FV3GEFS 35-day Tests and Verification

Wei Li, Eric Sinsky and Bing Fu
Acknowledgement: Xiaqiong Zhou, Hong Guan, Dingchen Hou
Project PI: Yuejian Zhu

Ensemble Project meeting
2018.5.17

Purpose of the Testing

- **Stability**
  - Run fast but stable out to 35 days

- **Performance**
  - Better skill and small bias for major concerned variables compared to OPR and SubX

Configuration

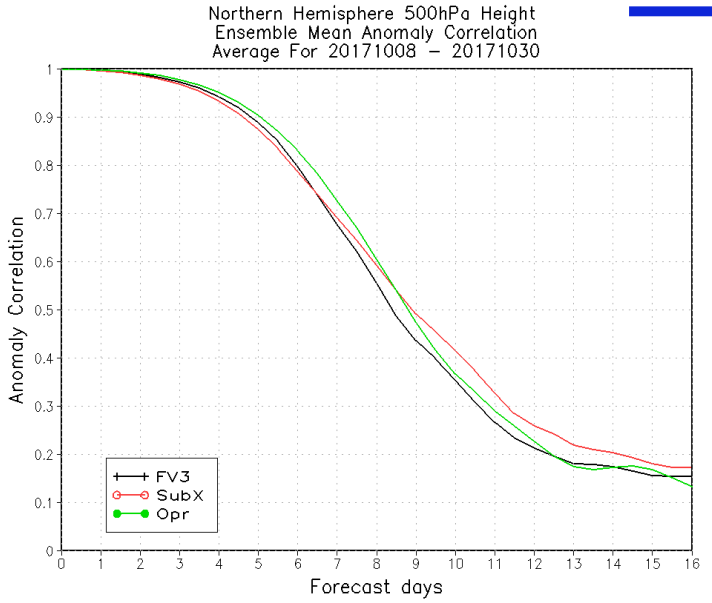
- **Forecast system:** FV3GEFS
- **Resolution:** C384 (~25km), L64
- **Forecast lead time:** 35 days initialized at 00Z
- **Ensemble size:** 21 members (1 control + 20 perturbed members)

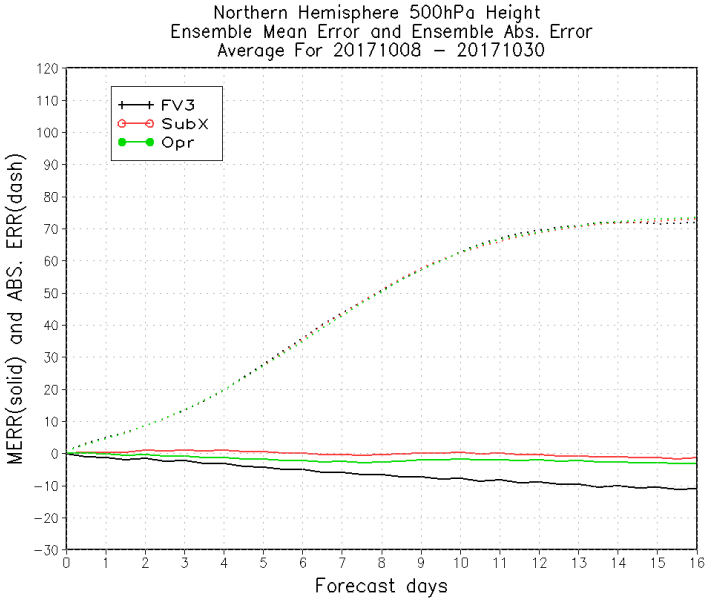
- **Initial Condition:** GFS production analysis + EnKF analysis or f06
- **Boundary SST forcing:** 2-tiered SST

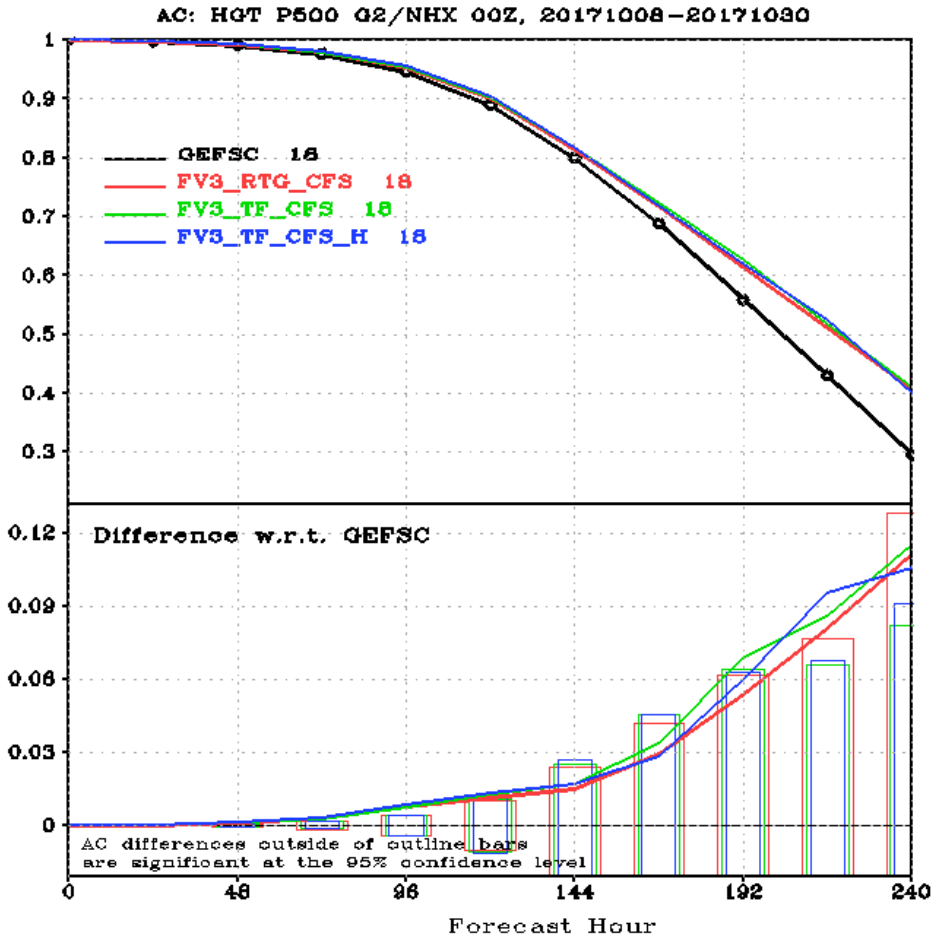
- **Stochastic perturbation:** SPPT + SHUM + SKEB

- **Reference data:** GFS production analysis

Motivation


Northern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20171008 – 20171030
Anomaly Correlation
Forecast days
FV3
SubX
Opr


Northern Hemisphere 500hPa Height
Ensemble Mean Error and Ensemble Abs. Error
Average For 20171008 – 20171030
MERR(solid) and ABS. ERR(dash)
Forecast days
FV3
SubX
Opr


AC: HGT P500 G2/NHX 00Z, 20171008-20171030
GEFSC 18
FV3_RTG_CFS 18
FV3_TF_CFS 18
FV3_TF_CFS_H 18
Difference w.r.t. GEFSC
AC differences outside of outline bars
are significant at the 95% confidence level
Forecast Hour

Primary Tests for Ensemble Run

Testing Period	ICs	SST	NSST	DT	Perturbation setting
20171008-20171030 (job015->)	old gfs	2-tiered using nst tref, 0.25x0.25	2,1,5,0,0	dt=300	SHUM=0.006 LS=250.E3
20171101-20171120 (job015->)	opr gfs, enkf analysis	2-tiered using nst tref, 0.25x0.25	2,0,5,0,0	dt=300	SHUM=0.004 LS=250.E3
20171008-20171018 (job010->)	opr gfs analysis, f06 enkf	2-tiered using nst tref, 0.25x0.25	2,0,5,0,0	dt=300	SHUM=0.004 LS=500.E3
20180101-20180411 (job010->)	opr gfs analysis, f06 enkf	2-tiered using nst tref, 0.25x0.25	2,0,5,0,0	dt=450	SHUM=0.004 LS = 500.E3

Primary Tests for Control Only

Testing Period	ICs	SST	NSST	DT
20170720-20180131 (job015->)	opr gfs analysis	2-tiered using nst tref, 0.25x0.25	2,0,5,0,0	dt=300
20170720-20180131 (job015->)	opr gfs analysis	RTG Climatological SST	2,0,0,0,0	dt=300

