

# **FV3-GEFS/Sub-seasonal**

## - Reforecast update

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Status Update: August 16<sup>th</sup> 2018

# Major Milestones

- **Q2FY18** - Prepare FV3-GFS for reanalysis project: Develop and test low-resolution version of FV3-GFS and FV3-GDAS, and configure the model for reanalysis project.
- **Q4FY18** - Determine ensemble configuration for FV3-GEFS: Configure for optimum ensemble size (# members), resolution, physics, and coupling to Land and Wave models using NEMS/NUOPC mediator; conduct testing for quality assurance and computational efficiency.
- **Q3FY19** - Produce ~20-year reanalysis datasets: Mainly ESRL/PSD activity. Determine configuration of the reanalysis system; develop observational database for reanalysis; prepare observational inputs; and produce reanalysis suitable for reforecasts and calibration.
- **Q4FY19** - Produce ~30-year reforecast datasets for FV3-GEFS: Finalize ensemble configuration and produce reforecasts consistent with the reanalysis data; extend the reforecast length to 35 days.
- **Q4FY19** – Produce 2-3 year retrospective forecast for FV3-GEFS: Use the same configuration as real-time, and retrospective FV3GFS/EnKF analysis.
- **Q2FY20** - Transition FV3-GEFS into operations: Conduct pre-implementation T&E; transition the system for operational implementation. Replace GEFSv11 and stop GEFSv10 (legacy run to support NWC) after we finish 30-y reforecast???

# FV3GEFS Implementation Plan

June 2018

## Implementation Plan for FV3-GEFS (FY2017-2020)

FV3GEFS	FY17				FY18				FY19				FY20				% complete
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
FV3GEFS Reanalysis Development			Develop and test low resolution FV3GFS with FV3GDAS, configure it for reanalysis (ESRL)														100%
FV3GEFS Ensemble Configuration		Configure FV3GFS ensemble resolution, members, physics, coupling to ocean and sea-ice, and extend forecasts to weeks 3&4 (EMC)															95%
FV3GEFS Reanalysis Production							Produce ~20-year reanalysis datasets using FV3GFS/GDAS (ESRL)										15%
FV3GEFS Reforecasts								Finalize FV3GEFS V12 configuration & produce 30-year reforecasts (extended to 35 days) for calibration and validation of HEFS/OWP									0%
FV3GEFS V12 Evaluation										Evaluate FV3GEFS V12 forecast performance out to weeks 3&4							0%
FV3GEFS V12 Implementation													FV3GEFS V12 in operation				0%
Advancement of FV3GEFS													Further advancements of FV3GEFS (GFS/GEFS unification, ensemble based coupled modeling)				

Today

\* Proposed changes for GEFS V12: 1) Produce FV3 based reanalysis in FY18 using the same configuration as Q2FY19 FV3GFS (ESRL); 2) Reforecasts will be based on FV3GEFS configured with 2-Tier SST approach; and 3) FV3GEFS Reforecasts extended to 35 days to include weeks 3&4 guidance.

# FV3-GEFS reforecast configuration

- Model configurations
  - The same as real-time GEFSv12 (C384L64)
- Period of retrospective
  - 30 years (1989 – 2018)
    - 1989 – 1999 (11 years) CFS analysis
    - 2000 – 2018 (19 years) Hybrid FV3 GFS/EnKF reanalysis (ESRL/PSD)
    - **Caution - Initial analyses and perturbations of 30 years are in-consistent**
- Frequency and ensemble size
  - Configuration: 30 years, initialized at 00UTC for every day; runs 5 members out to 16 days, except for 11 members out to 35 days every 7 days.
    - **Cost - ~ 715 nodes (Cray) for 9 months (7/24) === project to 1 year to finish (consider 25% extra time)**
- Output data
  - Format – GRIB2
  - Frequency and resolution
    - 3 hourly out to 10 days at 0.25 degree resolution
    - 6 hourly beyond 10 days at 0.5 degree resolution
  - **Will produce 12 new isentropic variables (requested by CPC)**
  - Save all variables at above resolution on HPSS for 5-year
  - Save selected variables on disk for CPC, MDL and NWC (depends on HPCRAC approving?)
    - Currently, combined all three centers --- about 77 variables
    - **Will produce 6-hourly and 3-hourly precipitation data alternately as current operation**
    - **Will provide relative humidity instead of specific humidity**
  - ESRL/PSD will convert GRIB format data to NetCDF for public access
  - Note: size of C384 master file for one forecast lead-time at 0.25 degree = **345mb**

# Upper Air Variables (selected #1) – 0.5degree

	U	V	T	RH	Height	VV	O3MR
10hPa	C,E	C,E	C,E		C,E		C
50hPa	C,E	C,E	C,E		E		C
100hPa	E	E	E		E		C
200hPa	C,M,E	C,M,E	C,M,E	C,M	C,M,E		
250hPa	M,E	M,E	M,E	M	M,E		
500hPa	C,M,E	C,M,E	C,M,E	C,M	C,M,E		
700hPa	C,M,E	C,M,E	C,M,E	C,M	C,M,E		
850hPa	C,M,E	C,M,E	C,M,E	C,M	M,E	E	
925hPa	M,E	M,E	M,E	M	M,E		
1000hPa	M,E	M,E	M,E	M	M,E		
0.996 (hybrid)	C	C	C	C			

Total: 55 variables to support CPC, MDL and EMC (NAEFS), but not for MDL's BMOS

C – CPC; M – MDL; N – NWC; E - EMC (the same for next slide)

