

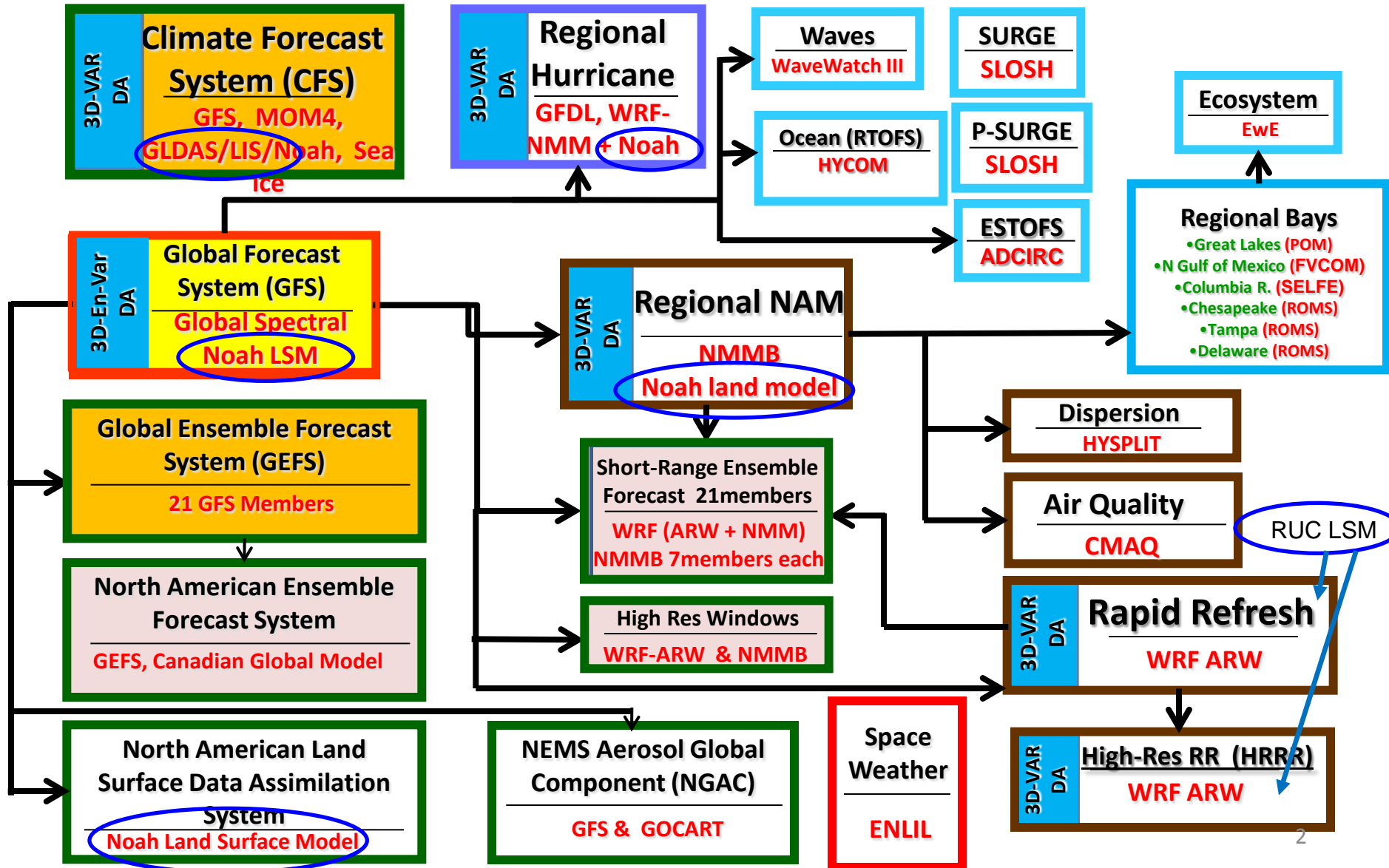


NCEP LAND APPLICATIONS

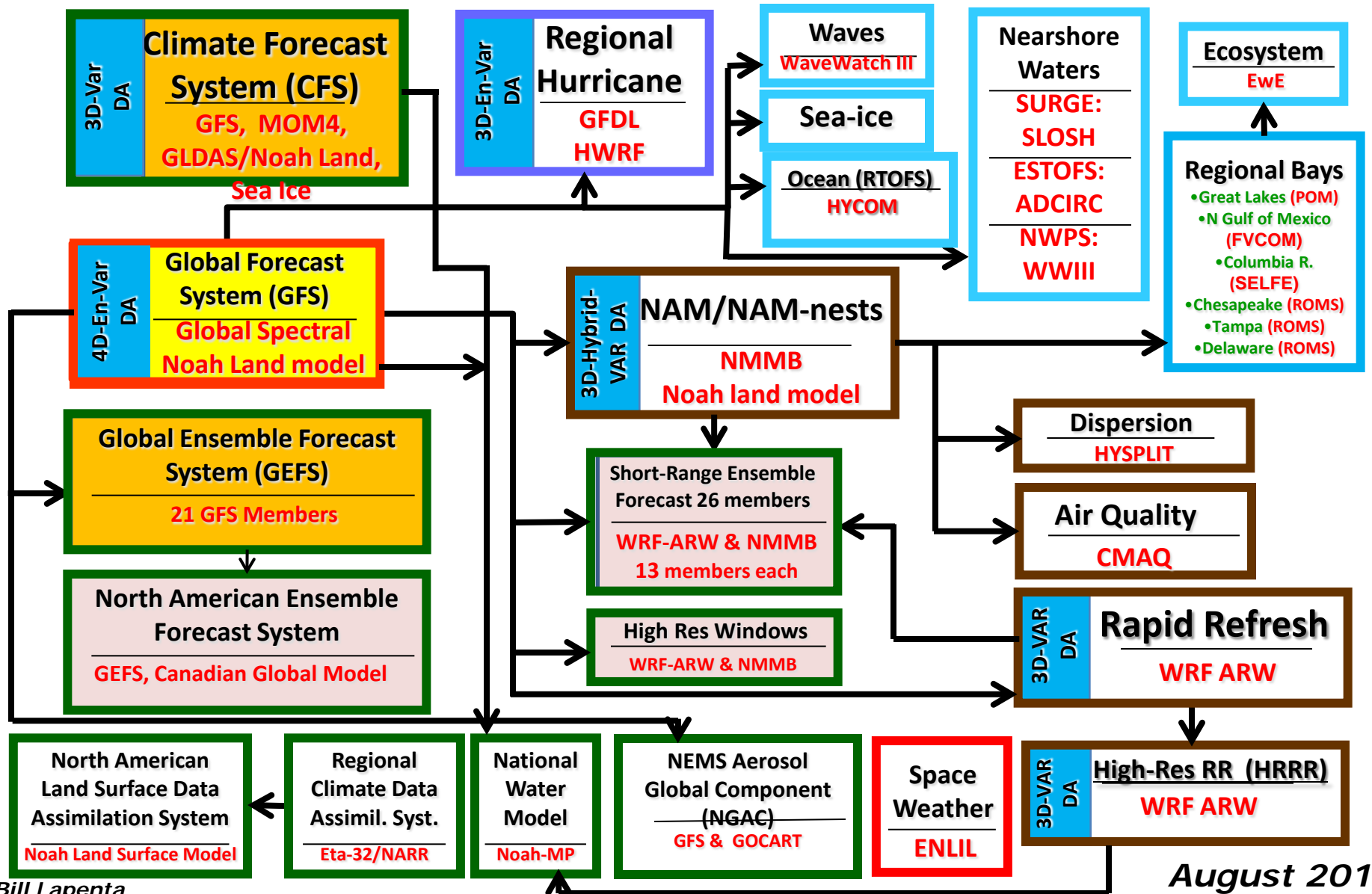
Mike Ek
NCEP/EMC

Yihua Wu, Weizhong Zheng, Helin Wei
IMSG

Land Prediction in Weather & Climate Models: NOAA's Operational Numerical Guidance Suite



