

# Seasonal Outlook for Colorado

Klaus Wolter

University of Colorado, CIRES & NOAA-ESRL PSD 1, Climate Analysis Branch  
[klaus.wolter@noaa.gov](mailto:klaus.wolter@noaa.gov)

- **What has happened to ENSO(+), and what will happen next?**
- **What have similar ENSO situations done to/for us?**
- **CPC forecasts into early 2015**
- **Seasonal Forecast Guidance for precipitation**
- **Executive Summary**

# ***Audience Feedback Requested***

***“An intellectual is a man who takes more words than necessary to tell more than he knows.”***

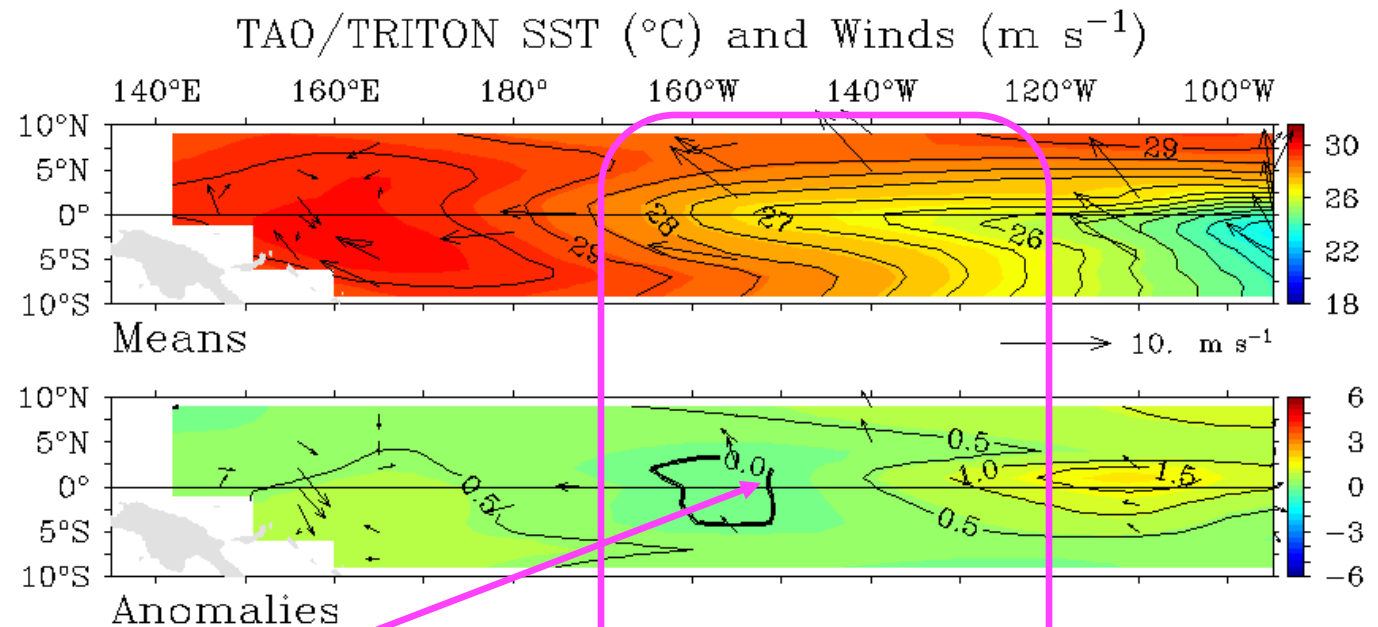
**Dwight D. Eisenhower**

***Can you help me to avoid this trap?***

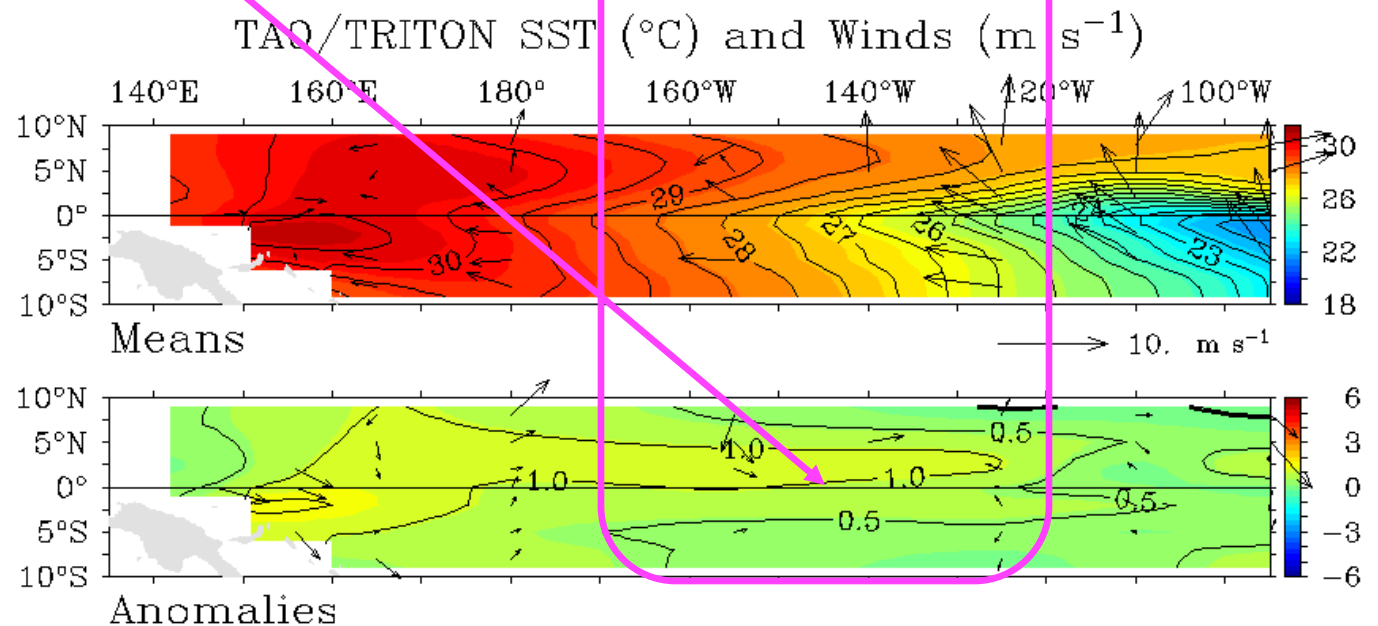
***Which parts of my talk are most confusing, or could be cut, or expanded?***

***Are you missing something that I rarely ever mention?***

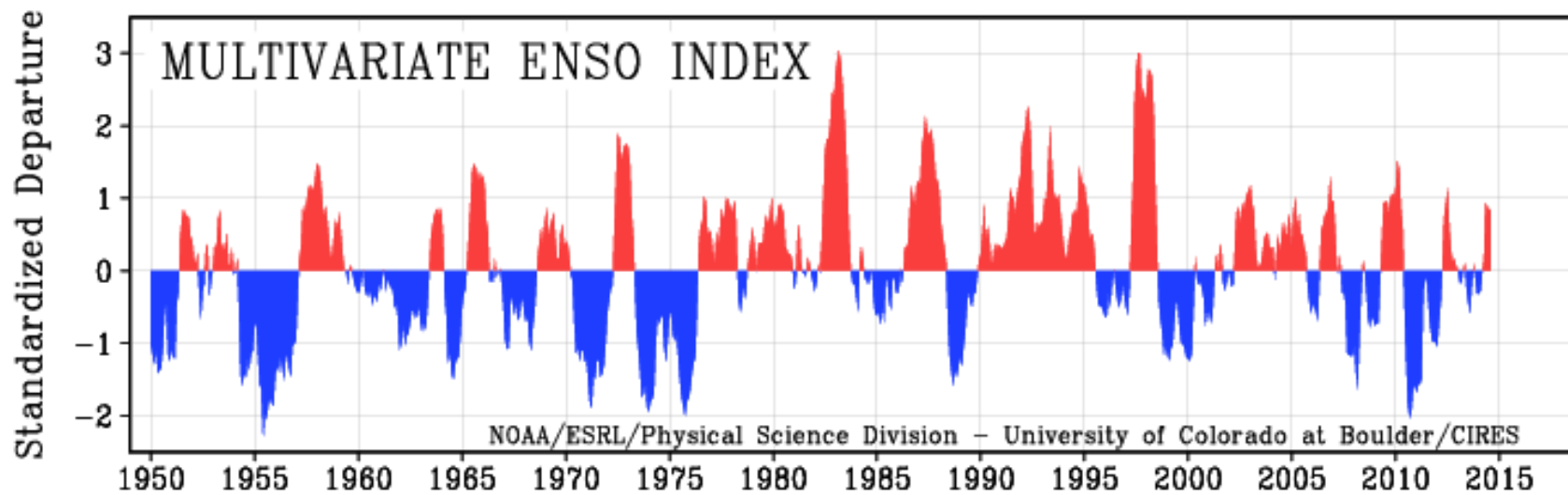
**Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to last month (top): Recent SST anomalies are more consistent with developing El Niño conditions, *with modest westerly wind anomalies that continue to nudge the Pacific towards at least a weak El Niño.***



