

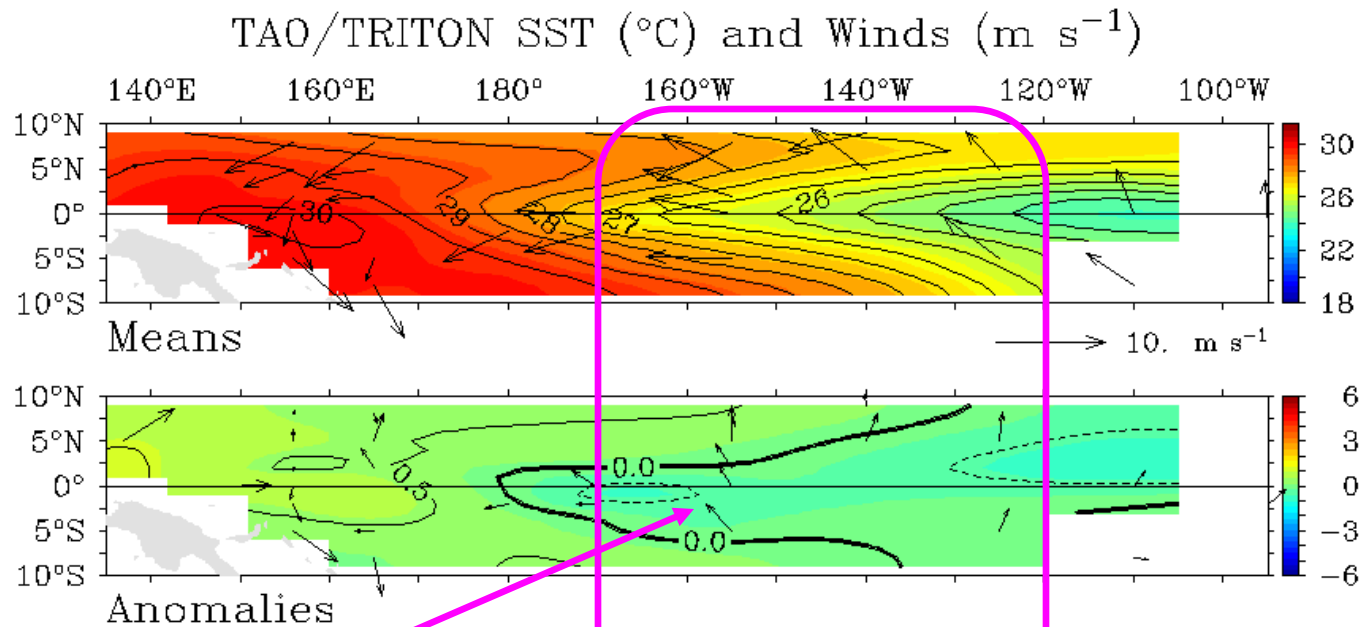
Seasonal Outlook for Spring 2014

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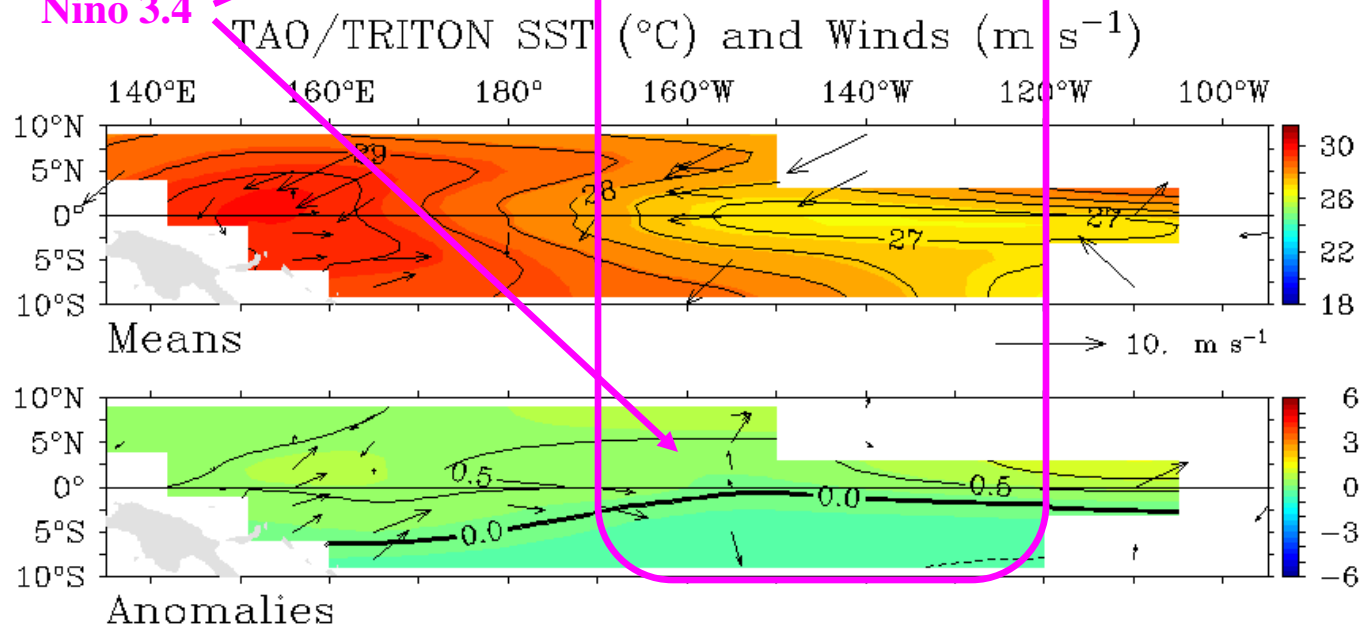
- **What has happened to ENSO(+), what will happen next, and what does that mean for us ?**
- **Expectations for the next two weeks**
- **CPC forecasts for March through June 2014**
- **Seasonal Forecast Guidance for precipitation & *1jun SWE***
- **Executive Summary**

Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to last year (top): What a difference two months make (aside from growing data holes): Current wind (& subsurface) anomalies are consistent with developing El Niño conditions, in fact, the subsurface warming is the most dramatic component evolving over the last month or two.

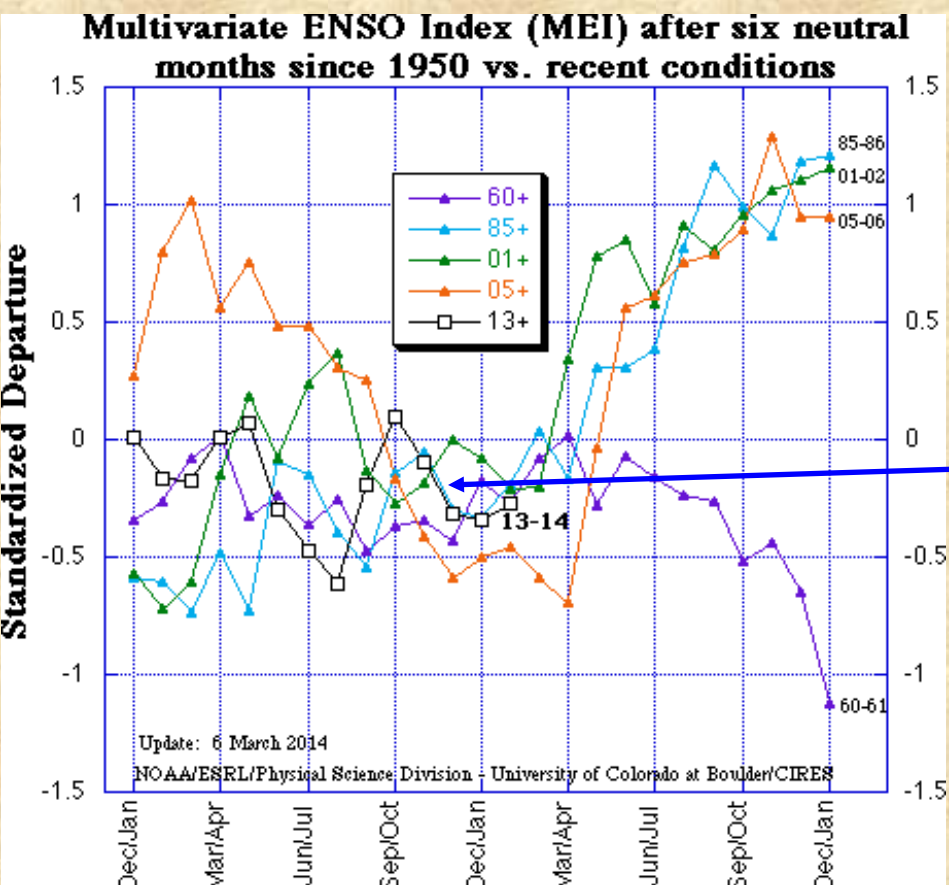
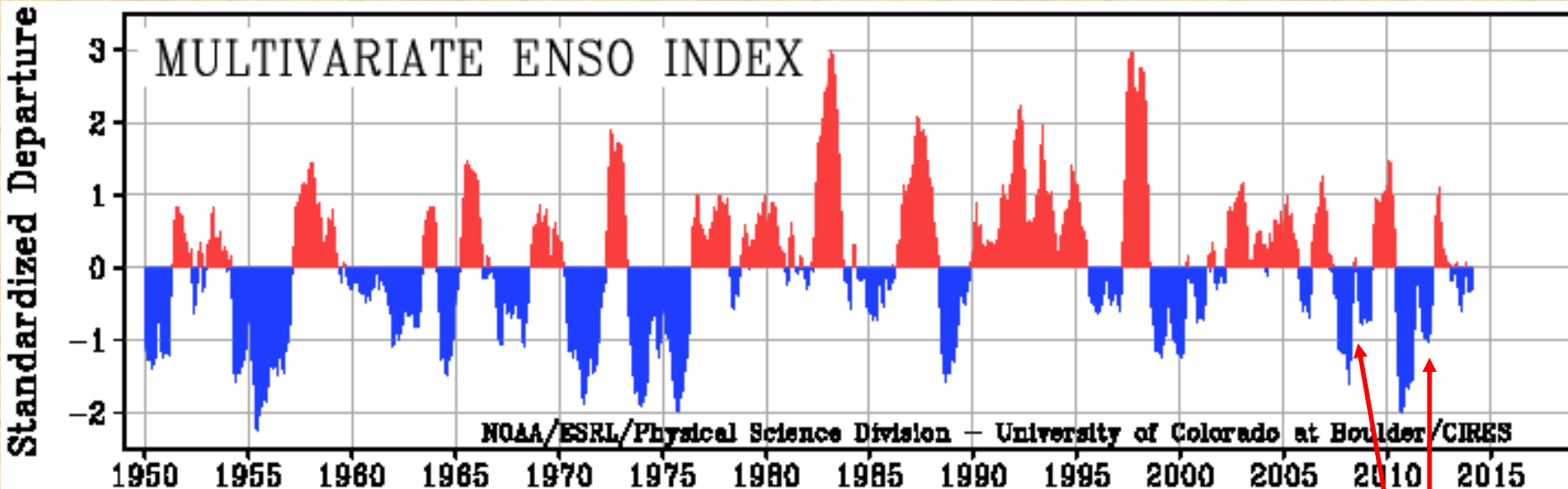


