Application of Satellite Land Surface Observations in NCEP Models: VIIRS GVF Data

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Motivation

➢ *Objective:*

To improve satellite data utilization over land in NCEP forecast models and data assimilation system and then improve the numerical weather prediction (NWP).

➢*Land satellite data assimilation:*

– Utilization of satellite data sets in the models (e.g., *GVF, snow, burning area, albedo, emissivity, LST, radiation, vegetation and soil type, etc.*)

– Assimilation of satellite products (e.g, *Soil moisture (SMAP, SMOPS); snow*);

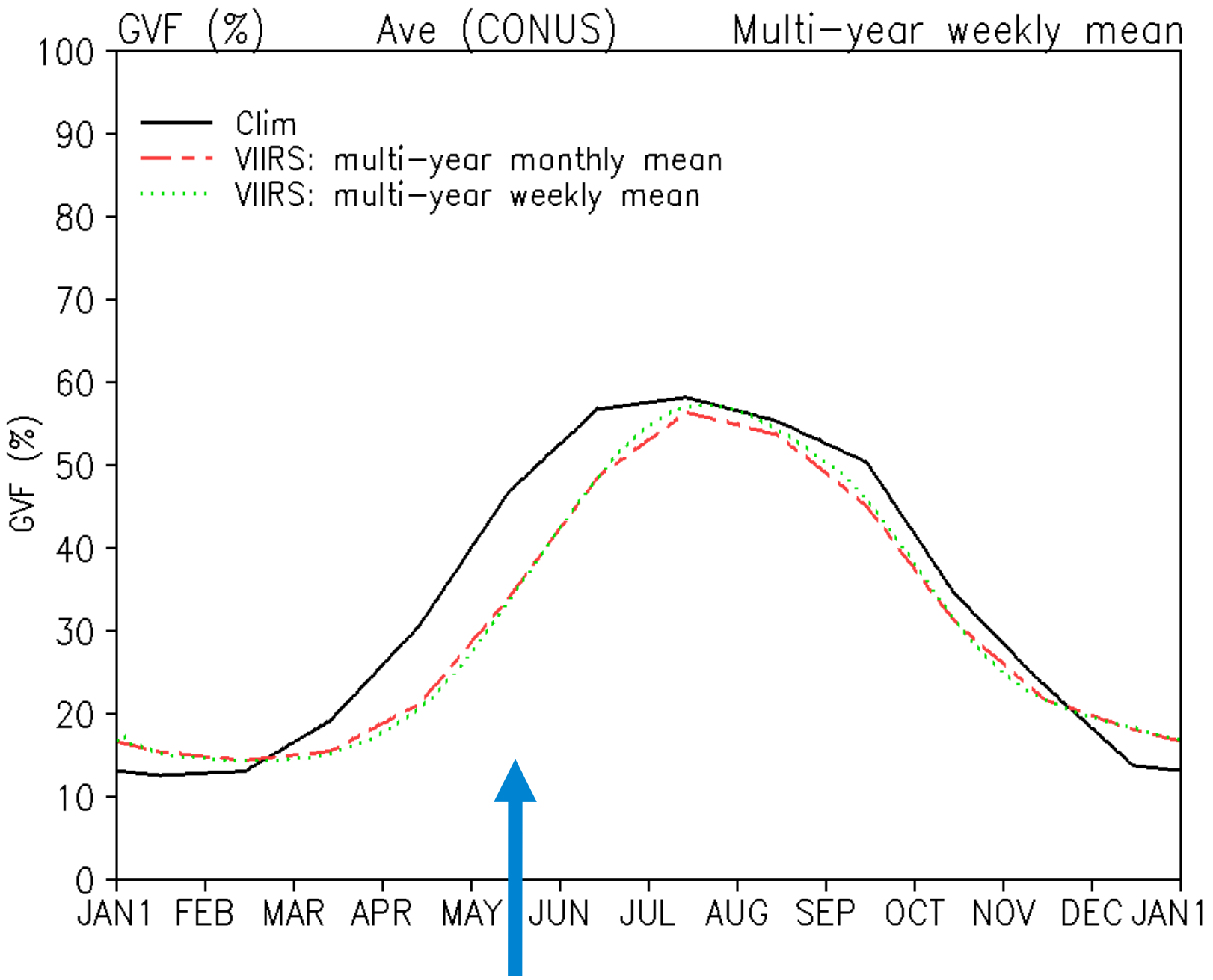
– Direct radiance assimilation (Tb)

Requiring a forward radiative transfer model (RTM) to calculate Tb with input of model atm profiles and sfc parameters. (sfc emissivity, sfc parameters). (Understand the interaction and feedback between land and atmosphere, and then improve NWP and DA)

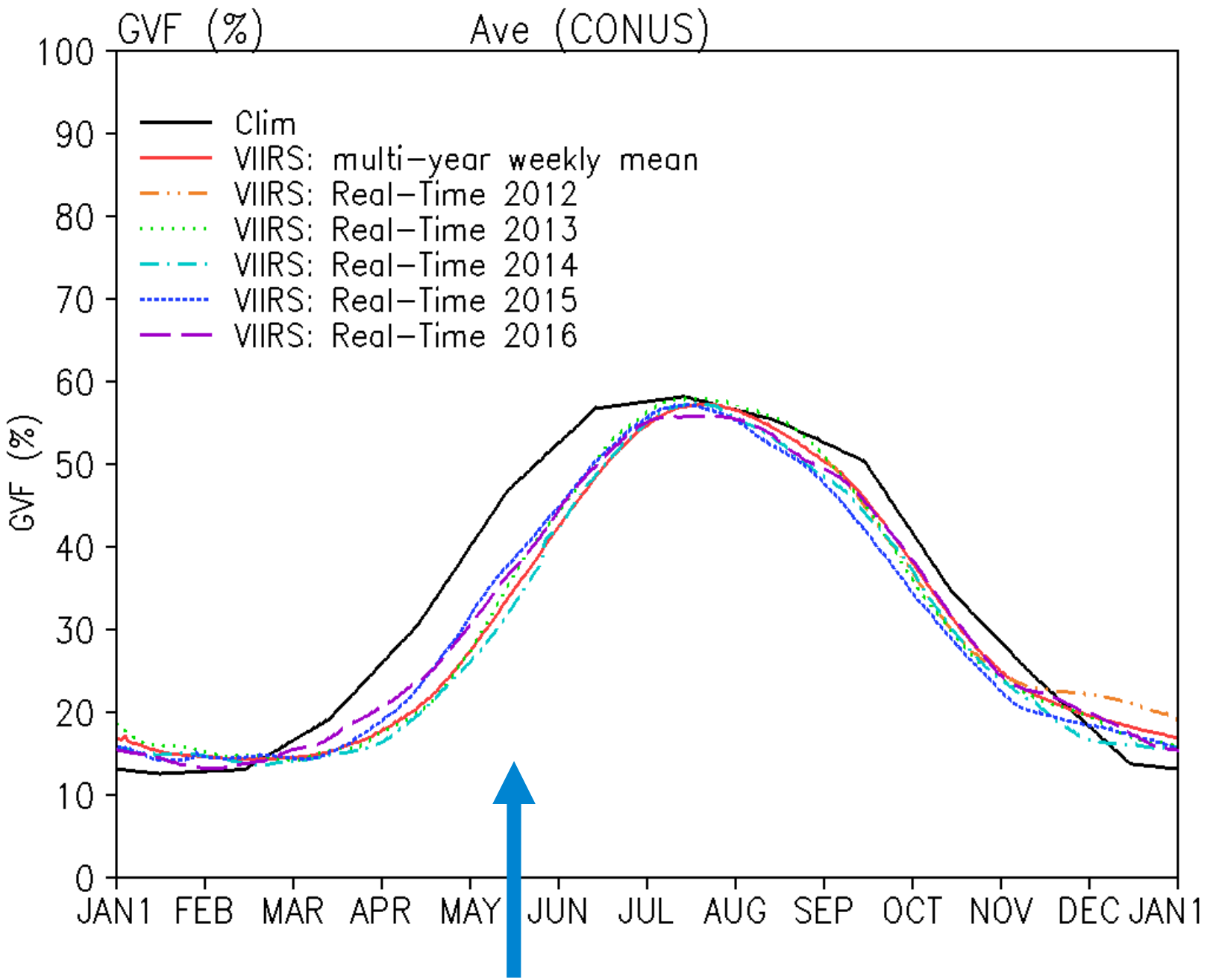
-time VIIRS GVF

- **NCEP Operations: Monthly 0.14-deg (16-km) global climatology of GVF**
- **Weekly GVF: VIIRS near real-time weekly global 0.036-deg (4-km) GV**
- **Three data sets: (a) Weekly climatology GVF;**
  (b) Monthly climatology GVF;
  (c) Near real-time weekly GVF
- **The other GVF data sets are also examined:**
  (a) Near real-time weekly AVHRR (Le Jiang et al., NESDIS);
  (b) Near real-time weekly MODIS (Xiaoyang Zhang, SD State U.).