Outline of the Verification Result

1. **Control member only (model bias issue)**

- **Investigating objectives: 2-tiered SST**
- **Experiments: 2-tiered SST vs. OPR SST**

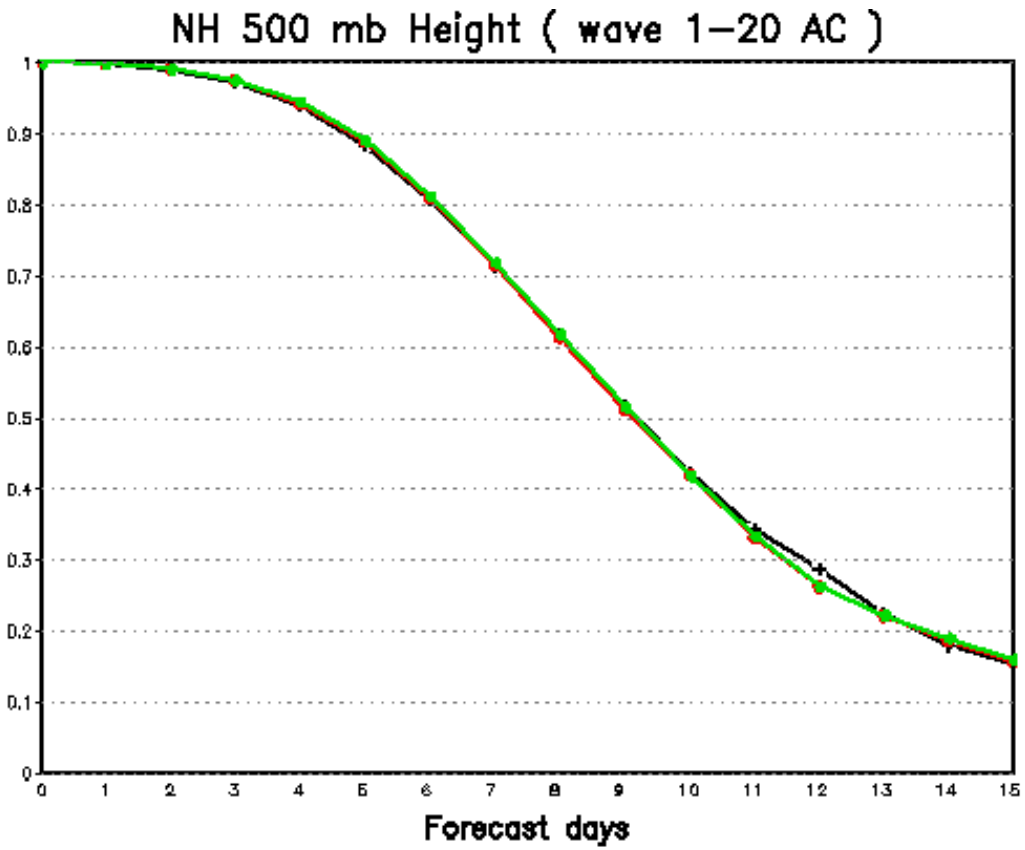
2. **Ensemble (spread and ensemble mean bias)**

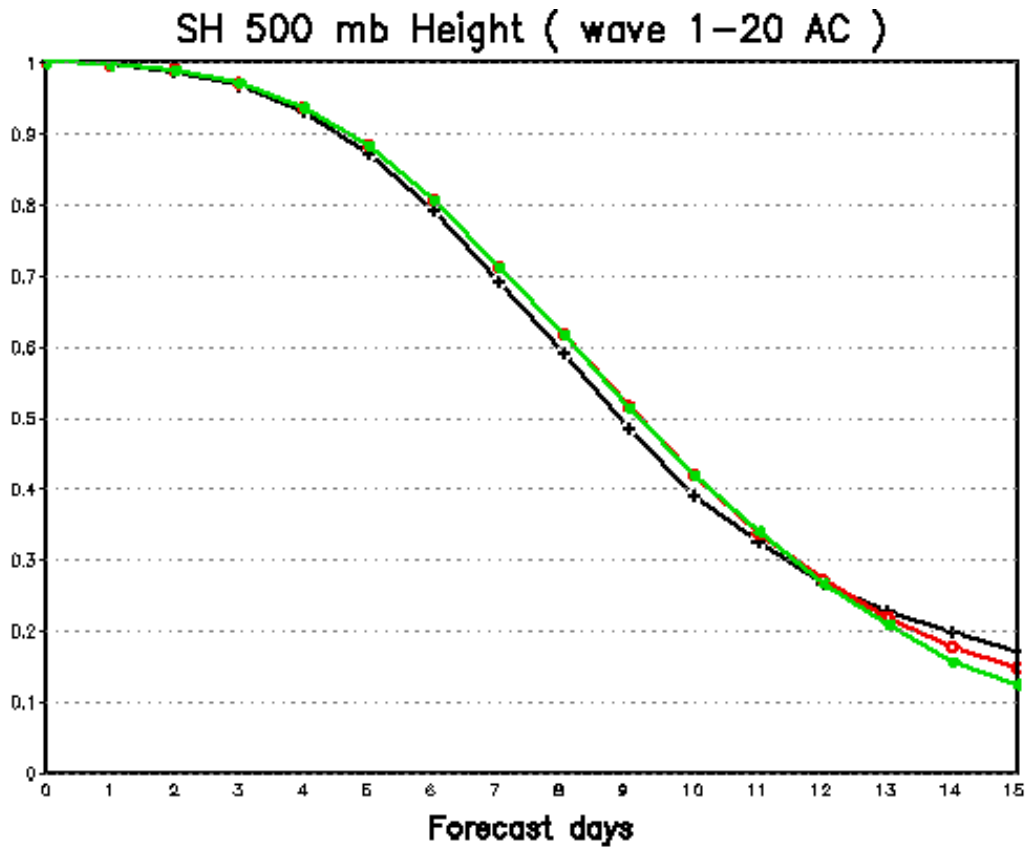
- **Investigating objectives: SKEB and SHUM length scale, initial condition**

20170720-20180131: Control Member only

ICs	SST	NSST	DT
opr gfs analysis	2-tiered using nst tref, 0.25x0.25	2,0,5,0,0	dt=300
opr gfs analysis	RTG Climatological SST	2,0,0,0,0	dt=300

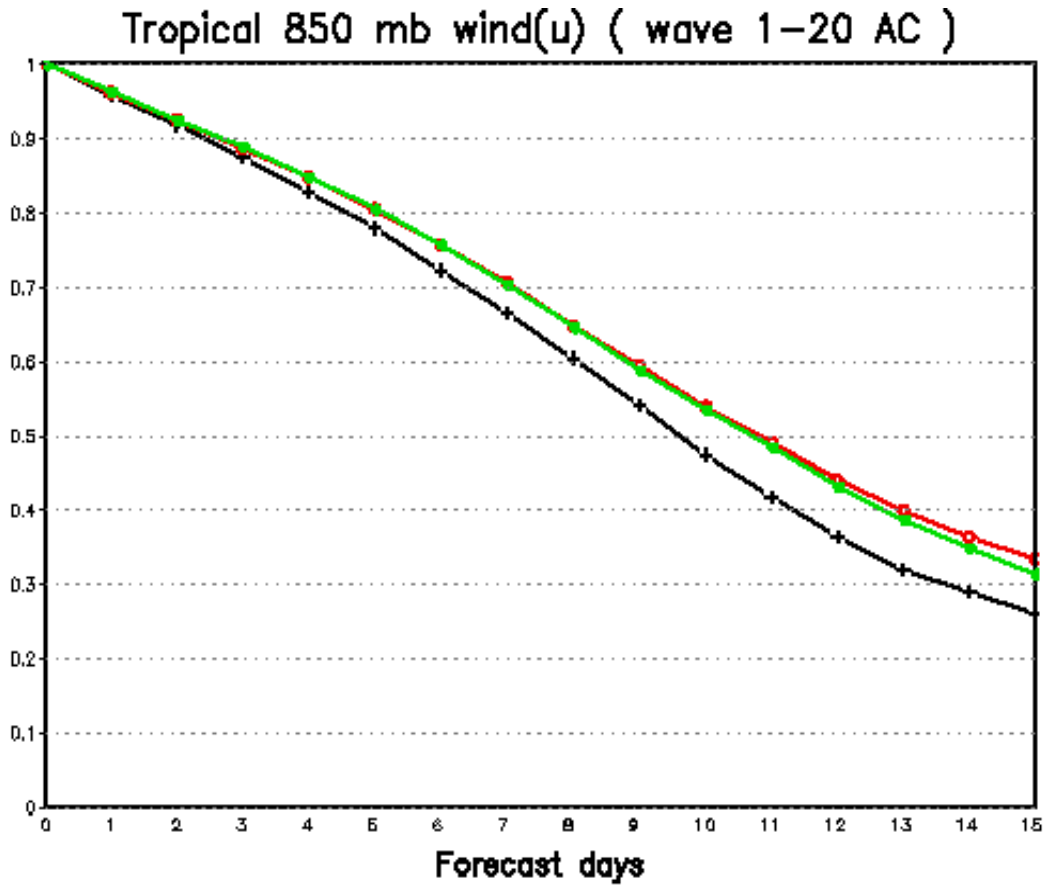
6-month Control-Only Extratropical Evaluation: Anomaly Correlation