Five-Day Mean Ending on January 19 2014

Niño 3.4



Five-Day Mean Ending on March 17 2014

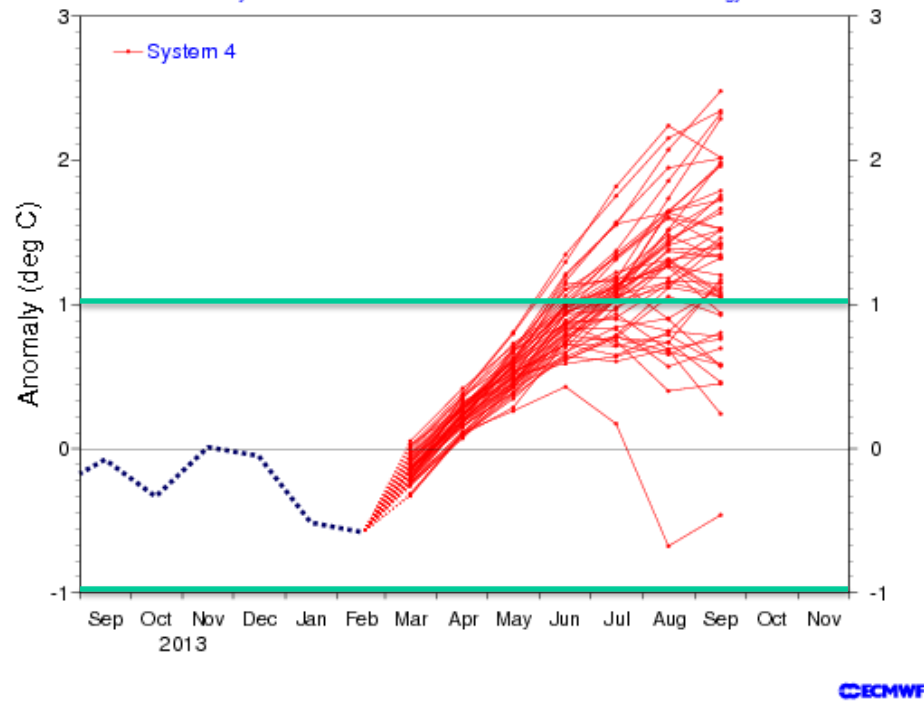


Last seven years have seen two 'double-dip' Las Niñas in a row, followed by a brief excursion to what looked like an El Niño event in 2012, and a return to ENSO-neutral or weak La Niña conditions for much of the last year.

What the figure on the left illustrates is how fast conditions can change during our spring season, and most often towards El Niño, last seen in 2006.

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

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

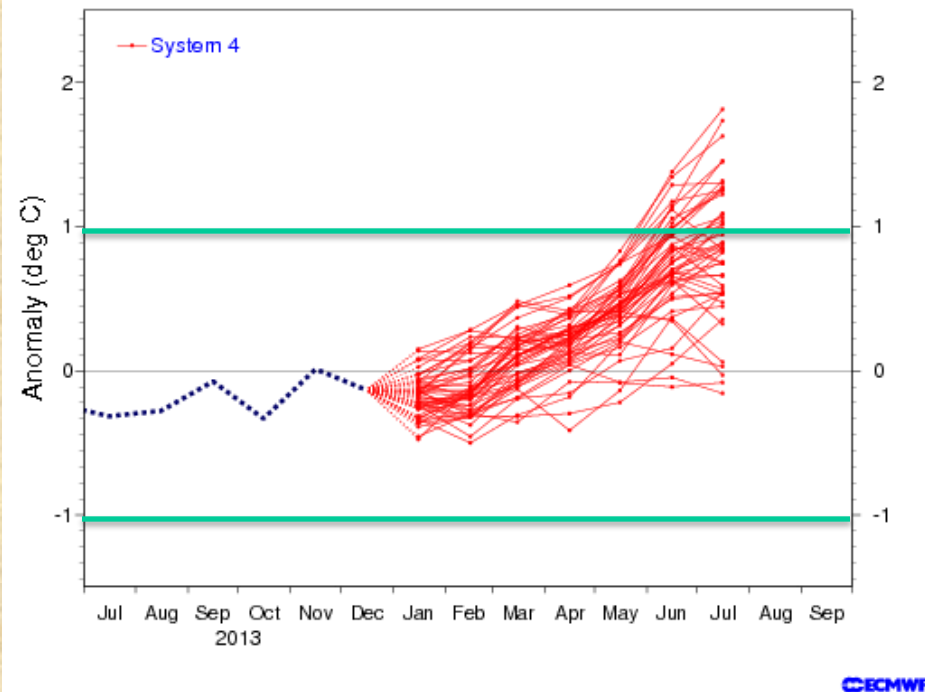


The latest ECMWF forecast (left) has near-unanimous support for a transition to El Niño by June 2014 – *with one lone dissenter out of 50*. I just released my own ENSO forecast that basically agrees with that (*67% chance for El Niño and 0% for La Niña six months from now*).

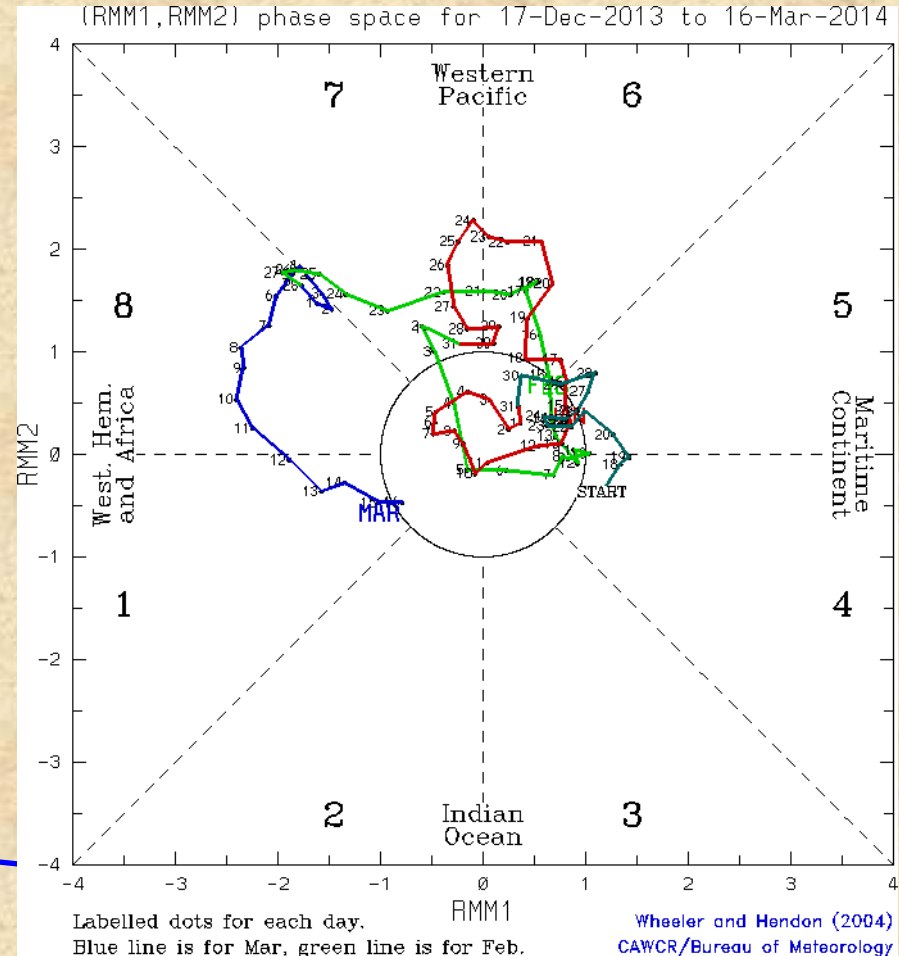
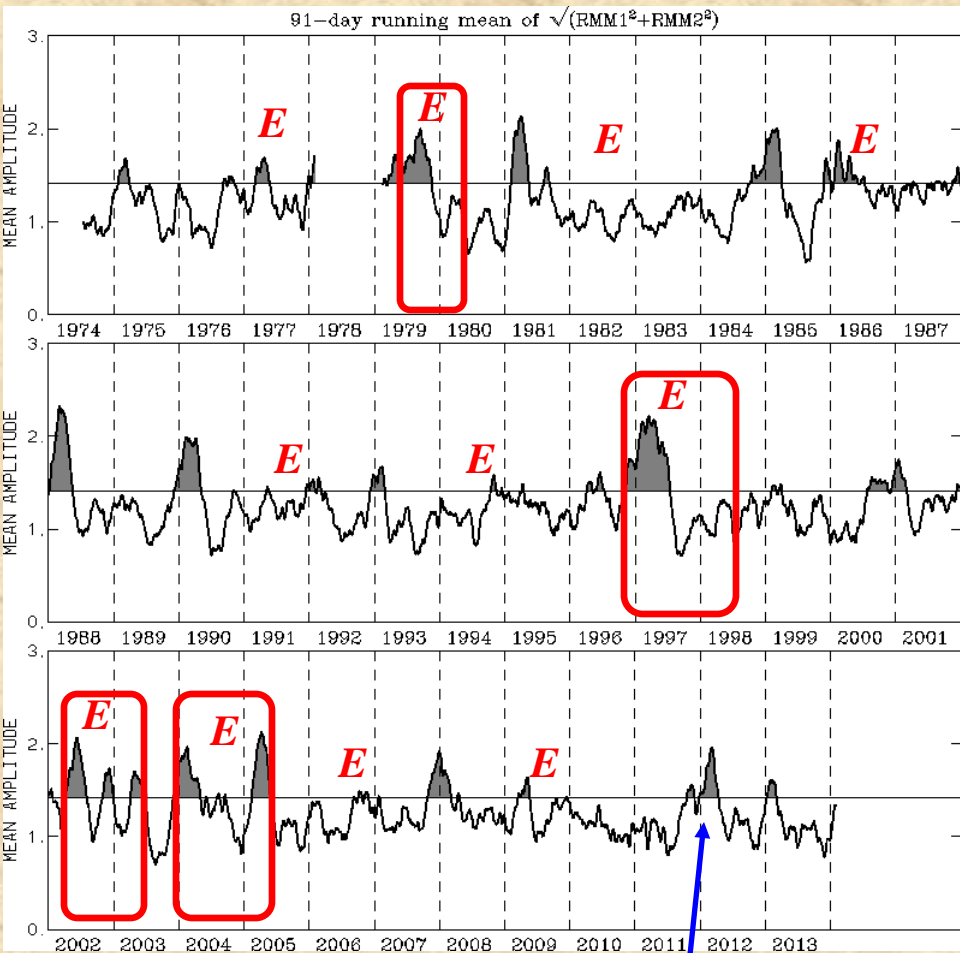
The ECMWF January 2014 forecast (right) advertised a pretty straightforward transition towards El Niño by mid-year, but only 20% of the 50 ensemble members showed moderate El Niño conditions by July (as compared to more than 50% in the above figure).

http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/seasonal_range_forecast/