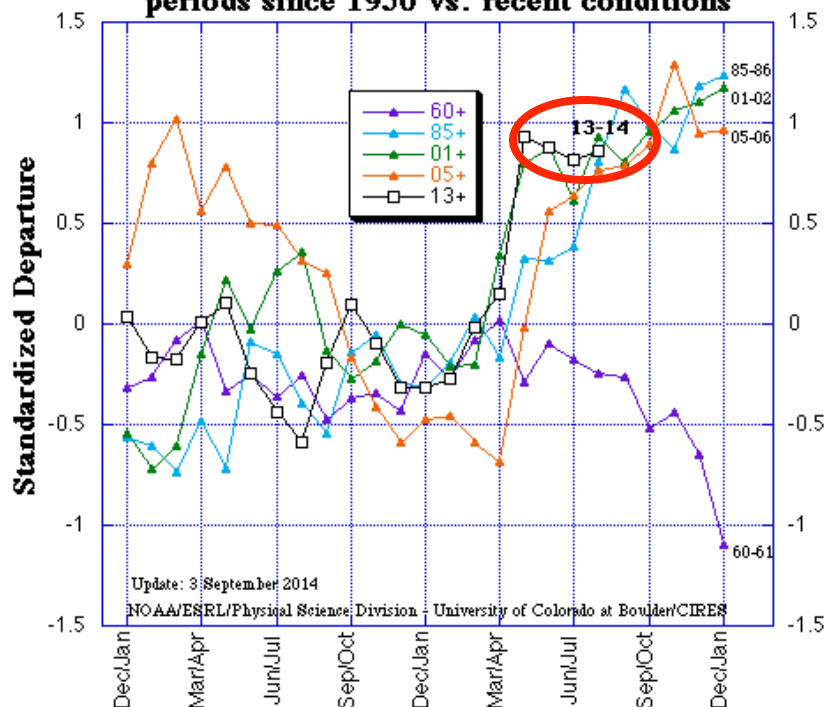
Five-Day Mean Ending on July 21 2014



Five-Day Mean Ending on September 15 2014



**Multivariate ENSO Index (MEI) after neutral August-February periods since 1950 vs. recent conditions**



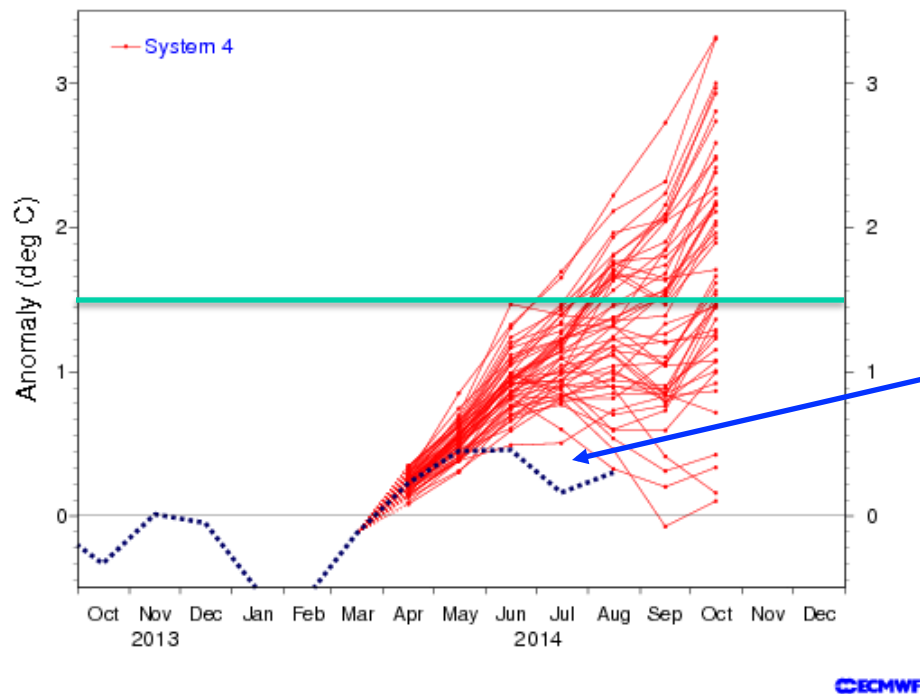
*During the last decade, we have been in a regime that favors La Niña, but does allow for occasional El Niño events, mostly of the weak-to-moderate variety.*

*ENSO conditions often change during our spring season. This year towards El Niño indeed, and the MEI has shown weak-to-moderate strength since April-May. The lack of monsoonal rain in India (-11%) and hurricanes over the Atlantic support the notion that El Niño has already arrived.*

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



NINO3.4 SST anomaly plume  
ECMWF forecast from 1 Apr 2014  
Monthly mean anomalies relative to NCEP OIv2 1981-2010 climatology

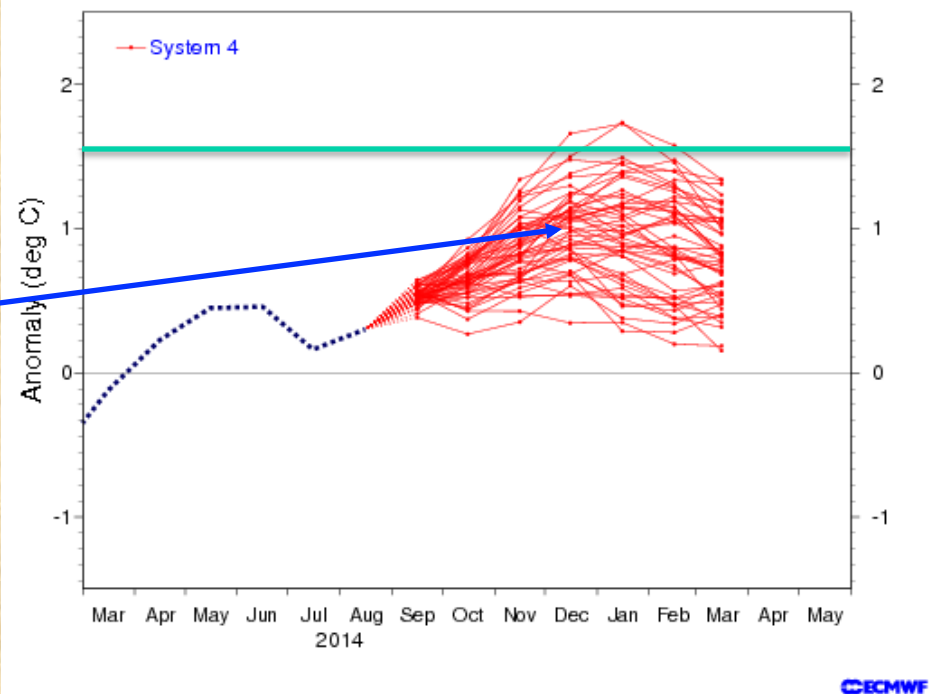


**While the ECMWF is recognized as the best model in this business, their April forecast (left) overestimated the chances for a strong El Niño (above green line), while the verification ended up at or below the range of ensemble forecast members (---).**