NOAA's Operational Numerical Guidance Suite

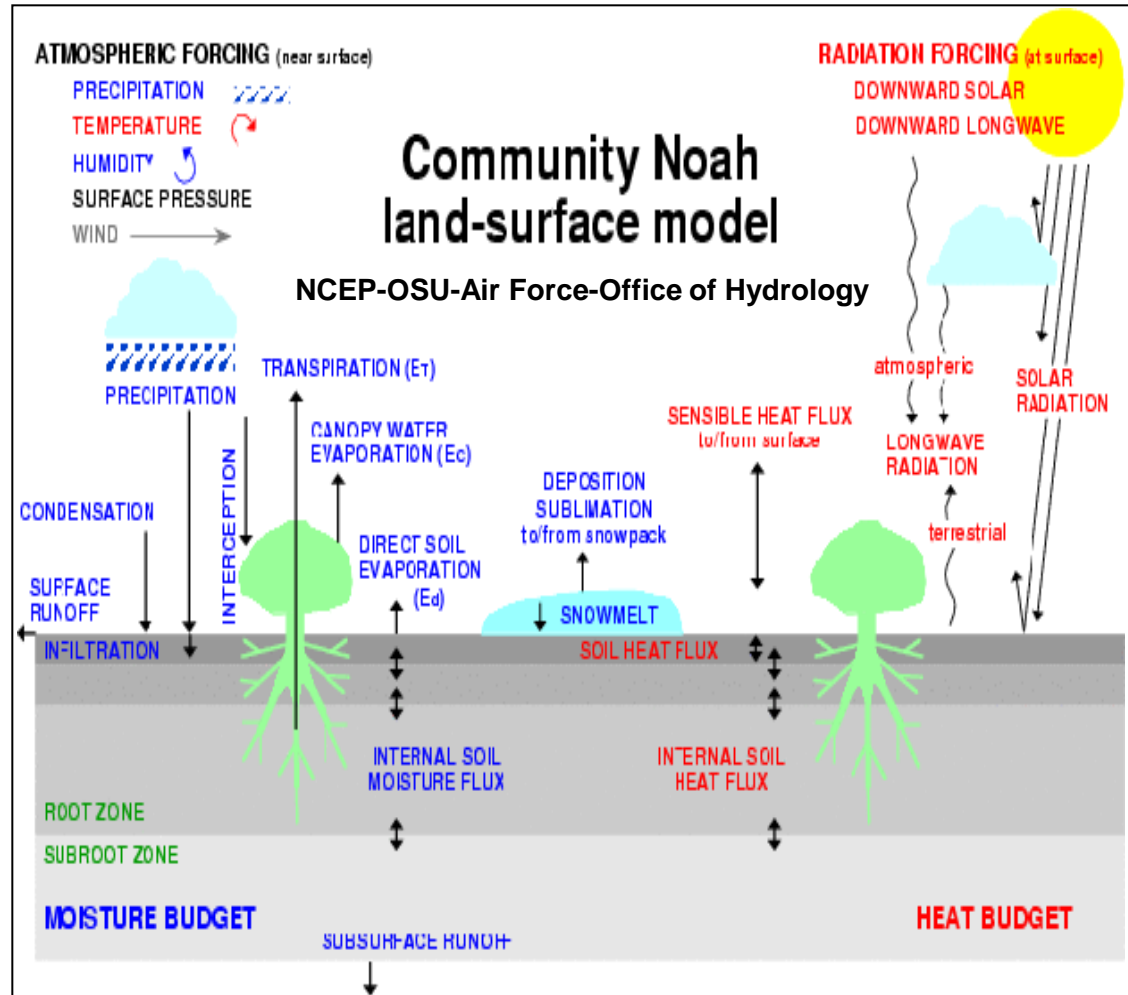


Bill Lapenta

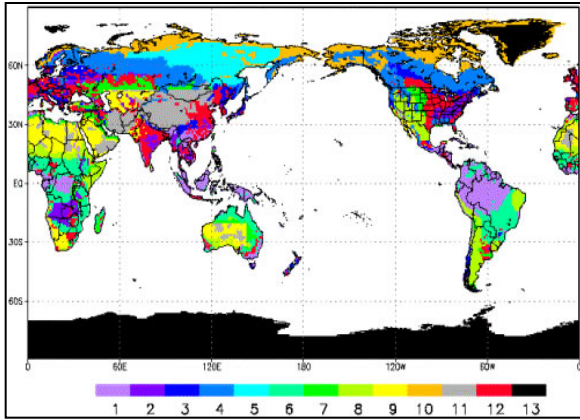
August 2016

NCEP-NCAR unified Noah land model

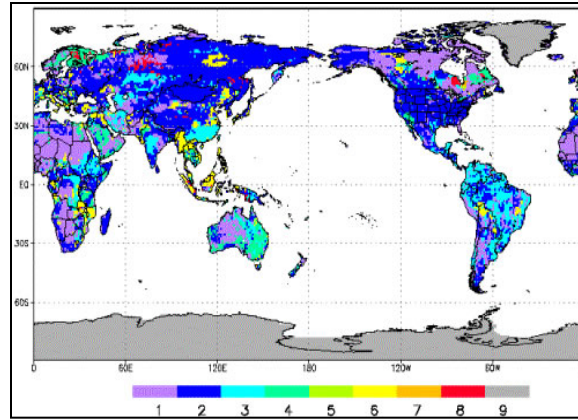
- Surface **energy** (linearized) & **water** budgets; 4 soil layers.
- Forcing: downward radiation, precip., temp., humidity, pressure, wind.
- Land states: T_{sfc} , T_{soil}^* , soil water* and soil ice, canopy water*, snow depth and snow density.
*prognostic
- Land data sets: veg. type, green vegetation fraction, soil type, snow-free albedo & maximum snow albedo.



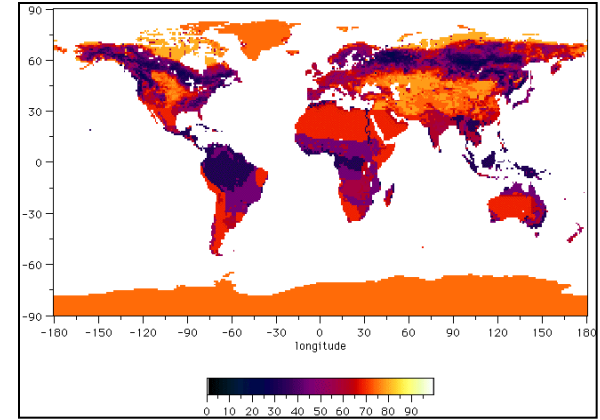
Land Data Sets (GFS and CFS, GLDAS)



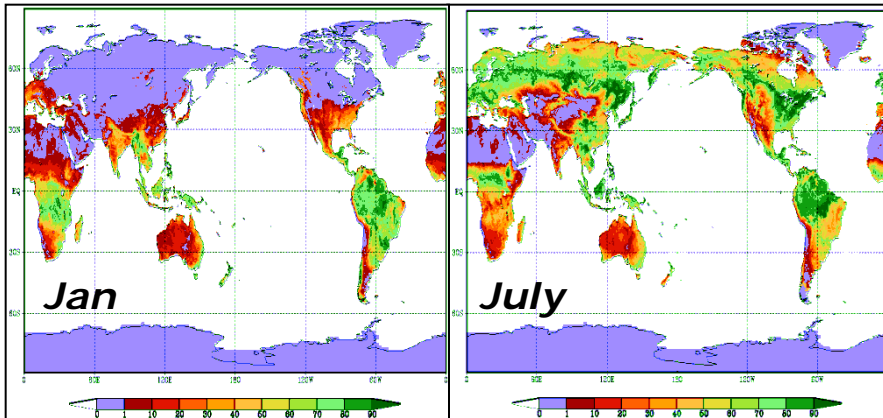
Vegetation Type
(1-deg, UMD)



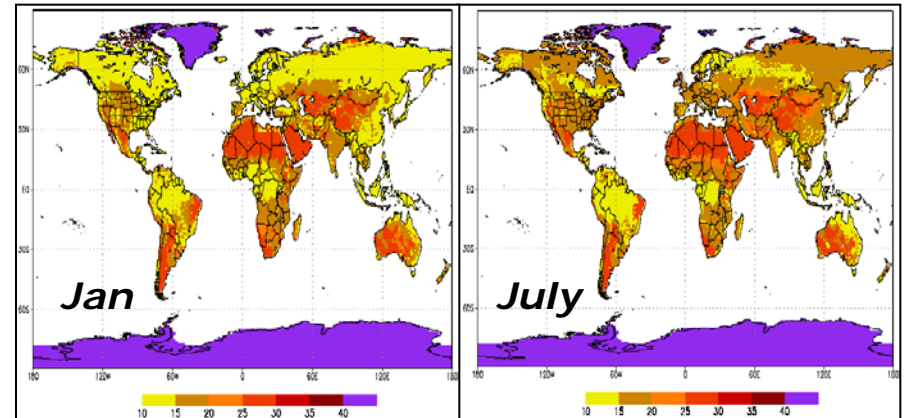
Soil Type
(1-deg, Zobler)



Max.-Snow Albedo
(1-deg, Robinson)

