Earth System Research Laboratory
Physical Sciences Division

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CO WATF,
20 July 2012
Denver

Seasonal Outlook into Fall 2012

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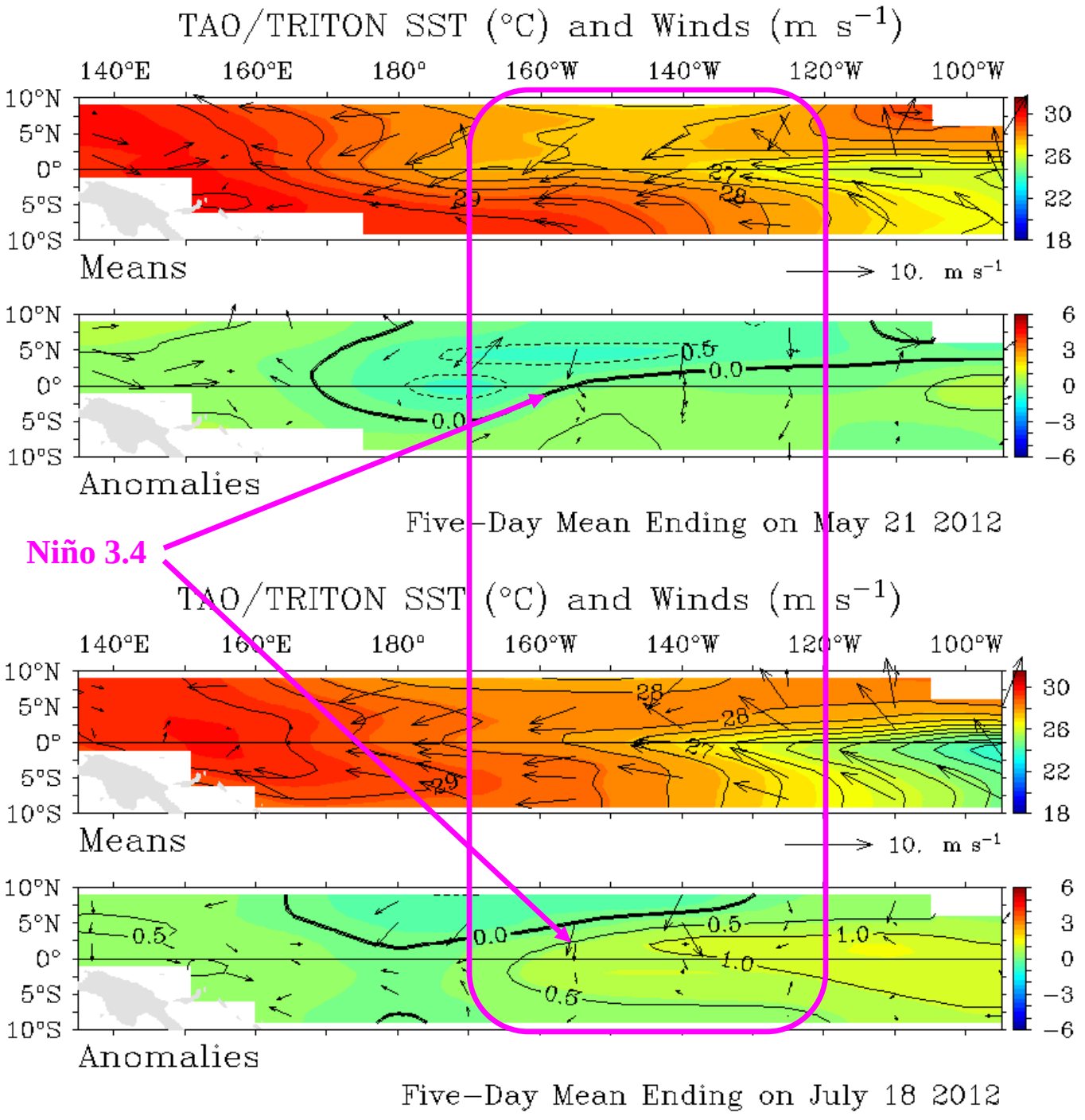
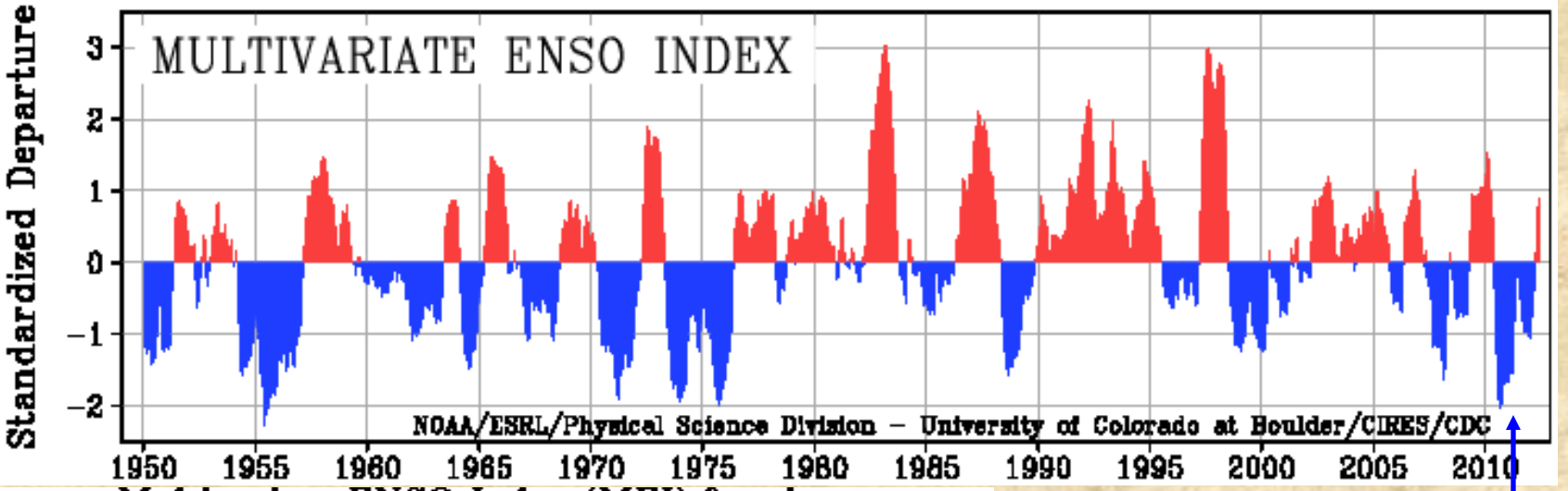
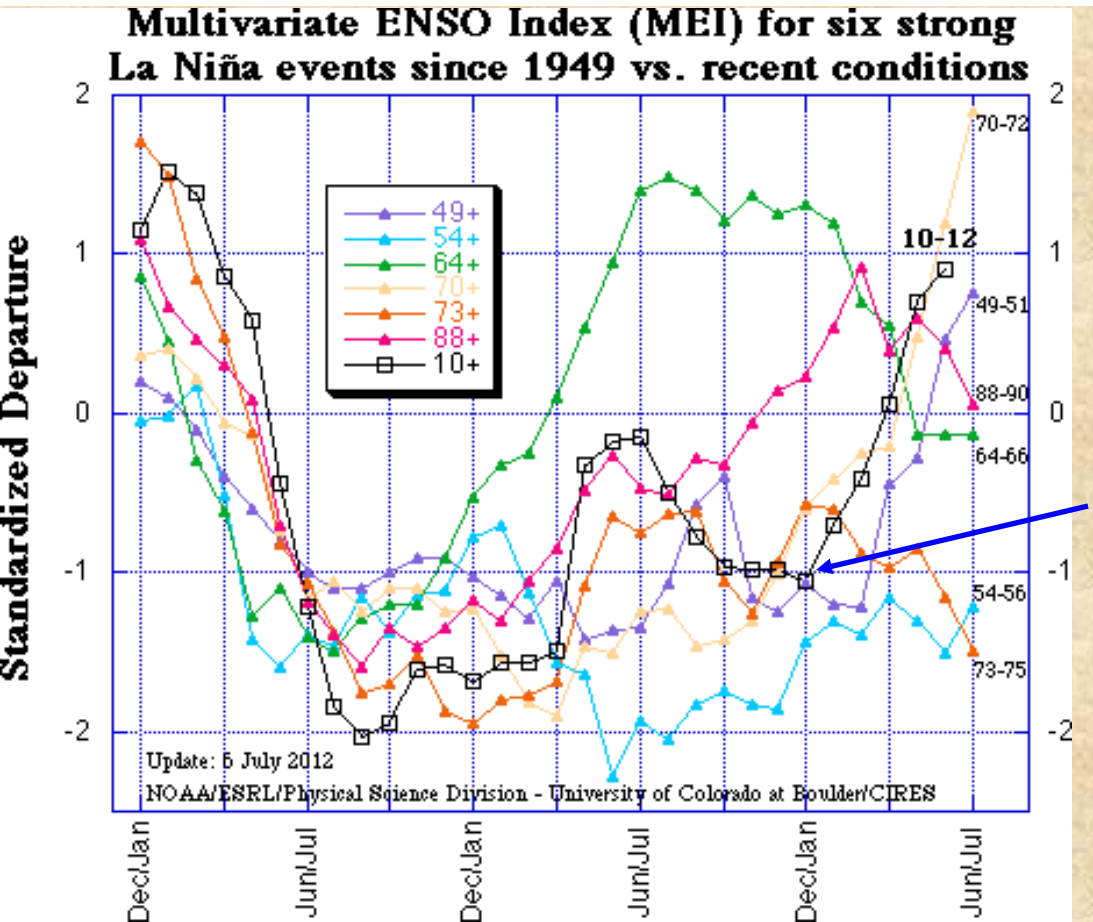
- **Good-bye La Niña - Hello El Niño!**
- **Expectations for the next two weeks**
- **CPC forecasts for August through December 2012**
- **Experimental Seasonal Forecast Guidance**
- **Executive Summary**

Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to last time (top): La Niña is almost completely gone. Eastern Pacific SST and westerly wind anomalies over Western Pacific are consistent with developing El Niño conditions.