# Surface and other variables (Selected #2) – 0.25degree

Variables	Requested	total	Notes
PMSL, Surface Pressure	C,M,N,E	2	
T2m, Tmax, Tmin	C,M,N,E	3	Tmax and Tmin for 6-hr
2m RH	M,N,E	1	Could convert to Td or q
U10m, V10m	C,N,E	2	
QPF	C,M,N,E	1	3-hr accumulation
Precipitation Types	C,M,E	4	Rain, Freezing rain, Ice Pellets, Snow
PWAT	M	1	
CAPE	C,M,E	1	
Helicity at 0-3000m	C	1	
CIN	C,M,E	1	
Total sky cover (TCDC)	M,E	1	
Snow water equivalent	C	1	
OLR	C,E	1	
SDLR	N	1	
SDSR	N	1	

**Total 22 variables, the BMOS variables are not counted in this list**

# Sample data for GEFsv12 reforecast – contributed by Hong Guan

All (CPC, MDL and NWC/OWP);

As we promised before, we will send out a sample data for selected variables to allow all our stakeholders to test/valid. Dr. Hong Guan is our contact (cced), please let us know if there is any question. We'd like to have your confirmation before next reanalysis/reforecast meeting (current schedule - July 17 2018)

We have saved 74 variables (see attached slides - sample for you to verify):

1. Five ensemble members include ensemble control
2. 0.25 degree for 0-10 days every 3 hours
3. 0.5 degree for 10-35 days every 6 hours.
4. We have 2 QPF records in this sample, but will delete duplicate one later.

Notes for CPC: we will add on O3MR for 10hPa, 50hPa and 100hPa later

Notes for MDL: sample has excluded your BMOS request

Notes for NWC/OWP: you need to have WCOSS access soon, ftp sample here for validation/demonstration only. Currently, EMC does not have ftp disk storage for public access, except for future coordination/discussion with ESRL/PSD

## To access sample data through website:

0.25 degree data: [ftp://ftp.emc.ncep.noaa.gov/gc\\_wmb/wd20hg/FV3GEFS\\_rfcst/2017060100/pgrb2ap25](ftp://ftp.emc.ncep.noaa.gov/gc_wmb/wd20hg/FV3GEFS_rfcst/2017060100/pgrb2ap25)

0.5 degree data: [ftp://ftp.emc.ncep.noaa.gov/gc\\_wmb/wd20hg/FV3GEFS\\_rfcst/2017060100/pgrb2ap50](ftp://ftp.emc.ncep.noaa.gov/gc_wmb/wd20hg/FV3GEFS_rfcst/2017060100/pgrb2ap50)

## or anonymous ftp:

ftp [ftp.emc.ncep.noaa.gov](ftp://ftp.emc.ncep.noaa.gov) ID: anonymous PW: your email

cd gc\_wmb/wd20hg/FV3GEFS\_rfcst/2017060100 (you will see two subsets)

## To access sample data from WCOSS directly (luna machine):

0.25 degree: /gpfs/hps3/emc/ensemble/noscrub/emc.enspara/FV3GEFS\_rfcst/2017060100/pgrb2ap25

0.5 degree: /gpfs/hps3/emc/ensemble/noscrub/emc.enspara/FV3GEFS\_rfcst/2017060100/pgrb2ap50

## See an inventory of one forecast (lead), and one member:

[http://www.emc.ncep.noaa.gov/gmb/wd20hg/FV3\\_anl/rfcst\\_output\\_0p25](http://www.emc.ncep.noaa.gov/gmb/wd20hg/FV3_anl/rfcst_output_0p25)

[http://www.emc.ncep.noaa.gov/gmb/wd20hg/FV3\\_anl/rfcst\\_output\\_0p50](http://www.emc.ncep.noaa.gov/gmb/wd20hg/FV3_anl/rfcst_output_0p50)

# Receives confirmation of sample output data

- MDL – John Wagner for EKDMOS
  - Hi Yuejian, I believe the sample data will be good for EKDMOS. I have not been able to test everything as the control member is encoded as a low-res control (even though its 0.25 degrees) and my code is expecting the high-res control member. I will need to make some changes to get this data into TDLPACK, which I haven't had time to because of the WCOSS outages. I was able to convert the other members to TDLPACK without error. I see no reason not to proceed with these settings. Thanks. - John
- CPC –
  - Face to face meeting in August 2<sup>nd</sup> between CPC (Arun Kumar, Matthew Rosencrans, Craig Long, Dan Collins, Hui Wang) and EMC (Yuejian Zhu and Hong Guan)
  - CPC has confirmed save samples, EMC agreed to add 12 new isentropical variables for CPC (still waiting for CPC's validation)
- OWP – Mark Fresch (future POC: Dr. Kaksu Lee)
  - Yuejian, The sample GEFsv12 reforecast is acceptable to OWP. Thanks, especially for Hong's help. – MarkF
- MDL and CPC are agreed to save selected (#1 group) pressure level variables at 0.5degree all the way to 10 days without change frequency – July 31<sup>st</sup> 2018



