Incorporate Satellite GVF & LAI Products into NOAA NEMS System

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[1]IMSG at NOAA/NCEP/EMC, [2]NOAA/NCEP/EMC, [3]NOAA/NESDIS/STAR

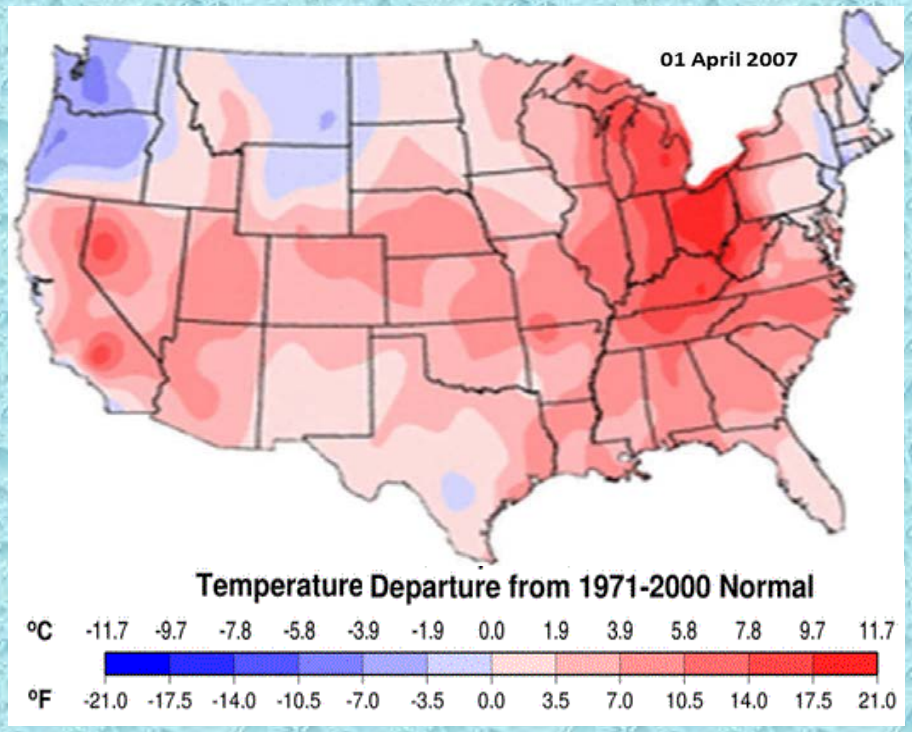
Outline

- Motivation
- Products of GVF & LAI
- Numerical Experiments
- Results
- Summary

Motivation

- Both GVF and LAI are very important parameters for representing the interactions between the land surface and the atmosphere in LSM. GVF is used to characterize land surface while LAI is used to characterize plant canopies in LSM.
- Both GVF and LAI have seasonal, spatial changes and annual variations; both can be affected by natural hazards, such as droughts, frosts and wild fires.
- The GVF currently used in NOAA Environmental Modeling System (NEMS) are monthly mean values from AVHRR data (from April 1985 to March 1991 with year 1988 excluded)
- The LAI used in the current model systems is an unrealistic constant value for all plant types.

