Towards closing the gap in NOAA's seamless suite of Forecast products. Prospects of "useful" Predictions for Weeks 3 & 4?

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Climate Prediction Center/NCEP

August 20, 2014

Seminar at VLAB Forum, NWS Head Quarters, Silver Spring, MD.

This talk is going to be pretty straightforward,
based on relatively simple calculations, and
hopefully with some practical implications
towards forecasts for weeks 3-4.

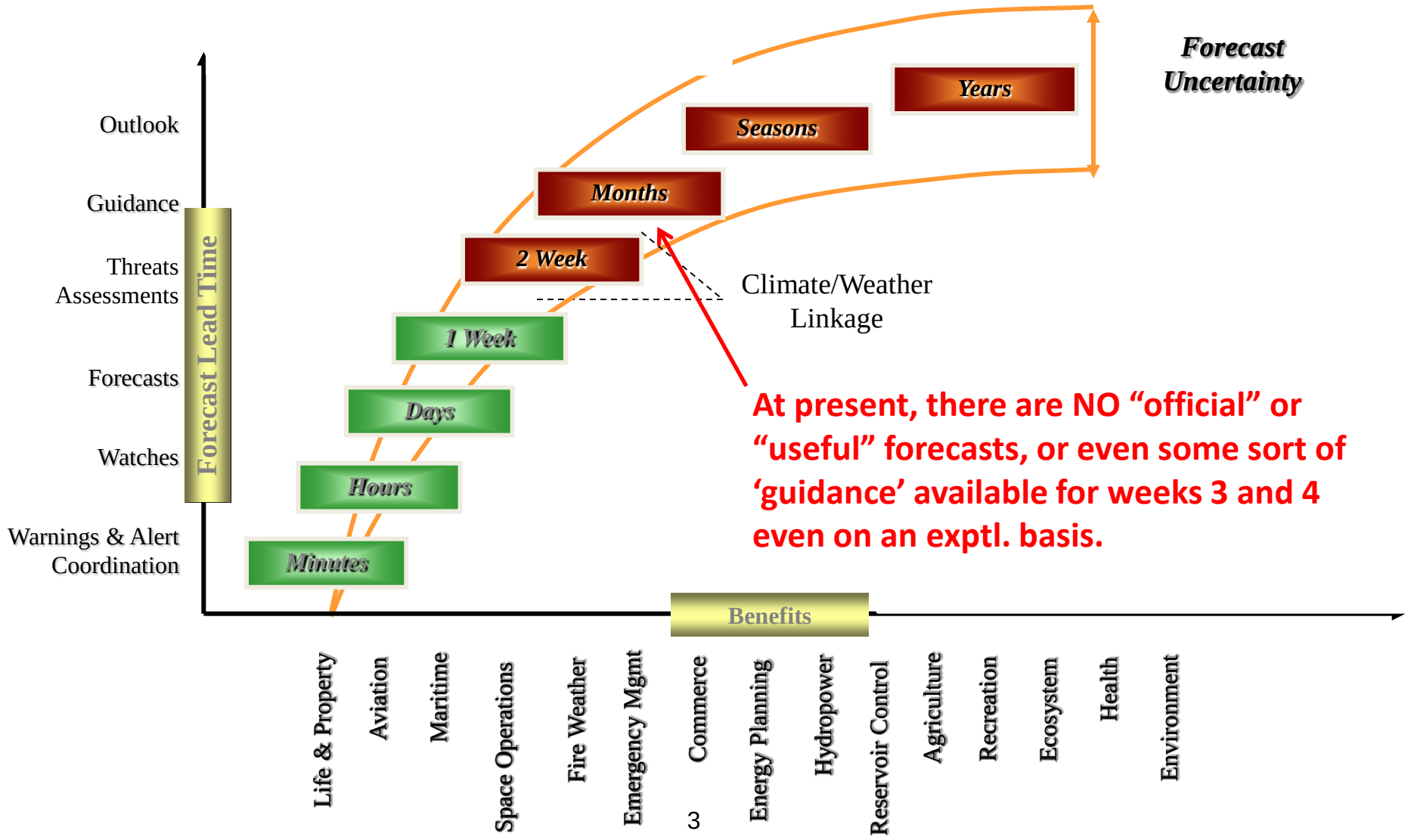
Thinking Outside the Box:
Prospects of "useful" Predictions for Weeks 3 & 4?

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



At present, there are NO "official" or "useful" forecasts, or even some sort of 'guidance' available for weeks 3 and 4 even on an exptl. basis.

NOAA's Weather Prediction Ctr (WPC, *formerly HPC*) issues weather forecasts for each of the next 5 (6-7?) days.

- *Private Forecasters (The Weather Channel/ AccuWeather) even extends this to about 10 days and beyond!!*
- The forecasts are issued for Total fields (deg. F, inch(es) of rain, etc).

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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Local forecast by: "City, St" or ZIP code

Enter location ... Go

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

En Español

Share

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 4:52pm 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:

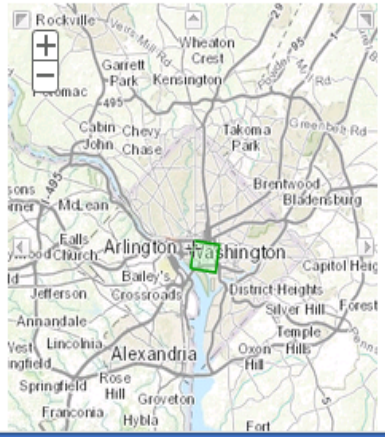
Baltimore, MD/Washington, D.C. Local Forecast Office

TONIGHT	WEDNESDAY	WEDNESDAY NIGHT	THURSDAY	THURSDAY NIGHT	FRIDAY	FRIDAY NIGHT	SATURDAY	SATURDAY NIGHT
		 50%	 30%	 50%	 50%	 50%	 30%	 30%
Mostly Cloudy	Partly Sunny	Chance Thunderstorms	Chance Thunderstorms	Chance Thunderstorms	Chance Showers	Chance Showers	Chance Showers	Chance Showers
Low: 70 °F	High: 84 °F	Low: 70 °F	High: 85 °F	Low: 70 °F	High: 79 °F	Low: 67 °F	High: 78 °F	Low: 65 °F

Detailed 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%.

Topographic ▼ Click Map For Forecast



Washington Weather

Expect dry conditions over the next six hours.

Hourly Forecast

- Yesterday
- Today
- Hourly
- Tomorrow
- Weekend
- 5 Day
- 10 Day
- Monthly
- Video Forecast
- Map

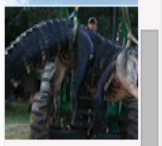
Forecasts

- Fishing
- Home & Garden
- Pollen
- Travel
- Road Conditions
- More

Desktop App

Over 200 Dead

Bad News for Nutella Lovers



RECORD-Breaking Gator Caught!

My 10 Day Forecast

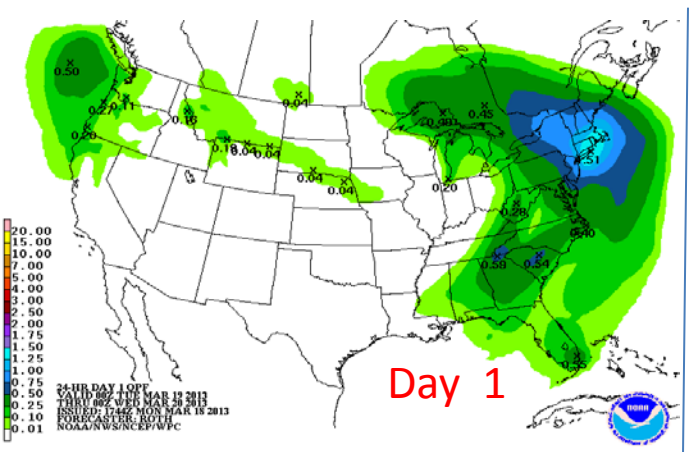
Updated: Aug 19, 2014, 9:18am EDT

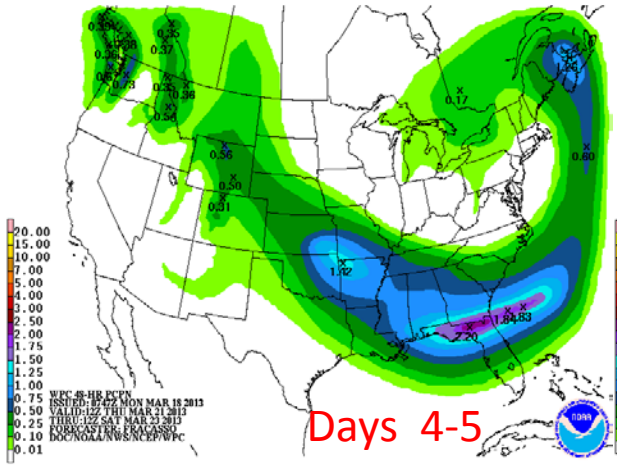
Desktop App

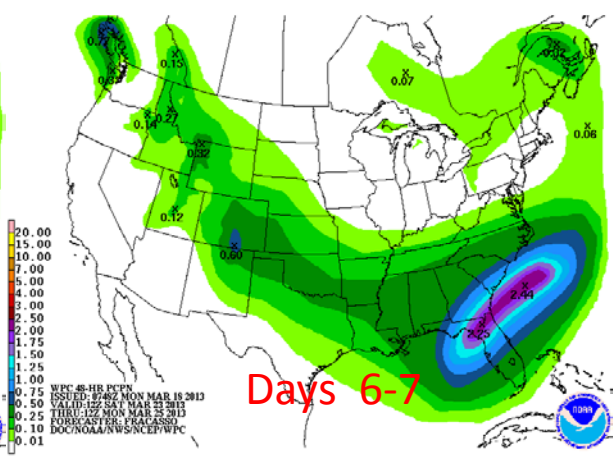
Today Aug 19	86°F	69°F	Partly Cloudy	CHANCE OF RAIN: 20%	WIND: ENE at 9 mph
Wed Aug 20	88°	70°	Mostly Sunny	CHANCE OF RAIN: 20%	WIND: ESE at 8 mph
Thu Aug 21	88°	69°	Scattered T-Storms	CHANCE OF RAIN: 40%	WIND: S at 6 mph
Fri Aug 22	81°	69°	Scattered T-Storms	CHANCE OF RAIN: 50%	WIND: ENE at 8 m
Sat Aug 23	79°	65°	Cloudy	CHANCE OF RAIN: 20%	WIND: ENE at 8 mph
Sun Aug 24	77°	66°	Scattered T-Storms	CHANCE OF RAIN: 50%	WIND: E at 8 mph
Mon Aug 25	82°	68°	Cloudy	CHANCE OF RAIN: 20%	WIND: SE at 7 mph
Tue Aug 26	86°	68°	Partly Cloudy	CHANCE OF RAIN: 20%	WIND: SSW at 7 mph
Wed Aug 27	89°	69°	Mostly Sunny	CHANCE OF RAIN: 20%	WIND: SW at 7 mph

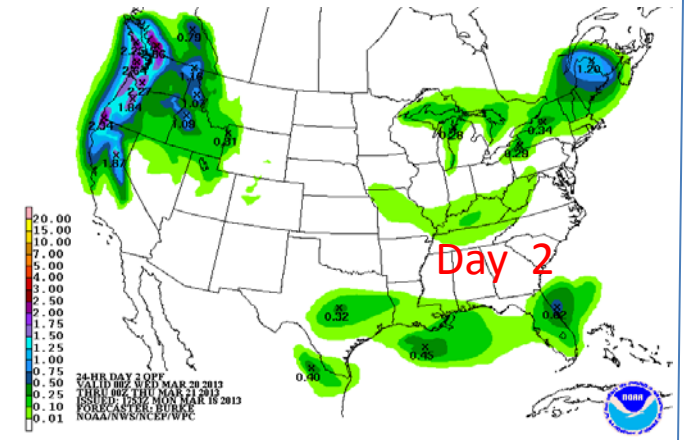
Details

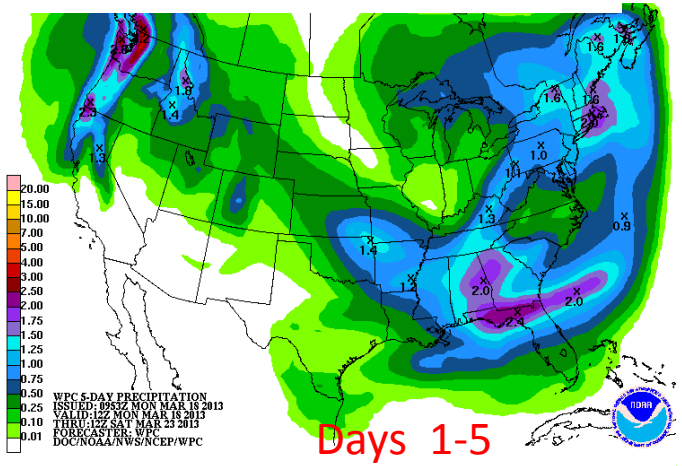
feedback



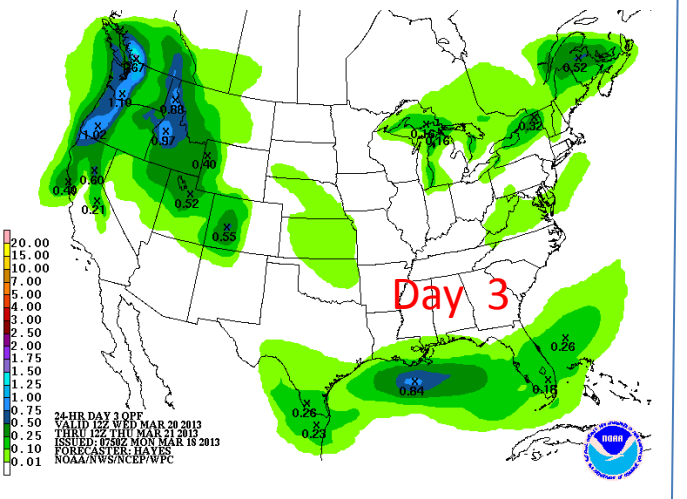


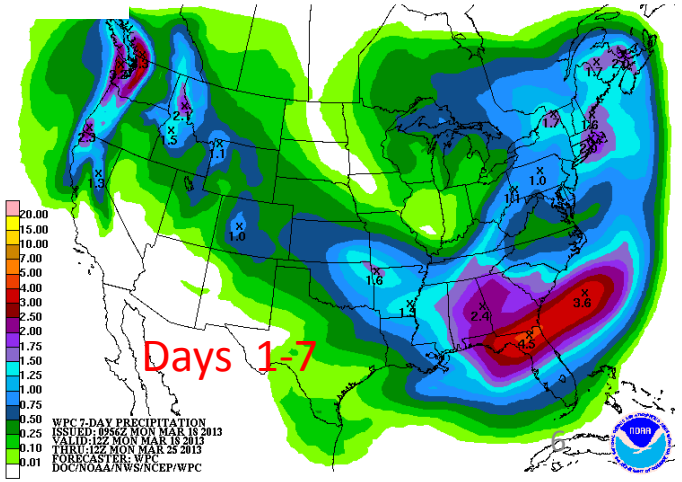






Examples of
NCEP WPC's(formerly HPC)
QPF (Quantitative
Precipitation Forecasts) -
Forecasts issued every day.





