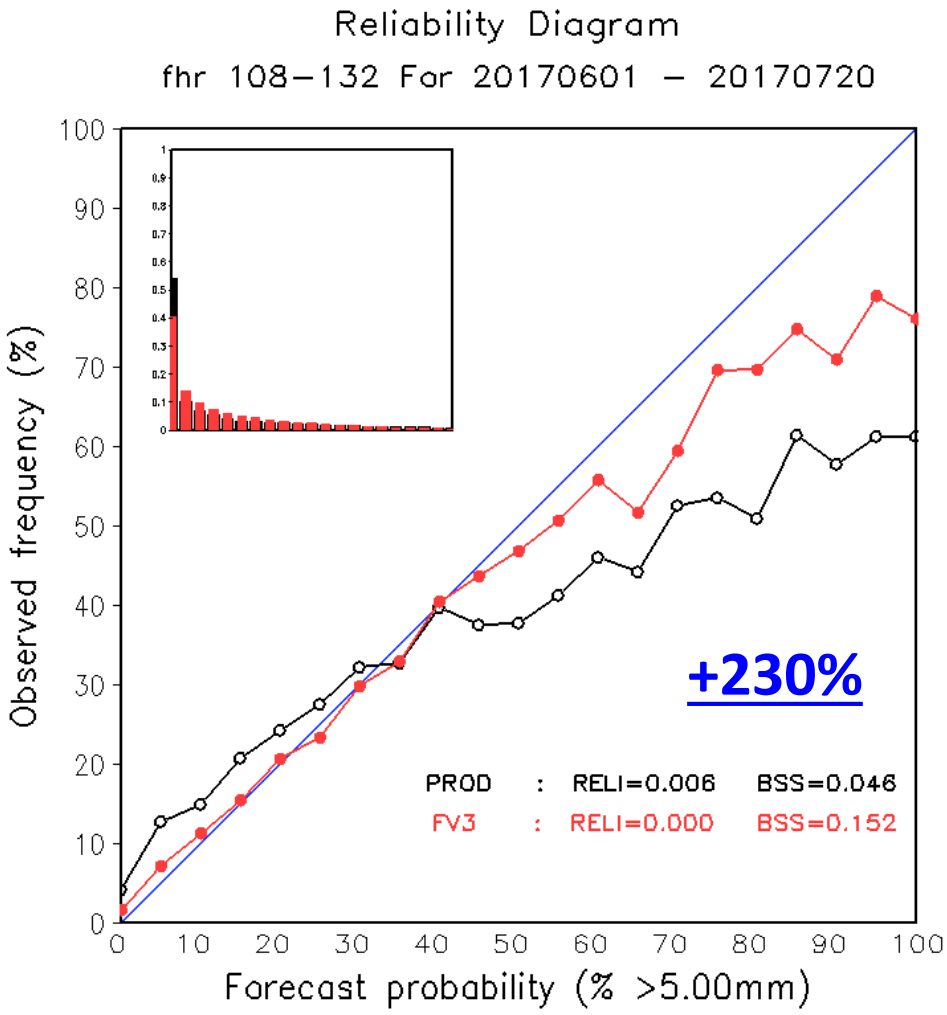
GEFSv11 (STTP) and GEFSv11 (new SPs)