# 1. FV3 EnKF ANL and F06 perturbations

Kate Zhou

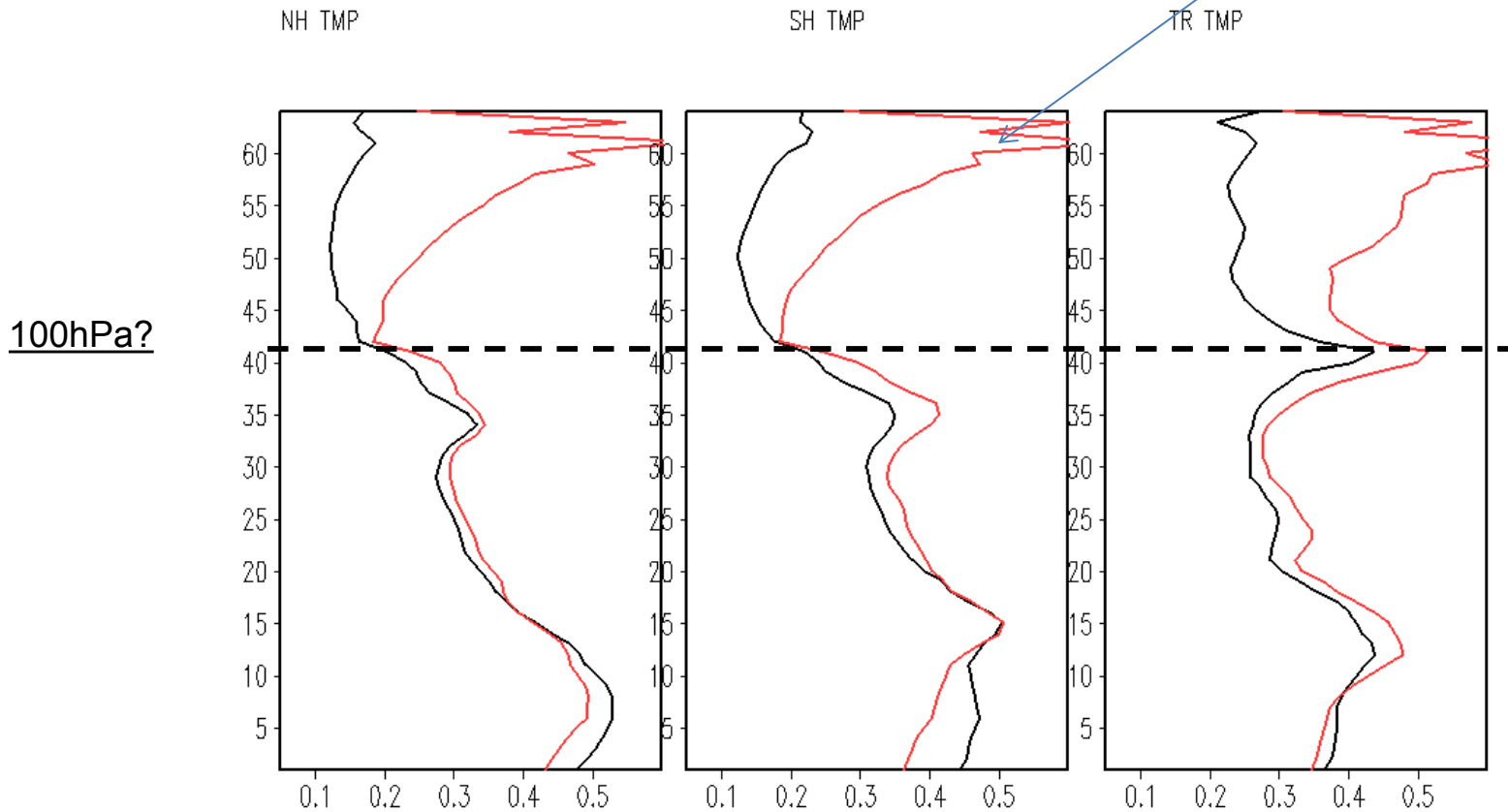
## ***Background:***

- Current status
  - Based on full-cycle experiments we have done. We have seen some (slightly) difference of initial perturbations for FV3GFS-EnKF.
  - It is necessary to review the difference of EnKF f06 from GSM and FV3
- Vertical profile
  - Look at one case only
  - Ensemble spread (or perturbations) for F06
  - Temperature and U, V
  - NH, SH and Tropical
  - Similar vertical profile of Anl (not shown)

# Prod vs FV3GFS

## TMP Spread profile from EnKF 6hr fcst

The uncertainty of stratosphere is unclear, but the noise (fluctuation) on the very top levels is not true (?)