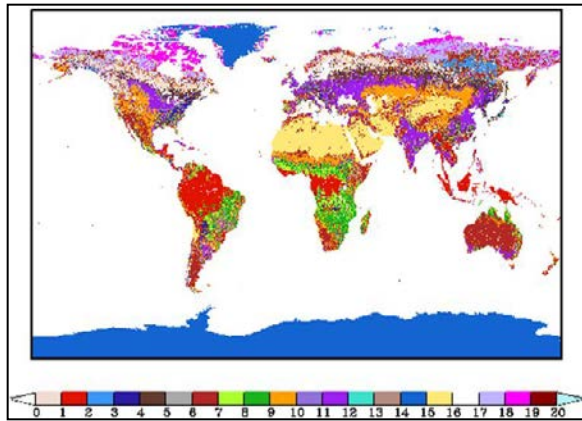


Green Vegetation Fraction
(monthly, 1/8-deg,
NESDIS/AVHRR)

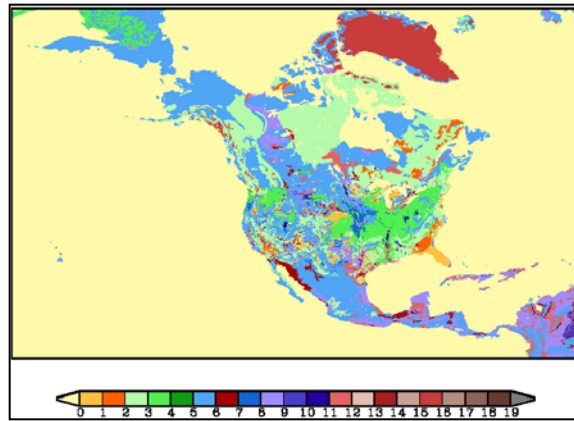


Snow-Free Albedo
(seasonal, 1-deg,
Matthews)

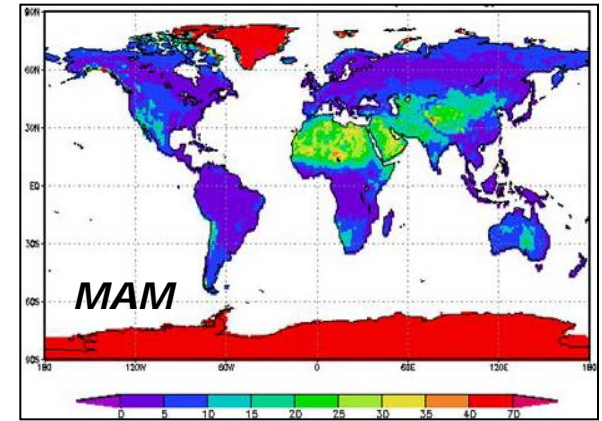
Land Data Sets (NAM, NLDAS)



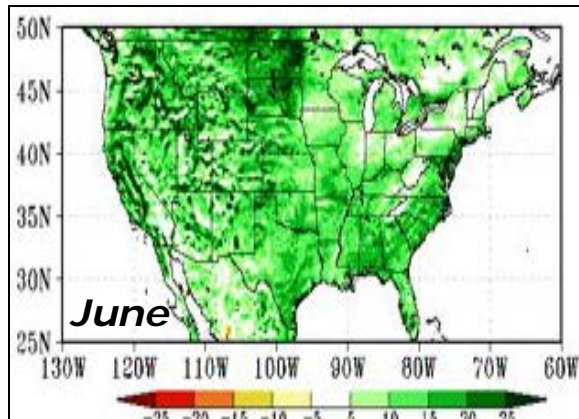
Vegetation Type
(1-km, MODIS)



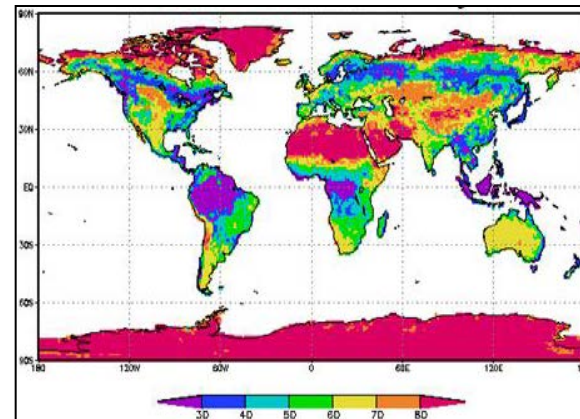
Soil Type
(1-km, STATSGO/FAO)



Snow-Free Albedo
(1-km, MODIS)



Green Vegetation Fraction
(1/8-deg, new NESDIS/AVHRR)



Max.-Snow Albedo
(5-km, MODIS)

LAND PRODUCTS USED IN MODELS

OBS TYPE	DATA SOURCE				APPLICATION IN MODELS	
	CURRENT		FUTURE			
	SOURCE	REQUIREMENTS	SOURCE	REQUIREMENTS	INITIAL	VERIFICATION
GVF	AVHRR	5 year Climate	VIIRS	Weekly value updated daily, 1KM	X	
ALB	Table	Seasonal		Hourly, 1KM	X	
LST			VIIRS	Hourly, 1KM		X
LAND TYPE	MODIS	Annual, 1KM	VIRRS	ANNUALLY Updated, 1KM	X	
SNOW COVER	AVHRR	12/24 Hour 1KM/4KM/24KM	VIRRS	HOURLY, 1KM	X	X
SWE/SNOW DEPTH	AVHRR	12/24 HOUR	VIRRS	HOURLY, 1KM	X	X
EMISSIVITY	Table	Seasonal	VIRRS	HOURLY, 1KM	X	
BURNED AREA	AVHRR/MODIS	6/12/Hour, 1KM/4KM	VIRRS	HOURLY, 1KM	X	
LW RADIATION			VIRRS	HOURLY, 1KM		X
SW RADIATION			VIRRS	HOURLY, 1KM		X

Consistency among all of the products is very important in developing future products

Testing in Coupled Models

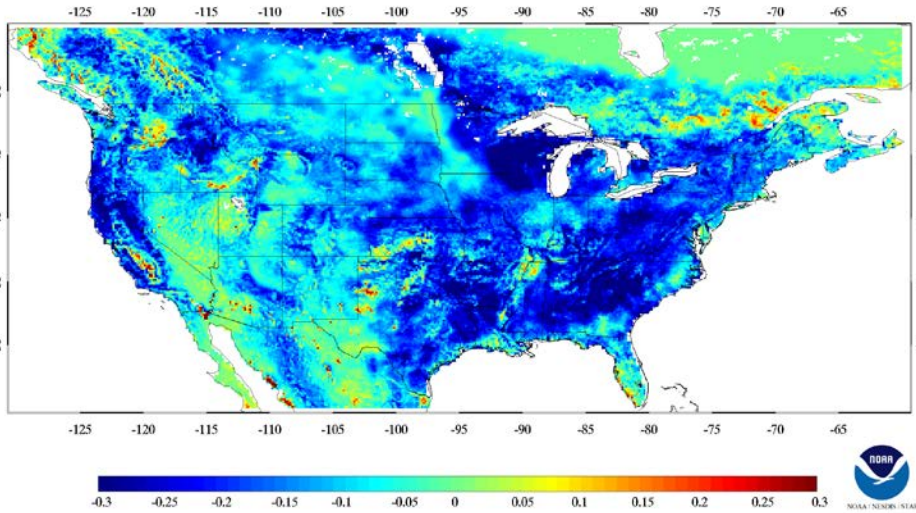
- Near real time GVF compared with the climatology
- Near real time GVF tested in NAM and GFS
- Burned Area used in NAM
- LST Validated over CONUS

Tests IN NAM

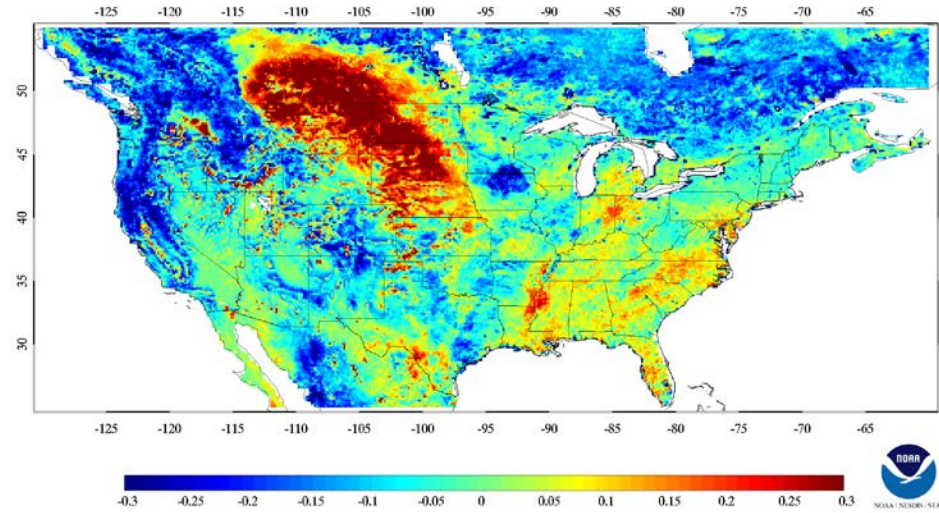
- 24 days (2 days each month, the beginning and the middle of each month) in 2014 were chosen for runs with NAM
- 3 GVFs were used
 - CLIMO—Control run
 - RGVF1—Xiaoyang Zhang
 - RGVF2—NESDIS
 - Surface update program developed by George Gayno was used to interpolate the real time GVF to NAM domain
- 84 hours simulation was conducted for each run
- Analysis was conducted over 218 GRID domain

GVF difference (VIIRS-AVHRR clim.)