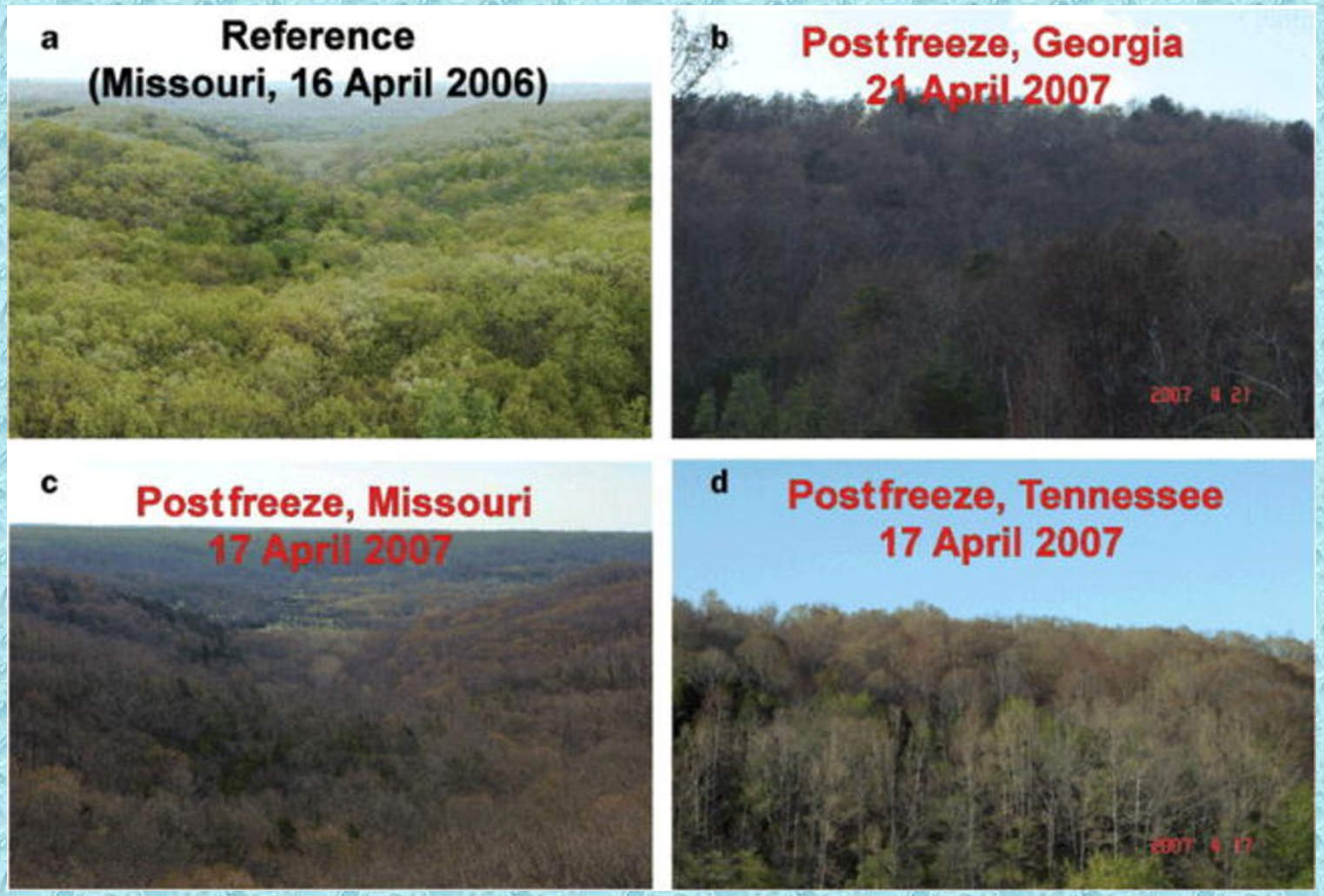
The Easter Freeze of April 2007





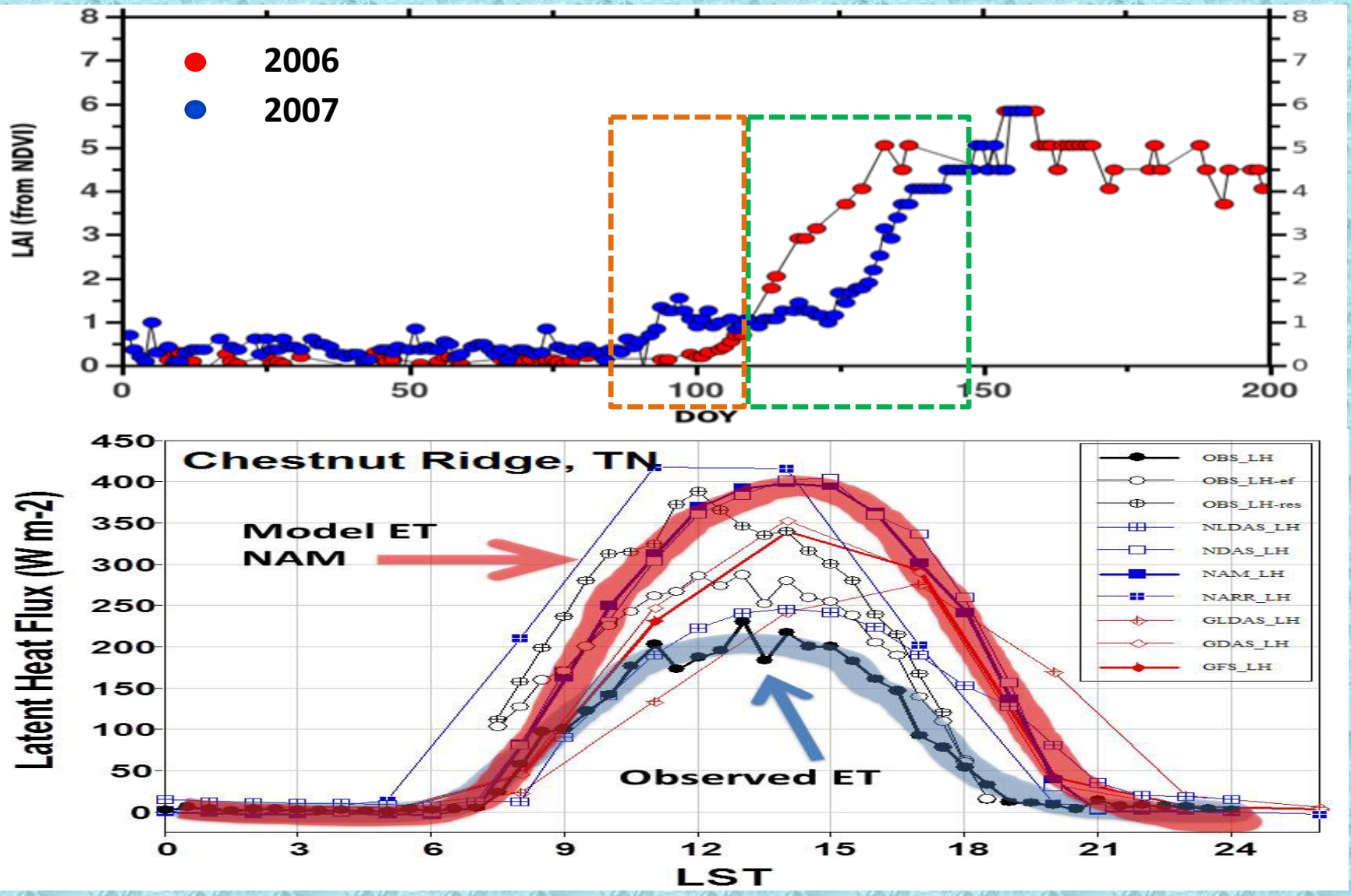
- In March 2007, unseasonably warm weather over the eastern half of the United States prompted early growth of many agricultural and horticultural crops.
- In early April (4-10), an arctic cold hit the same region. Air temperatures in many locations were well below 25°F and lasted almost a week in some areas.
- The widespread freeze extensively damaged agriculture in 18 states in the region, resulting in losses over $2 billion. Many farmers lost about 90% or nearly all of their crops.
- It also caused problems in NOAA weather forecast.

Canopy Damage from The Easter Freeze of April 2007



Gu, Lianhong, et al. The 2007 Eastern US spring freeze: increased cold damage in a warming world? *BioScience*, vol. 58, no. 3, 2008, p. 253+. *Academic OneFile*, Accessed 21 July 2017

LAI Reduced by The Easter Freeze of April 2007



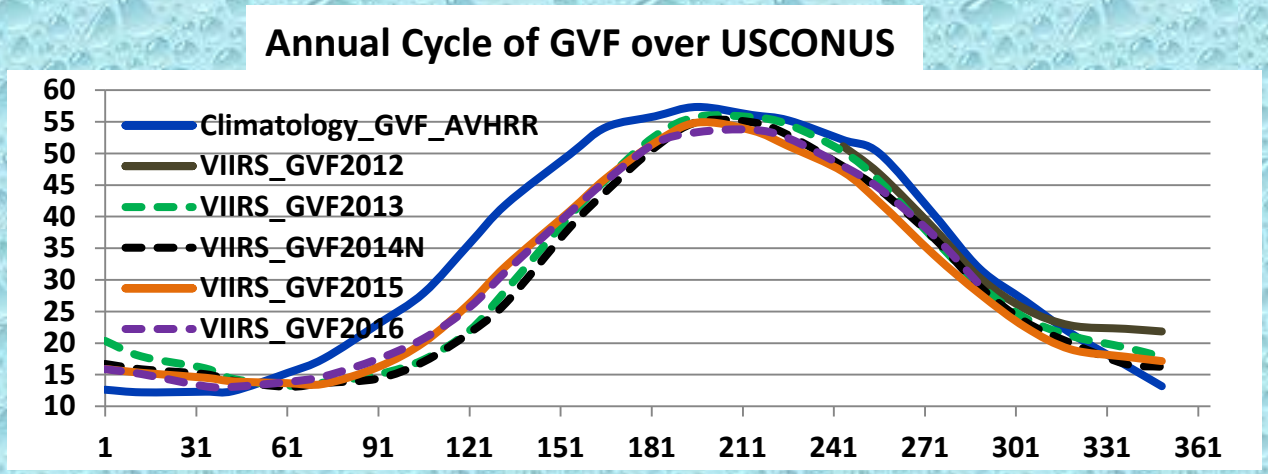
Courtesy: Tilden Meyers

Products of GVF & LAI

- Near real time satellite products for GVF starting from 2012 have been developed
- Near real time LAI products will be developed from VIIRS?
- These new products have weekly values and are updated daily.
- These new products have 4-km resolution at global scale and 1-km resolution at regional scale
- The products will be in lat/lon project and in GRIB2 data format

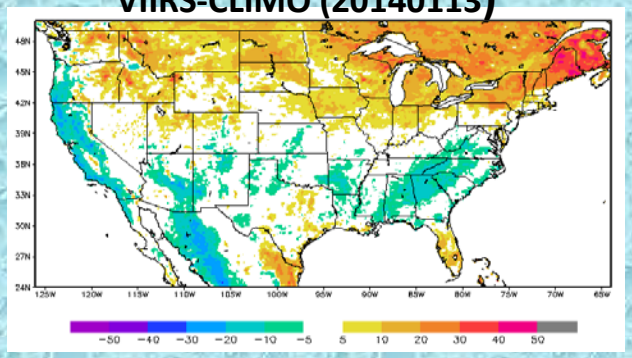
http://www.ospo.noaa.gov/Products/land/gvf/

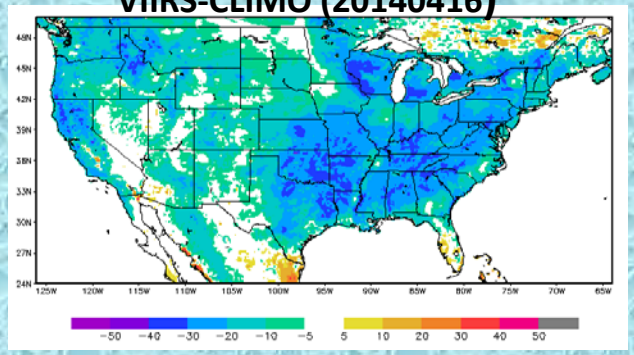
Comparison between VIIRS and Climatology GVF

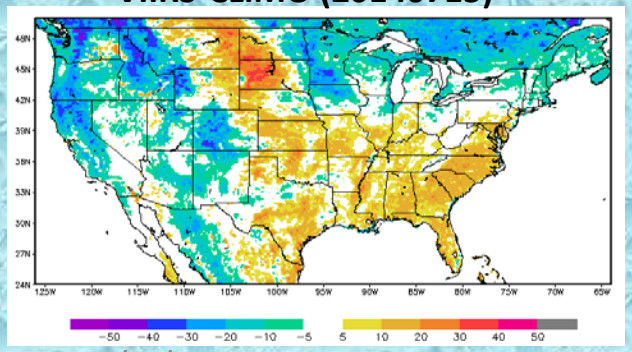


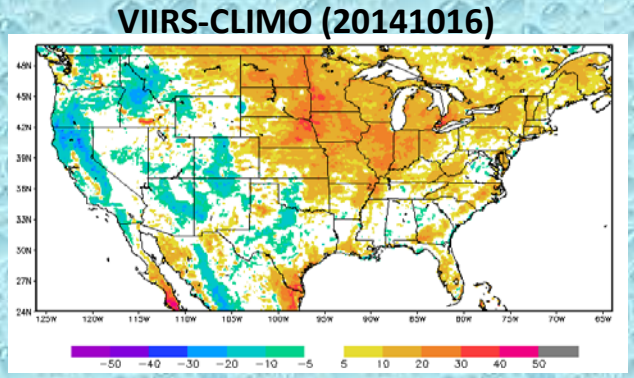
- Climatology GVF green up earlier
- Climatology GVF is higher most of a year

GVF difference in 2014 (VIIRS-AVHRR CLIMO)





