

# Prospects of “Useful” Predictions for Weeks 3 & 4?

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Climate Prediction Center/NCEP/NWS

October 22, 2014

This talk is based on a “very simple idea, from the user-perspective and need” and relatively simple calculations, and hopefully with some practical implications towards forecasts for weeks 3-4 (can even be extended to forecasts for days 6-10, & week2)

The ‘extended forecast time period’ (2-3-4 weeks) in-between the ‘deterministic weather’ and the ‘probabilistic climate’ is “Neither weather nor climate” So, we do have to think differently about how to handle this period!

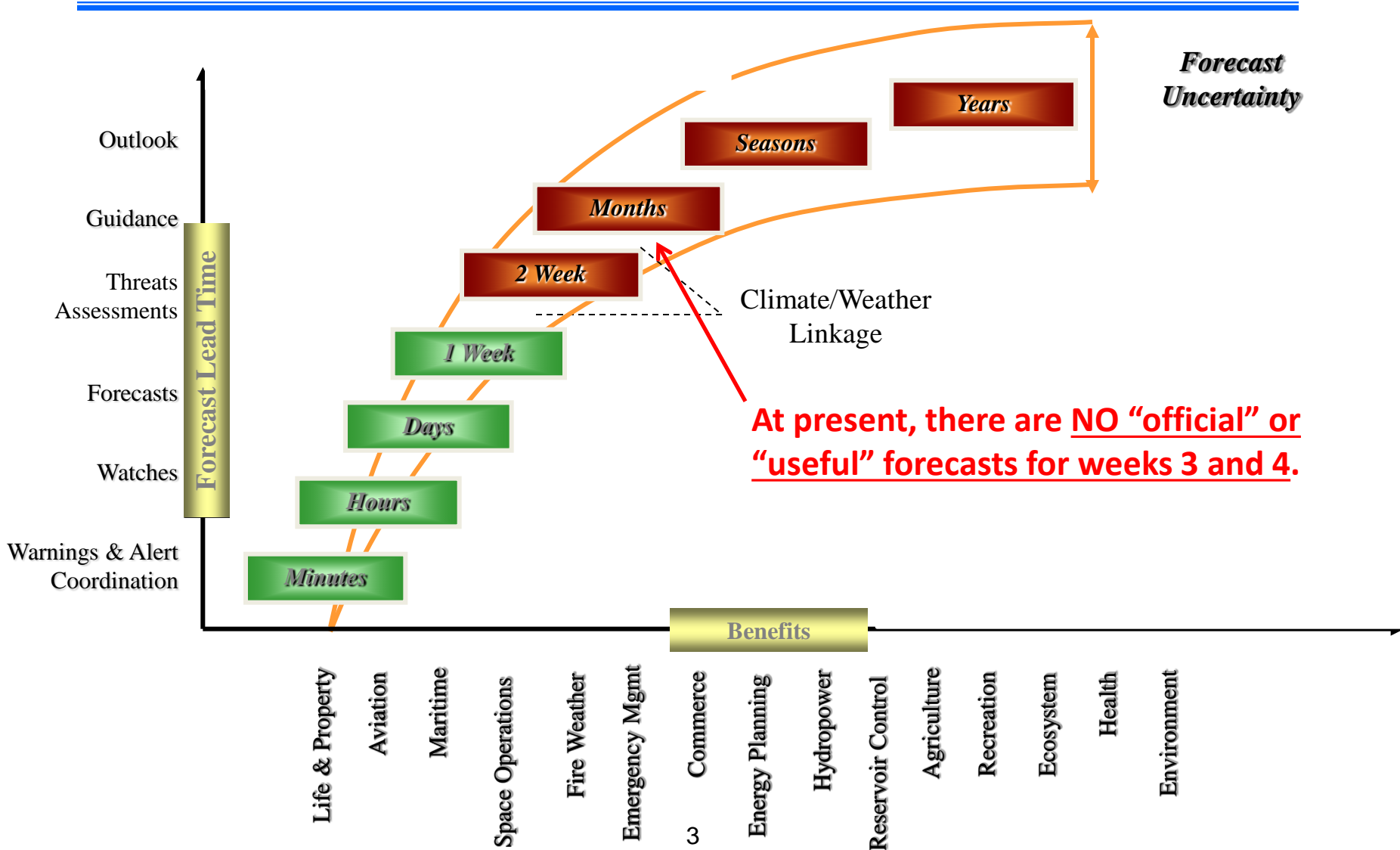
The motivation for this work came from this quote:

**“Rather than work forward from a technology or a complex strategy, work backwards from the needs of customers and build the simplest product possible”**

– Eric Ries, author of “The Lean Startup”



# NOAA Seamless Suite of Forecast Products Spanning Climate and Weather



## Weather to climate transition .....

- NOAA's Weather Prediction Ctr (WPC) issues weather forecasts for each of the next 5 (6-7?) days for Temperature and Precipitation (Weather Channel or ACCU Weather may extend this to even 10 days !!)
- The forecasts are issued for Total fields (deg. F, inch(es) of rain, etc). People have no problem understanding this...

Local forecast by:  
City, ST or ZIP code

Enter location

[Location Help](#)

**Severe weather possible for parts of Midwest and Ohio Valley**

The NWS Storm Prediction Center is forecasting a risk of severe thunderstorms on Tuesday, from eastern Missouri across southern Illinois, northern Kentucky, much of Indiana, western Ohio and into southern Michigan. Damaging wind and large hail will be the primary threats.

[Read More...](#)

**Current Conditions**

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Mostly Cloudy  
**85°F**  
29°C

Humidity 53%  
Wind Speed E 7 mph  
Barometer 29.86 in (1011.0 mb)  
Dewpoint 66°F (19°C)  
Visibility 10.00 mi  
Heat Index 87°F (31°C)  
Last Update on 19 Aug 4:52 pm EDT

Current conditions at  
**Washington DC, Reagan National Airport (KDCA)**  
Lat: 38.86°N Lon: 77.03°W Elev: 16ft.

[More Local Wx](#) | [3 Day History](#) | [Mobile Weather](#)

**Washington DC**

7 Day Forecast

For More Weather Information:

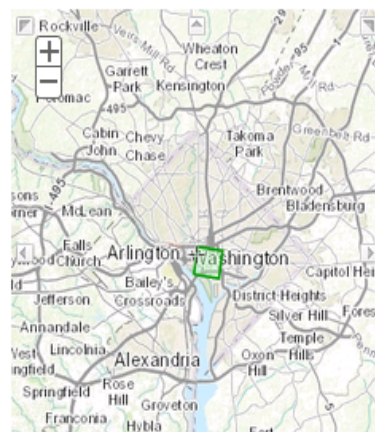
[Baltimore, MD/Washington, D.C. Local Forecast Office](#)

TONIGHT	WEDNESDAY	WEDNESDAY NIGHT	THURSDAY	THURSDAY NIGHT	FRIDAY	FRIDAY NIGHT	SATURDAY	SATURDAY NIGHT
Mostly Cloudy Low: 70 °F	Partly Sunny High: 84 °F	Chance Thunderstorms Low: 70 °F	Chance Thunderstorms High: 85 °F	Chance Thunderstorms Low: 70 °F	Chance Showers High: 79 °F	Chance Showers Low: 67 °F	Chance Showers High: 78 °F	Chance Showers Low: 65 °F

**Detailed Forecast**

Topographic  Click Map For Forecast

Tonight	Mostly cloudy, with a low around 70. East wind 3 to 7 mph.
Wednesday	Partly sunny, with a high near 84. East wind 3 to 7 mph.
Wednesday Night	A chance of showers and thunderstorms. Mostly cloudy, with a low around 70. Southeast wind 5 to 7 mph. Chance of precipitation is 50%.
Thursday	A chance of showers and thunderstorms. Mostly cloudy, with a high near 85. Light and variable wind. Chance of precipitation is 30%.
Thursday Night	A chance of showers and thunderstorms. Mostly cloudy, with a low around 70. South wind around 6 mph becoming calm in the evening. Chance of precipitation is 50%.
Friday	A chance of showers. Mostly cloudy, with a high near 79. Chance of precipitation is 50%.
Friday Night	A chance of showers. Mostly cloudy, with a low around 67. Chance of precipitation is 50%.



**Washington Weather**

Expect dry conditions over the next six hours.

[Hourly Forecast](#)

Yesterday

Today

Hourly

Tomorrow

Weekend

5 Day

10 Day

Monthly

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Map

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Fishing

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Pollen

Travel

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More

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Over 200 Dead



Bad News for Nutella Lovers



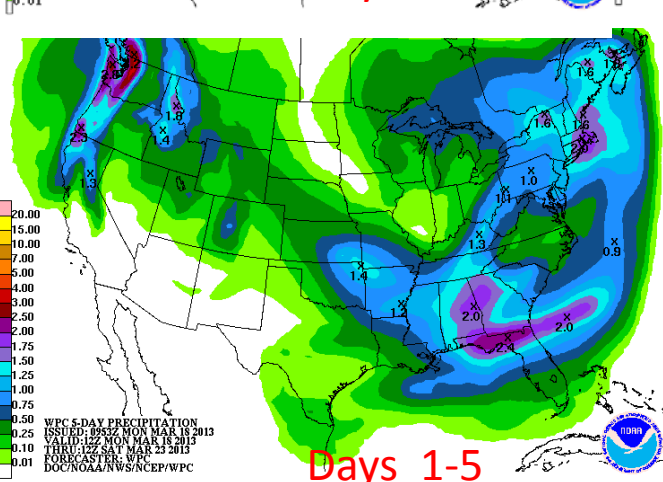
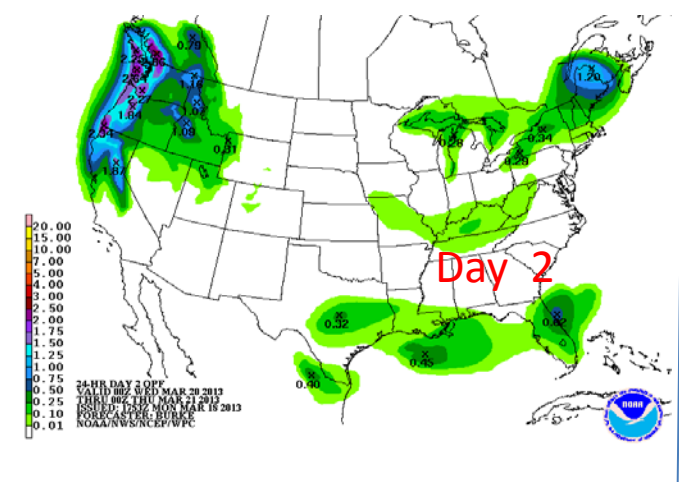
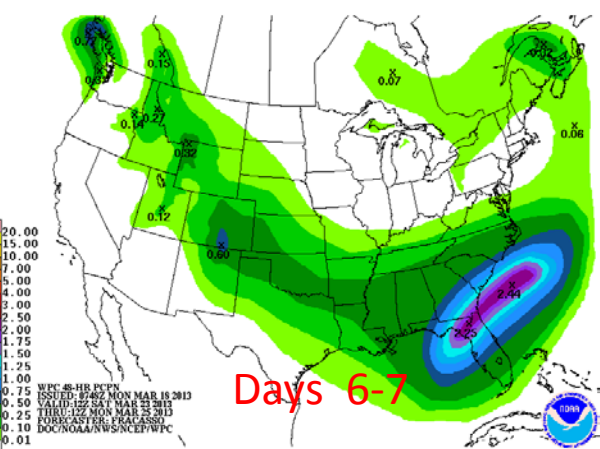
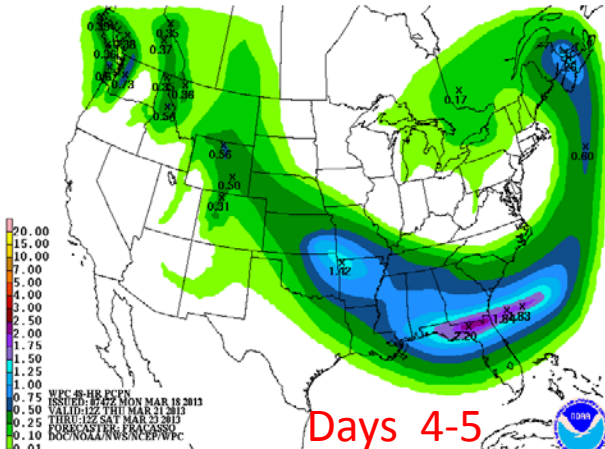
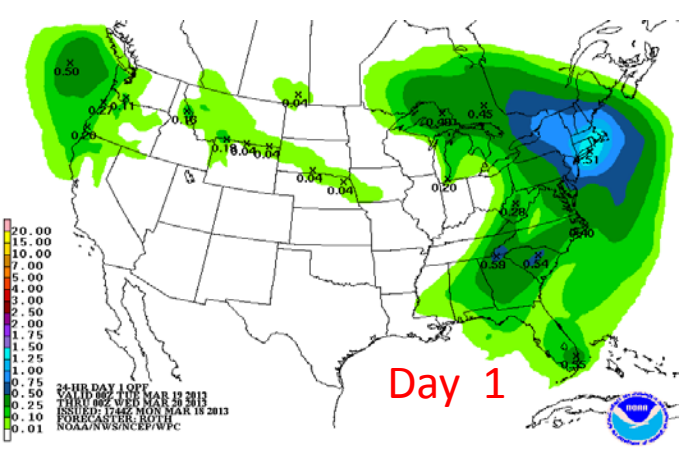
RECORD-Breaking Gator Caught!

**My 10 Day Forecast**

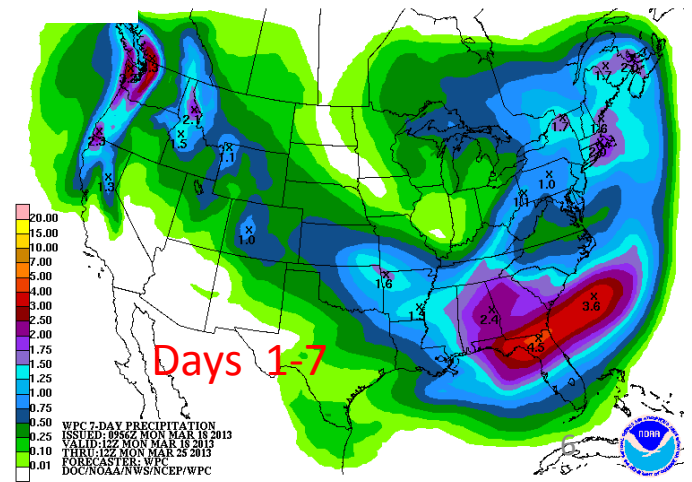
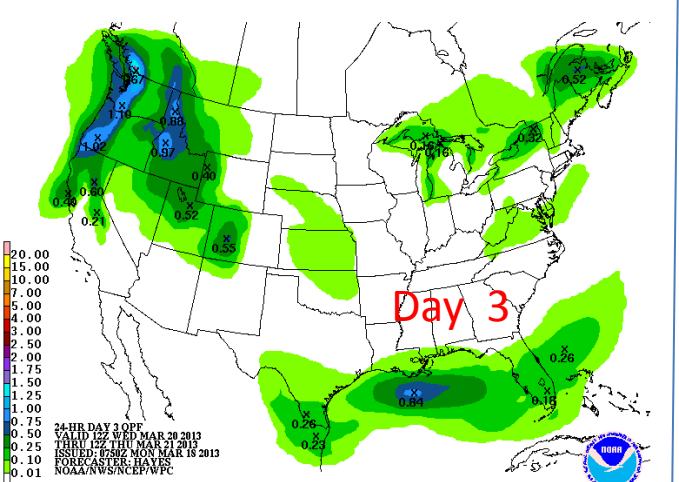
Updated: Aug 19, 2014, 9:12am EDT [Desktop App](#)

Today Aug 19		86° 69°	CHANCE OF RAIN: 20%	WIND: ENE at 9 mph	<a href="#">Details</a>
10 Day	Partly Cloudy				<a href="#">Details</a>
Wed Aug 20		88° 70°	CHANCE OF RAIN: 20%	WIND: ESE at 8 mph	<a href="#">Details</a>
Thu Aug 21		88° 69°	CHANCE OF RAIN: 40%	WIND: S at 8 mph	<a href="#">Details</a>
Fri Aug 22		81° 69°	CHANCE OF RAIN: 50%	WIND: ENE at 8 mph	<a href="#">Details</a>
Sat Aug 23		79° 65°	CHANCE OF RAIN: 20%	WIND: ENE at 8 mph	<a href="#">Details</a>
Sun Aug 24		77° 66°	CHANCE OF RAIN: 50%	WIND: E at 8 mph	<a href="#">Details</a>
Mon Aug 25		82° 68°	CHANCE OF RAIN: 20%	WIND: SE at 7 mph	<a href="#">Details</a>
Tue Aug 26		86° 68°	CHANCE OF RAIN: 20%	WIND: SSW at 7 mph	<a href="#">Details</a>
Wed Aug 27		89° 69°	CHANCE OF RAIN: 20%	WIND: SW at 7 mph	<a href="#">Details</a>

[feedback](#)



Examples of NCEP WPC's QPF - Quantitative Precipitation Forecasts - issued every day.