**The ECMWF September 2014 forecast (right) continues a moderating trend of this model over the last few months, but still giving us 50/50 odds for a medium-size event (close to +1°C). This time of year, the range of possible outcomes is smaller than in boreal spring.**

[http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/seasonal\\_range\\_forecast/](http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/seasonal_range_forecast/)

NINO3.4 SST anomaly plume  
ECMWF forecast from 1 Sep 2014  
Monthly mean anomalies relative to NCEP OIv2 1981-2010 climatology



## *Prospects for El Niño in 2014-15*

To anticipate ENSO/MEI conditions for the next six months, at a time of high persistence of the ENSO systems, I resorted to two different analogue predictions. For the first one, I picked the three closest MEI analogue cases over the last 12 months (1990-91, 2001-02, and 2008-09), as well as the three most extreme anti-analogues (1953-54, 1963-64, and 1972-73). I calculated a multiple regression forecast for the next six months based on the 1<sup>st</sup> three predictors, then the 2<sup>nd</sup> set, and finally all six. Here is the outcome:

Season	3+	3-	All 6	Ranked MEI range (#1 = strong El Niño)
Sep-Oct'14	1.00	0.88	0.80	<b>10-18</b> (out of 64) = weak-to-moderate
Nov-Dec'14	0.88	0.77	0.62	<b>12-20</b> (a bit weaker)
Jan-Feb'15	0.95	0.56	0.53	<b>10-19</b> (out of 65) = similar to Sep-Oct

*This gives me 9-10 analogue cases for each season, but not always the same cases.*

## ***Prospects for El Niño in 2014-15***

The 2<sup>nd</sup> analogue method considers MEI cases with similar amplitudes as for the last two months, requiring a rising scenario within the calendar year ('Year 0' for El Niño events), PLUS some similarity in the status of Niño 3 SST, the Southern Oscillation Index (SOI), as well as the Pacific Decadal Oscillation (PDO) in July-August 2014.

This gave me a set of **nine analogue cases** that are kept the same going forwards:

*1957-58, 1986-87, and 1991-92* (considered strong El Niño events)

and

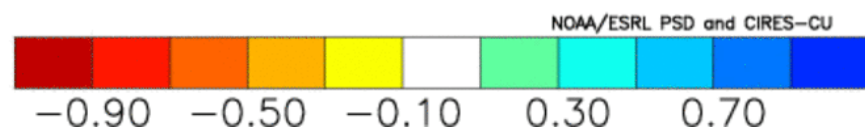
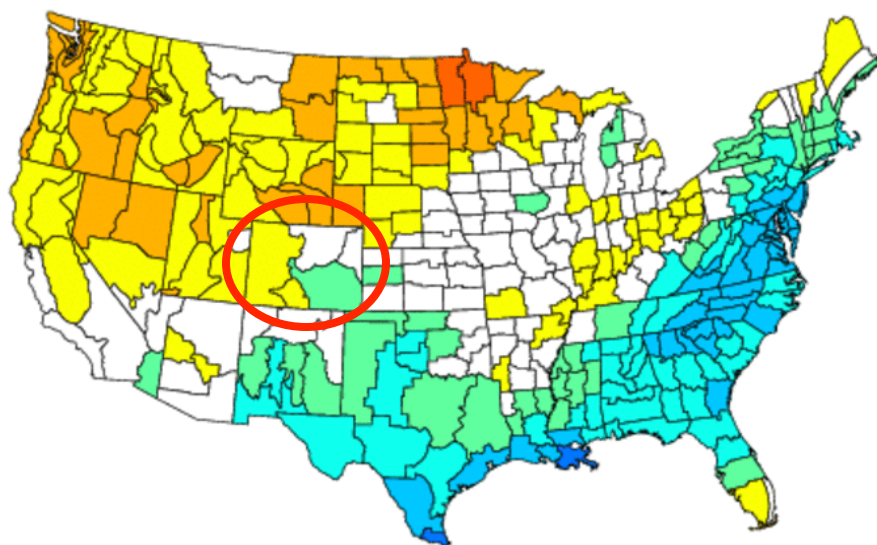
*1976-77, 77-78, 79-80, 2002-03, 04-05, and 06-07* (considered weak-to-moderate).

The average outcome from these nine analogues is between +0.8 and +1.0 for the next six months, slightly bigger than the 1<sup>st</sup> analogue scenario, especially during winter.

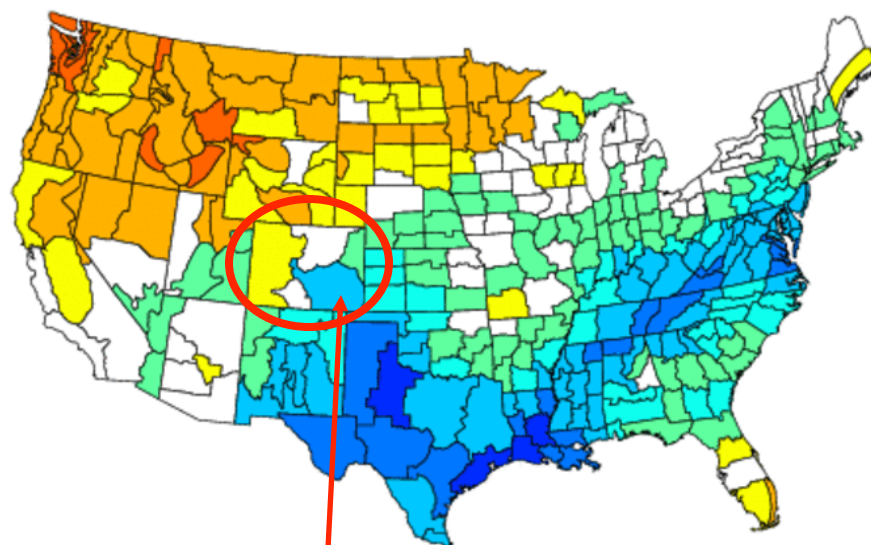


## October-December: Precipitation

NOAA/NCDC Climate Division Composite Standardized Precipitation Anomalies  
Oct to Dec 1992,1951,1963,2006,1976,2002,1986,1977,1991  
Versus 1951–2010 Longterm Average



NOAA/NCDC Climate Division Composite Standardized Precipitation Anomalies  
Oct to Dec 1957,1976,1977,1979,1986,1991,2002,2004,2006  
Versus 1951–2010 Longterm Average

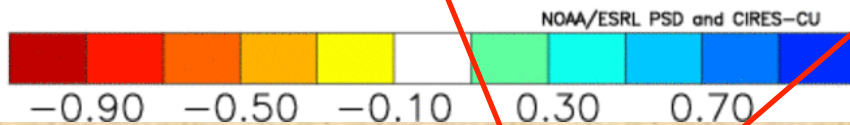
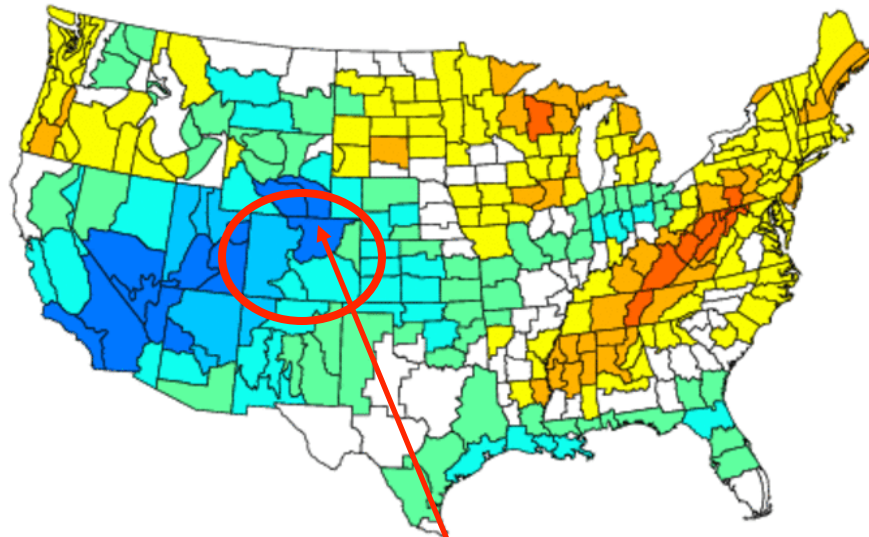