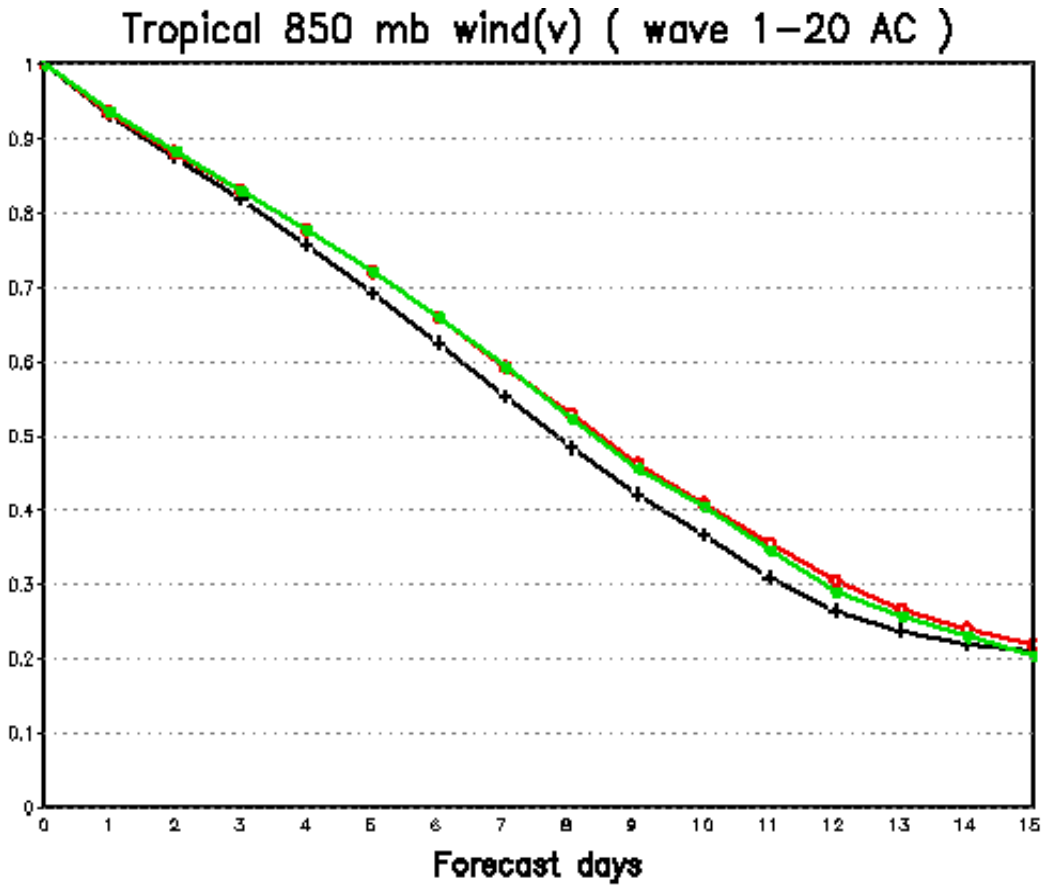




1. Operational GEFS CTL [**black line**]
2. FV3GEFS CTL - 2-tiered SST - NSST (nstf_name:-"2,0,5,0,0") [**red line**]
3. FV3GEFS CTL - Operational SST (damped to RTG climatology) - NSST (nstf_name:-"2,0,0,0,0) [**green line**]

6-month Control-Only Tropical Evaluation: Anomaly Correlation





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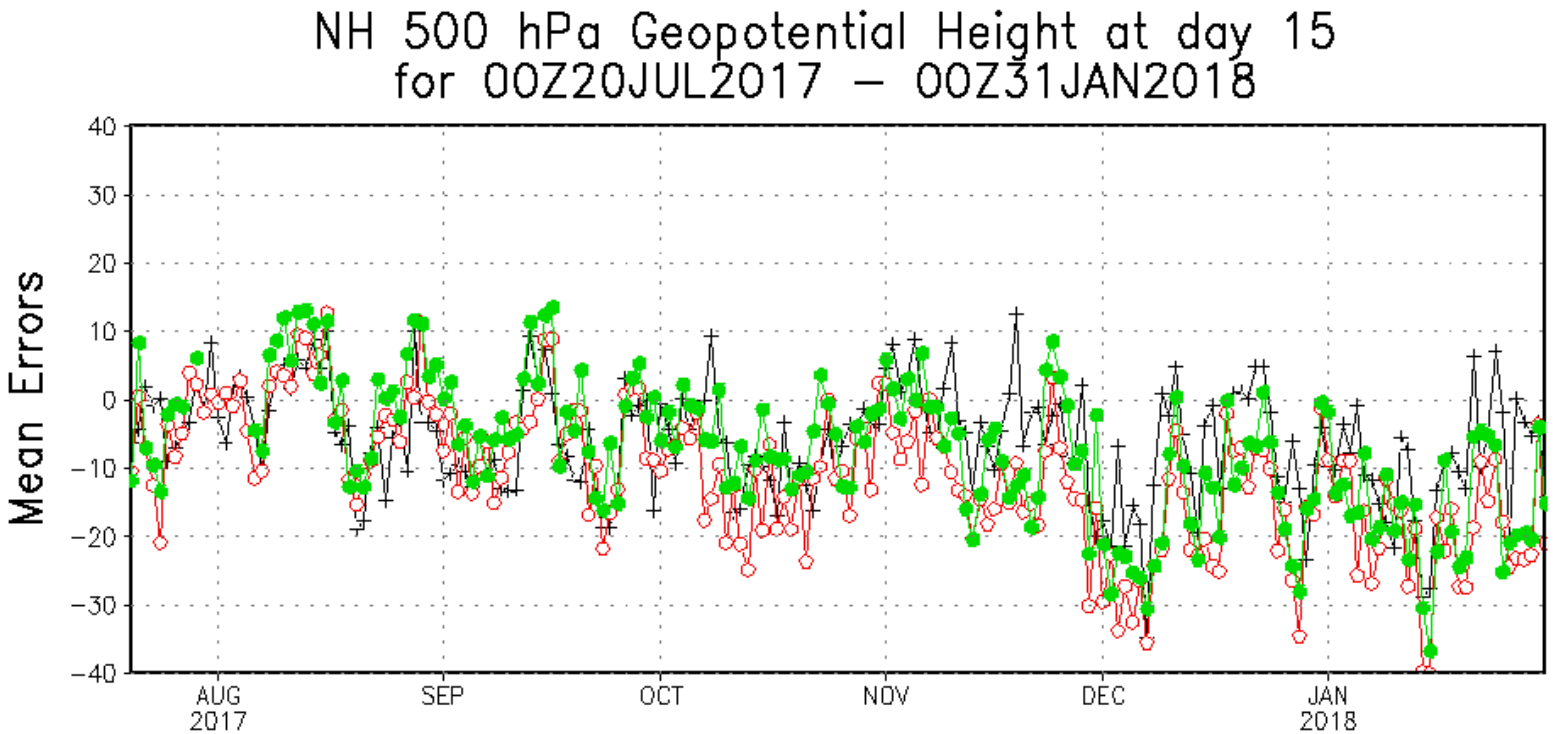
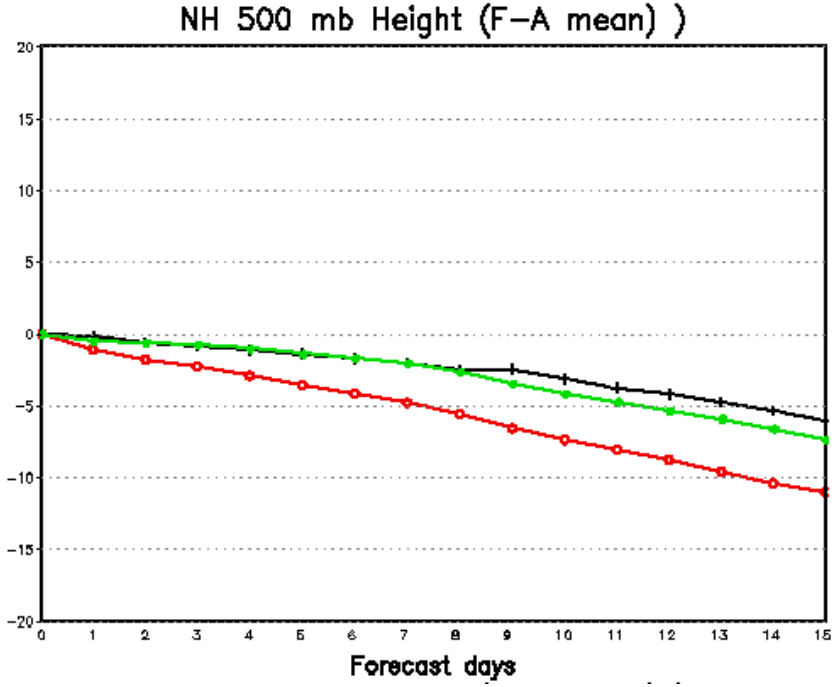
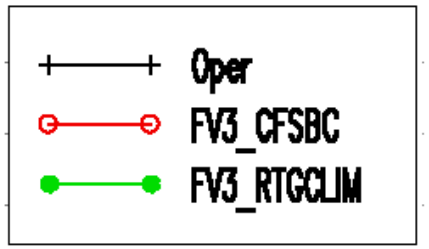
6-month Control-Only Extratropical Evaluation: Mean Error