GEFSv11 and GEFSv12

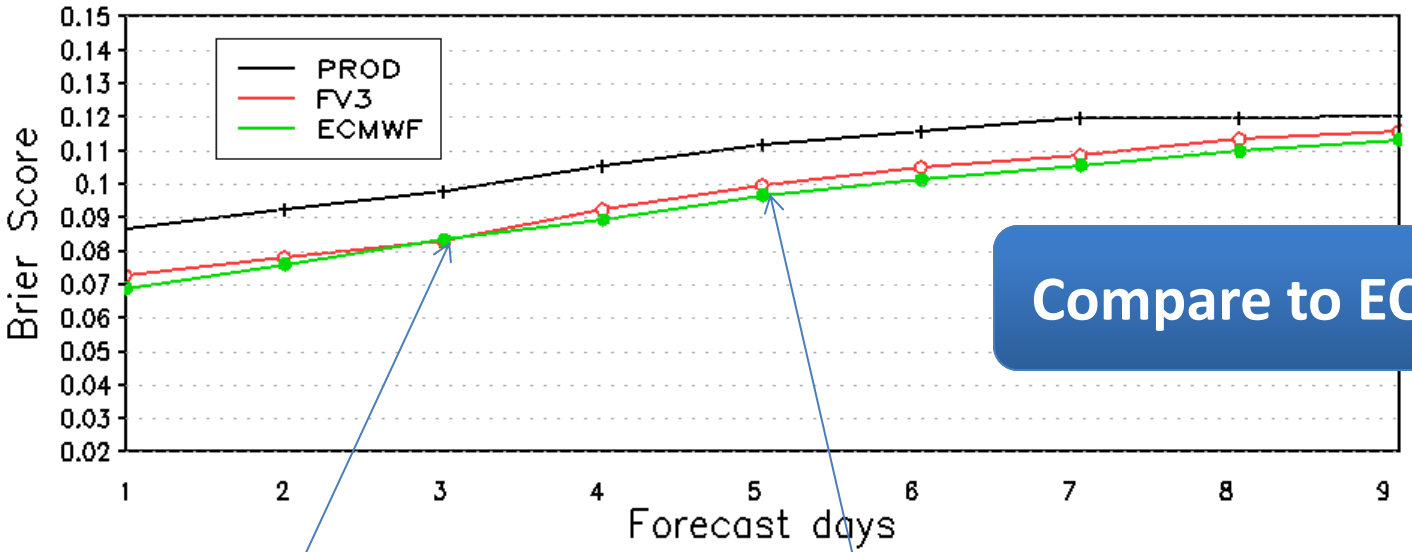
Comparison of GEFSv11 and GEFSv12 with/without new SPs



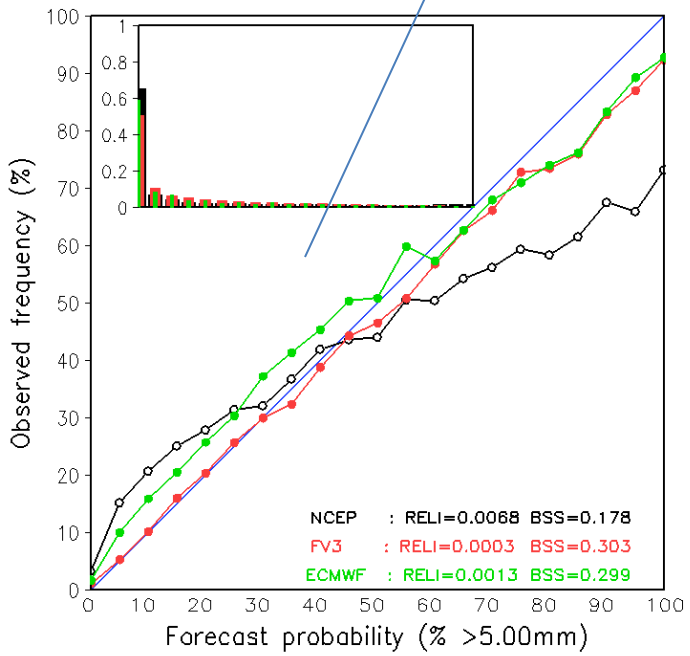


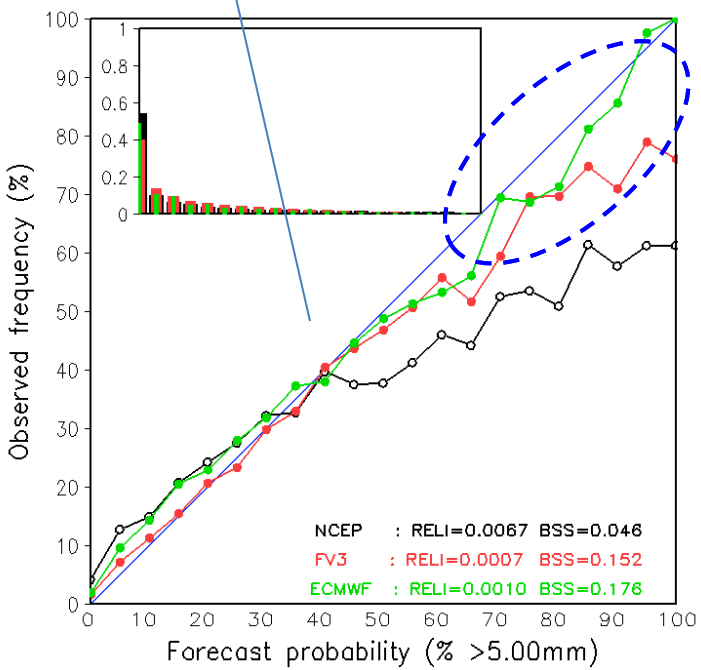
GEFSv11 (STTP) and GEFSv11 (new SPs)

GEFSv11 and GEFSv12



Compare to ECMWF





Could be "ensemble size"