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

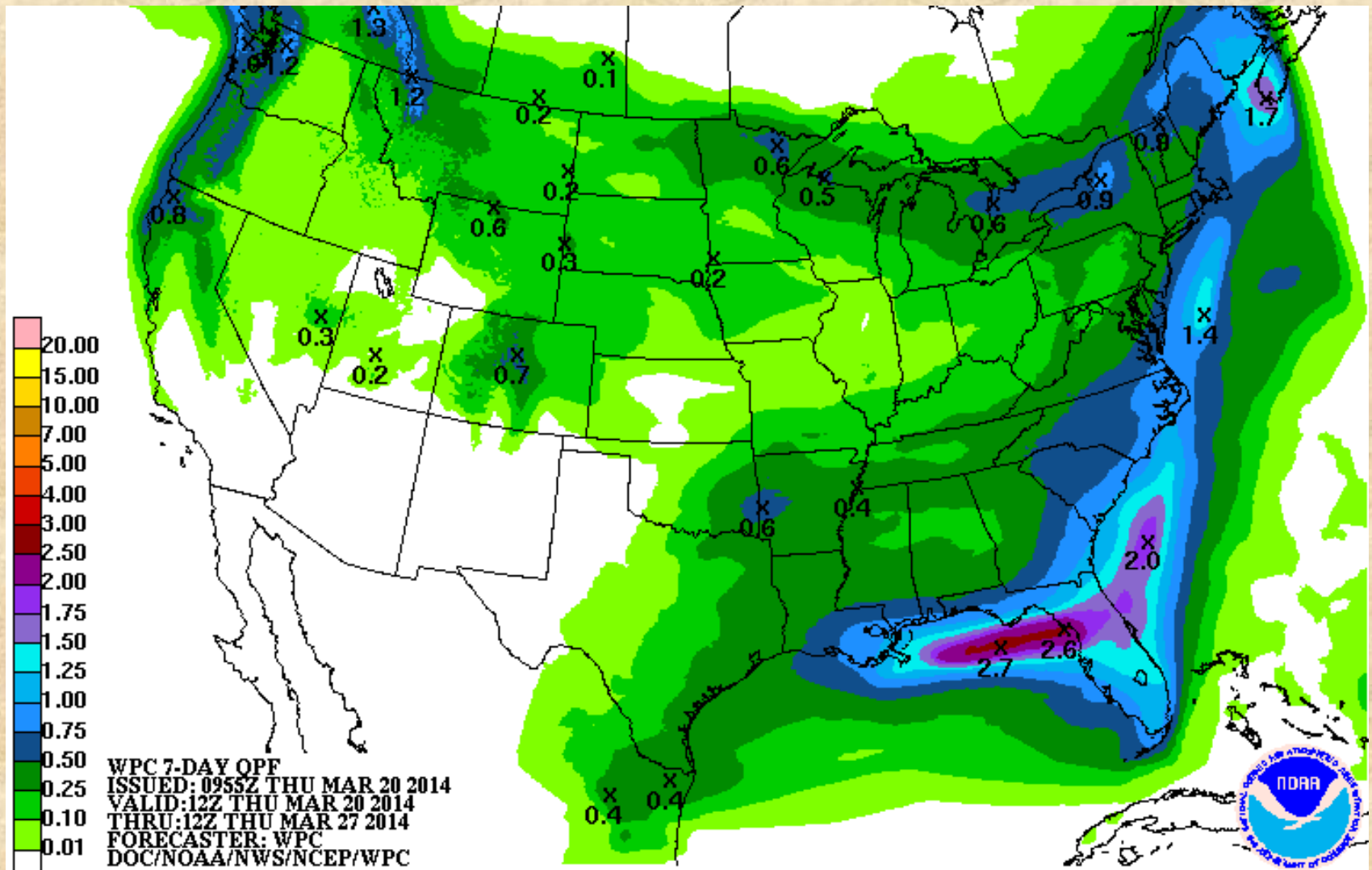


Jumpstarting El Niño?



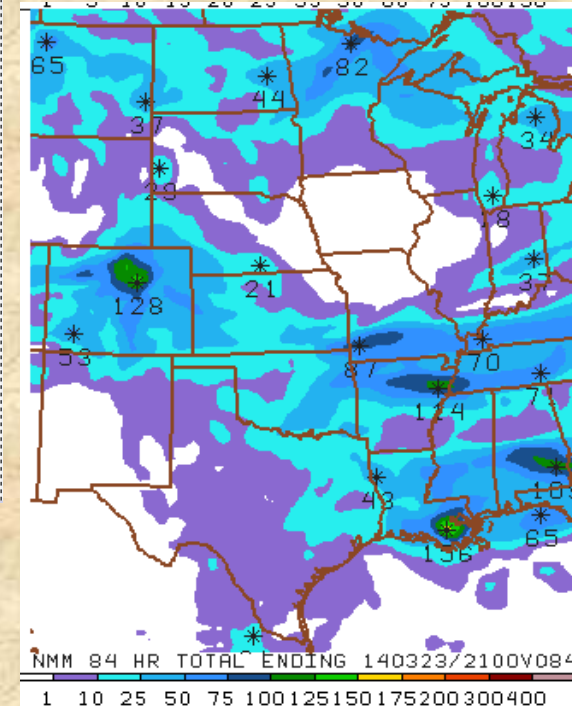
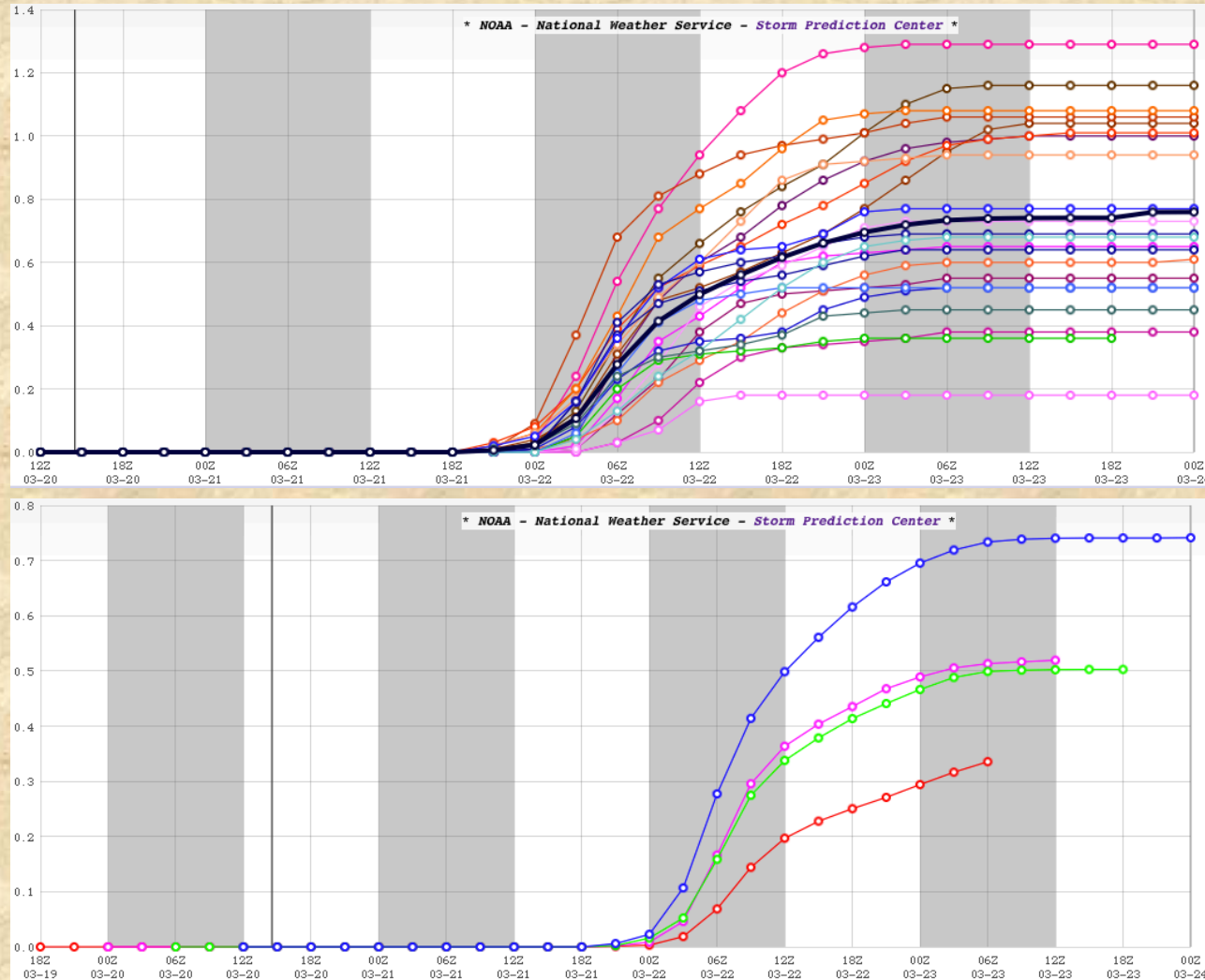
While some El Niño onsets (such as 1997) can clearly be associated with an intraseasonal event ('MJO'), many are not, but it is a factor to be considered. The last attempt (2012) 'failed', i.e., the 2012 'El Niño' was extremely short-lived.

What can we expect in the next seven days?