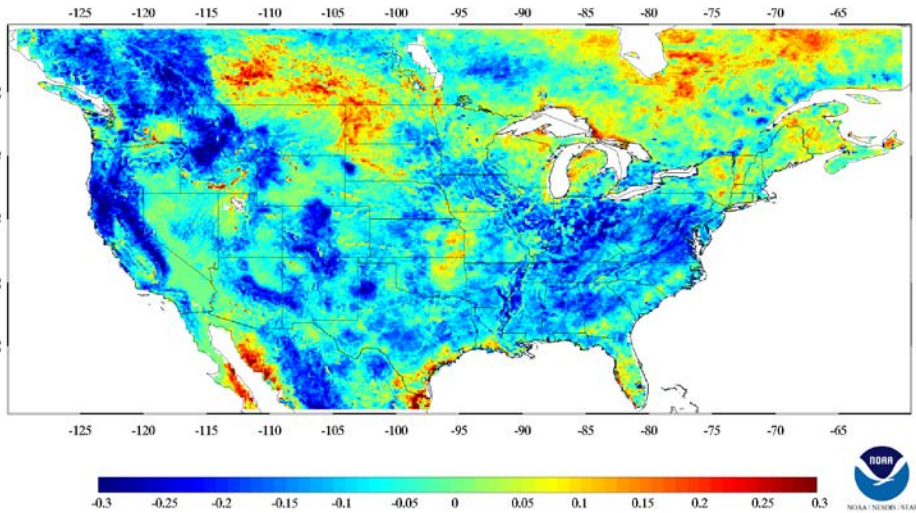
GVF difference (VIIRS - GVF_clim) April 9 - April 15, 2013



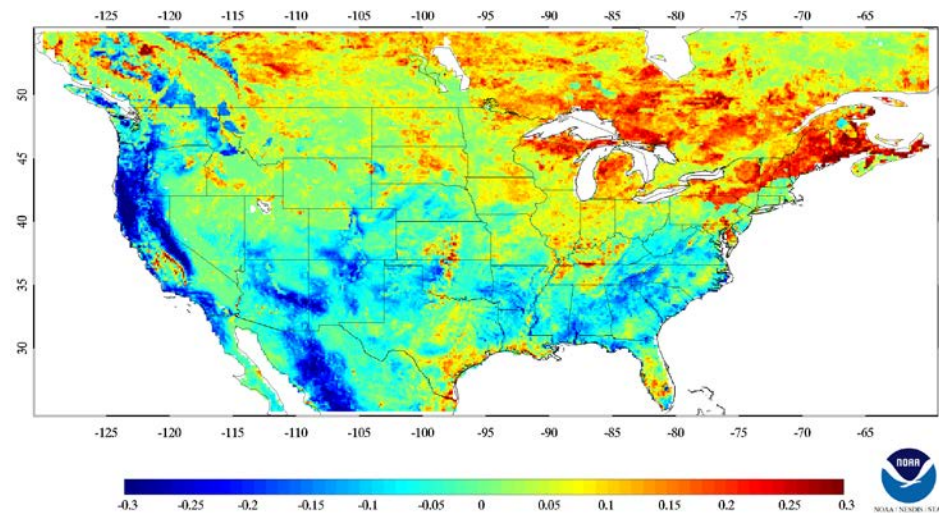
GVF difference (VIIRS - GVF_clim) July 9 - July 15, 2013



GVF difference (VIIRS - GVF_clim) October 9 - October 15, 2015



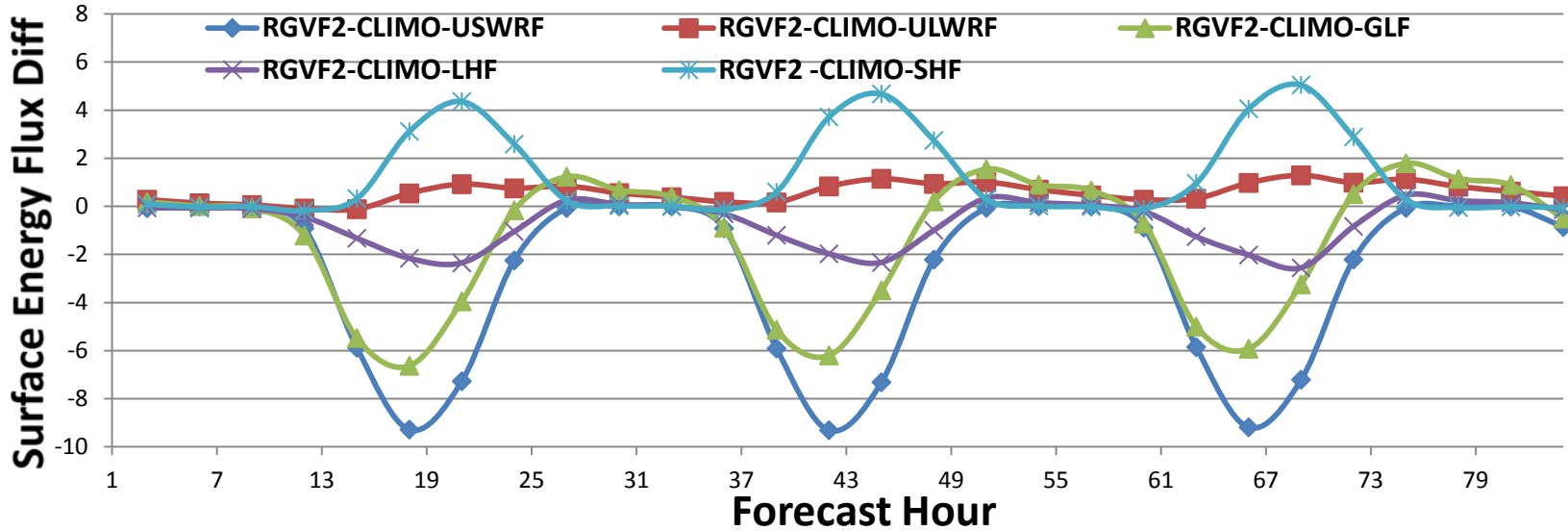
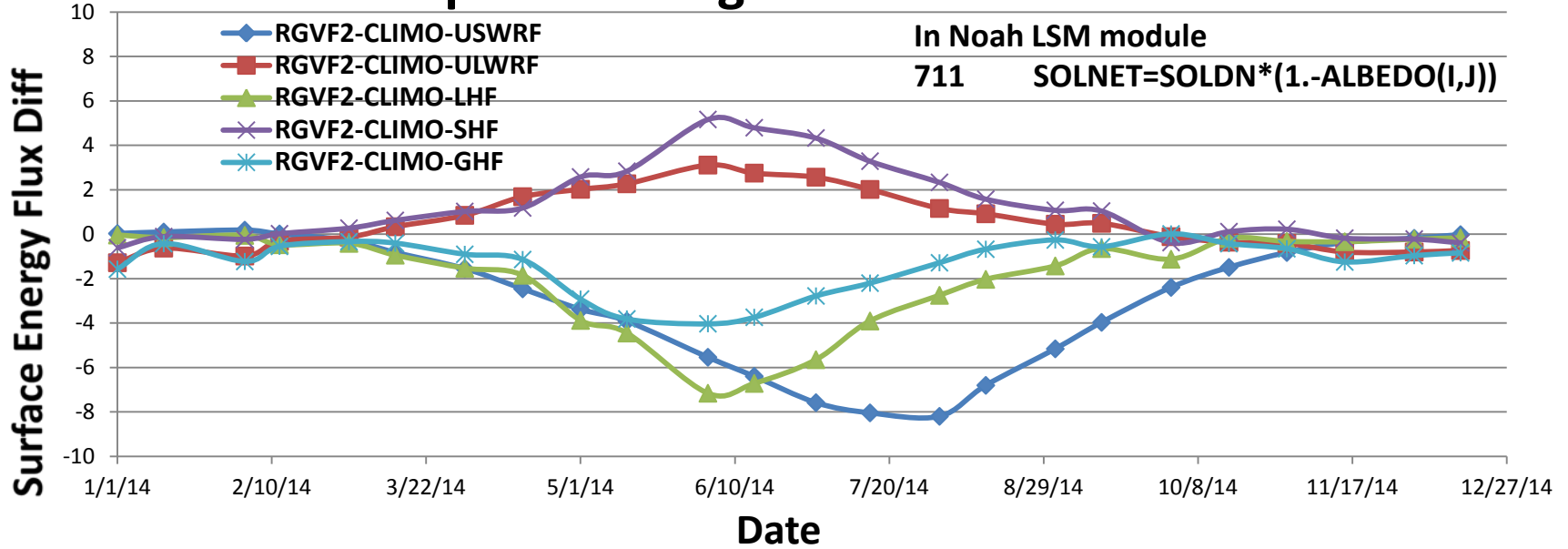
GVF difference (VIIRS - GVF_clim) January 9 - January 15, 2016