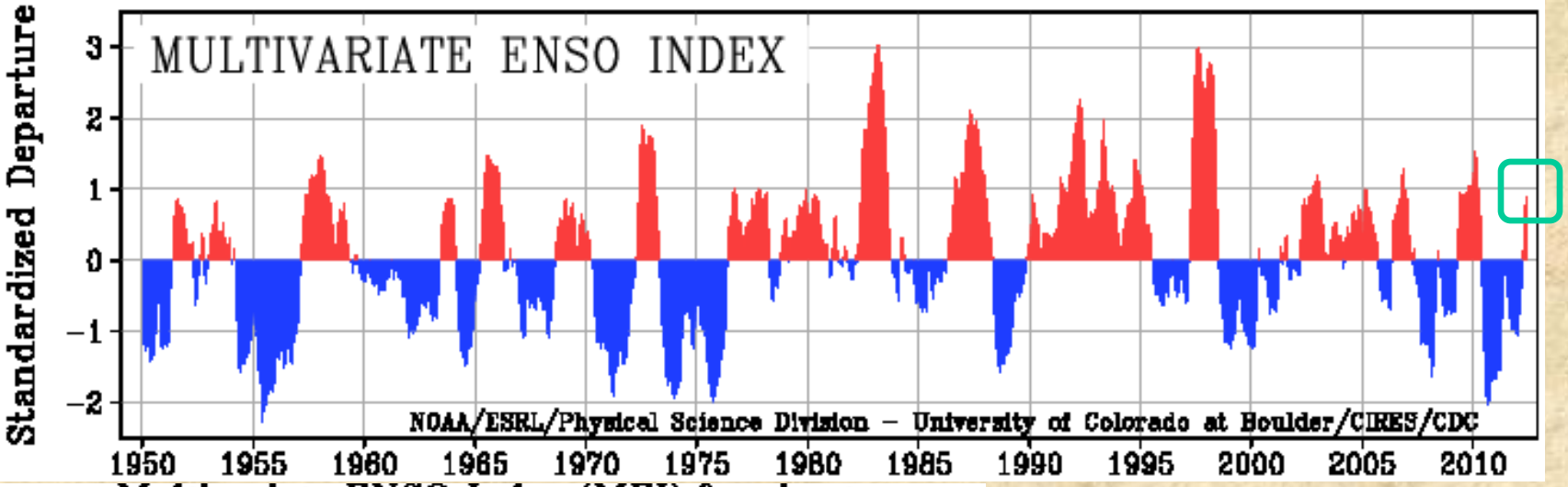


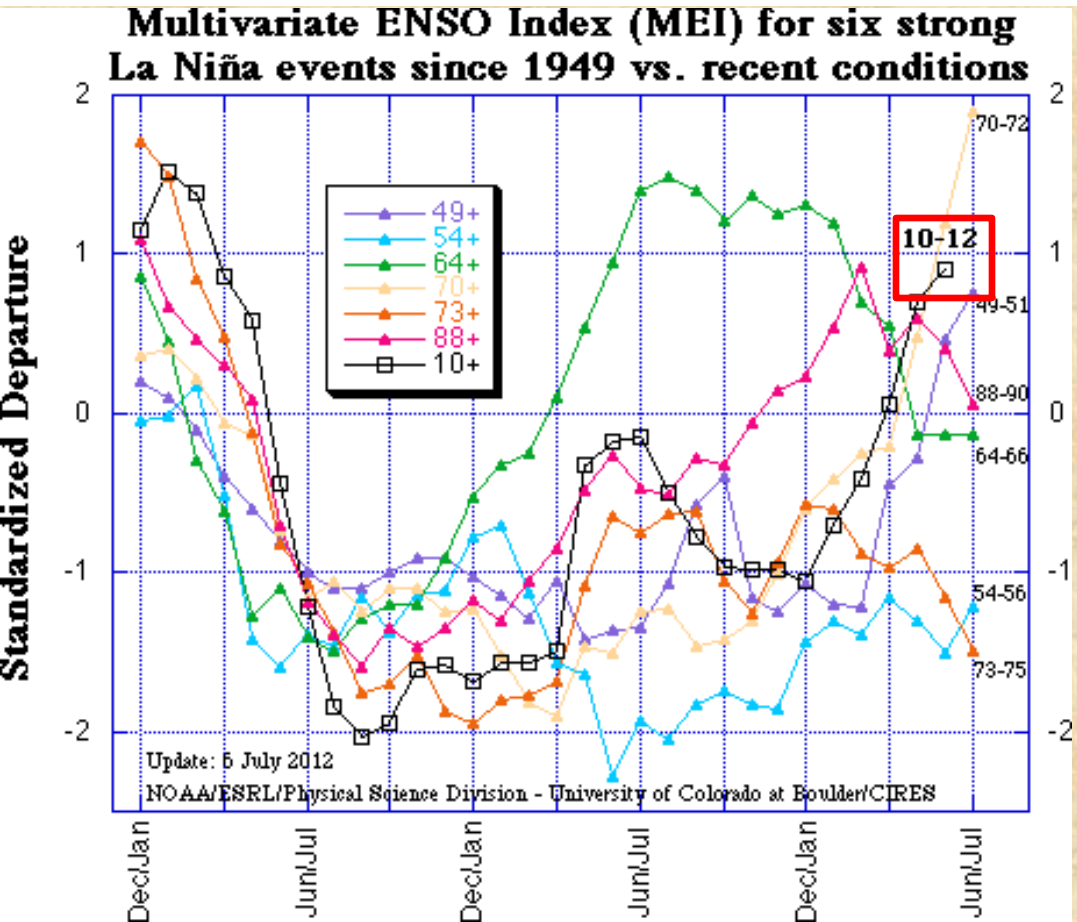




2010-12 La Niña event reached its biggest peak since the mid-70s in late 2010, followed by a brief excursion to ENSO-neutral conditions during mid-2011; it reached a second peak last winter

http://www.esrl.noaa.gov/psd/enso/mei





2010-12 La Niña event reached its biggest peak since the mid-70s in late 2010, followed by a brief excursion to ENSO-neutral conditions during mid-2011; it reached a second peak last winter, and is now being followed by transition to El Niño.

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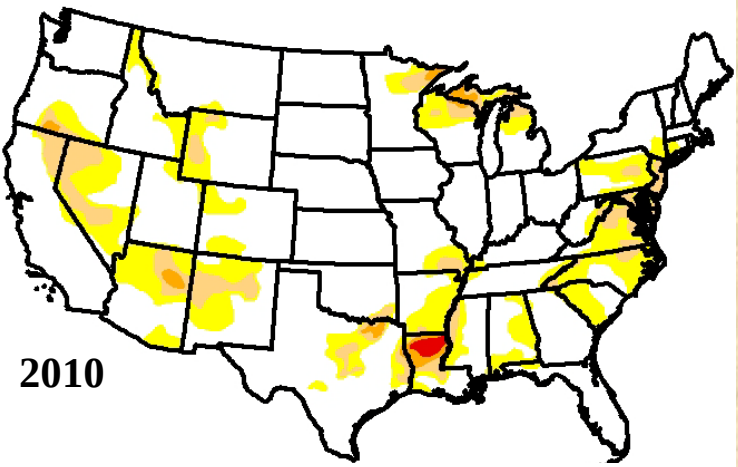
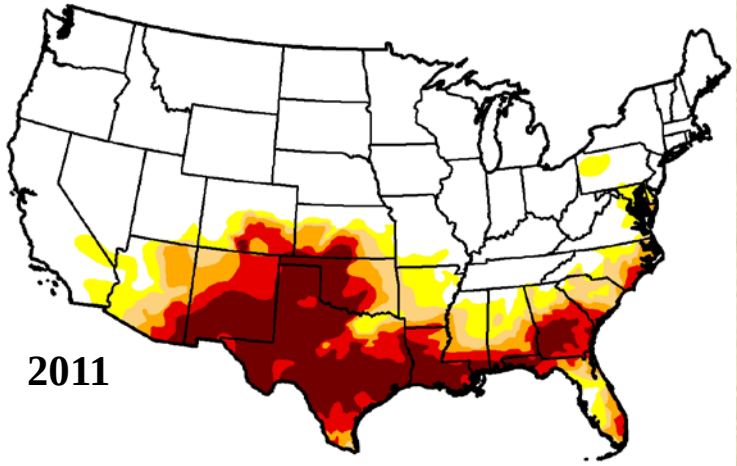
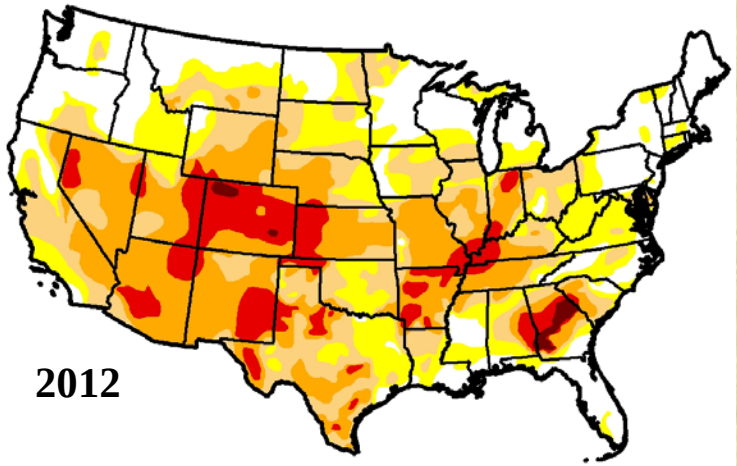






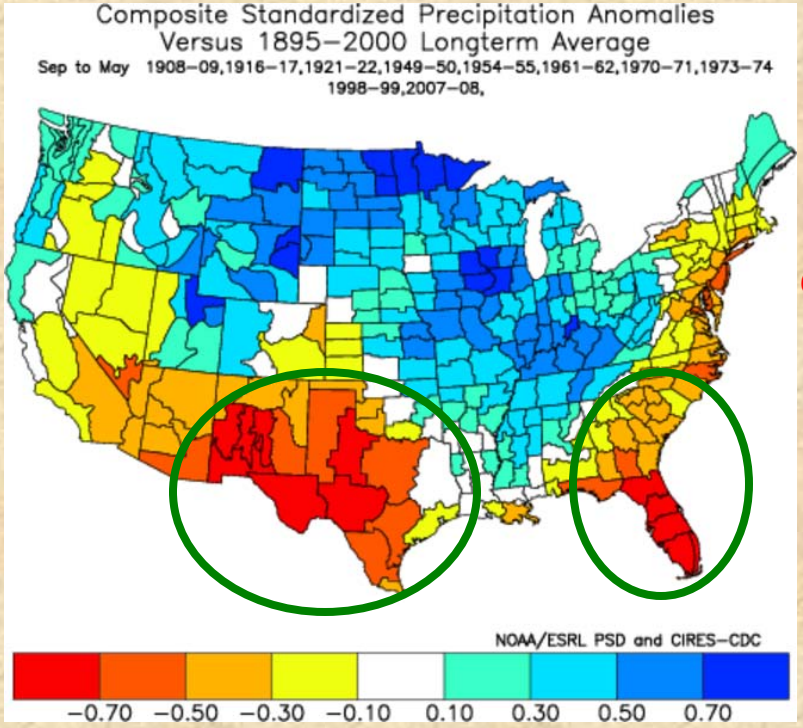
Two years ago (top left; U.S. Drought Monitor of 13 July 2010), much of the Upper Colorado and ACF basins were drought free.