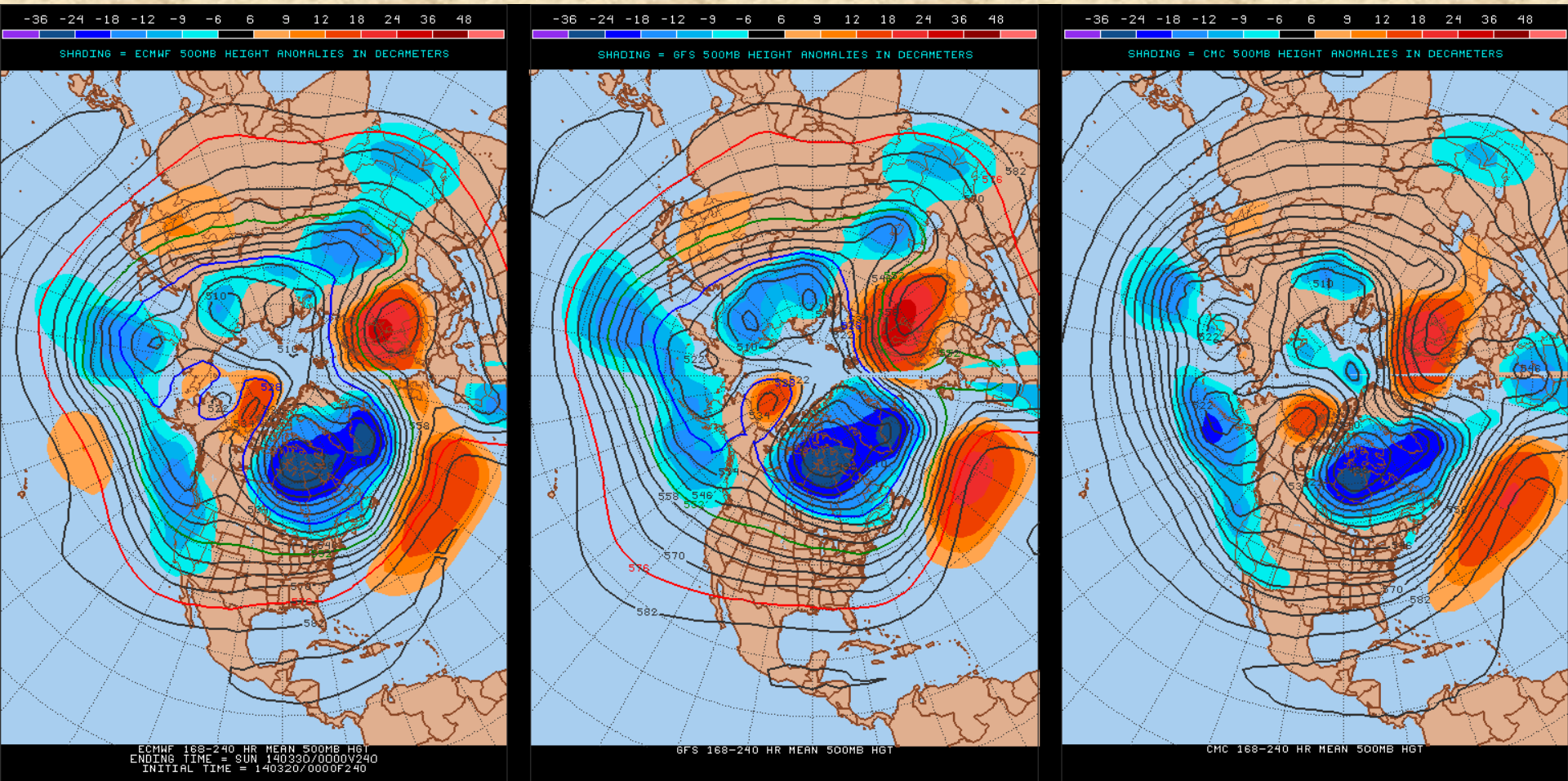
Expected total precipitation, according to the Hydrological Prediction Center (NOAA): Little drought relief for SE Colorado, not much new snow for the mountains (and that's o.k.) – BUT: Beware of the SREF!

What can we expect in the next three days?



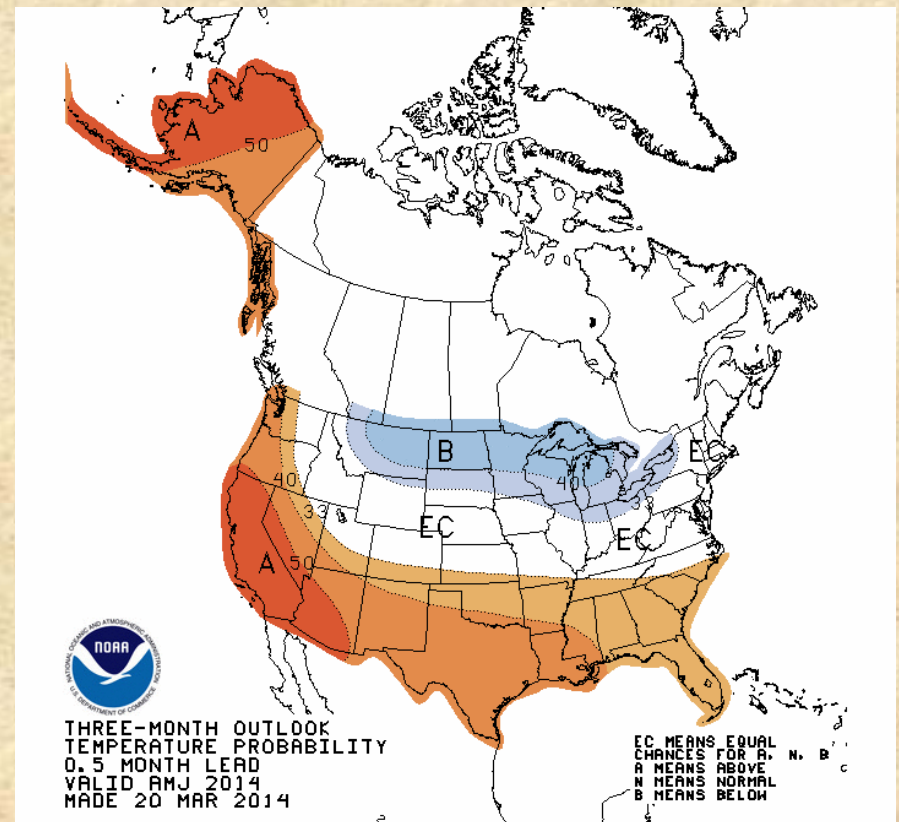
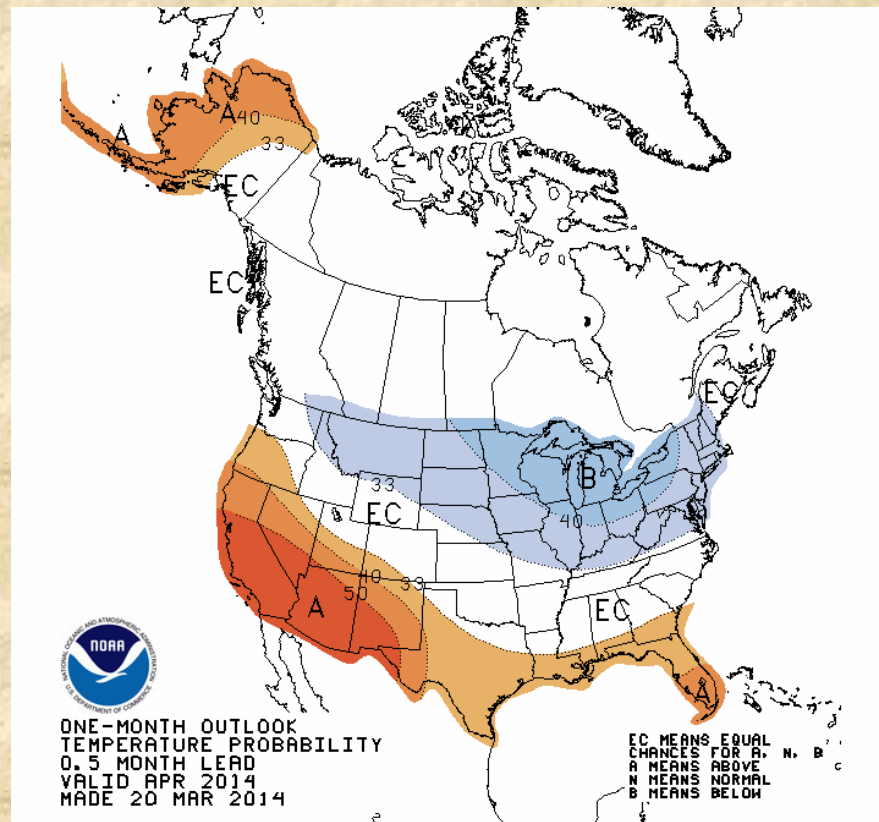
Over the last two days, and according to the SREF, there has been a steady increase in predicted precipitation over us (bottom left), with other models playing ‘catch-up’, a median forecast amount approaching $\frac{3}{4}$ ” (top left), and predicted peak amounts to possibly exceed 1” (right). Most of this would fall on Saturday, leaving a sloppy mess in the plains.

What can we expect later next week?



No major anomalies over us 7-10 days from now, pattern has ‘feel’ of a transitional situation, perhaps setting up a trough over drought-parched CA (ECMWF version, left). However, a glimpse at “Week 2” does not reveal anything interesting – yet.

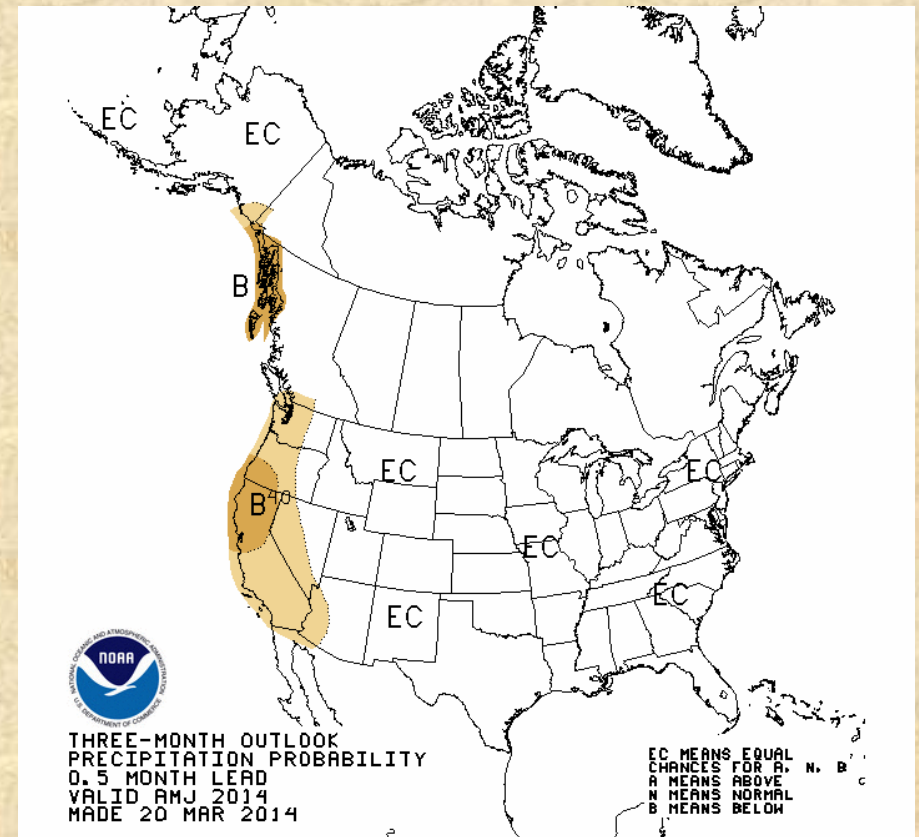
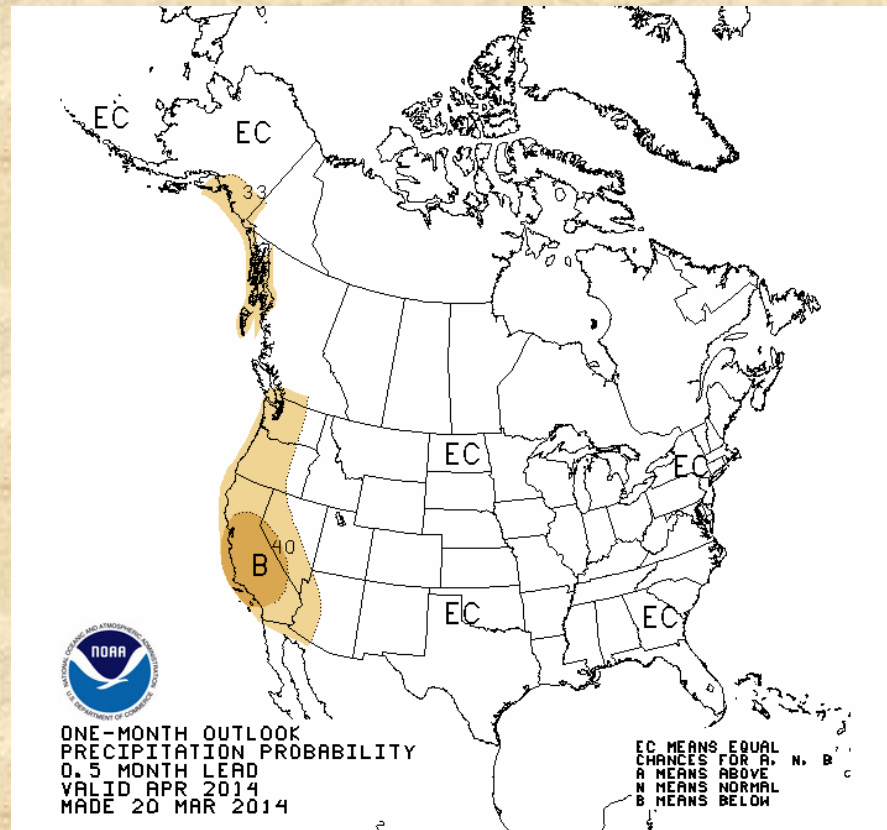
Climate Prediction Center Temperature Forecasts



Persisting cold in the Midwest and warmth in the southwest remains the story into spring. This is not good news for folks in the Midwest (or CA for that matter).