National Weather Service  
**Climate Prediction Center**

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 • U.S. Monthly and Seasonal Drought Outlook Verifications now available  
 • WCRP/SPARC Data Assimilation & Reanalysis Intercomparison Workshop  
 • El Niño Watch Issued  
 • NOAA's 39th Climate Diagnostics and Prediction Workshop  
 • New CPC Web Page Design

Click on a product title to go to product page. Move cursor over product parameter name to display the graphic -- click to enlarge. Links to these same products are also available below.

6-10 Day Outlook (Interactive Display) Temperature Precipitation	One Month Outlook Temperature Precipitation
8-14 Day Outlook (Interactive Display) Temperature Precipitation	Three Month Outlook Temperature Precipitation
U.S. Hazards Outlook 3-7 Day 8-14 Day	U.S. Drought Information Monitor Monthly Outlook Seasonal Outlook

6-10 DAY OUTLOOK  
 TEMPERATURE PROBABILITY  
 MADE 18 AUG 2014  
 VALID 24 - 28, 2014

DASHED BLACK LINES ARE CLIMATOLOGY (DEG F). SHADED AREAS ARE 10% VALUES ABOVE (A) OR BELOW (B) NORMAL. UNSHADED AREAS ARE NEAR-NORMAL.

90% 80% 70% 60% 50% 40% 33% 33% 40% 50% 60% 70% 80% 90%

Probability of Below Normal Probability of Above

Related Products  
 6-10 Day Outlook, 8-14 Day Outlook, 30 Day Outlook, 90 Day Outlook, U.S. Hazards Outlook, U.S. Drought Information

CPC takes over from day 6 and issues Temp & Precip forecasts over the US for time averages of:

- next 6-10 days (referred to as Week 1P (1 Plus), in this talk)
- next 8-14 days (week 2), monthly /seasonal/etc
- But the forecasts are issued as probabilities for above/near/below conditions from some climatology in just the same way as monthly/seasonal forecasts are issued.

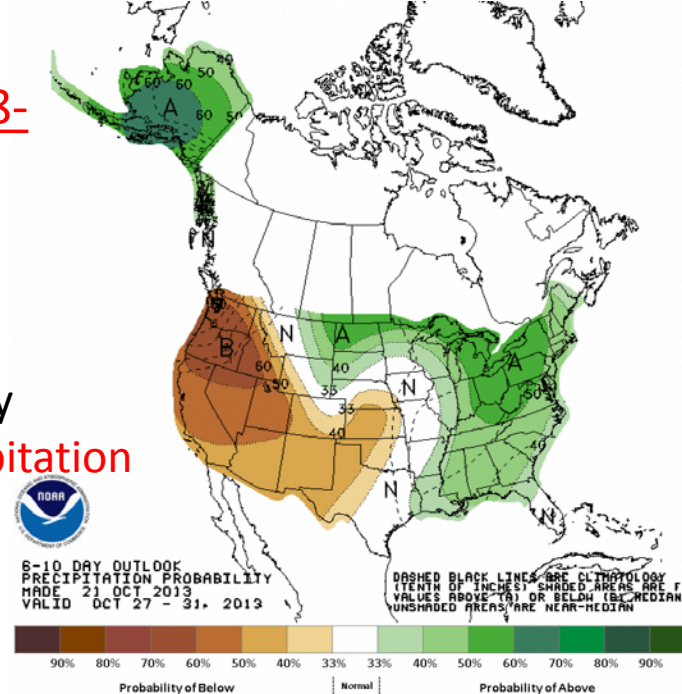
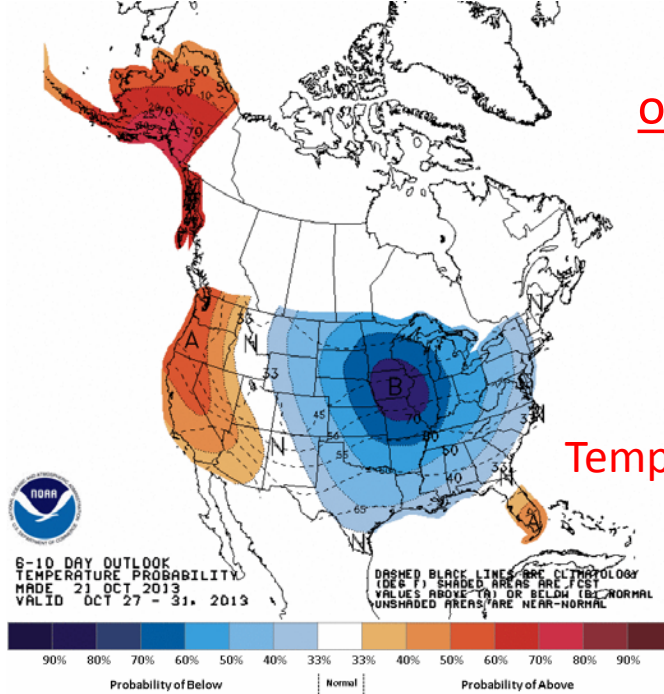
So, at least in the context of prediction metric we seem to jump from "TOTAL FIELD" weather metric (next few days) to "CLIMATE ANOMALY" metric at day 6.

Typical Examples of CPC outlooks for 6-10 days and 8-14 days as anomalies (departures) from some climatology (1981-2010)

6-10 day Outlook Probability

Temperature

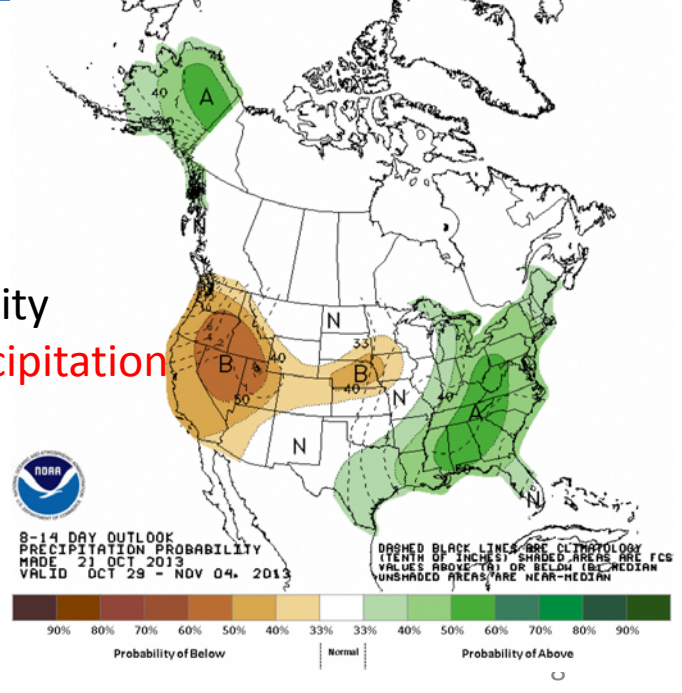
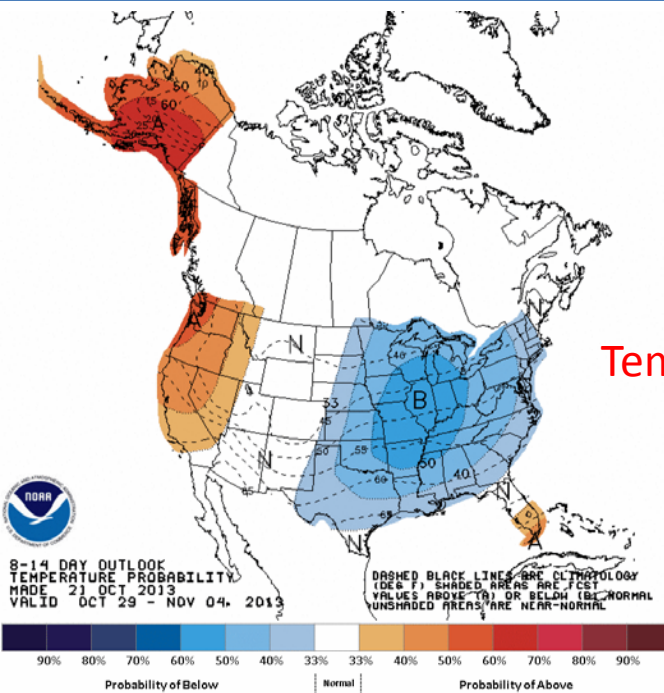
Precipitation



8-14 day Outlook Probability

Temperature

Precipitation





NWS started forecast of :    6-10 days (60's/70's ?)    &    8-14 days ( ~ 2000?)  
    Monthly means – 1970's,            Seasonal means – 1990's.

So, why does the '3-4 weeks hole' in the forecast suite continue to exist?  
Have the model forecasts in the weeks 3-4 time scale improved with time?

Long-range weather forecasts through numerical and empirical methods,

H.M. van den Dool. (Dynamics of Atmospheres & Oceans, **1994**)

Based on the so called "DERF" (Dynamical Extended Range Forecast ) runs in the late 1980s and early 90's.

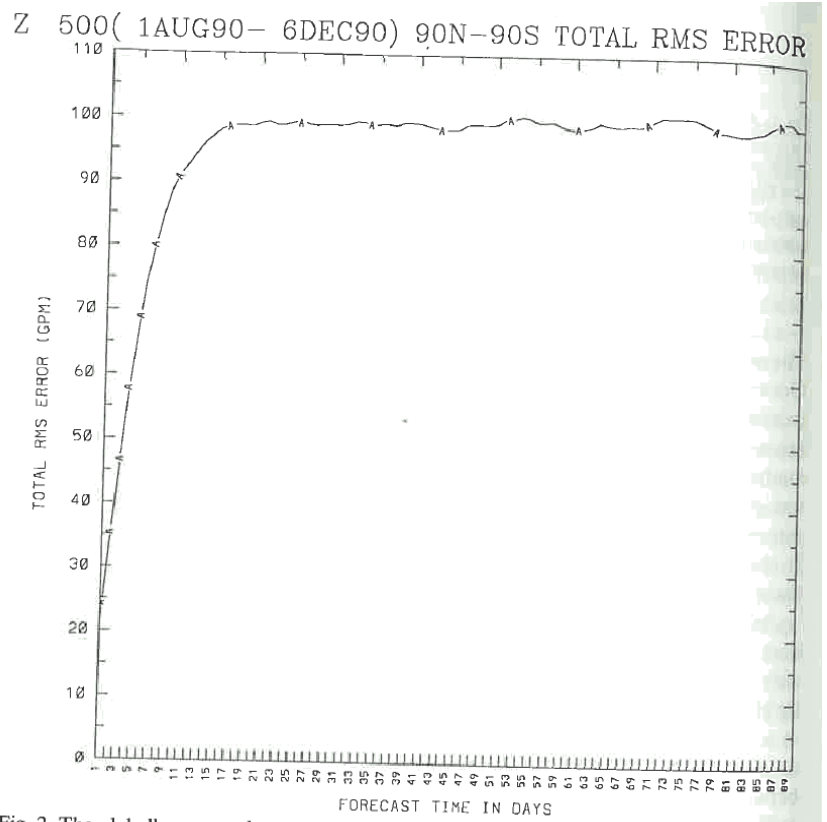
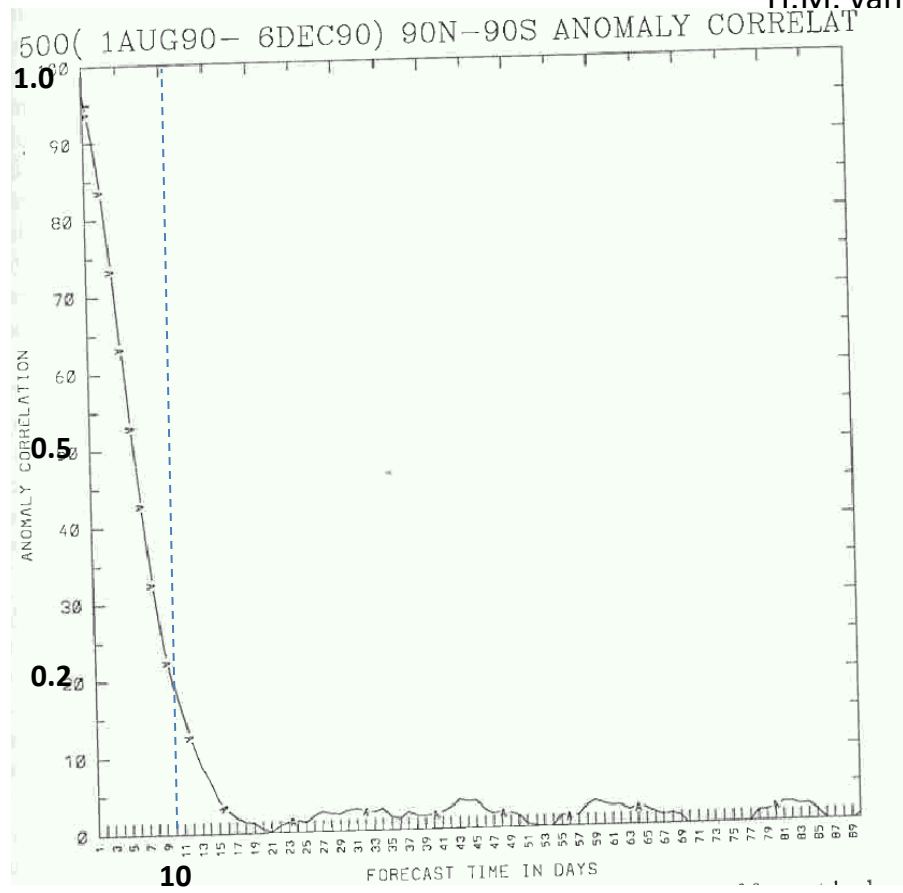


Fig. 2. The globally averaged r.m.s. error of 500 mbar geopotential forecasts, averaged over the Lorenz block (1 August 1990–6 December 1990) as a function of forecast lead time (Days 1–90).