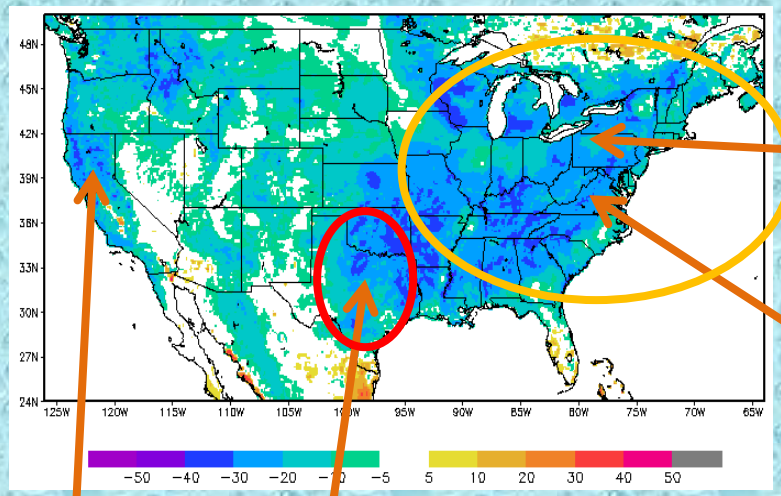




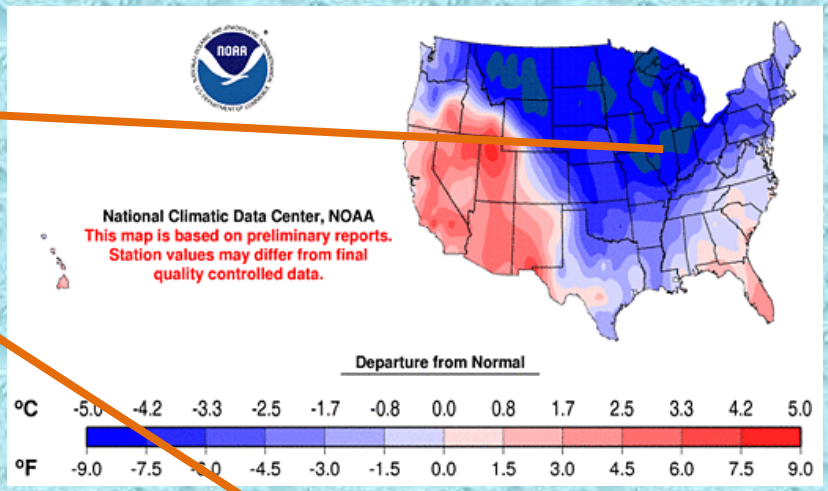
- VIIRS GVF is higher at high latitude in January
- VIIRS GVF is much lower over the entire USCONUS in April
- VIIRS GVF is higher in southeast US in July
- VIIRS GVF is higher over the eastern US

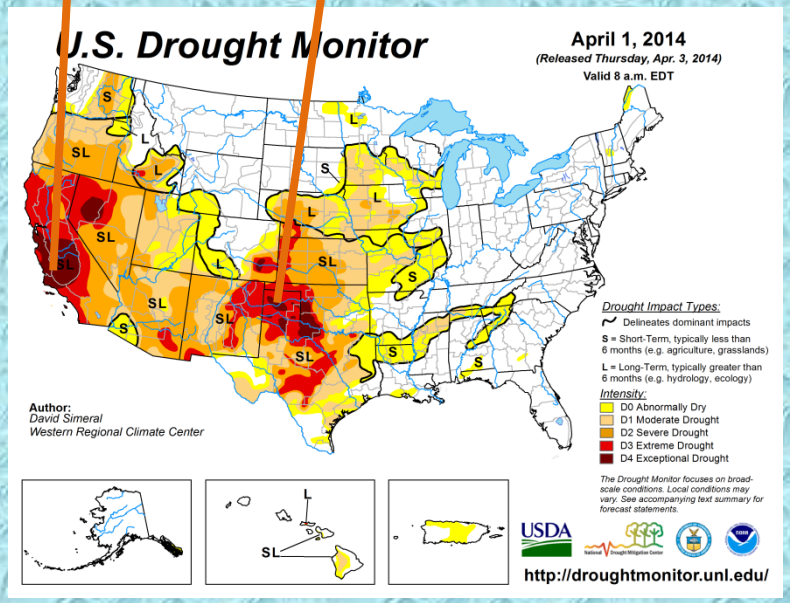
2014 Cold Spring & Drought Effects on GVF in US

