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Colorado WATF, 11-15-16, Denver

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Seasonal Outlook for Colorado

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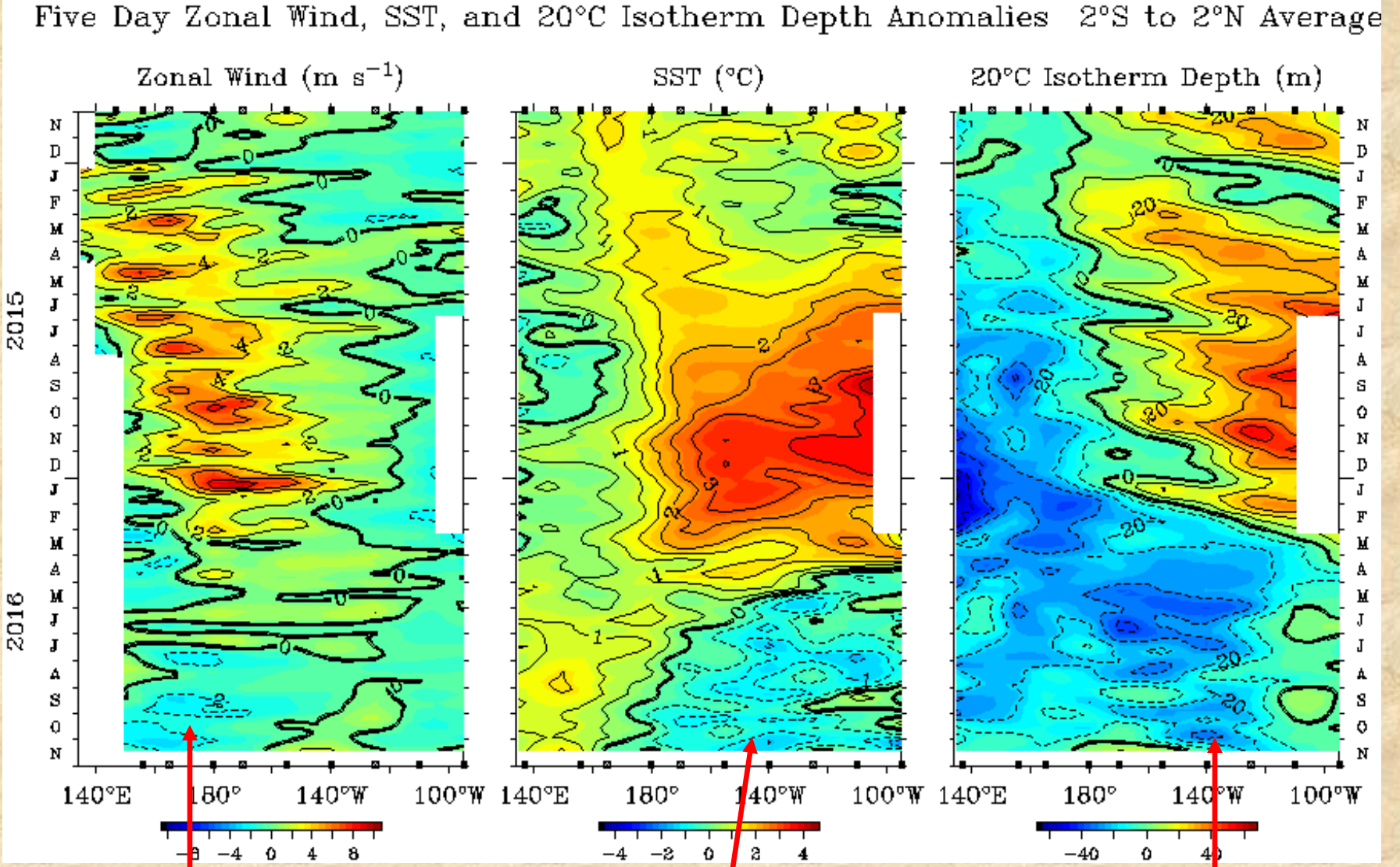
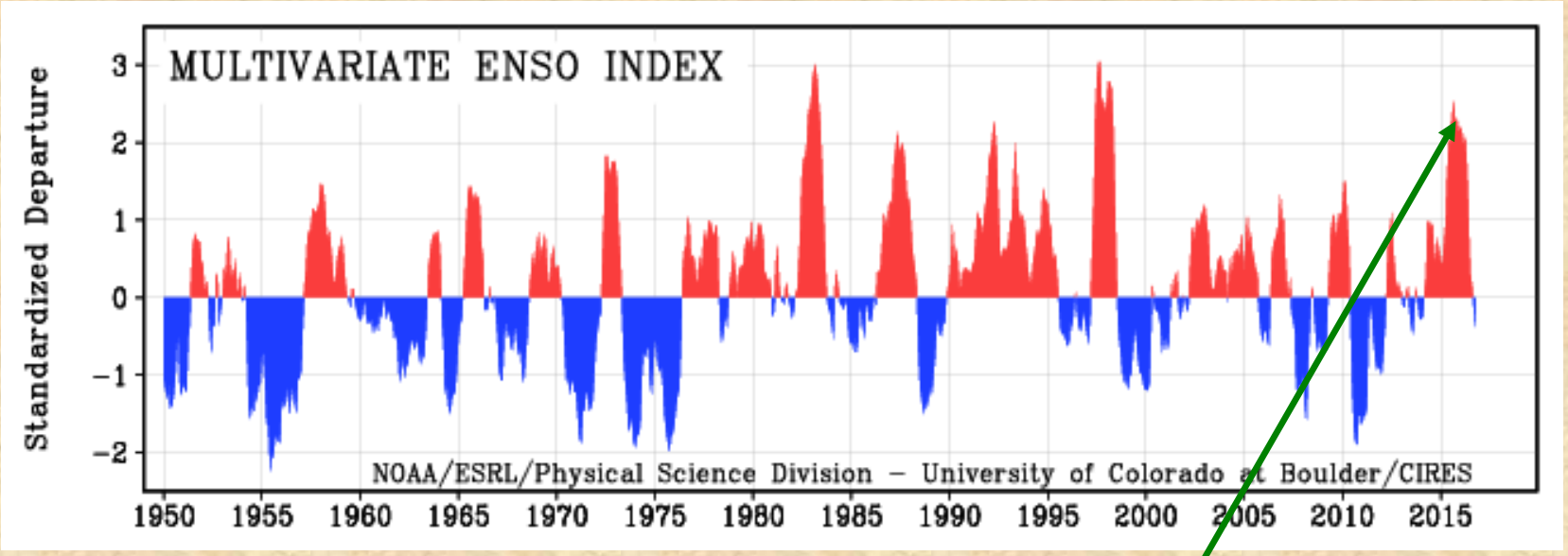
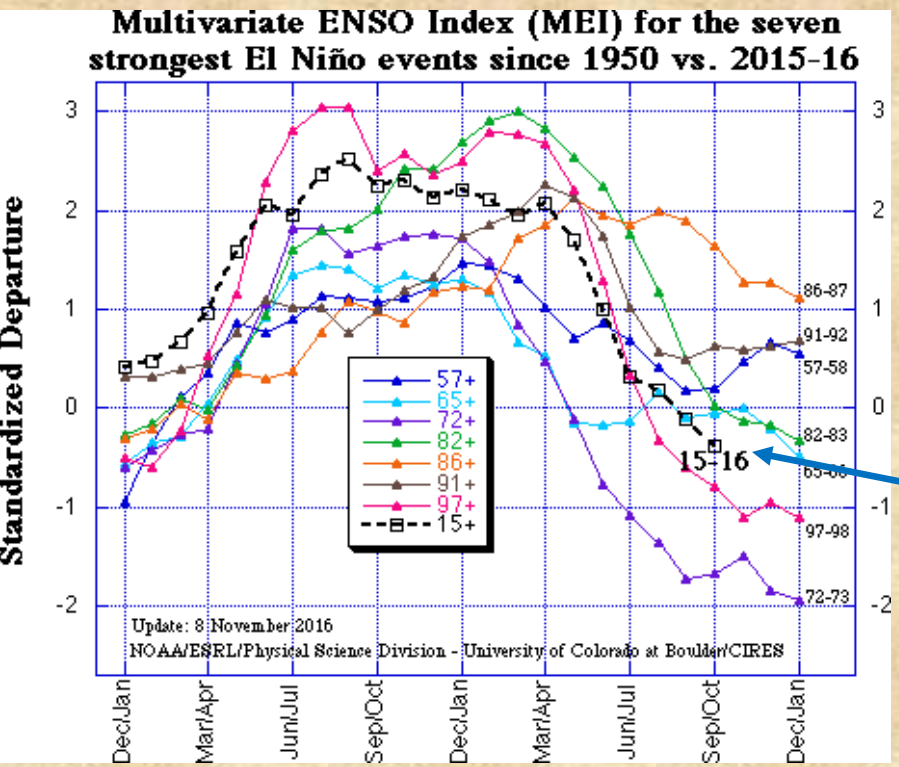
- ***La Niña may have secured the 'Electoral College'!***
- ***Experimental forecast guidance and Postmortem for Jul-Sep***
- ***Analogues***
- ***CPC forecasts***
- ***Next week or two***
- ***Executive Summary (15 November)***