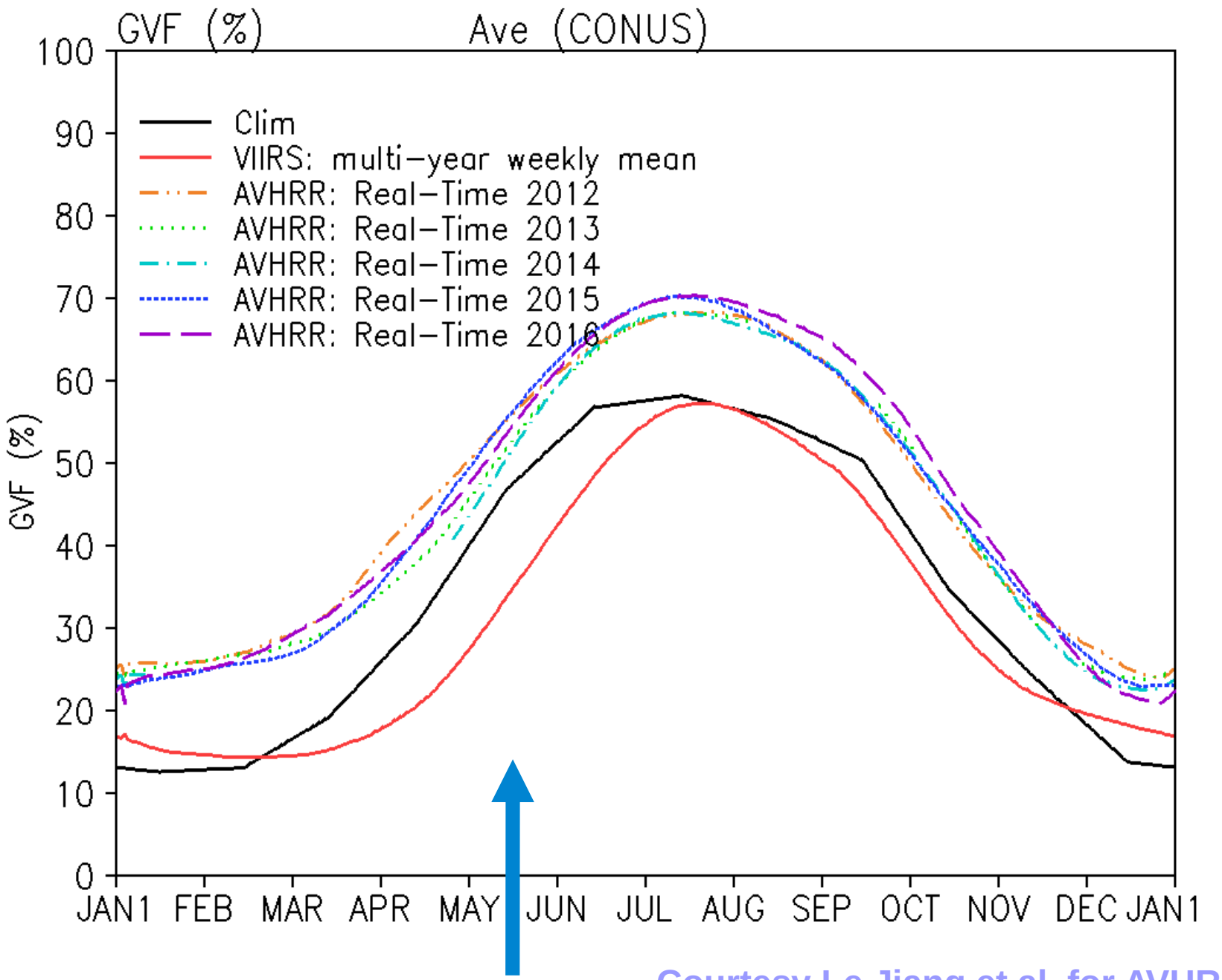
Multi-year mean VIIRS GVF over CONUS



Average VIIRS GVF over CONUS: Near Real-Time

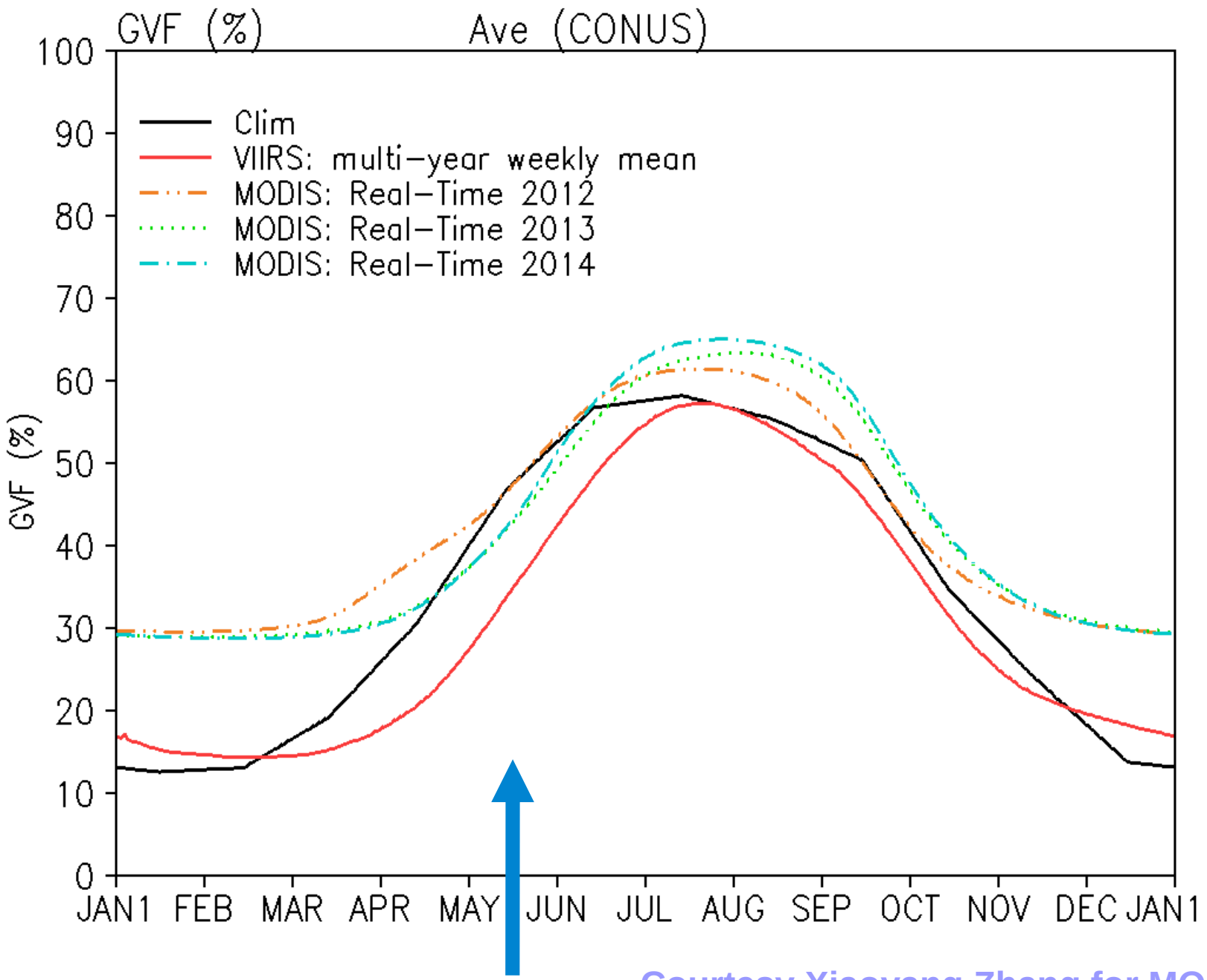


Average AVHRR GVF over CONUS: Near Real-Time



Courtesy Le Jiang et al. for AVHRR data

Average MODIS GVF over CONUS: Near Real-Time

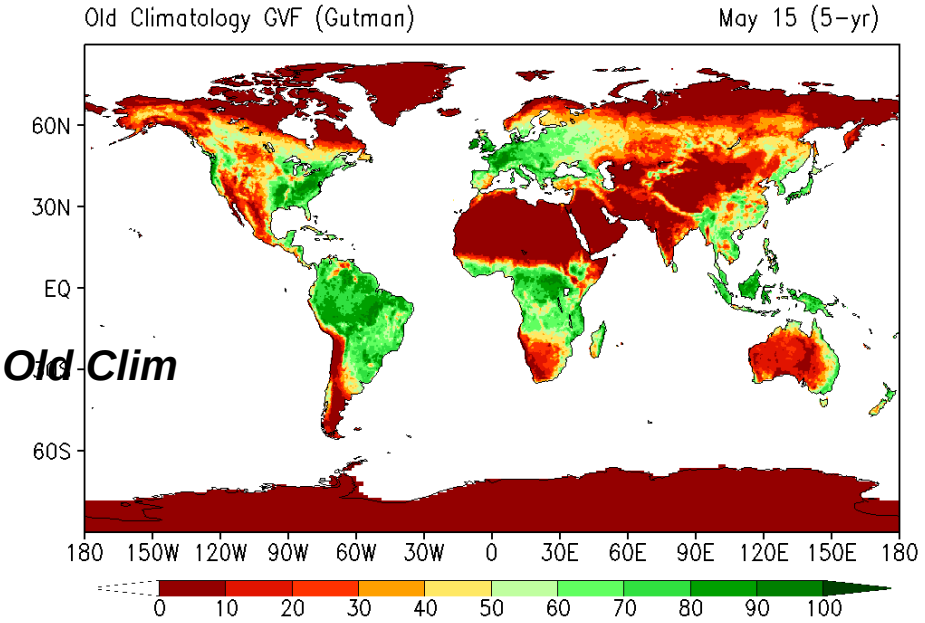


Courtesy Xiaoyang Zhang for MODIS data

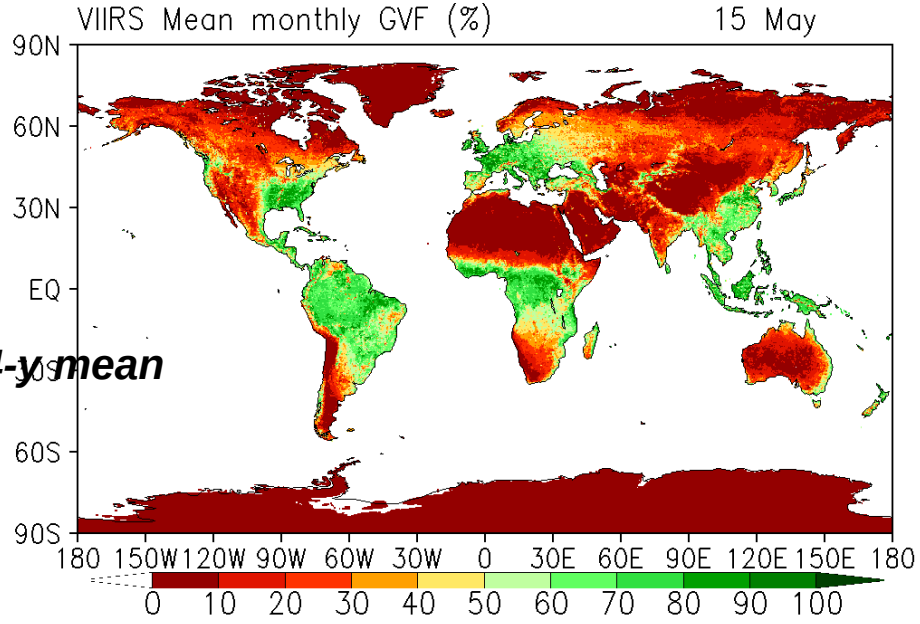
VIIRS GVF (4-y monthly mean) test:

5/02 – 6/02, 2016

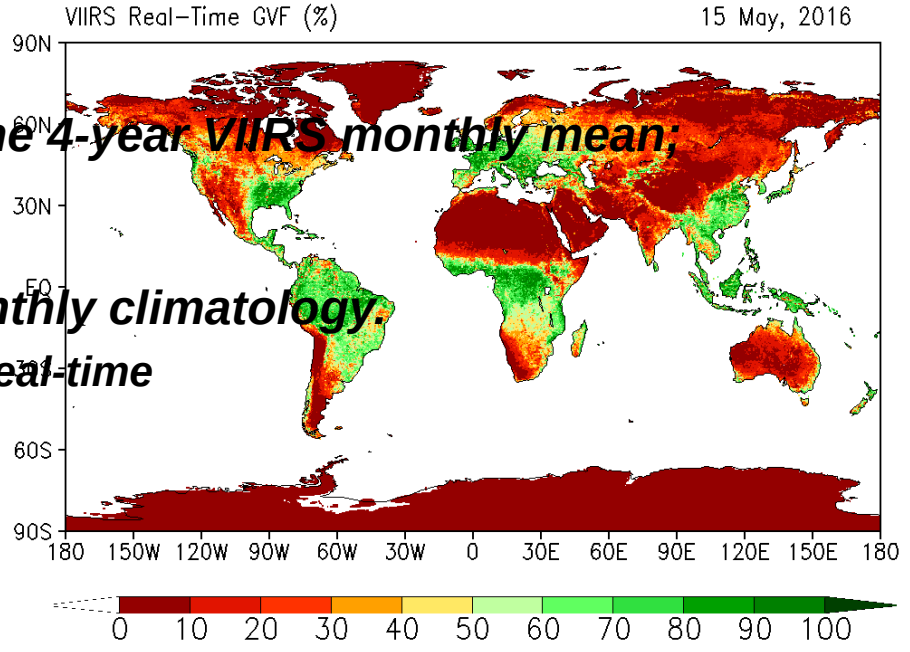
n and VIIRS data: 15 May 2016



Old Clim



4-y mean

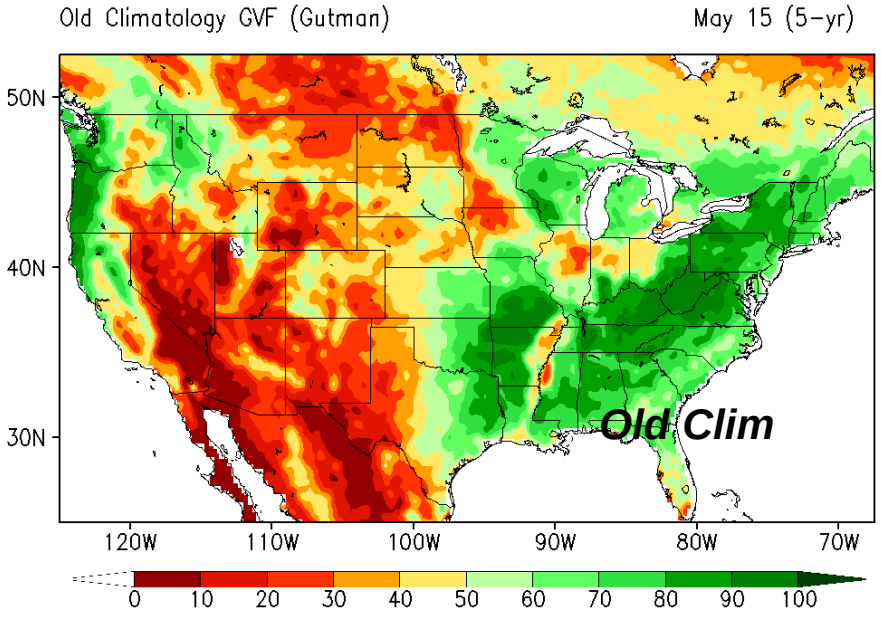


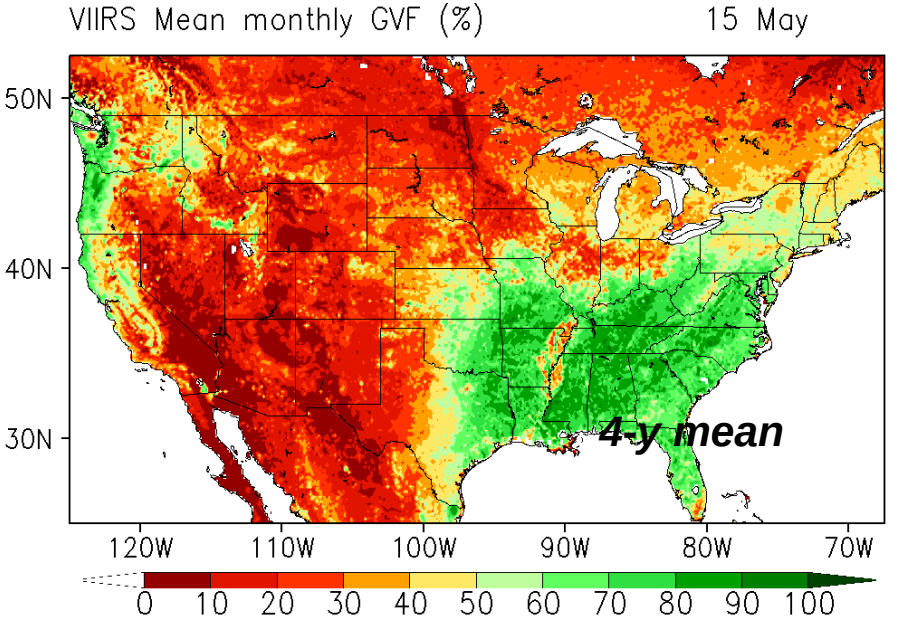
Real-time

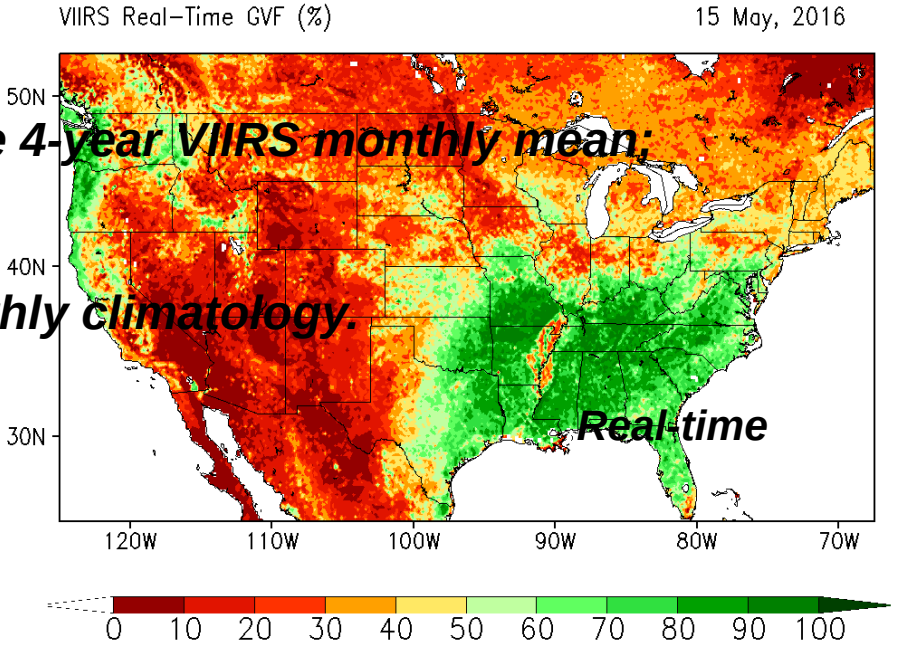
– Near real-time VIIRS GVF is similar to the 4-year VIIRS monthly mean;

– Both are lower than the old AVHRR monthly climatology.

m and VIIRS data: 15 May 2016



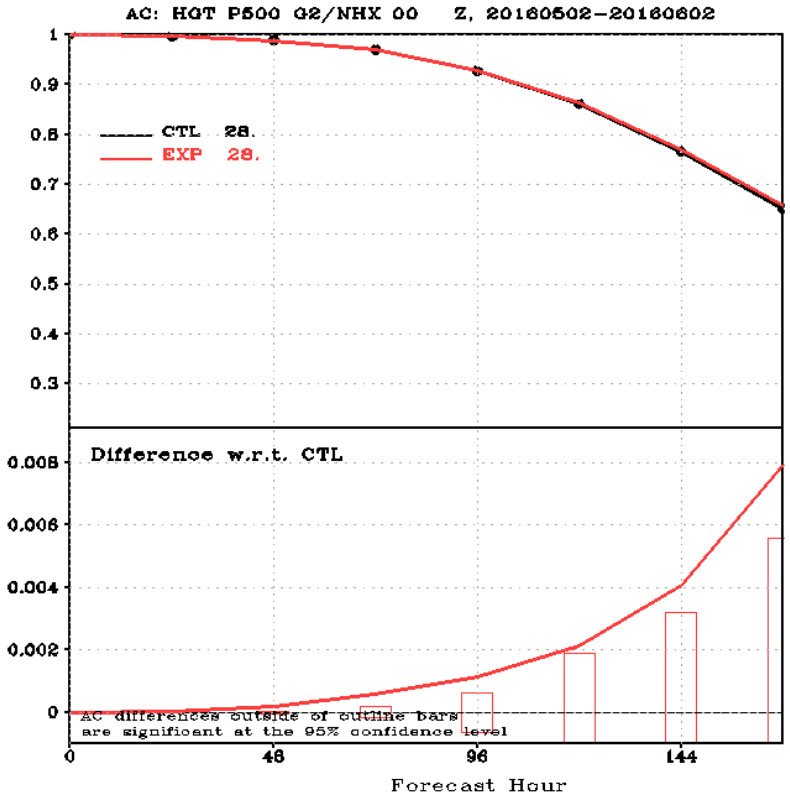




- ***Near real-time VIIRS GVF is similar to the 4-year VIIRS monthly mean;***
- ***Both are lower than the old AVHRR monthly climatology.***