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

Climate Prediction Center Precipitation Forecasts

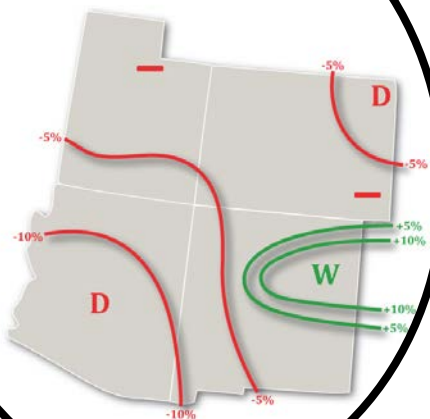


There is little agreement among CPC forecast tools for the next three months, except for continued drought along the West Coast. This early in the game an emerging El Niño is not a factor yet, according to CPC (my own take follows later).

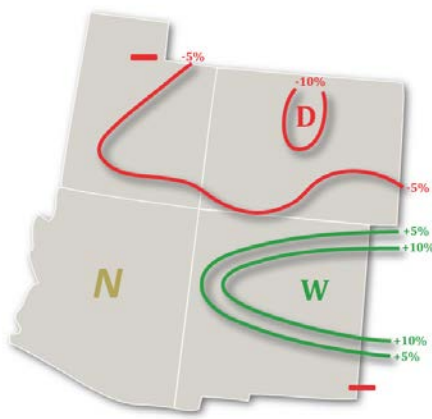
Source: <http://www.cpc.ncep.noaa.gov/products/predictions/>

Postmortem on Jan-Mar '14

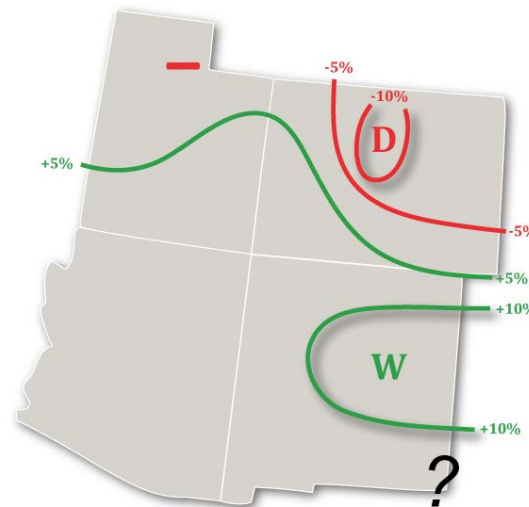
Experimental PSD Precipitation Forecast Guidance
JAN – MAR 2014 (Issued September* 2013)



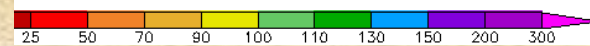
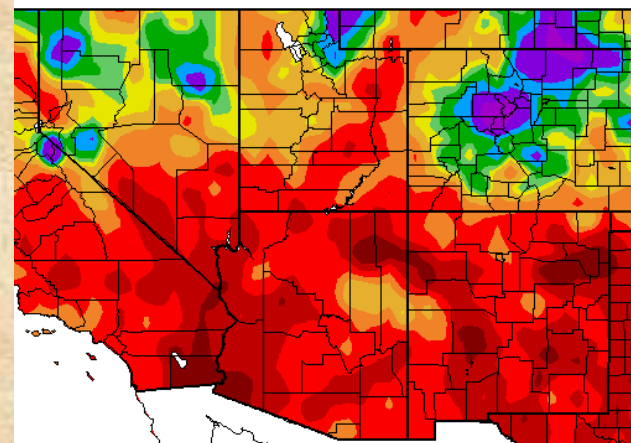
Experimental PSD Precipitation Forecast Guidance
JAN – MAR 2014 (Issued November 13, 2013)



Experimental PSD Precipitation Forecast Guidance
JAN – MAR 2014 (Issued January 17, 2014)

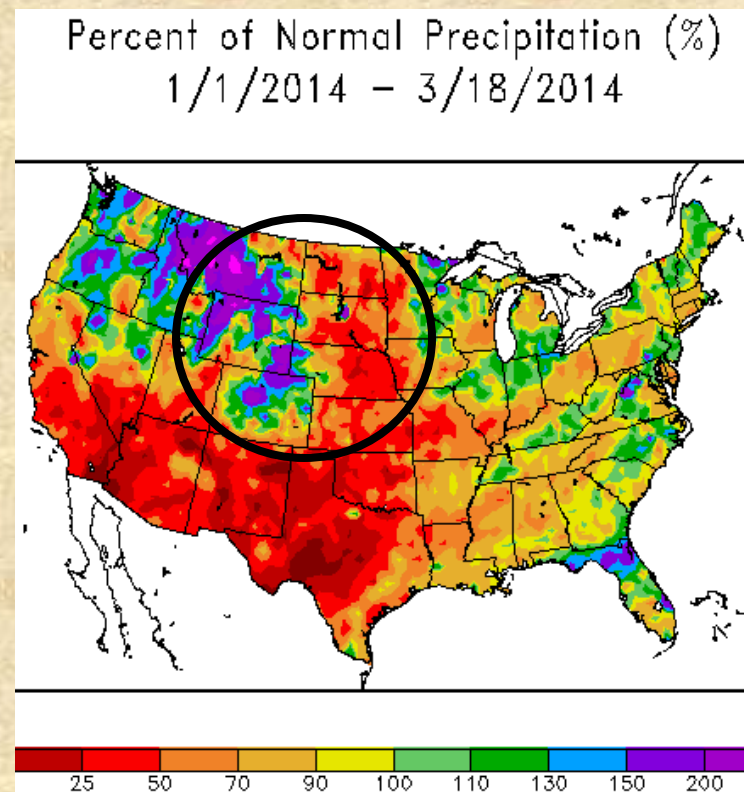
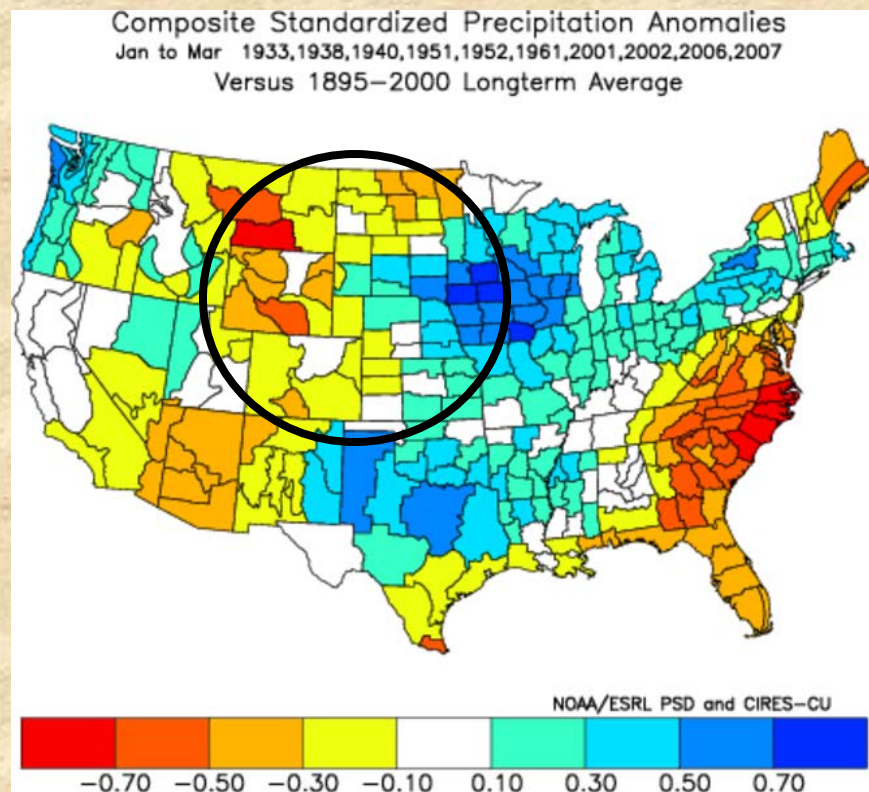