## MONTHLY WEATHER REVIEW

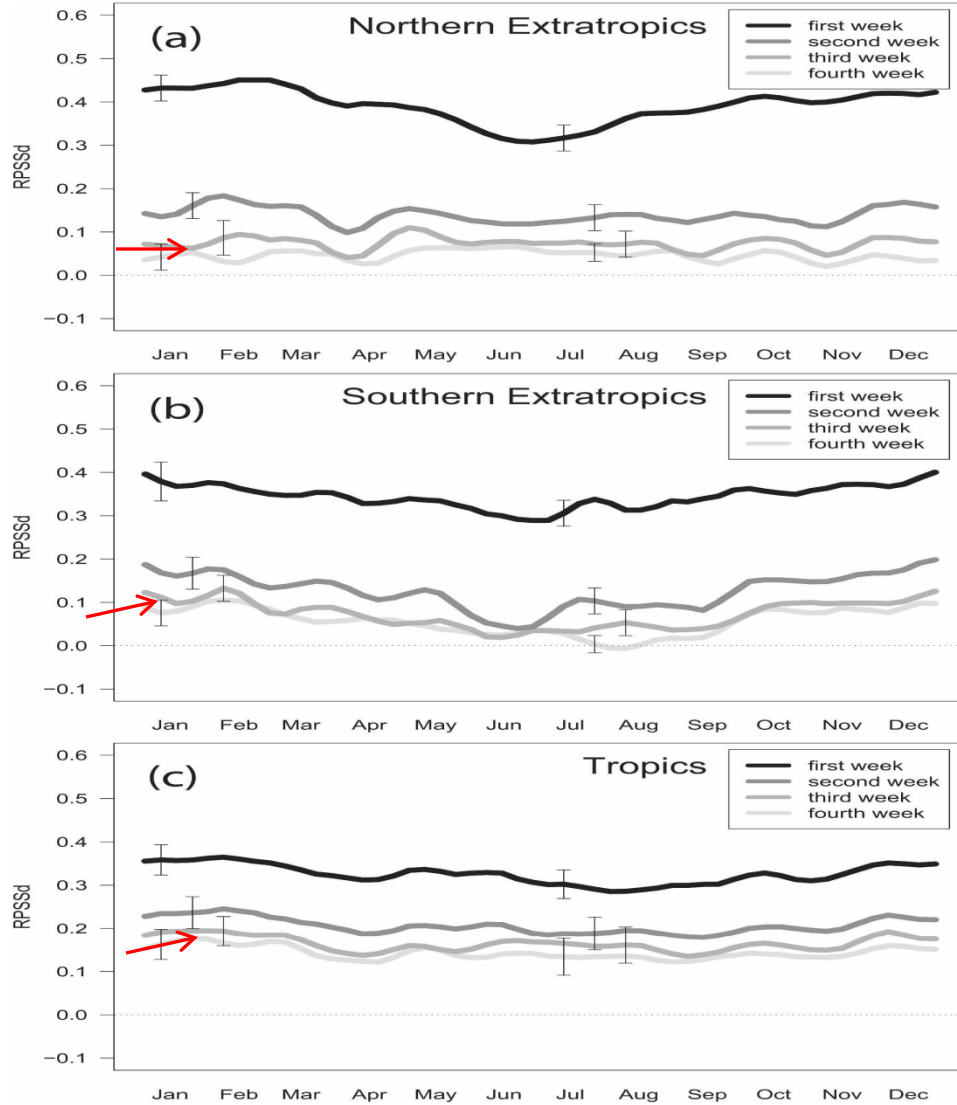


FIG. 5. Annual cycle of average skill in (a) the northern extratropics ( $30^{\circ}$ – $85^{\circ}$ N), (b) the southern extratropics ( $30^{\circ}$ – $85^{\circ}$ S), and (c) the tropics ( $30^{\circ}$ S– $30^{\circ}$ N). A five-point symmetric moving-average filter has been applied as described in the text. Both land and sea points are considered. A few typical confidence intervals are plotted to illustrate the range of uncertainty of the skill values obtained.

## Probabilistic Verification of Monthly Temperature Forecasts

ANDREAS P. WEIGEL, DANIEL BAGGENSTOS, AND MARK A. LINIGER

*Federal Office of Meteorology and Climatology, MeteoSwiss, Zurich, Switzerland*

FRÉDÉRIC VITART

*European Centre for Medium-Range Weather Forecasts, Reading, United Kingdom*

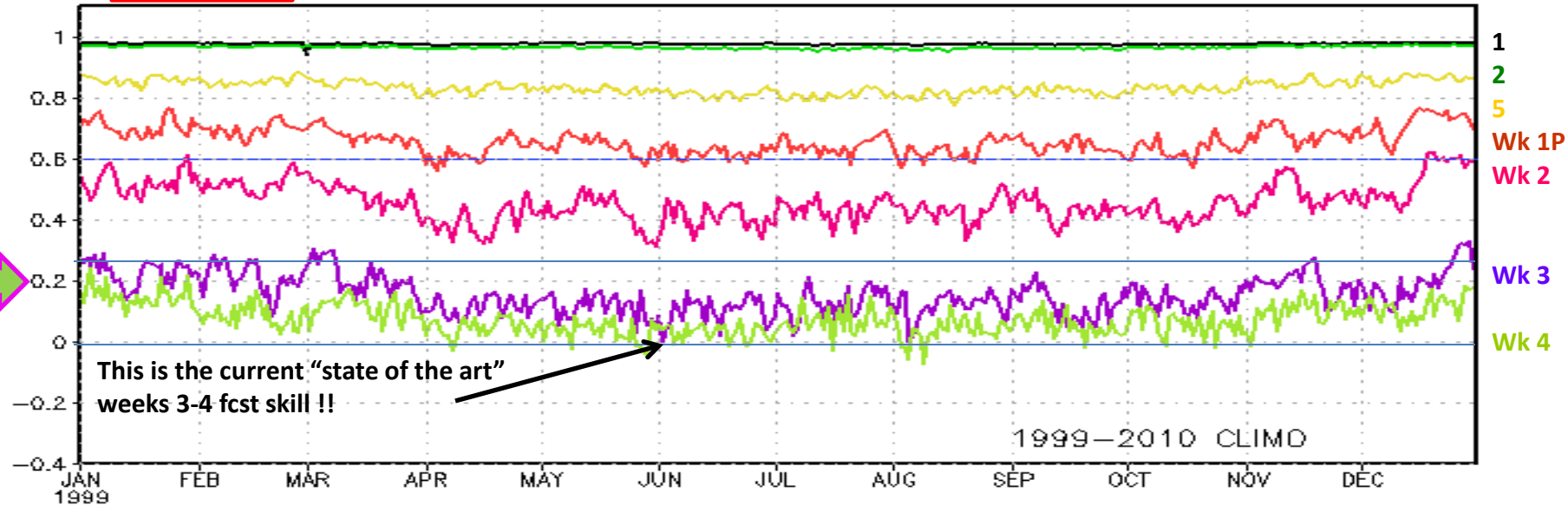
CHRISTOF APPENZELLER

*Federal Office of Meteorology and Climatology, MeteoSwiss, Zurich, Switzerland*

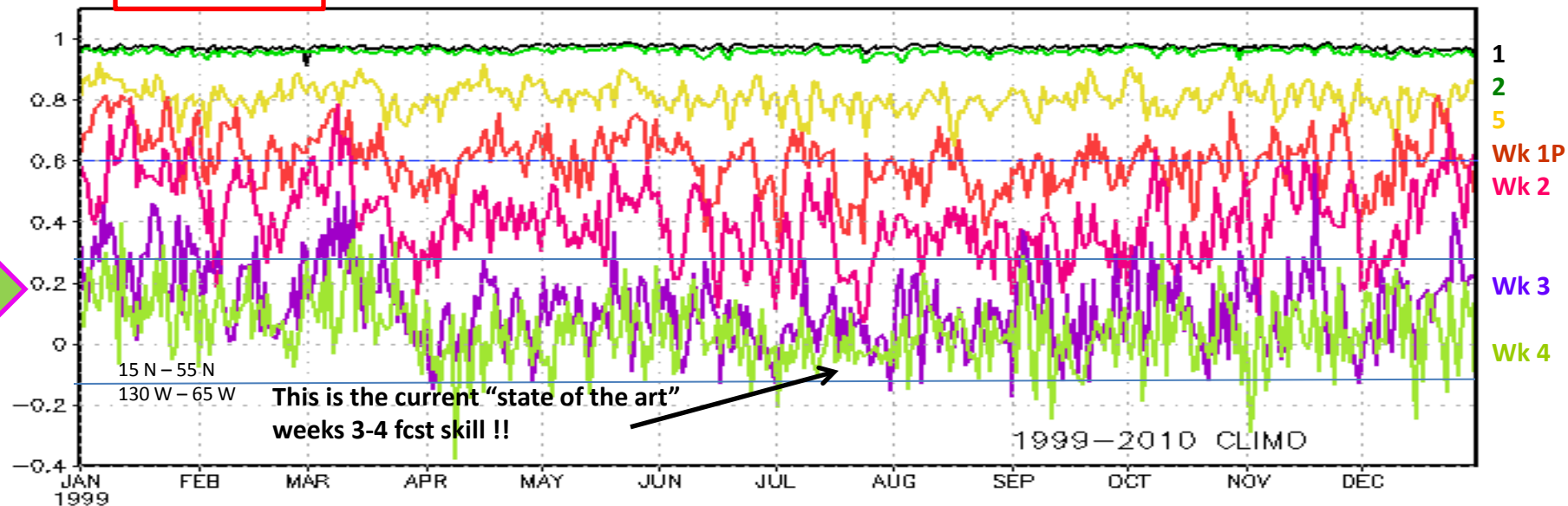
(Manuscript received 6 February 2008, in final form 16 April 2008)

**2014:** Based on CFS V2's 45 day forecast runs. (1999-2010), 4 ensemble member fcsts/day.

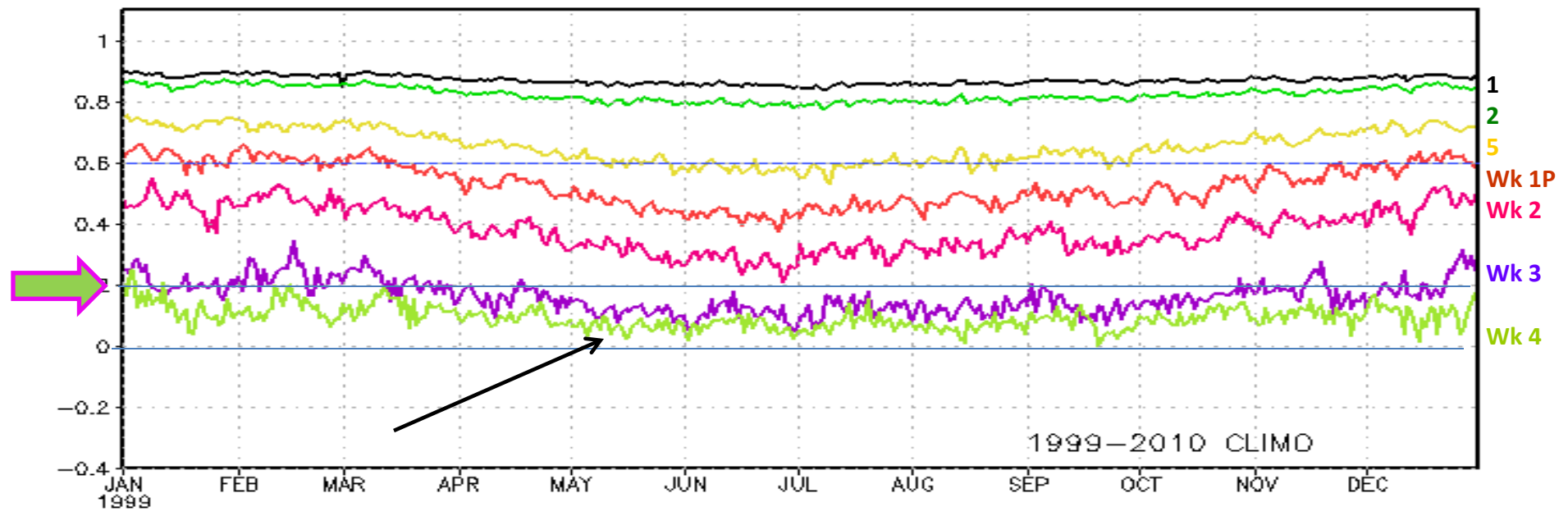
H500 **GLOBE** CFSRR:Dys 1/2/5 & Wks 1P/2/3/4 FCST SKIL



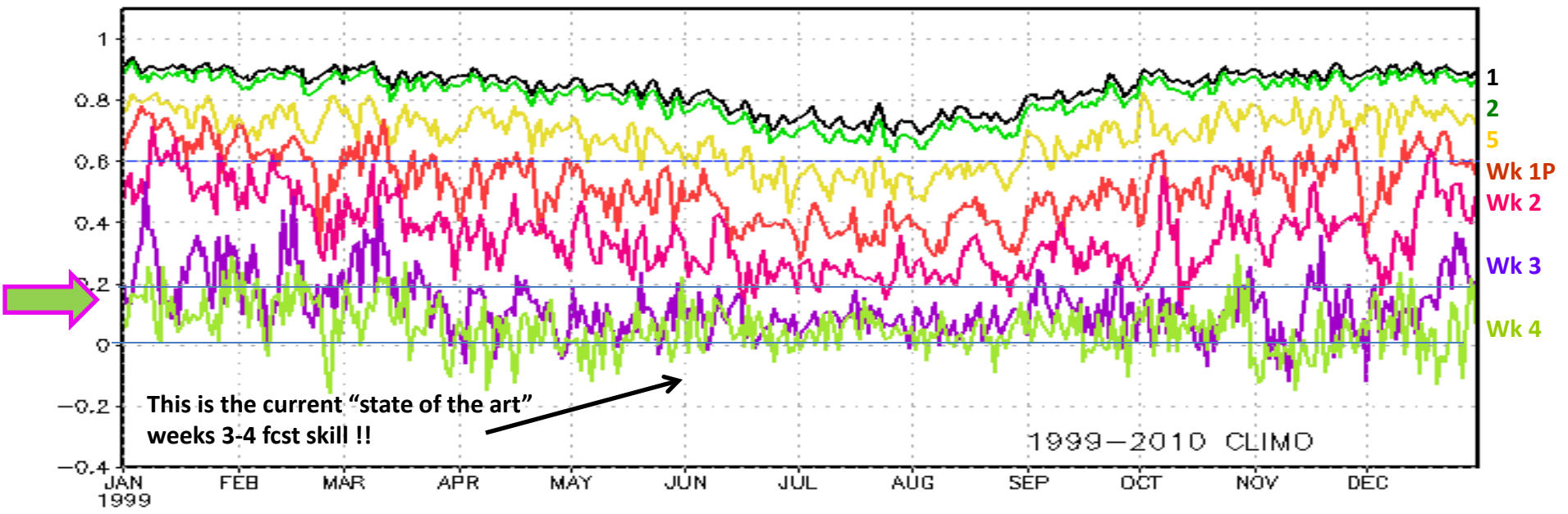
H500 **NearUS** CFSRR:Dys 1/2/5 & Wks 1P/2/3/4 FCST SKIL



# T2m GLOBE CFSRR:Dys 1/2/5 & Wks 1P/2/3/4 FCST SKIL

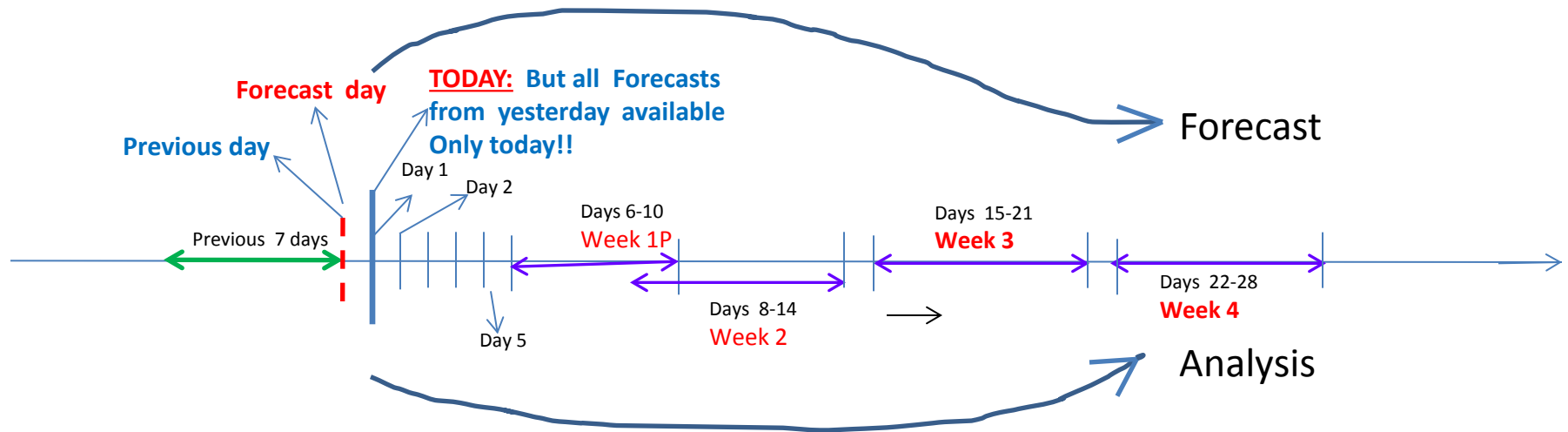


# T2m NearUS CFSRR:Dys1/2/5 & Wks 1P/2/3/4 FCST SKIL



- To evaluate weeks 3-4 predictions we have always mostly used “anomaly/correlation” as the main metric where anomaly is computed as departure from some climatology (base period) - We suddenly switch from the immediate weather mode (next few days) and treat this period (weeks 2? 3, 4) as climate, using anomalies from a long term mean!!!
- What then is the appropriate period for the Climatology? Longest period available? 50 years? WMO’s 30 years? 15 yrs? OCN? Observed (model analyses) Climatology from the same forecasting model? Or from another model (ECMWF)? What about model biases? Depending on the base –period used, the predicted anomalies will be different?
- No matter what the base period is, do the public understand that? OR Does the public really care? All they need is some ‘guidance’, some ‘educated guess’ for how the ‘average’ weather will be like in the upcoming weeks, so they can go on with their lives!!
- **The general public understands:** Yesterday’s/Today’s/Tomorrow’s Weather such as Totals: Snow, Rain/More rain/No rain... Heat wave/Cold in numbers 90’s upper 60s, 40’s ....
- Public understand: Changes from “recent/current weather” that they can remember: If we are NOW in a hot spell, or if in severe cold, or if it has been raining for a while – people want to know how soon is this going to change, or if the current conditions (good or bad) stay the same, or will it change in the future?