One year later (center left; 12 July 2011), exceptional drought was covering much of the south-central and southeastern U.S.

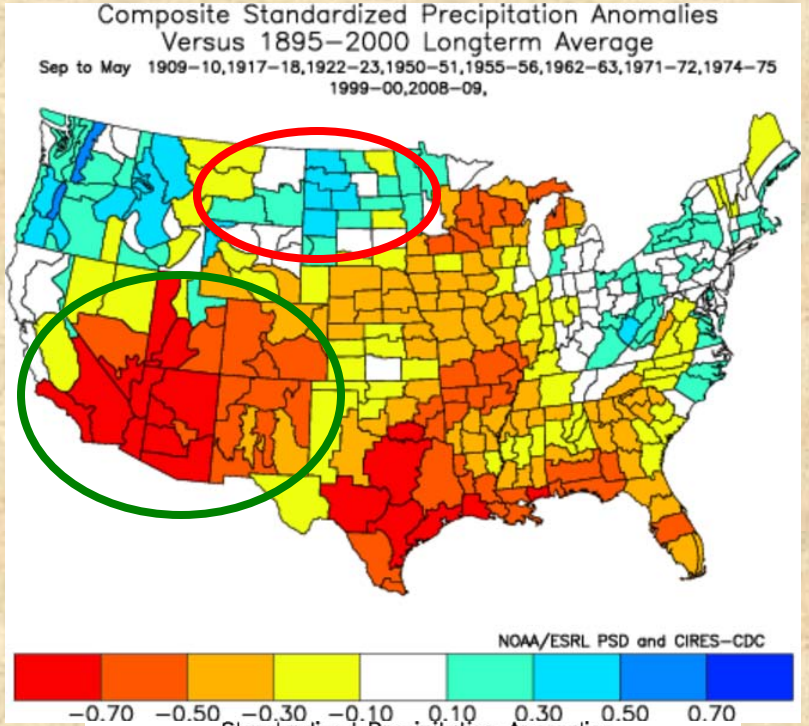
Two weeks ago (bottom left): drought is now covering much of the lower 48 states – talk about a growth business…

Was is the predictable outcome of La Niña?

Is there a difference between 1st and 2nd year La Niña impacts?



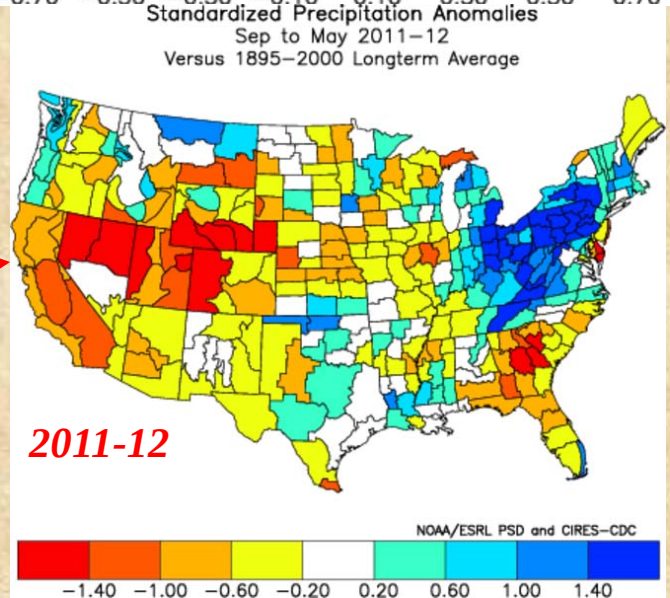
Composites

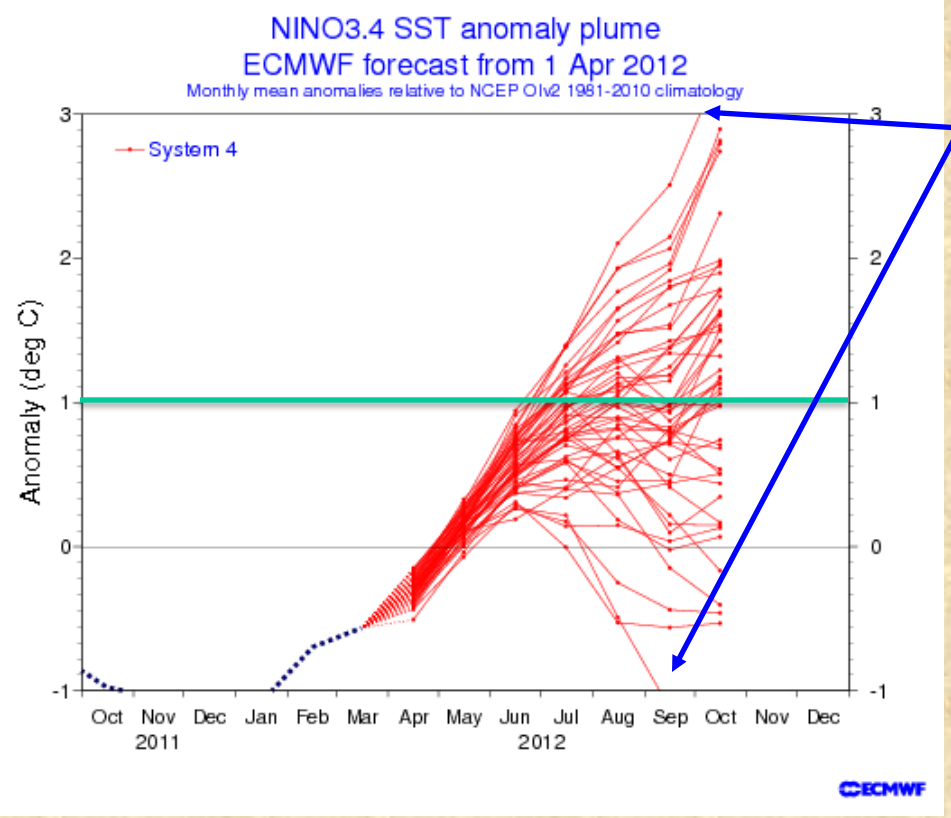


Was it possible to anticipate the expansion of drought conditions in last two years?

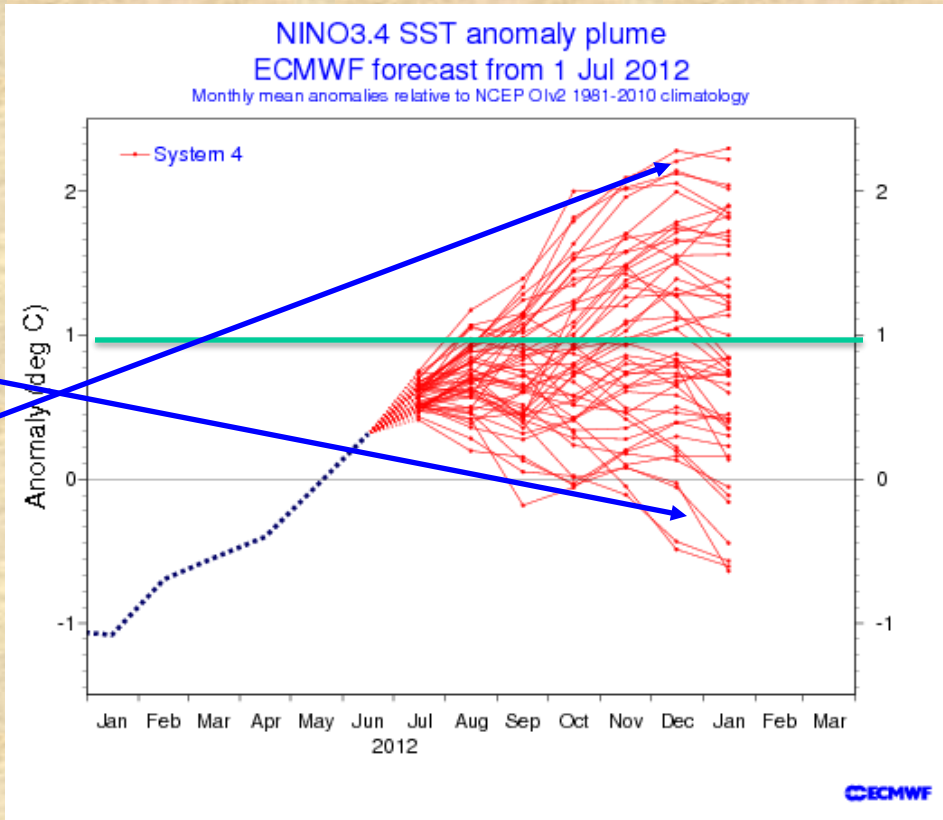
I would argue that, yes, it matched expectations, including a less wet 2nd year La Niña in the northern plains.

The expected drought materialized in CO – we did not get a break like TX did this year...



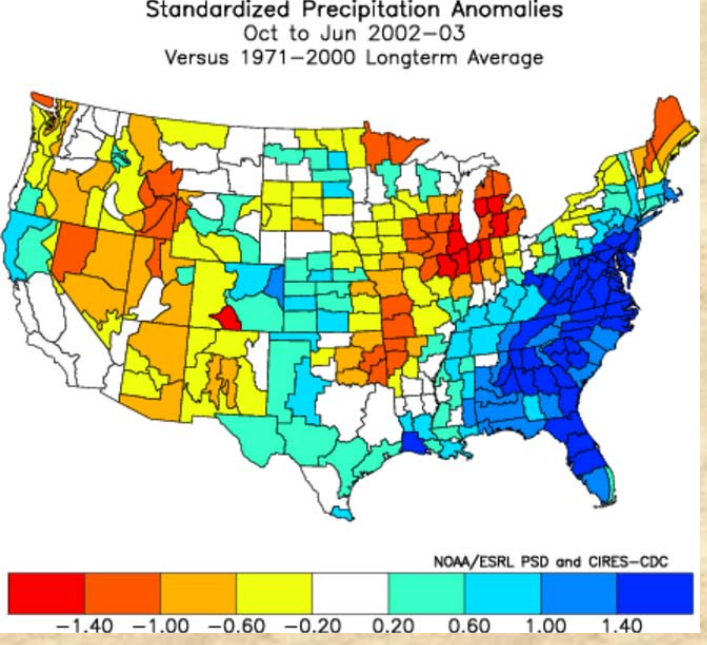


The ECMWF April 2012 forecast (left) showed an astonishing range – with a single member in the moderate-to-strong *La Niña* category (-1°C) to seven members reaching 'Super-*El Niño*-size' of +2°C or more by October 2012. The mean outcome (close to +1°C) was El Niño by about August 2012.