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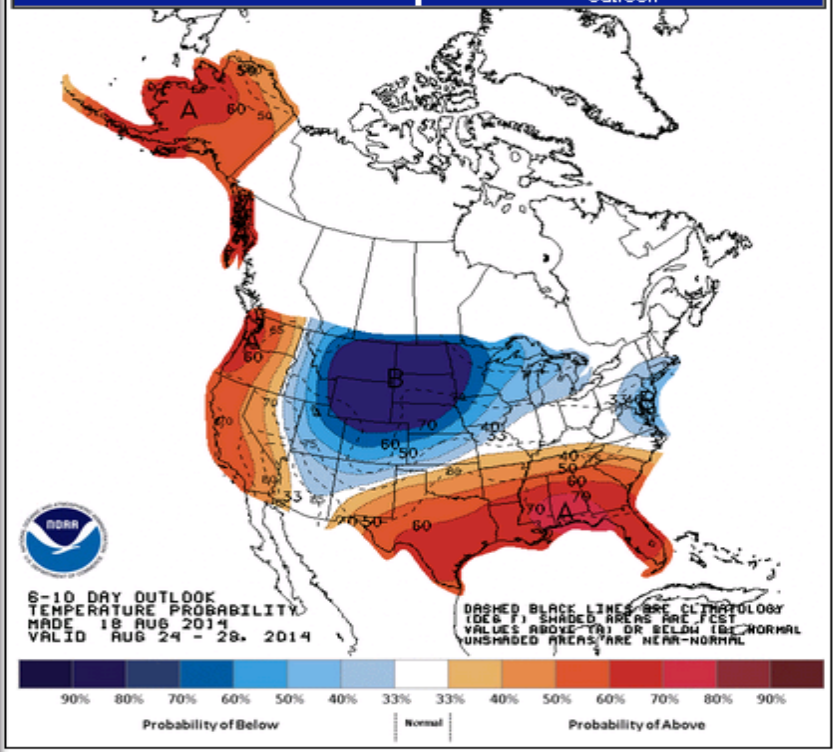
- **WCRP/SPARC Data Assimilation & Reanalysis Intercomparison Workshop**
- **El Niño Watch Issued**
- **NOAA's 39th Climate Diagnostics and Prediction Workshop**
- **New CPC Web Page Design**

Click on 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



Related Products

6-10 Day Outlook, 8-14 Day Outlook, 30 Day Outlook, 90 Day Outlook, U.S. Hazards Outlook,

Climate Prediction Center (CPC) issues Temp & Precip forecasts over the US for **time averages of**:

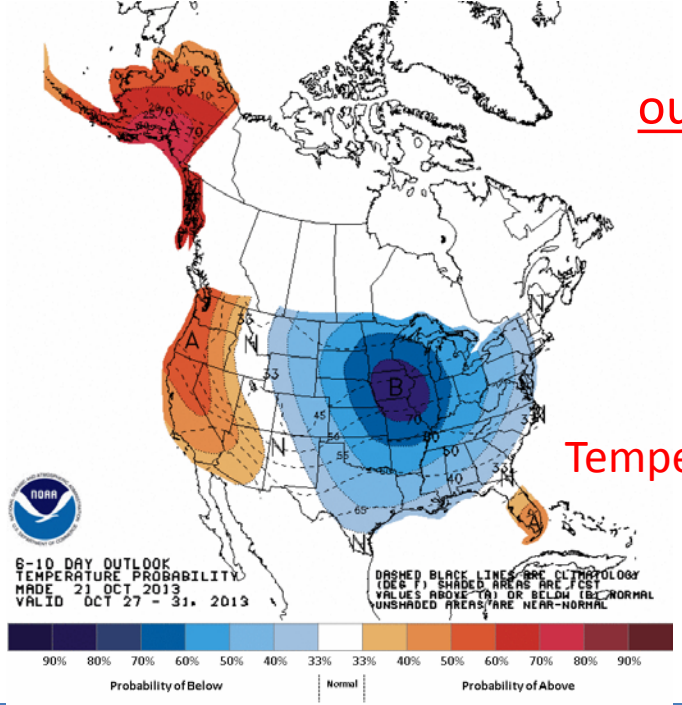
- next 6-10 days (referred to as Week 1P in this talk)
- next 8-14 days (week 2)
- **next month, next few seasons, etc.**

- But the forecasts are issued as probabilities for above/ near/below conditions from some climatology.

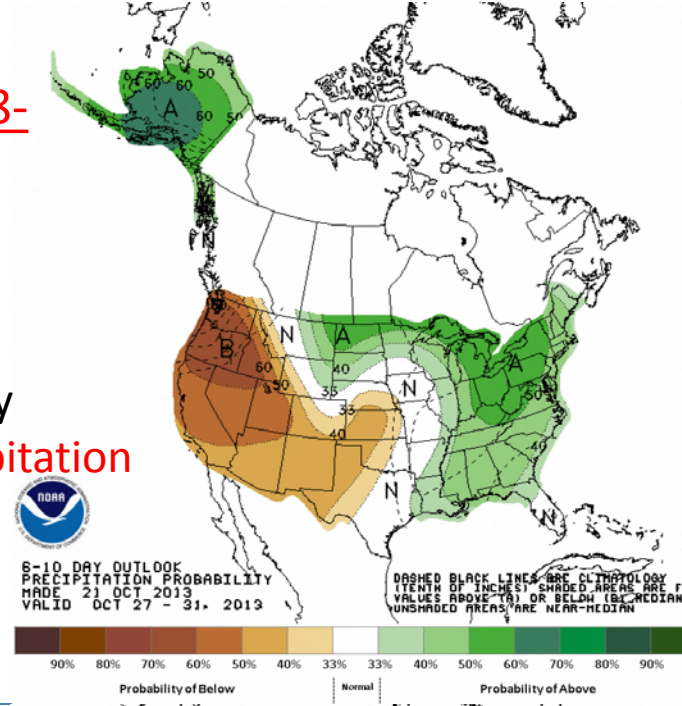
Typical Examples of CPC outlooks for 6-10 days and 8-14 days as anomalies (departures) from some climatology (1981-2010)

6-10 day Outlook Probability

Temperature

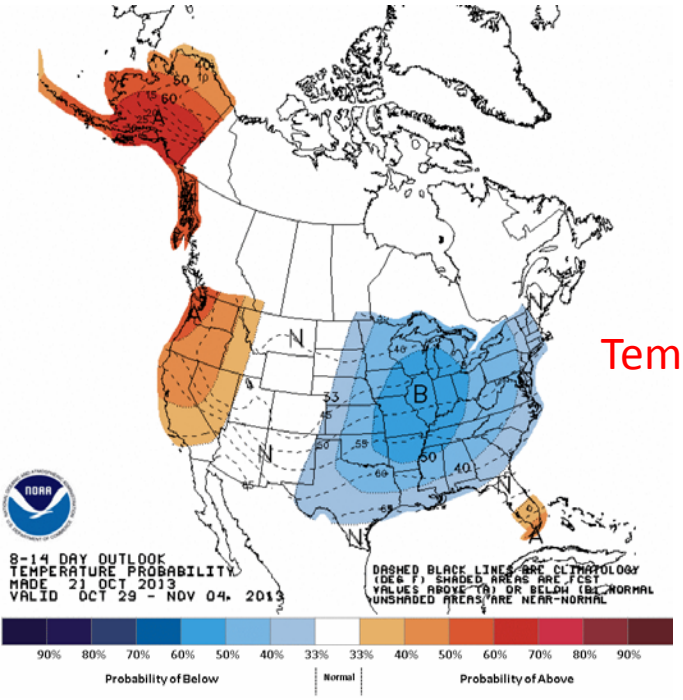


Precipitation

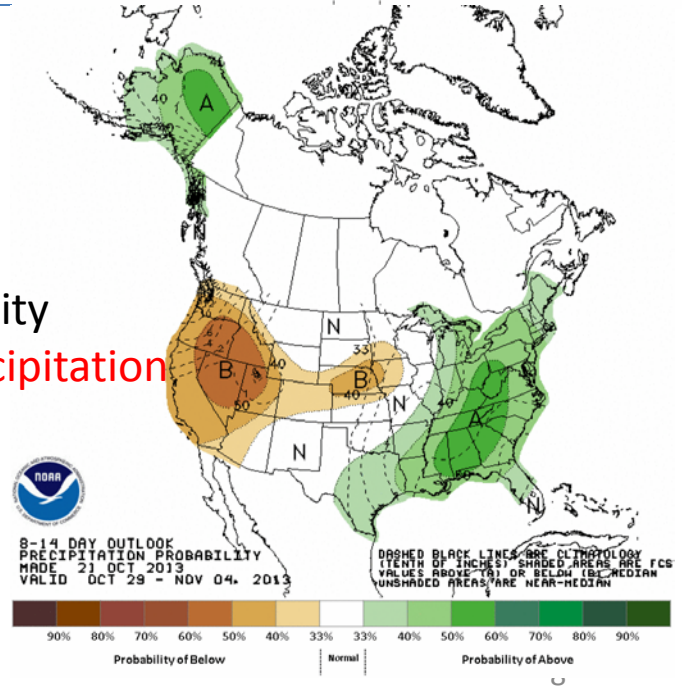


8-14 day Outlook Probability

Temperature



Precipitation

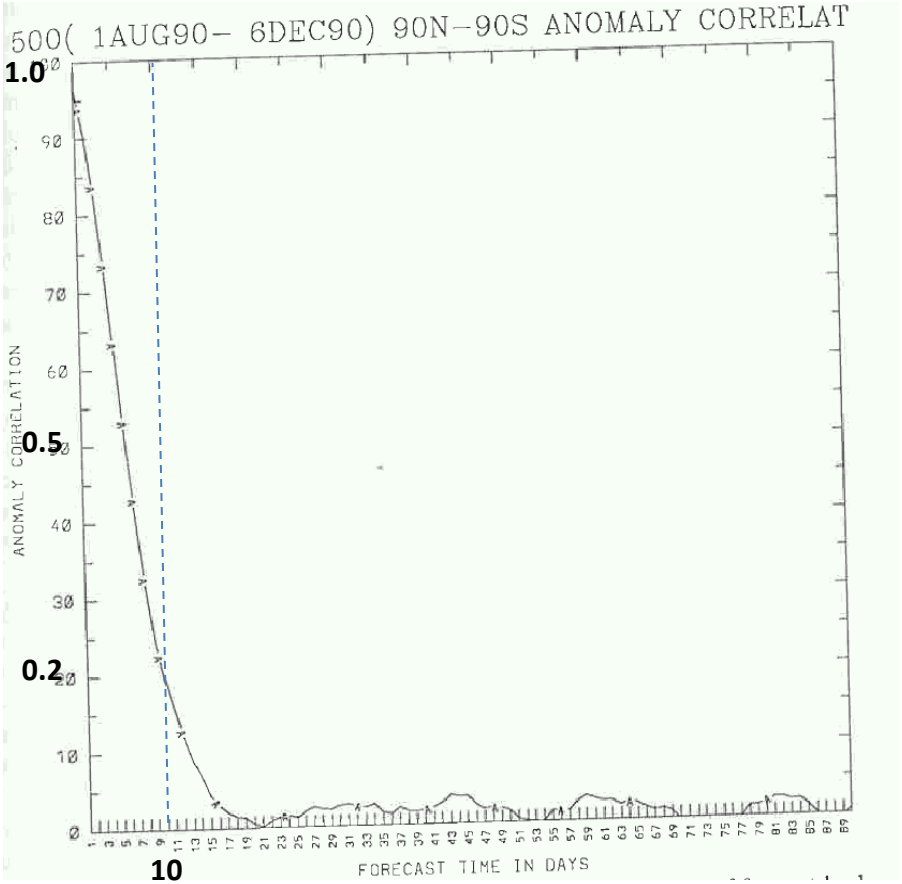


NWS started forecast of : 5-day means - circa 1940s, 6-10 (60's/70's ?) & 8-14 days (~ 2000?)
Monthly means – 1970's, Seasonal means – 1990's.

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.

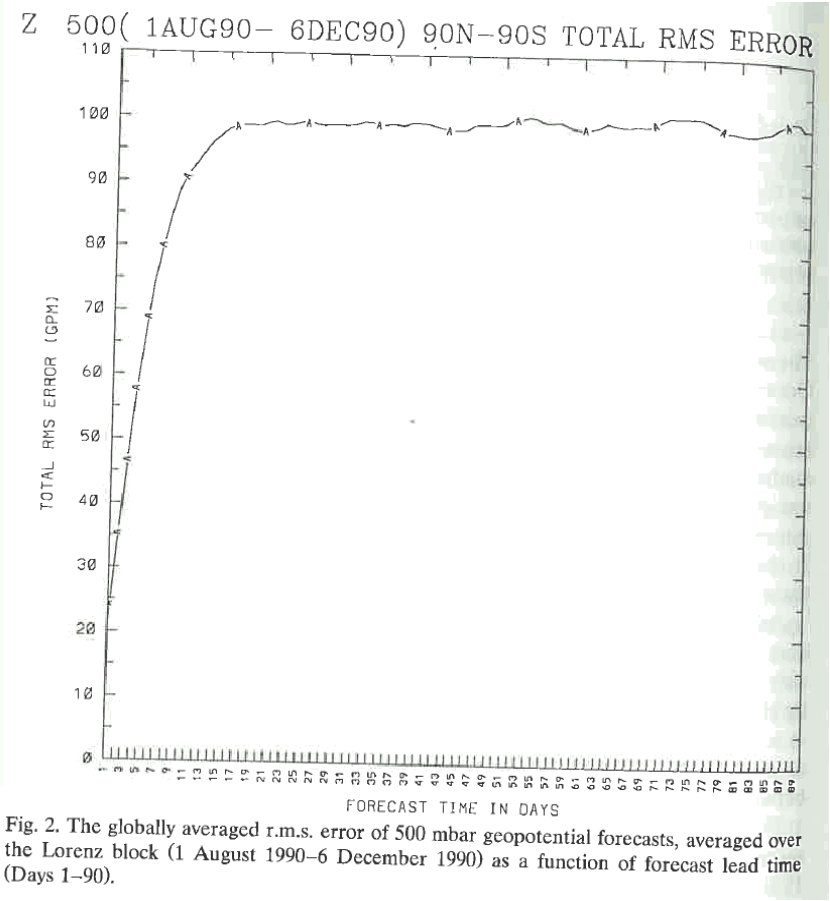


Fig. 2. The globally averaged r.m.s. error of 500 mbar geopotential forecasts, averaged over the Lorenz block (1 August 1990–6 December 1990) as a function of forecast lead time (Days 1–90).