"The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them."



I propose we compute the Tendency correlation ( $f-i$  correlated with  $v-i$ ), where the forecast is framed in terms of something else we know, which is the current weather (instead of from some arbitrary climatology).

Why? Because,

“If we keep asking the same question, and if we keep getting the same answer (we don’t like ☹) for a long time, then we have to also consider asking the question differently or ask a different question”

But some may think this will lead to inflated correlations, since these two quantities ( $f-i$  and  $v-i$ ) are generally highly correlated!!

## Correlation of Differences or Tendency Correlation (Thanks to Tim Delsole of COLA/GMU)

Let  $i, v, f$ , and  $c$  be the initial condition, verification, forecast and climatology respectively. Let us call the well known traditional anomaly (from climatology) correlation coefficient as  $cor_{Tr}$ , which can be defined as

$$cor_{Tr} = cor[v - c, f - c] = \frac{cov[v-c, f-c]}{\sqrt{var[v-c]var[f-c]}}$$

Under the null hypothesis of no predictability, it is obvious that  $cor_{Tr} = 0$ .

However, if one considers the correlation  $cor_D$  between the forecast  $f$  and verification  $v$  as differences relative to the initial condition  $i$ , then the correlation skill of differences  $cor_D$  is defined as (which can also be called as correlation skill in the tendency field)

$$cor_D = cor[v - i, f - i] = \frac{cov[v-i, f-i]}{\sqrt{var[v-i]var[f-i]}} \quad \text{Under the null hypothesis of no predictability: } v$$

and  $i$  are independent ( $cov[v, i] = 0$ ), the forecast has no skill ( $cov[f, v] = 0$ ), and the forecast is uncorrelated with the initial condition ( $cov[f, i] = 0$ ). It then follows that

$$cor_D[v - i, f - i] = \frac{cov[v, f] - cov[v, i] - cov[f, i] + var[i]}{\sqrt{var[v-i]var[f-i]}} \quad (3)$$

$$= \frac{var[i]}{\sqrt{(var[v] + var[i])(var[f] + var[i])}} \quad (4)$$

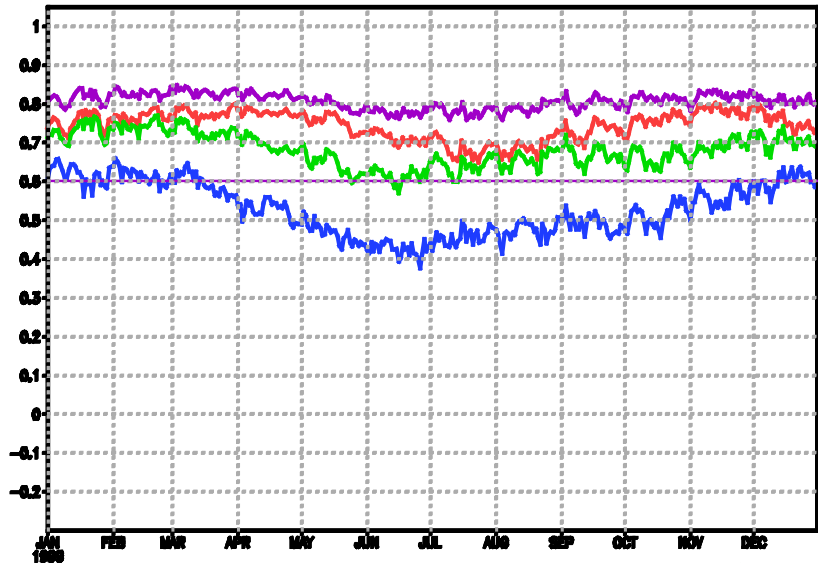
If the system is stationary, then  $var[v] = var[i]$ .

Also when the forecast ensemble members are not large  $var[f] \sim var[i]$ ,

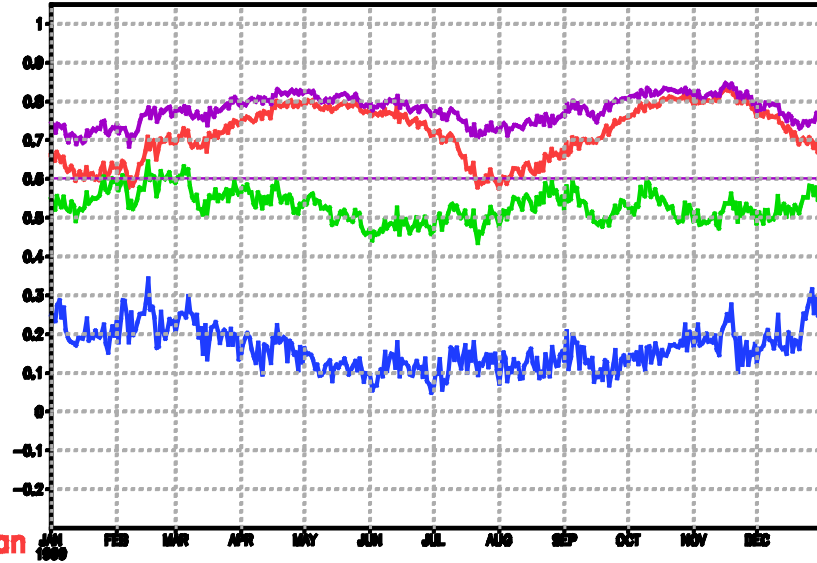
$$cor_D[v - i, f - i] = \frac{var[i]}{\sqrt{(2 var[i])(2 var[i])}} = \frac{1}{2} = \mathbf{0.5} \quad \text{(Tim Delsole argues this value is 0.7}$$

argues when  $var(f) = 0$ )

T2m: GLOB: WK 1P FCST skill CLIMO: 6 diff ways



T2m: GLOB: WK 3 FCST skill CLIMO: 6 diff ways



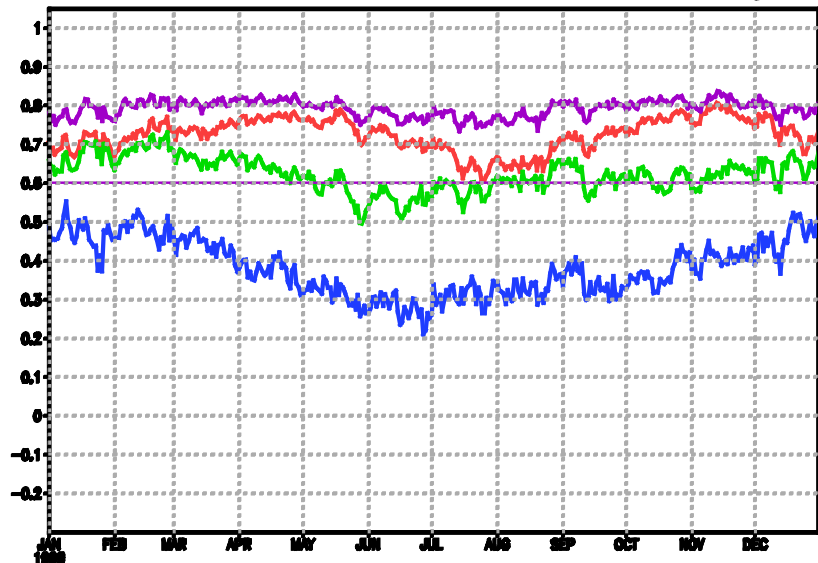
-7dy Mean  
-7dy Mean -Clim.tendency  
-Trad.Climo  
-1dy Mean

T 2m.

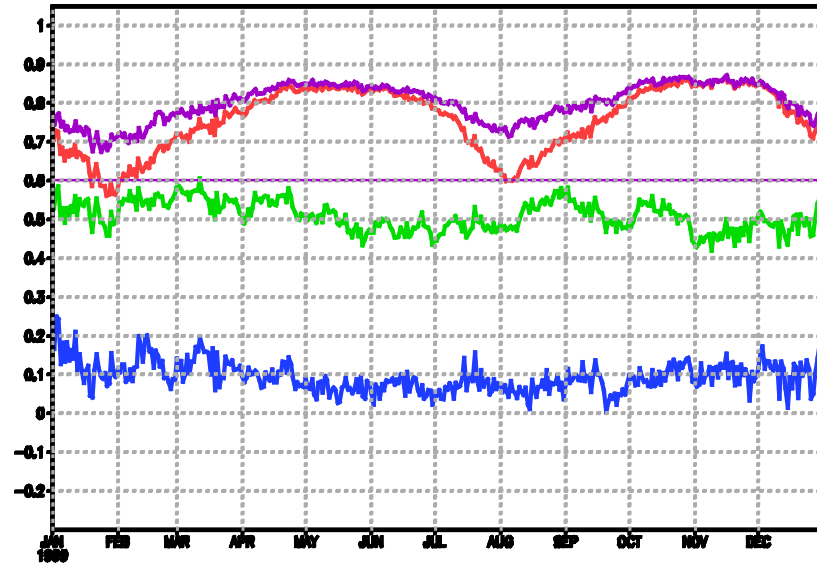
Globe

Wk 1P  
Wk 2  
Wk 3  
Wk 4

T2m: GLOB: WK 2 FCST skill CLIMO: 6 diff ways

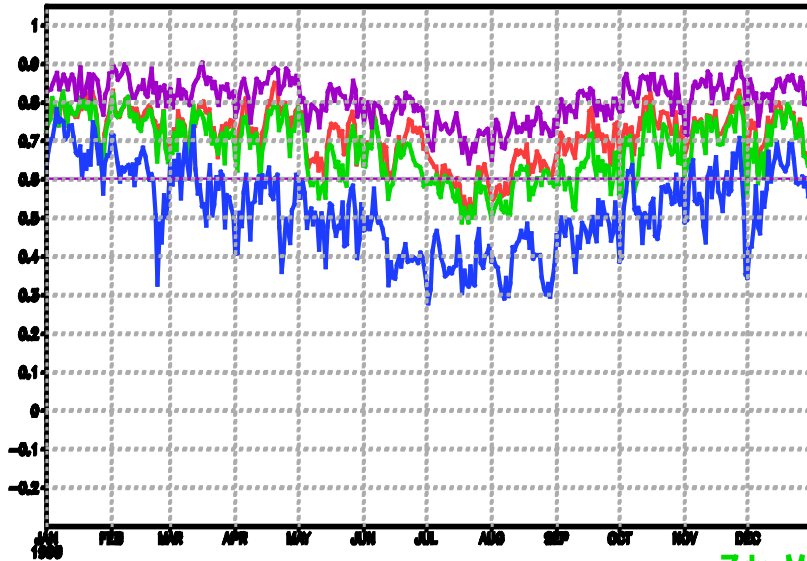


T2m: GLOB: WK 4 FCST skill CLIMO: 6 diff ways

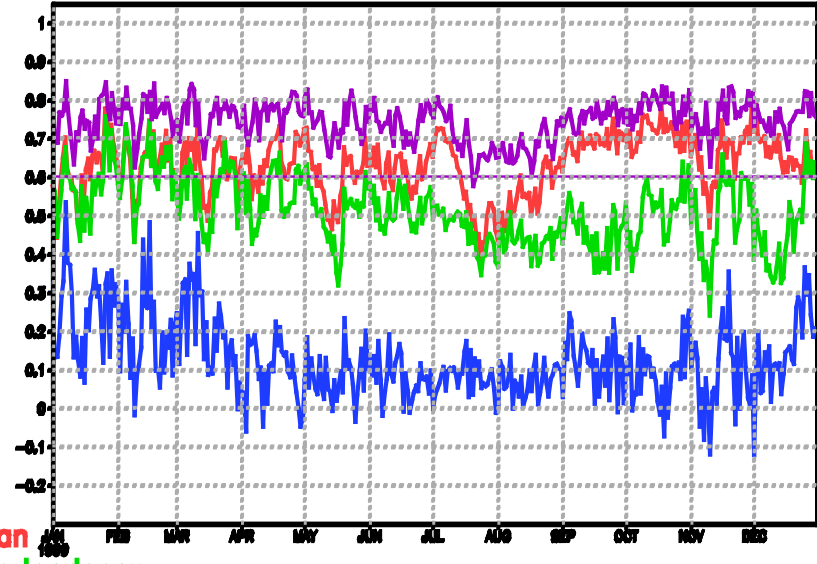




T2m: Near US: WK 1P FCST skill CLIMO: 6 diff ways



T2m: Near US: WK 3 FCST skill CLIMO: 6 diff ways

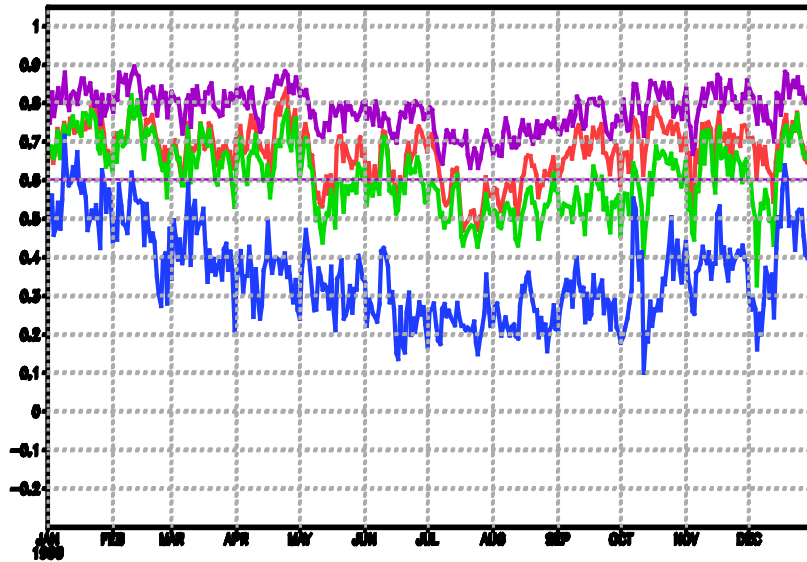


T 2m.