El Niño is over, still has NOT been decisively replaced by La Niña in surface wind field (left), SST anomalies (middle), or subsurface heat content (right). However, occasional easterly wind anomalies (left), mostly negative SST (middle), and negative heat content mean that we can call this La Niña ('lite')…

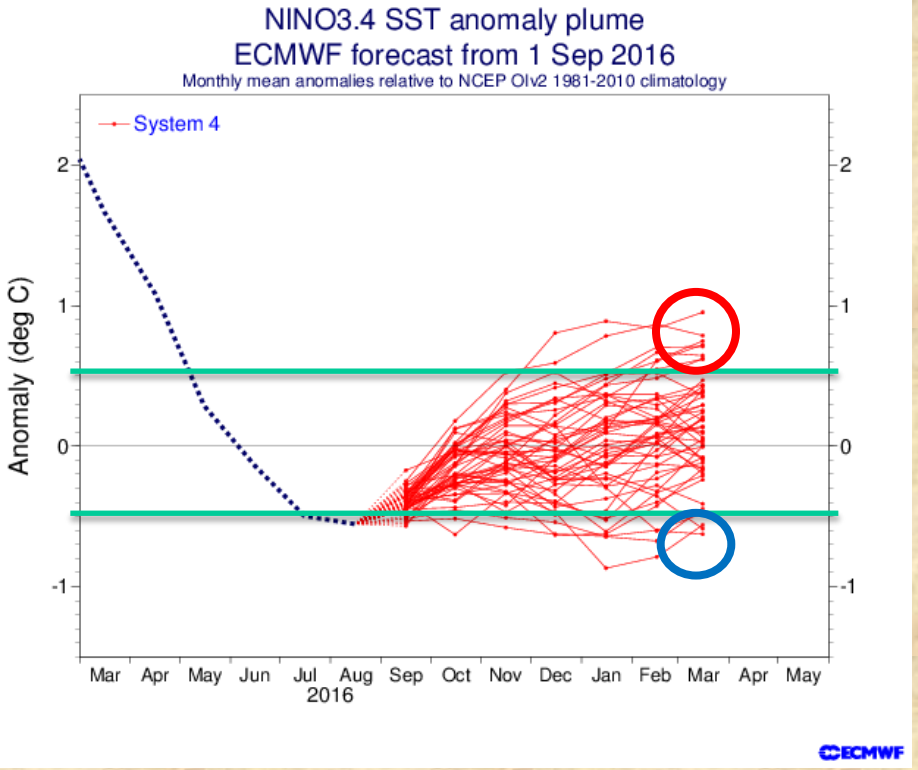
http://www.pmel.noaa.gov/tao/jsdisplay/index.html





The **MEI** monitors ENSO based on all observed fields over the tropical Pacific (pressure, wind, temperatures, cloudiness). It is the 1st combined Principal Component, normalized with respect to the season. **The latest El Niño peaked in Aug/Sep 2015 at +2.53, the largest MEI value since 1998**. Since June-July 2016, I would classify it as ENSO-neutral, with the very latest value getting quite close to La Niña territory (*only need another -0.1 to get there*).