GVF climatology is higher than VIIRS GVF over vegetated area in spring

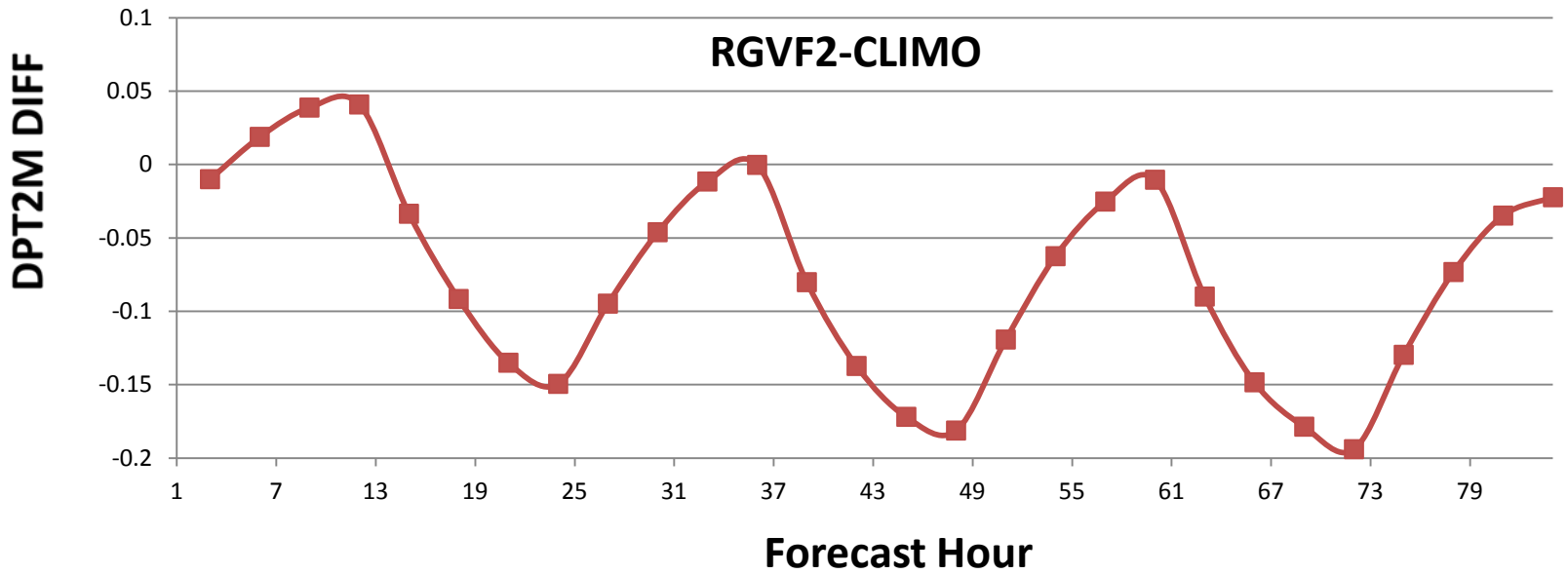
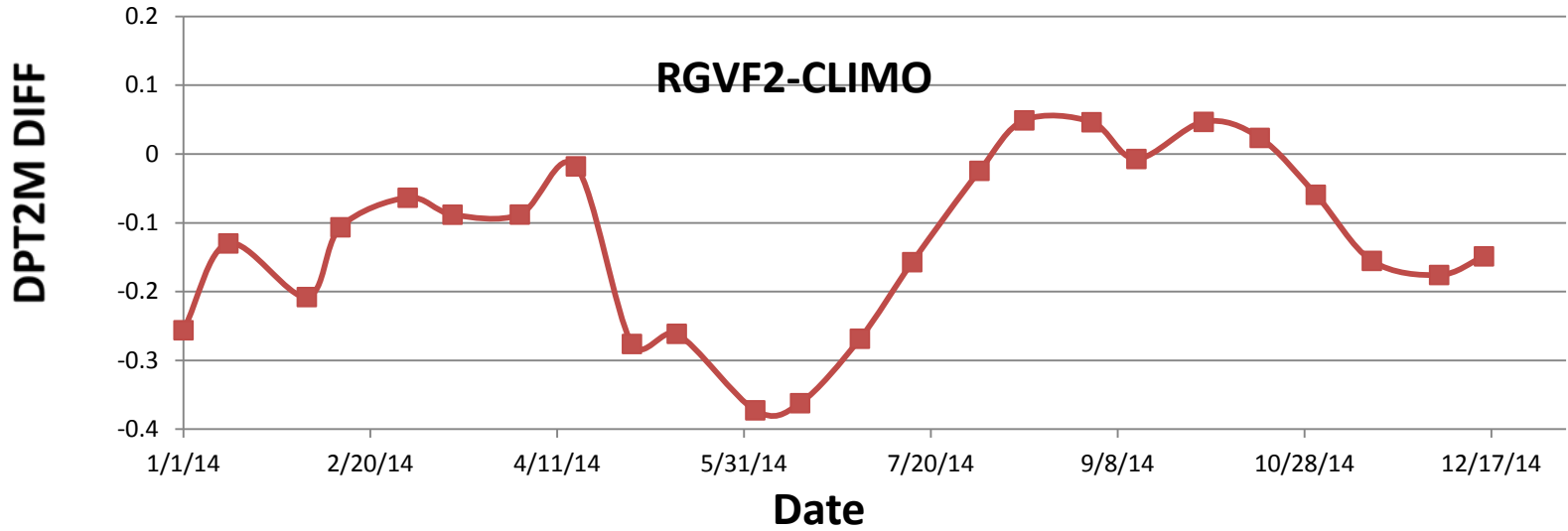
NAM GVF TESTING