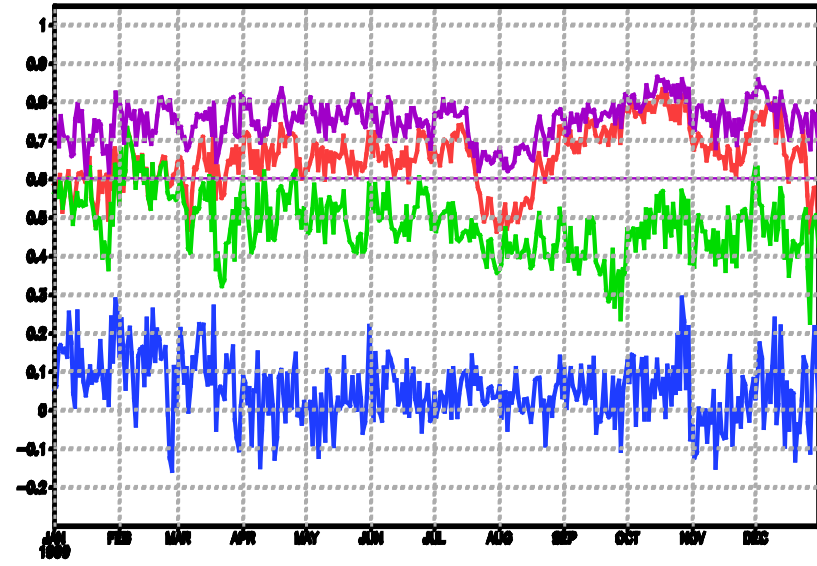
Near US

-7dy Mean  
 -7dy Mean -Clim.tendency  
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 -1dy Mean

T2m: Near US: WK 2 FCST skill CLIMO: 6 diff ways

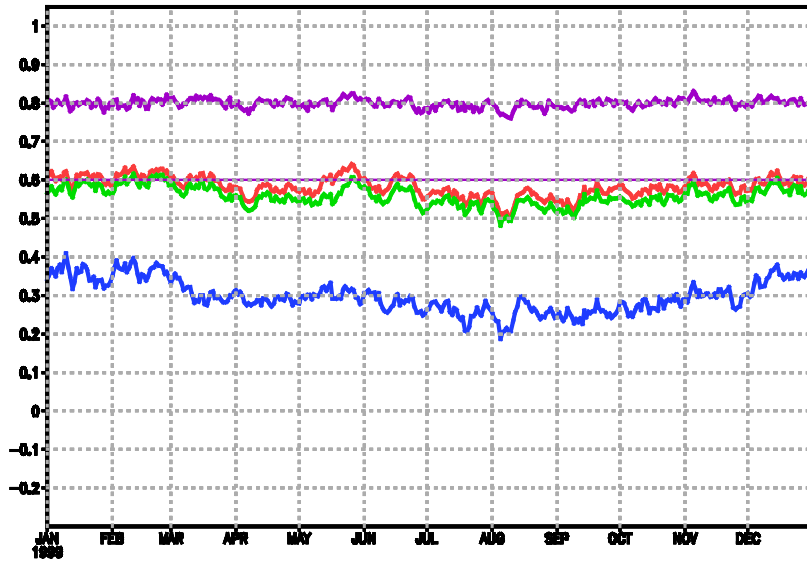


T2m: Near US: WK 4 FCST skill CLIMO: 6 diff ways

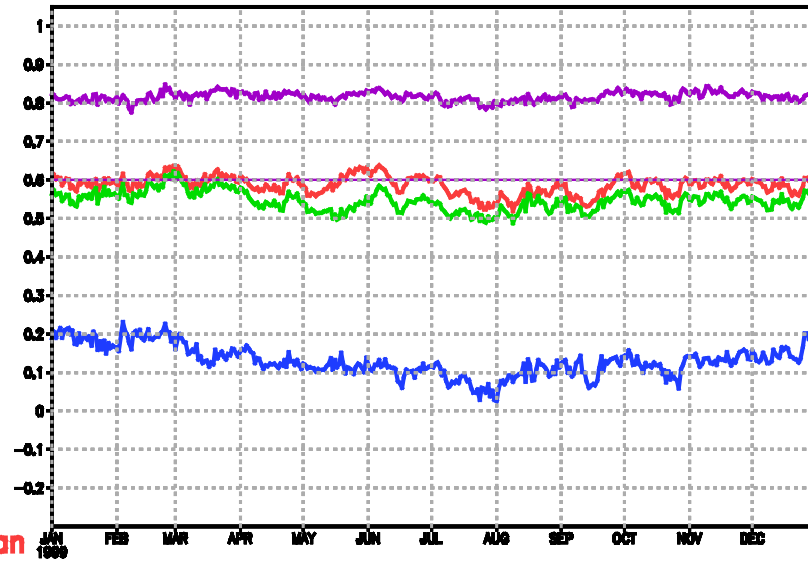


Wk 1P  
 Wk 2  
 Wk 3  
 Wk 4

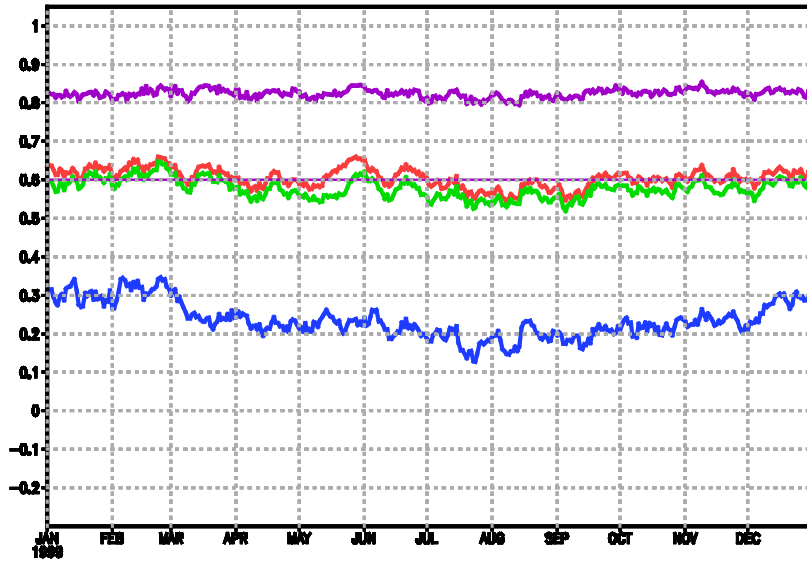
Prate: GLOB: WK 1P FCST skill CLIMO: 6 diff ways



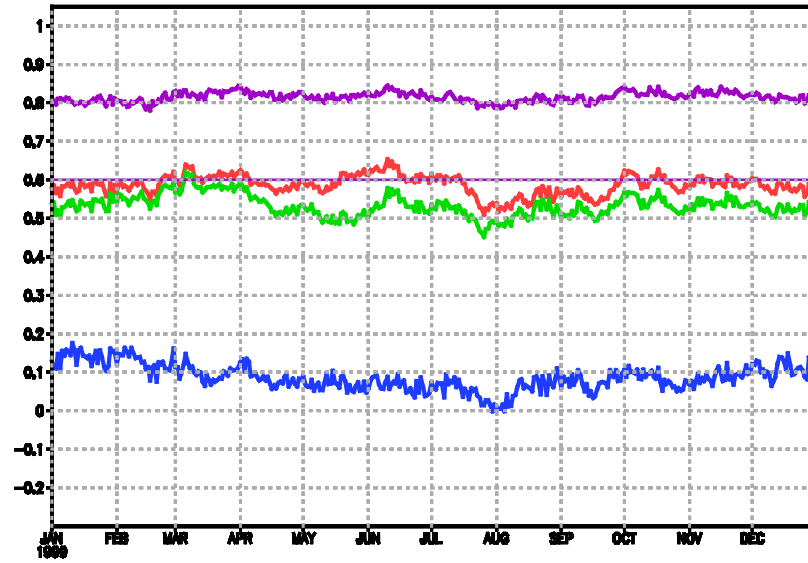
Prate: GLOB: WK 3 FCST skill CLIMO: 6 diff ways



Prate: GLOB: WK 2 FCST skill CLIMO: 6 diff ways



Prate: GLOB: WK 4 FCST skill CLIMO: 6 diff ways



-7dy Mean

-7dy Mean -Clim.tendency

-Trad.Climo

-1dy Mean

Prate

Globe

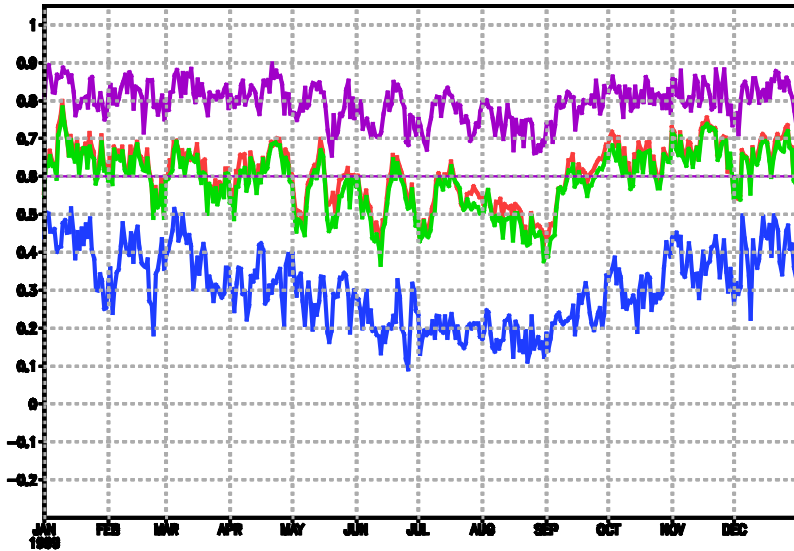
Wk 1P

Wk 2

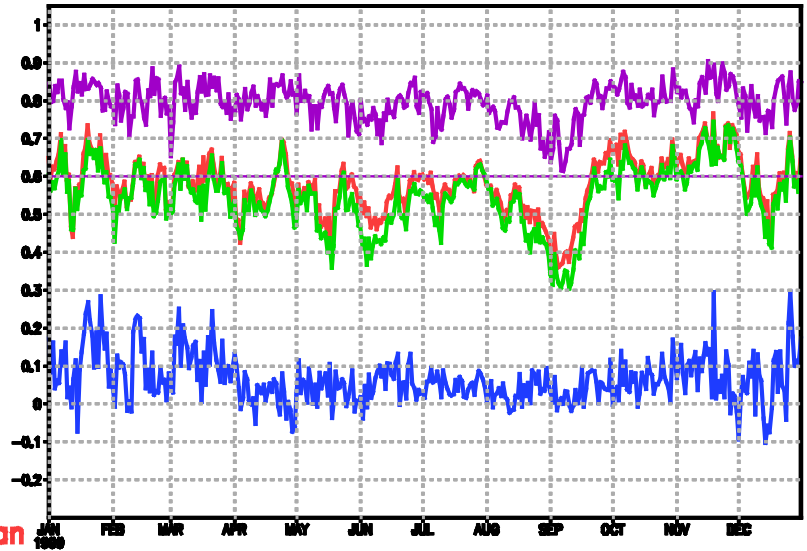
Wk 3

Wk 4

Prate: Near US: WK 1P FCST skill CLIMO: 6 diff ways



Prate: Near US: WK 3 FCST skill CLIMO: 6 diff ways



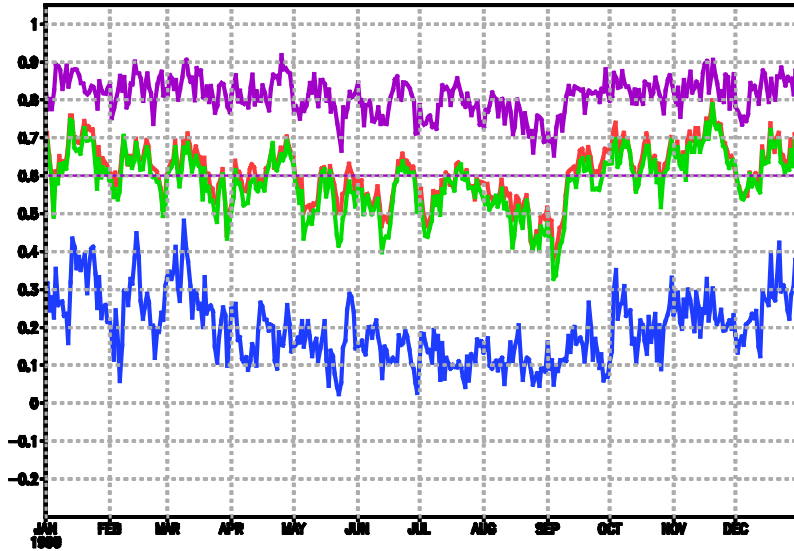
Prate

Near US

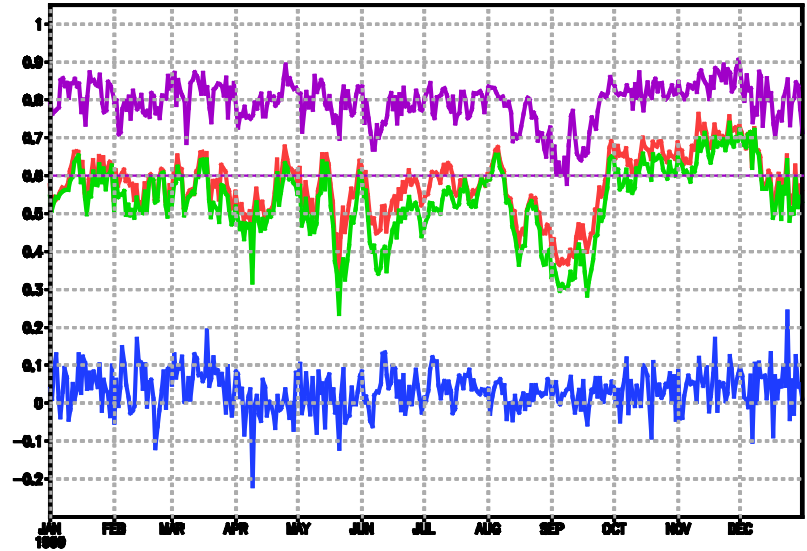
-7dy Mean  
 -7dy Mean -Clim.tendency  
 -Trad.Climo

Wk 1P  
 Wk 2  
 Wk 3  
 Wk 4

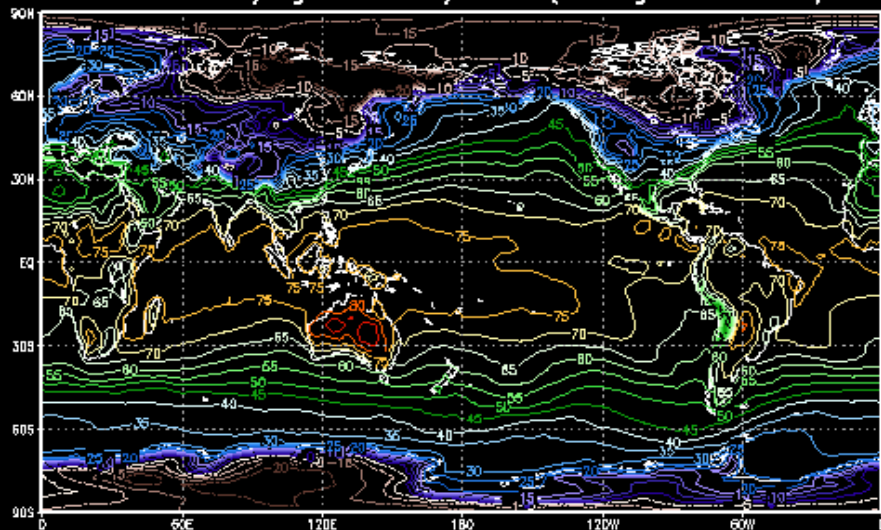
Prate: Near US: WK 2 FCST skill CLIMO: 6 diff ways



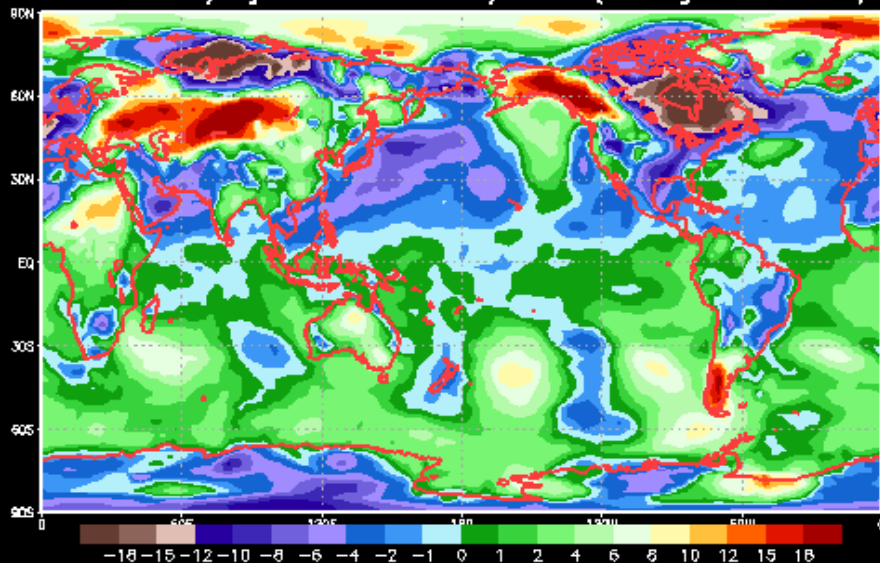
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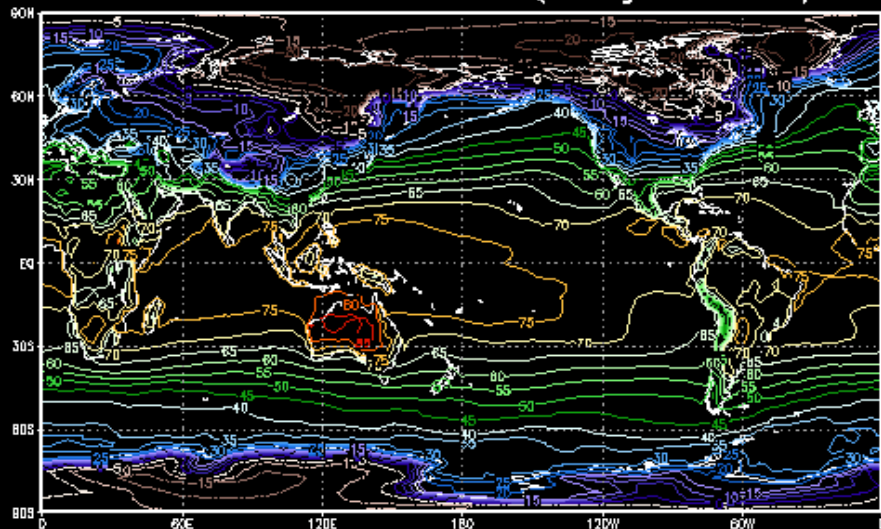
CFSR: Verifying T2m 7day mean(ending 21Jan2013)