Black – GSM  
Red – FV3

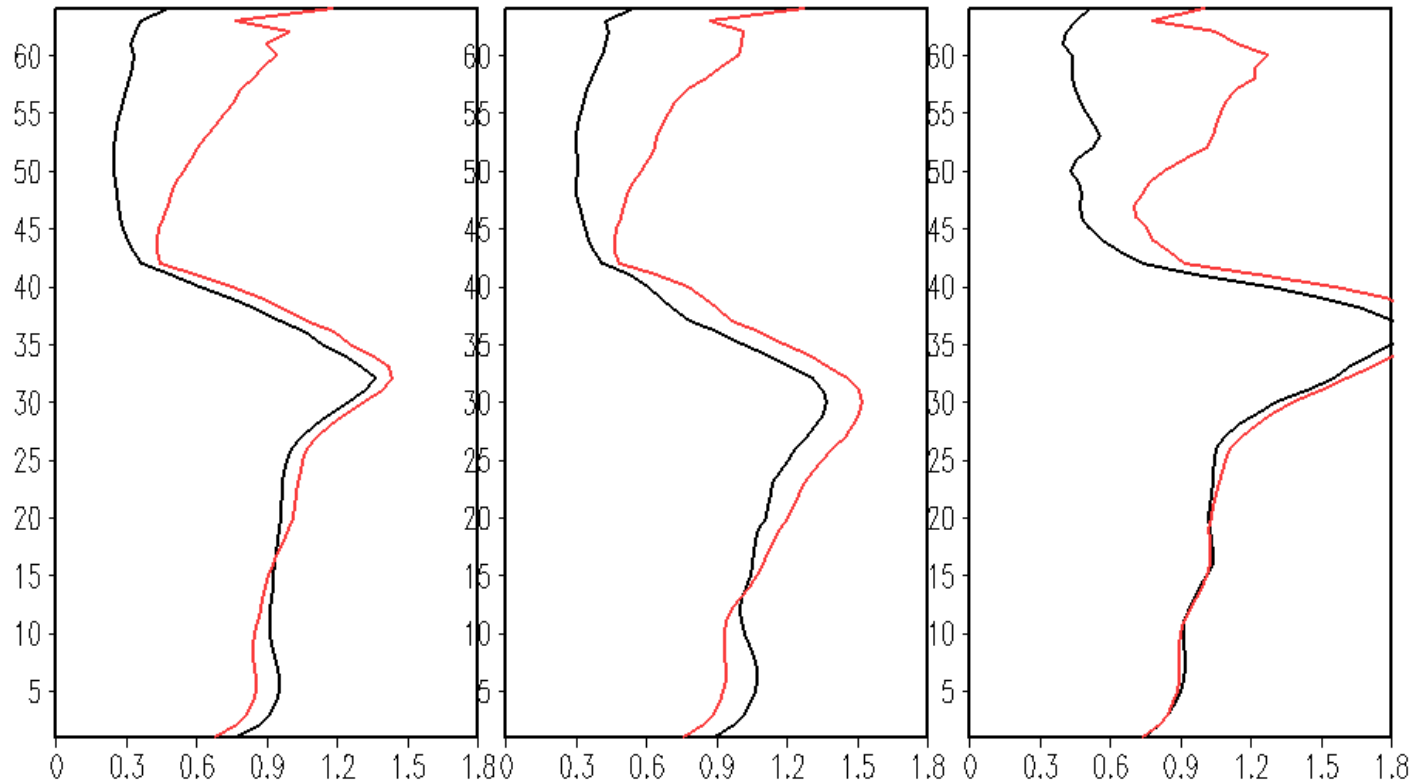
# Prod vs FV3GFS

## U Spread profile from EnKF 6hr fcst

NH ugrd

SH ugrd

TR ugrd



Black – GSM

Red – FV3

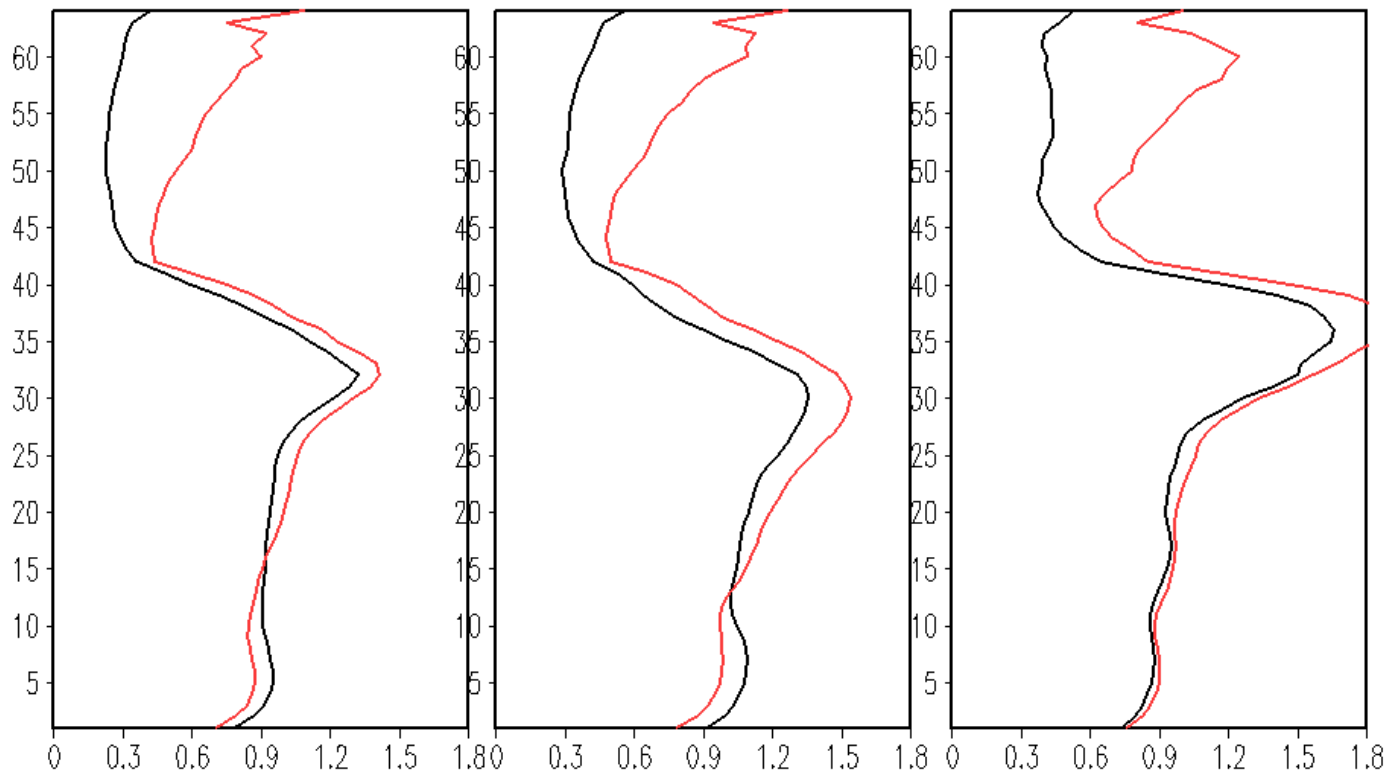
# Prod vs FV3GFS

## V Spread profile from EnKF 6hr fcst

NH vgrd