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

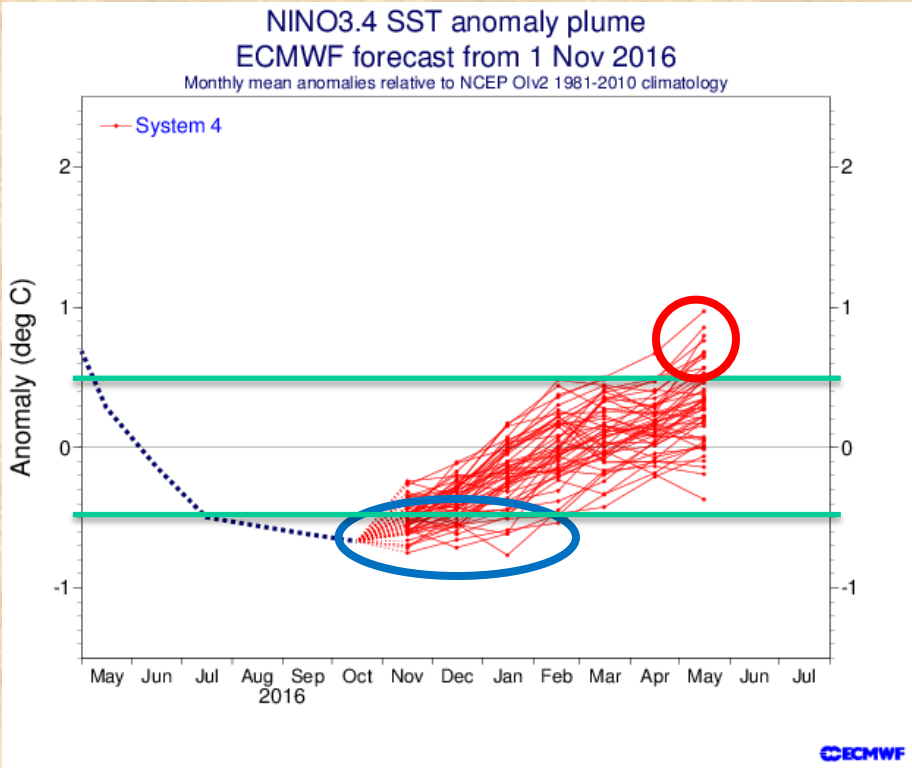


The ECMWF September 2016 forecast (left) showed a rebound to ENSO-neutral conditions later this fall and into early next year (+/-0.5C; green bars), with only a handful of the 50 ensemble members indicating either El Niño or La Niña by next March.

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

The new ECMWF forecast (right) reaffirms a pessimistic outlook on the current weak La Niña, with a nod towards El Niño by next May, and little chance of La Niña to last beyond January. ***However, the last two forecast rounds underestimated the cooling that was under way, so we are not exactly in a regime of successful forecasts (unlike last year).***

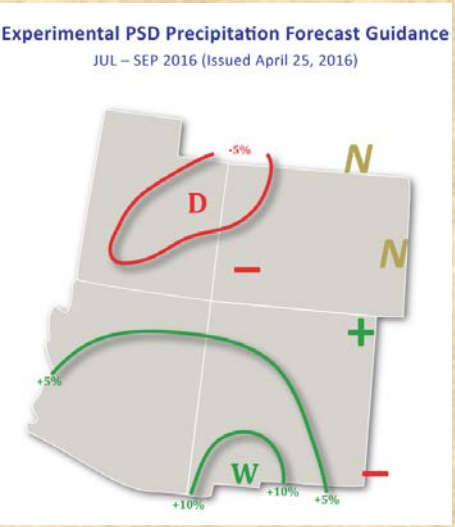
PDO hovering around +0.5 since August.

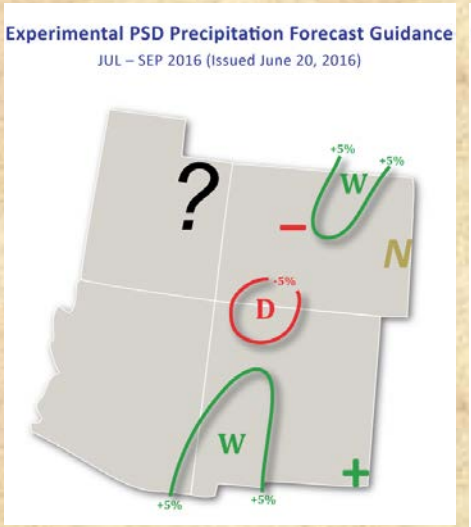


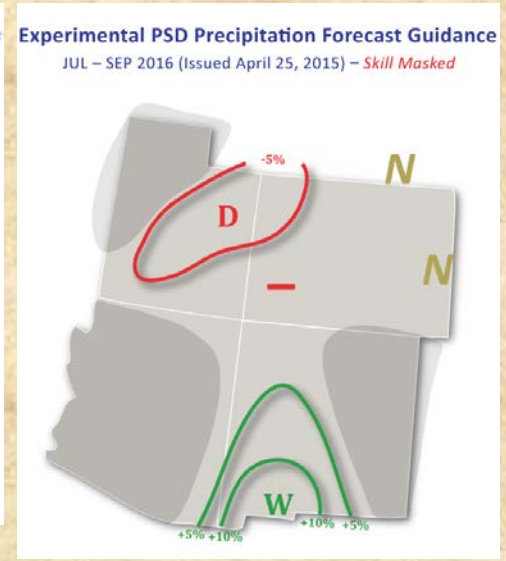
Postmortem for Jul-Sep 2016

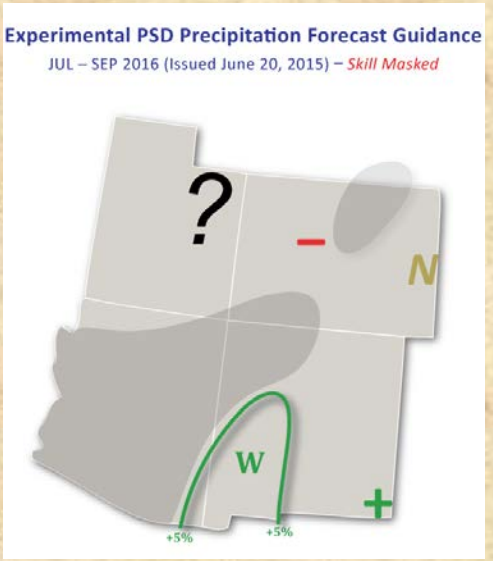
Colorado Water Conservation Board
Department of Natural Resources