GVF Difference (VIIRS-CLIMO) 20140416

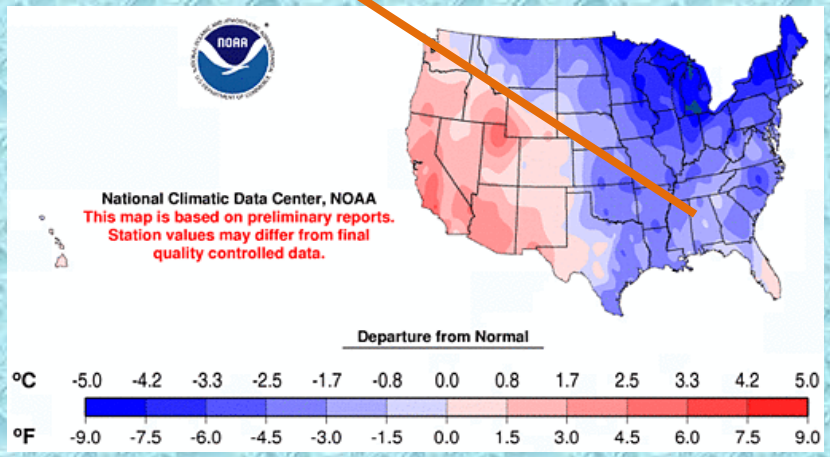


February 2014 Mean Temperature Departure from 1981-2010 Normal





March 2014 Mean Temperature Departure from 1981-2010 Normal

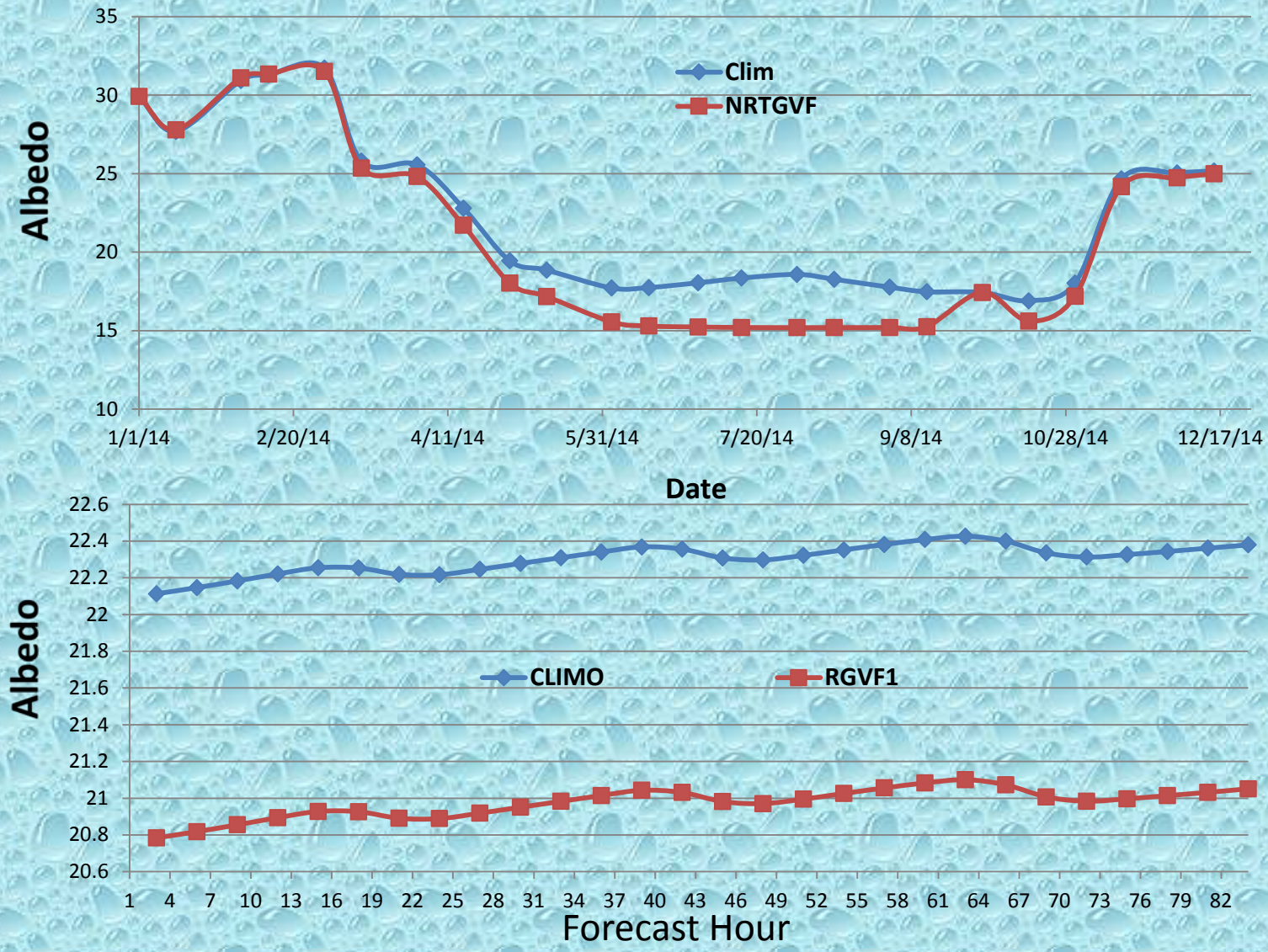


https://www.ncdc.noaa.gov/temp-and-precip/asos/avgtemp.dfn/dot/monthly/201405

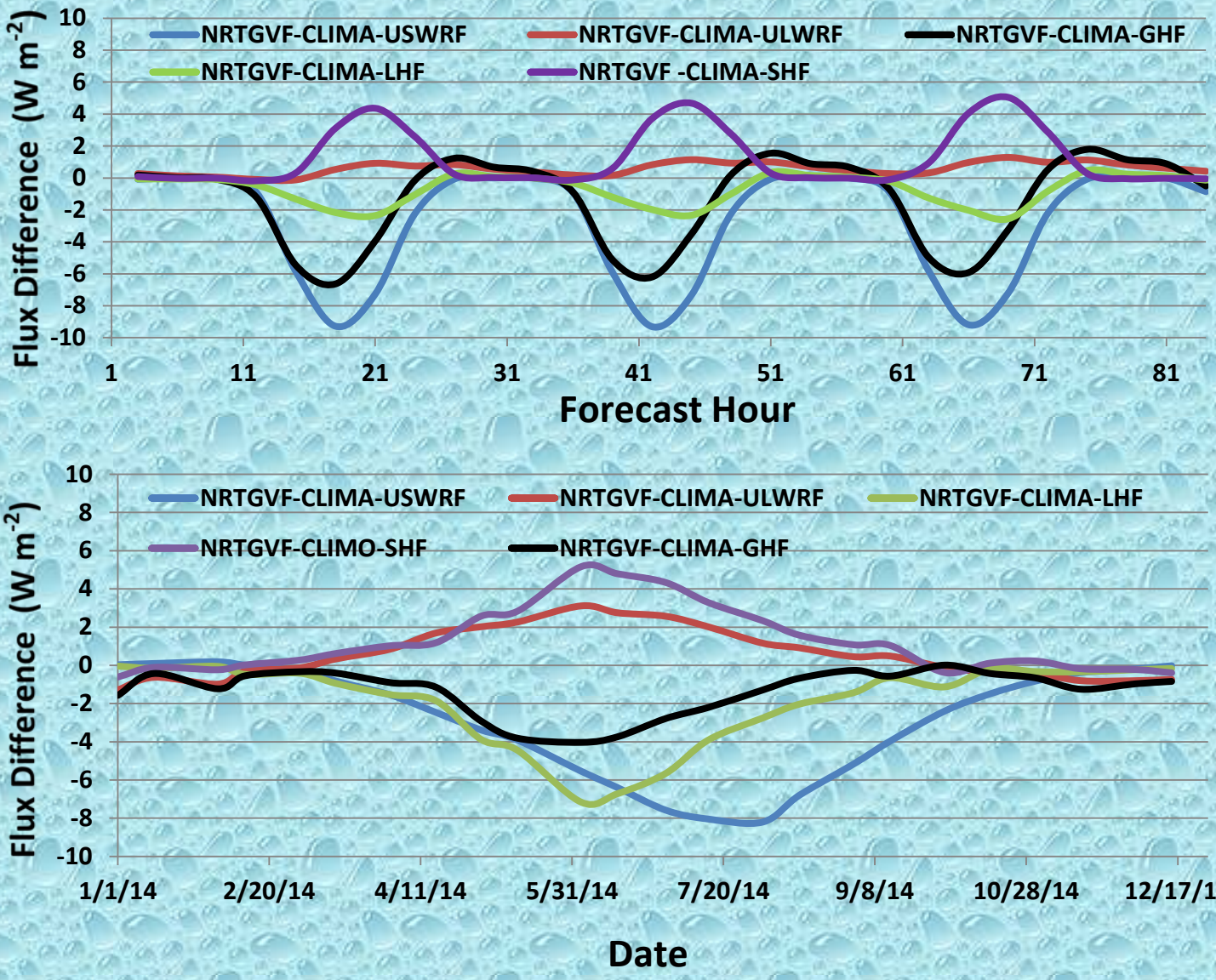
Numerical Experiments

- NAM was run with 2 GVF products for 2014: AVHRR climatology, the real time VIIRS GVF
- The BUDGET method was used to interpolate the products to the NAM domain (at least 25 points are chosen in one model grid box, then are weighted with area to get one value for the model grid box)
- Data on 24 days (two from each month, the beginning and middle day of each month) were used for tests. Total 48 runs were conducted with the 2 GVF products.
- 84 hour simulation was conducted for each run. Analysis was done for all land points over 218 grid domain.