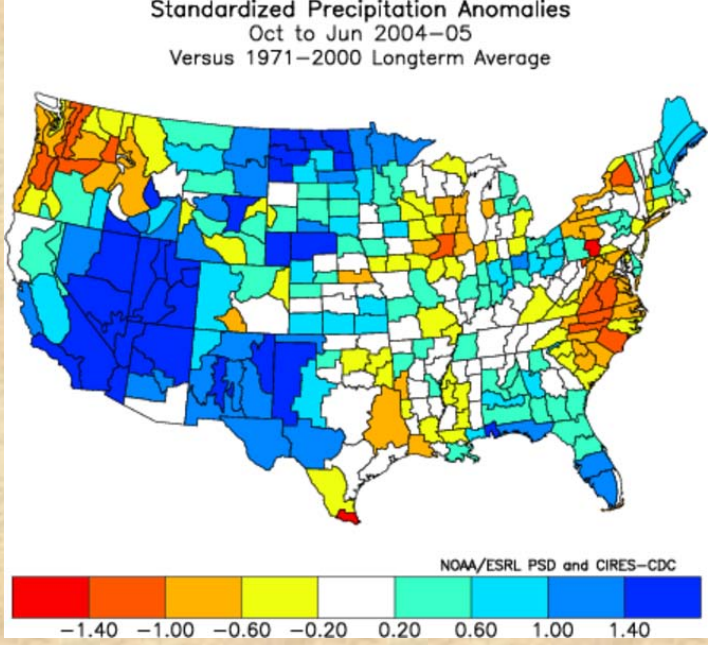
The ECMWF July 2012 forecast (right) shows a smaller, but still substantial range – with seven members below 0°C and five members reaching 'Super-*El Niño*-size' of +2°C or in next six months.

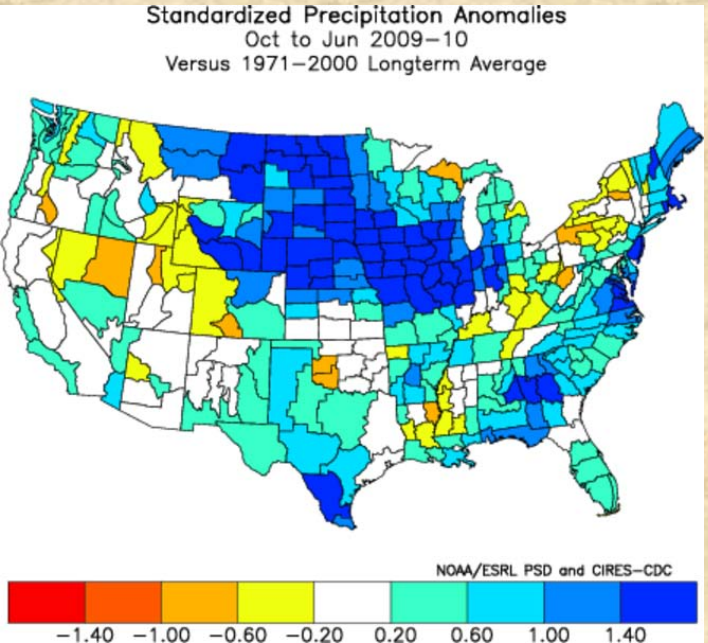
Compared to earlier forecasts, the transition to El Niño is virtually certain this summer, but it may be short-lived event.



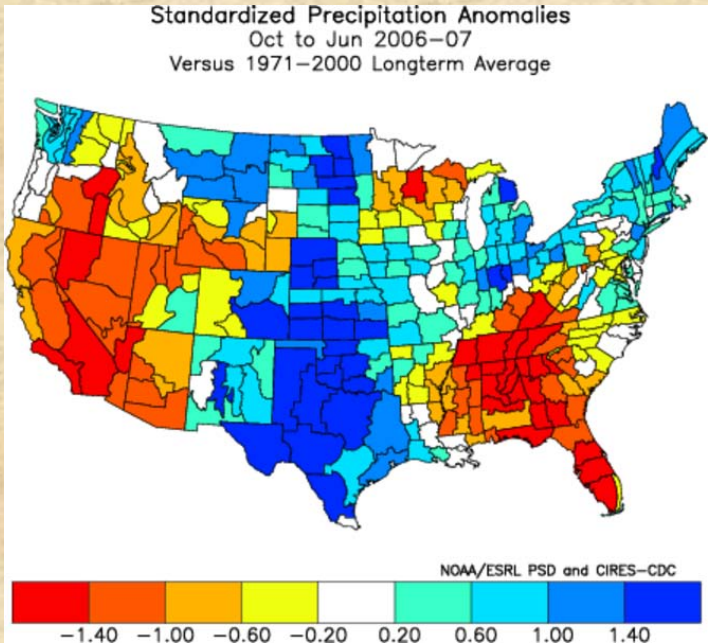
Los Niños since 2002

Last decade had many El Niño events, in 2002-03 (top left), 04-05 (top right), 06-07 (bottom right), and 09-10 (bottom left). Somewhat erratic impacts in the U.S., except for *TX where every single one of them ended up on the wet side* –





In CO, the eastern plains have the best chances of moisture from October ‘12 to June ‘13, in fact, one could argue that the Northern Front Range may end up with the ‘wettest’ outcome.

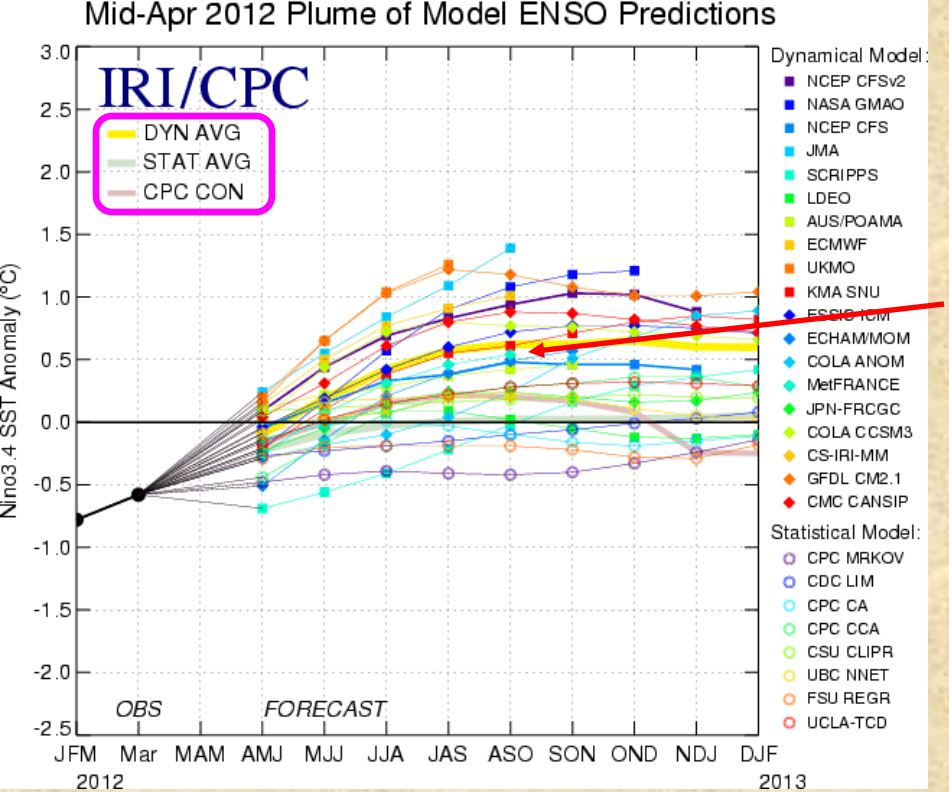


Multivariate ENSO Index forecast

Target Season	P of La Niña / El Niño	Median	Heidke Skill Score
JA'12	10% / 60%	0.73	+47*
SO'12	14% / 43%	0.51	+39*
ND'12	00% / 56%	1.18	+47*
JF'13	08% / 46%	0.41	+22

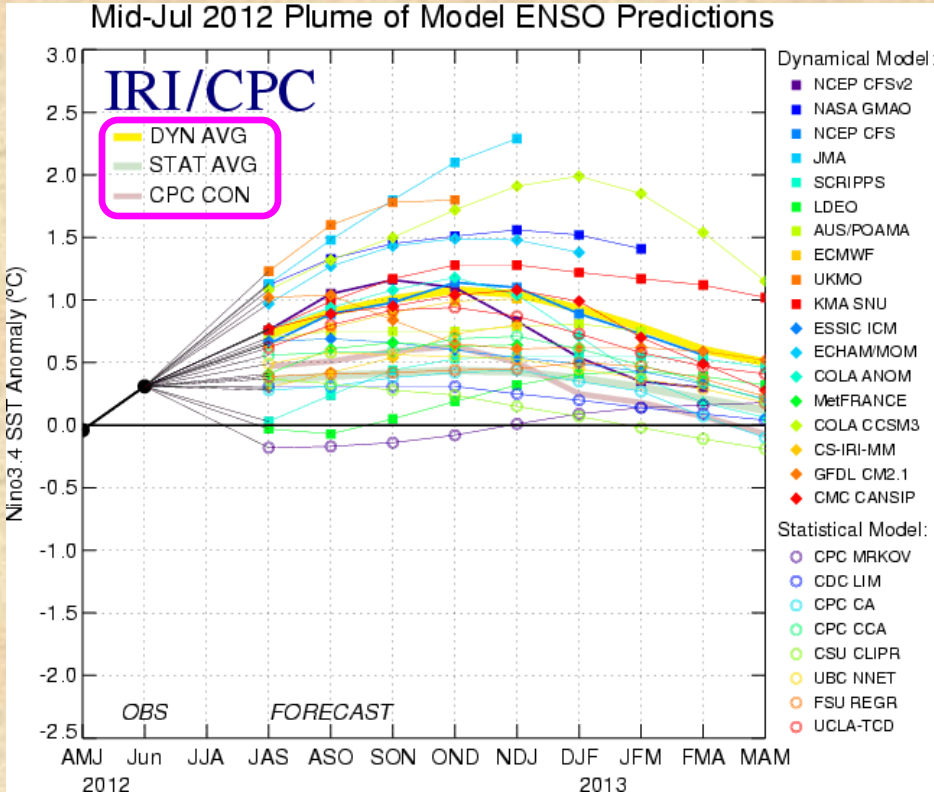
Compared to my forecasts from April, this one has essentially 'flipped' from the prospect of a 3rd La Niña winter to an El Niño forecast through the next six months. El Niño/La Niña refer to the top/bottom 30% of the historical distribution, with 40% covering ENSO-neutral conditions.

Long-lived La Niña events have a more pronounced tendency to 'flip' to El Niño (60% of two-year events end up in El Niño in 3rd year) than to stay the course (remaining 40%), with no precedent of an 'ENSO-neutral' winter following a 2nd year La Niña winter in the last century.