Skill-masked maps



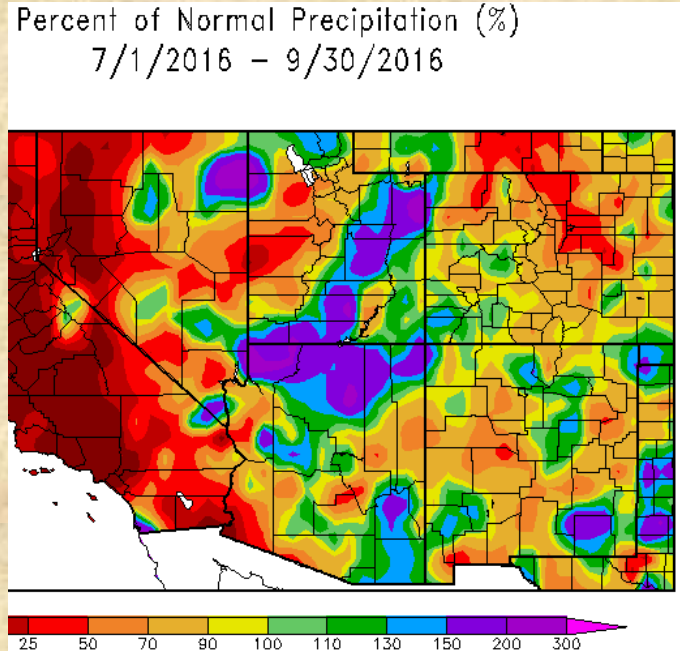




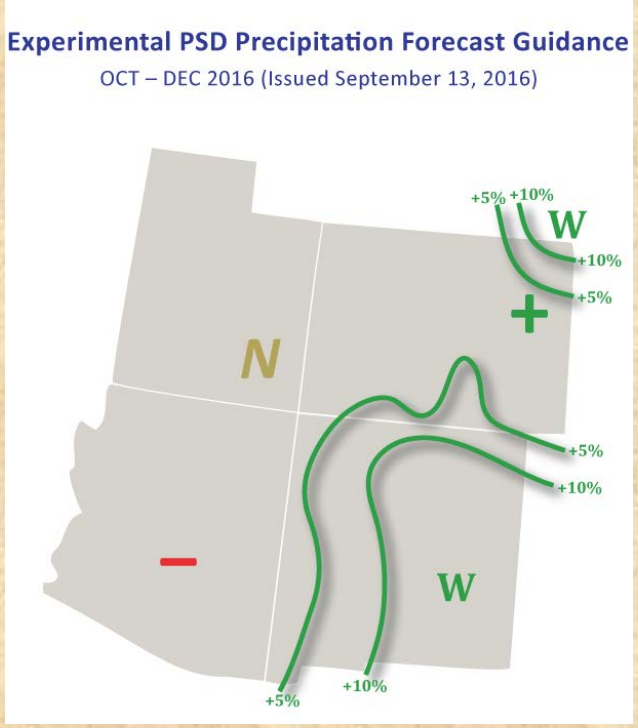


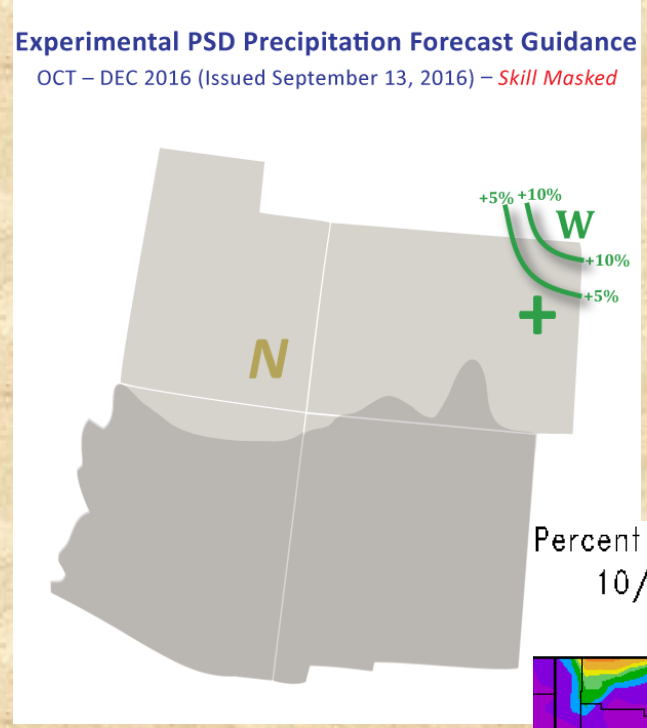
Late summer precipitation forecasts initially favored near-normal for eastern CO, and dry over western CO (top left). The updated forecast (left middle) was a bit more optimistic for the Front Range, but continued leaning dry southwest of here. *Skill-masked forecasts did not change the original forecast for CO (right middle), but took out both the wettest (Front Range) and driest (San Juans) forecasts in update (top right).*

While the overall outcome was drier than expected in Colorado (bottom right), the skill-mask did its job…

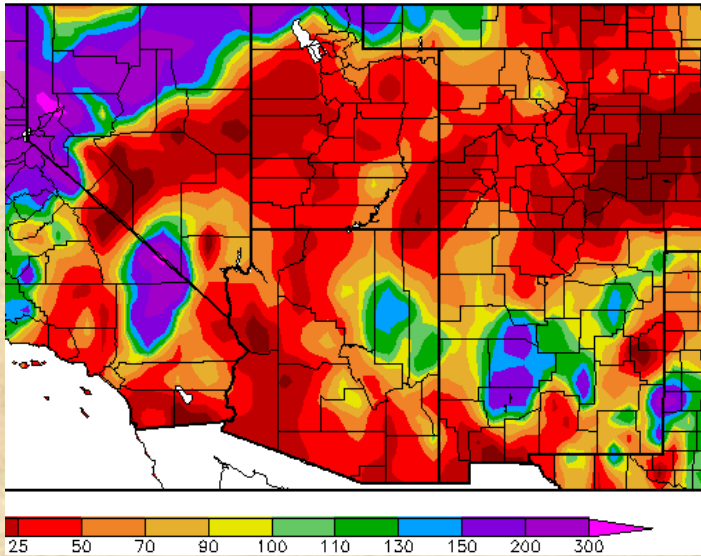


Forecast for Oct-Dec 2016



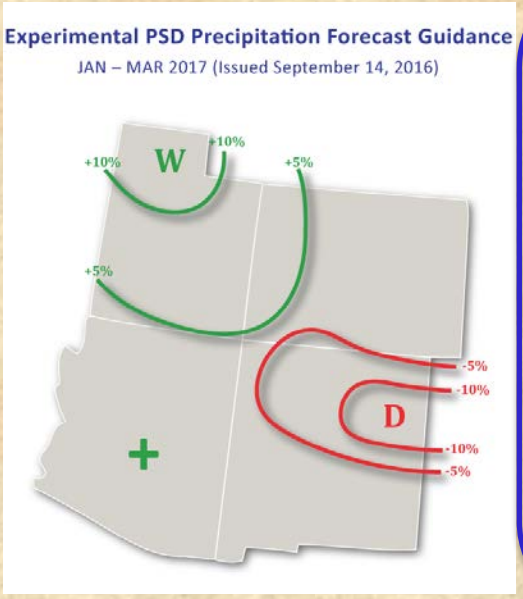


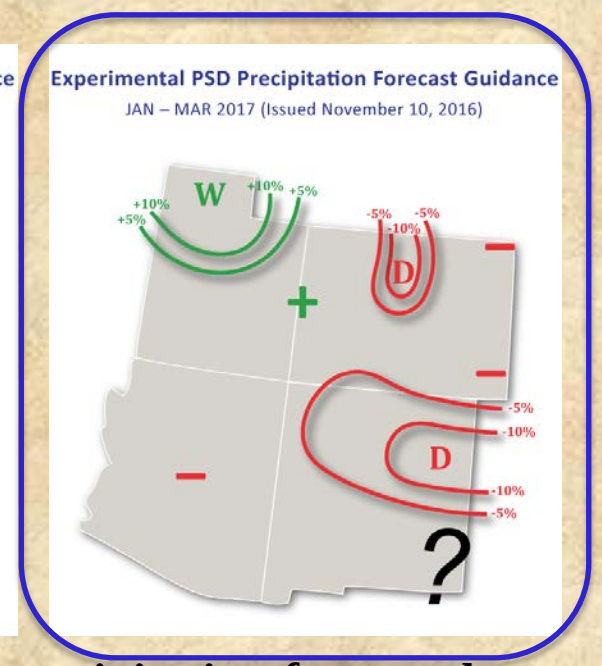
Percent of Normal Precipitation (%)
10/1/2016 – 11/13/2016