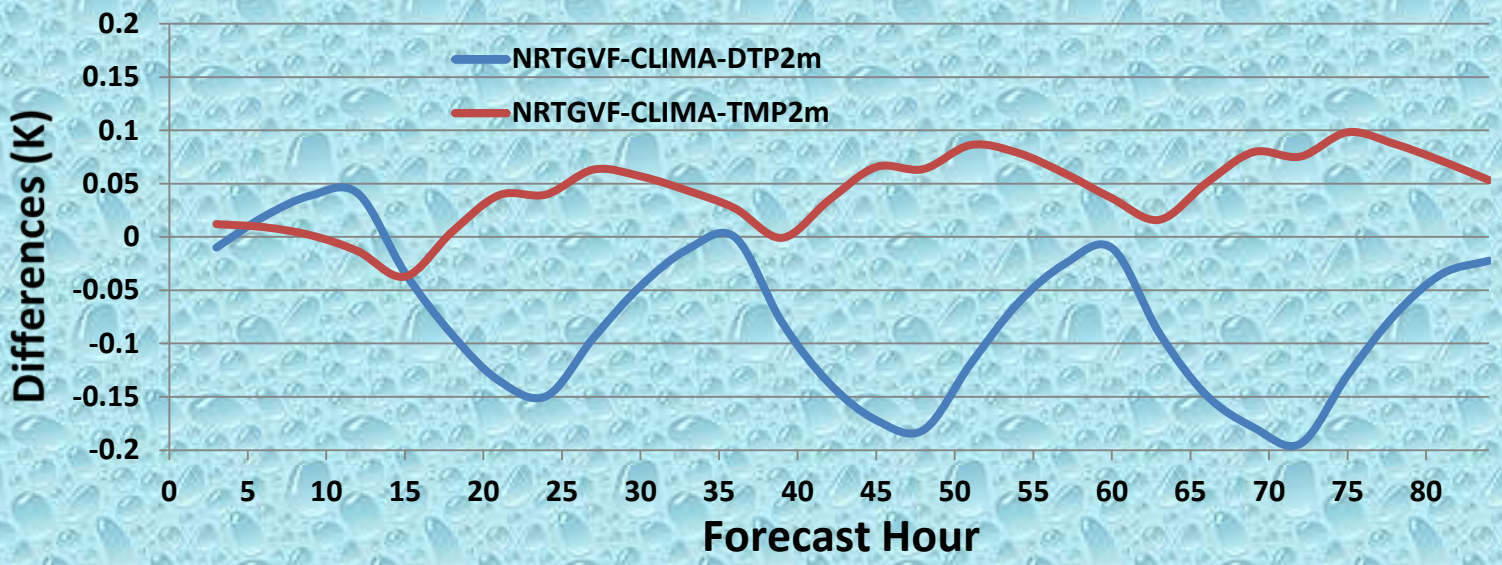
Land Surface Albedo in the Two Runs

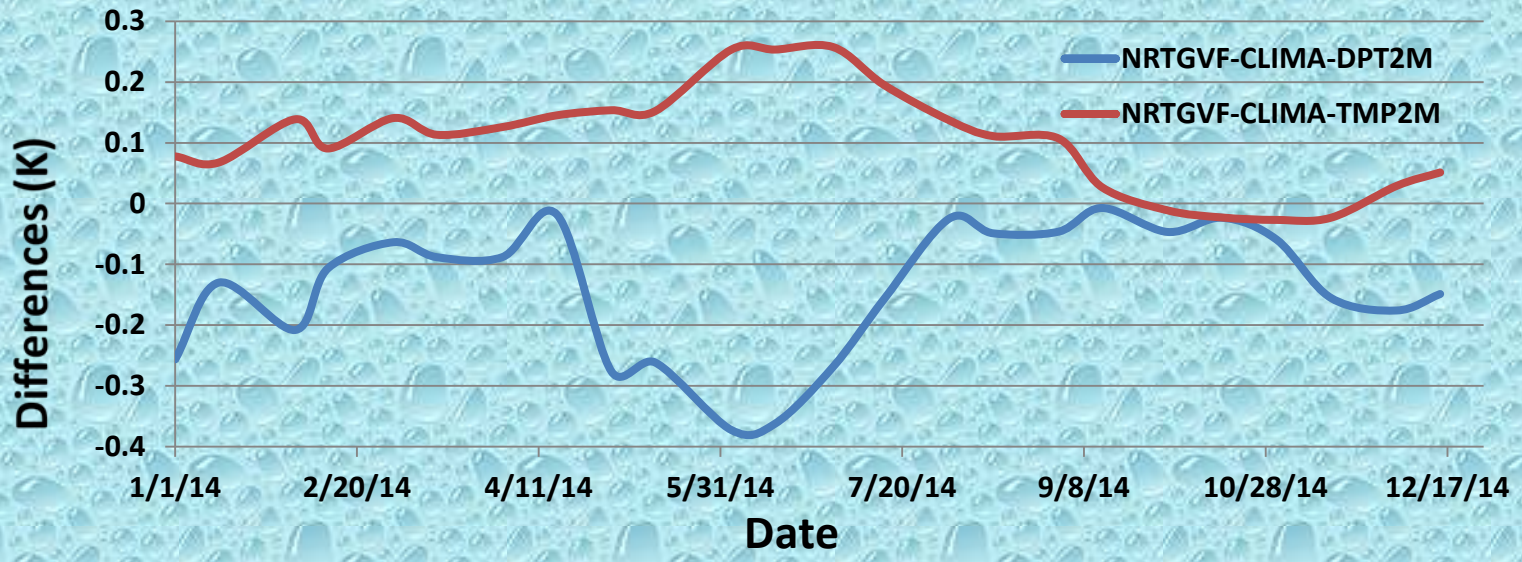


Flux Difference Between the Two Runs

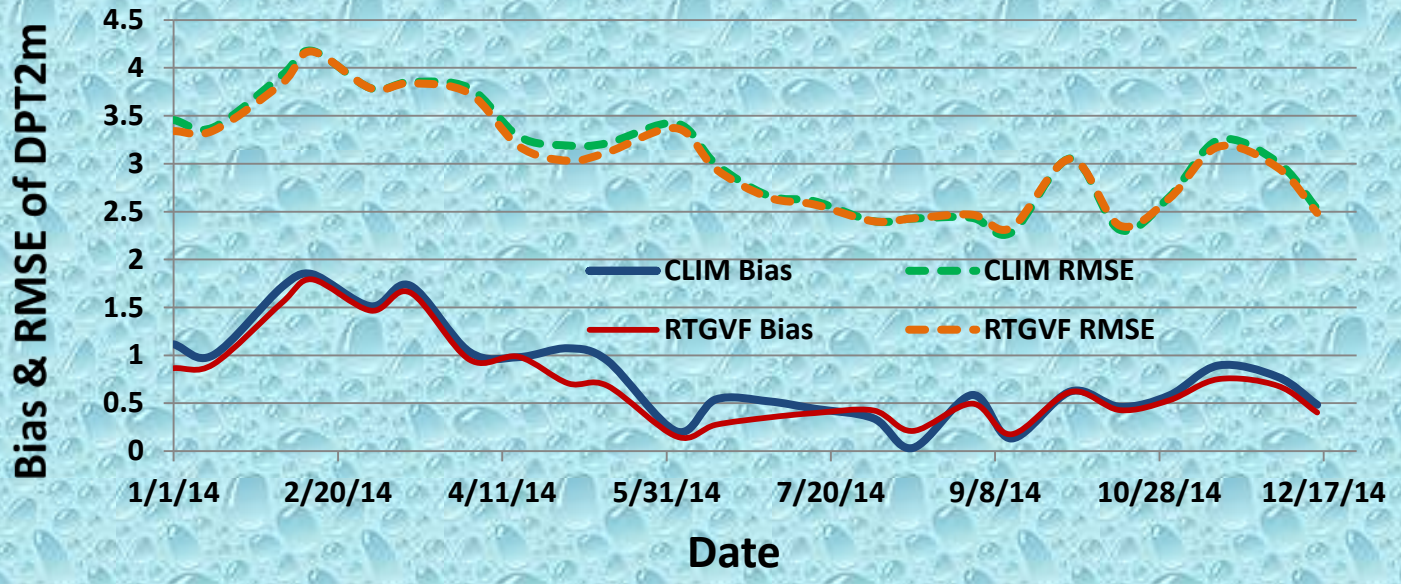


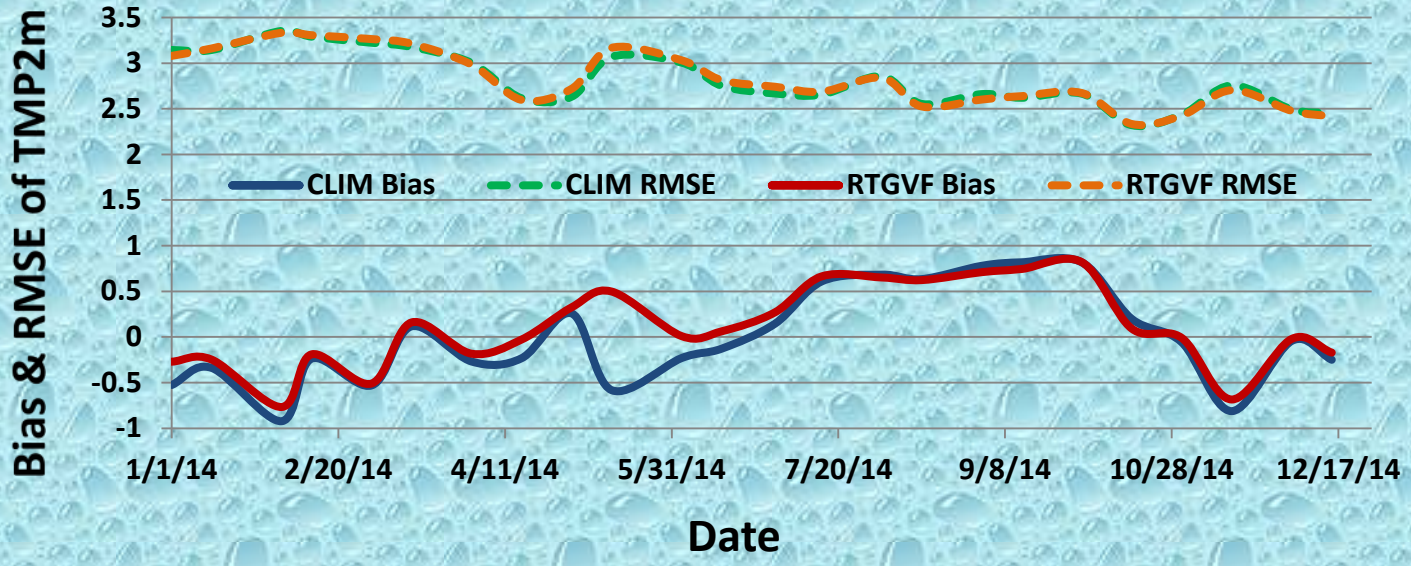
DPT2m & TMP2m Difference Between the Two Runs





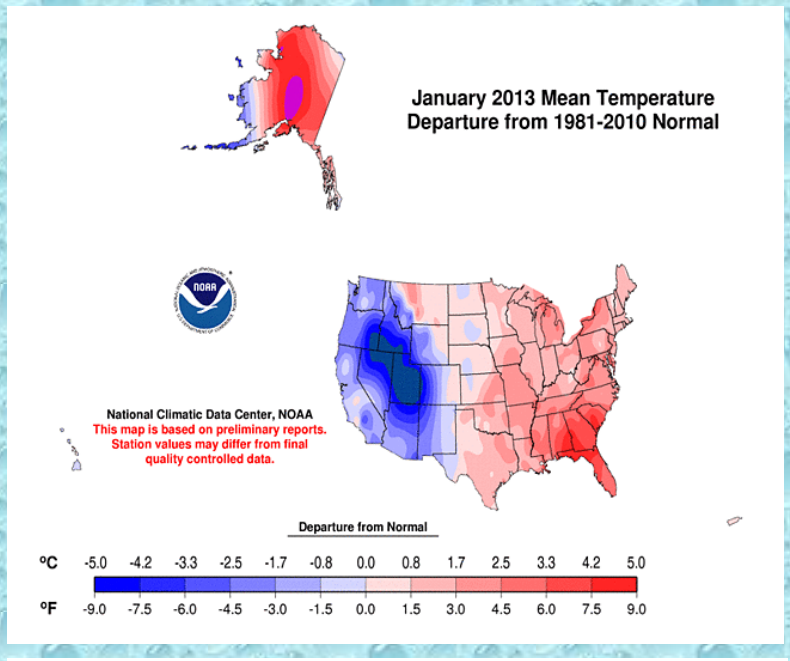
Bias & RMSE of DPT2m & TMP2m in the Two Runs