- Cool bias mainly occurs in Boreal Winter over NH.

Oper=−6.056
FV3_CFSBC=−11.036
FV3_RTGCLIM=−7.381



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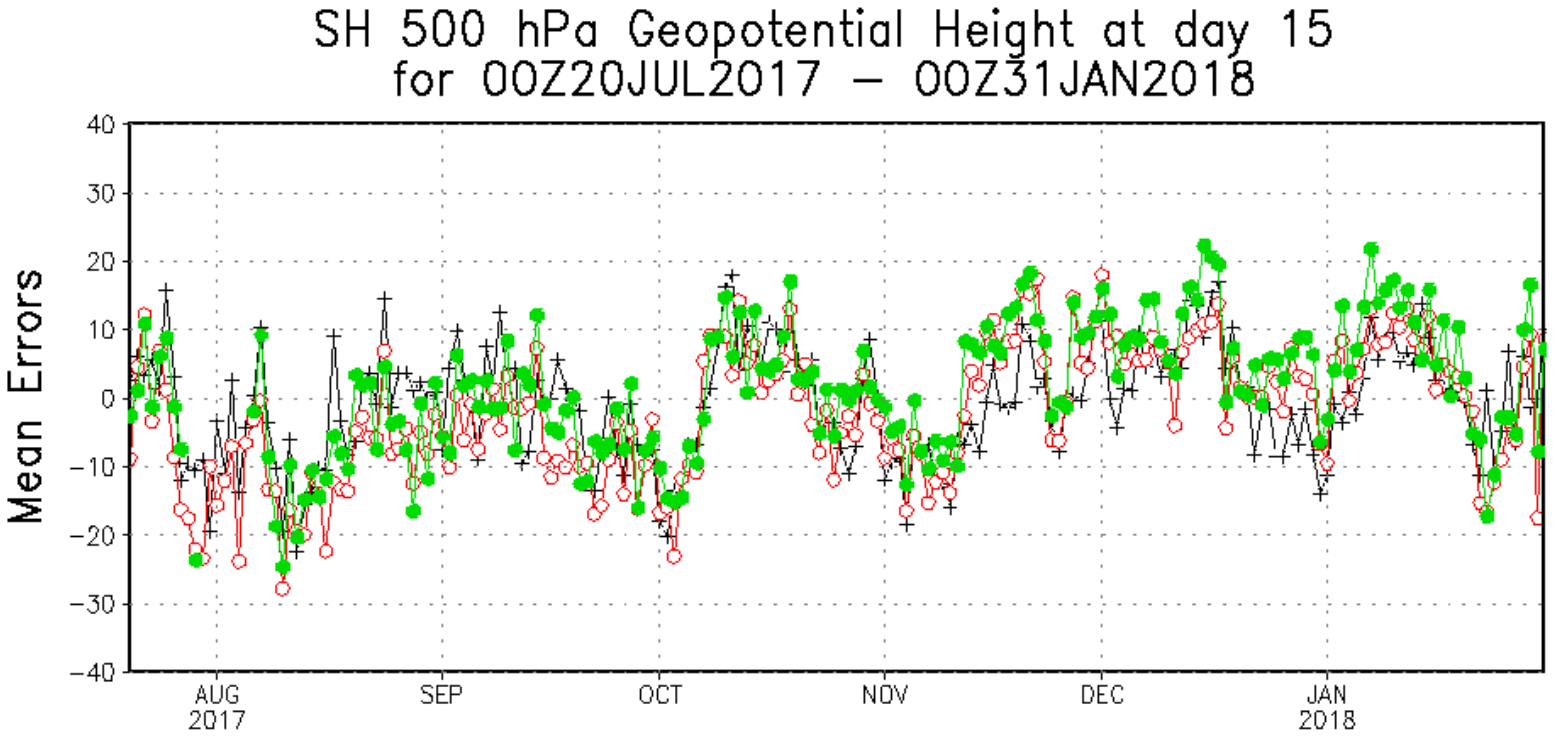
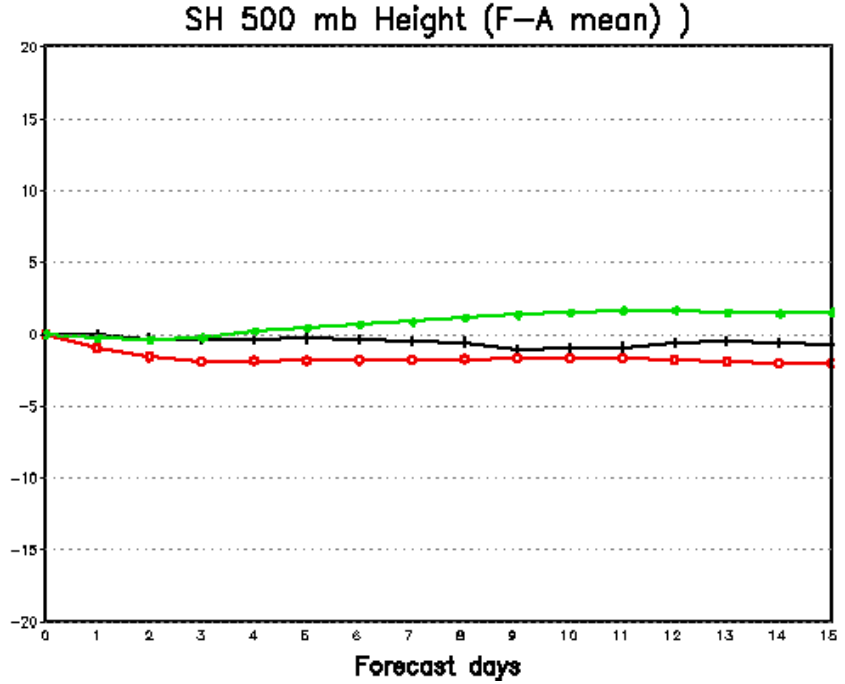
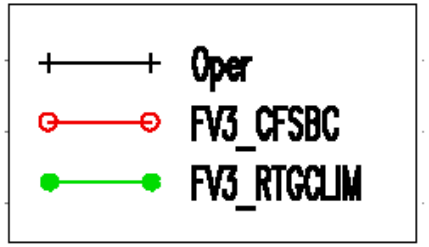
6-month Control-Only Extratropical Evaluation: Mean Error





Oper=−0.766
FV3_CFSBC=−2.076
FV3_RTGCLIM=1.527



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3. FV3GEFS CTL - Operational SST (damped to RTG climatology) - NSST (nstf_name:-"2,0,0,0,0") [**green line**]