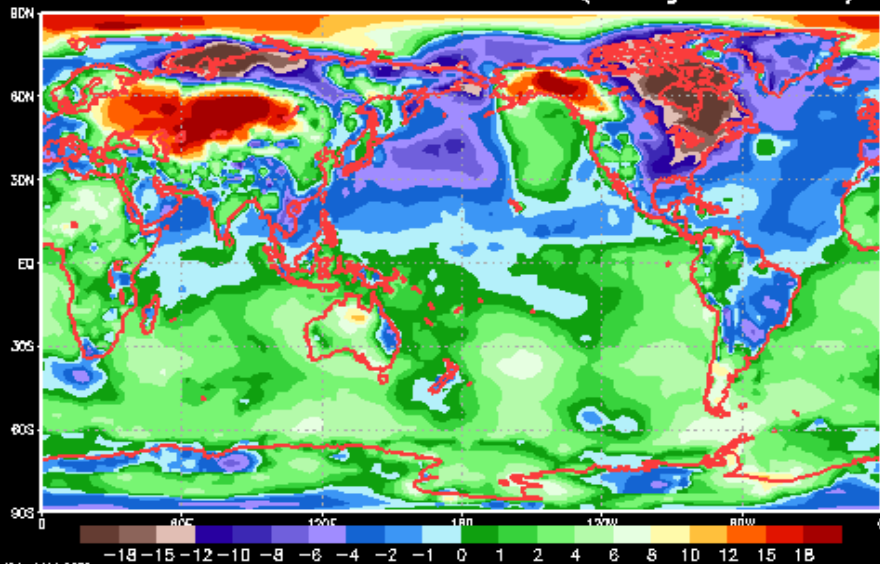
CFSR: Verifying ANOM T2m 7day mean(ending 21Jan2013)



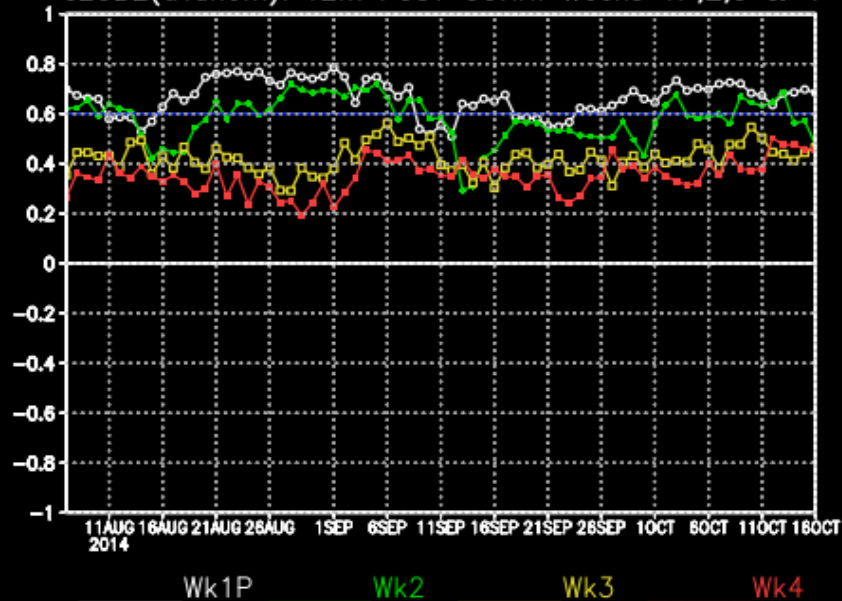
CFSRR: FCST T2m for WEEK 4(ending 21Jan2013)



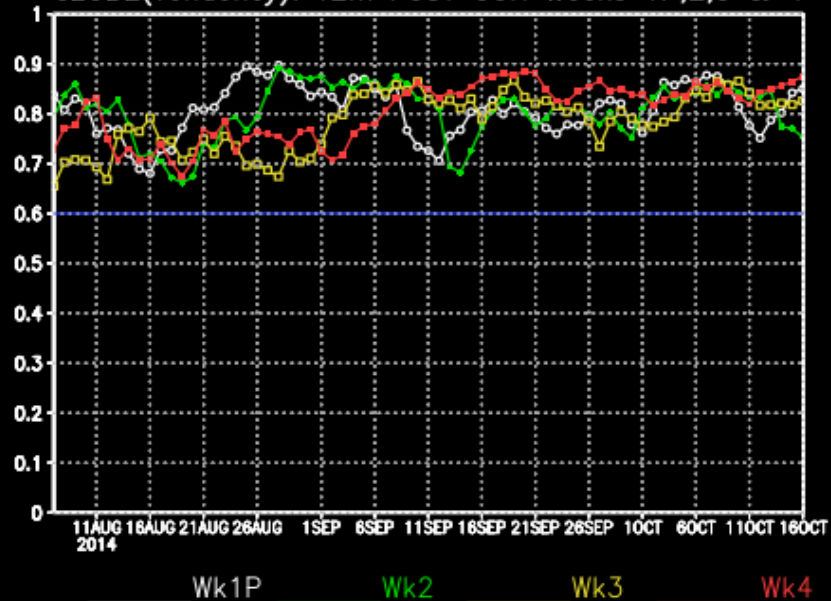
CFSRR: FCST ANOM T2m for WEEK 4(ending 21Jan2013)



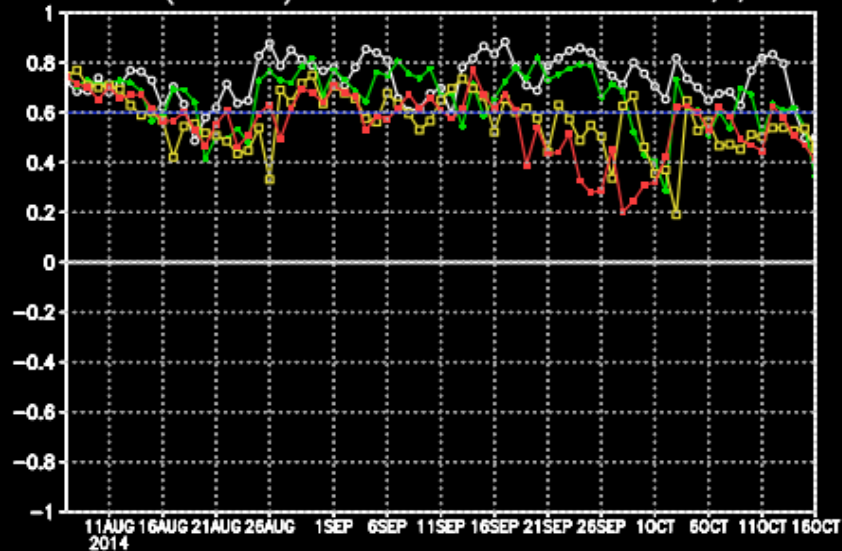
GLOBE(tr.anom): T2m FCST CORR: Weeks 1P,2,3 & 4



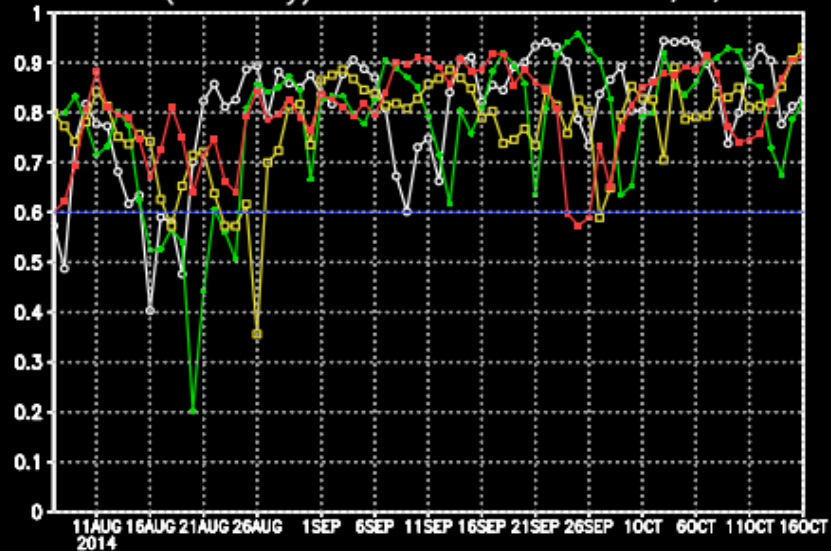
GLOBE(Tendency): T2m FCST COR Weeks 1P,2,3 & 4

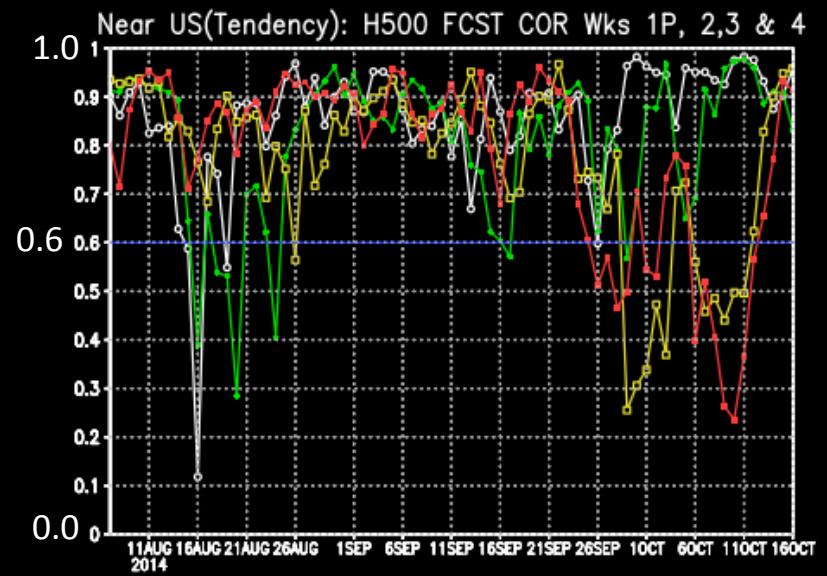
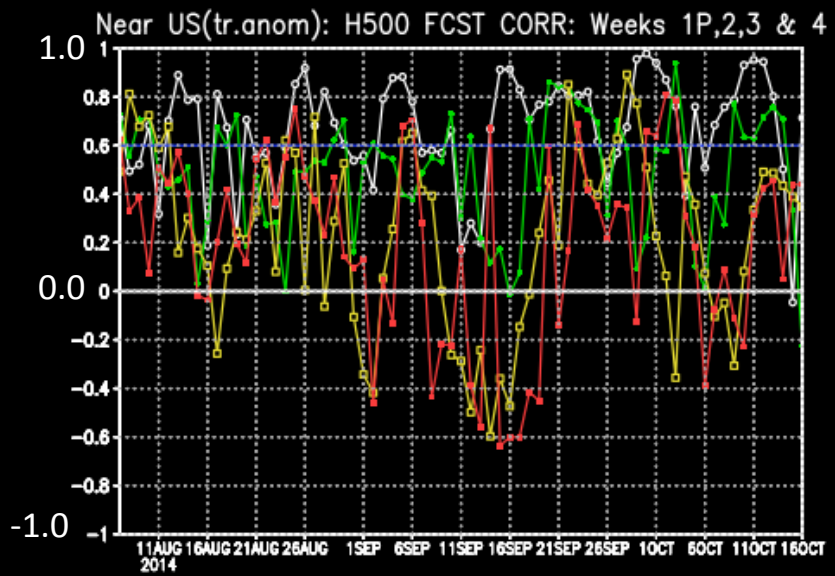
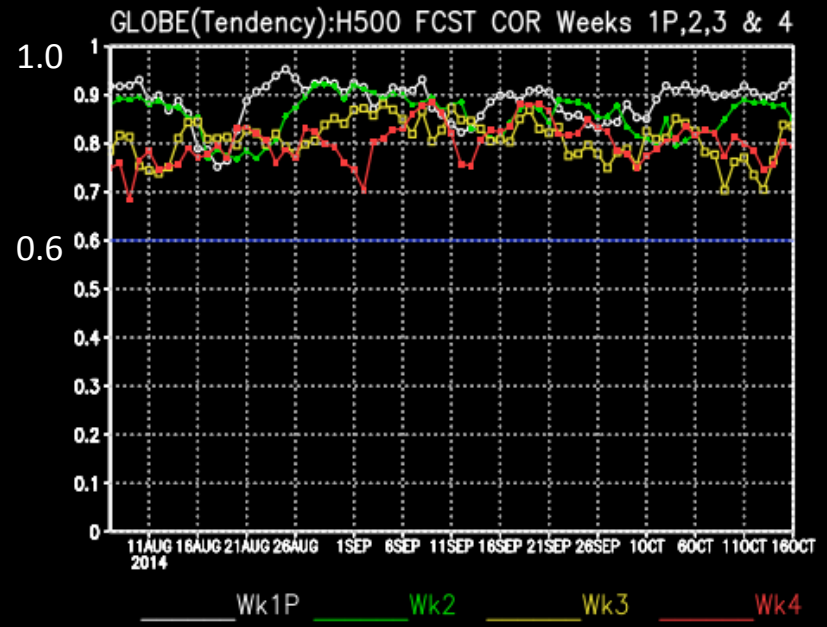
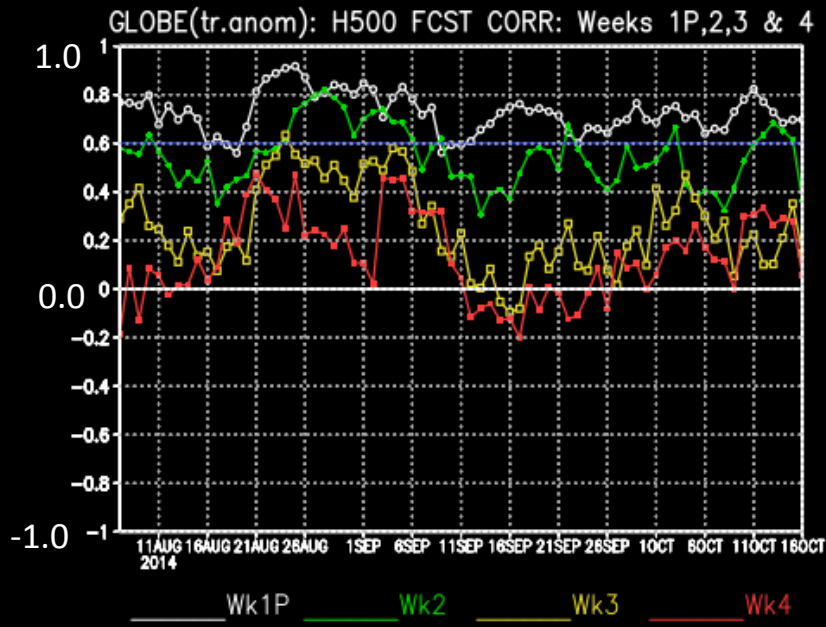