2008

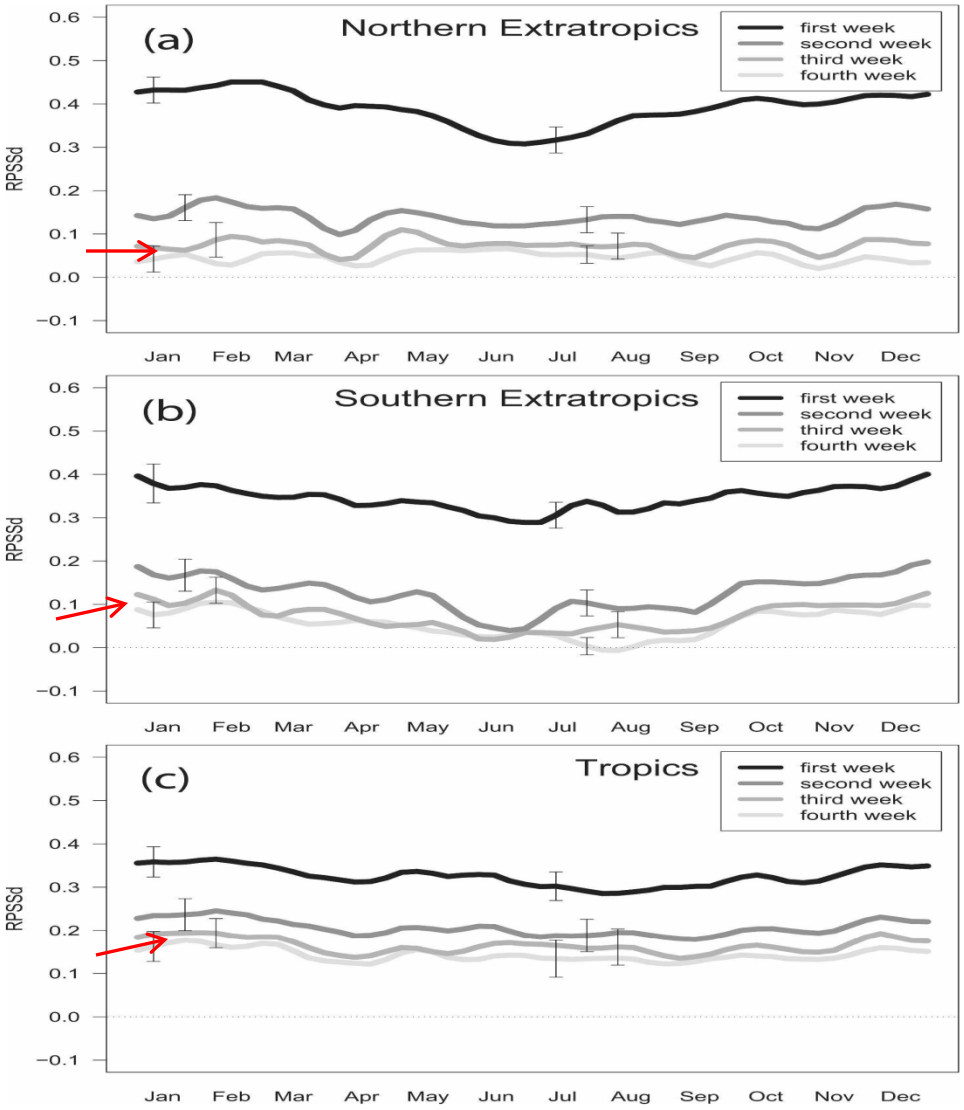


FIG. 5. Annual cylce of average skill in (a) the northern extratropics (30°–85°N), (b) the southern extratropics (30°–85°S), and (c) the tropics (30°S–30°N). A five-point symmetric moving-average filter has been applied as described in the text. Both land and sea points are considered. A few typical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

Probabilistic Verification of Monthly Temperature Forecasts

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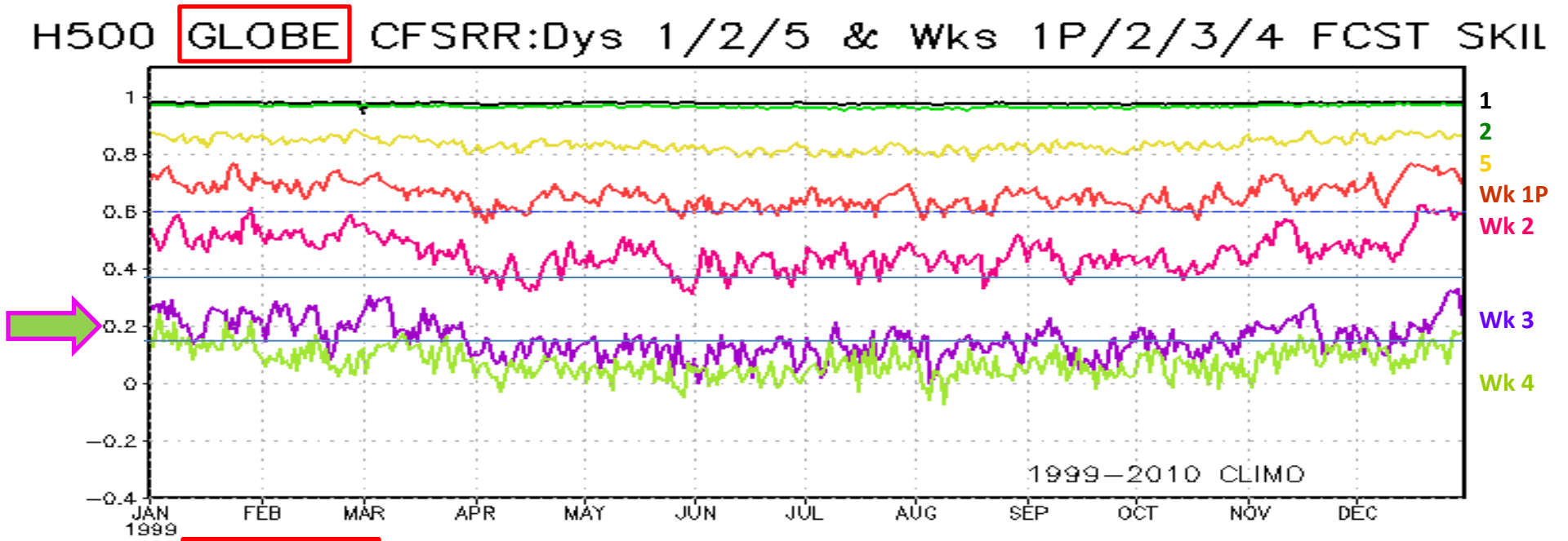
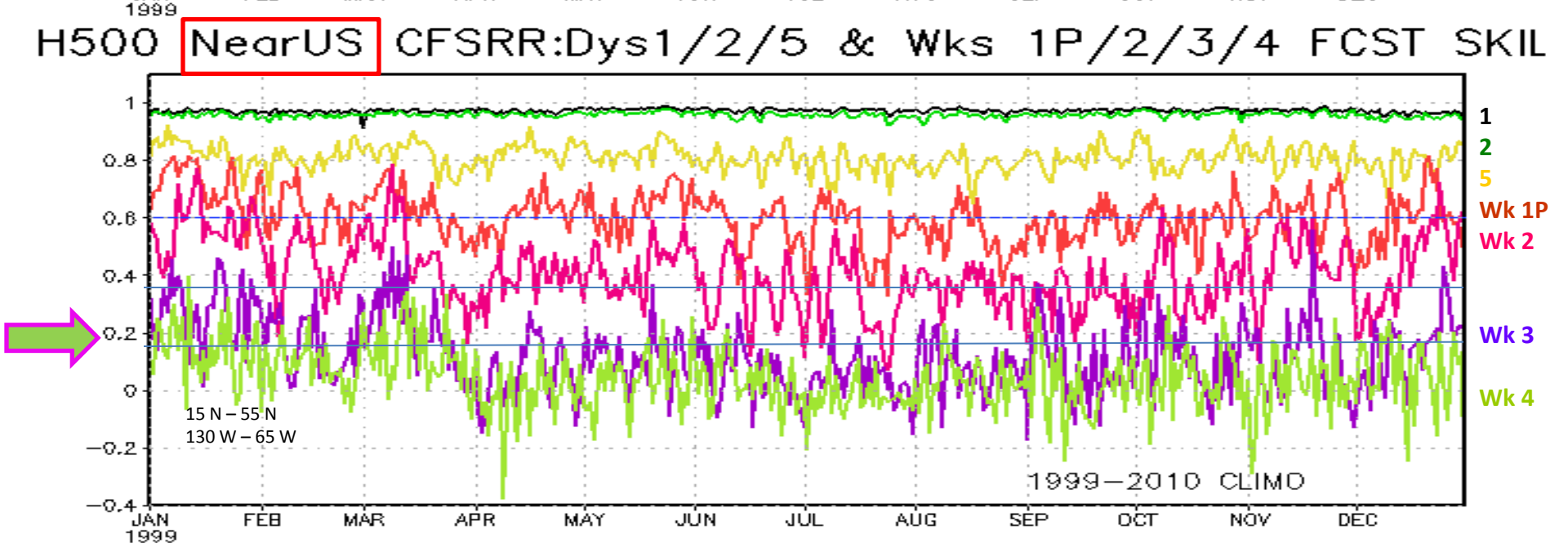
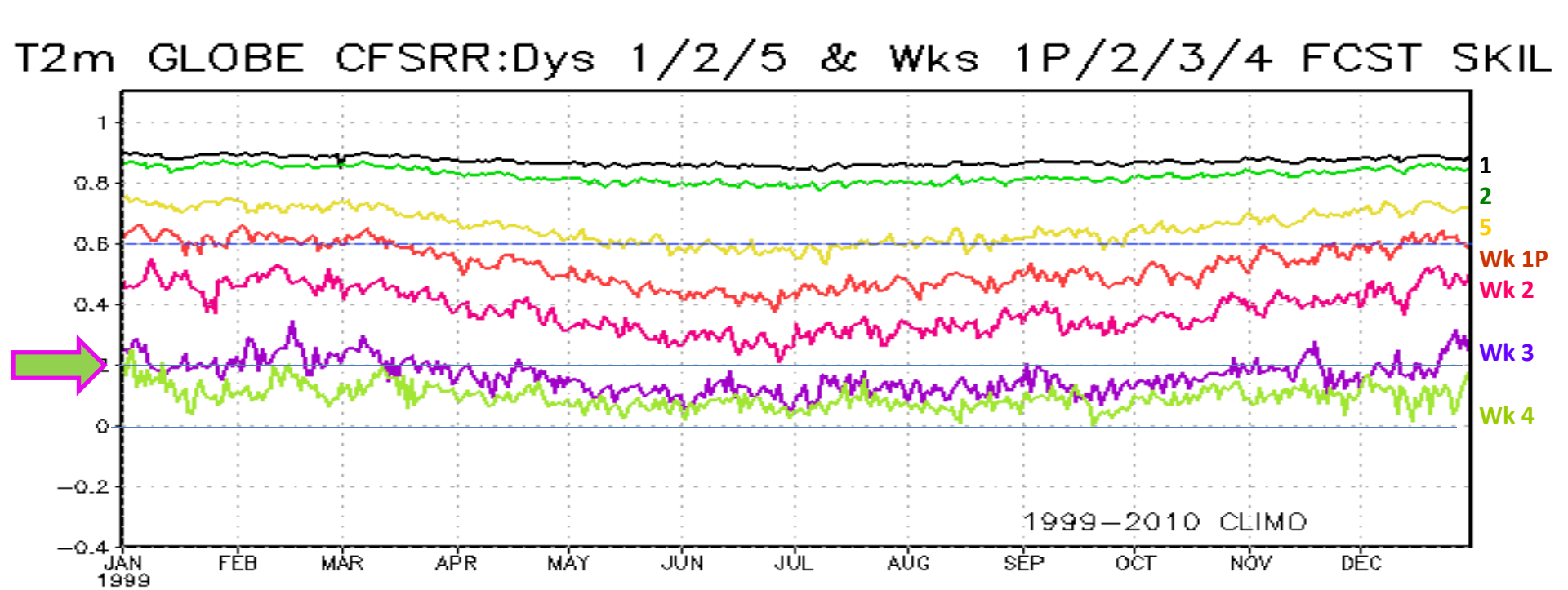
(Manuscript received 6 February 2008, in final form 16 April 2008)

2013: Based on CFS V2's 45 day forecast runs. (1999-2010), 4 ensemble member fcsts/day.






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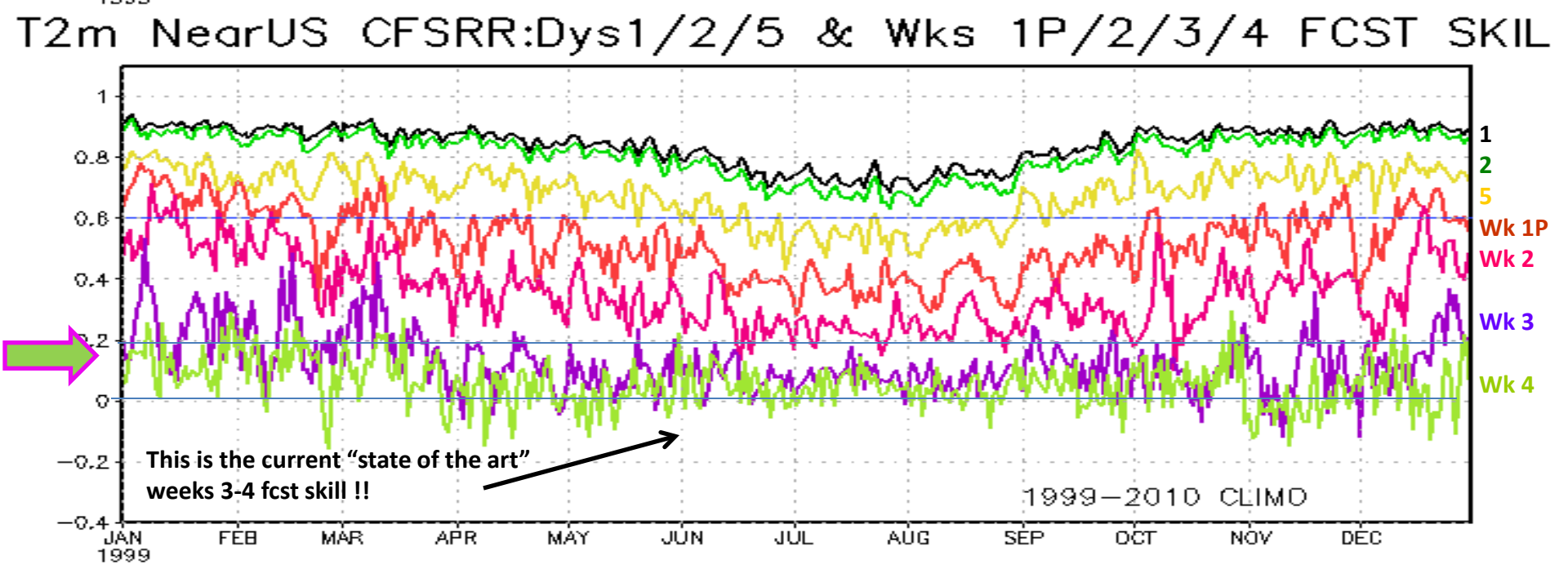
Wk 4