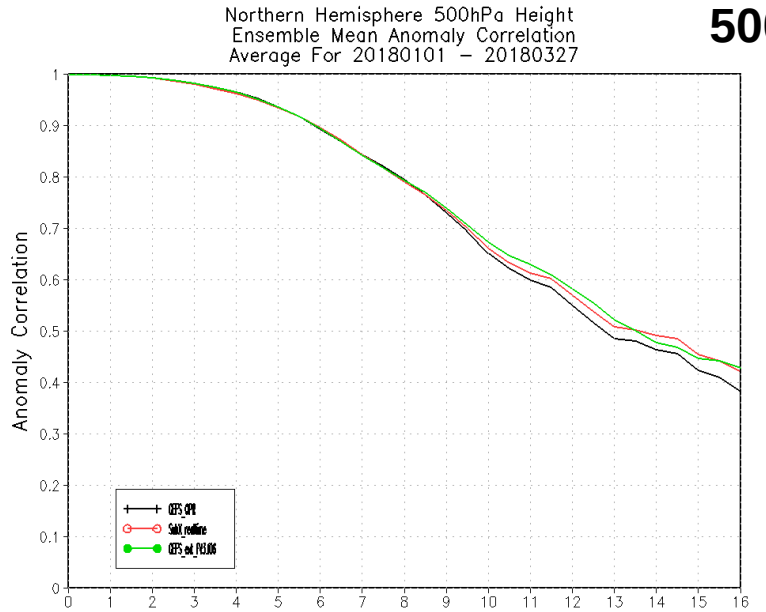
20180101-20180327: 21 member ensemble

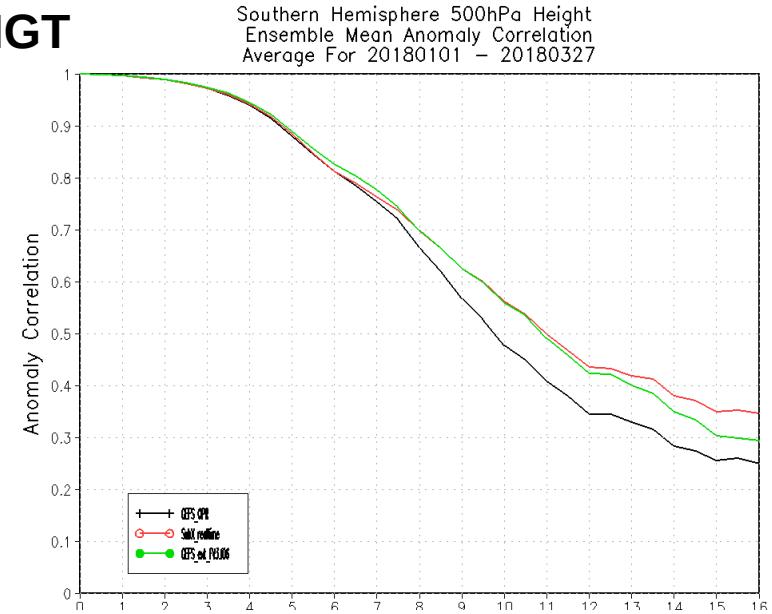
ICs	SST	NSST	DT	Perturbation setting
opr gfs analysis, f06 enkf	2-tiered using nst tref, 0.25x0.25	2,0,5,0,0	dt=450	SHUM=0.004, SHUM and SKEB length scale = 500.E3