ENSO forecasts from a record 19 dynamical & 8 statistical forecast models from April (left):

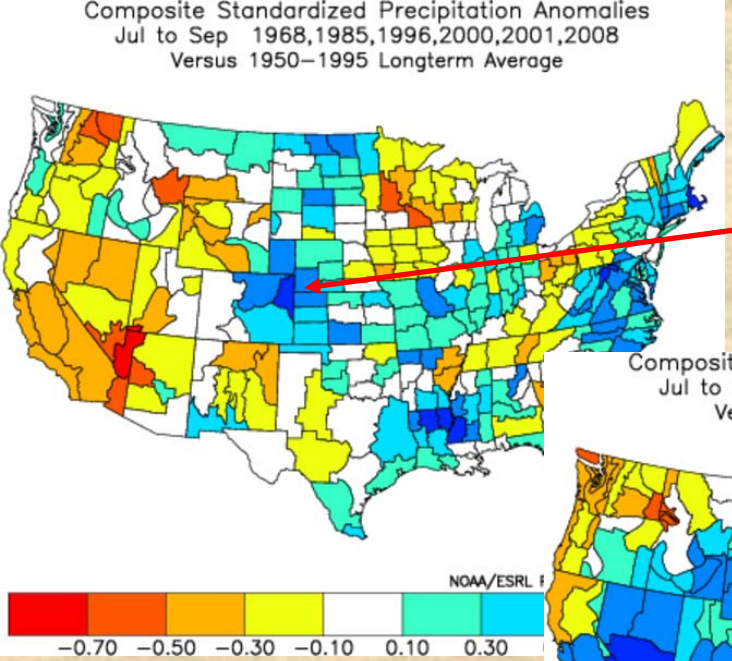
Dynamical models (yellow average) showed clear preference for El Niño by July-September 2012, while statistical models never reached that threshold.

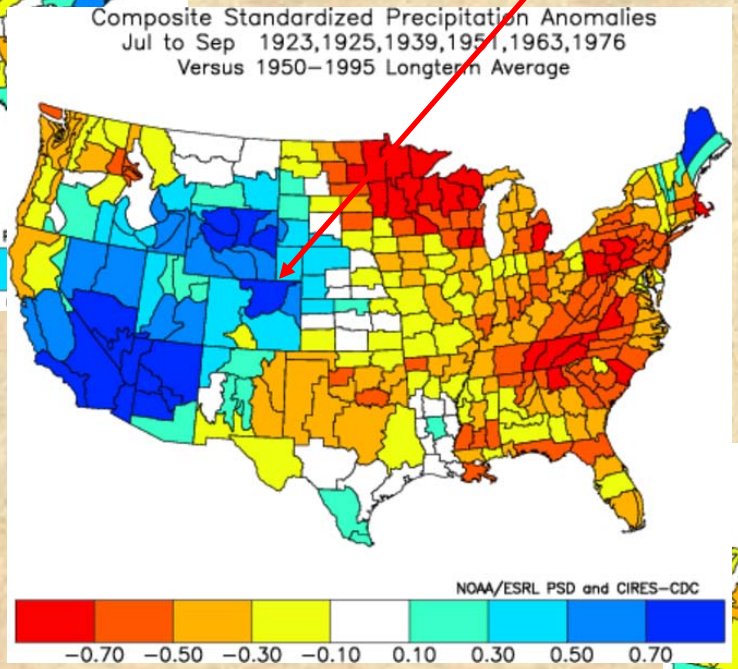


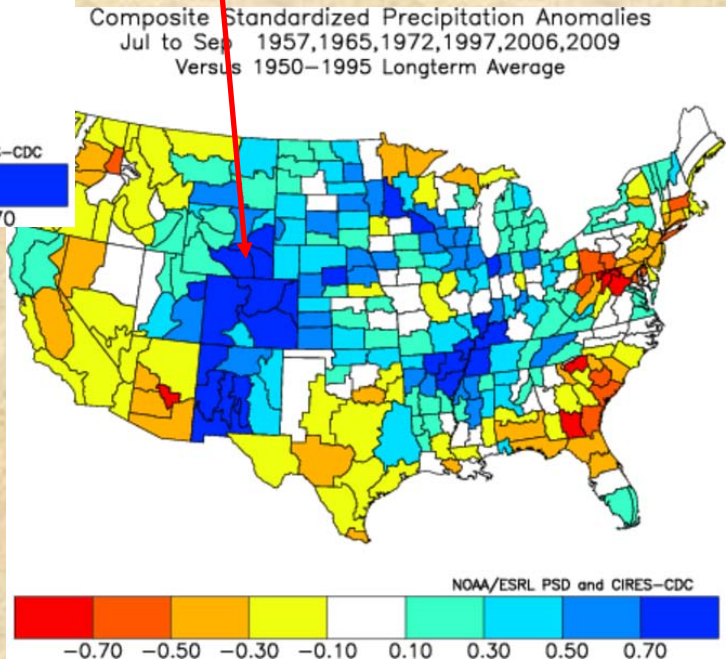
Recent dynamical forecasts (right) show an early peaking El Niño by the end of 2012, while half of the statistical models still 'withhold their support' for any El Niño. The difference in predicted outcomes reaches 0.7°C in the fall season. A similar situation in 2009 ended up with an El Niño, a historic 'victory' for the dynamical models.

Post-La Niña summers

ENSO-neutral (left) vs. late El Niño (middle) vs. early El Niño (bottom right) summers

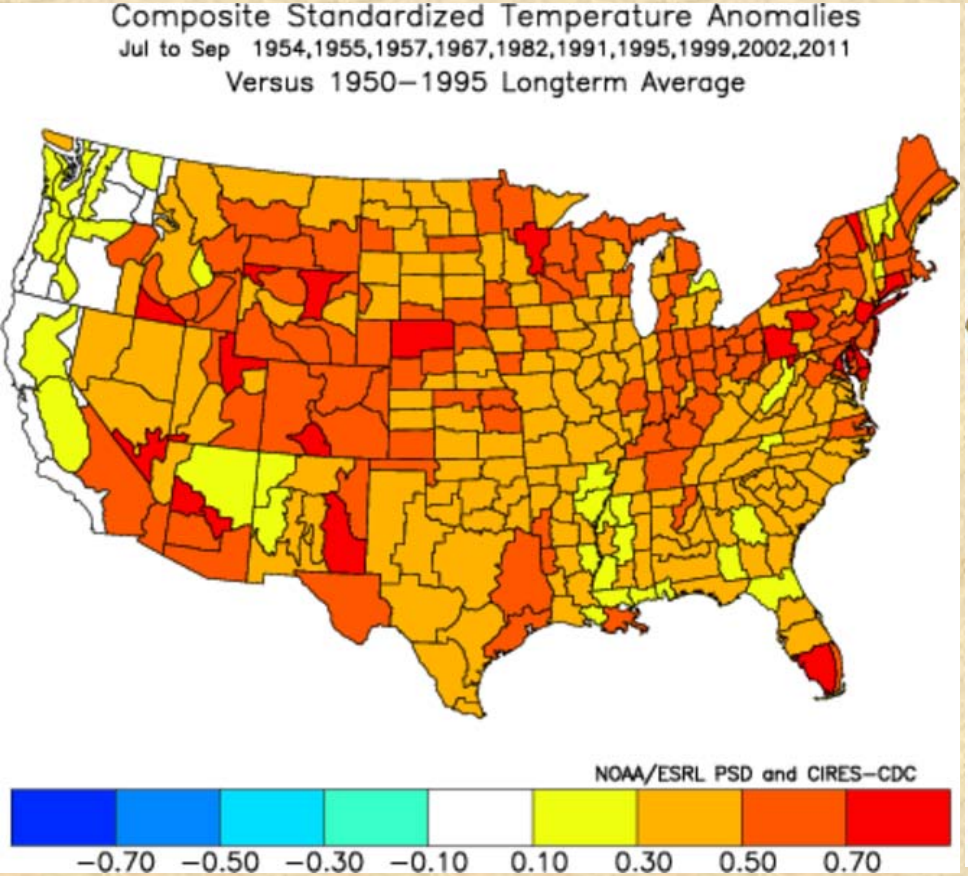


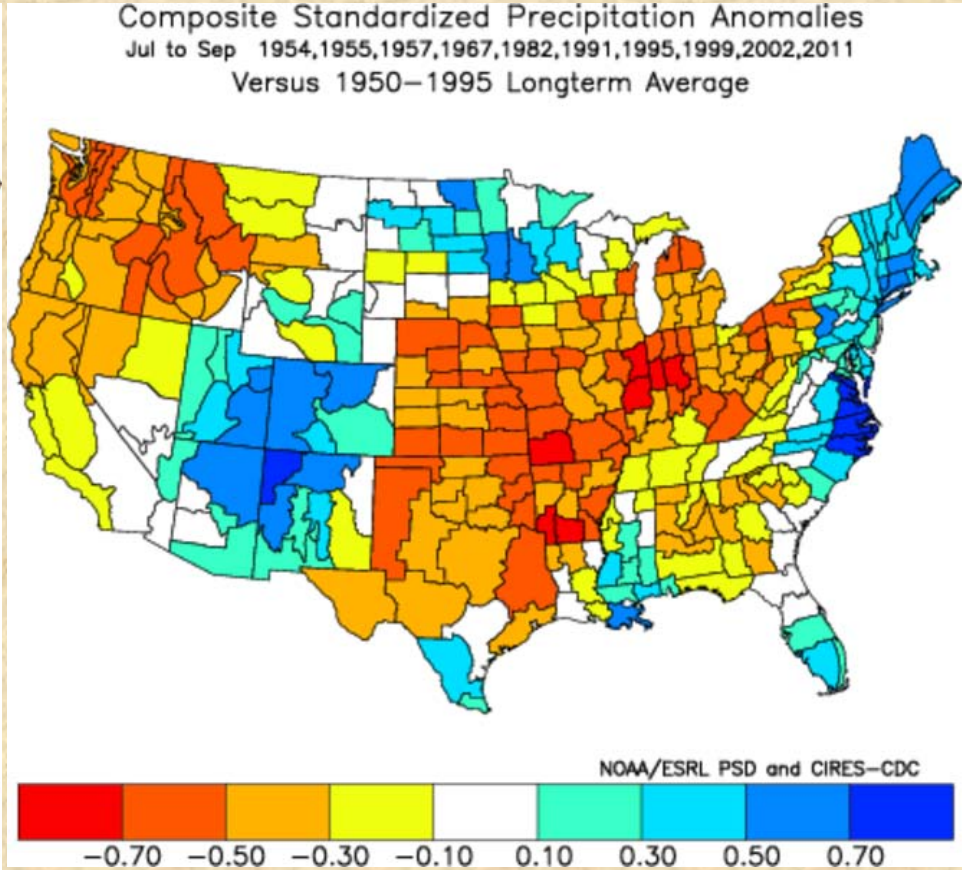




Northeast Colorado has the best chance of getting a decent monsoon season this year (in all 3 scenarios), while southern and western Colorado has a better chance of ending up near-normal.