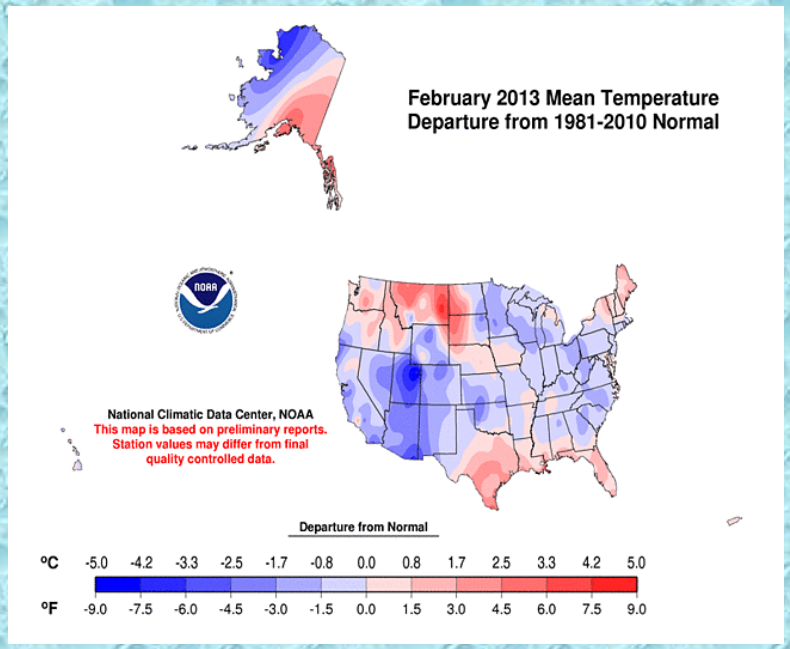


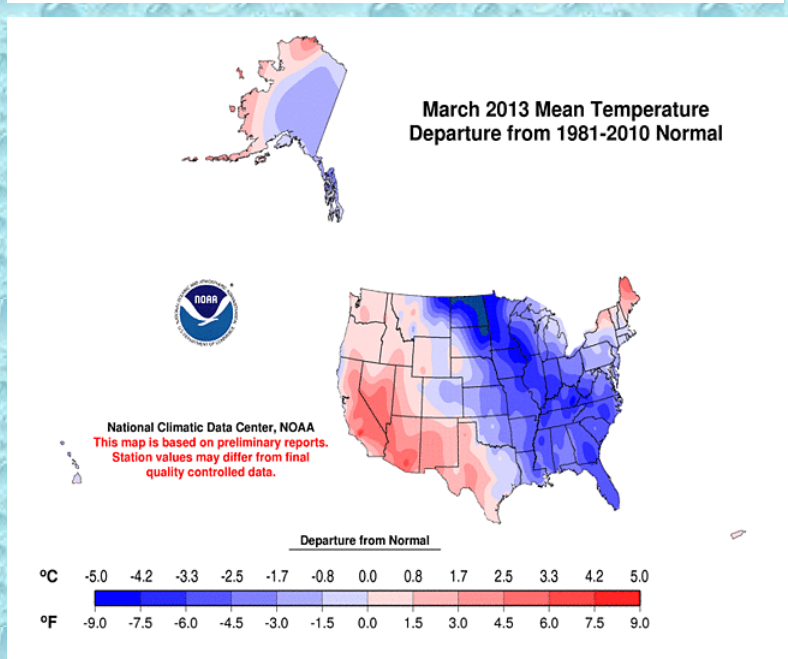


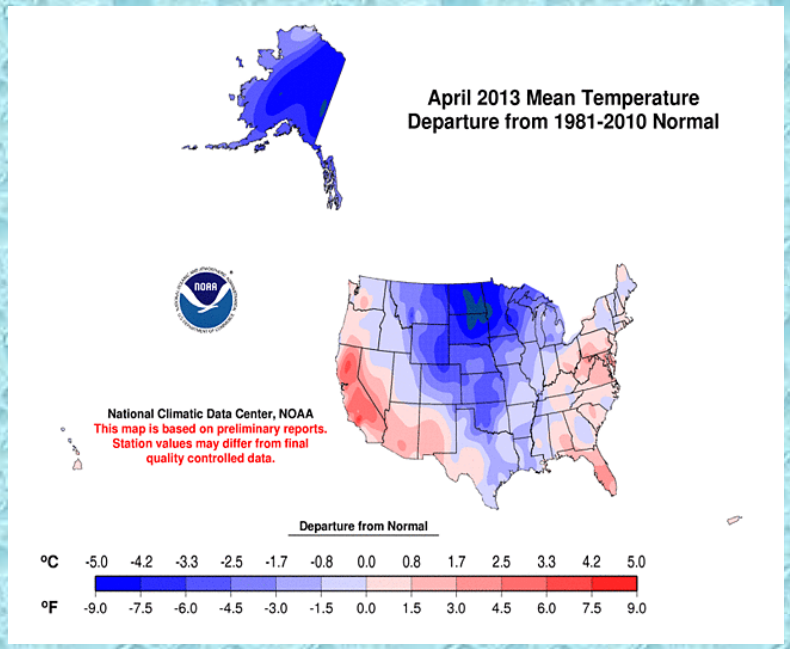
Summary

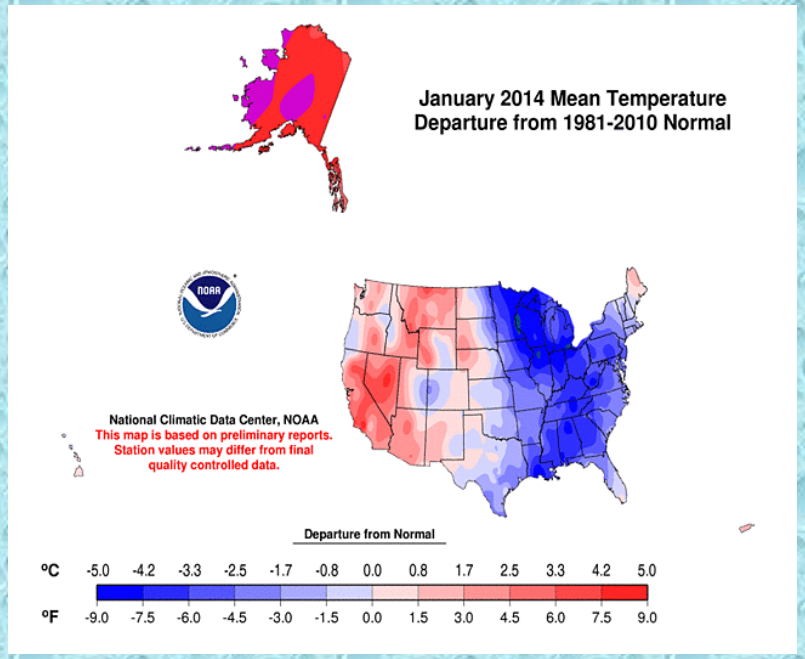
- Near real time VIIRS GVF products has been developed and tested with the North American Model system.
- Numerical sensitive tests were conducted with NAM for 2014
- Replacing Climatology GVF changes not only GVF, but also surface albedo in NAM.
- The near real time GVF has smaller values which reduced latent heat fluxes, increased sensible heat fluxes, and reduced the NAM wet bias of DPT2m and cold bias of T2m in 2014
- VIIRS GVF dataset have been produced to enable ingest into the NCEP NEMS system
- Near real time LAI will be developed soon, and be used in NCEP NEMS system ?