Percent of Normal Precipitation (%)
1/1/2014 – 3/18/2014



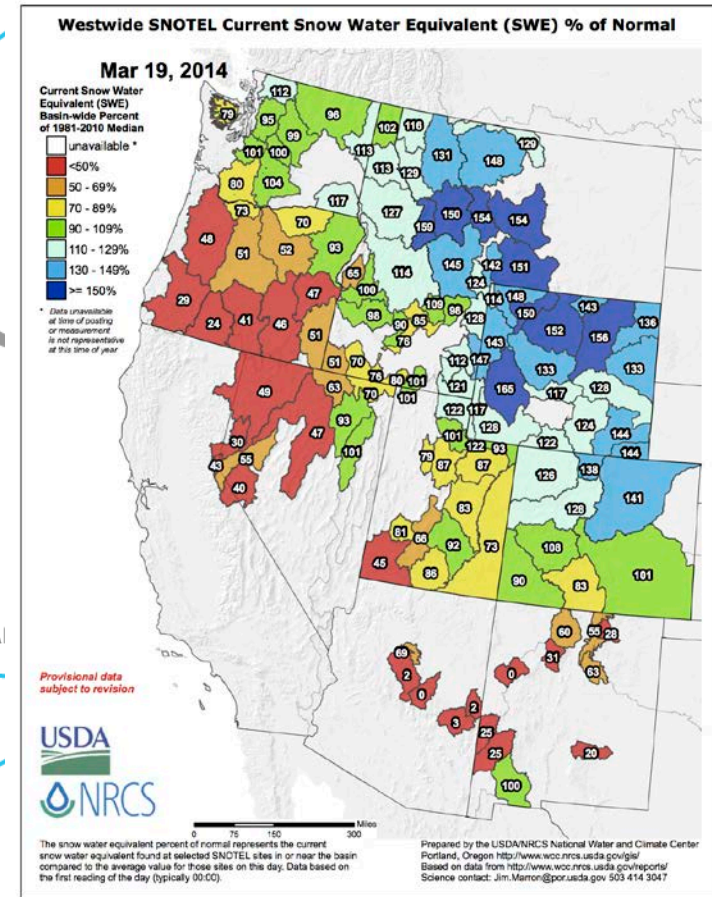
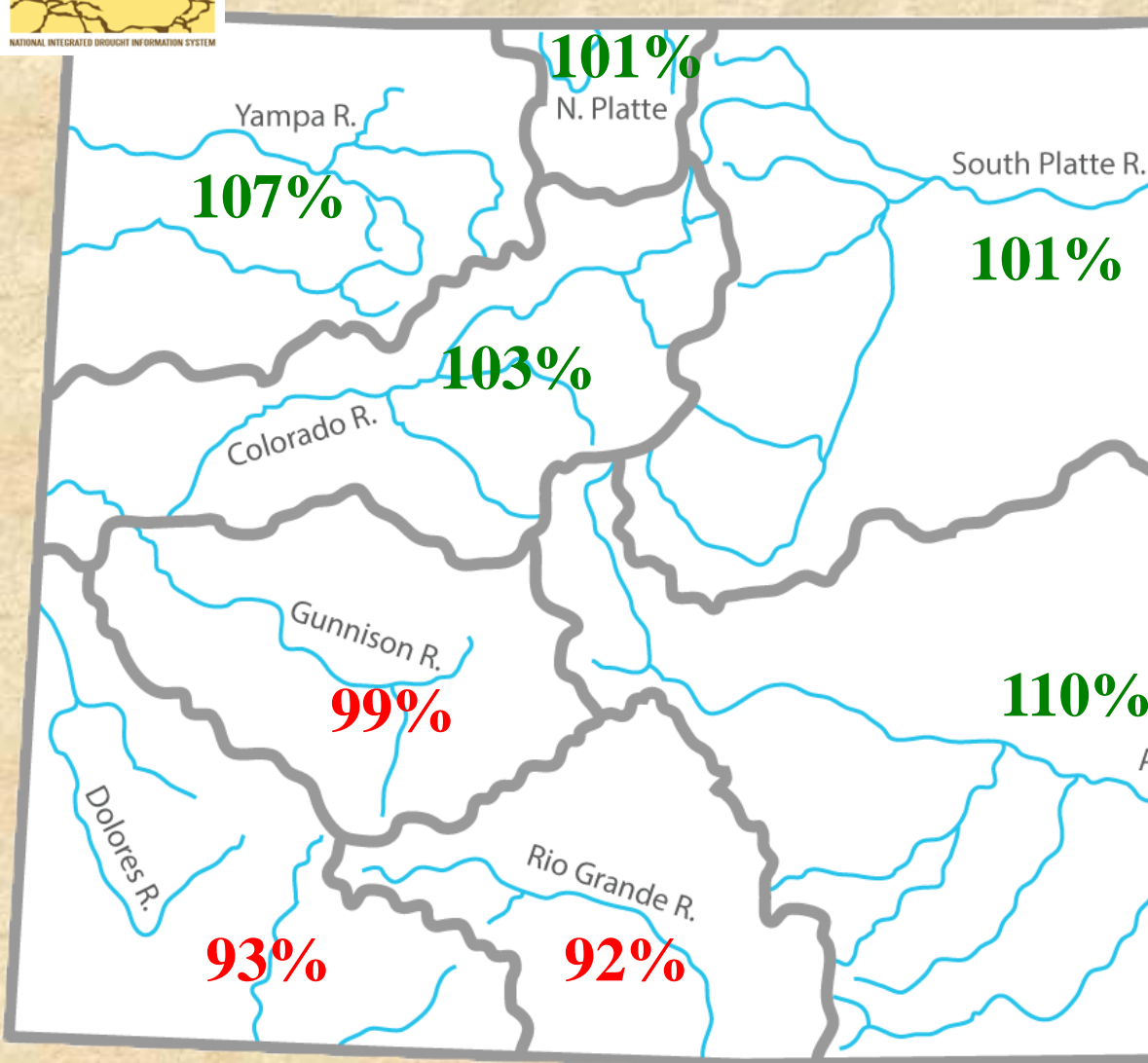
The precipitation forecast for January-March '14 from September initial conditions (left) was dry for much of the Southwest, neutral over Colorado's mountains, and dry over our eastern plains. The November forecast (middle) was drier for our state. The final update (right) kept it dry over northern and eastern Colorado, while increasing the odds for moisture to our south. Verification through mid-month is about as bad as it gets, except for dry conditions in NW and SE CO. *Note that September forecast (far left) appears to verify best (AZ/UT)!*

Postmortem on *PDO-AMO* angle?



While this particular way of foreshadowing seasonal precipitation anomalies worked well in much of WY'13 and Oct-Dec'13, this winter (left) pretty much ended up the opposite way from what was expected in CO as well as to the north and east (right), confirming that this was an unusual forecast season.

SWE forecast for 1 April 2014 (50%ile)

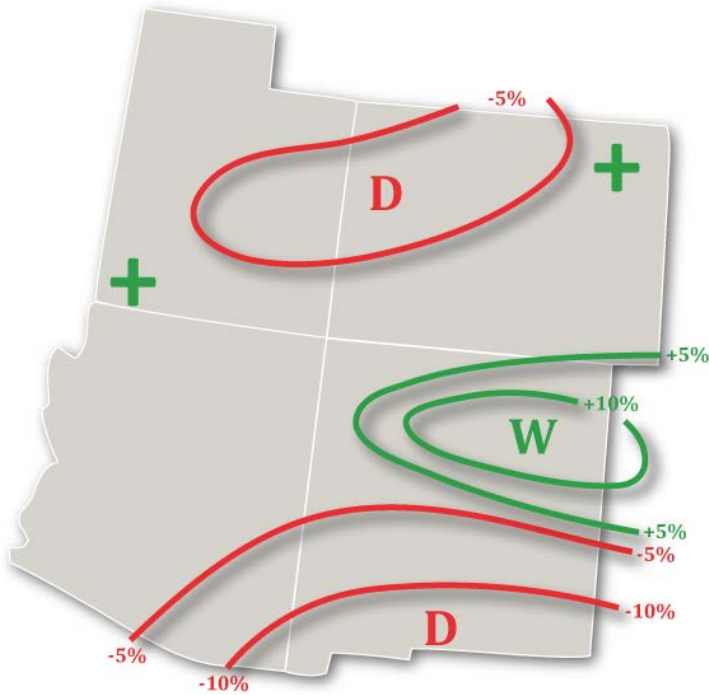


My median forecast for 1 April snowpack made in January was higher than the long-term median in the northern & eastern basins, in contrast to the southwestern basins.

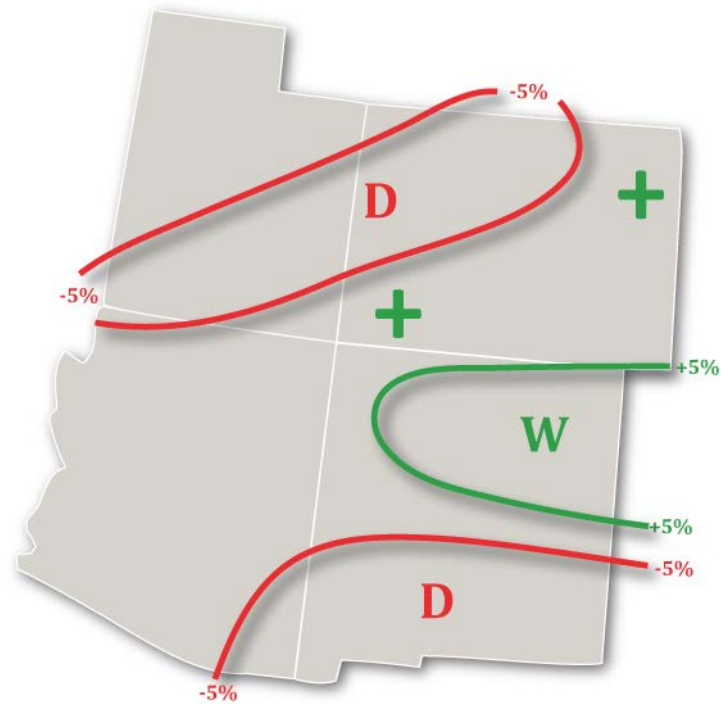
So far, so good, and much better than for the precipitation forecasts in previous slide.

Statistical Forecast for April-June 2014

Experimental PSD Precipitation Forecast Guidance
APR – JUN 2014 (February 2014)

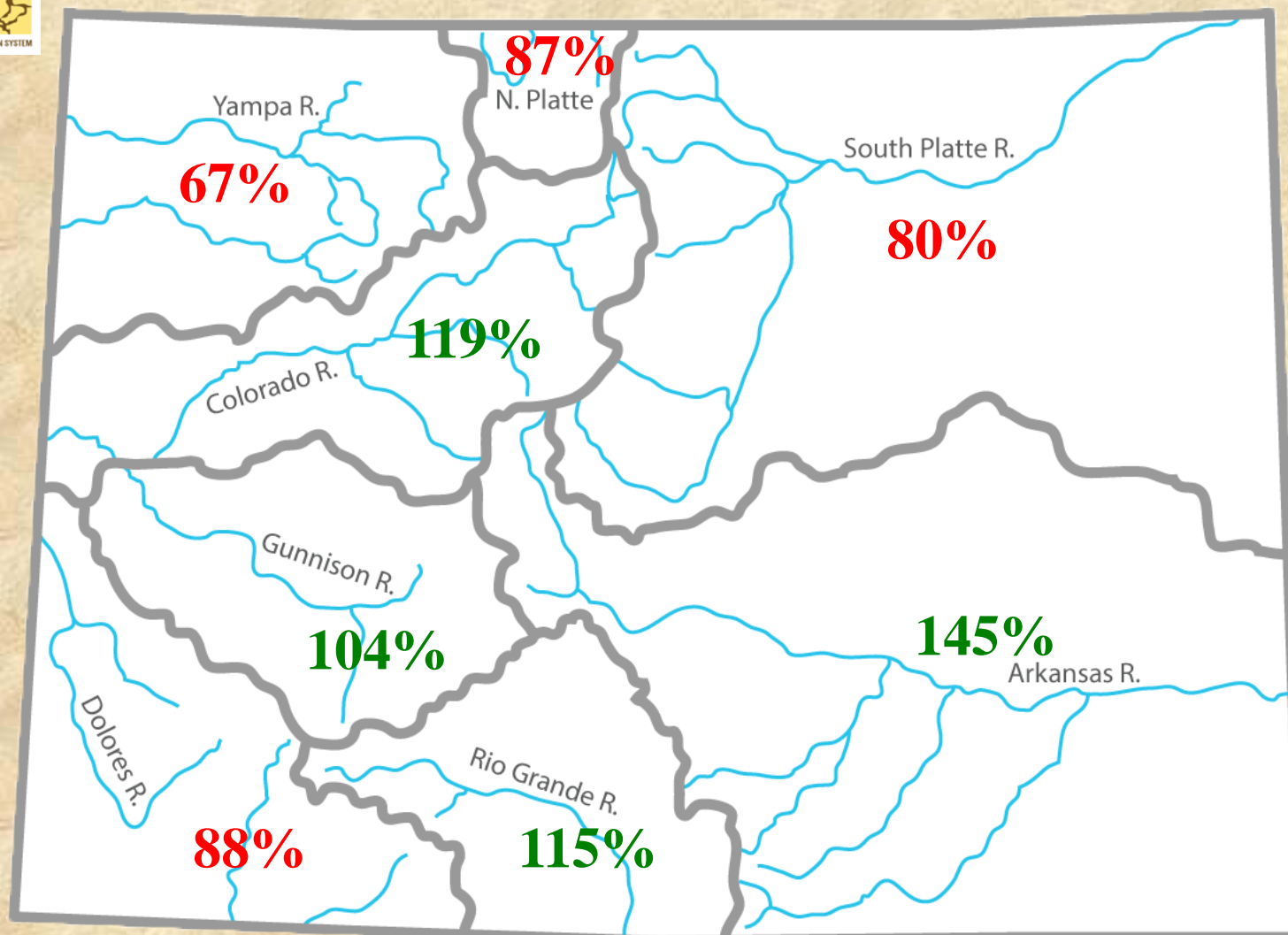


Experimental PSD Precipitation Forecast Guidance
APR – JUN 2014 (March 14, 2014)