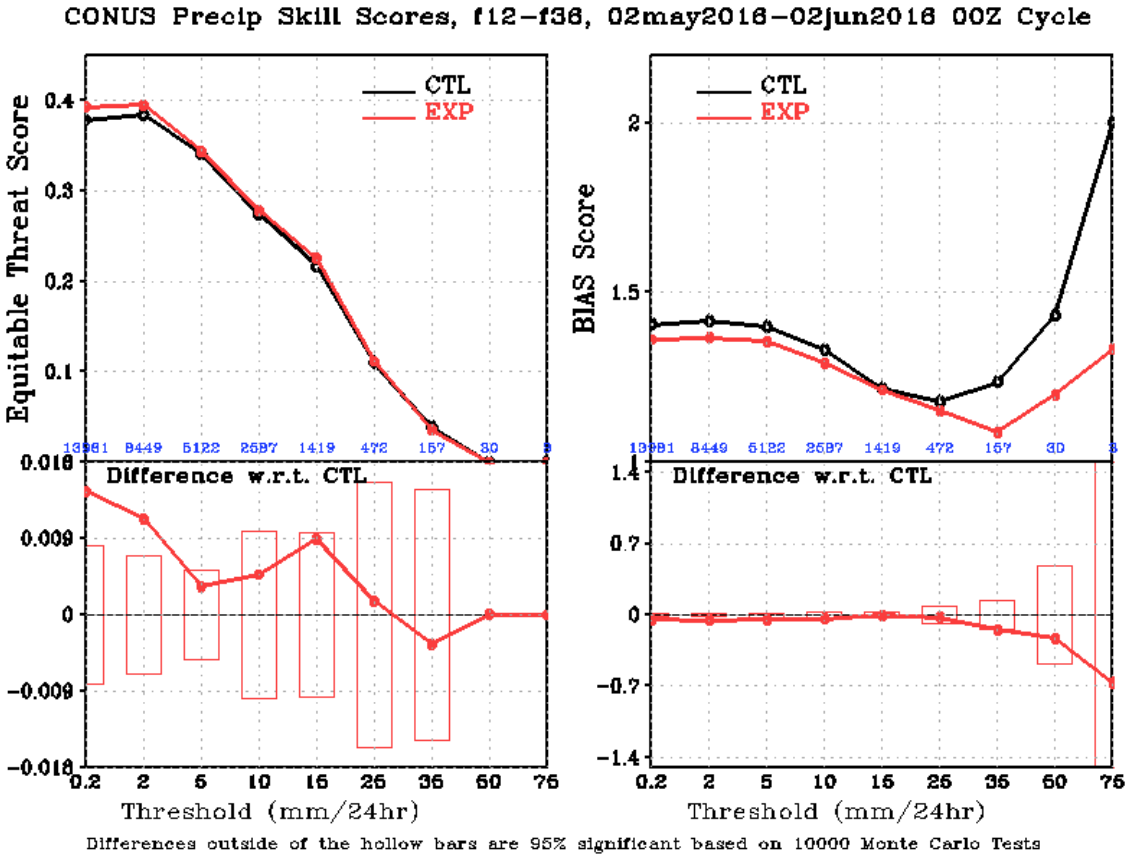
ean) test: 5/02 – 6/02, 2016

AC: HGT 500 hPa G2/NHX



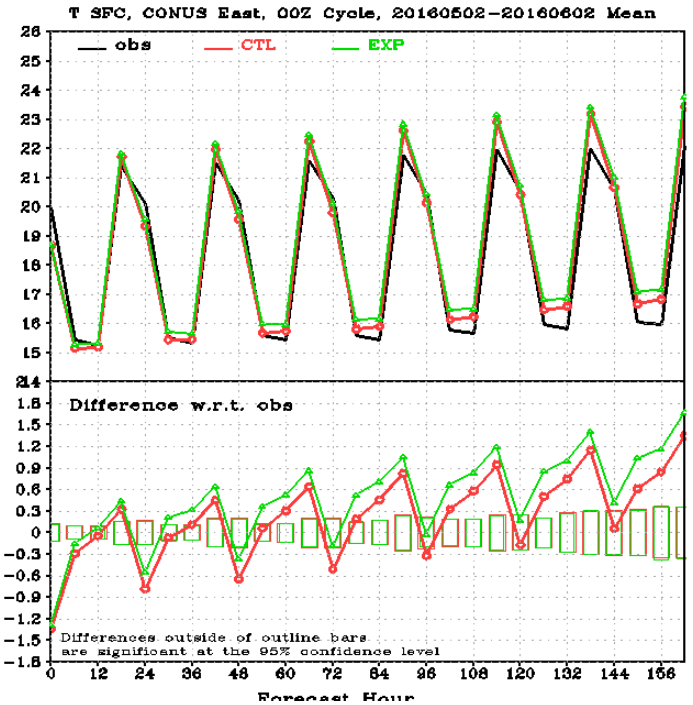
VIIRS test: Improve AC score @500 hPa.

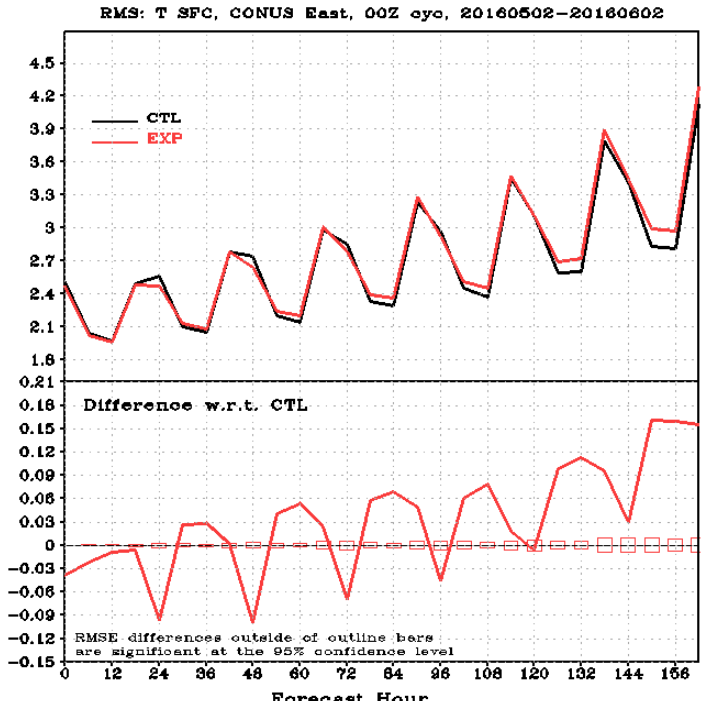
Precipitation Skill Scores over CONUS: f12-f36



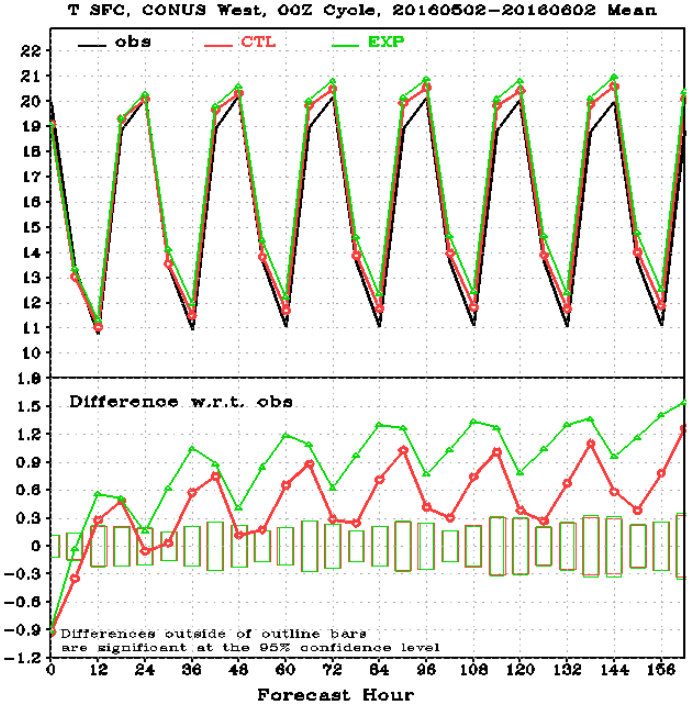
VIIRS test: positive impact for light precipitation