Land point averages over Grid218 Domain



NAM GVF TESTING

Land point averages over Grid218 Domain



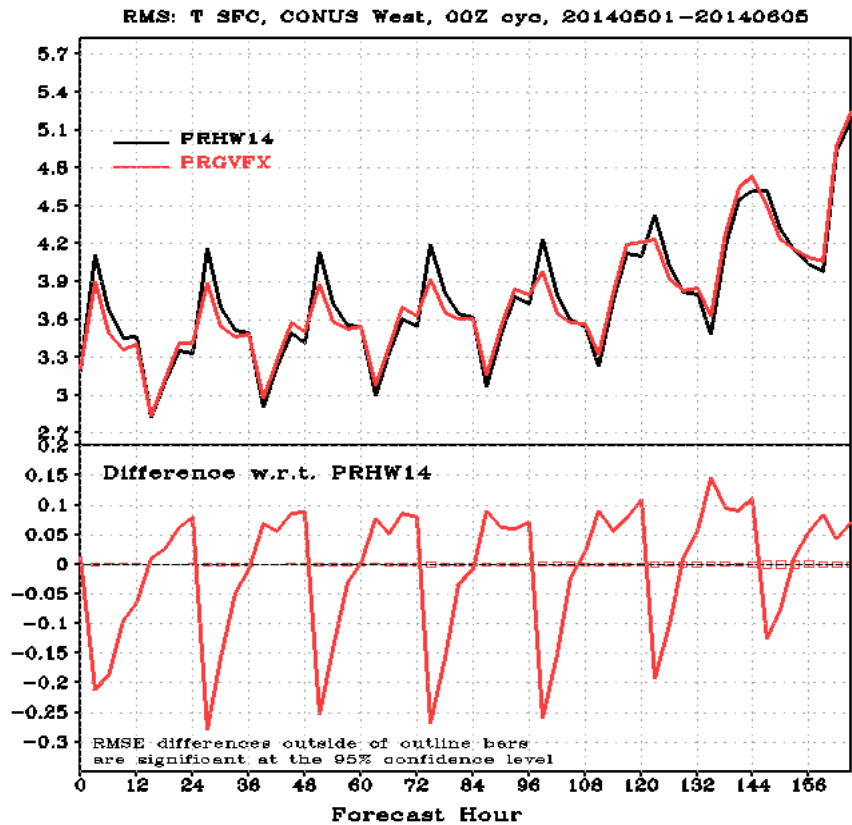
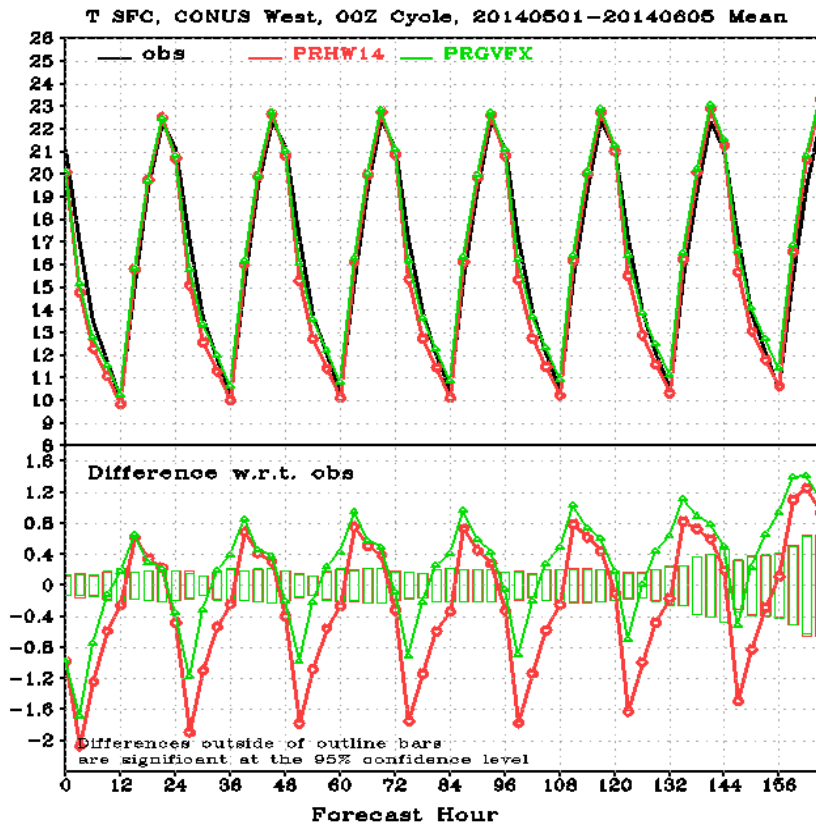
TESTS in GFS

- **NCEP Operations**: Monthly 0.14-deg (16-km) global climatology of GVF from AVHRR. (Gutman & Ignatov, 1998).
- **Weekly GVF**: VIIRS near real-time weekly global 0.036-deg (4-km) GVF (Marco Vargas team). It starts from Sep. 2012 to current.
- **Three data sets**:
 - (a) **Weekly climatology GVF**;
 - (b) **Monthly climatology GVF**;
 - (c) **Near real-time weekly GVF**
- **The new GVF data sets can potentially improve the NWP skills, especially during the spring growing season when vegetation has large variations.**

GFS GVF testing

GFS: Surface temp. and its RMSE

CONUS West

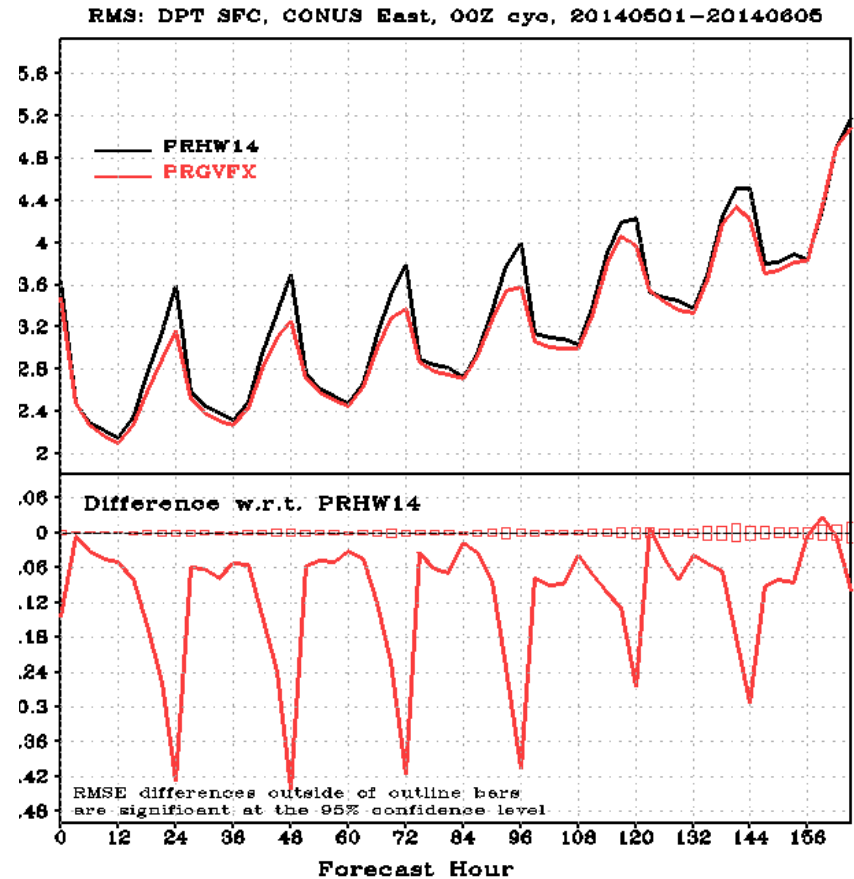
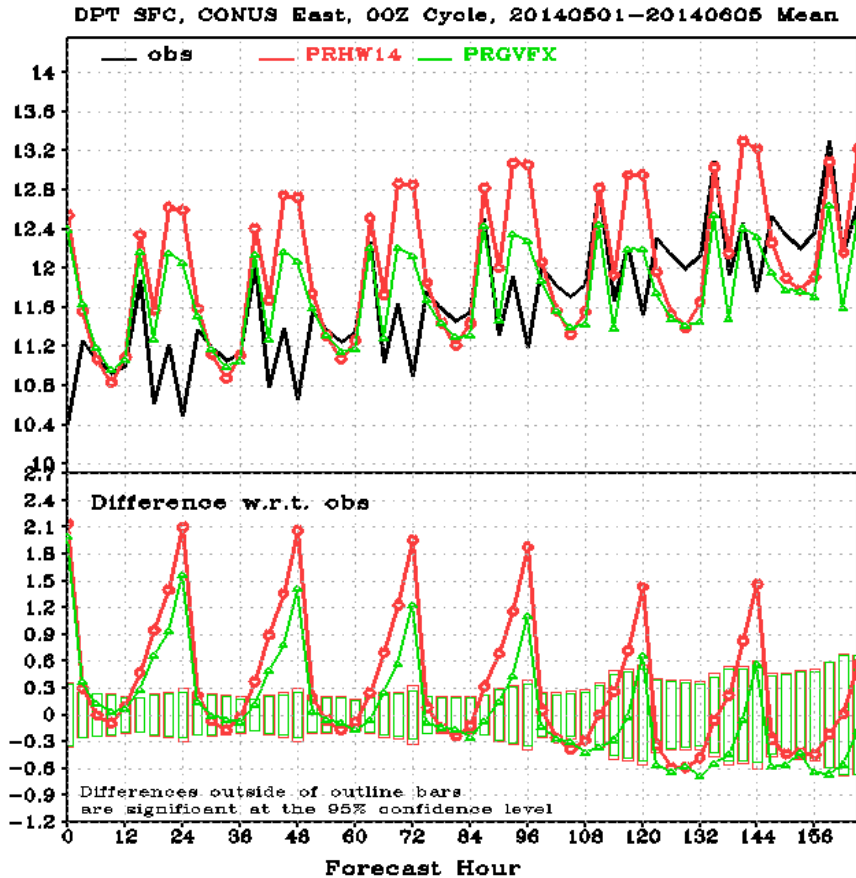


Reduced cold bias (~1 °C) and RMSE (~0.25 °C) afternoon and nighttime.