T2m NearUS CFSRR:Dys1/2/5 & Wks 1P/2/3/4 FCST SKIL
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1999−2010 CLIMO
1
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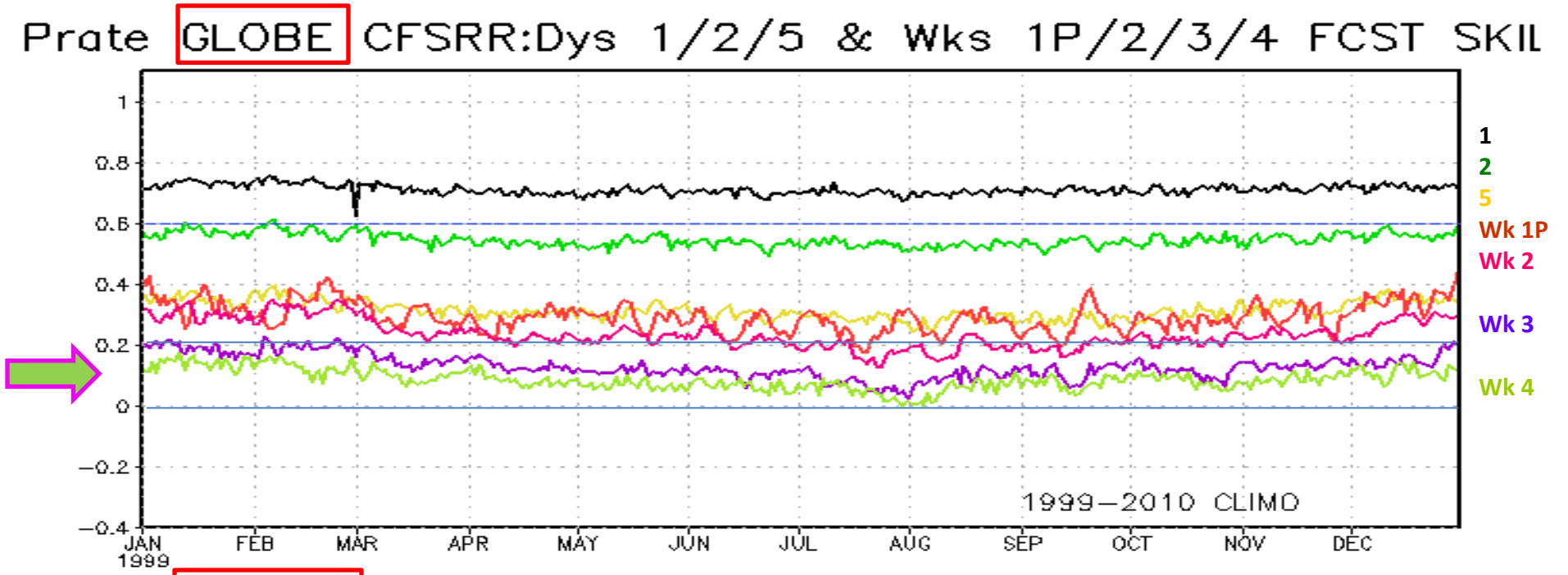
Wk 1P
Wk 2
Wk 3
Wk 4
This is the current “state of the art”
weeks 3-4 fcst skill !!


Prate GLOBE CFSRR:Dys 1/2/5 & Wks 1P/2/3/4 FCST SKIL
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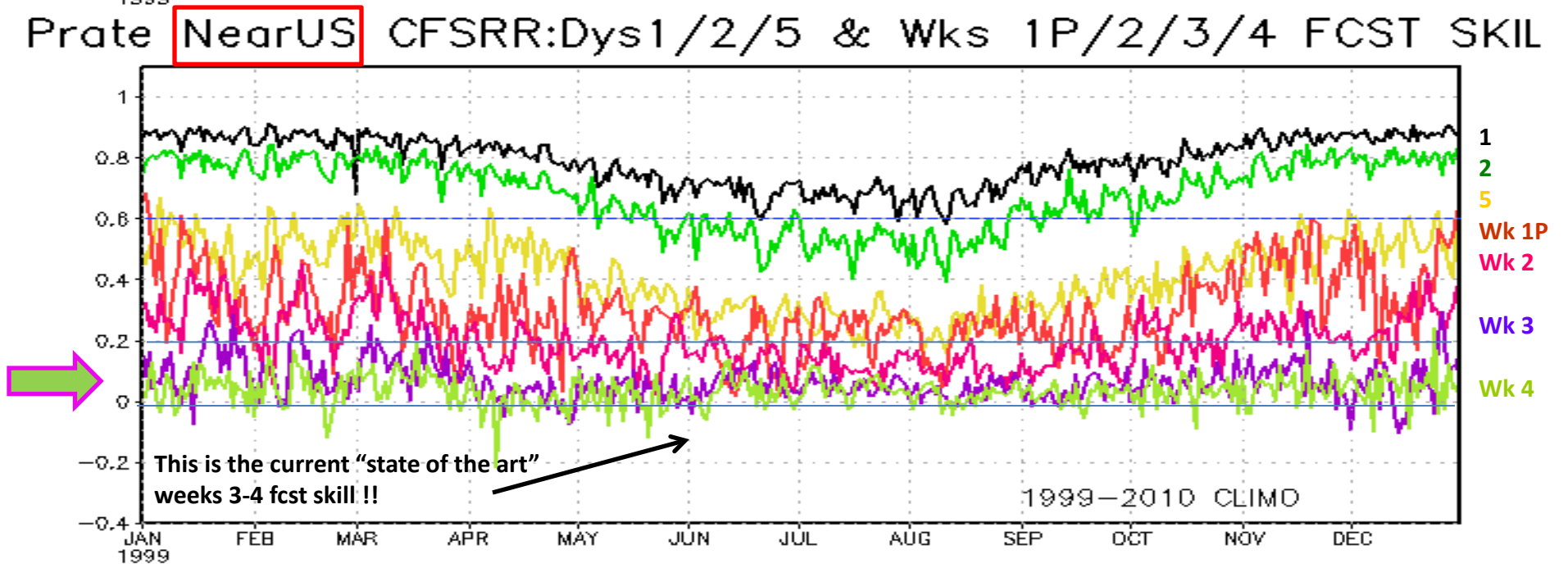
Prate NearUS CFSRR:Dys1/2/5 & Wks 1P/2/3/4 FCST SKIL
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−0.4
JAN 1999
FEB
MAR
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MAY
JUN
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AUG
SEP
OCT
NOV
DEC
1999−2010 CLIMO
1
2
5
Wk 1P
Wk 2
Wk 3
Wk 4
This is the current "state of the art"
weeks 3-4 fcst skill !!

But, for the last twenty to thirty years, in spite of the vast improvements in our understanding data assimilation techniques, and modeling and so on, the predicted skill of anomalies in weeks 3-4 range have remained stubbornly low ~ 0.2.

So, if you keep asking the same question, and if you keep getting the same answer you don't like for a long time, then it is time to start asking the question in a different way, or to ask a different question.

- *"We know that at shorter lead times (say for less than 7-10(?) days), the future state of the atmosphere is sensitive mainly to the initial condition of the FAST atmosphere,– depends on the time/flow patterns etc?)*

- *While at longer lead times (monthly (?) seasonal time scales & beyond), it is sensitive to the initial condition of the SLOW ocean (and possibly the intermediate land surface) component(s) only."*

- This 'time scale' (3-4 weeks) in-between the 'deterministic weather' and the 'probabilistic climate' , It is neither weather nor climate!

- What metrics are useful to verify the forecasts/guidance in this time period: weeks 3-4 !
  Such as the ones used for weather, or the ones for climate?

- 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 ….

- They 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."

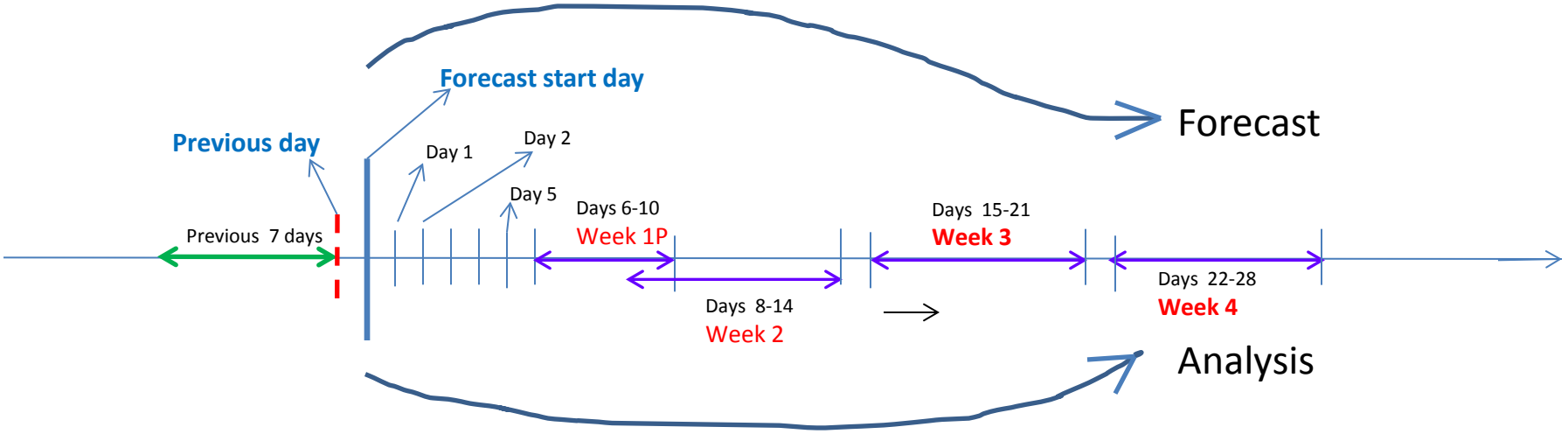
- William Lawrence Bragg (youngest ever ? Nobel Laureate in physics)

In the following, we show Climatological annual cycle of 1999-2010 mean Forecasts of:

Wk 1P(days 6-10), Wk 2, (shown for comparison only)
Wk 3, & Wk 4 Fcst. skill (correlation)

for 2 regions: GLOBE & large US region.

First we show for ~~H500,~~ T2m & Precip



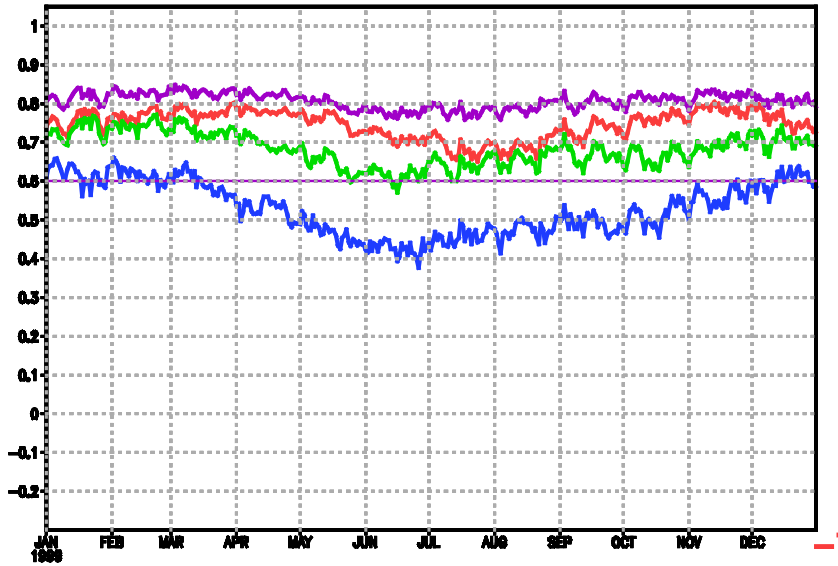
In this study for the 3, 4 week forecasts, instead of computing the traditional anomaly correlation coefficient (where 'predictand' and 'predictor' anomalies are computed as departures from some climatology),
I propose and compute the correlation between the tendencies in the forecast (predictand) and the verifying analysis. The impact of tendency in climatology will be accounted for.

- Traditional method: The traditional anomaly correlation – where anomaly (be it for 1/2/5 day or for weeks 1p/2/3/4) is computed as departure from **'Traditional'** long term mean (here 1999-2010) climo.

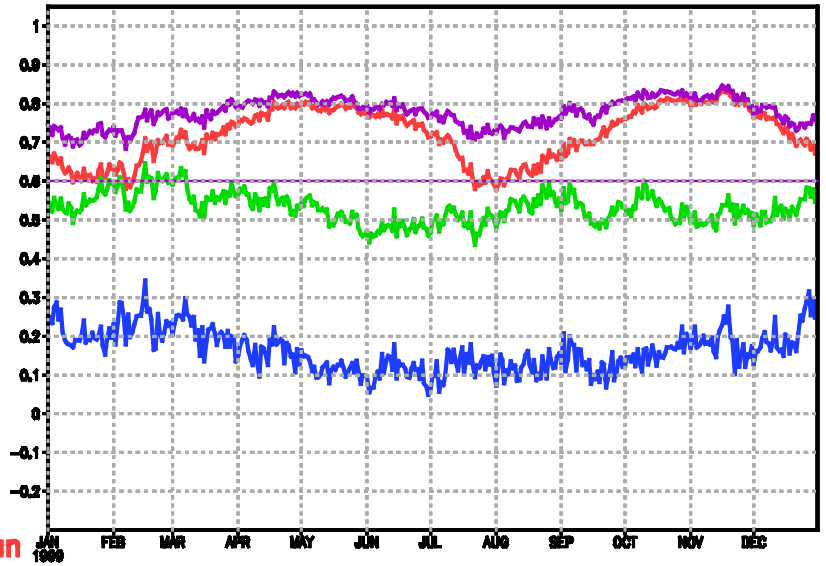
- **-7dy Mean:** Anomaly correlation between the forecast and verifying analyses where anomalies are computed as departures from the previous '7 day means' immediately preceding the forecast day.
- **-7dy Mean – Clim.Tendency:** Same as above, except that the climatological tendency part (for eg. From prev. week to wk3/wk4) is also subtracted before computing correlation.

- **-1 day (previous day) Mean:** Anomaly correlation between the forecast and verifying analyses where anomalies are computed as departures from the 'previous day' means immediately preceding the forecast day.