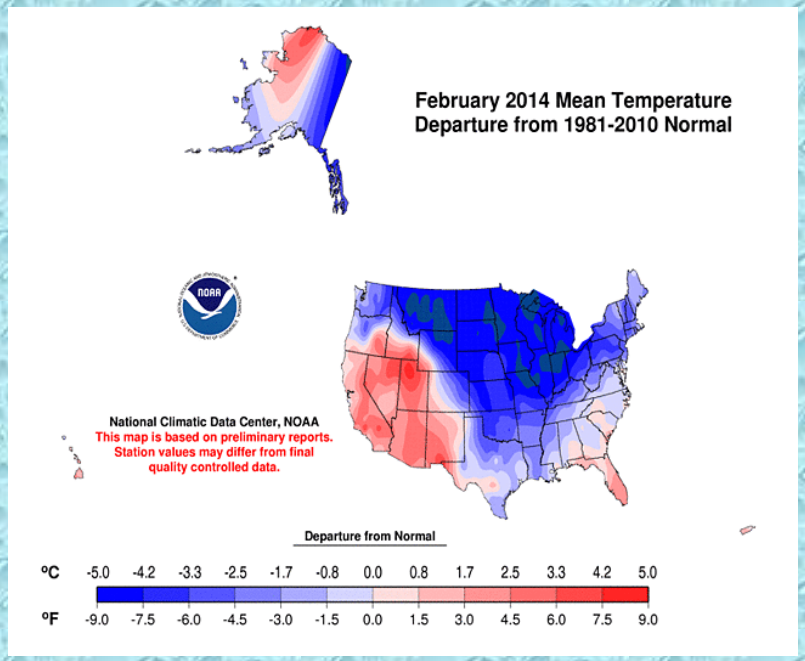

January 2013 Mean Temperature
Departure from 1981-2010 Normal
National Climatic Data Center, NOAA
This map is based on preliminary reports.
Station values may differ from final
quality controlled data.
Departure from Normal
°C -5.0 -4.2 -3.3 -2.5 -1.7 -0.8 0.0 0.8 1.7 2.5 3.3 4.2 5.0
°F -9.0 -7.5 -6.0 -4.5 -3.0 -1.5 0.0 1.5 3.0 4.5 6.0 7.5 9.0

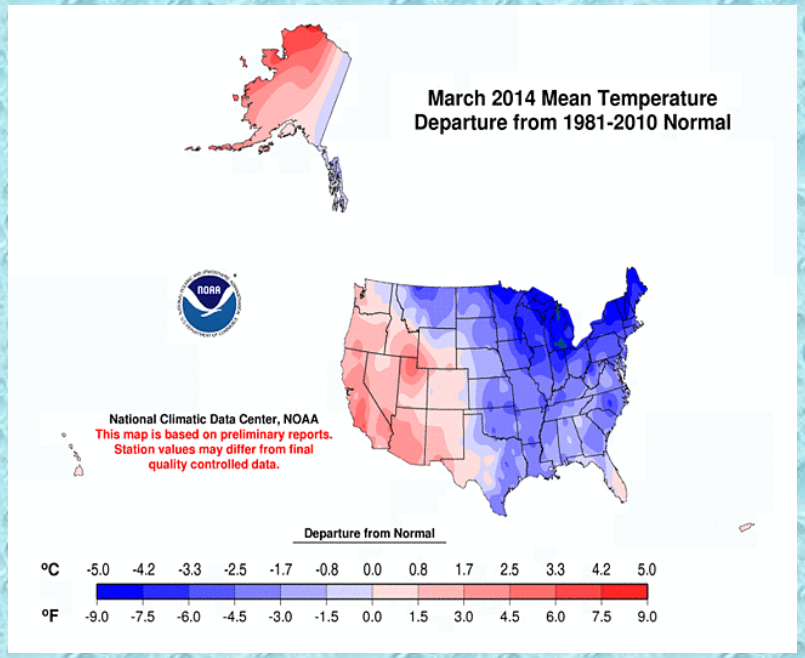

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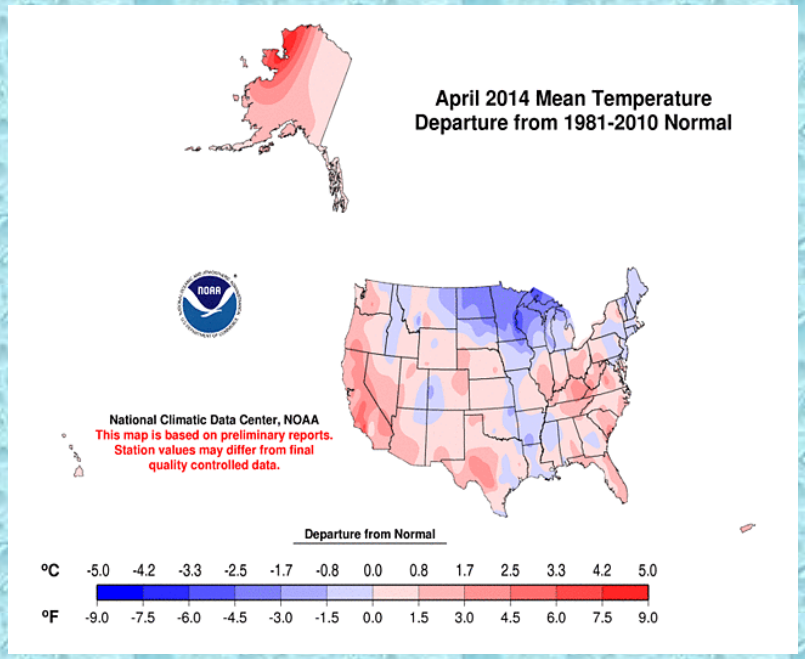

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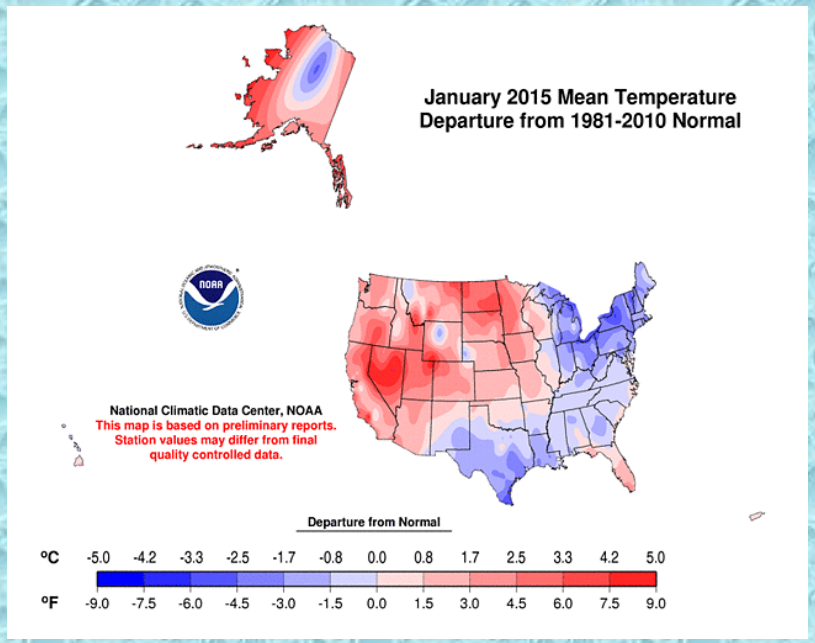

April 2013 Mean Temperature
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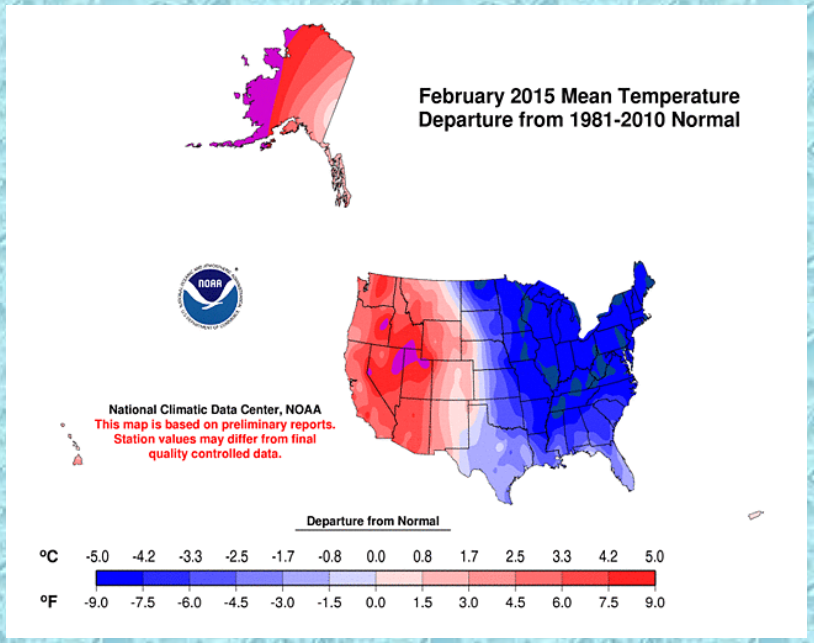