16 days verification: PAC

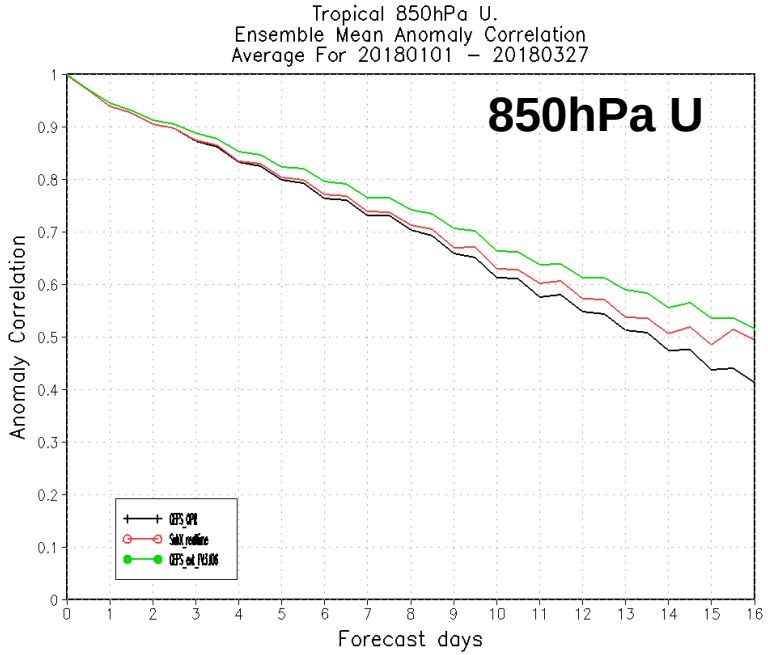
500hPa HGT

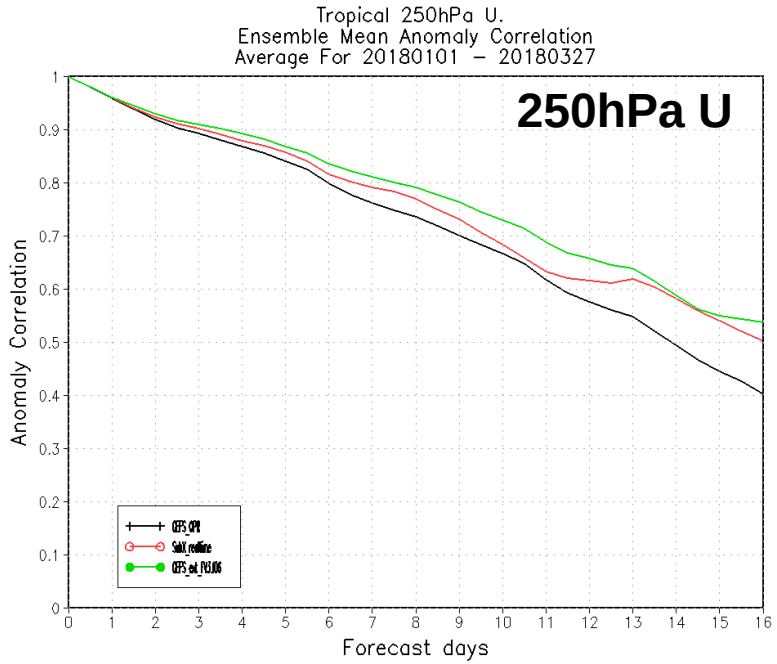
Extratropics





Tropics

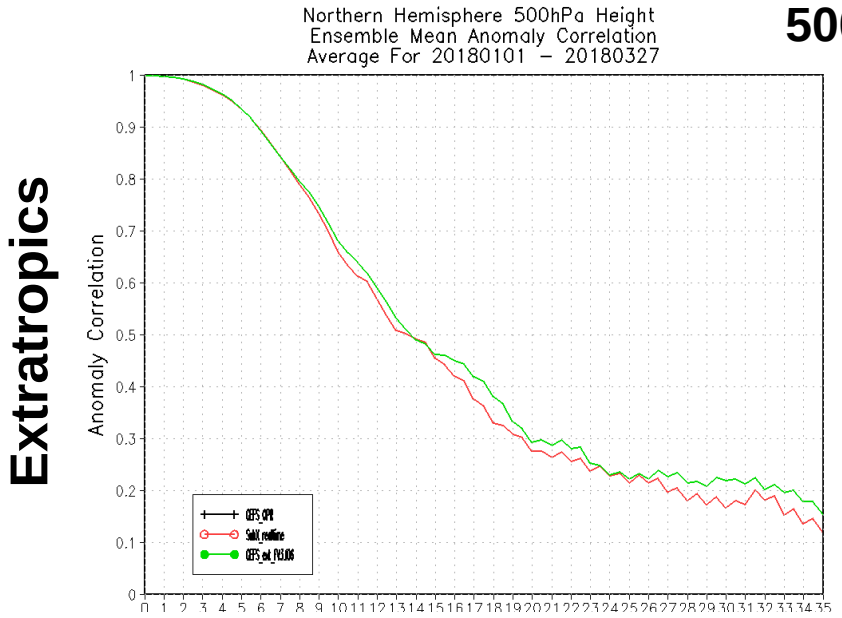


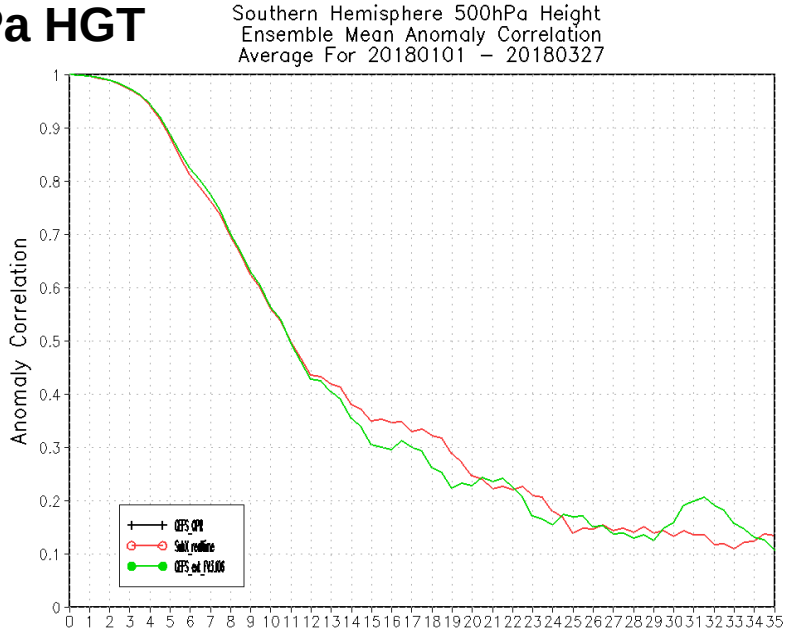


35 days verification: PAC

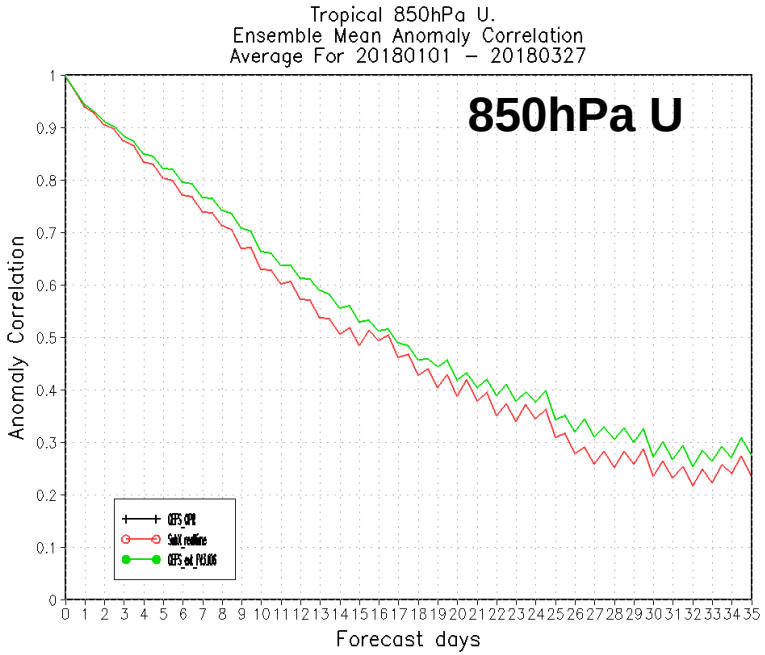
500hPa HGT

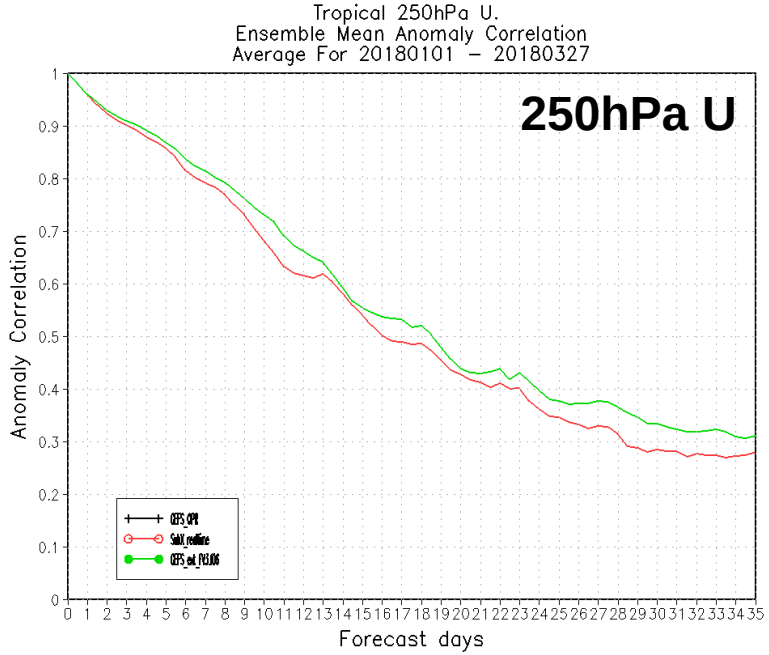