GFS GVF testing

Surface dew point temp and its RMSE

CONUS West



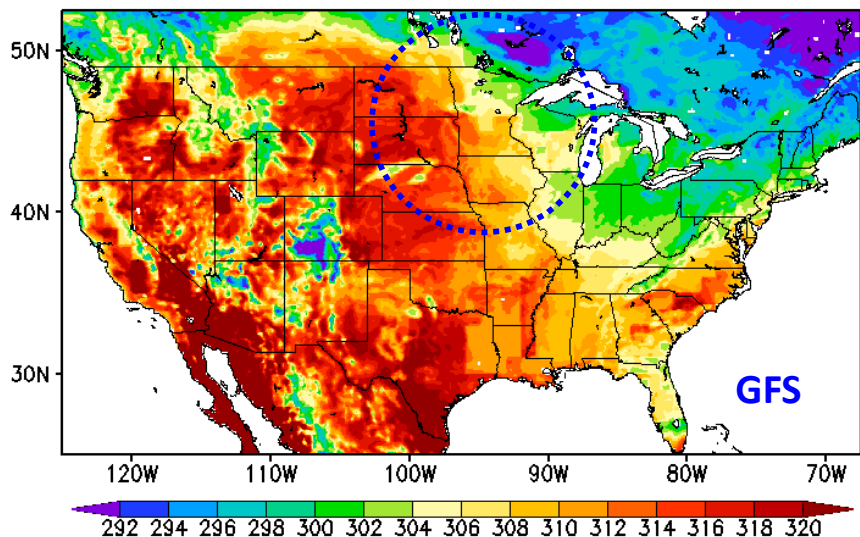
Reduced wet bias and RMSE afternoon and nighttime (~ 0.4 °C)

Comparison of LST: GFS, GFSX and VIIRS

20Z Aug 1, 2015

GFS: Tskin (K)

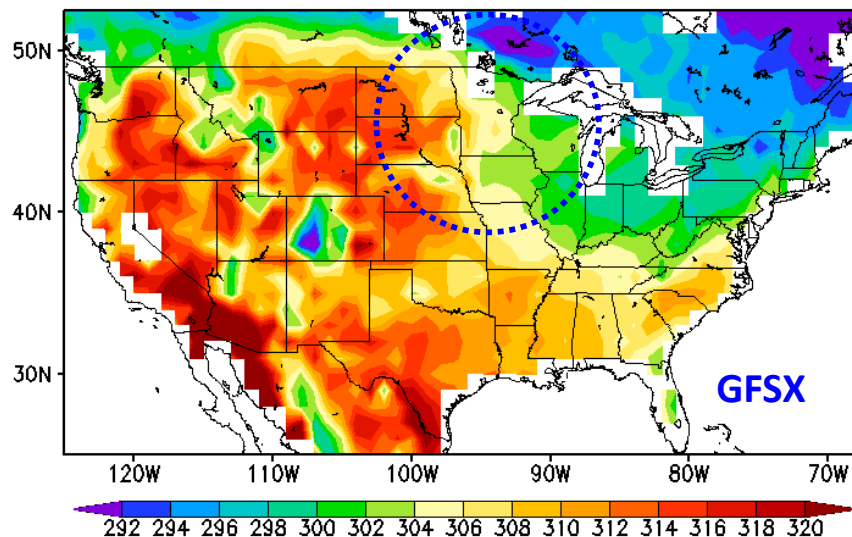
20Z 01AUG2015



GFSX: Tskin (K)

(f06-09h)

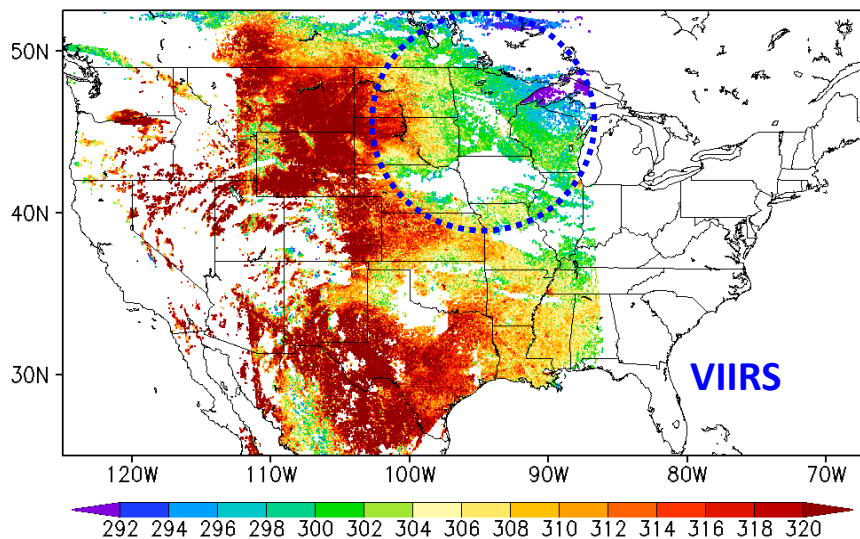
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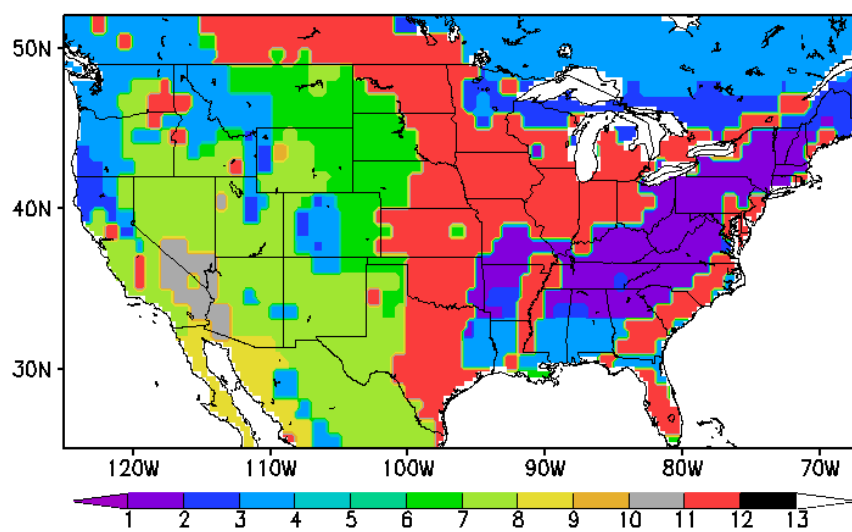
Zhen Song & Bob Yu

VIIRS: Tskin (K)

20Z 01AUG2015

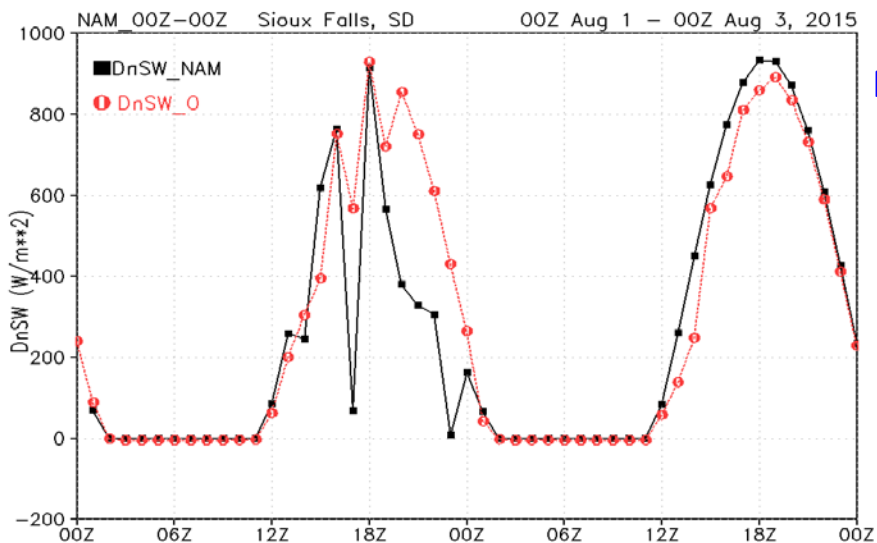
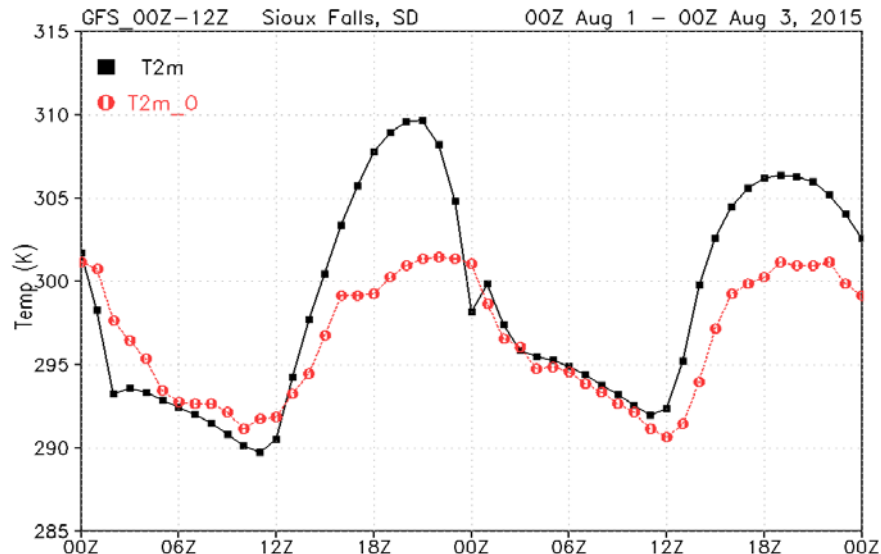
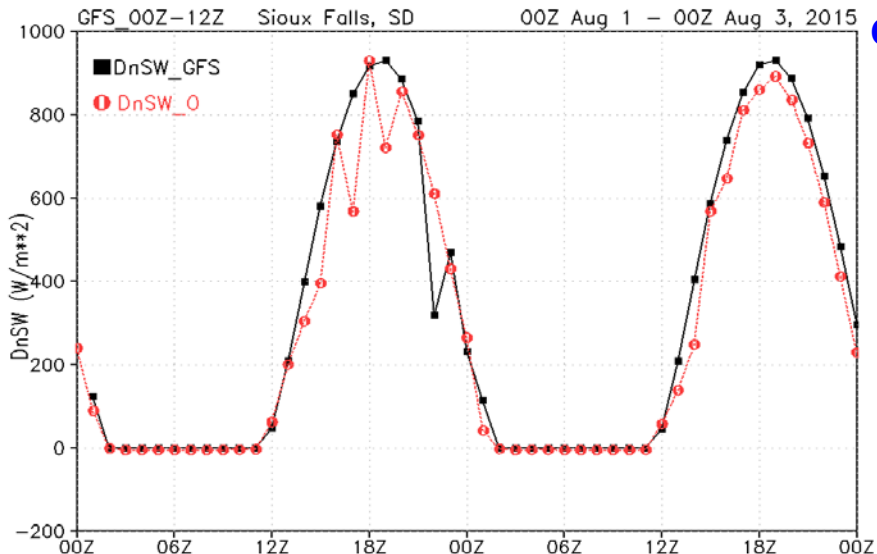