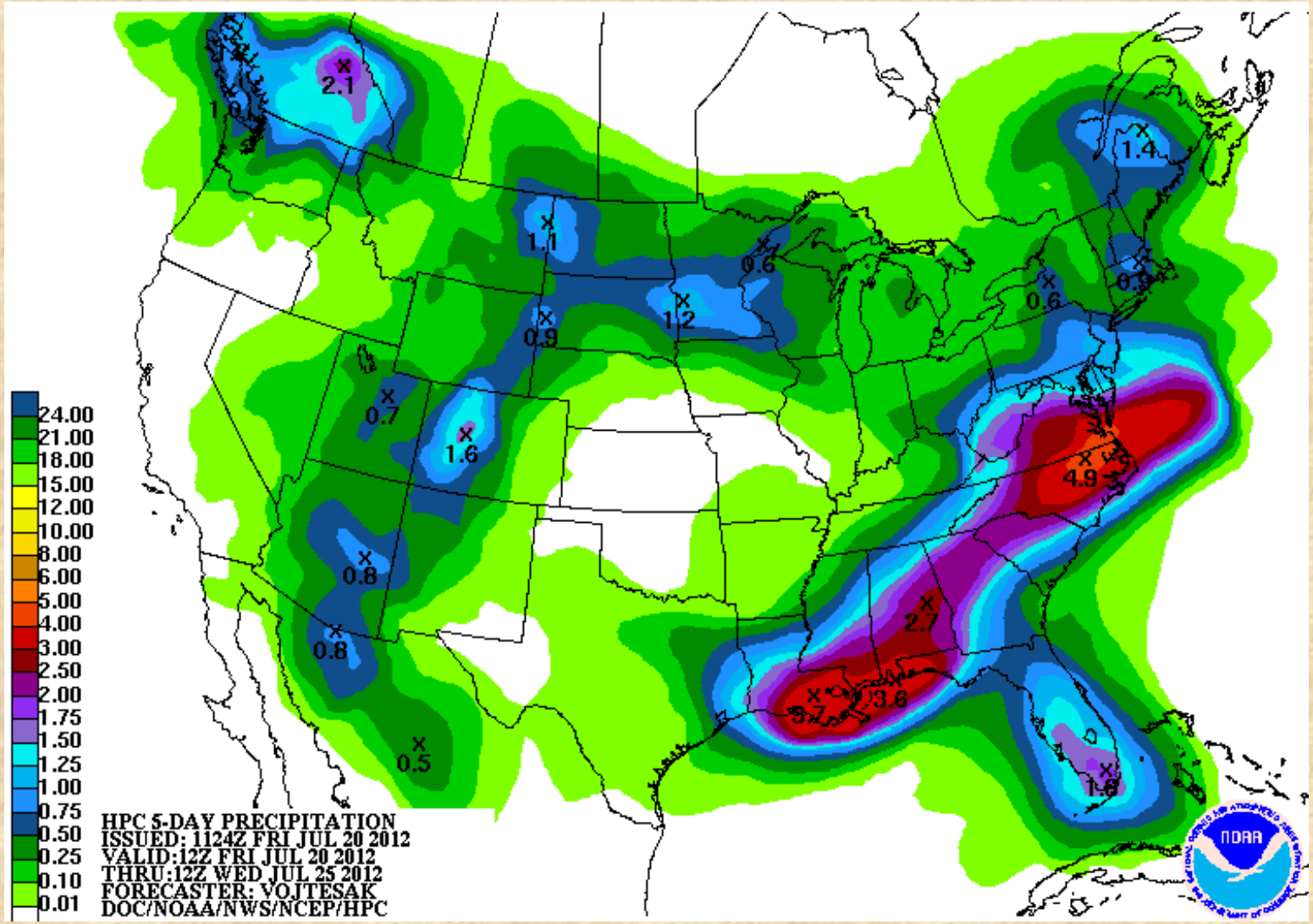
Other considerations - Warm Gulf of Mexico





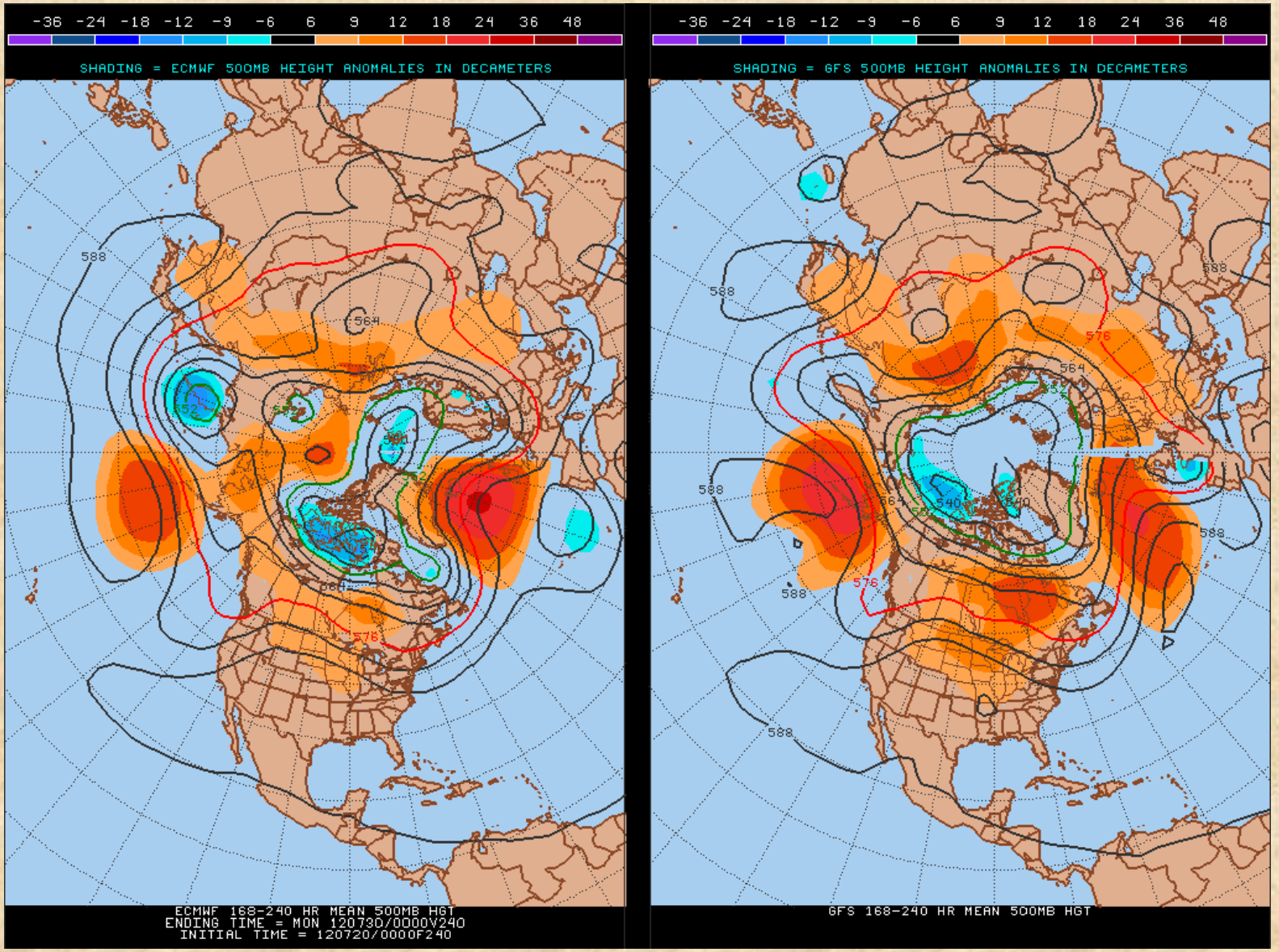
These are the composites for late summer (July-September) based on warm Gulf of Mexico SST in April (same as before). For Colorado, this would be an unusual combination of *warm and wet.*

What can we expect in the next two weeks?



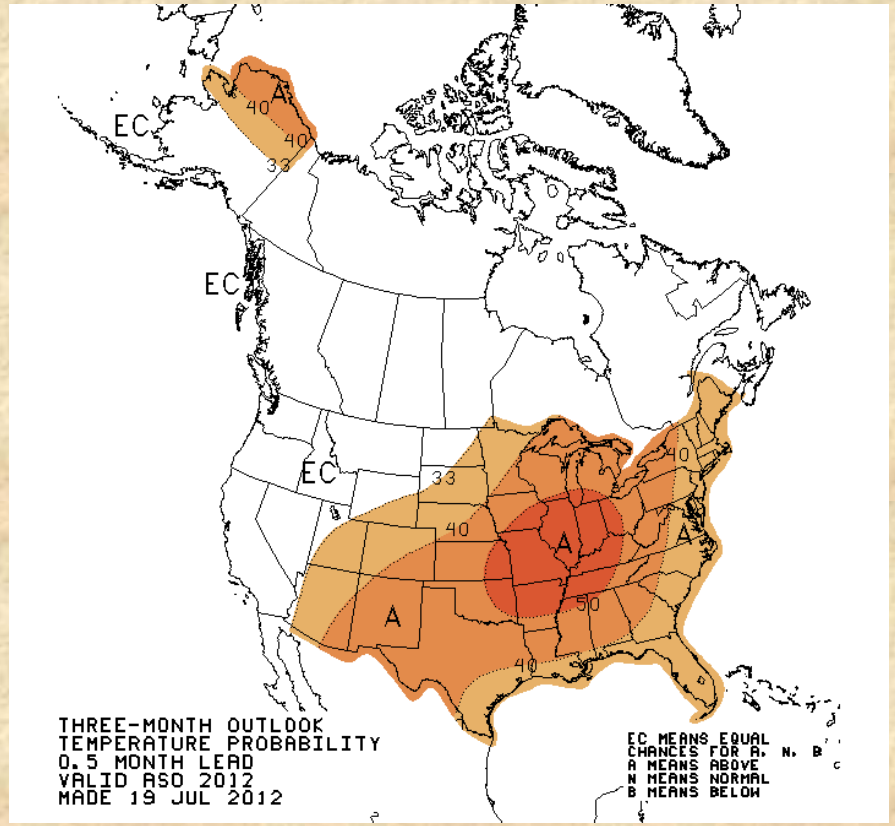
Expected total precipitation thru Wednesday morning, according to the Hydrological Prediction Center (HPC): Western Colorado may get decent moisture, with less drought relief further east – an *average monsoon pattern* right now...