Extratropics



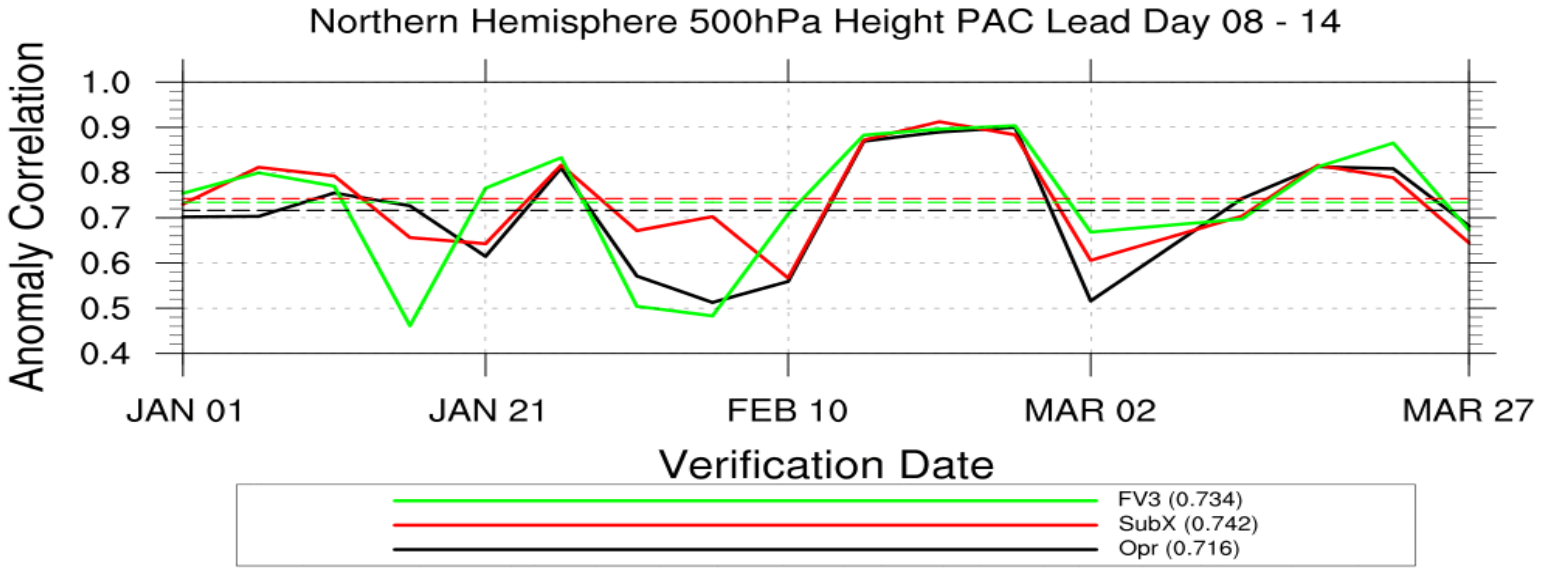


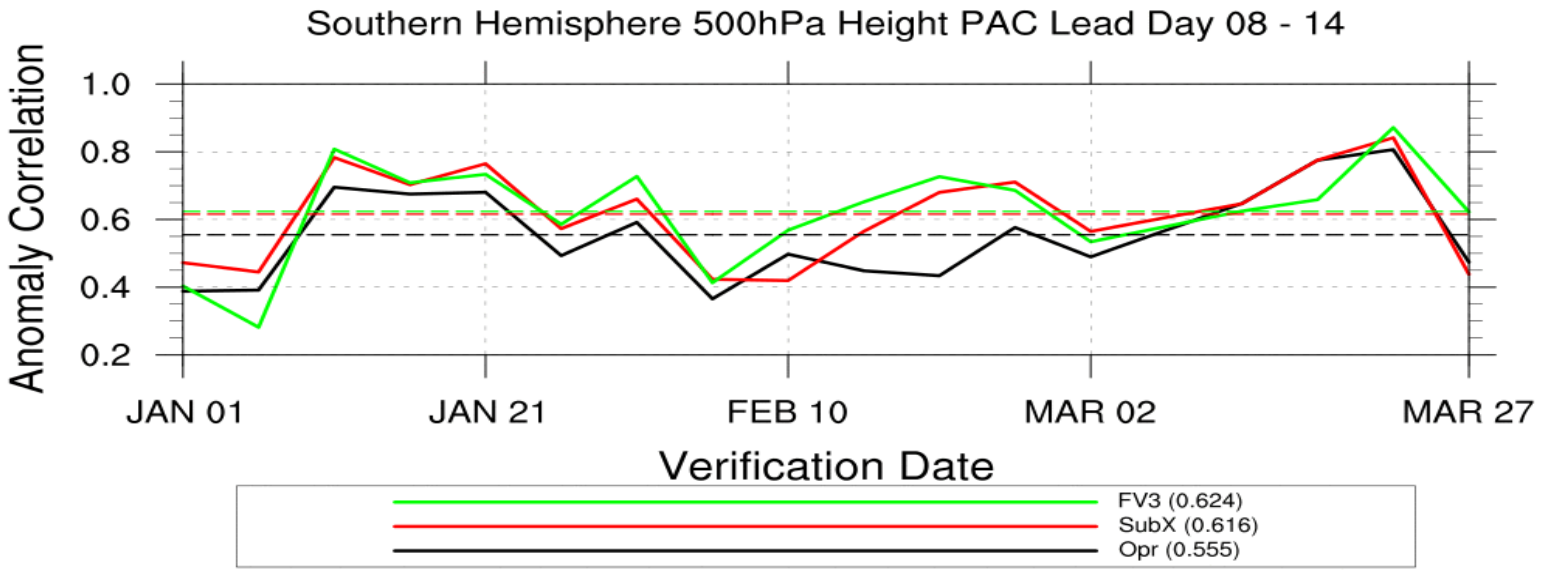
Tropics





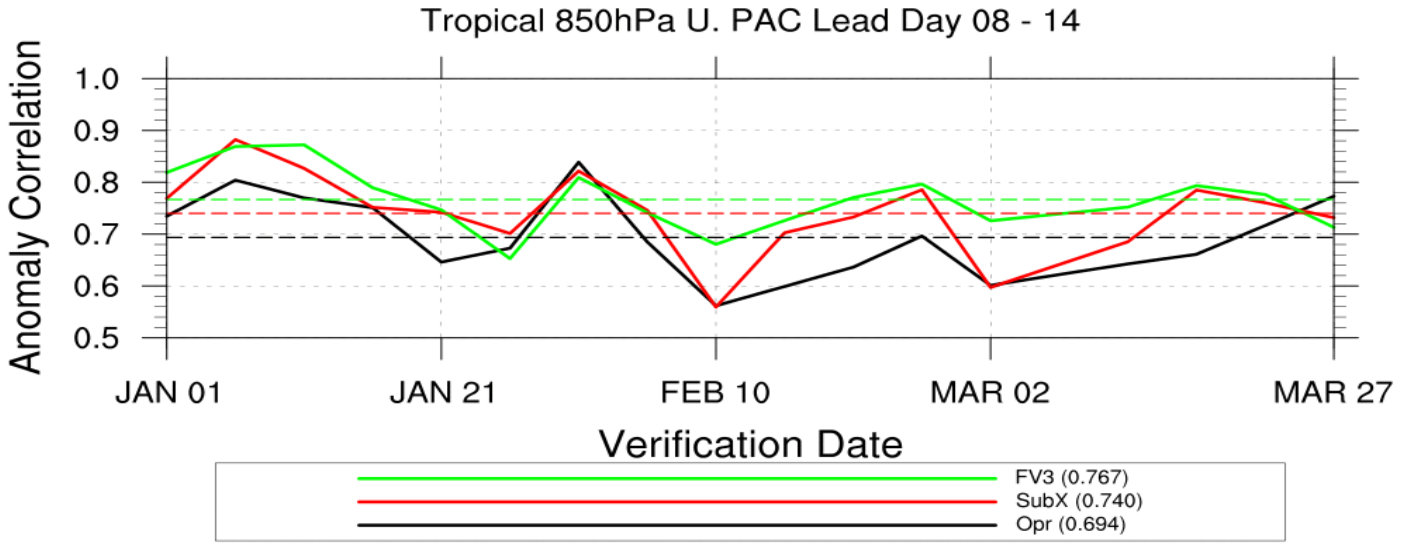
Week 2: Ensemble Mean PAC

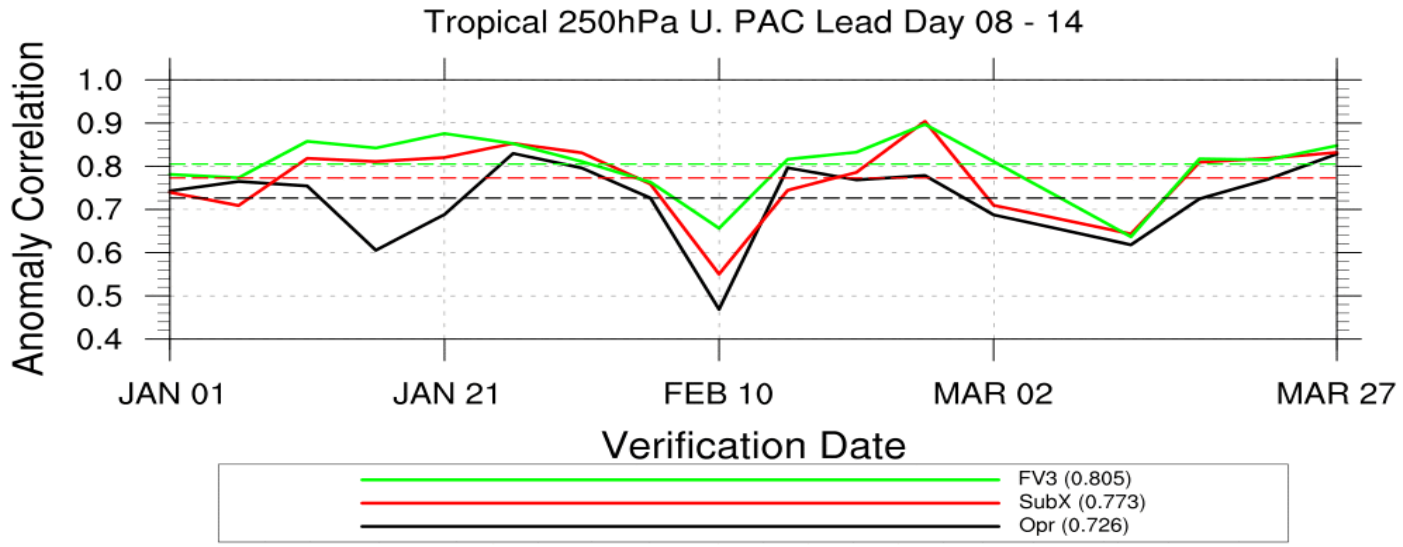




1. Operational GEFS CTL [**black line**]
2. SubX [**red line**]
3. FV3GEFS - 2-tiered SST - NSST (nstf_name:-"2,0,5,0,0") [**green line**]