My forecast for April-June 2014 from February (left) and March (right) show slightly increased chances for moisture in the southeastern half of CO (where they could use it) and less in the northwestern half. *Operational skill has been best over UT and CO.*

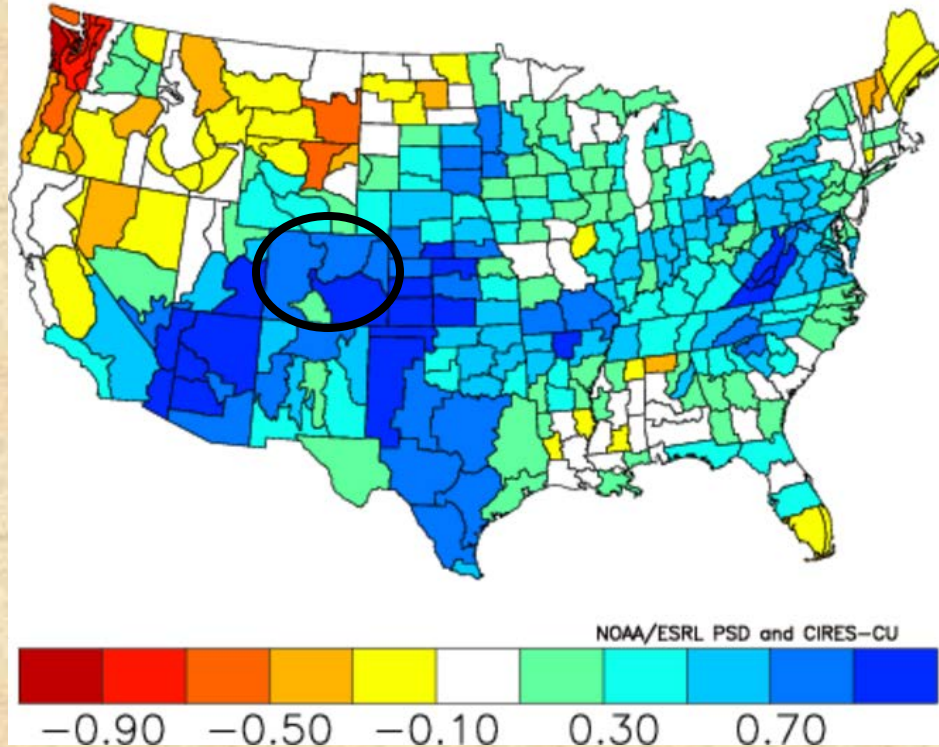
SWE forecast for 1 June 2014 (50%ile)



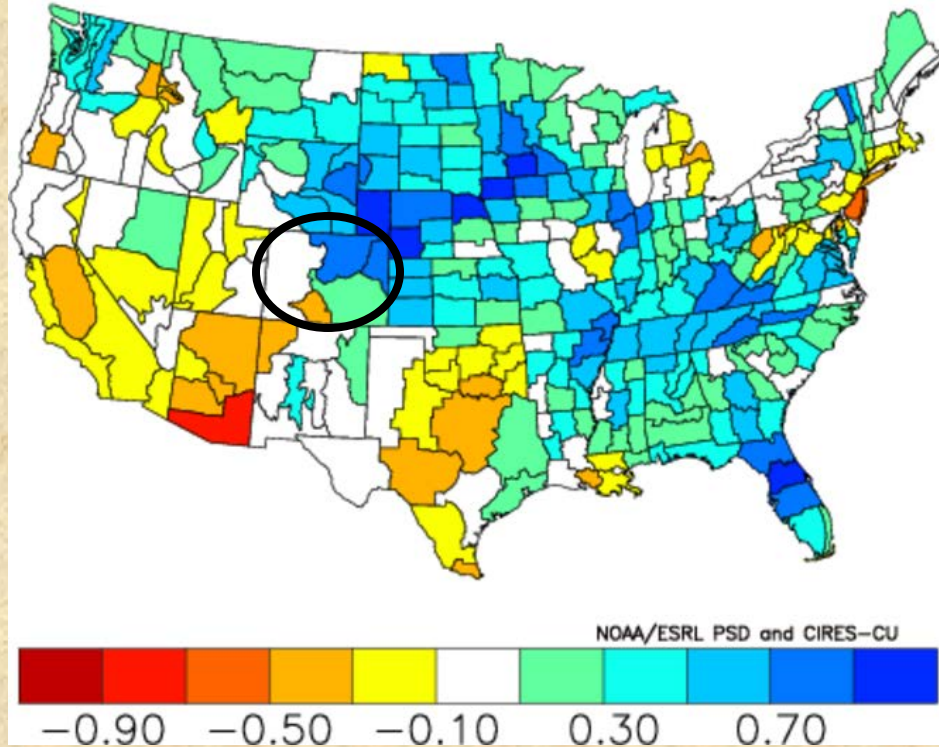
My median forecast for 1 June snowpack is higher than the long-term median from the Colorado River basin southeastward, and lower for the western San Juans as well as to the north and east. Snowpack this late in season is a function of preceding moisture and spring temperatures, complicating this particular forecast season. *Update will follow next month.*

Transitioning to El Niño

Composite Standardized Precipitation Anomalies
Apr to Jun 1951, 1957, 1965, 1972, 1979, 2004
Versus 1950–1995 Longterm Average



Composite Standardized Precipitation Anomalies
Jul to Sep 1951, 1957, 1965, 1972, 1979, 2004
Versus 1950–1995 Longterm Average



If we really are on track towards an El Niño, the upcoming six months promise to be at least near-normal or even on the wet side, especially in northeast CO where we need it the least, but also in southeast CO which could use it the most.

For the first time since moving to Colorado in 1988, I am not rooting for a wet growing season in the Front Range...

Notes on flooding risks in 2014

SNOWMELT-RELATED:

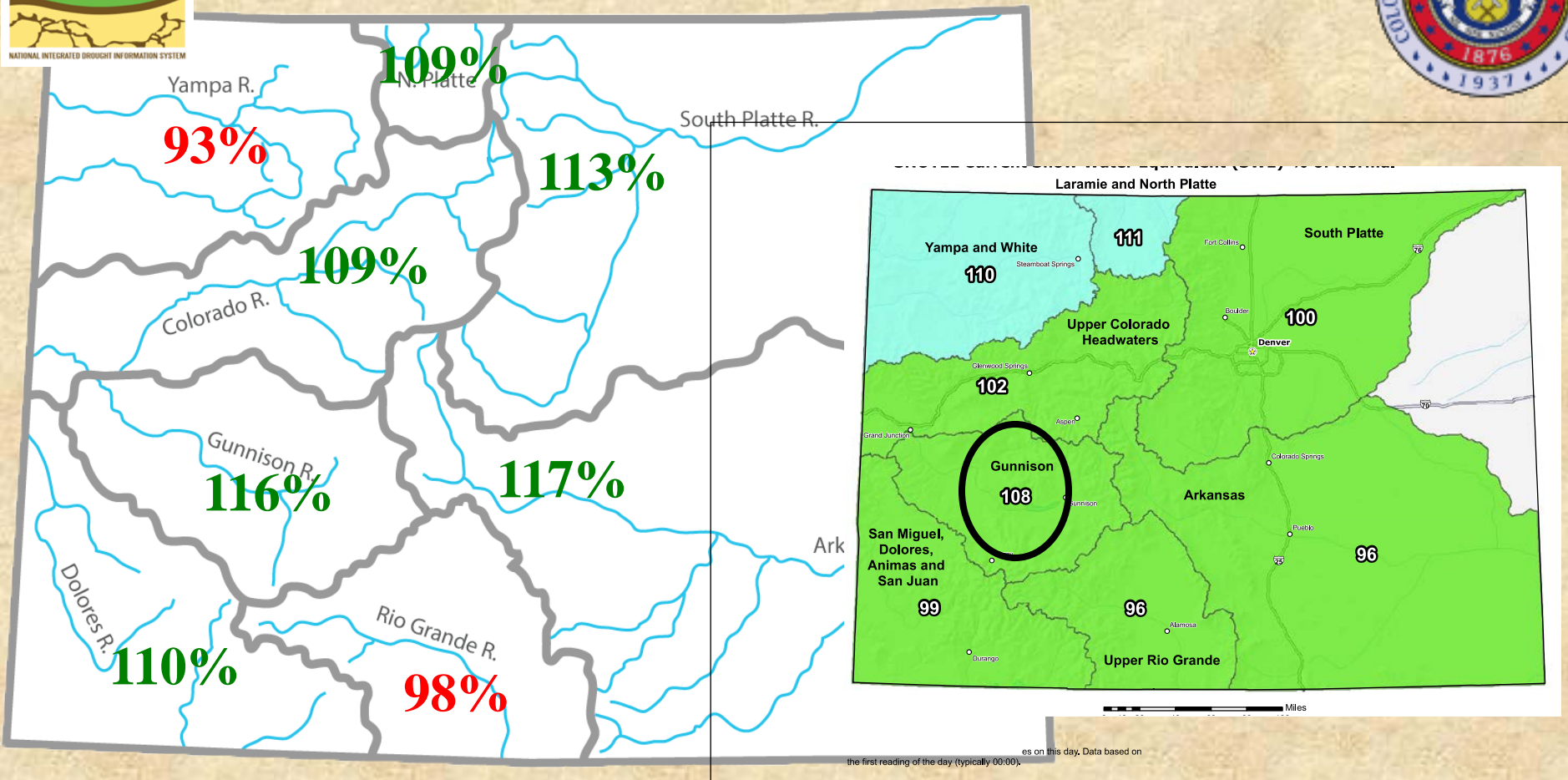
- *High snowpack increases snowmelt-related flooding potential in South Platte basin in particular (just where we don't need it).*
- *Very low dust load does not threaten to increase the speed of snowmelt – so far!*
- *Active storm track this winter and early spring means a lowered risk of stationary 'heat waves' that could trigger an early melt surge.*