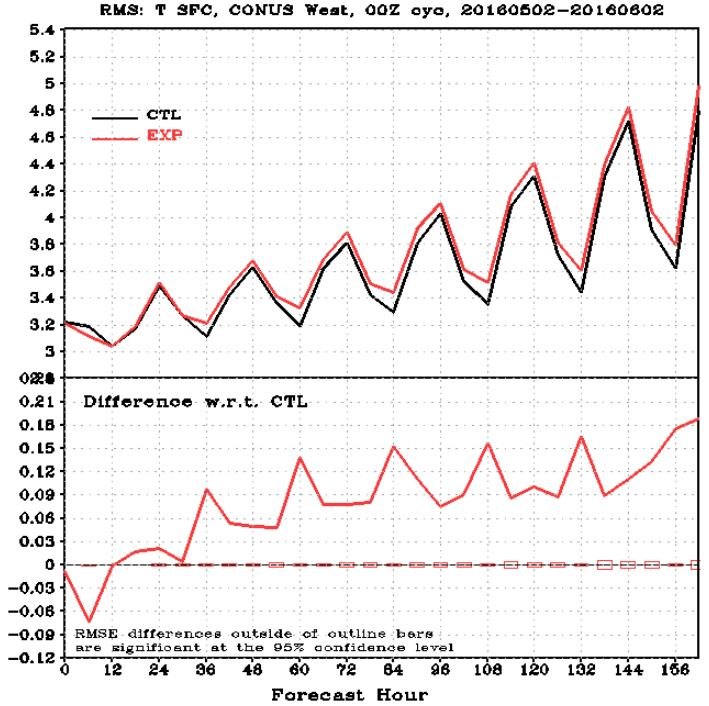
&W. CONUS 5/02-6/02, 2016





East CONUS



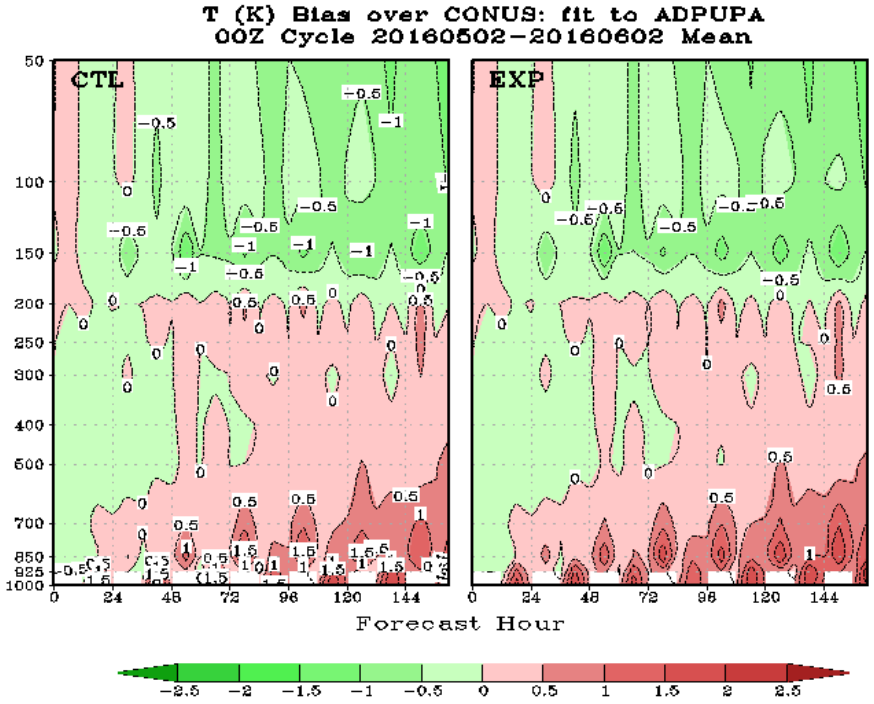


West CONUS

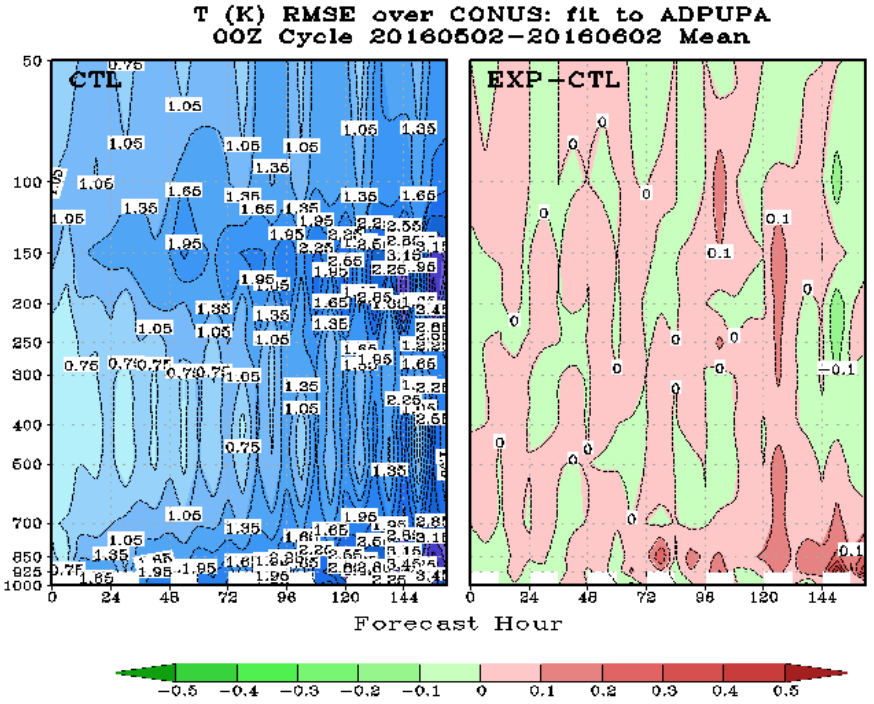
<u>VIIRS:</u>
Increase warm bias and RMSE!

er CONUS 5/02-6/02, 2016

Temp Bias

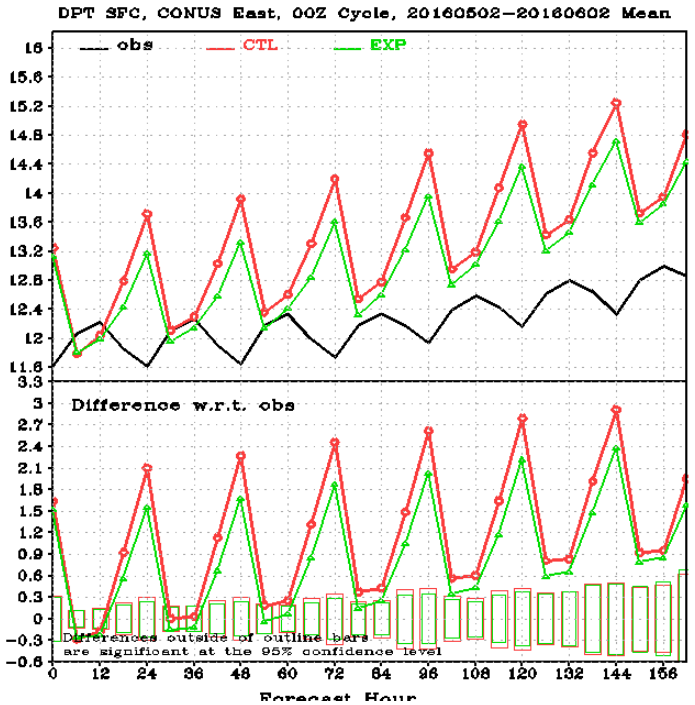


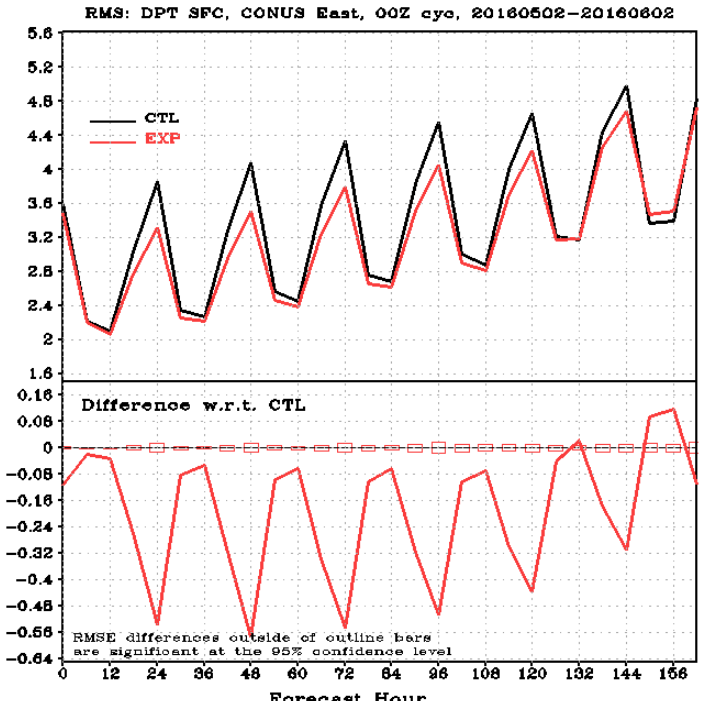
Temp RMSE



VIIRS: Increase warm bias and RMSE!

&W. CONUS 5/02-6/02, 2016



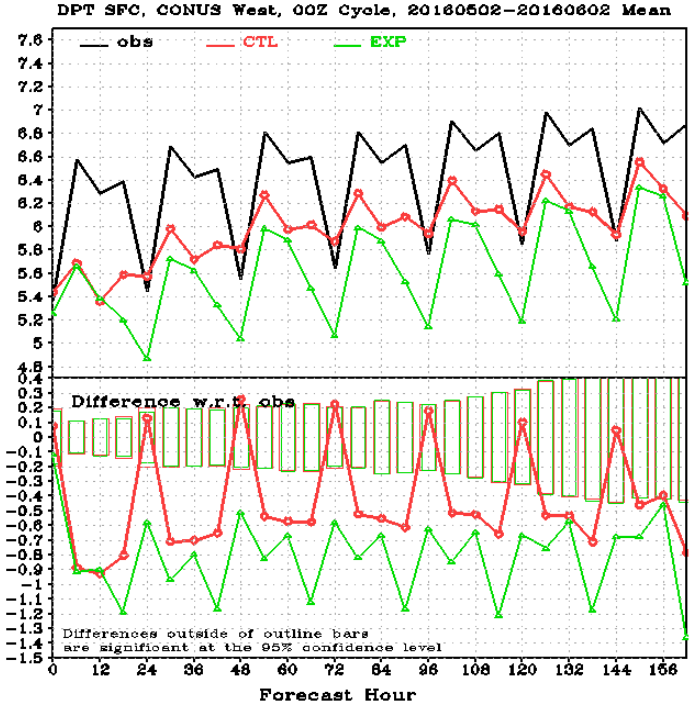


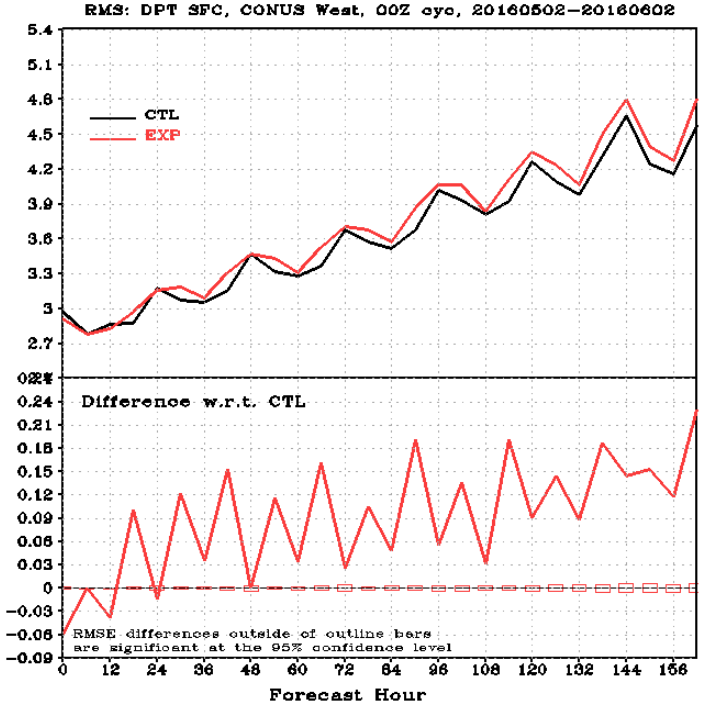
East CONUS

VIIRS:

East CONUS:
Reduce wet bias and RMSE.

West CONUS:
Increase dry bias and RMSE.