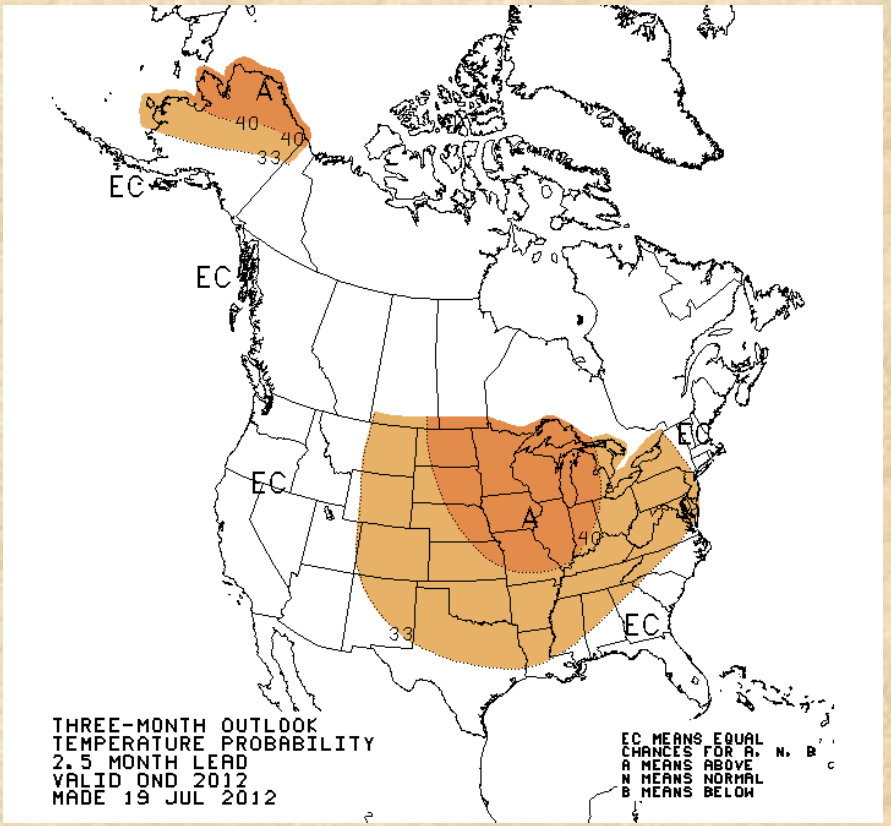
What can we expect towards the end of July?



Both ECMWF and GFS show a near-normal monsoonal flow pattern 7-10 days from yesterday. "Near-normal" is good!

Climate Prediction Center Temperature Forecasts

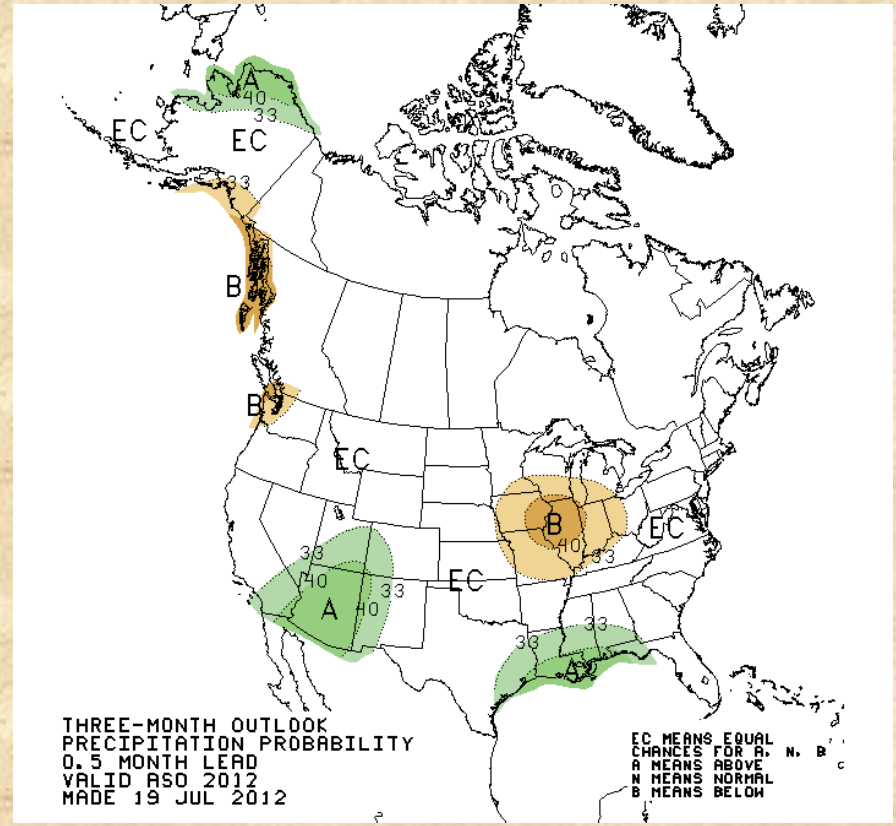


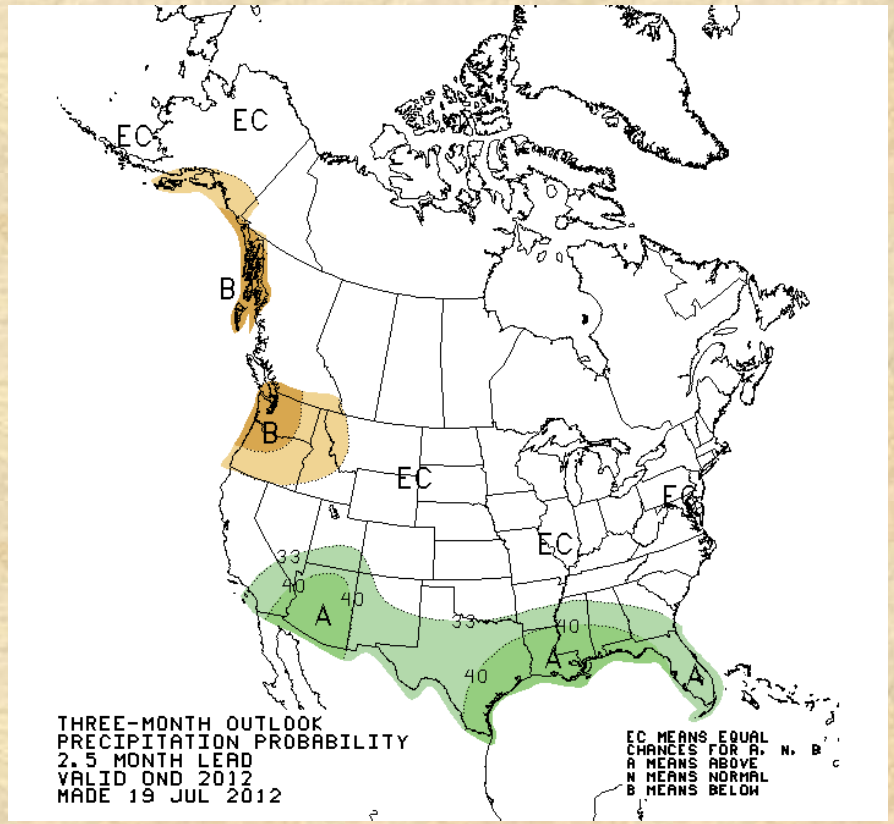


CPC's temperature forecasts for August-October (left) and October-December (right) reflect recent warming trends – El Niño is factored in for the latter season.

Source: ***http://www.cpc.ncep.noaa.gov/products/predictions/***

Climate Prediction Center Precipitation Forecasts

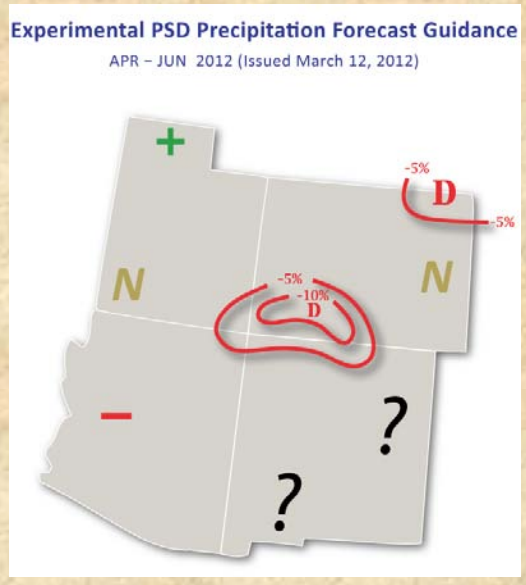


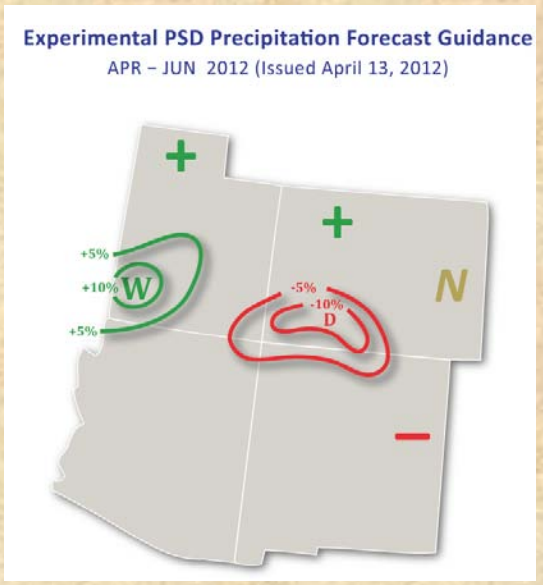


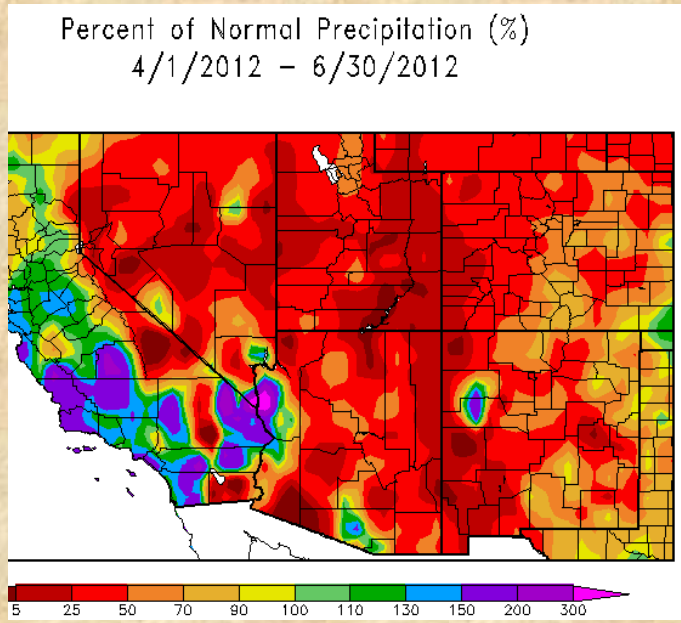
CPC's precipitation forecasts for August-October (left) and October-December (right) reflect recent trends PLUS El Niño, leaving Colorado mostly with climatological odds ('EC'), and a southern storm track.