SH vgrd

TR vgrd



Black – GSM

Red – FV3

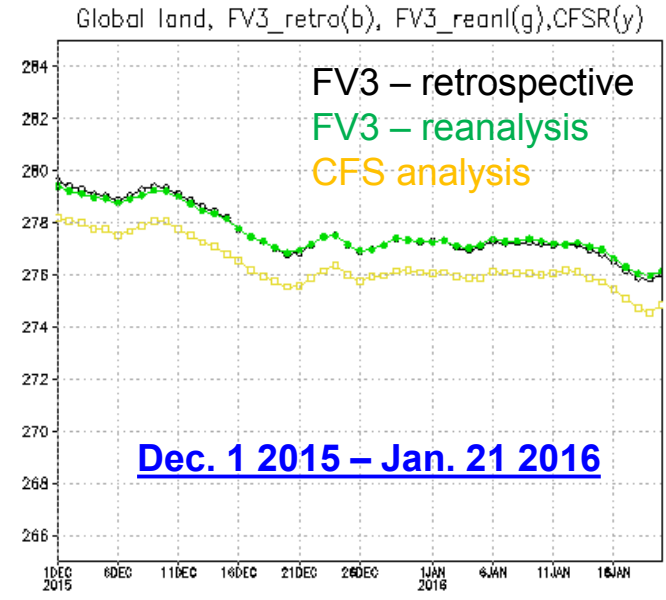
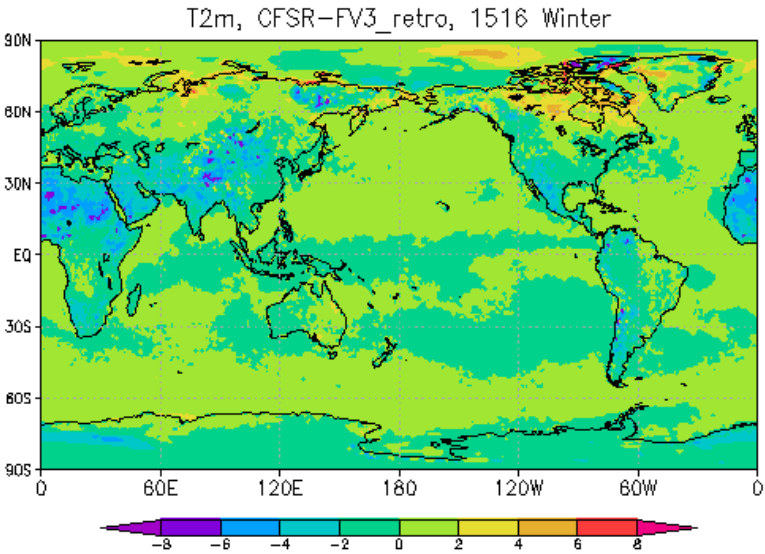
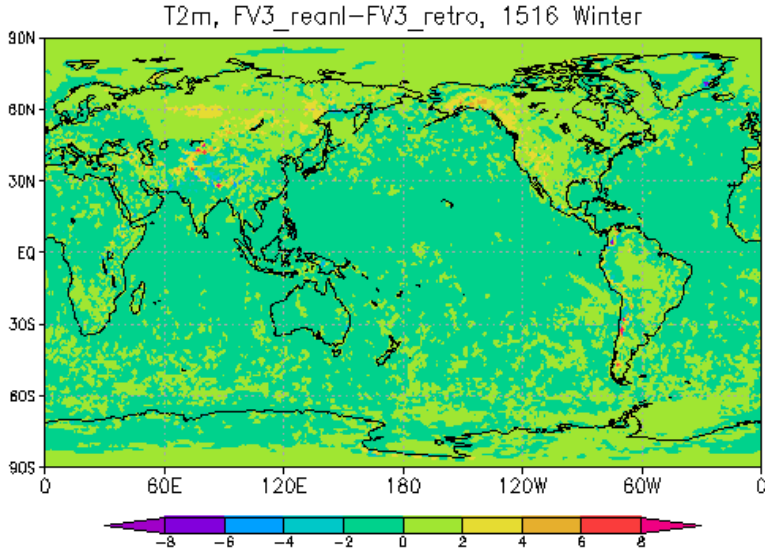
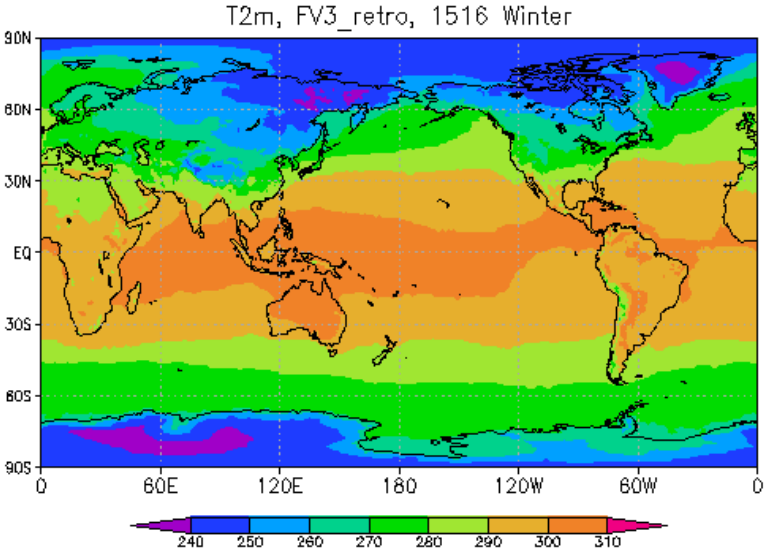
## 2. Preliminary comparison of surface temperature analyses