Expected precipitation anomalies according to ‘Method 1’ (left), and ‘Method 2’ (right). Values in excess of  $\pm 0.5$  are considered statistically significant. Remember that both methods anticipated a weak-to-moderate El Niño event this winter. *For CO, only the 2<sup>nd</sup> scenario gives us a significant chance for a wet fall in the Arkansas Valley.*

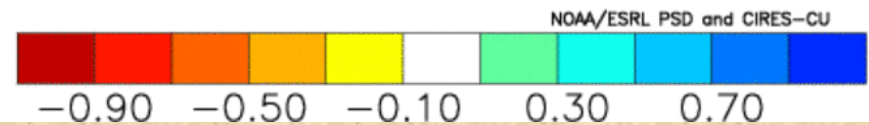
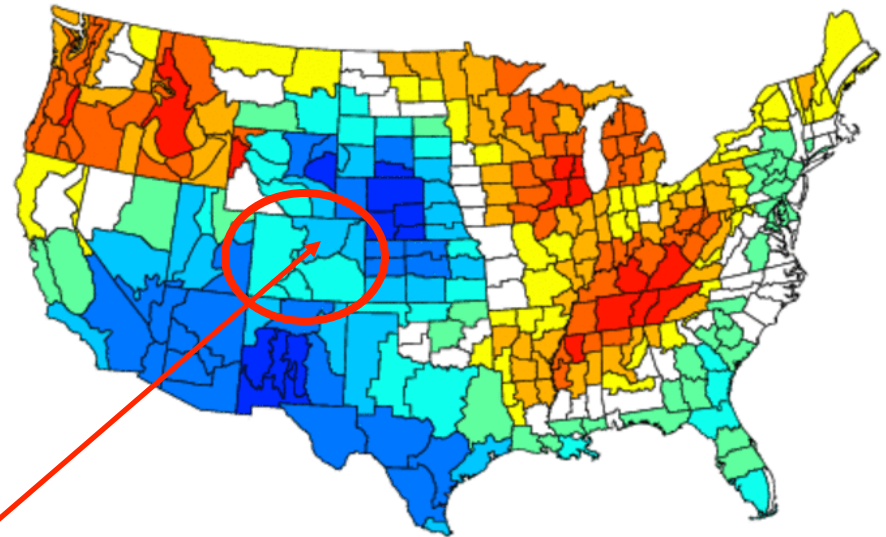


## January-March: Precipitation

NOAA/NCDC Climate Division Composite Standardized Precipitation Anomalies  
Jan to Mar 2007,1990,1980,1988,2005,1959,1969,1978,2003,1995  
Versus 1951–2010 Longterm Average



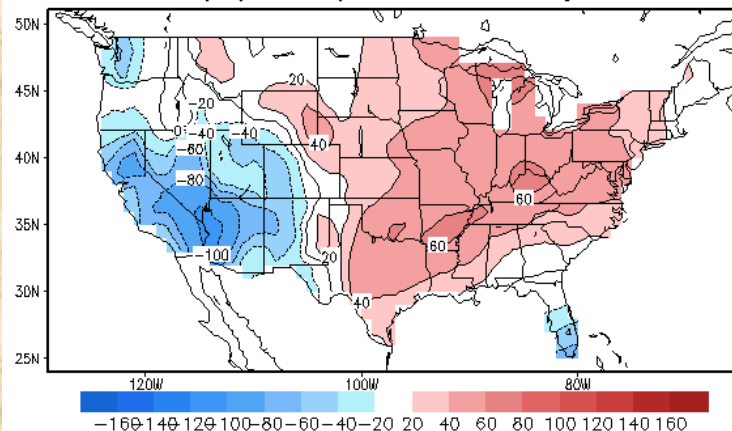
NOAA/NCDC Climate Division Composite Standardized Precipitation Anomalies  
Jan to Mar 1958,1977,1978,1980,1987,1992,2003,2005,2007  
Versus 1951–2010 Longterm Average



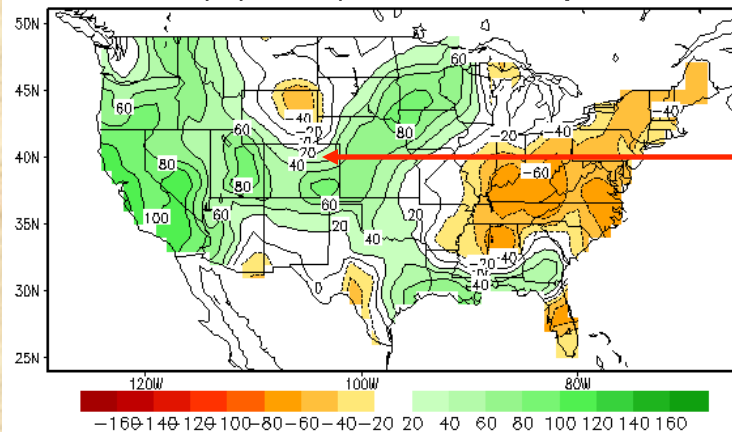
Expected precipitation anomalies according to ‘Method 1’ (left), and ‘Method 2’ (right). Values in excess of +/-0.5 are considered statistically significant. *For CO, this season looks most promising for the South Platte basin, followed by the Upper Colorado basin.* Much of this wet outlook hinges on a typical El Niño **March** outcome.

# CPC Soil Moisture Analogue Forecasts

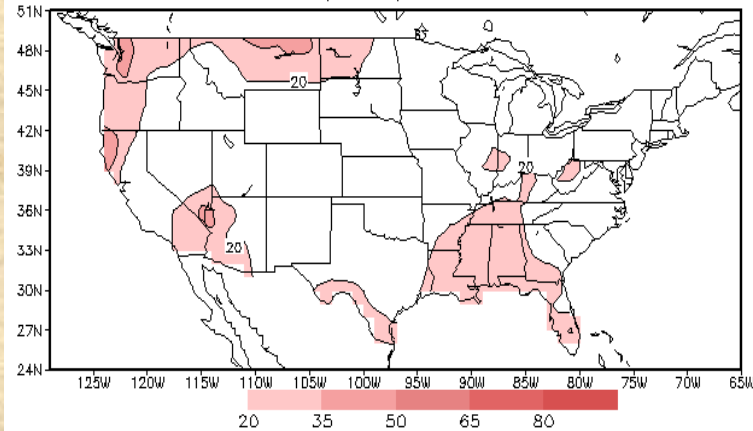
Lagged Averaged Temperature Outlook for OND 2014  
units: anomaly (sdX100), SM data ending at 20140915