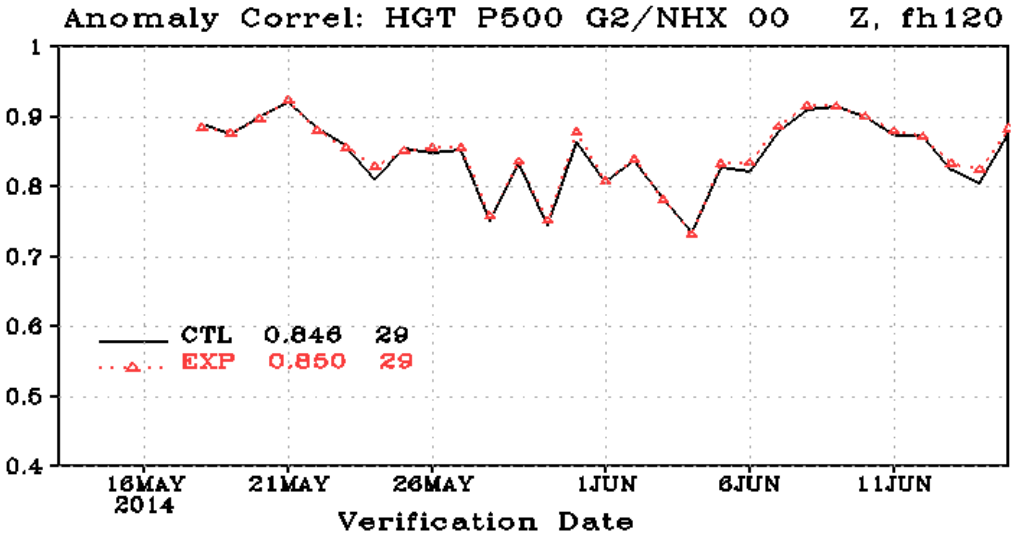


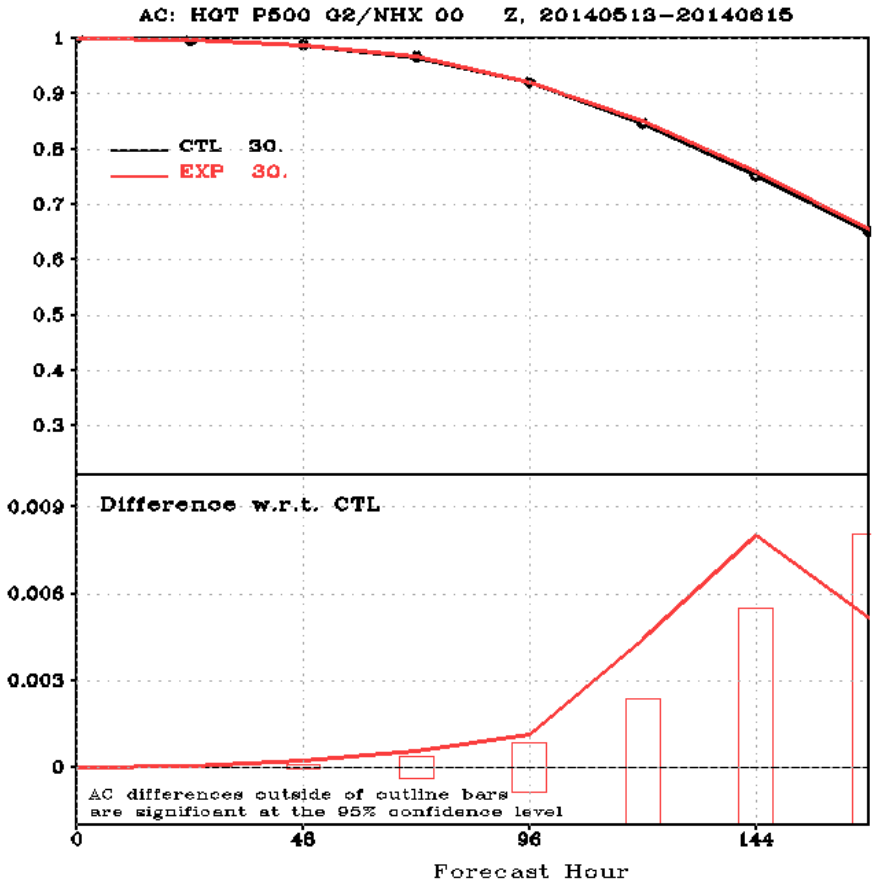
West CONUS

VIIRS GVF (4-y monthly mean) test:

5/13 – 6/15, 2014

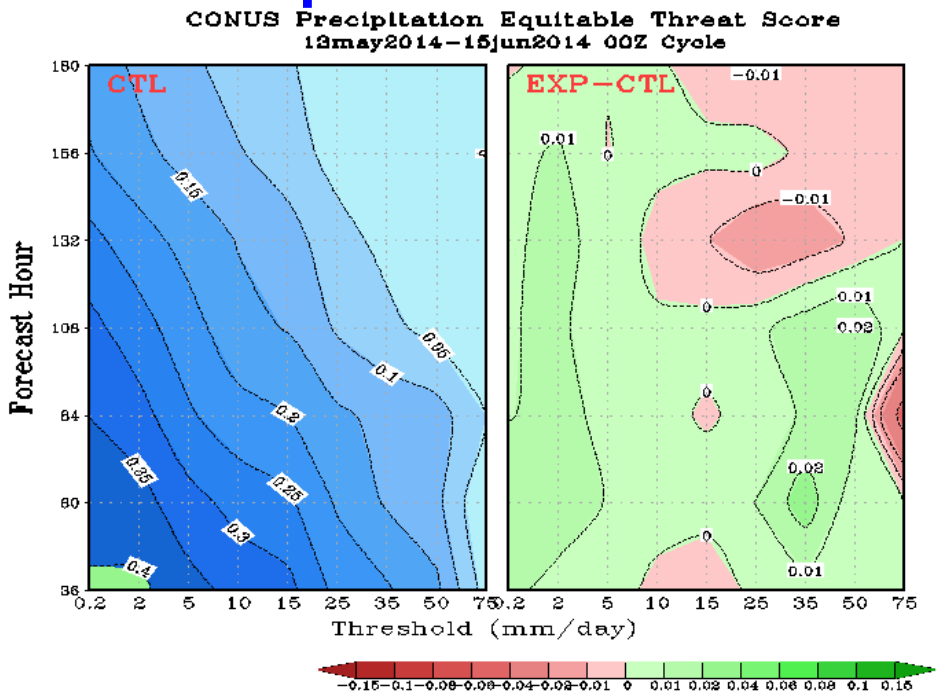
AC: HGT 500 hPa G2/NHX 5/13-6/15 2014

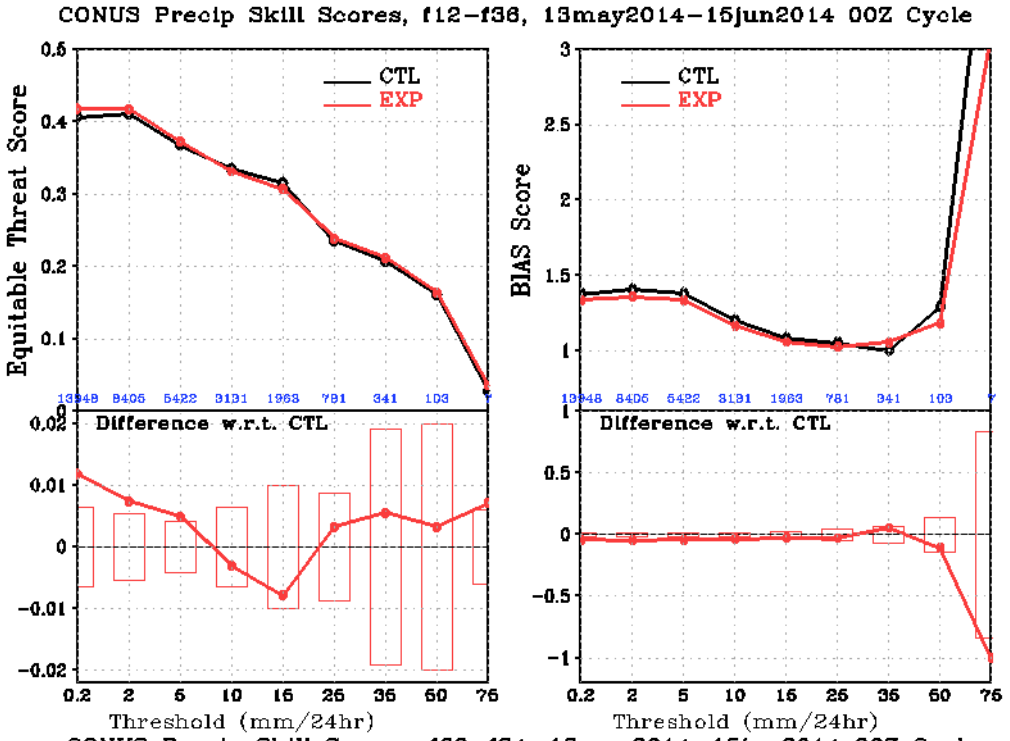


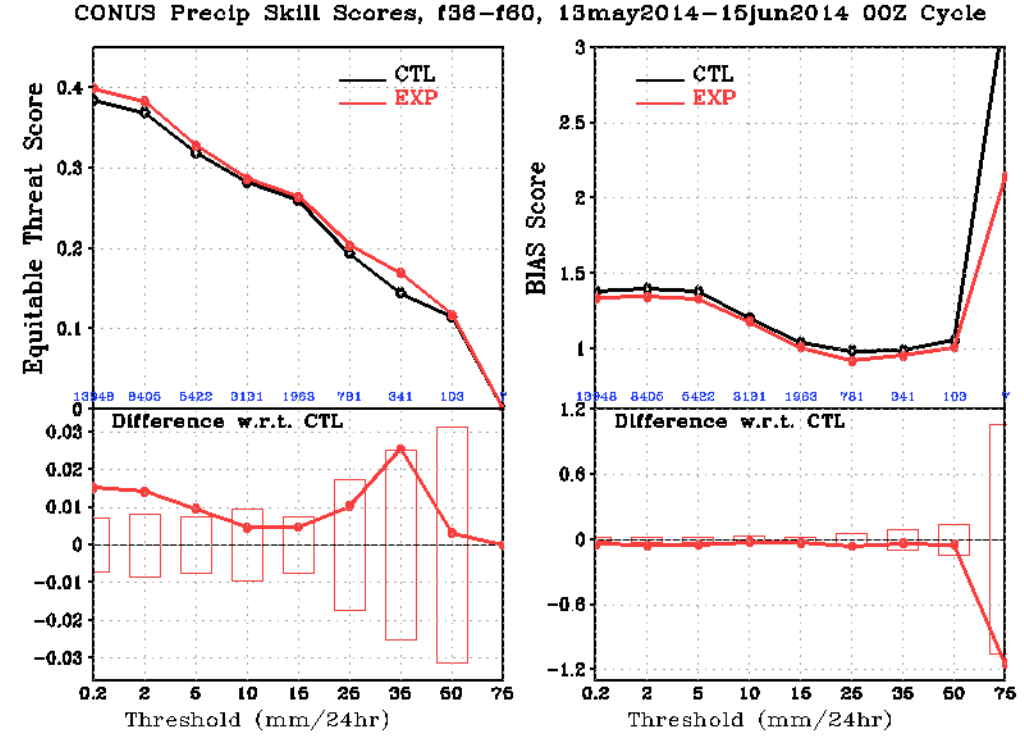


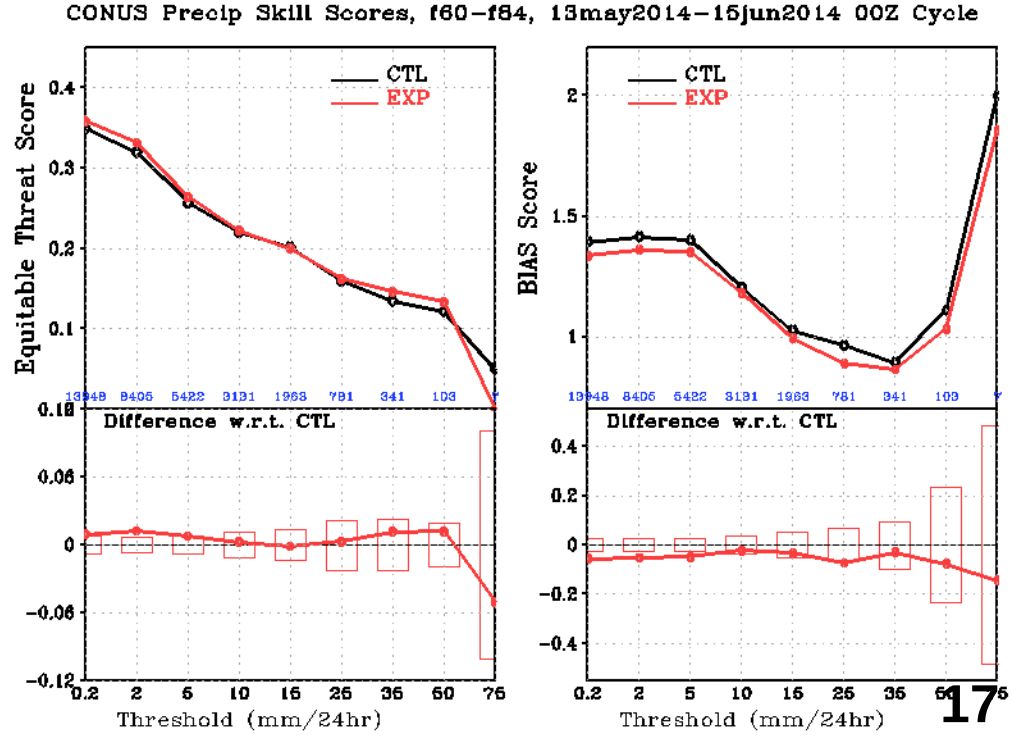
VIIRS test: Improve AC score @500 hPa.

Precipitation Skill Scores over CONUS: 5/13-6/15 2014

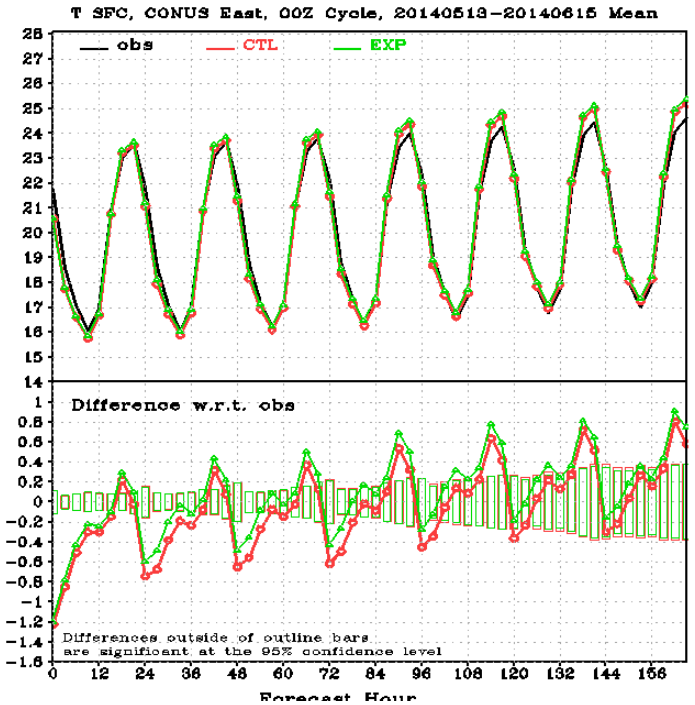


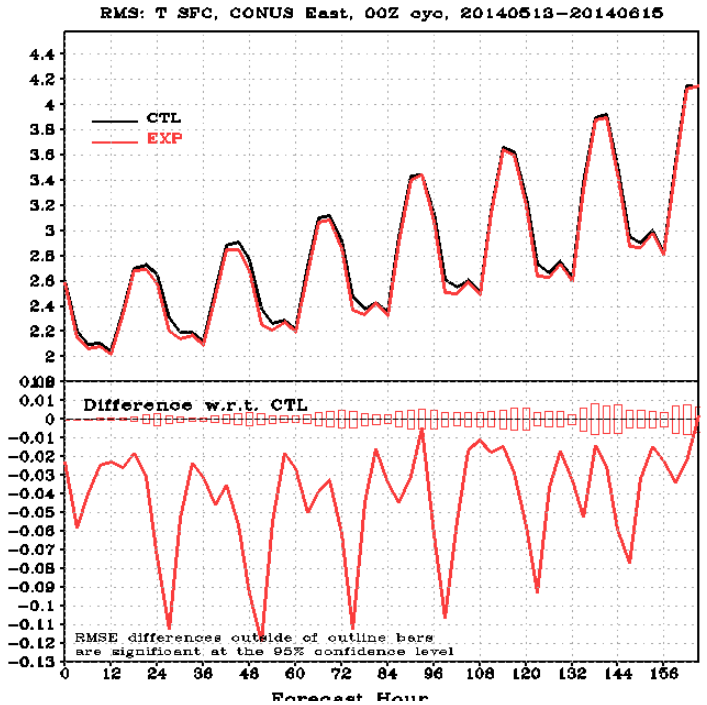






&W. CONUS 5/13-6/15, 2014

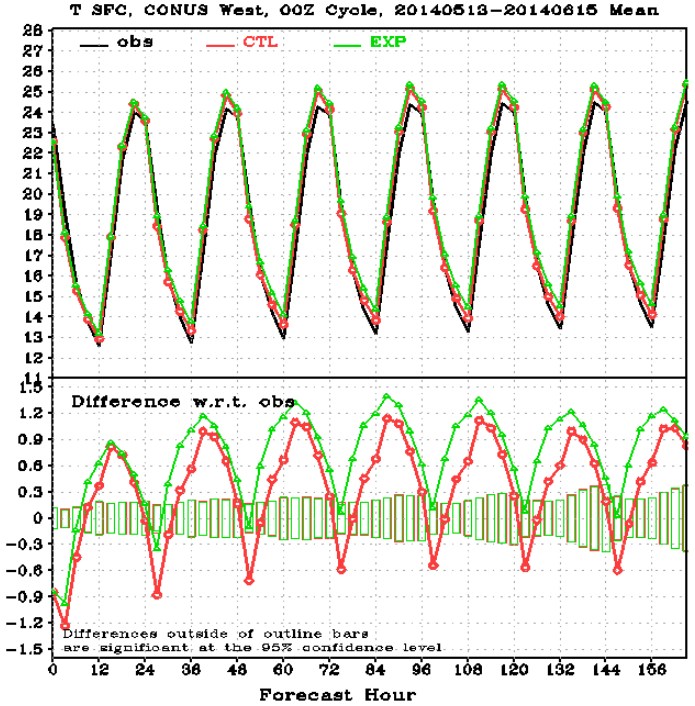


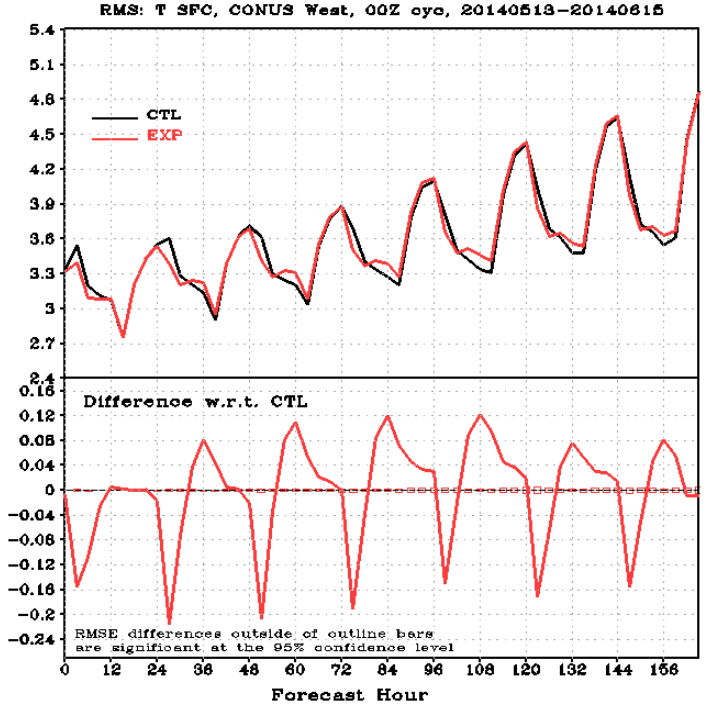


East CONUS

VIIRS:

East CONUS:
Reduce RMSE.