Hong Guan

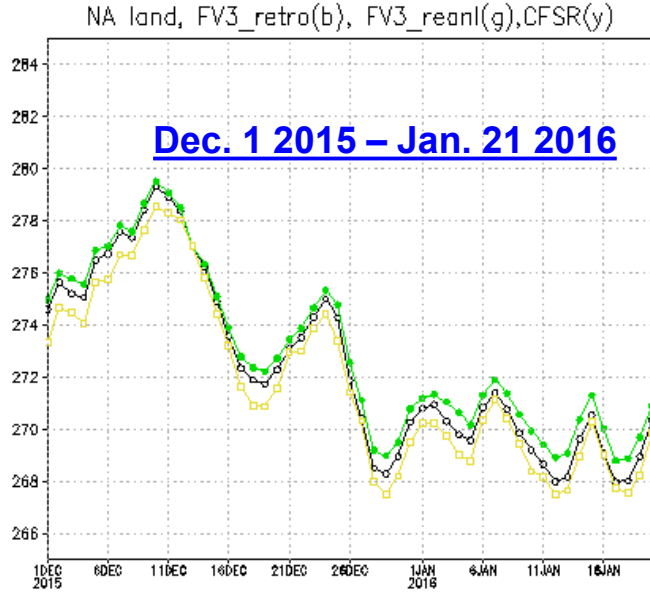
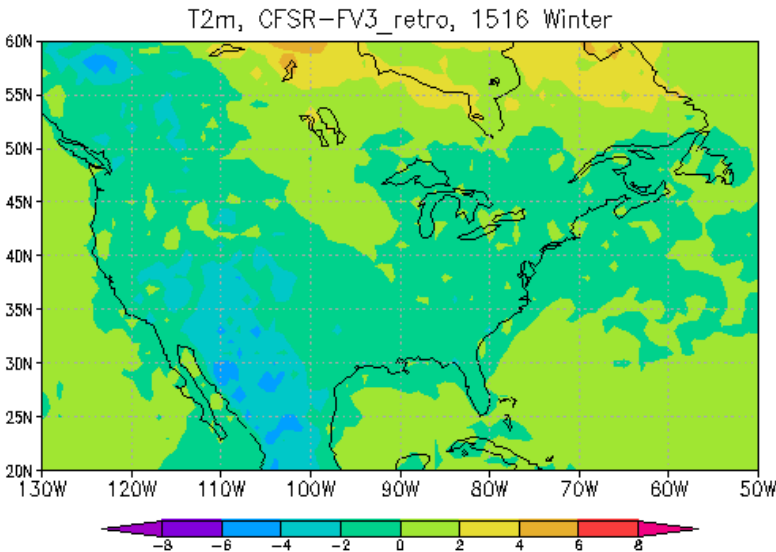
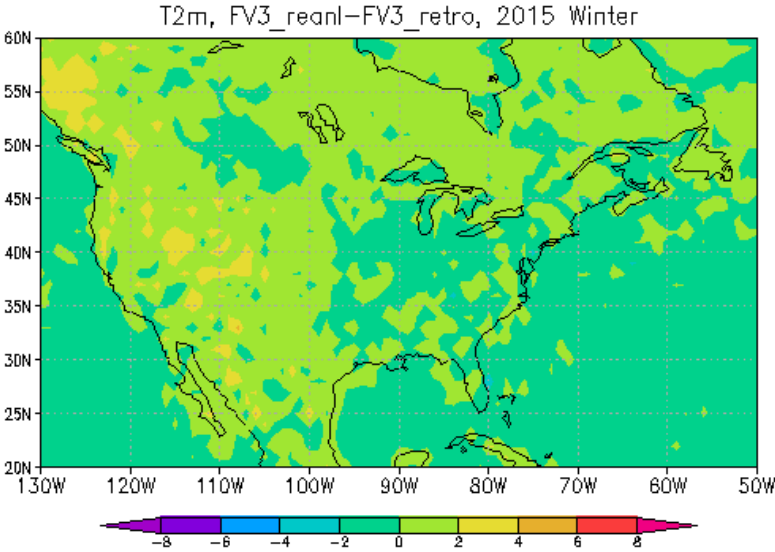
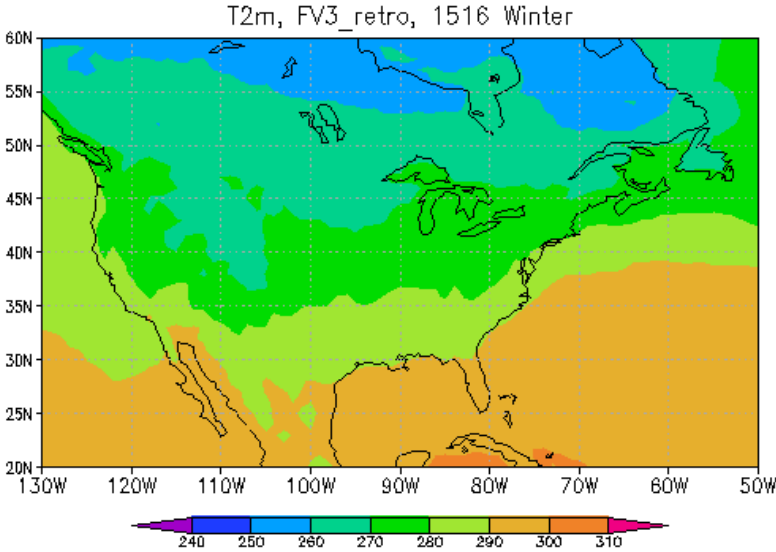
### ***Background:***

- Reanalysis/Reforecast generation
  - Mainly for forecast calibration
  - The systematic model error (or bias) may dominate for errors. Especially for longer leads forecast
  - 30 years reforecast will base on 30 years reanalysis and perturbations.
  - Currently: 1989-2000 (CFSR analyses and ETR perturbations); 2001-2018 (FV3 based new reanalysis)
- 2-meter temperature comparison
  - Three systems; CFSR; FV3-retrospective; FV3-reanalysis
  - Winter period: Dec. 1<sup>st</sup> 2016 – Jan. 21 2016
  - Summer period: Jun. 1<sup>st</sup> – Aug. 14<sup>th</sup> 2015
  - Difference for global and CONUS (maps and time series of domain average)