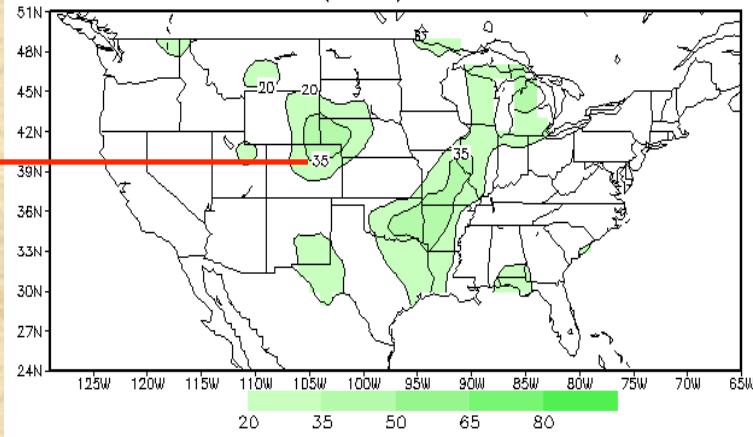
Lagged Averaged Precipitation Outlook for OND 2014  
units: anomaly (sdX100), SM data ending at 20140915



lead 1 skill of temperature CAS forecast for OND  
units: correlation (X100) based on 1981-2005



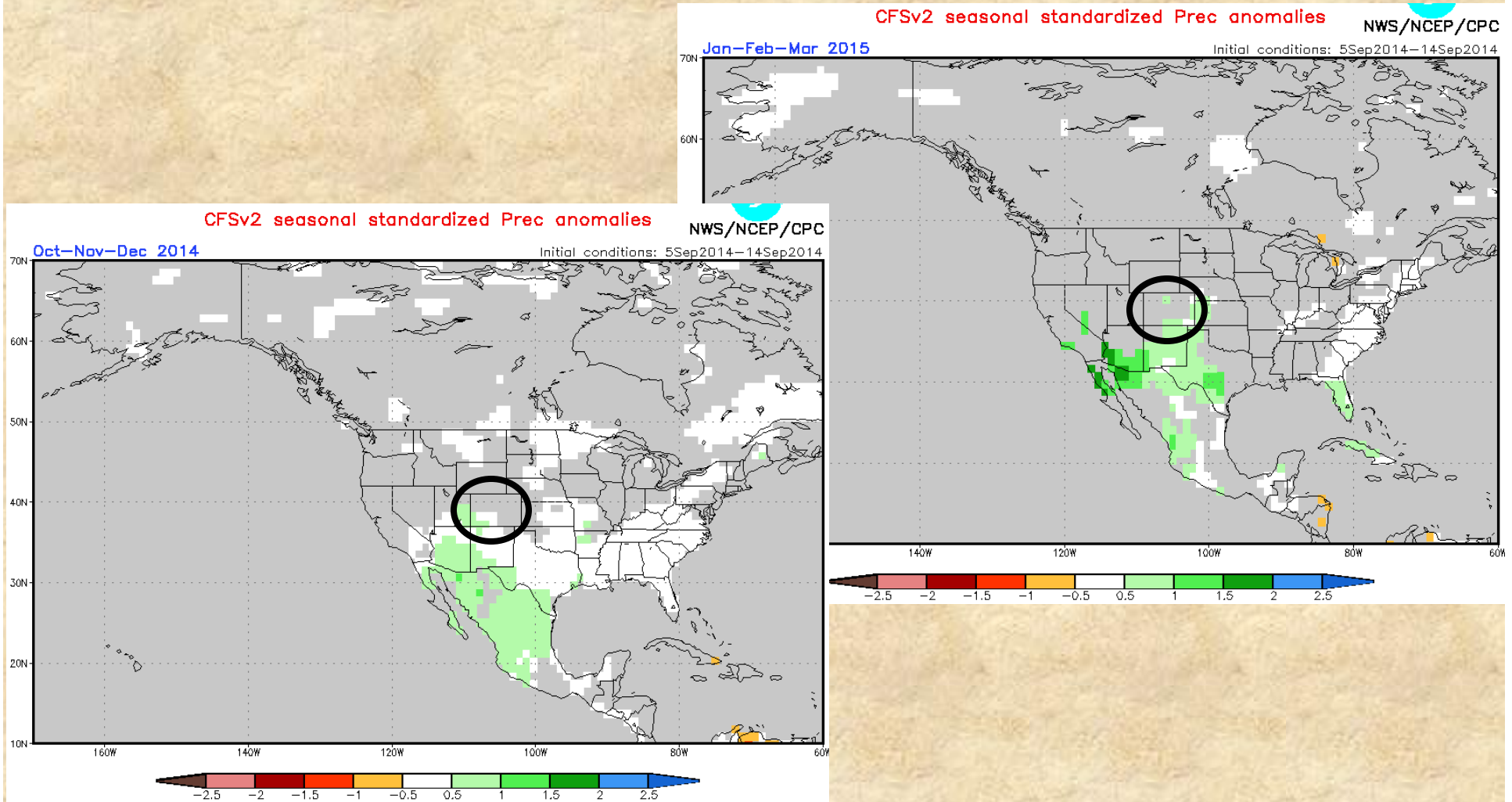
lead 1 skill of precipitation CAS forecast for OND  
units: correlation (X100) based on 1981-2005



CPC's soil moisture tool anticipates a mostly cool and moist late fall over our state, supported by marginal skill in precipitation – *last season to be shown here.*

<http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/>

# CPC Coupled Forecast System Version 2

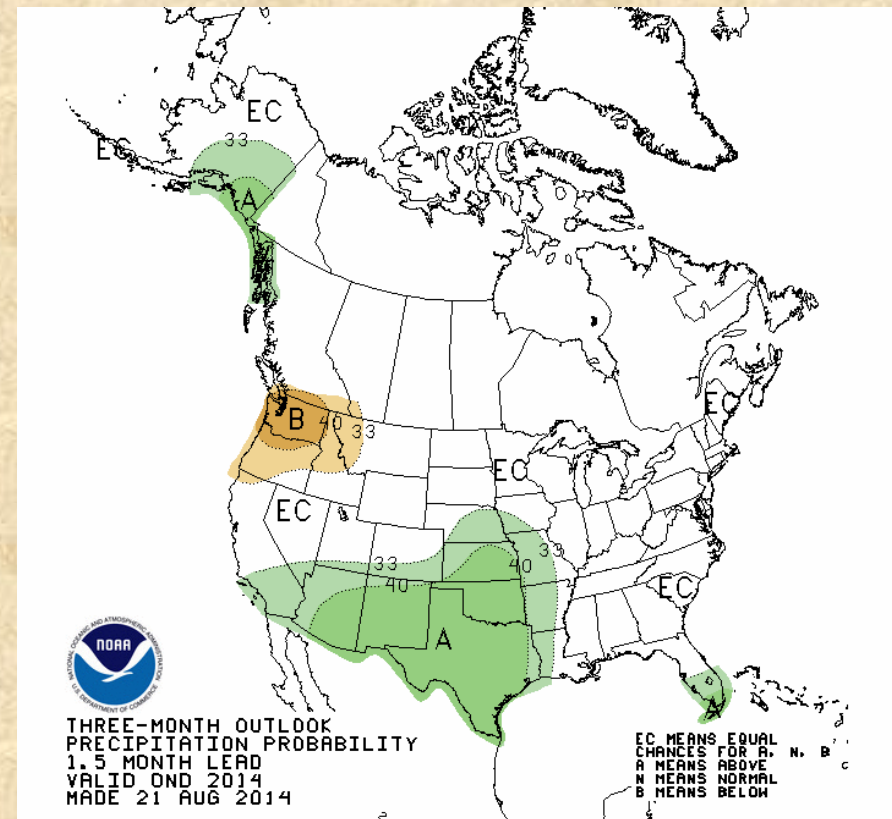
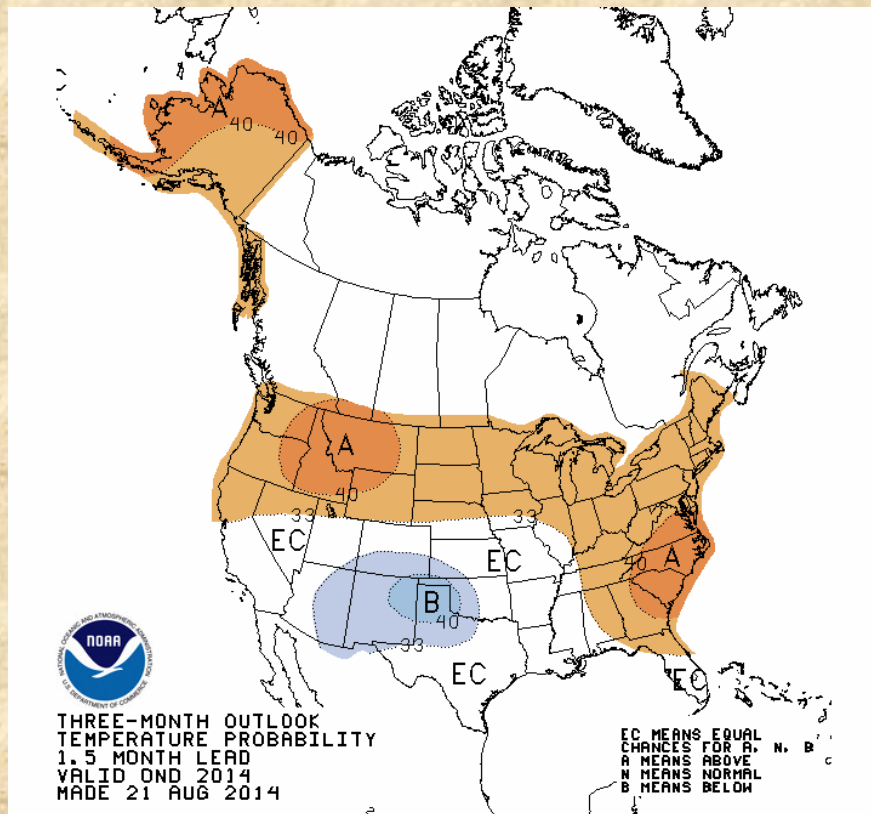