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



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



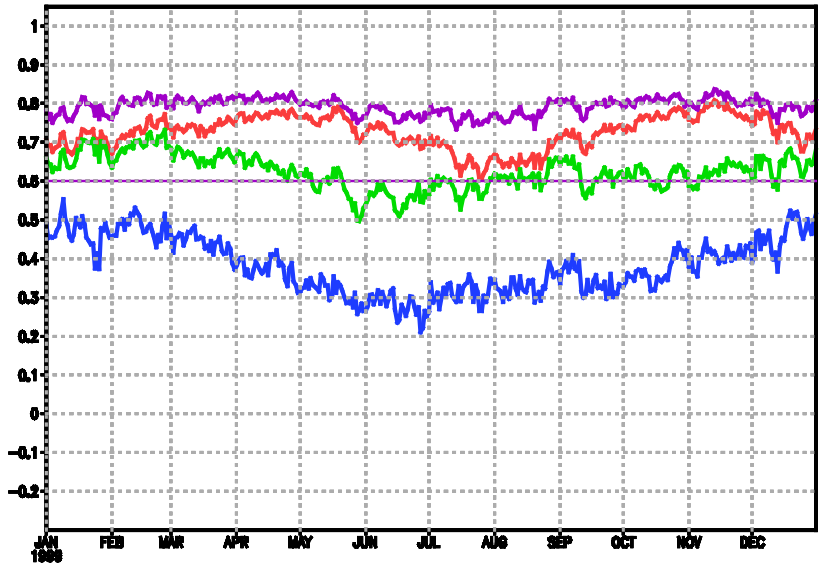
T 2m.

Globe

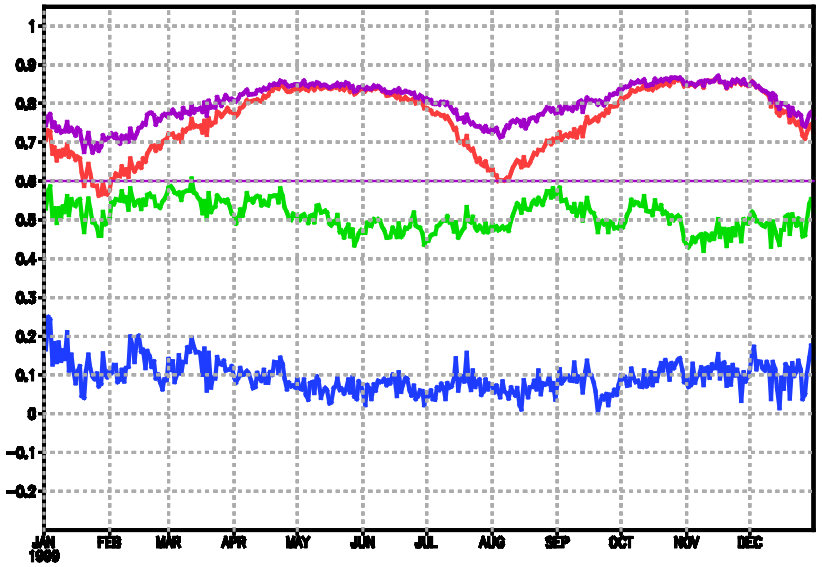
Wk 1P
Wk 2
Wk 3
Wk 4

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

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



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



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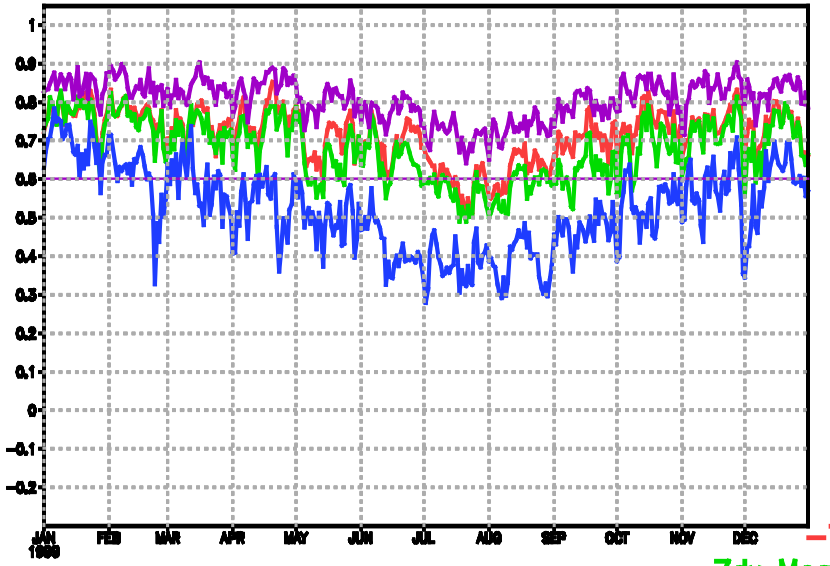
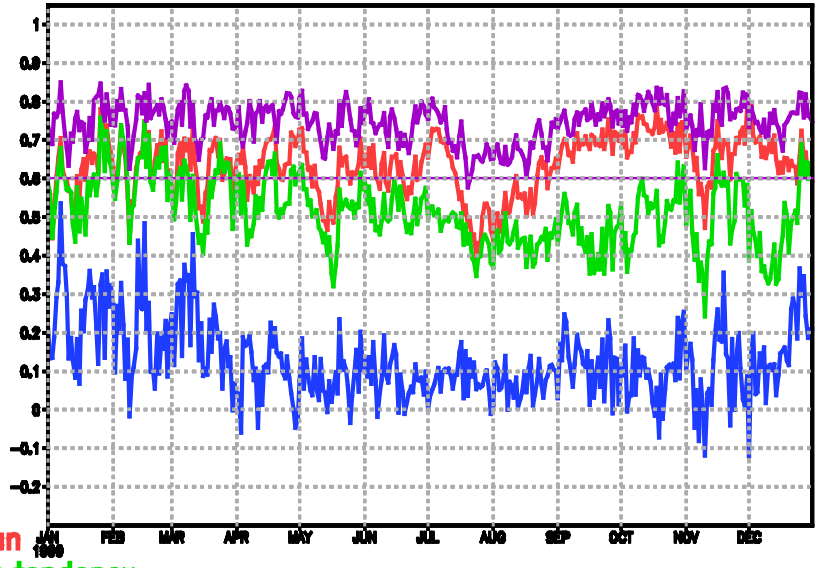
T 2m.

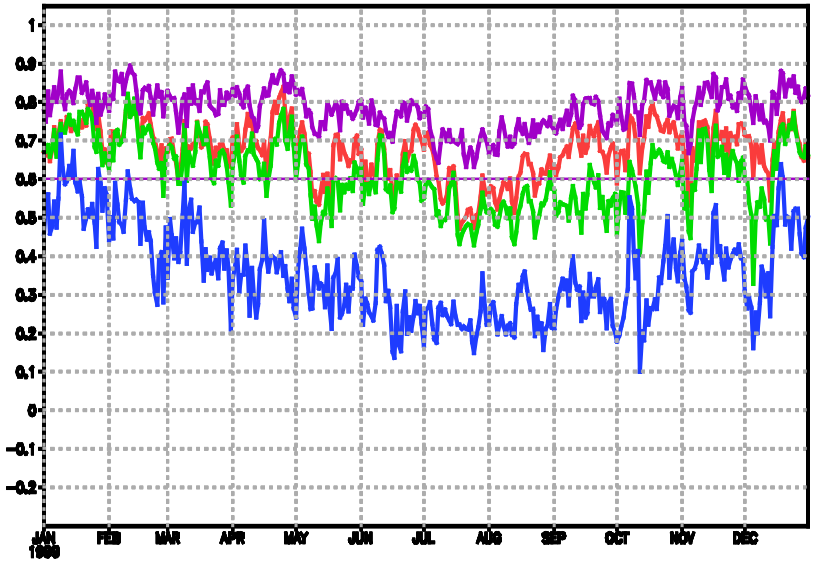
Near US

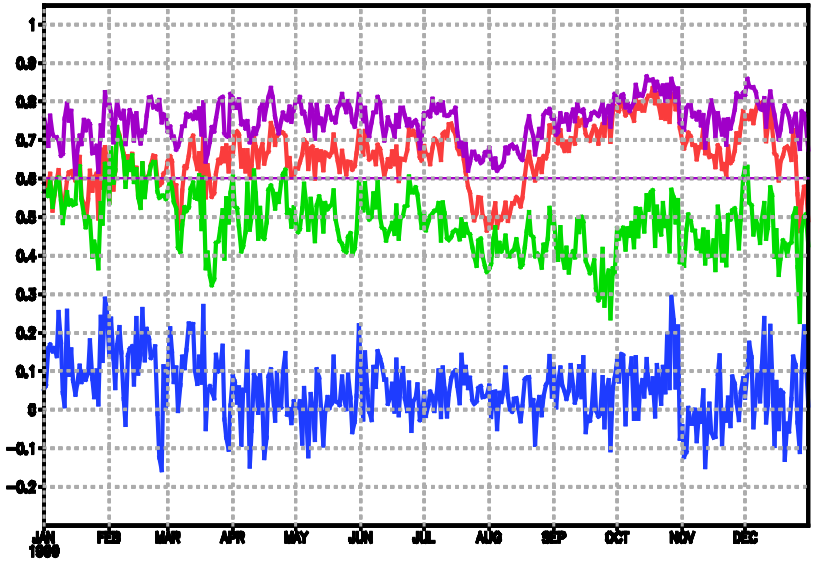
Wk 1P
Wk 2
Wk 3
Wk 4





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





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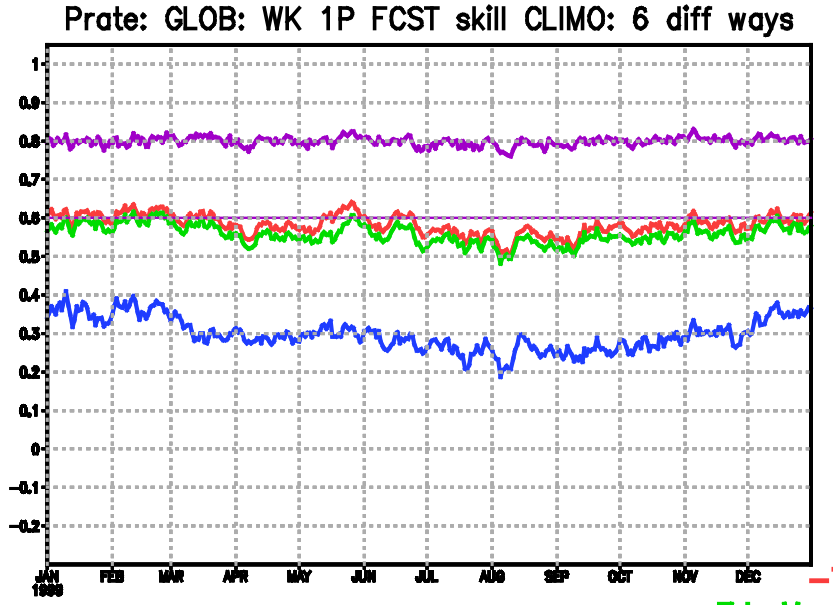
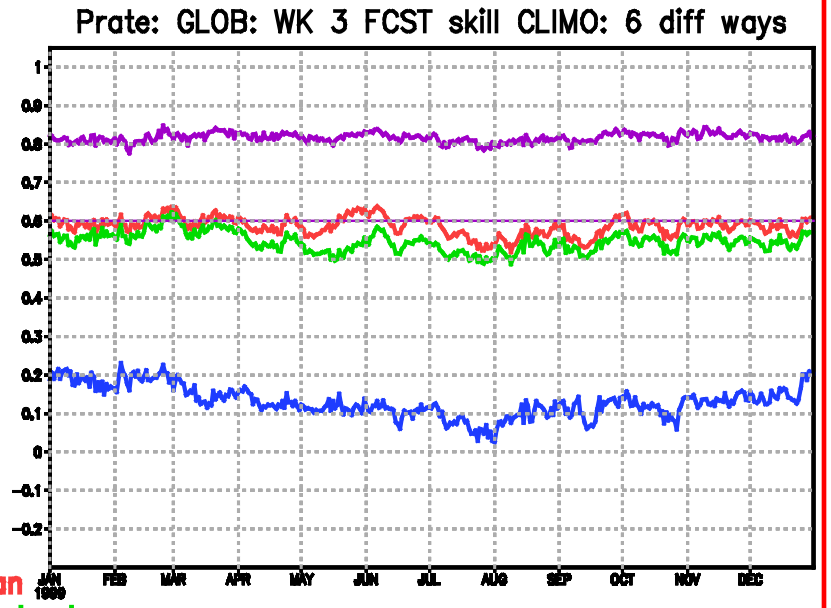
Prate