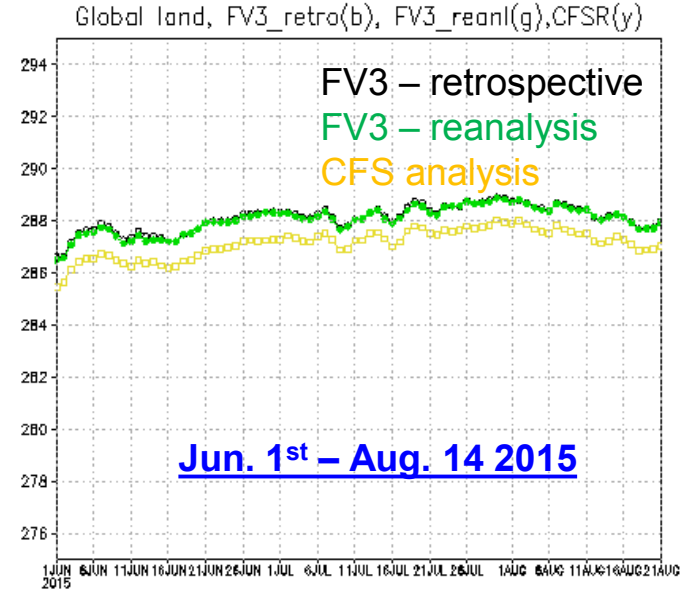
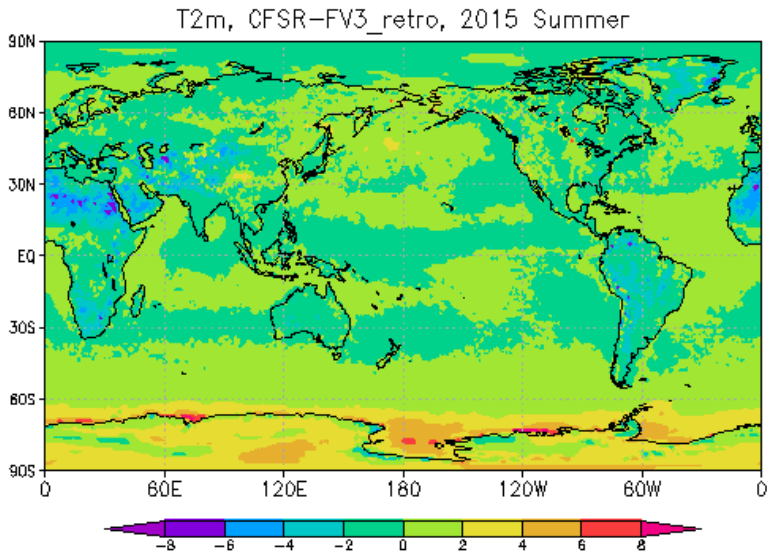
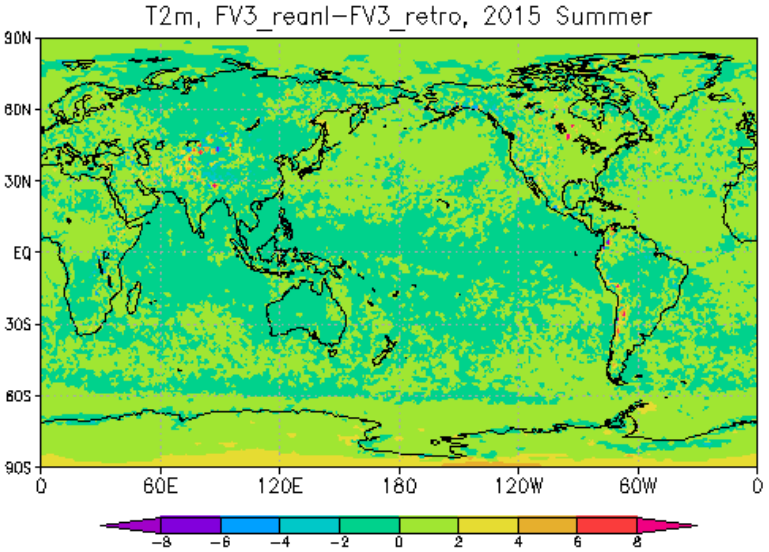
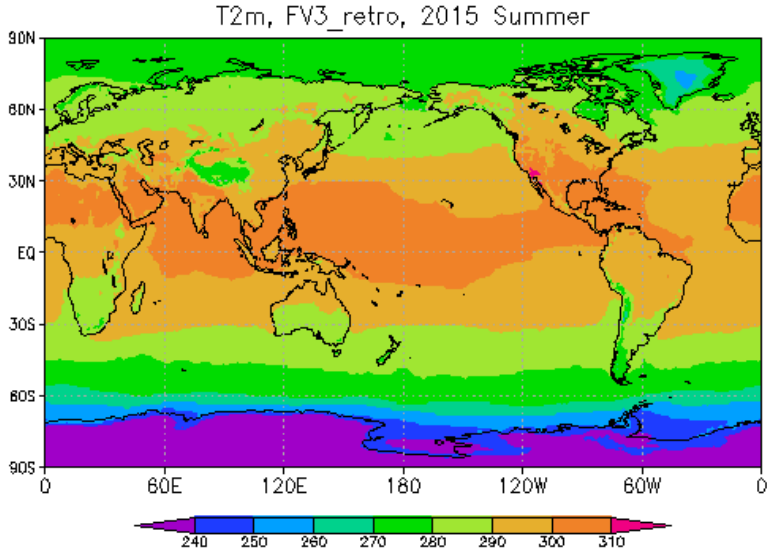
# Analysis comparison from three different systems