**CFS forecasts for Oct-Dec (left) and Jan-Mar (right) keep most of the extra moisture to the south, or to be more specific, do not show skill over Colorado**

<http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/index.pri.html>



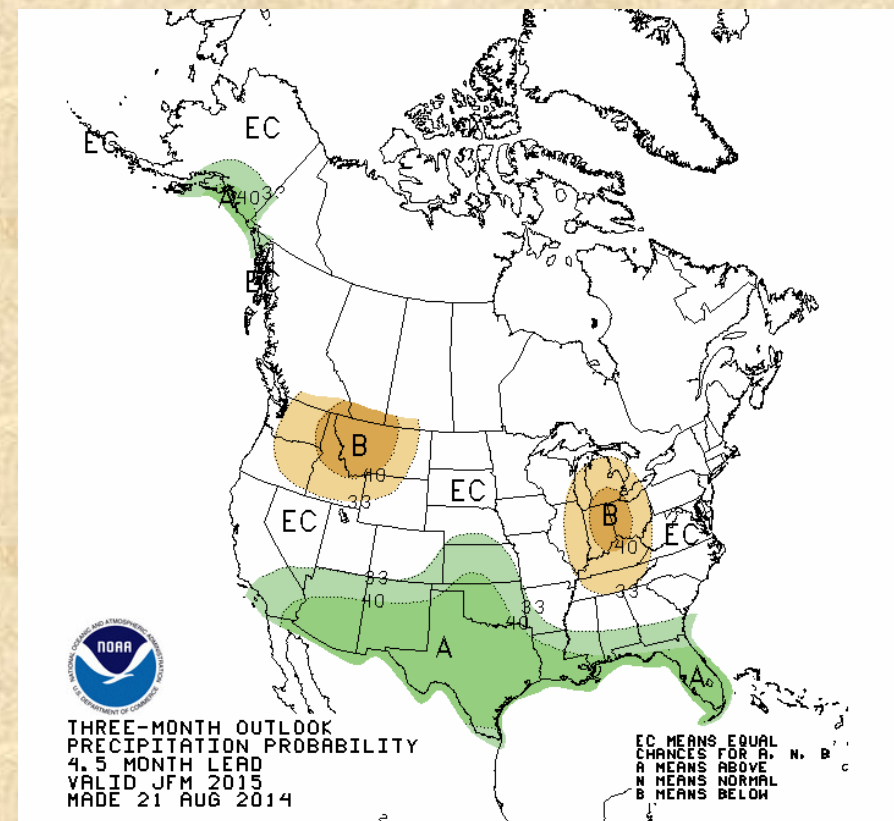
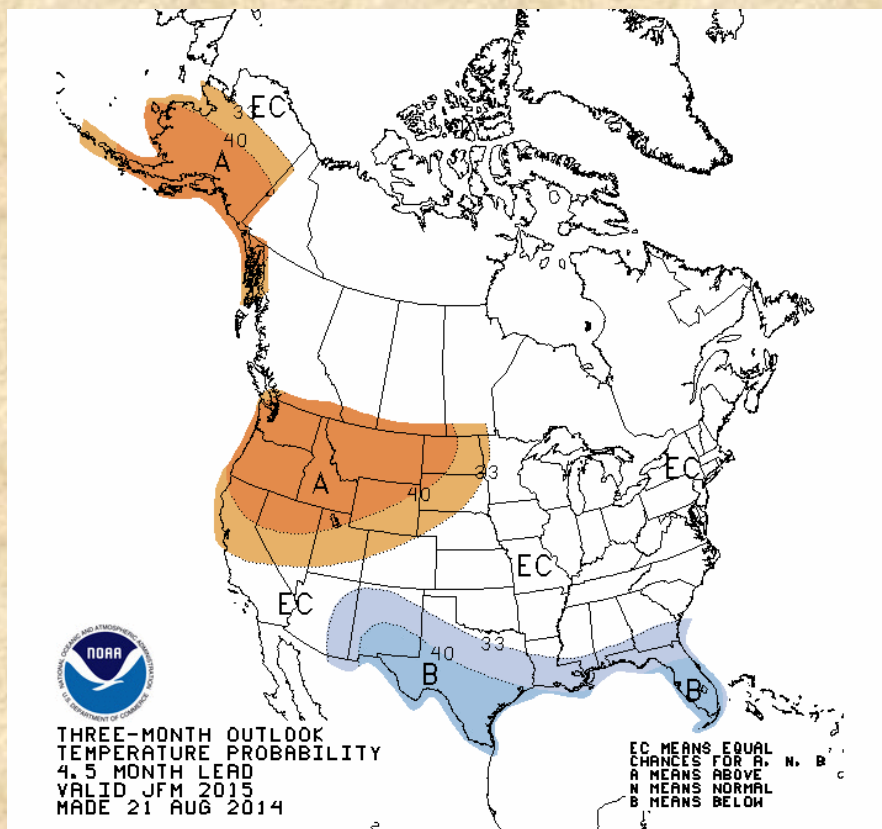
# Climate Prediction Center Forecasts



Colorado is not likely to be warmer-than-average this fall according to CPC (left). Their moisture forecast (right) keeps excess moisture mostly to our south. This is mostly consistent with CPC's El Niño composites. *Update tomorrow!*

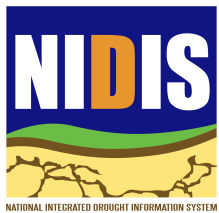
Source: <http://www.cpc.ncep.noaa.gov/products/predictions/>

# Climate Prediction Center Forecasts



The long-lead winter temperature forecast by CPC (left) keeps Colorado near-normal for now. Their moisture forecast (right) looks suspiciously similar to the late fall forecast. This particular forecast ignores a tendency for Colorado to have wet Marches during El Niño conditions. *Update tomorrow!*