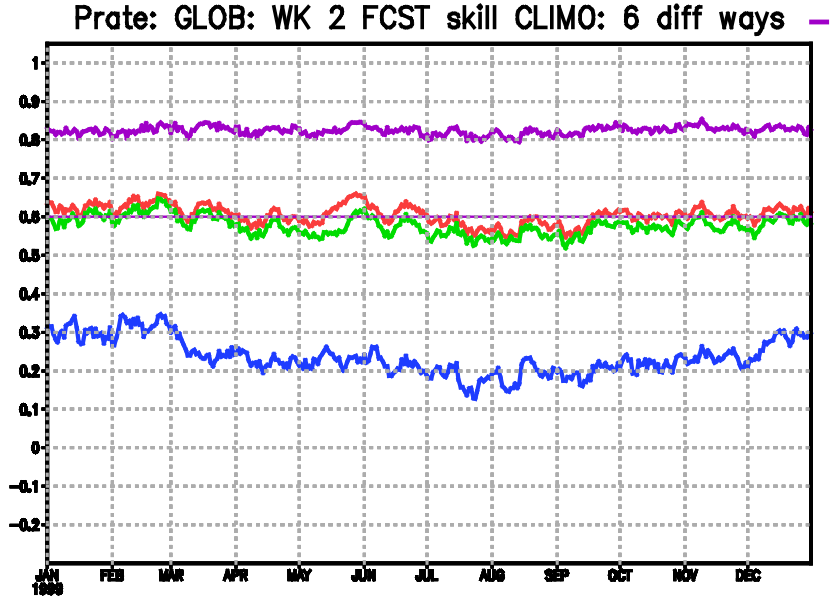
Globe

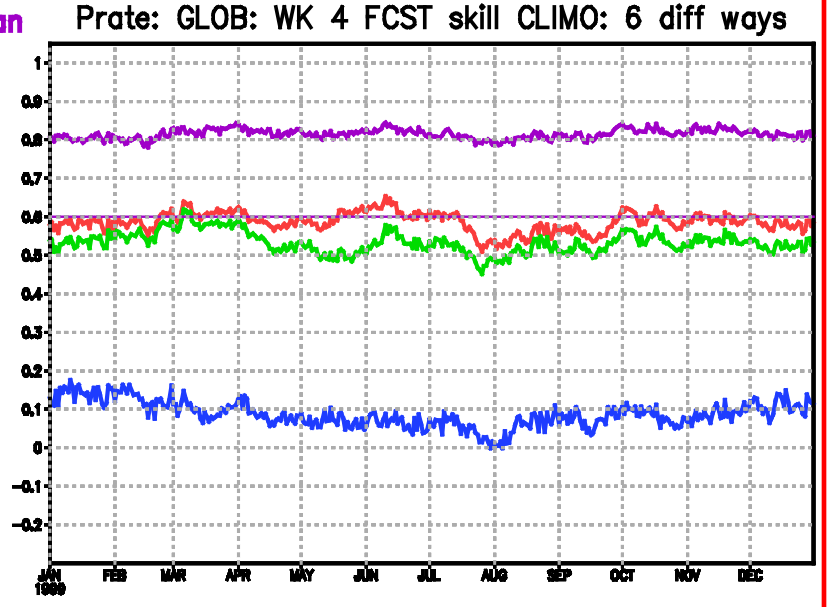
Wk 1P
Wk 2
Wk 3
Wk 4





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





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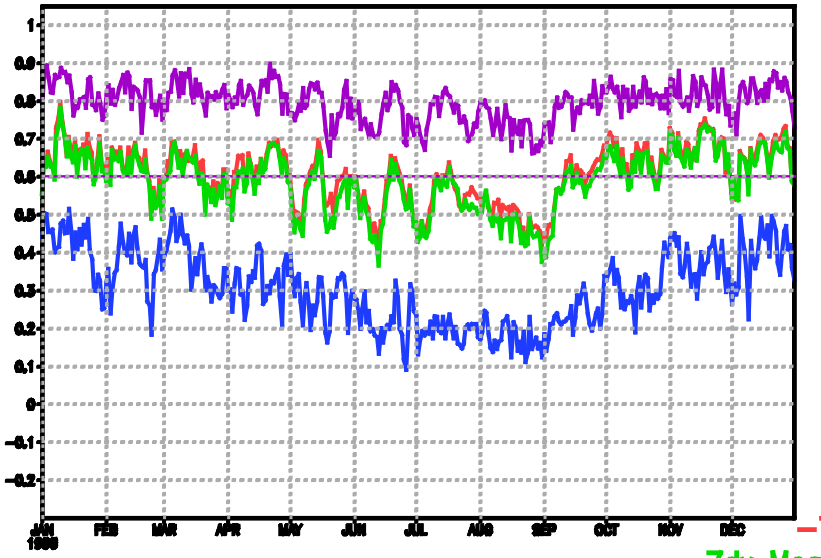
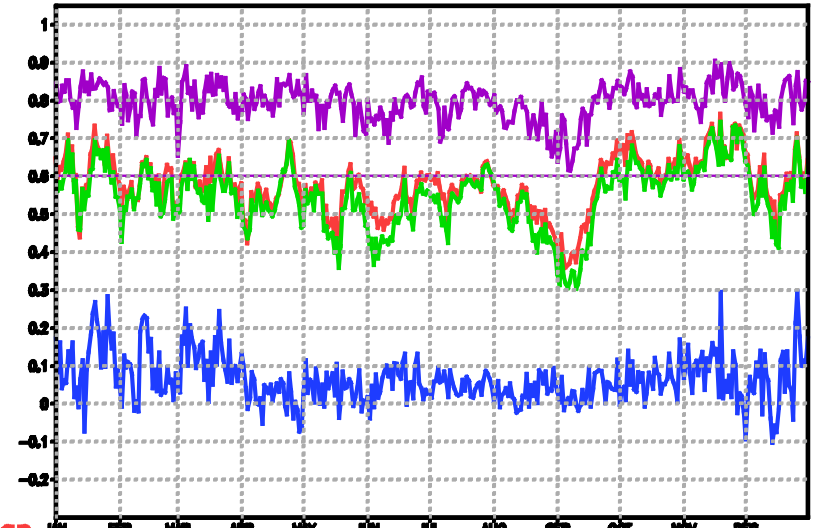
Prate: Near US: WK 1P FCST skill CLIMO: 6 diff ways



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



Prate

Near US

—7dy Mean

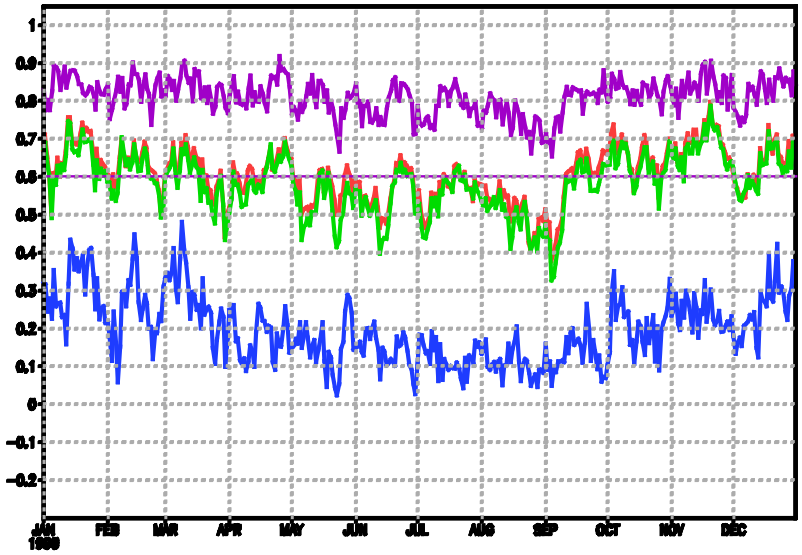
—7dy Mean —Clim.tendency

—Trad.Climo

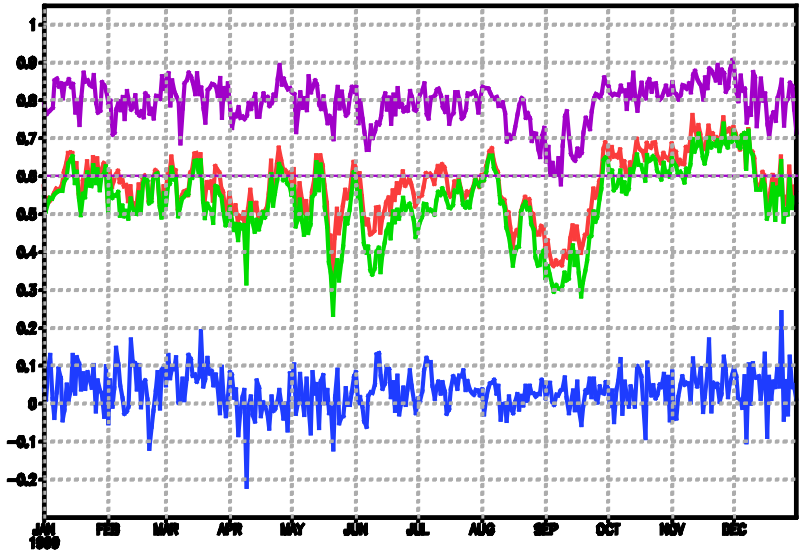
—1dy Mean

Wk 1P
Wk 2
Wk 3
Wk 4

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



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



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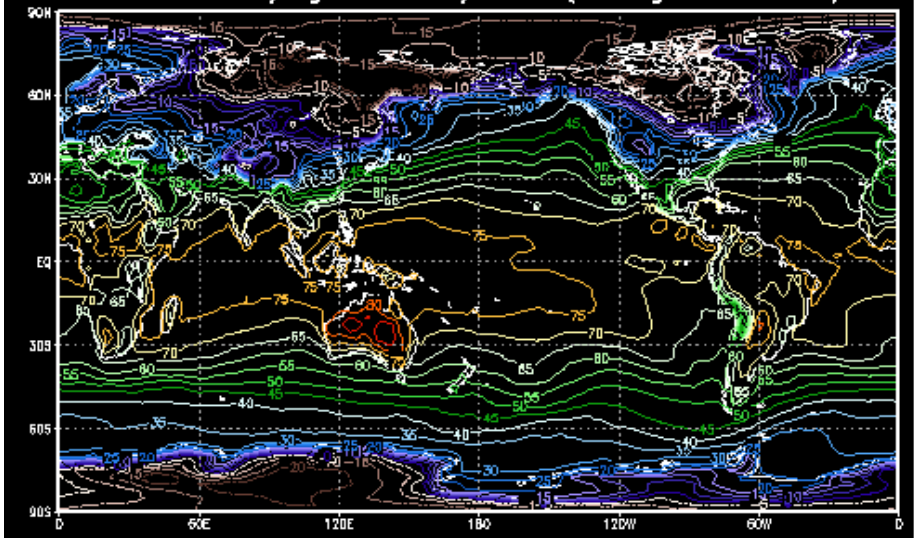
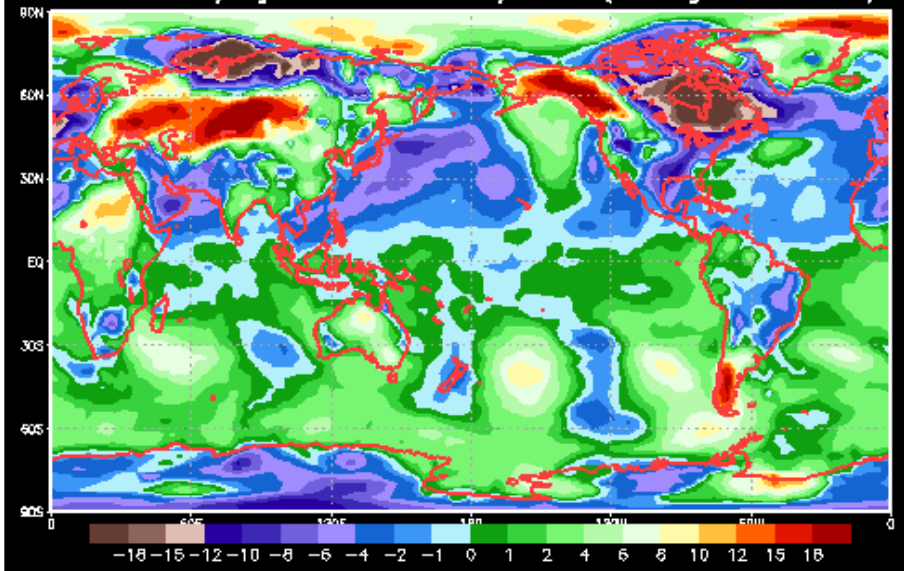
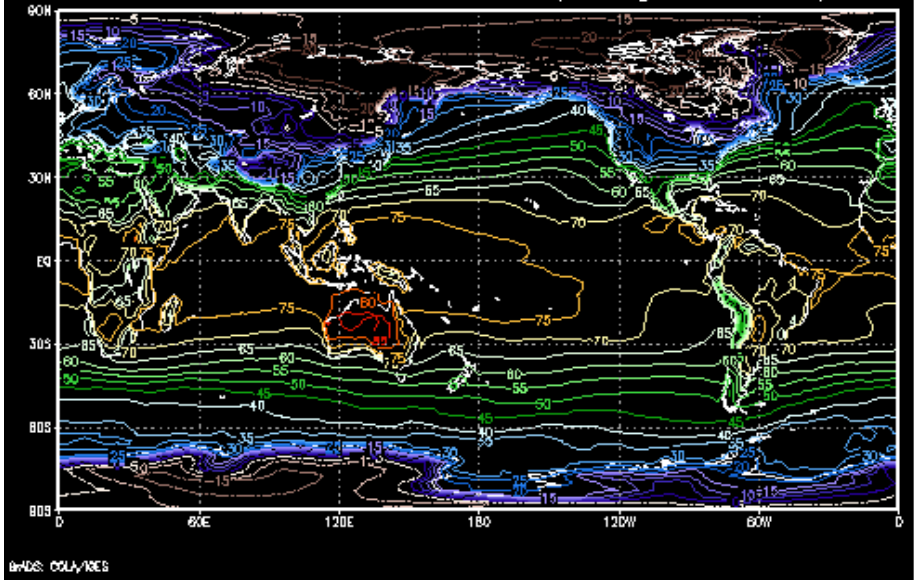
CFSR: Verifying T2m 7day mean(ending 21Jan2013)



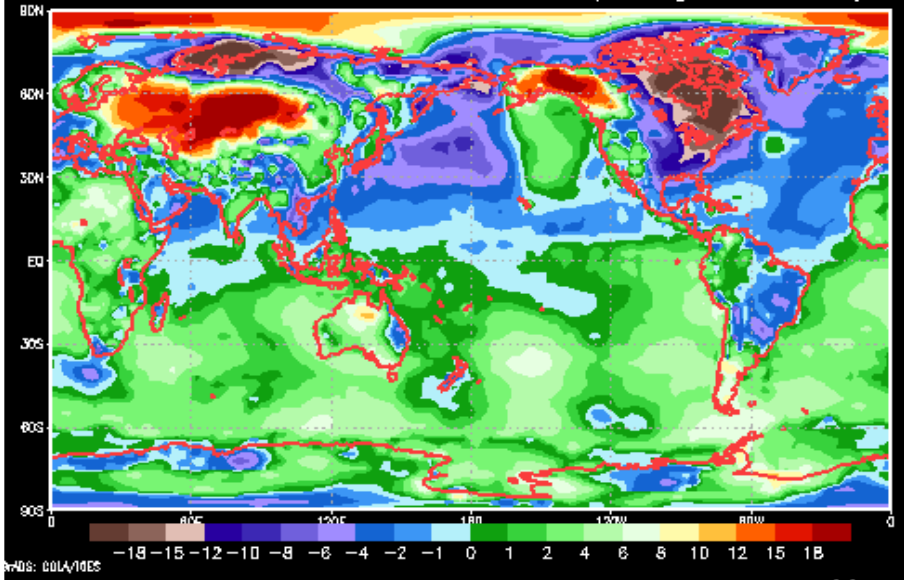
CFSR: Verifying ANOM T2m 7day mean(ending 21Jan2013)