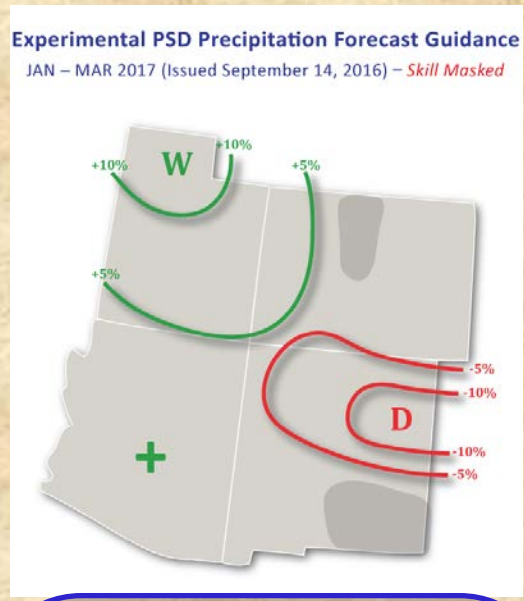


My late fall precipitation forecast was either neutral or wet for Colorado (left), with best odds for wetness in northeast corner of the state. The skill-masked forecast (right) maintained climatological odds west of here, and more likely wet conditions for the northeastern plains. ***Similar forecasts for the Upper Basin were slightly more favorable than near-normal in their outcomes.*** ***As is typical for La Niña, October started this season off on a 'dry foot'!***

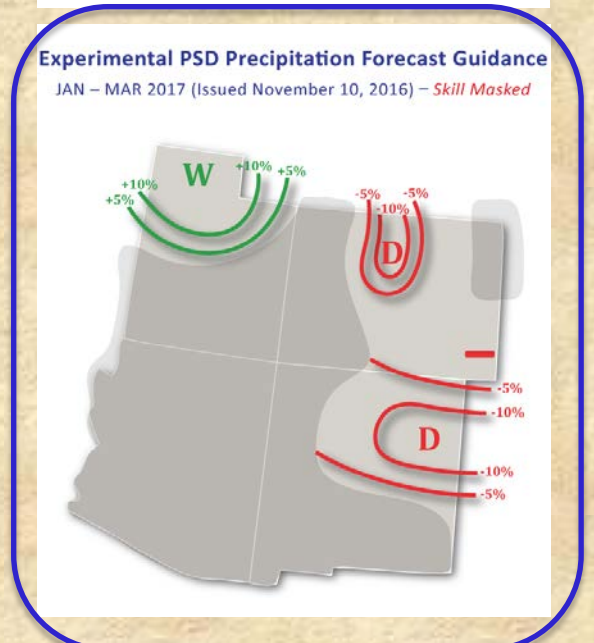
Forecast for Jan-Mar 2017







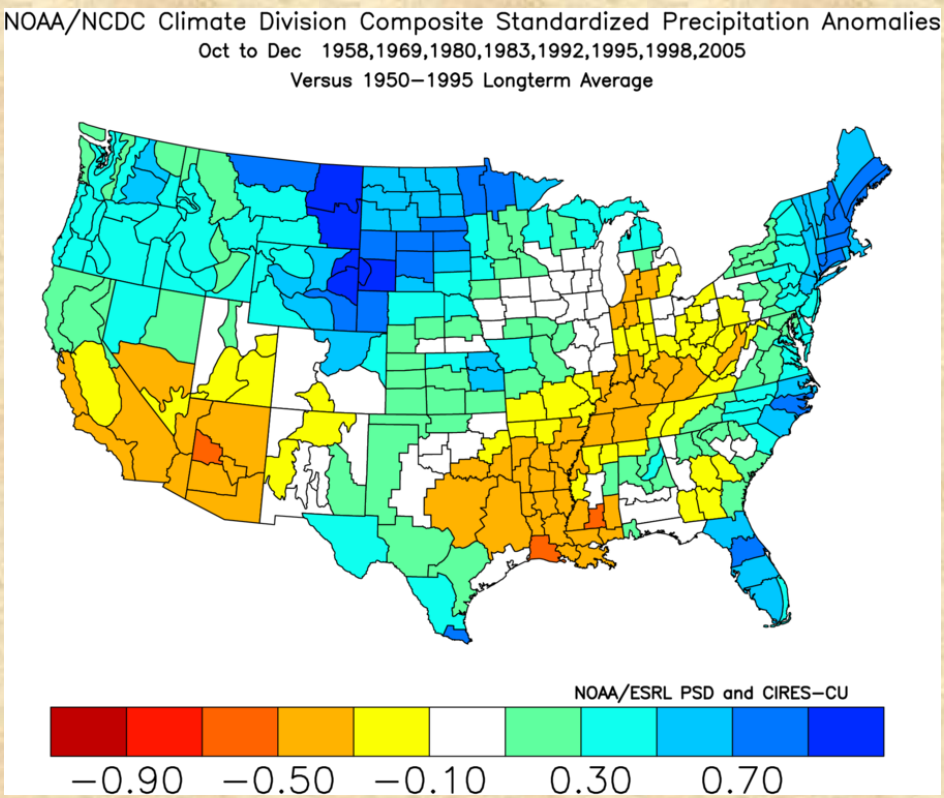
My original late winter precipitation forecast kept anomalous moisture mostly to our west (left), leaving the best odds in our state for westernmost Colorado. The skill-masked version (top right) looked very similar, since there is proven skill for this season and lead-time, *except for SE NM and the north-central mountains of CO. Similar forecasts for our mountains were slightly more favorable than near-normal in their outcomes. The updated versions (center, and bottom right, respectively) are generally drier in Colorado, but also less skillful. Not good news, either way!*