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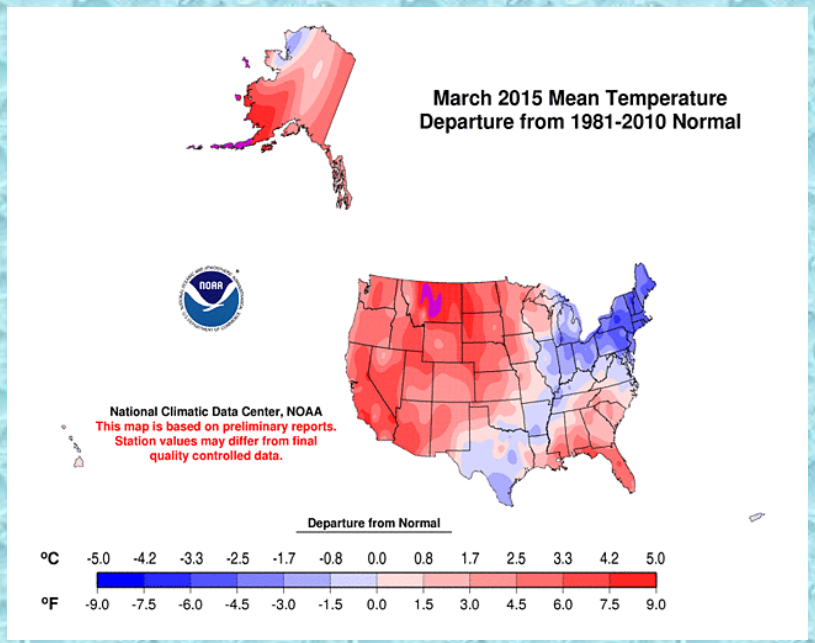

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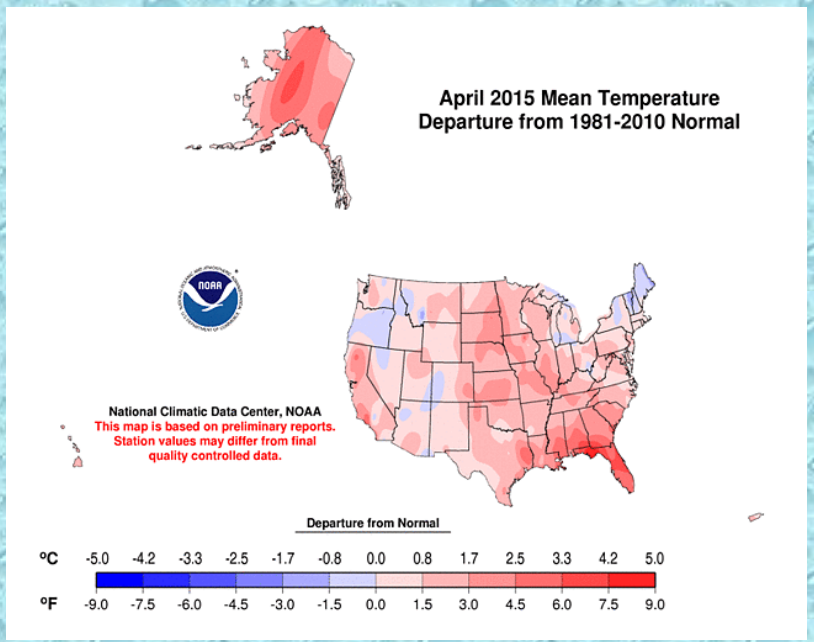

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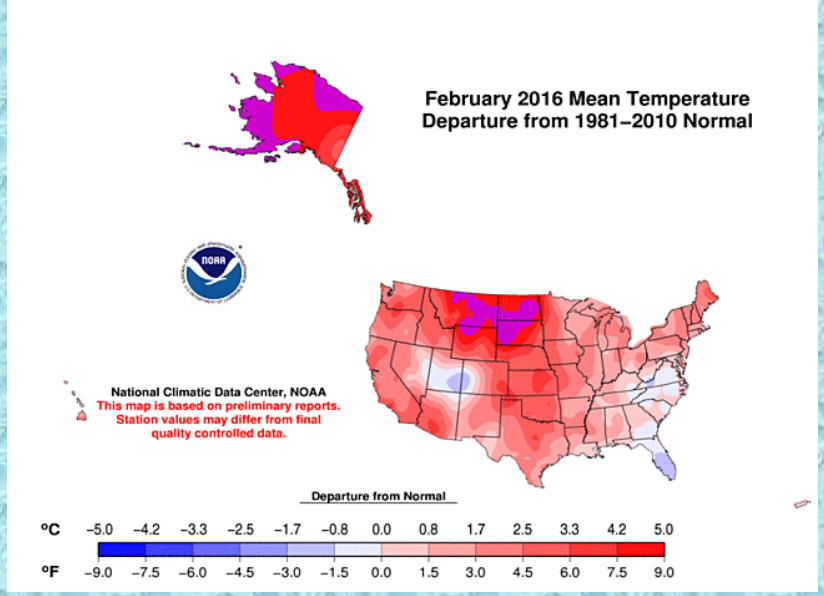

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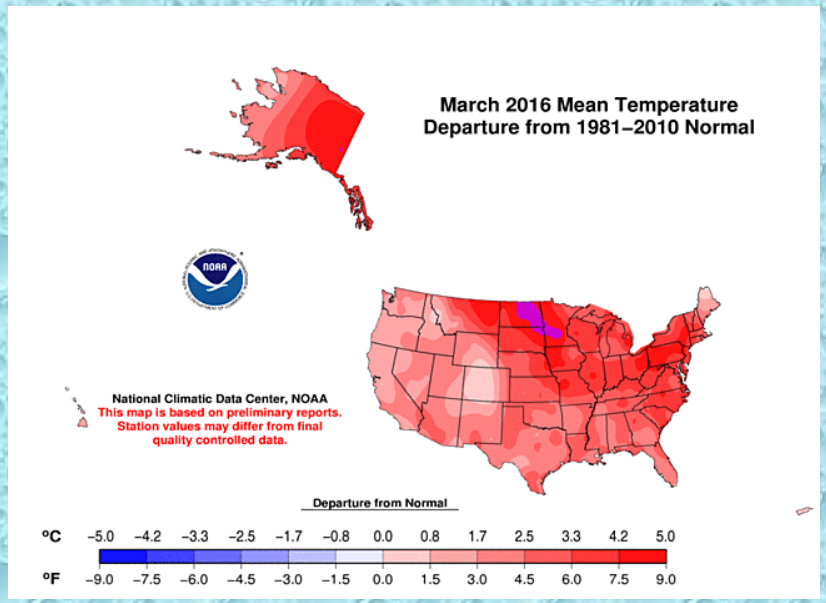

January 2015 Mean Temperature
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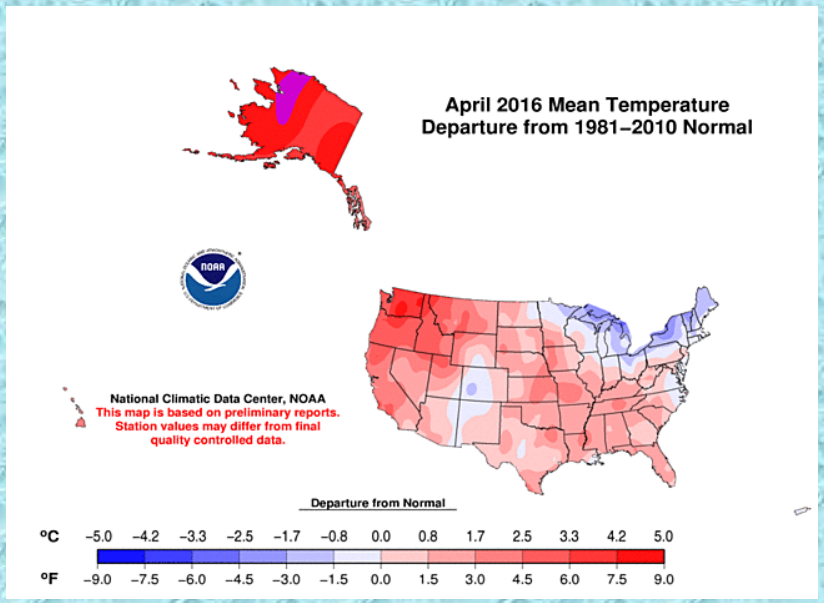

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February 2016 Mean Temperature
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°C −5.0 −4.2 −3.3 −2.5 −1.7 −0.8 0.0 0.8 1.7 2.5 3.3 4.2 5.0
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