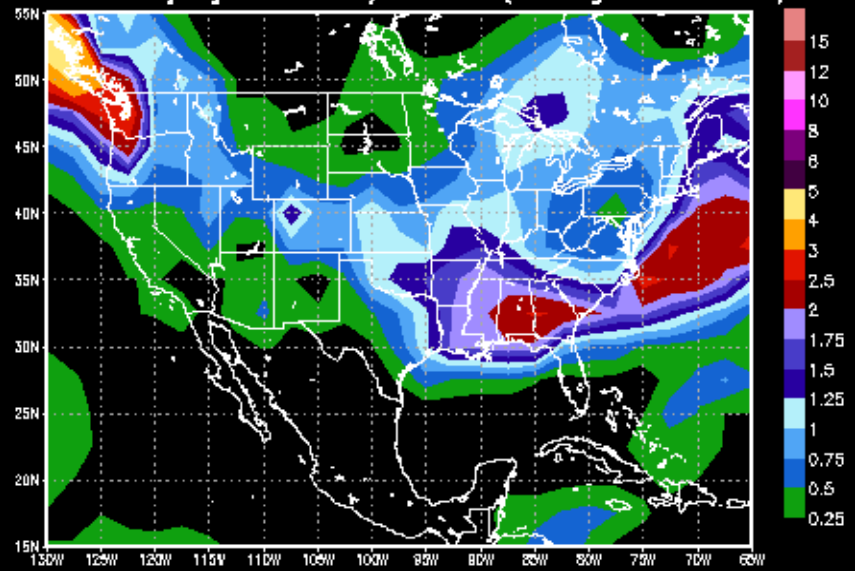


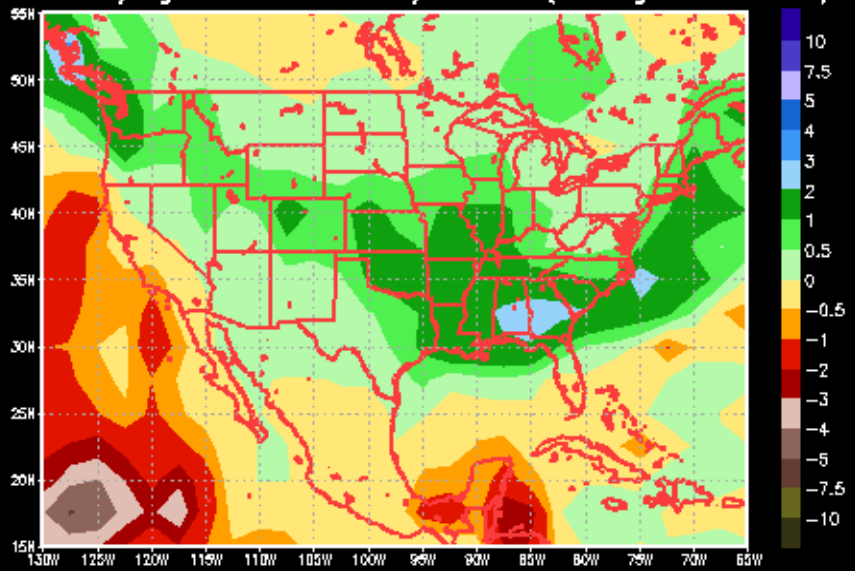
CFSRR: FCST T2m for WEEK 4(ending 21Jan2013)

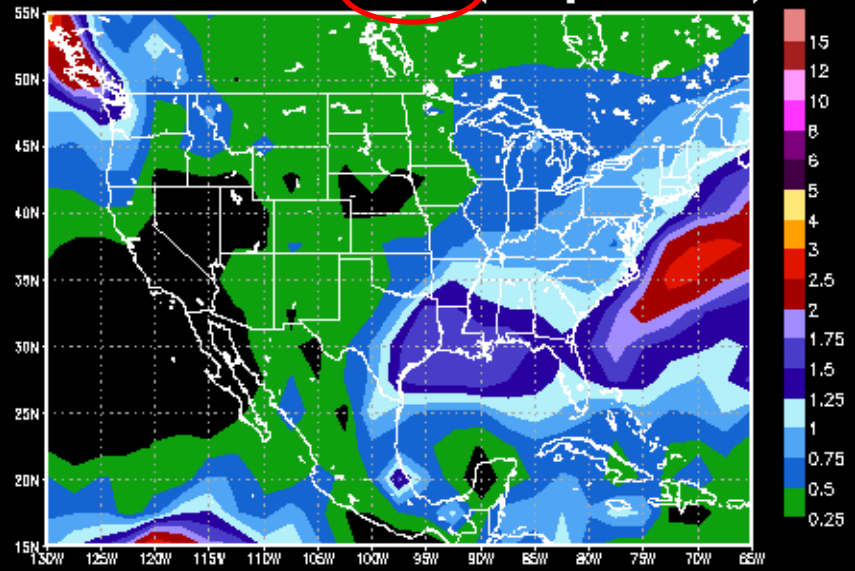


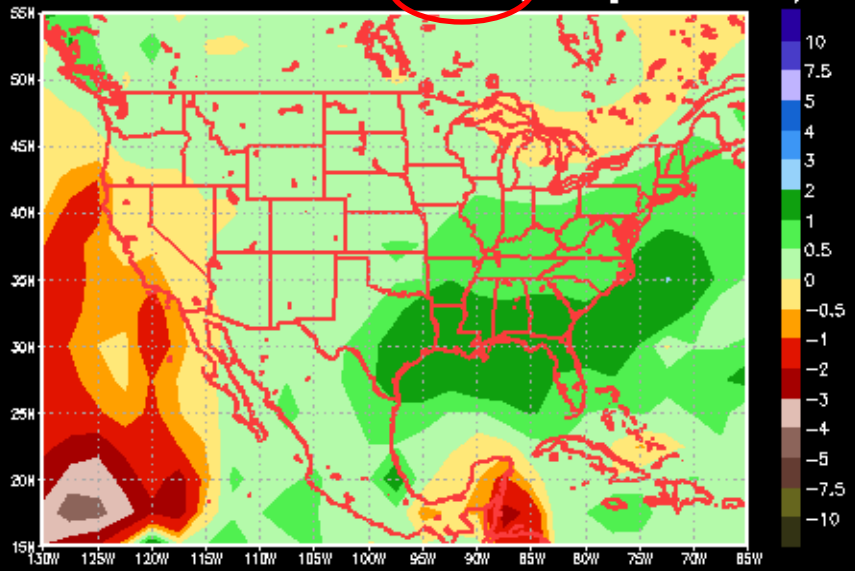
CFSRR: FCST ANOM T2m for WEEK 4(ending 21Jan2013)

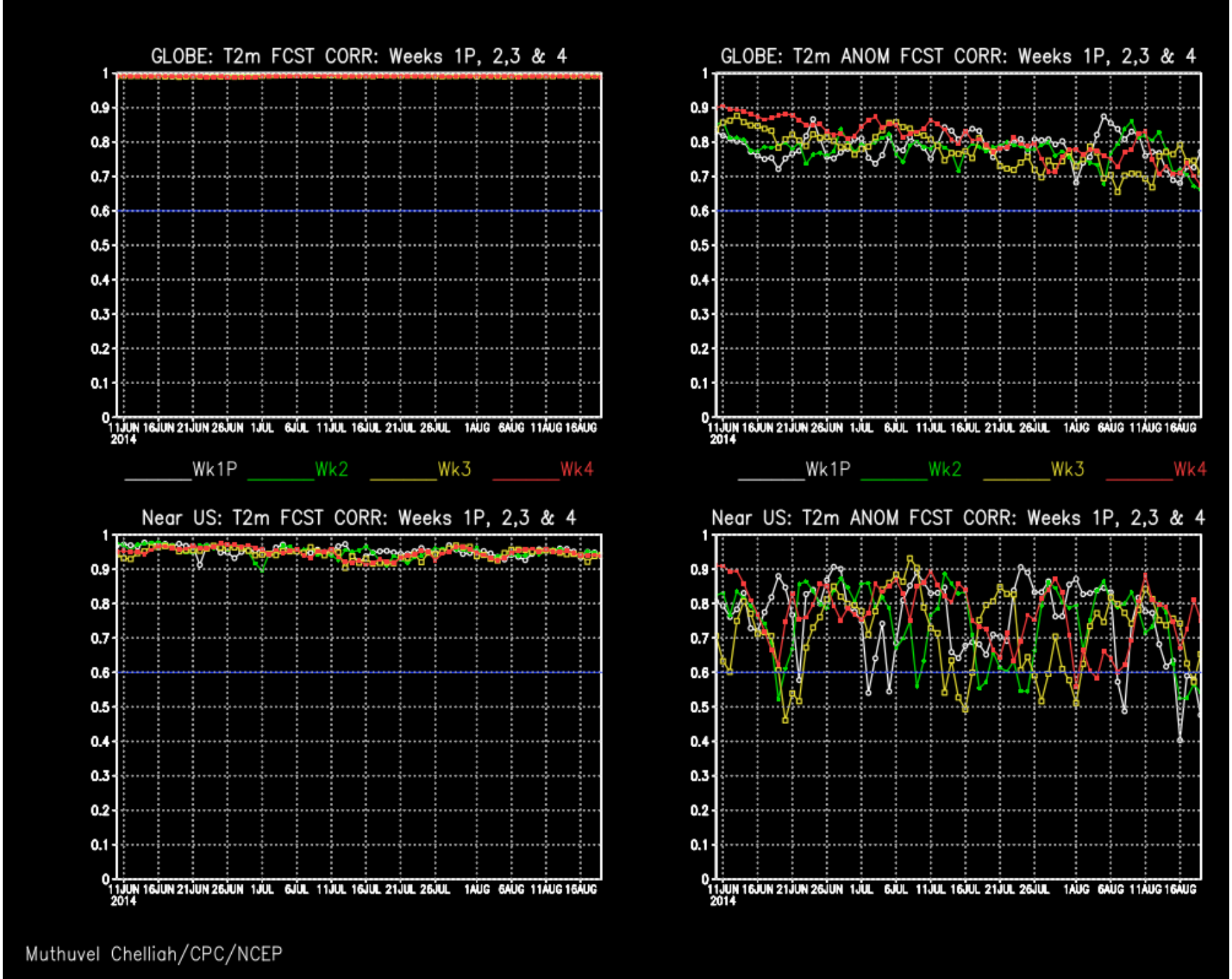


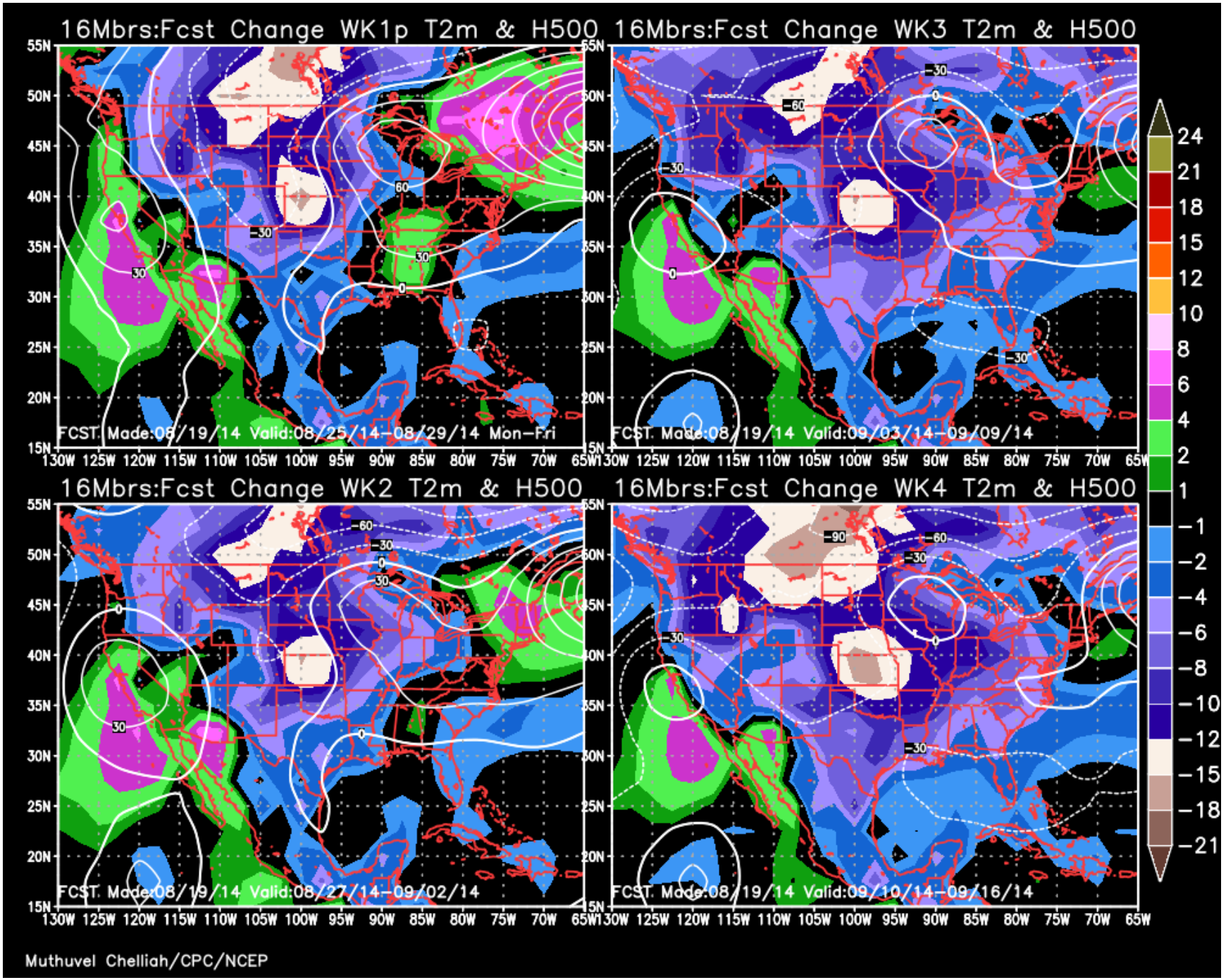

CFSR: Verifying RAIN 7day accum.(ending 24Feb2013)
15
12
10
8
6
5
4
3
2.5
2
1.75
1.5
1.25
1
0.75
0.5
0.25


CFSR: Verifying ANOM RAIN 7day accum.(ending 24Feb2013)
10
7.5
5
4
3
2
1
0.5
0
-0.5
-1
-2
-3
-4
-5
-7.5
-10


CFSRR: FCST RAIN for WEEK 4(ending 24Feb2013)
15
12
10
8
6
5
4
3
2.5
2
1.75
1.5
1.25
1
0.75
0.5
0.25


CFSRR: FCST ANOM RAIN for WEEK 4(ending 24Feb2013)
10
7.5
5
4
3
2
1
0.5
0
-0.5
-1
-2
-3
-4
-5
-7.5
-10


GLOBE: T2m FCST CORR: Weeks 1P, 2,3 & 4
GLOBE: T2m ANOM FCST CORR: Weeks 1P, 2,3 & 4
Wk1P Wk2 Wk3 Wk4
Near US: T2m FCST CORR: Weeks 1P, 2,3 & 4
Near US: T2m ANOM FCST CORR: Weeks 1P, 2,3 & 4
11JUN 16JUN 21JUN 26JUN 1JUL 6JUL 11JUL 16JUL 21JUL 26JUL 1AUG 6AUG 11AUG 16AUG
2014
Muthuvel Chelliah/CPC/NCEP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16Mbrs:Fcst Change WK3 T2m & H500
FCST. Made:08/19/14 Valid:09/03/14-09/09/14
16Mbrs:Fcst Change WK2 T2m & H500
FCST. Made:08/19/14 Valid:08/27/14-09/02/14
16Mbrs:Fcst Change WK4 T2m & H500
FCST. Made:08/19/14 Valid:09/10/14-09/16/14
24 21 18 15 12 10 8 6 4 2 1 -1 -2 -4 -6 -8 -10 -12 -15 -18 -21
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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 and think outside the box, and produce forecasts, or at least some sort of 'guidance' for 'weeks 3 & 4' along the lines presented here, even on an 'experimental basis', this study offers a new proposal to make and evaluate forecasts in the weeks 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 forecasts and recent skill scores in my experimental/personal website with appropriate caveats of course at http://www.cpc.ncep.noaa.gov/products/people/muthu/chek.cfsr.fcst/
- A better website is under construction, which will soon replace the one above.