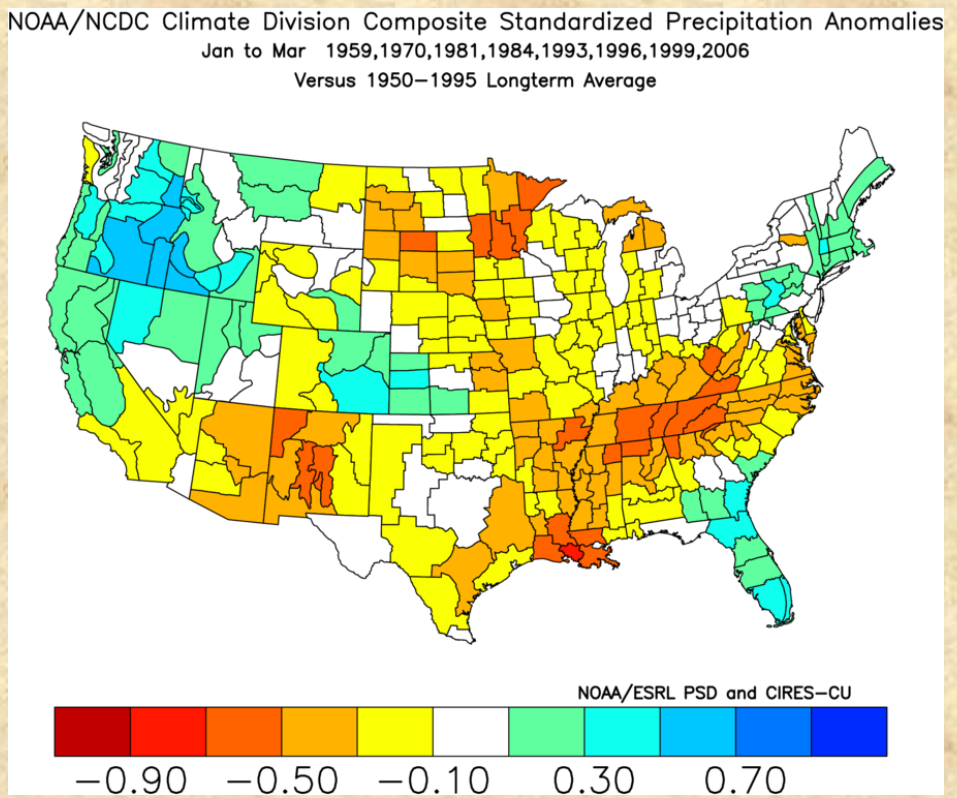



Is there anything to cheer us up?

Analogue forecast based on similar MEI rankings for Jan-Aug ’16

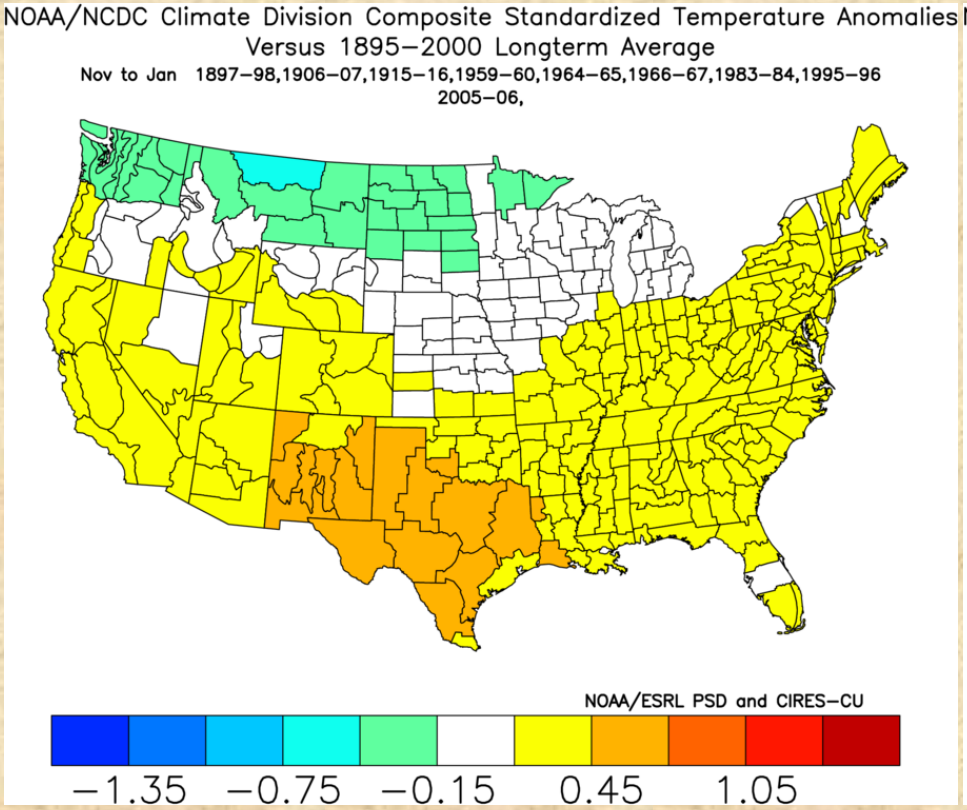
(shown in September)

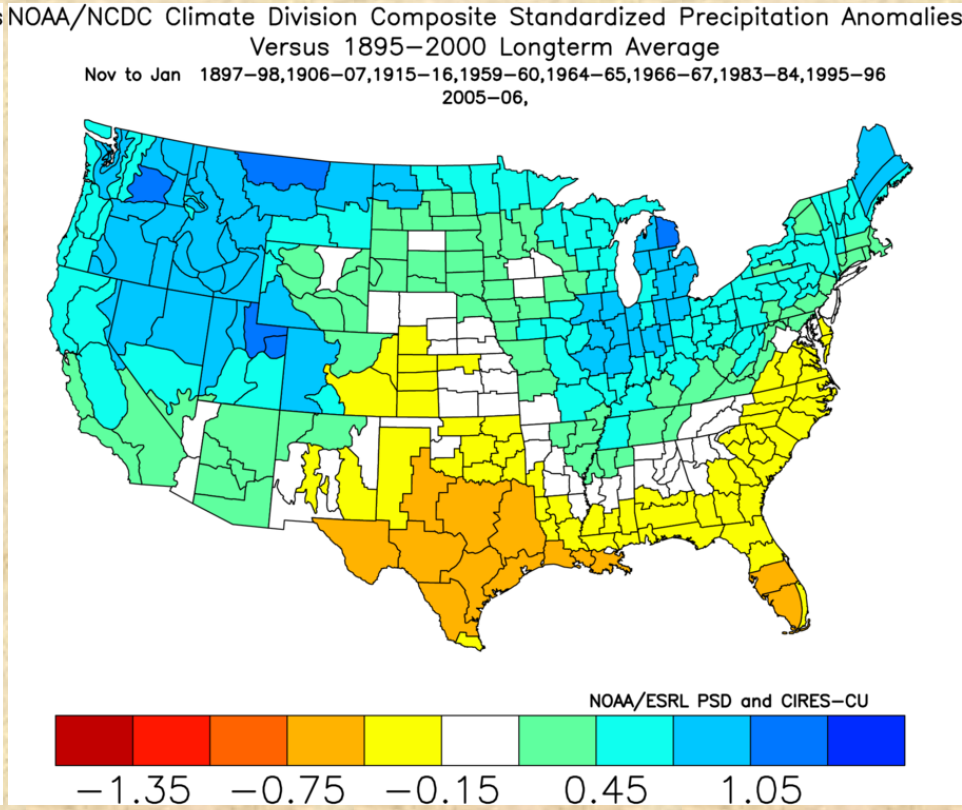




The eight analogues used here had the most similar MEI rankings for the current year through July-August, requiring El Niño at the beginning and closer to ENSO-neutral by mid-year. Some cases became La Niña by winter (95-96, 98-99, and 05-06), some rebounded to El Niño (58-59, 92-93), the rest stayed neutral. The average outcome of these analogues is near-normal for CO in both seasons, perhaps most likely wet EAST of the Divide.