FLASHFLOOD-RELATED:

- *Some of the most prominent examples of flash-flooding occurred during El Niño onset years ('65, '76, '97; also: 1896, 1904, 1911) – odds for that are the highest since 2009.*
- *Soil moisture and water table have remained high in regions hit by September floods. All natural reservoirs are also about as full as I have ever seen around here going into spring (have man-made ones been slowly drained ahead of spring-runoff?). Reservoirs that are still full would have a lot less 'wiggle-room' in dealing with new inflow. A lot of temporary fixes to our infrastructure may end up getting severely tested.*

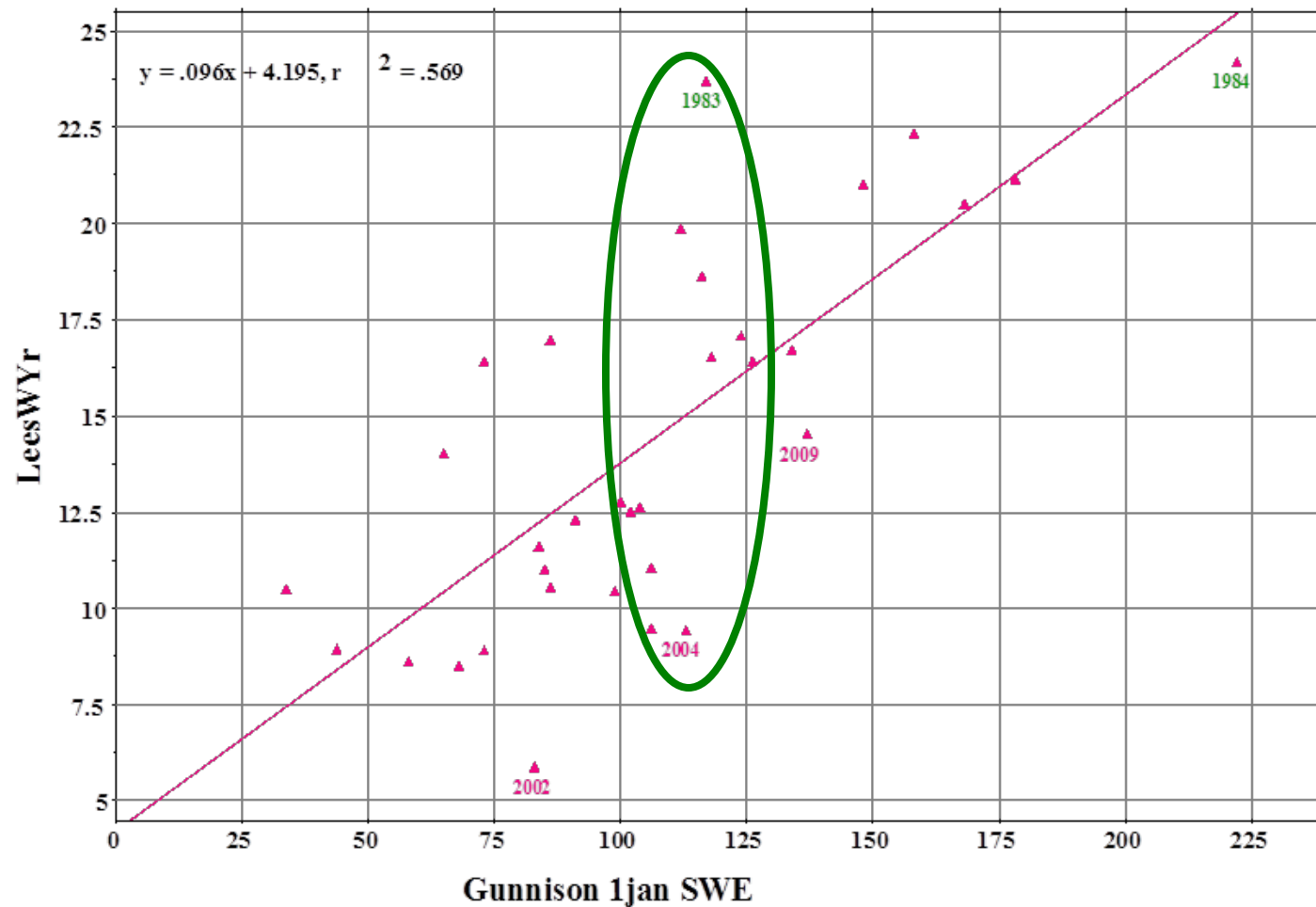
- While El Niño/La Niña can provide decent guidance for climate outlooks around here, this was not very helpful in two years of ENSO-neutral conditions. We are now on track for El Niño to return soon. This should favor lower elevations in particular with moisture during the growing season.
- New forecasts for snowpack conditions on the 1st of January, April, and June held out the promise of a near-normal year, or much better than in 2012 and 2013. Snowpack is highest compared to normal exactly where we don't really need it (South Platte).
- My statistical forecast for late spring (April-June) shows a slight tilt towards wetness covering the eastern plains which is good news for the Arkansas valley in particular. Mountains are less likely to end up wet which could hurt the most in the San Juans where snowpack has been lagging the rest of the state. If we remain on track for a transition to El Niño this summer, odds for a wet growing season are higher than normal over the eastern plains of CO.
- Given the rains of last September, an above-normal snowpack in the northern mountains, and a likely transition to El Niño, the stage is set for increased flood risk during the next six months. *You still need an individual weather event 'trigger' to realize the potential of this risk, but we should definitely be on 'high alert' status.*

SWE forecast for 1 January 2014 (50%ile)



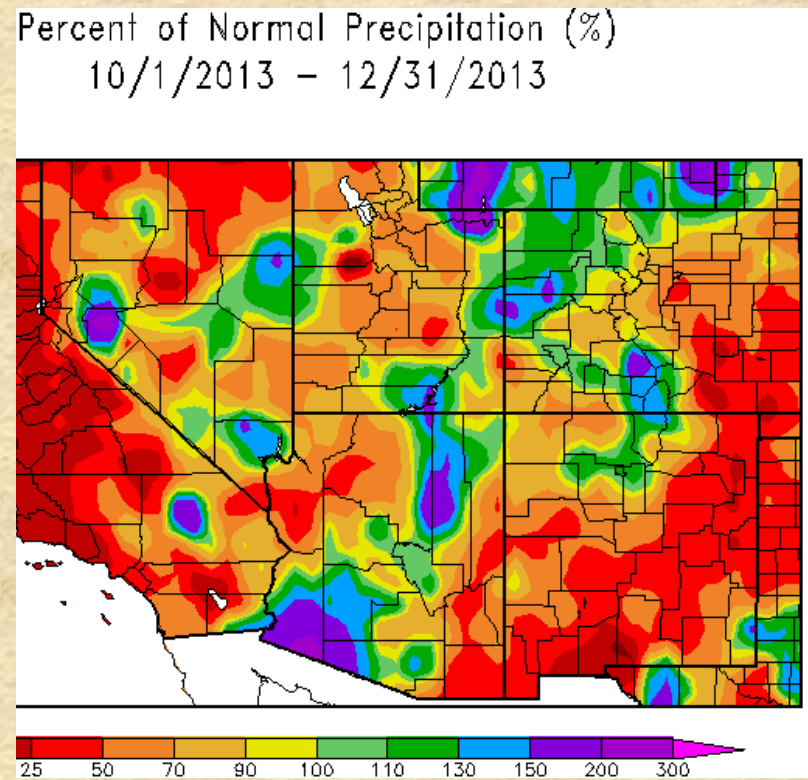
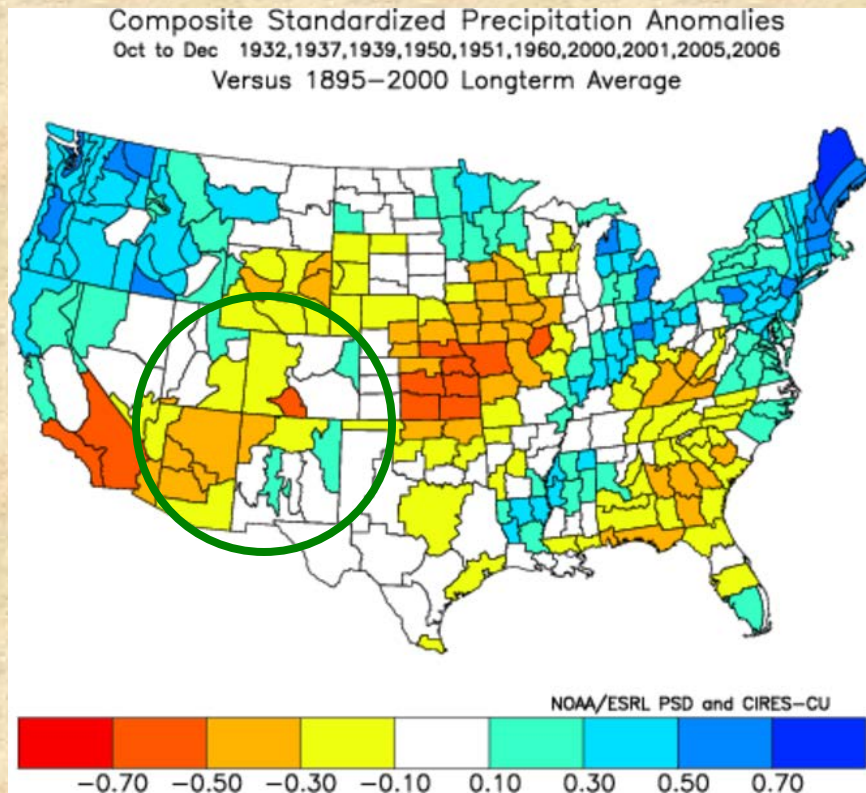
My inaugural median forecast for early season snowpack back in September (left) was mostly higher than the long-term median in our state, except for the Yampa and Rio Grande basins. Verification (right) averaged about 5% lower than expected, **lowest in Arkansas basin** (21% lower than median forecast, the only basin below the predicted 25%ile forecast), and **surprisingly high in Yampa basin** (17% higher than median forecast). *Note relatively wet outcome in Gunnison basin.*

WY'14 – Relationship of Gunnison basin to Lees Ferry inflow



*The Gunnison Basin 1 January SWE correlates highest with ‘natural’ Water Year runoff at Lees Ferry, explaining over 50% of the variance. January 1st SWE ended up at 108%, right where the possible range for WY runoff is quite large: 2004 on the low end versus 1983 on the high end, but it certainly beats 2002. **My independent forecast made based on fall mountain moisture and preceding ENSO flavors preceding that also went ‘near-normal’.***

What might happen in WY'14– the PDO-AMO angle?



Not as pronounced a 'forecast' as last year for this part of the U.S. in the wake of a less extreme PDO-AMO summer (ranked 17th out of over 100, as opposed to 1st in 2012). BUT, not too bad for calling out drought conditions in southern high plains. Perhaps that big blizzard in early October makes this map look worse...