Near US(tr.anom): T2m FCST CORR: Weeks 1P,2,3 & 4

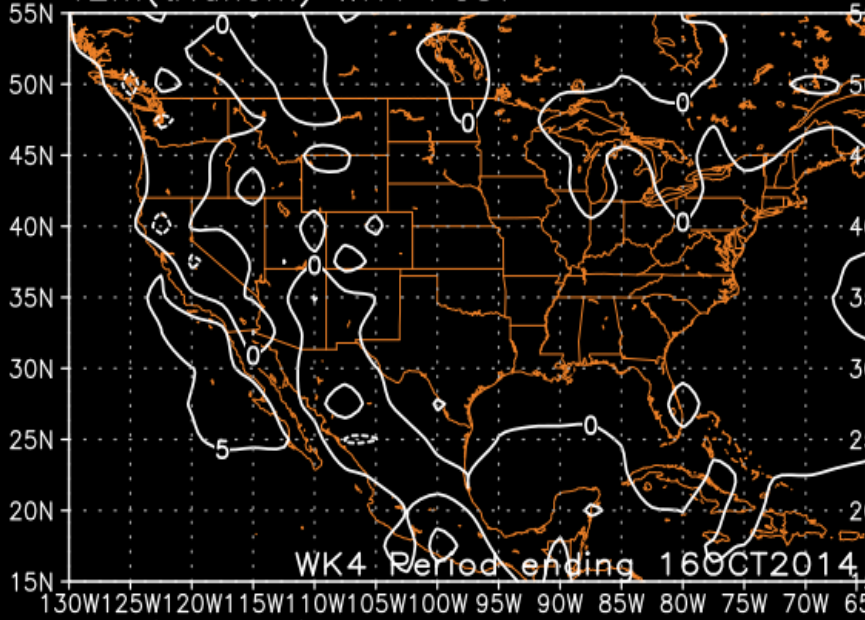


Near US(Tendency): T2m FCST COR Wks 1P, 2,3 & 4



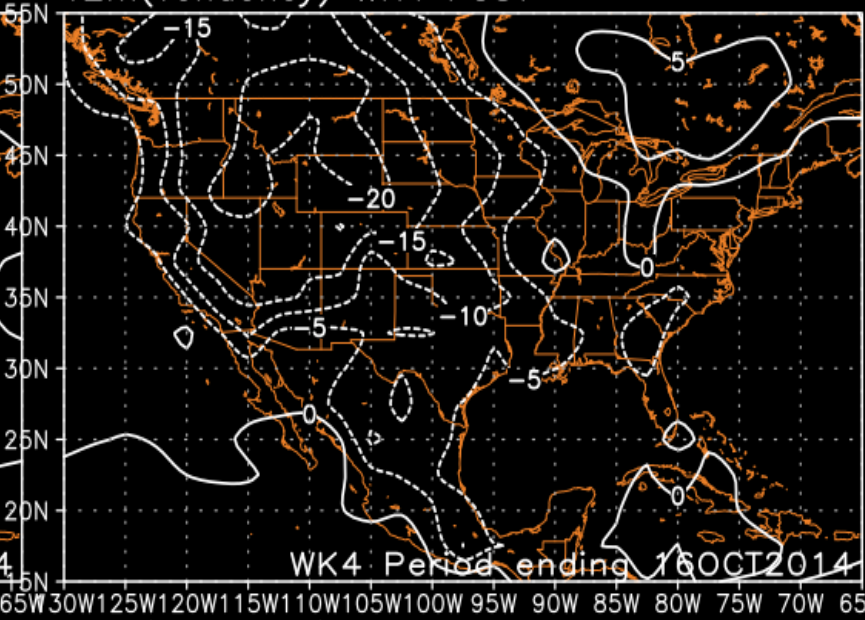


T2m(tr.anom) WK4 FCST



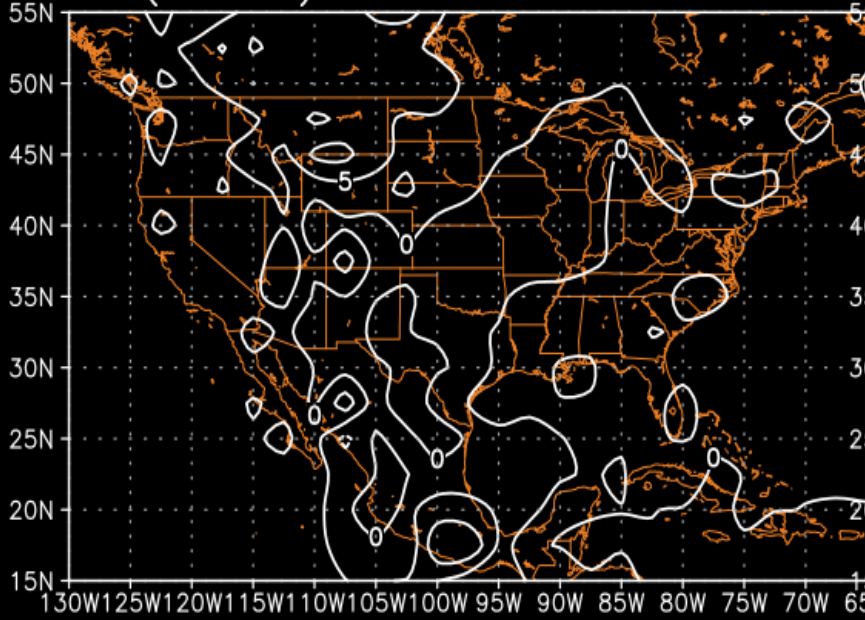
WK4 Period ending 16OCT2014

T2m(Tendency) WK4 FCST

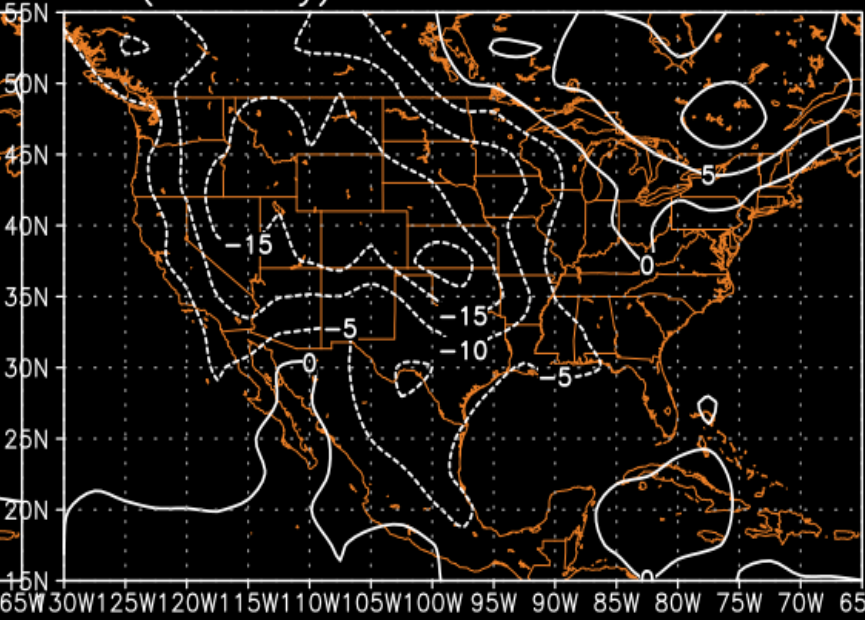


WK4 Period ending 16OCT2014

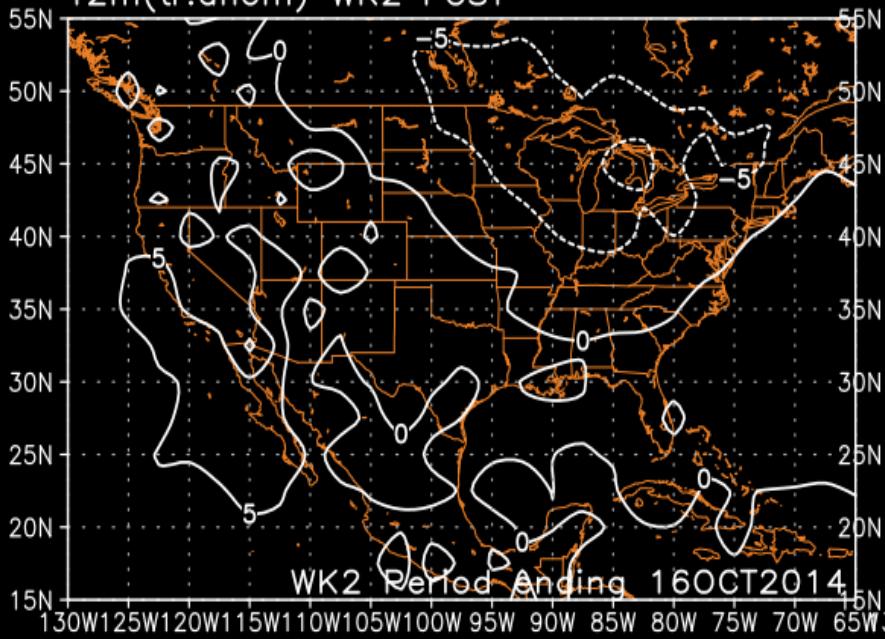
T2m(tr.anom) WK4 Verification CORR= 0.41



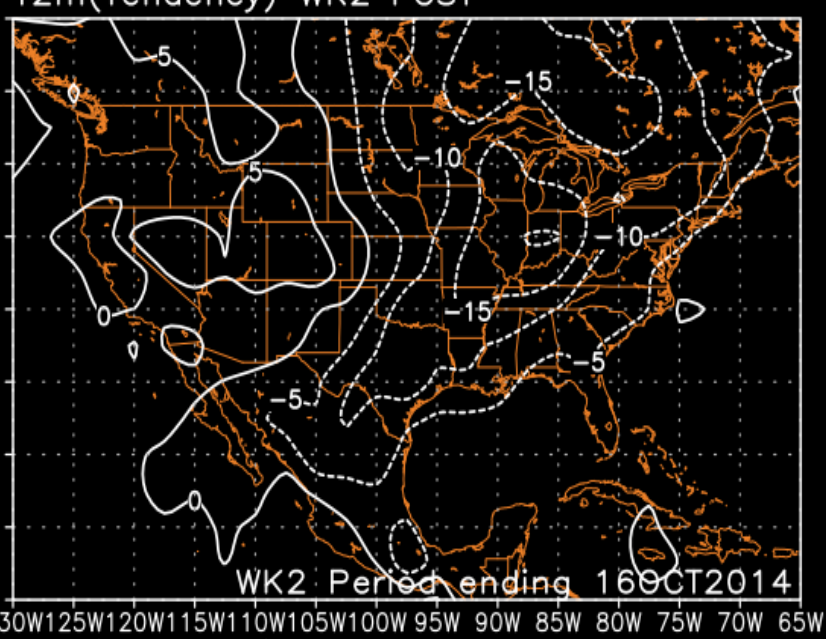
T2m(Tendency) WK4 Verification CORR= 0.91