November-January Climate Analogue Guidance (@late Oct'16)

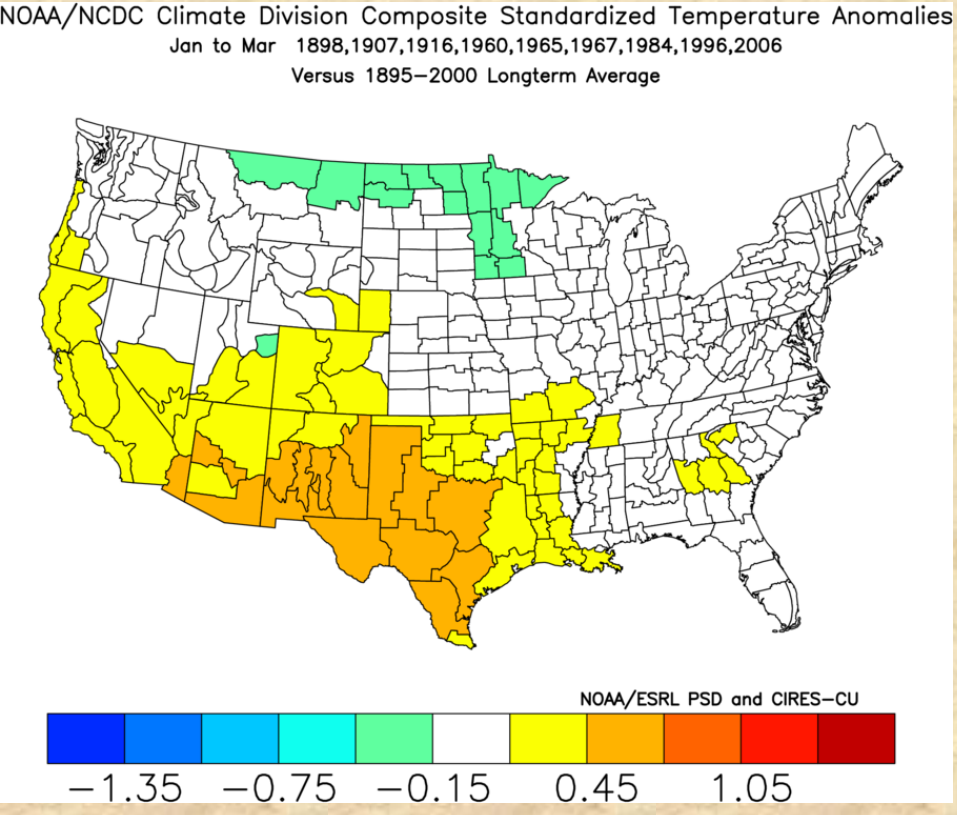


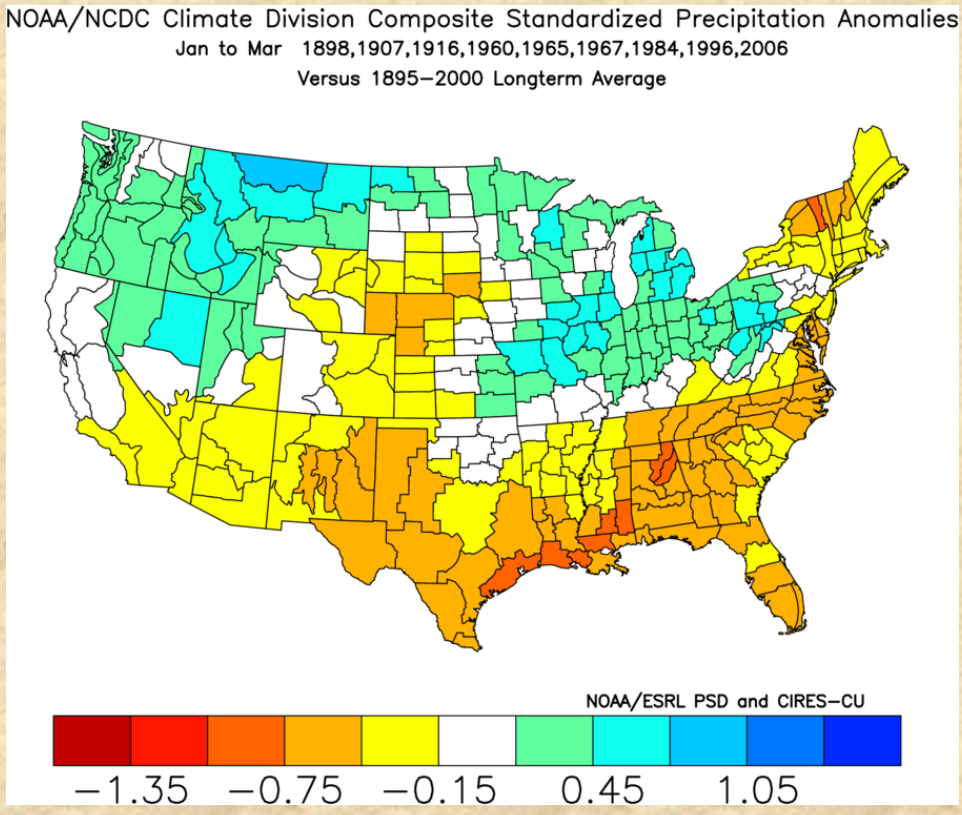


These analogues were based on <u>rapid declines in the MEI and PDO from positive values without hitting major negative values in the following winter</u> during last century(+) for temperatures (left) and precipitation (right). With a sample size of nine, the 2nd color shade (beyond +/-0.45 standard deviations) is considered 'significant'. *The temperature map reinforces the idea that it will be a warm winter over the southwestern US, while the wet signal for UT and western CO stand out on the positive side.*

http://www.esrl.noaa.gov/psd/data/usclimdivs/

January-March Climate Analogue Guidance (@late Oct'16)