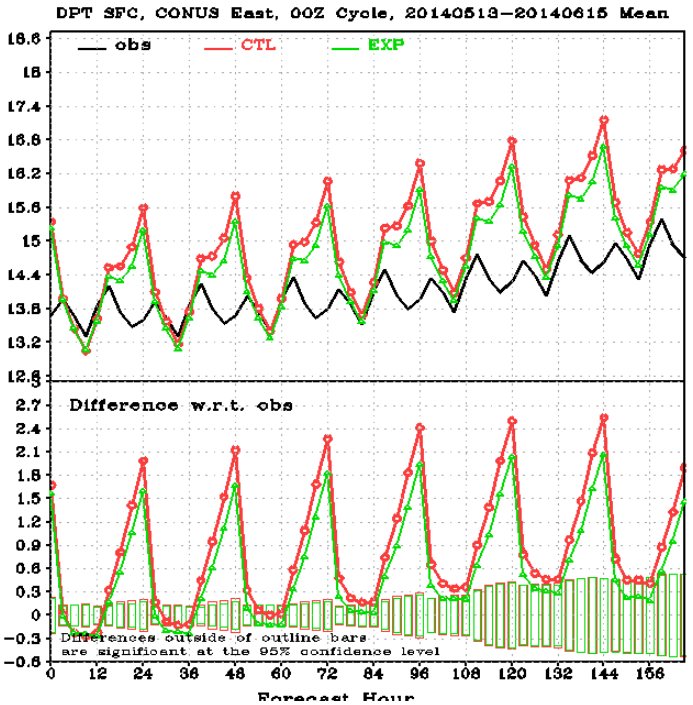


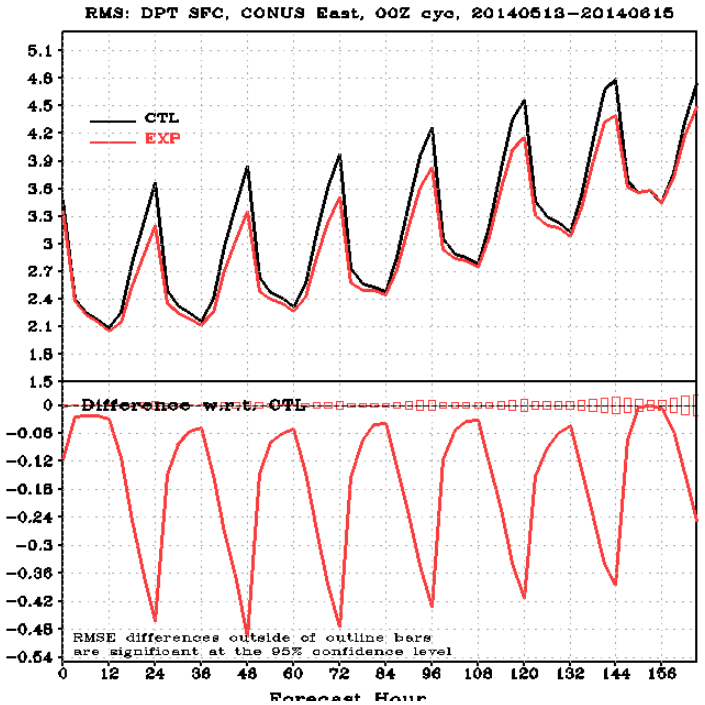


West CONUS:
Increase warm bias.

West CONUS

&W. CONUS 5/13-6/15, 2014



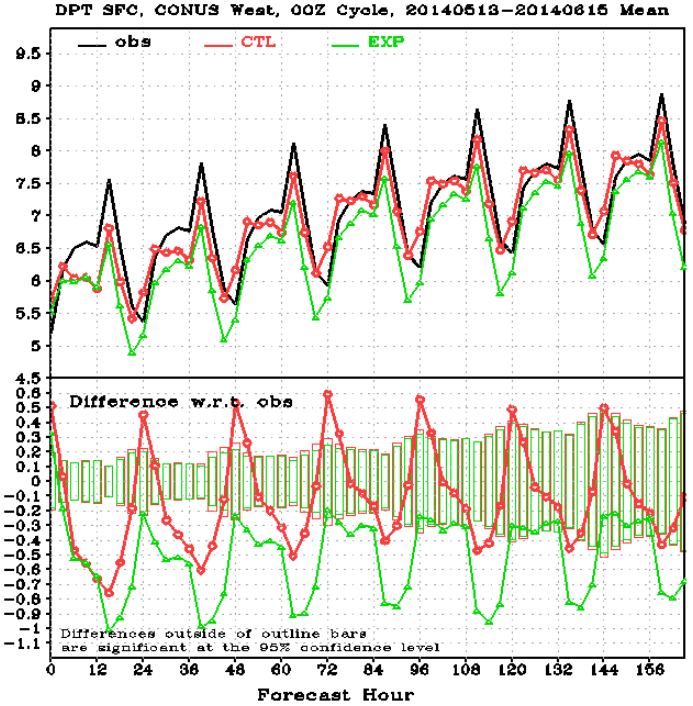


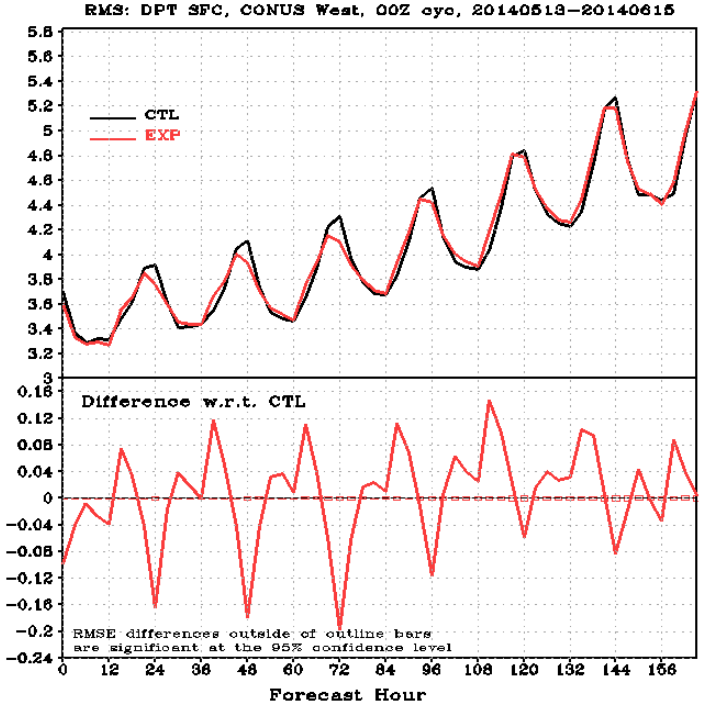
East CONUS

VIIRS:

East CONUS: Reduce wet bias and RMSE.

West CONUS: Increase dry bias.

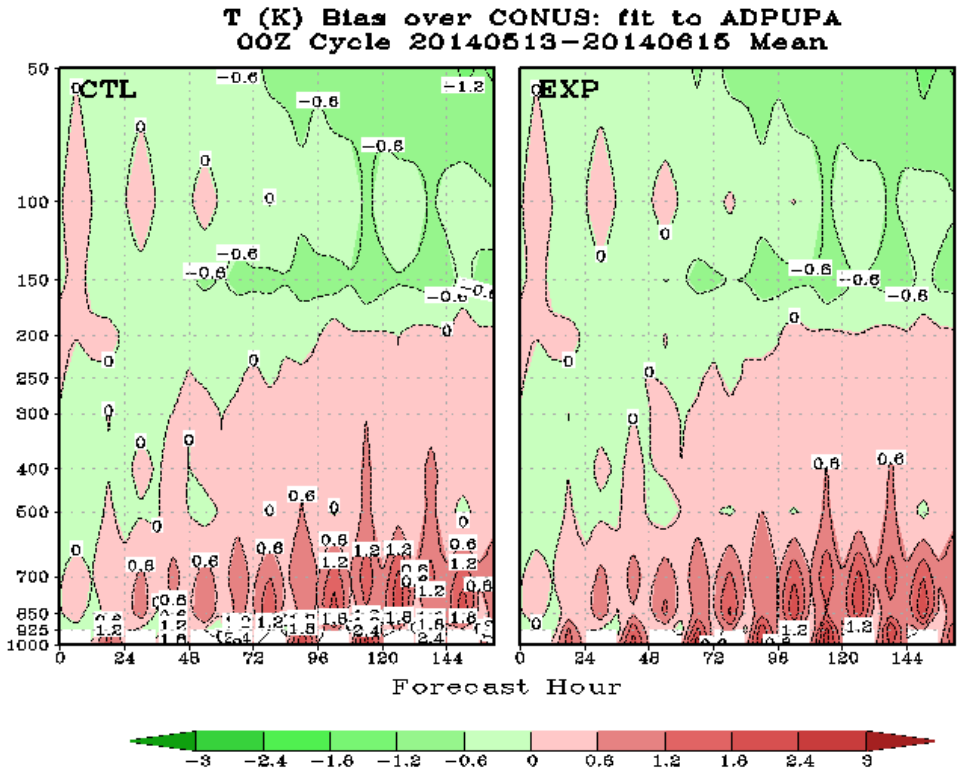




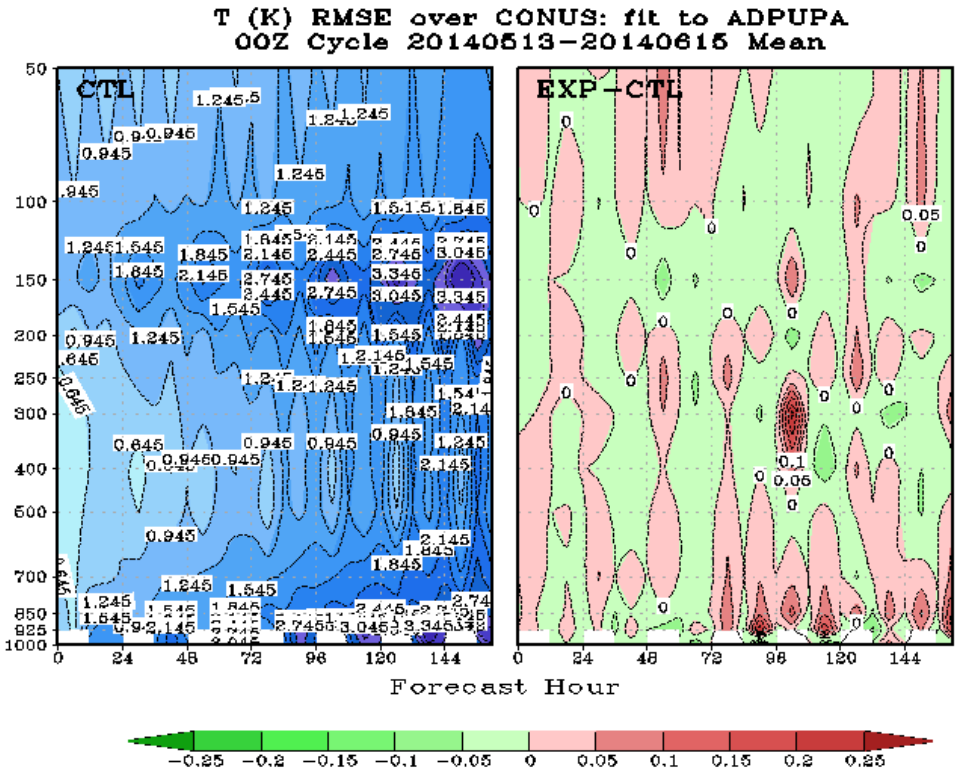
West CONUS

er CONUS 5/13-6/15, 2014

Temp Bias



Temp RMSE



VIIRS: Increase warm bias and RMSE!

Summary

- **Several satellite data sets developed recently (e.g., GVF, snow, burning area, albedo, radiation, soil and vegetation type) have been tested in the NCEP models. The results show good improvements, compared with the current data sets; However, some data sets need further validation with ground measurements, and consistence of all these data sets is required.**

- **VIIRS GVF data has lower values than other data sets, especially in growing seasons, which needs further investigation with ground measuements.**

- **We will continue our efforts and working together with several research teams including NESDIS to improve satellite data utilization and data assimilation and then improve NCEP NWP.**

Thank You !

Any questions/comments?