Vegetation Type (13 types) in GFS

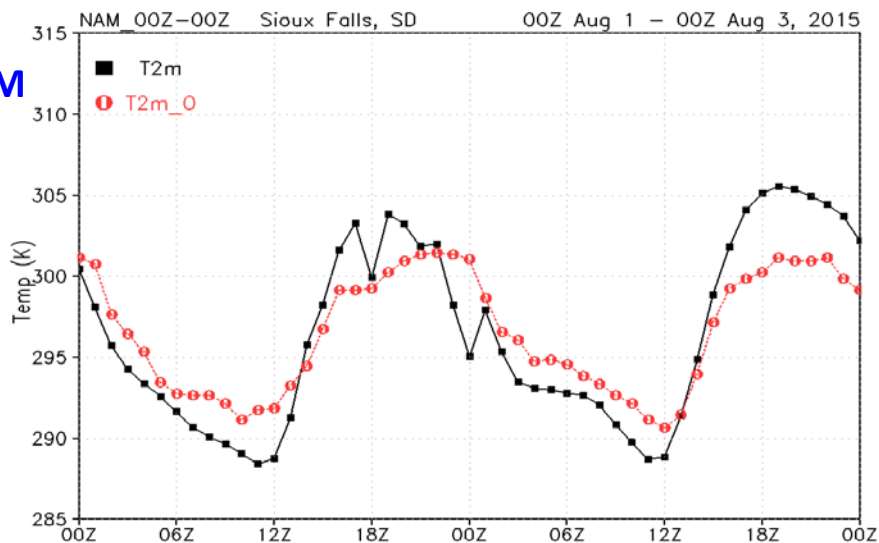


VIIRS LST VS Model LST

Verification of Swdn and T2m for GFS & NAM: 00Z Aug1-3, 2015



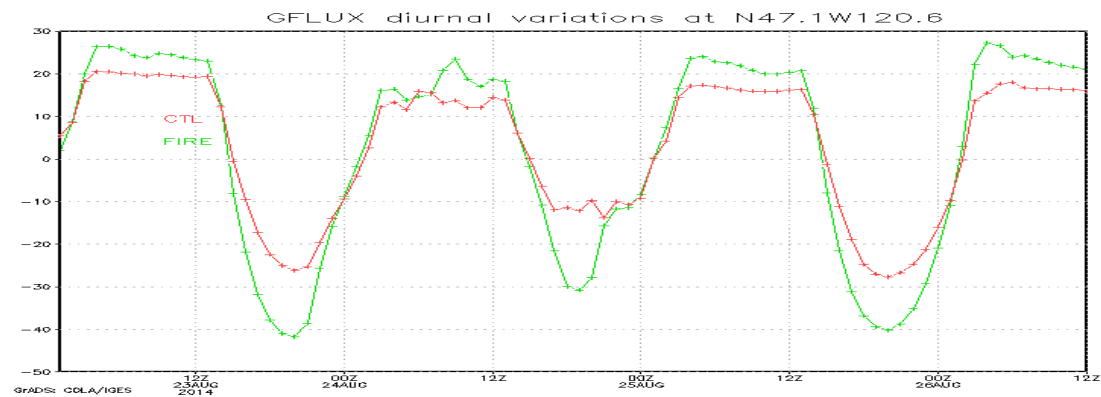
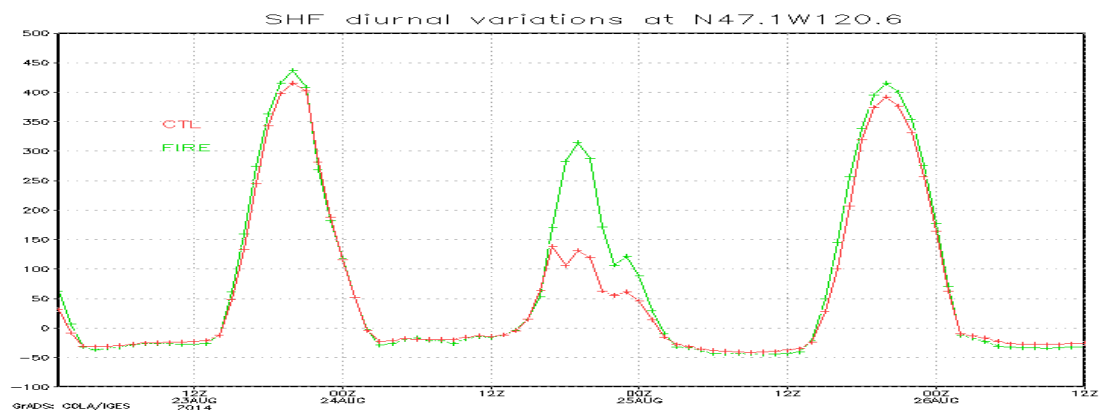
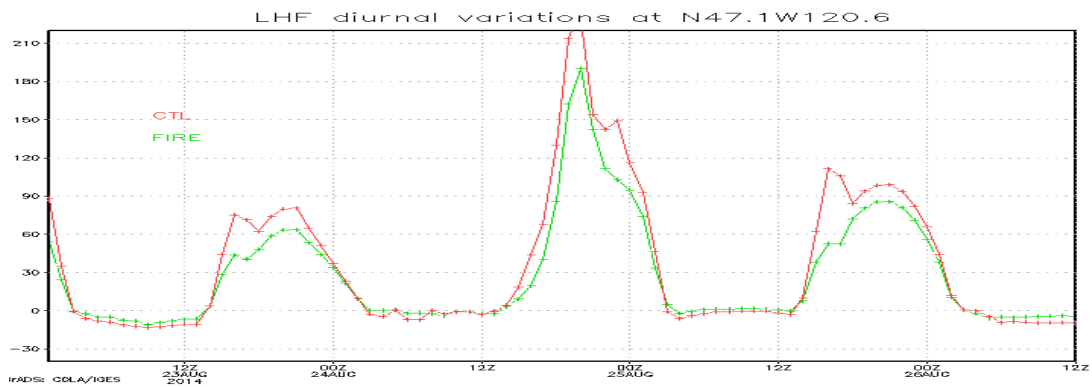
NAM



To Incorporate Fire Effect in NAM

- Surface physical characteristics in NAM are updated based on burning products derived from satellite
- Two burned files are read in by the surface update program of NAM:
 - 30 day accumulation of burned area
 - 2 day accumulation of burned area which is included in the 30 day accumulation
- Vegetation cover, Roughness and Albedo are updated based on the 30 day accumulation while the surface temperature, soil temperature and moisture for top soil layer are updated based on the 2 day accumulation

Fire Effect in NAM



SUMMARY

- Several satellite data sets developed recently (e.g., GVF, LST and albedo) have been tested in the NCEP models.
- The results show good improvements, compared with the current data sets
- However, some data sets need further verification with ground measurements.
- **Consistency among all of the products is very important in developing future products**