Source: ***http://www.cpc.ncep.noaa.gov/products/predictions/***

Verification for April-June 2012



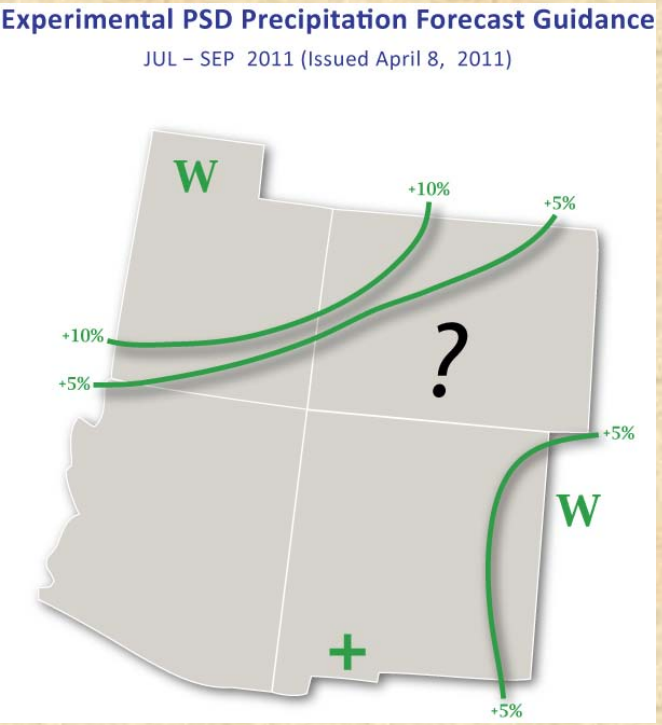


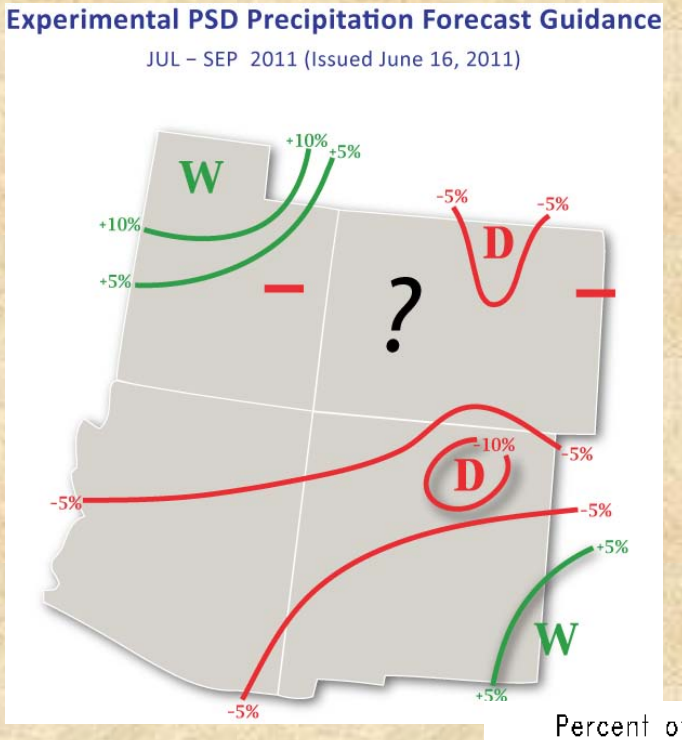


March's (left), and April's (center) forecasts for April-June 2012 were fairly confident that SW Colorado would see below-normal moisture. ***Historical skill since 2000 had been better over Utah and Colorado than over New Mexico.***

Unfortunately (right), moisture was rare all around, especially unexpected in UT (the updated forecast was worse than the original). Less extreme moisture deficits over the eastern plains of NM and CO were more than canceled out by an early onset growing season and repeated warm spells.

Verification for July-September 2011

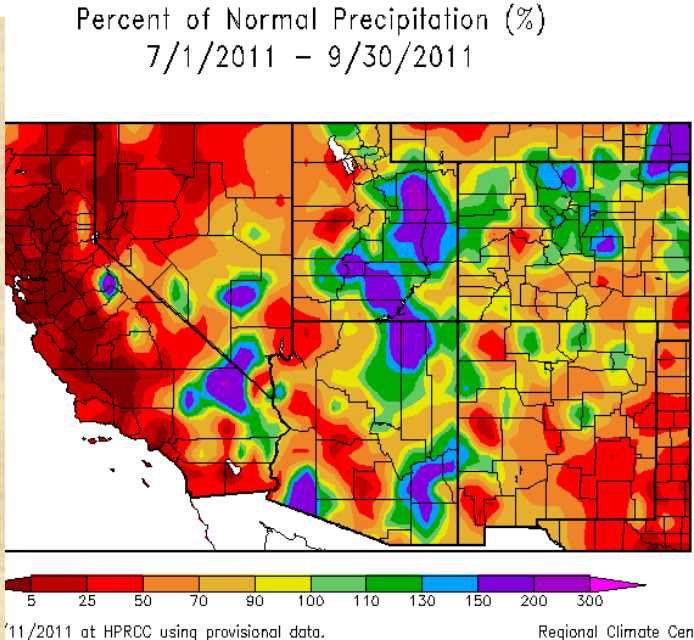




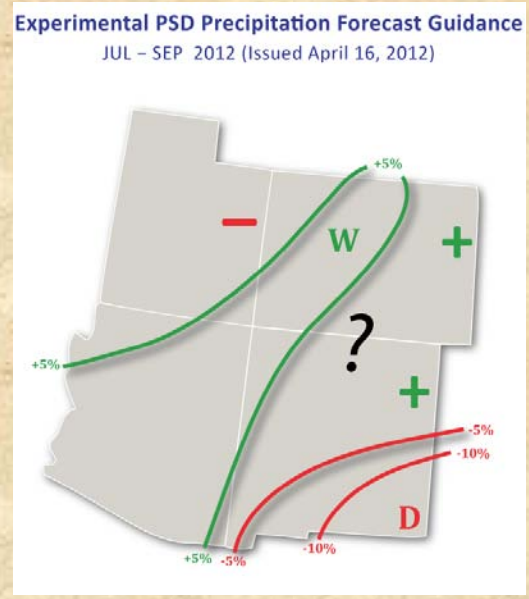
Actual precipitation anomalies (below) reflect the western edge of the south-central U.S. drought in 2011.

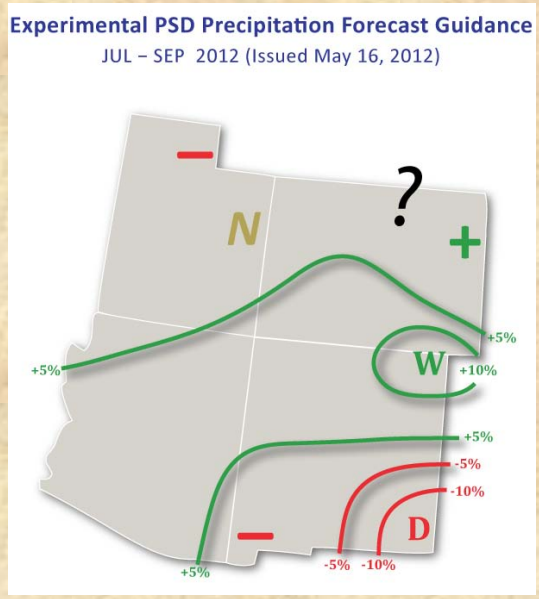
The April forecast for July-September 2011 (left) was optimistic for northwestern CO, and undecided for the rest of the state. The June forecast (top right) was significantly drier, including my 1st dry summer forecast for the eastern plains in more than one decade.

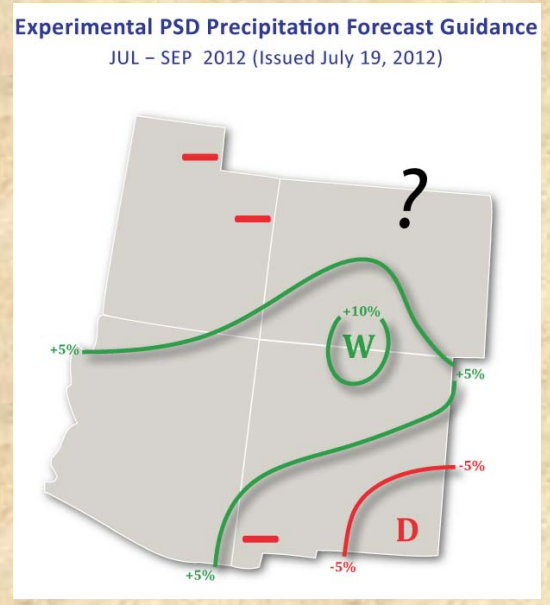
Dry conditions did indeed prevail in much of eastern CO, especially in the Arkansas Valley which was already carrying drought conditions. Early July wetness (plus a couple of storms in September) kept the northern Front Range wetter than expected.



Statistical Forecast for July-September 2012







April's forecast for July-September 2012 (left) was optimistic from AZ into CO, and pessimistic for eastern UT and southern NM. The May forecast (middle) remained guardedly optimistic for most of Colorado. *Operational skill has been best over UT, northwest and eastern Colorado, as well as from southwest to northeast NM. There has been little skill from AZ into southwest Colorado, as well as over southeast NM.*

Update in July is slightly dry in NW CO, undecided in Front Range, 'EC' in eastern plains, and tilting towards a wet monsoon over southern CO.

Executive Summary (20 July 2012)

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1. **La Niña ended up weaker than last year, and did not leave all the typical footprints (lucky Texas!). For Colorado, an overall drier Water Year was correctly anticipated based on typical 2nd year La Niña outcomes. A full transition to El Niño appears to be underway, with (wet) impacts in CO finally materializing this month.**

1. **A dry spring was consistent with lingering La Niña impacts. The next two weeks will continue with near-normal monsoonal moisture but also above-average temperatures that reduce the positive impact of the former. Nevertheless, fire danger should remain seasonal (rather than extreme) for the duration of the monsoon.** ***A dry spell in September *could* return high fire danger for us!***

2. **My forecast for late summer (July-September) shows a tilt towards wet conditions covering most of southern Colorado, with little information away from climatology further north. However, the developing El Niño should improve our chances for moisture statewide, especially from *September* onwards.**

3. **Bottomline: The 'Hail-Mary Pass' to a quick onset of El Niño appears to have worked after all this spring, but typical impacts have been slow to catch on. Dynamical coupled forecast models correctly anticipated El Niño as early as January 2012, while statistical techniques did not catch on to this until about June. A return to La Niña can be ruled out for the upcoming winter. Note that our mountains tend to be the least favored by El Niño compared to lower elevations – the details of this event may make all the difference –** ***stay tuned*****. However, for much of our state, especially the eastern plains, even a short-lived El Niño should bring beneficial moisture.**