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

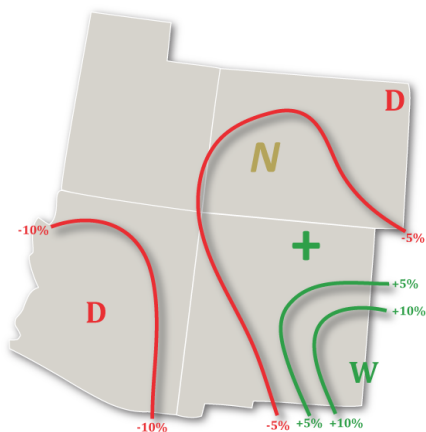


# ‘Postmortem’ for July-September 2014

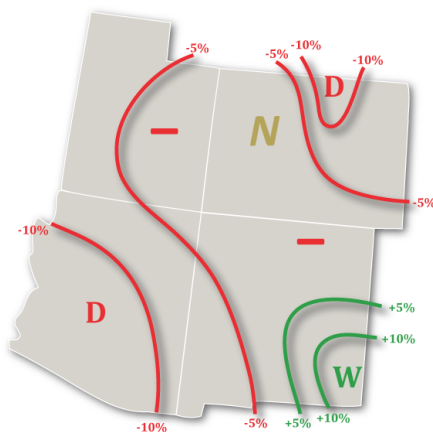
*High month-to-month consistency does not a good forecast make...*



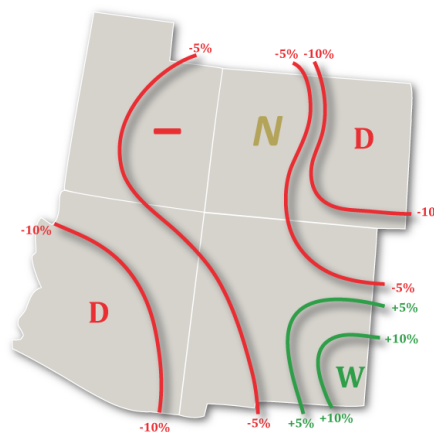
Experimental PSD Precipitation Forecast Guidance  
JUL – SEP 2014 (April 16, 2014)



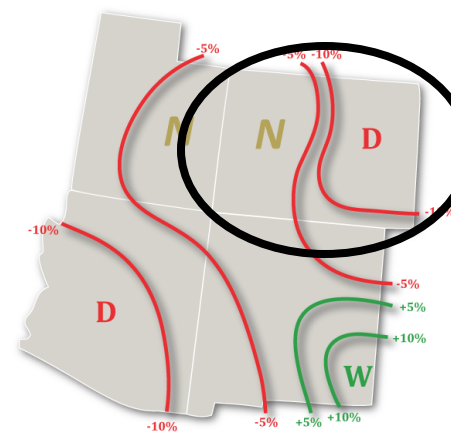
Experimental PSD Precipitation Forecast Guidance  
JUL – SEP 2014 (May 15, 2014)



Experimental PSD Precipitation Forecast Guidance  
JUL – SEP 2014 (June 17, 2014)

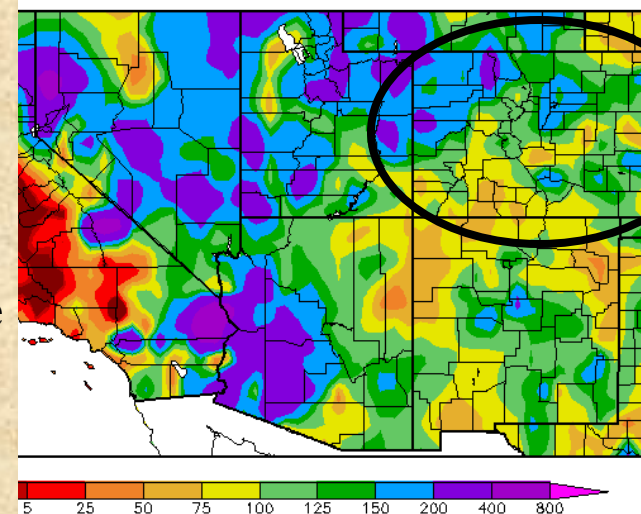


Experimental PSD Precipitation Forecast Guidance  
JUL – SEP 2014 (July 16, 2014)



Percent of Normal Precipitation (%)  
7/1/2014 – 9/15/2014

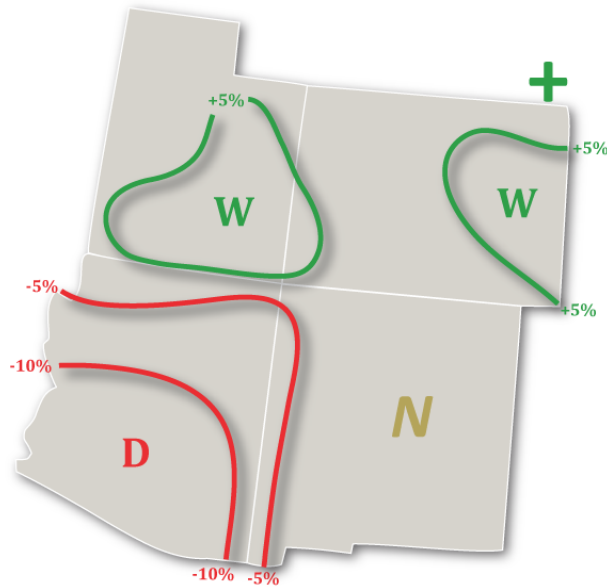
**All statistical seasonal forecasts ended up too dry for the interior Southwest. Looking at western CO (near-normal forecast), the San Juans may verify best, while it was wetter than normal towards the Yampa basin. Over eastern CO (dry forecast), only a few pockets ended up significantly dry. This explains the ever-shrinking percentage of drought conditions in CO, but means essentially a failed forecast. The weak El Niño did not translate into a dry summer after all for most of us. *We got lucky!***