# Analysis comparison from three different systems

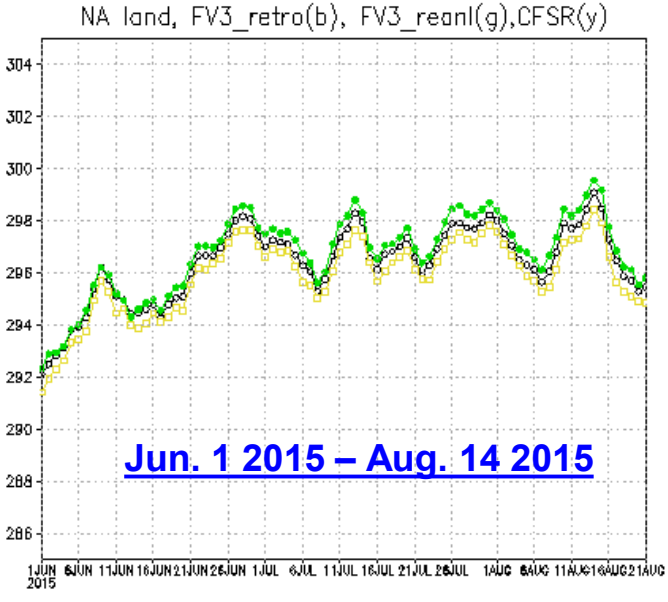
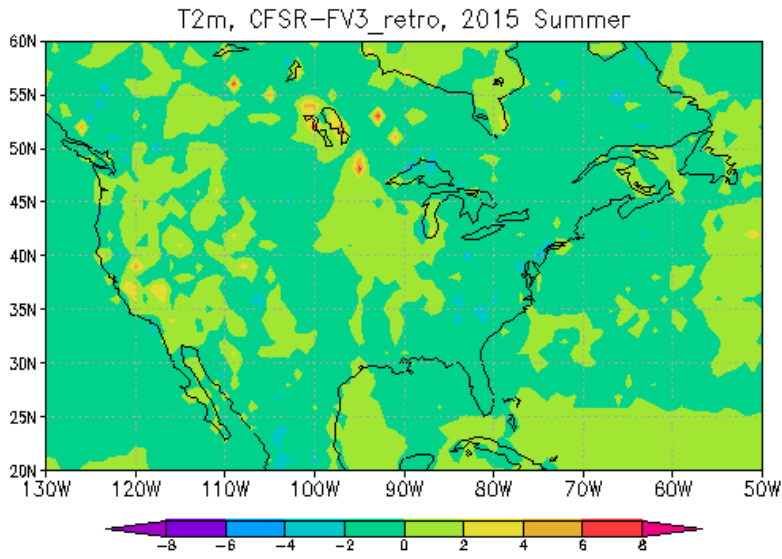
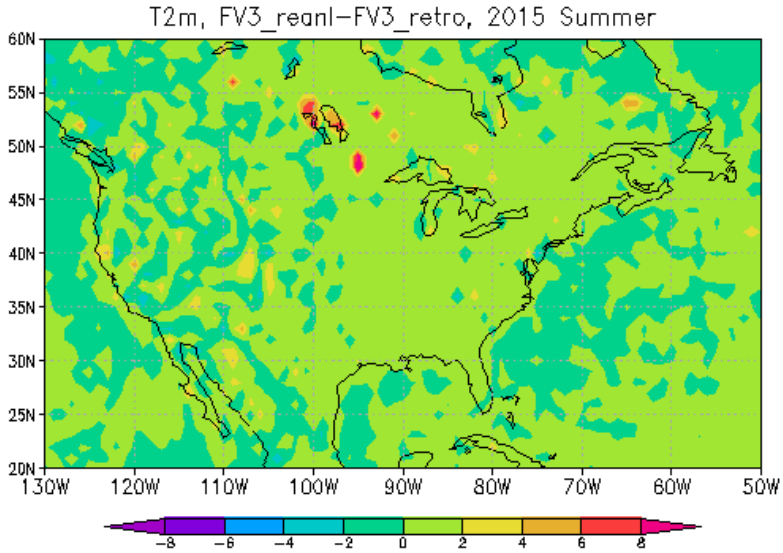
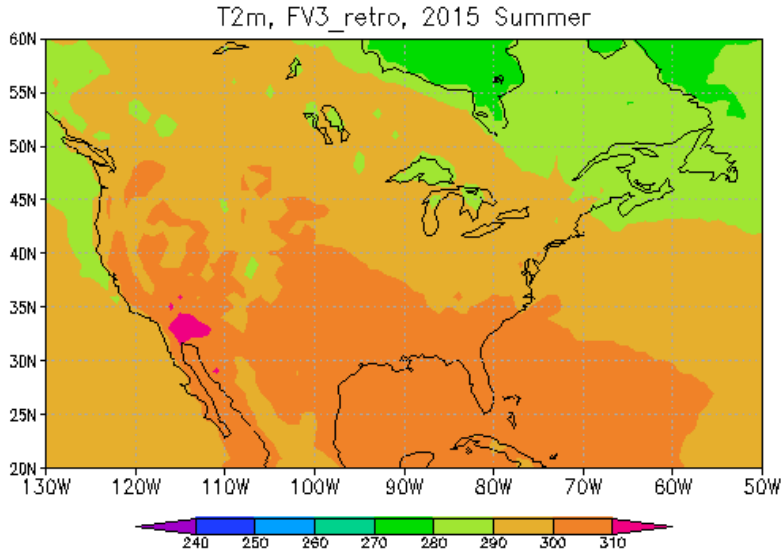


# Analysis comparison from three different systems





# Analysis comparison from three different systems



# Latest Status Update

- Closed to have final FV3GEFSv12 for starting reforecast
- Waiting for NCO permission to access Dell (WCOSS)
- Waiting for assigning disk storage (400TB) on Dell (WCOSS) for reforecast
- Working with PSD (Jeff and Scott) to have best ensemble initialization