- Prelim. write-up of this work is available online at recent 38th CDPW Digest. (http://www.nws.noaa.gov/ost/climate/STIP/Collections.htm)
- A manuscript is under preparation.

The END ☺

Thanks for listening!

Any questions?

Index of /products/people/muthu/chek.cfsr.fcst

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Parent Directory		-
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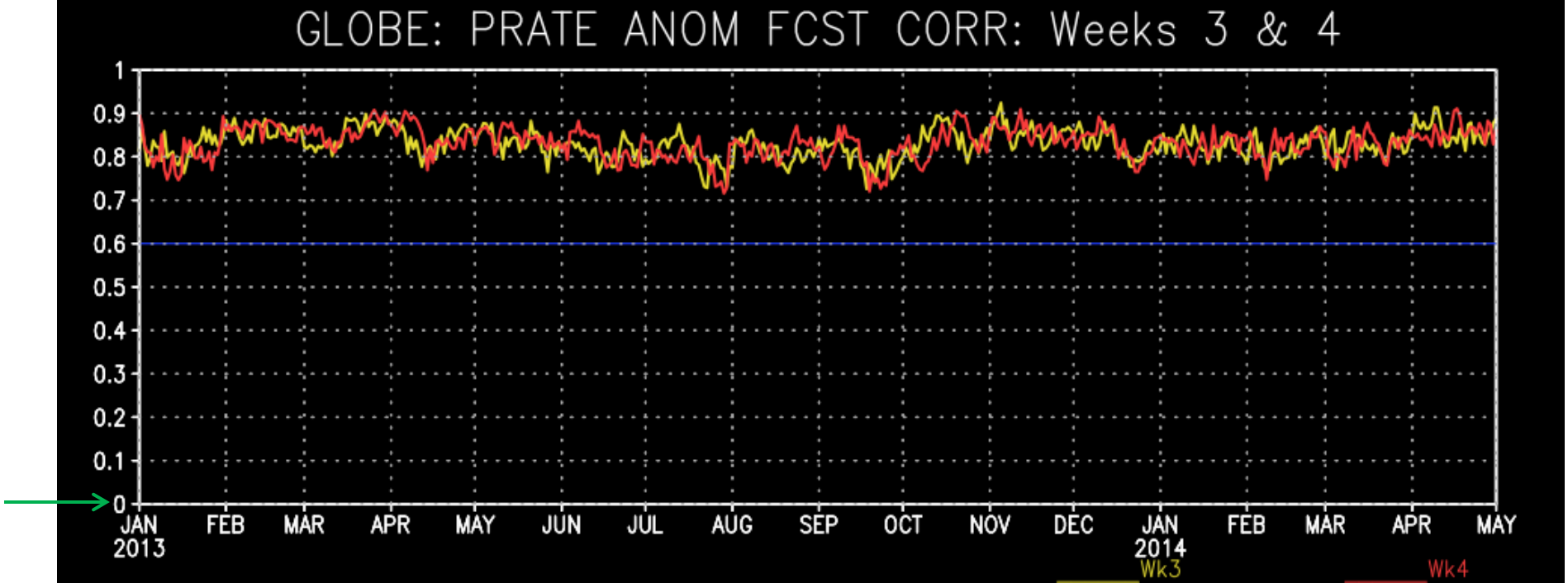
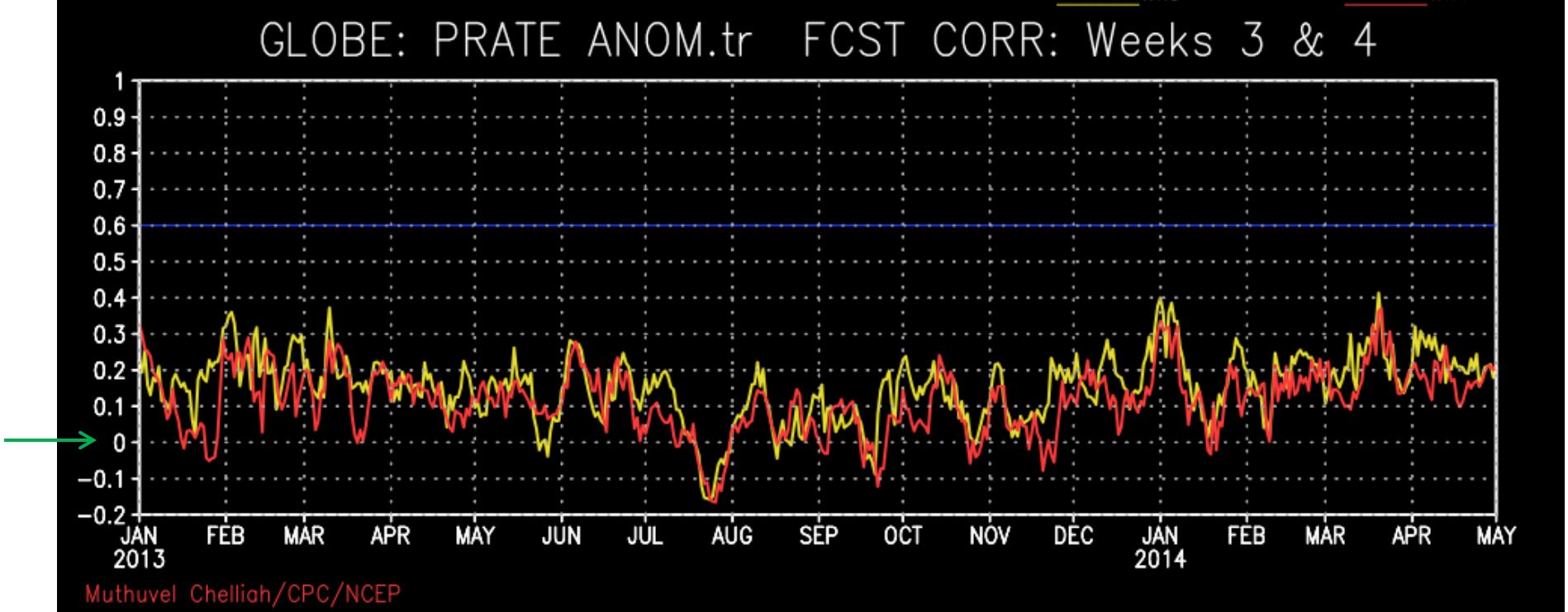
For this website, Google: CPC products Muthu


GLOBE: PRATE ANOM FCST CORR: Weeks 3 & 4
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
JAN 2013
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN 2014
FEB
MAR
APR
MAY
Wk3
Wk4


GLOBE: PRATE ANOM.tr FCST CORR: Weeks 3 & 4
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
JAN 2013
FEB
MAR
APR
MAY
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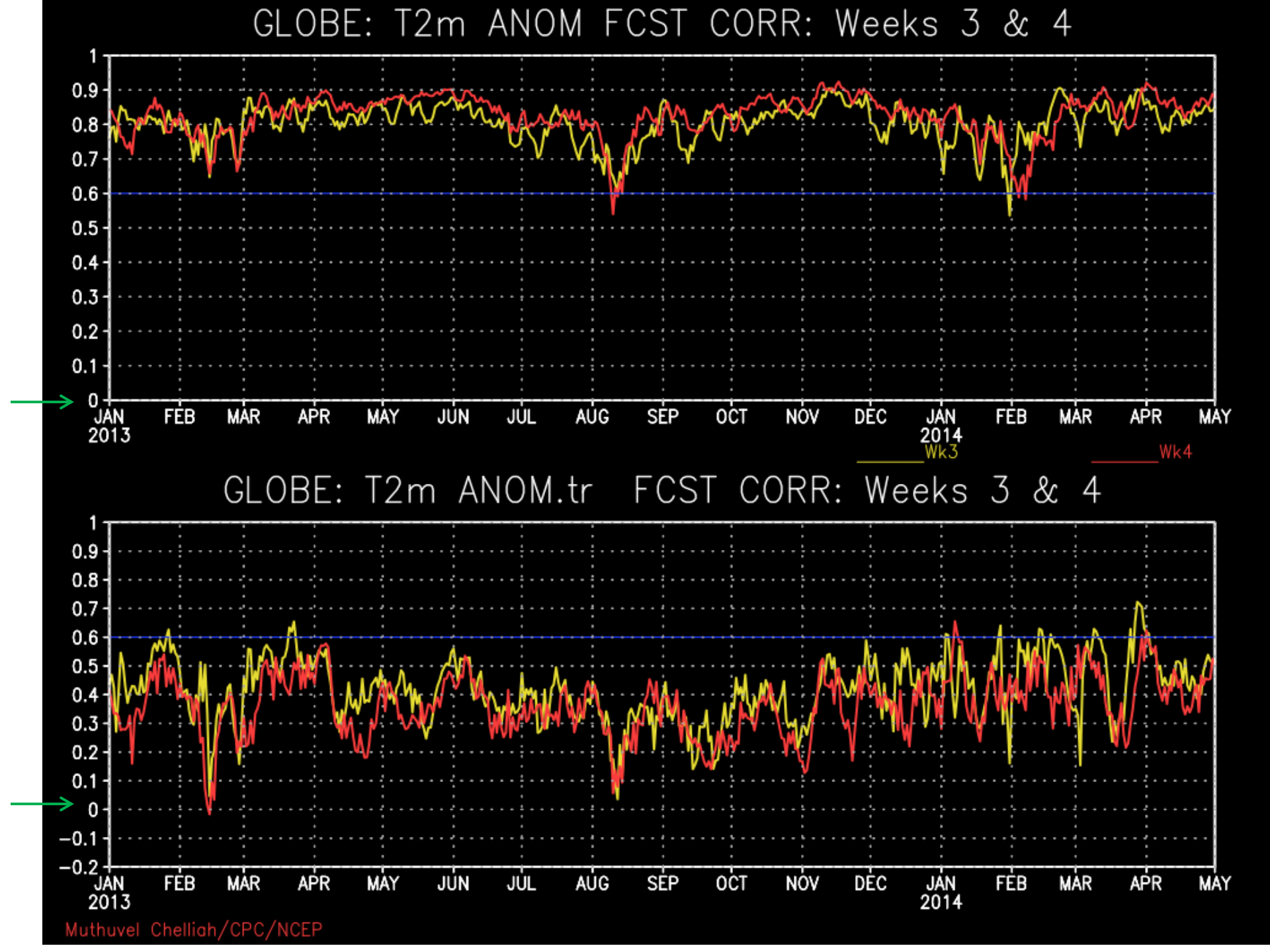
MAY
Muthuvel Chelliah/CPC/NCEP


GLOBE: T2m ANOM FCST CORR: Weeks 3 & 4
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0.2
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JAN 2013
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MAR
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Wk3
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GLOBE: T2m ANOM.tr FCST CORR: Weeks 3 & 4
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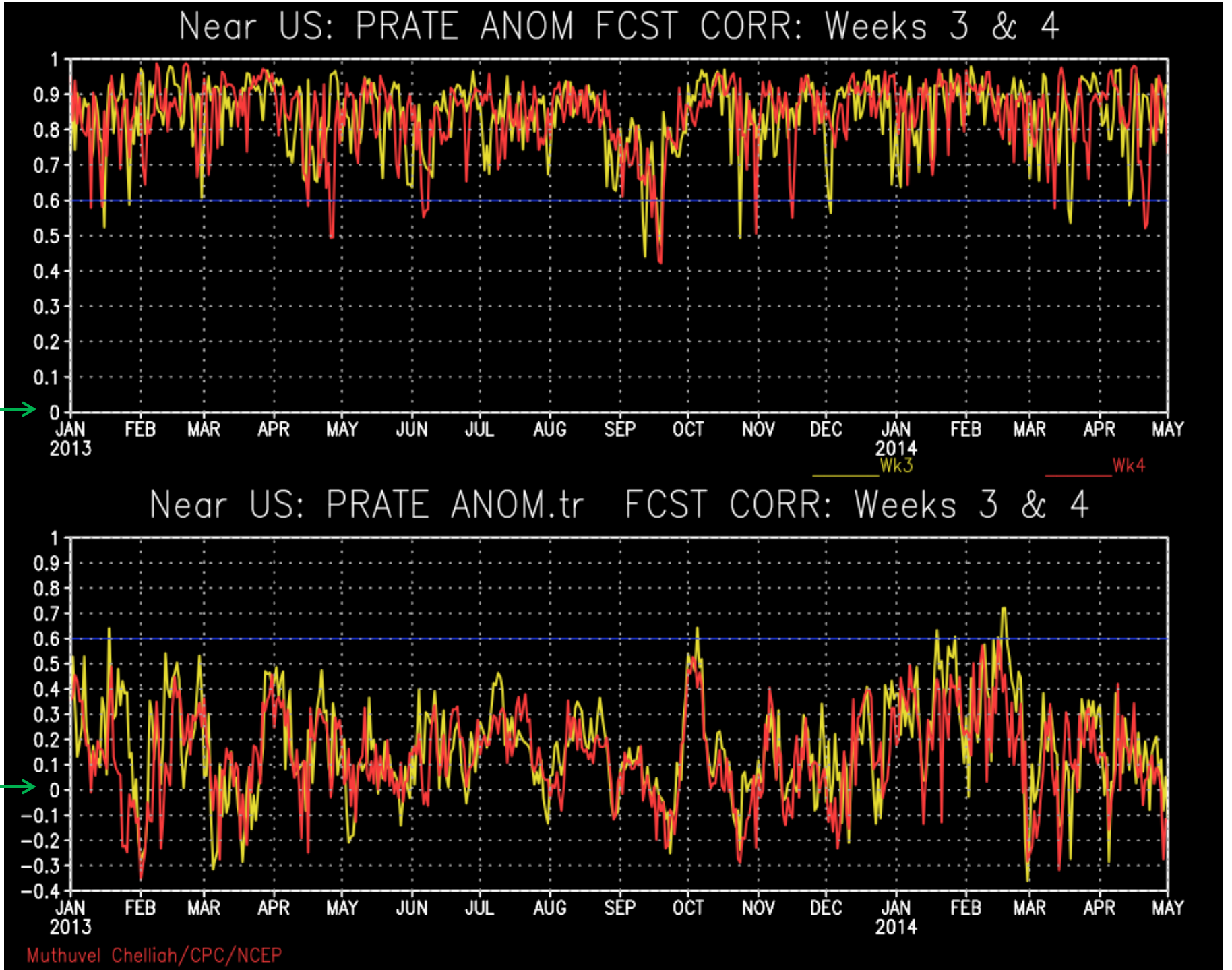
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1
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0.2
0.1
0
JAN 2013
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Wk4
Near US: PRATE ANOM.tr FCST CORR: Weeks 3 & 4
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