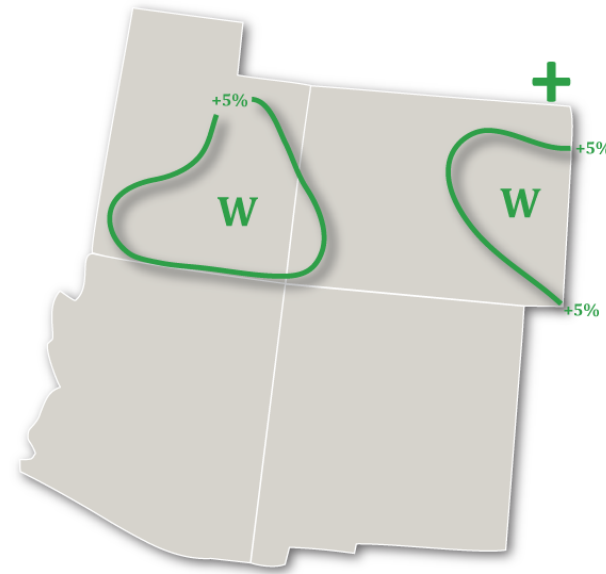


# Statistical Forecast for Oct-Dec 2014

**Experimental PSD Precipitation Forecast Guidance**  
OCT – DEC 2014 (Issued September 15, 2014)

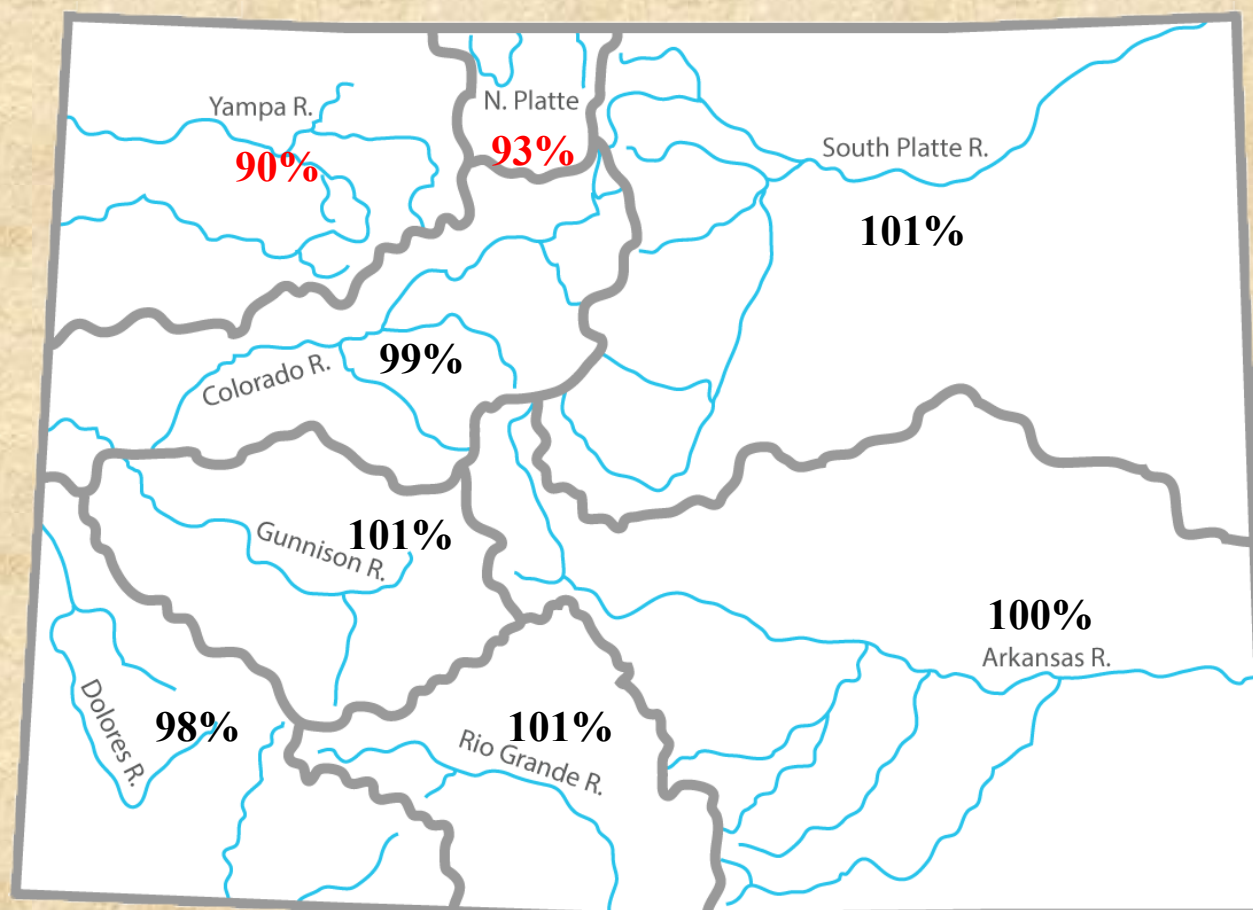


**Experimental PSD Precipitation Forecast Guidance**  
OCT – DEC 2014 (Issued September 15, 2014) – *Skill Masked*



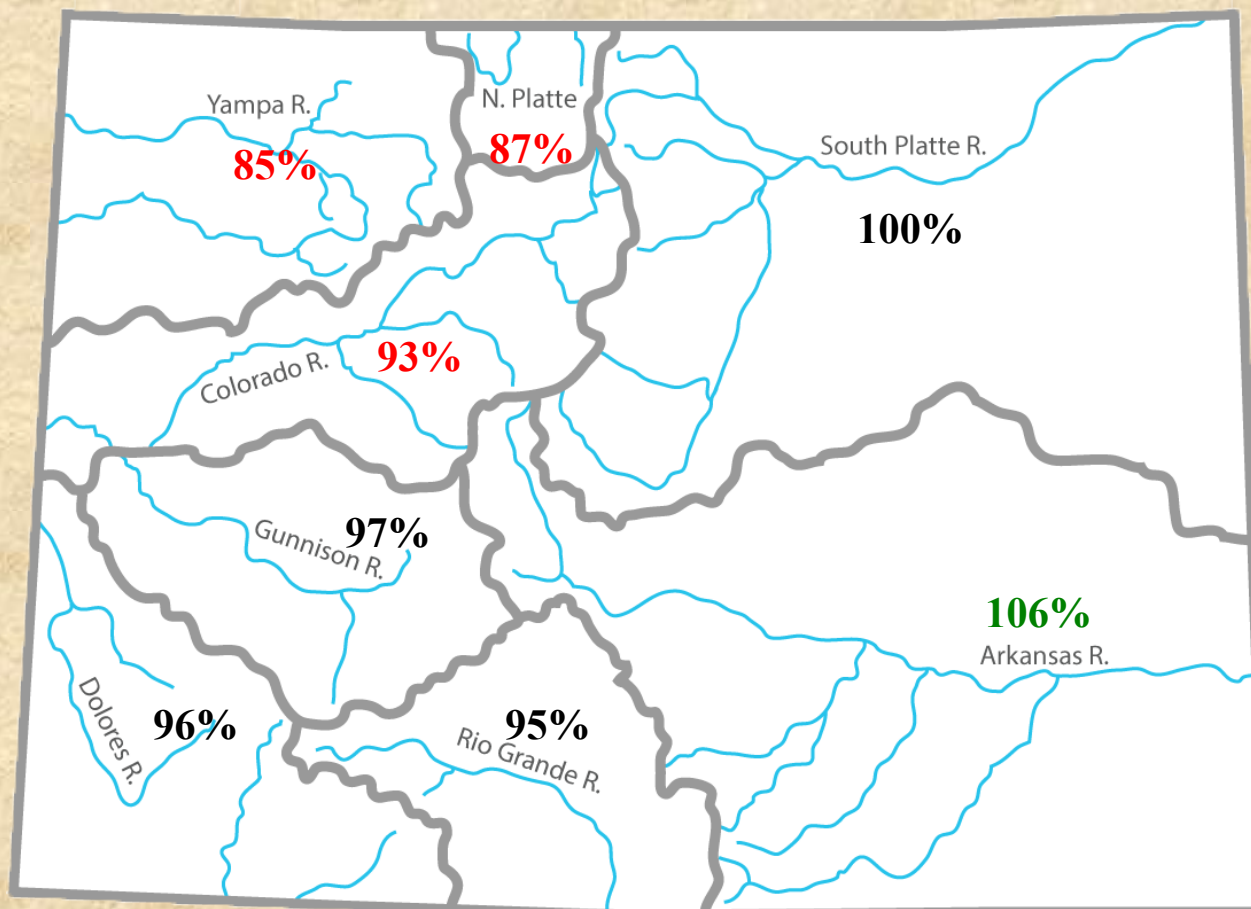
Fall forecast (left) is either neutral (mountains) or on the wet side for Colorado (mostly eastern plains). New skill-masked forecast (right) shows that the wet forecasts are supported by operational skill (since 1999), while forecasts for AZ&NM are not.

## El Niño composites for 1jan SWE



**Median outcome for weak-to-moderate Los Niños since 1980  
(during fall season: '86, '91, '93, '02, '06, '09)**

## El Niño composites for 1 apr SWE



**Median outcome for same set of weak-to-moderate Los Niños since 1980  
(during fall season: '86, '91, '93, '02, '06, '09)**



## Executive Summary (17sep2014)

[klaus.wolter@noaa.gov](mailto:klaus.wolter@noaa.gov)

- While El Niño/La Niña can provide decent guidance for climate outlooks around here, this was not very helpful in two years of ENSO-neutral conditions. A weak El Niño is expected to continue as a weak-to-moderate event into early next year.
- My own forecast for the Multivariate ENSO Index (MEI) confirms this outlook through the winter, with a small chance for further growth into a bigger event, and no chances for La Niña.
- A weak-to-moderate El Niño translates into a climatological forecast for fall west of the divide, while the odds are more favorable east of the divide. This is confirmed by my statistical forecast as well as two analogue scenarios. Over the eastern plains, late winter into early spring is often wetter-than-average.
- CPC's forecasts do not depart from climatological odds for Colorado during the next six months.
- A first look at SWE conditions during weak-to-moderate Los Niños confirm an overall near-normal outlook for the fall season, but show a *distinct threat of dry conditions by 1 April for the northwestern basins, including the Colorado River.*