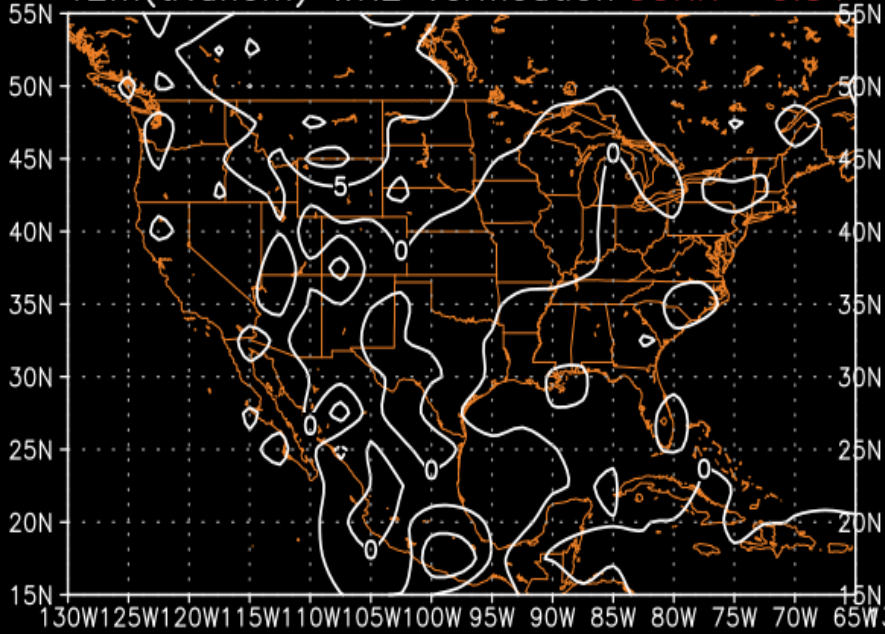
T2m(tr.anom) WK2 FCST



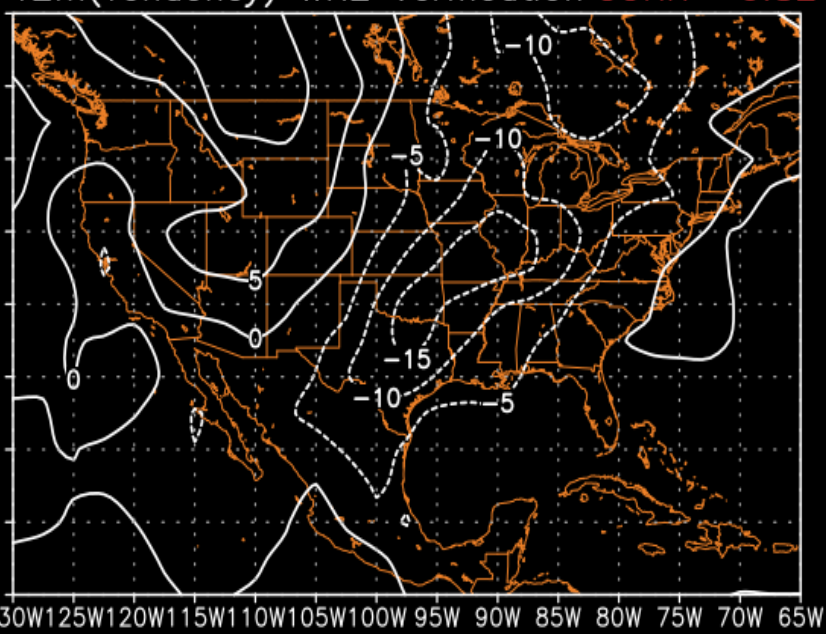
T2m(Tendency) WK2 FCST



T2m(tr.anom) WK2 Verification CORR= 0.34

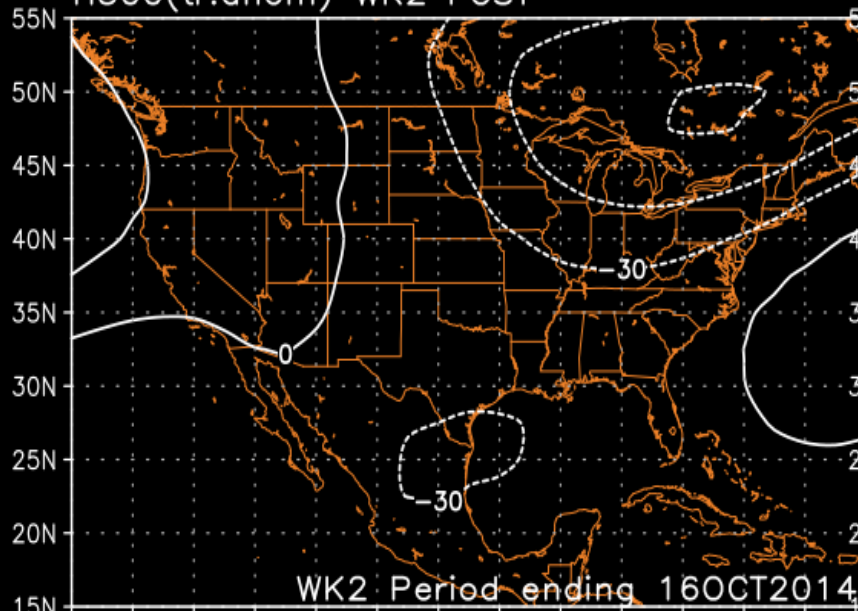


T2m(Tendency) WK2 Verification CORR= 0.82

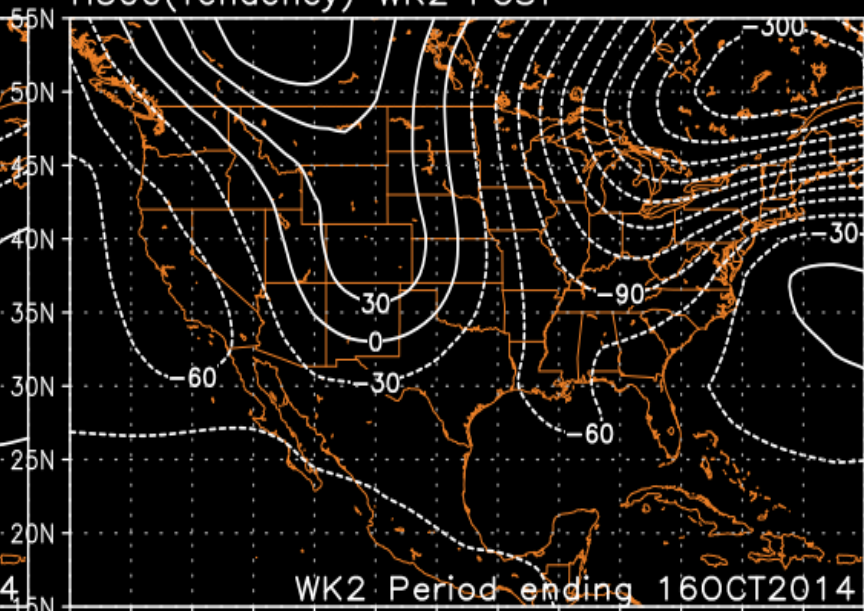




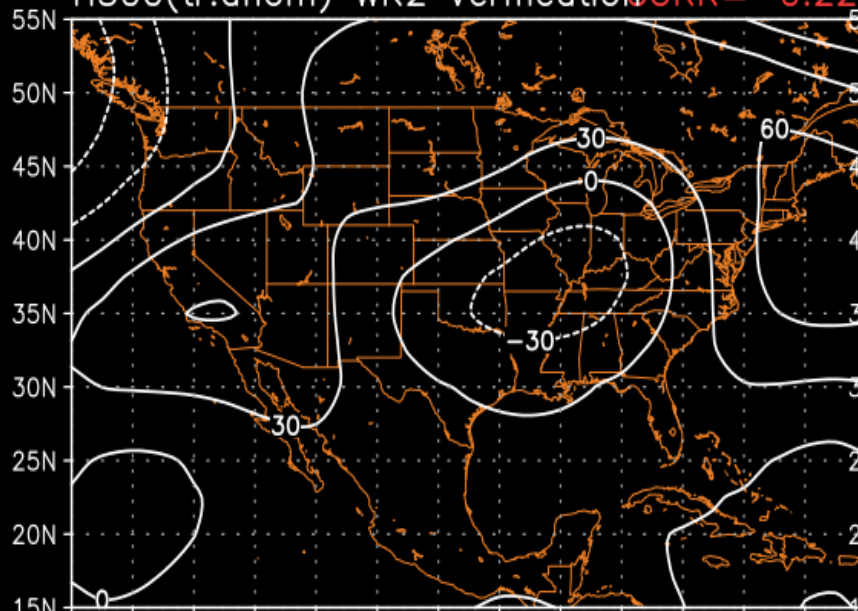
H500(tr.anom) WK2 FCST



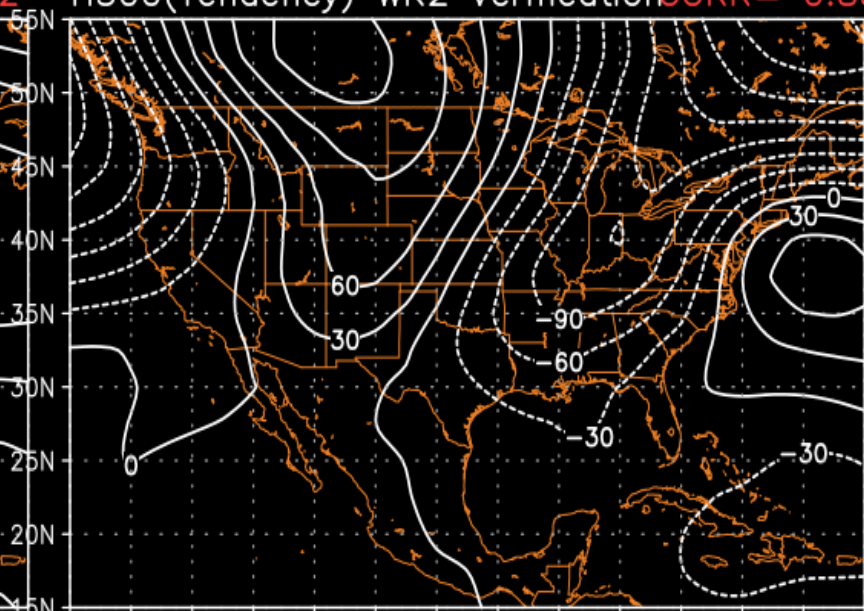
H500(Tendency) WK2 FCST



H500(tr.anom) WK2 Verification **CORR = -0.22**



H500(Tendency) WK2 Verification **CORR = 0.83**



## In summary:

- In spite of the enormous progress that has been made in modeling , physical parameterizations, and data assimilation that lead to significant advances in weather prediction, real progress in the extended range - a few weeks to seasons - remain very slow. If we do not have an open mind and are not willing to think differently about how we make and verify forecasts in particular in the elusive weeks 3-4 time scale, then fifteen/twenty years from now, I am not sure whether we will be in a different place than we are now!
- But if we are willing to experiment with, and think outside the box, and consider to also generate “alternate” form of skillful Tendency forecasts, for some sort of ‘guidance’ for ‘weeks 3 & 4’, even on an ‘experimental basis’, this study offers a new proposal to make and evaluate forecasts in the weeks 1P, 2, 3 4 range, and let the public be the judge of whether these “forecasts” are of ‘any value’ to them. (No need for expensive long-term hindcasts, or delays in implementing model improvements)
- I am making and updating in a ‘real time’ basis, and put these experimental forecasts and recent skill scores in my experimental/personal cpc website with appropriate caveats of course at \_\_\_\_\_  
(can’t see it ? Google: products muthu forecast)
- Prelim. write-up of this work is available online at <http://www.nws.noaa.gov/ost/climate/STIP/Collections.htm>
- A manuscript is under preparation.

**The END.**

**Thanks for listening!**

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For this website, search/Google:

products Muthu weeks.3-4.forecast

On Fri, Sep 12, 2014 at 11:28 AM, Ray Wolf - NOAA Federal <[ray.wolf@noaa.gov](mailto:ray.wolf@noaa.gov)> wrote:

**Hello Muthuvel,**

**I just reviewed your Vlab presentation and wanted to pass on I thought it was brilliant.** First, the focus of customer needs vs. needs determined by scientists is something we have long ago learned in NWS WFOs and is an excellent and fruitful approach. It is great to see that philosophy at CPC because I believe it can open the door to so many other service opportunities.

**Equally brilliant was reframing the outlook process by comparison to current conditions vs. climatology.** This is something I have done informally my entire career when sharing the 6-10 day outlook with farmers as far back as the late 1980s. I am pleased to see skill documented for such an approach, and it will reinforce our local efforts in pushing the week 2 outlook as well.

**Your approach is exactly how people think.** If we are in drought or a serious dry spell, the question is when will the pattern change to a wetter one. Likewise with temperature anomalies. The more extreme or stagnant the pattern, the greater the interest becomes in when it will change.

I would encourage you to think further and see if there are any other hazards, such as severe weather, that might show some signal in weeks 3-4. I have seen literature on the MJO and relationship to tornado outbreaks that suggests this is possible. There might also be some applications for wind energy if that variable might have skill (see attached paper). Wind energy is a big deal in our part of the U.S.

In short, **I wanted to let you know there is someone in the field who is looking at the potential for sharing useful information like you spoke about for weeks 2-3-4 with our customers. Your presentation has boosted my enthusiasm in doing so.**

Regards,

**Ray Wolf**

**Science and Operations Officer (SOO)**

**NOAA / National Weather Service**

**Davenport (Quad Cities), Iowa**

[weather.gov/dvn](http://weather.gov/dvn)

On 3-4 Week Forecasts

Steve Lyons

Aug 25, 2014

Muthu,

**.... I got a copy of your 3-4 week forecasts effort and was pretty interested in it. I am on the operational side now MIC in San Angelo TX....**

I think it most important and what we currently (I think) tend to not tout enough are BIG CHANGES in weather/weather patterns that will bring hot/cold/wet/dry. **May I suggest you look at how well you are able to predict the big/bigger events that are most important to our customers.** This might easily be done by verifying situations that exceed 1/1.5/2 sigma across portions/all of the US or any other area (world). **Value in giving a heads up and valuable guidance on the magnitude of the event would be most useful to our customers.** Obviously they care that temps will be average, because they are worried about large departures, but if you can value add on how anomalous you have a winner. Think about orange crops and a big freeze potential in winter, or big freeze or frost for strawberries in spring, etc.

Sincerely, Steve

Dr. Steve Lyons – **MIC WFO San Angelo, TX**

Adjunct professor Texas A&M University

Tropical & Marine Weather,

325-944-9445

On Wed, Oct 15, 2014 at 1:55 PM, John Eise - NOAA Federal <[john.eise@noaa.gov](mailto:john.eise@noaa.gov)> wrote:

.....

I have been very impressed with the work by Dr. Chelliah at CPC. When I first listened to his presentation, I thought "why haven't we thought of this before?" He took a very creative approach to this forecast problem.

I am a strong believer that the Weeks 2-4 period will become a very important part of Impact Decision Support Services in the NWS. The emergency management community including FEMA would benefit greatly from a "heads up" on the types of hazards that they may be looking at to allow for long range planning.

.....

Thanks,

John

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John Eise, Deputy SSD Chief, Climate Program Manager

*Central Region Headquarters*

*7220 NW 101st Terrace*

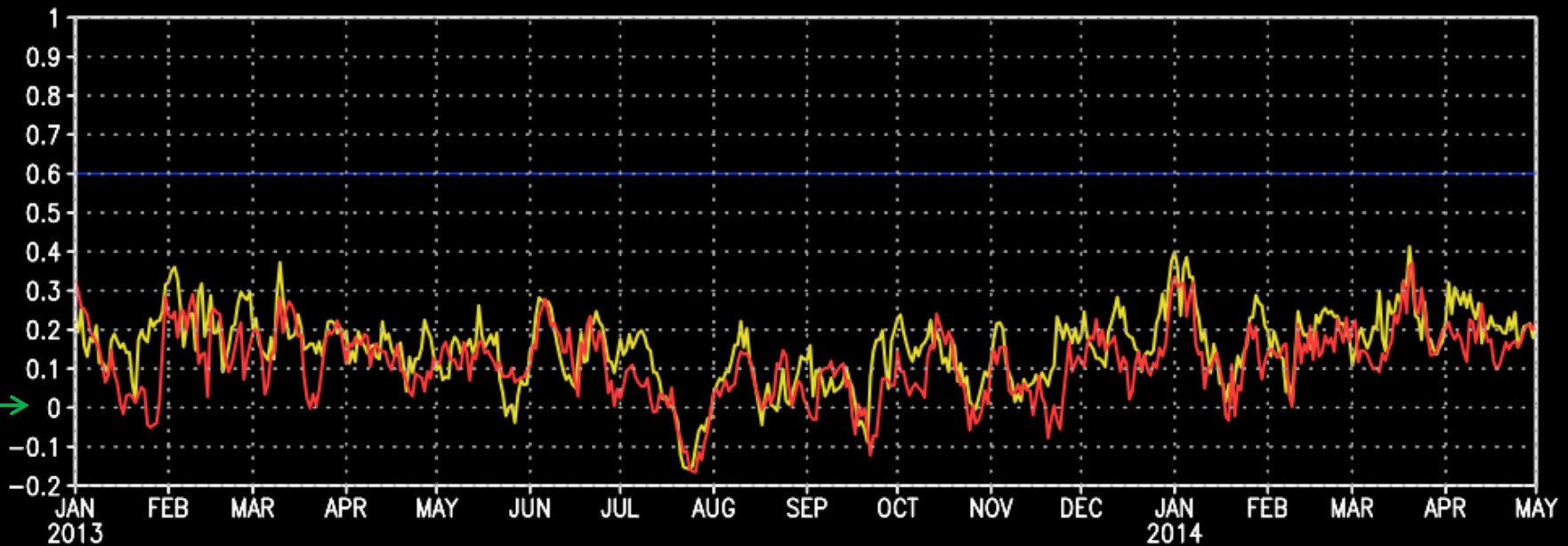
*Kansas City, MO 64153*

[\(816\) 268-3144](tel:8162683144)

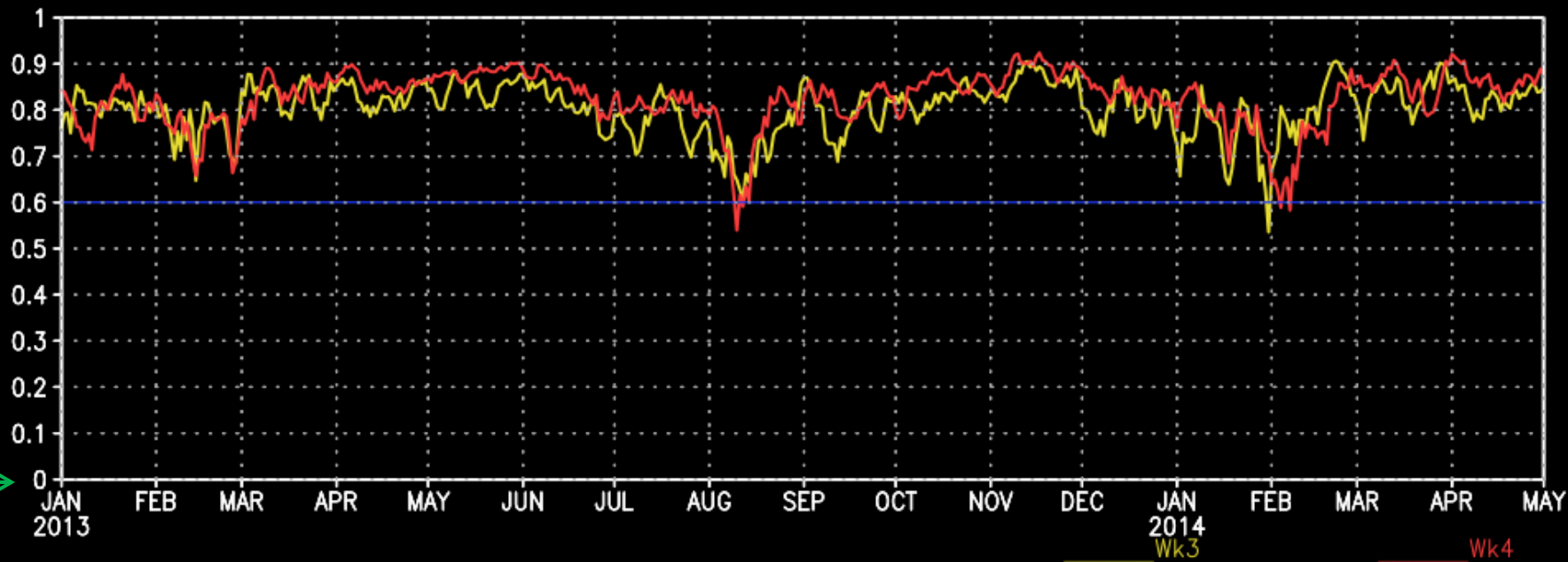
# GLOBE: PRATE ANOM FCST CORR: Weeks 3 & 4



# GLOBE: PRATE ANOM.tr FCST CORR: Weeks 3 & 4



# GLOBE: T2m ANOM FCST CORR: Weeks 3 & 4



# GLOBE: T2m ANOM.tr FCST CORR: Weeks 3 & 4





Near US: PRATE ANOM FCST CORR: Weeks 3 & 4



Near US: PRATE ANOM.tr FCST CORR: Weeks 3 & 4