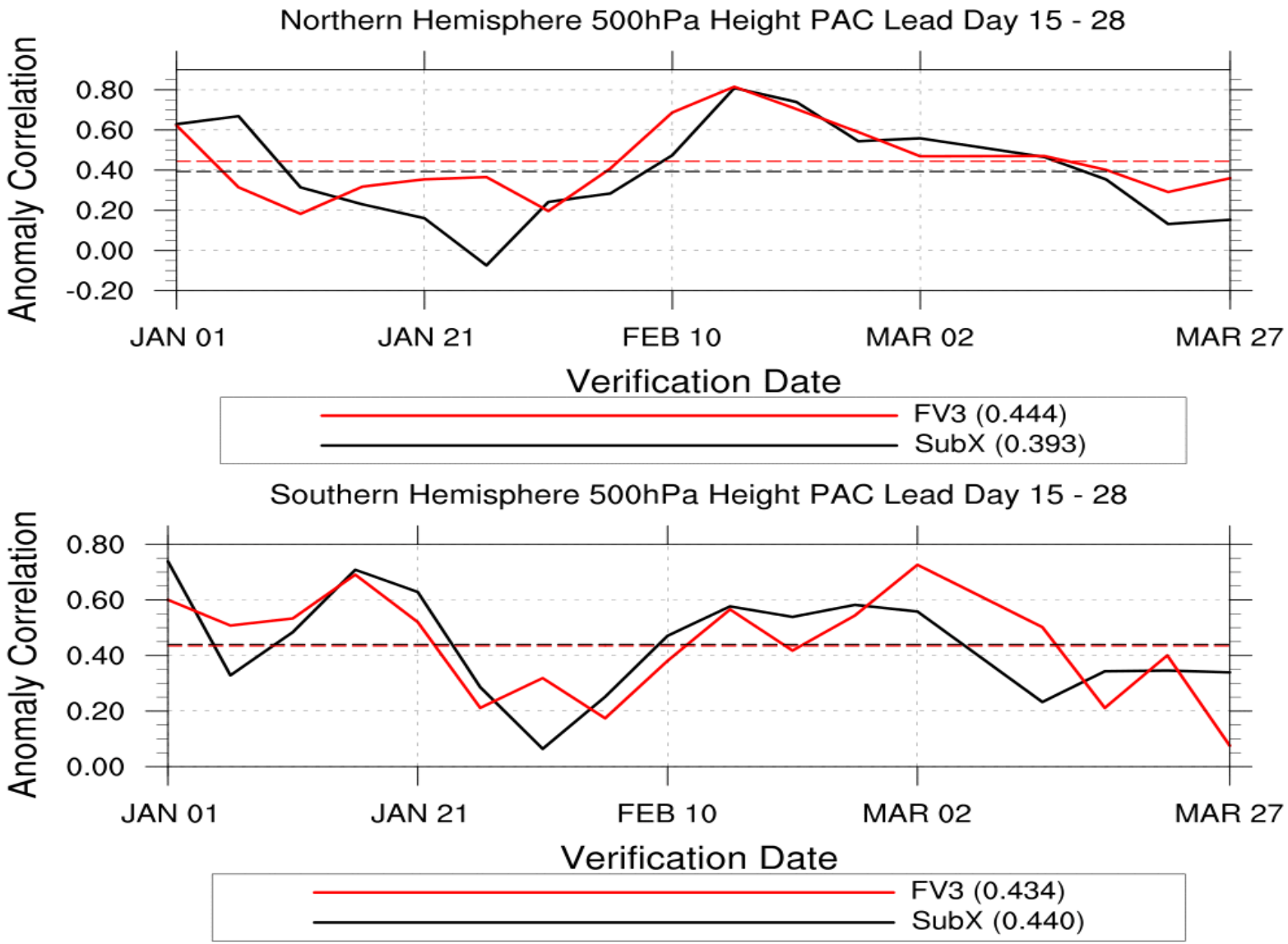
Week 2: Ensemble Mean PAC





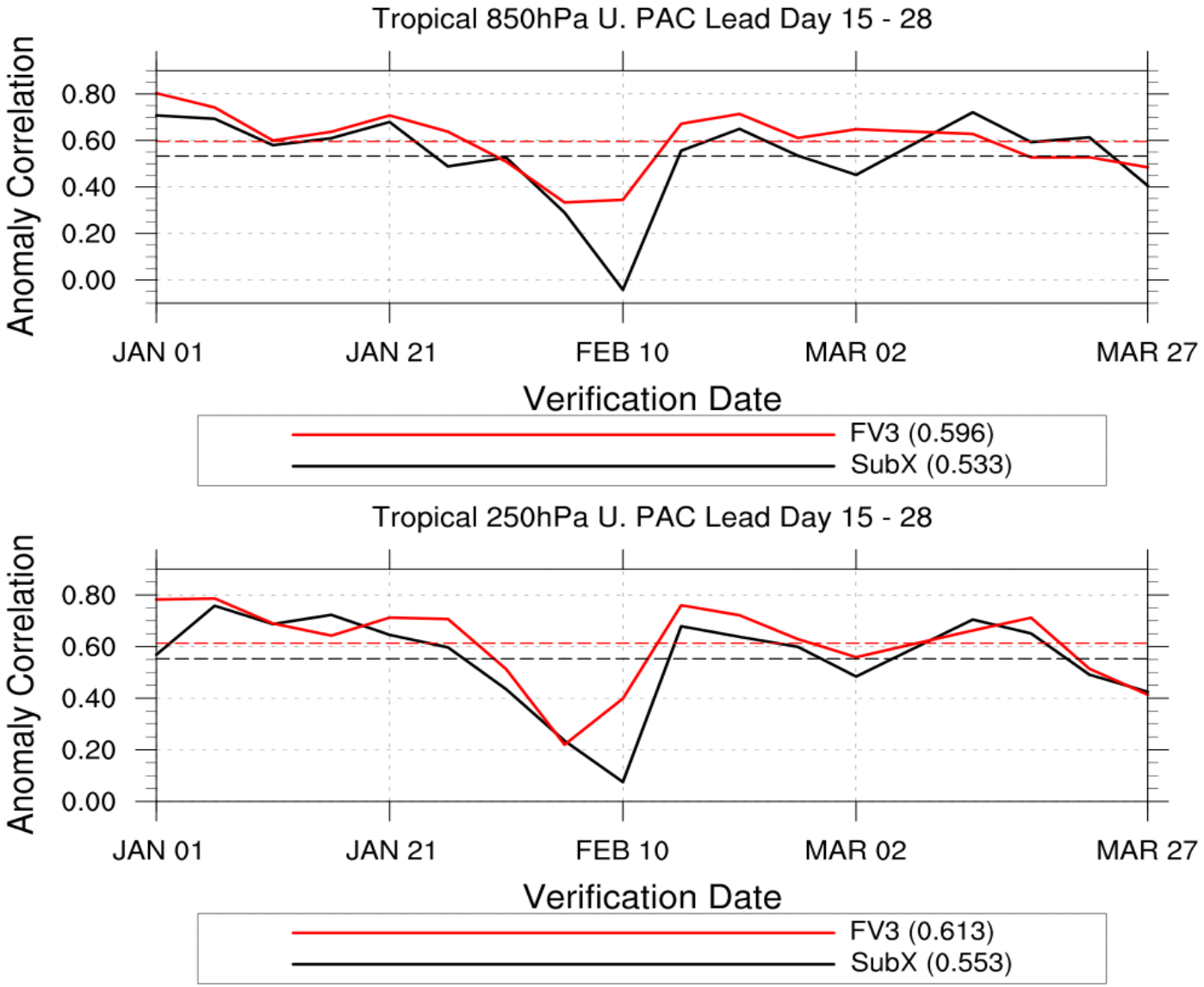
1. Operational GEFS CTL [**black line**]
2. SubX [**red line**]
3. FV3GEFS - 2-tiered SST - NSST (nstf_name:-"2,0,5,0,0") [**green line**]

Week 3-4: Ensemble Mean PAC



1. SubX [**black line**]
2. FV3GEFS - 2-tiered SST - NSST (nstf_name:-"2,0,5,0,0") [**red line**]

Week 3-4: Ensemble Mean PAC



1. SubX [**black line**]
2. FV3GEFS - 2-tiered SST - NSST (nstf_name:-"2,0,5,0,0") [**red line**]

Summary and Discussion

- **Based on verification during 20180101-20180327, FV3GEFS outperformed operational GEFS and SubX for NH_500HGT, TR_U250 and TR_U850**
- **Compared to operational GEFS, spread in NH_500HGT was increased in short lead time up to ~8days**
- **Cold bias in NH_500HGT. Is it due to the analysis data?**
- **Seasonality of the bias. Also skill?**
- **Stability issue for 450s.**

Next:

- **Extend the testing period to 2017**
- **MJO evaluation**

Verification links

For 20171008-20171030:
FV3 vs. SubX, 35 days
http://www.emc.ncep.noaa.gov/gc_wmb/wli/html/GEFS_ext_FV3_23cases.html

FV3 vs. OPR vs SubX, 16 days
http://www.emc.ncep.noaa.gov/gmb/esinsky/html/FV3_vs_SubX_vs_OPR_noctl_20mem.html

For 20171109-20171115
FV3 vs. OPR, 16 days
http://www.emc.ncep.noaa.gov/gc_wmb/wli/html/OPR_GEFS_ext_FV3.ie_7cases.html

For 20180101-20180327:
FV3 vs. OPR vs. SubX, 16 days
http://www.emc.ncep.noaa.gov/gc_wmb/wli/html/GEFS_ext_FV3.f06_new_subx.20180101_20180327.html

FV3 vs. SubX, 35 days
http://www.emc.ncep.noaa.gov/gc_wmb/wli/html/GEFS_ext_FV3.f06_new_subx.20180101_20180327_35d.html

Week2, week3&4 verification:
http://www.emc.ncep.noaa.gov/gmb/esinsky/images/SubX_vs_FV3_vs_OPR_2018/index.html