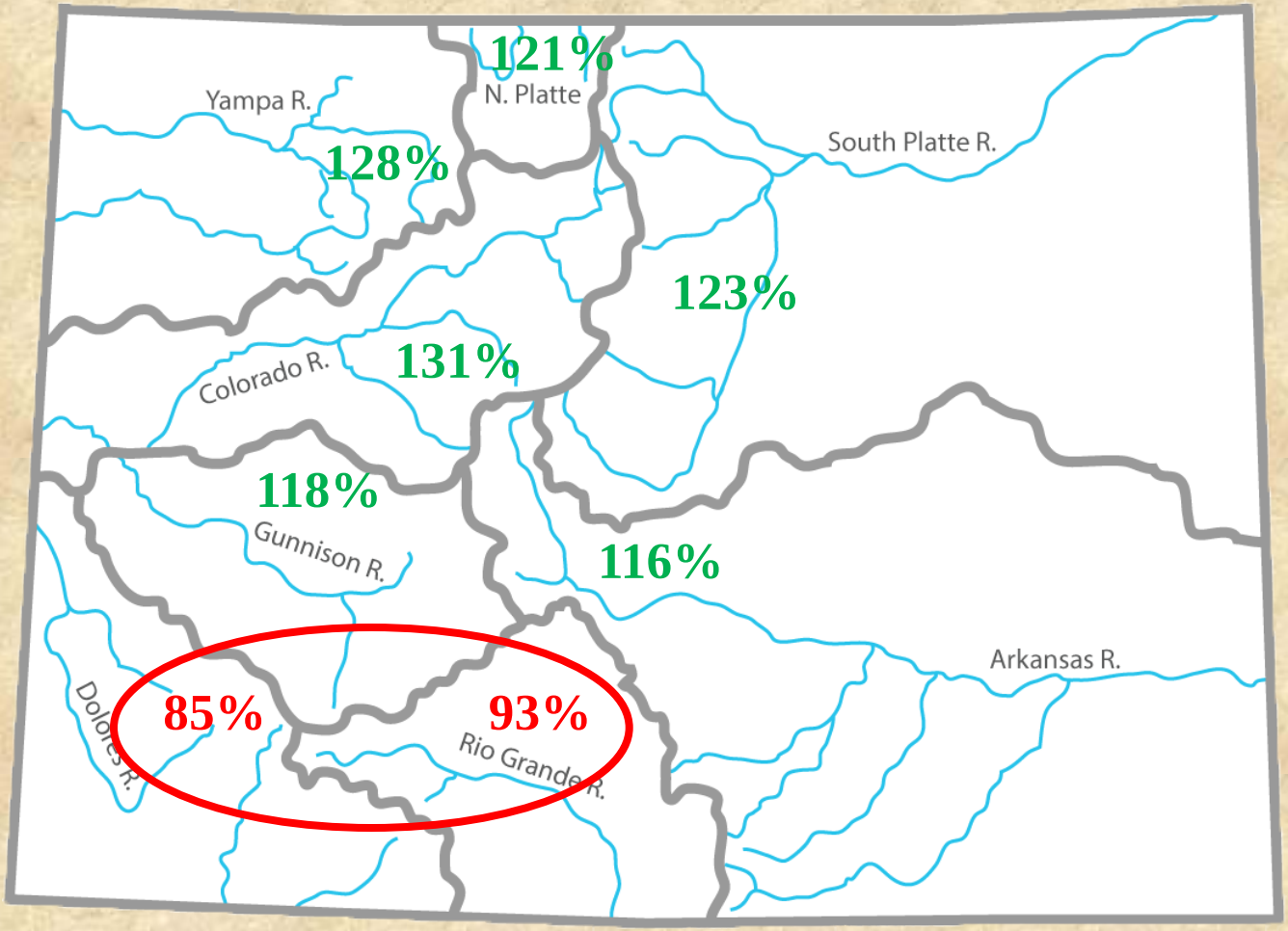




Same set of analogues for temperatures (left) and precipitation (right). ***Coverage remains more impressive for precip (right) than for temps, with the wet coverage in the West retreating to the northwest, but only NM showing a significant dry signal. There is an overlap of three cases with the previous analogue selection: 1983-84, '95-96, and '05-06 (I would not mind an outcome along those lines).***

http://www.esrl.noaa.gov/psd/data/usclimdivs/

Six analogue SWE for 1apr



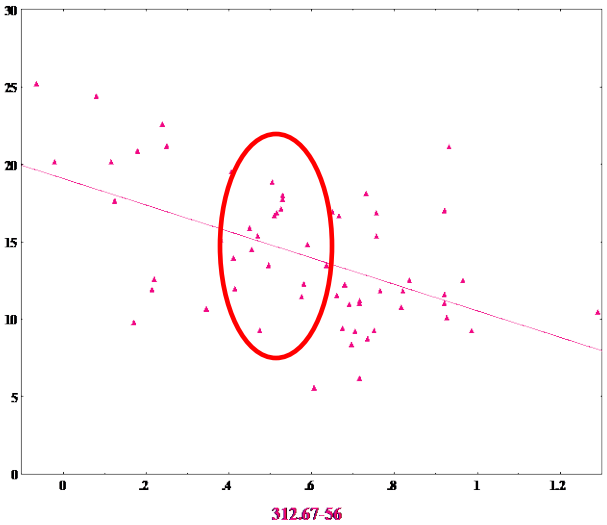
Median outcome for Colorado snowpack based on the subset of six analogue cases since 1950: favorable in the northern, central, and Front Range mountains. Poor in San Juans (cases: 1960, 65, 67, 84, 96, 2006).

Lees Ferry Naturalized Runoff in Water Year 2017

Key predictors: *Onset behavior of ENSO (left) + <Oct-Dec>precip (right)*

1983

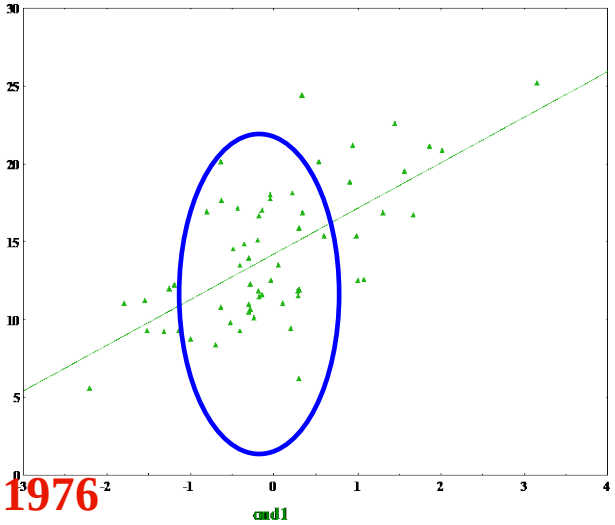
2016: 0.40 (< 2007 & 2008)



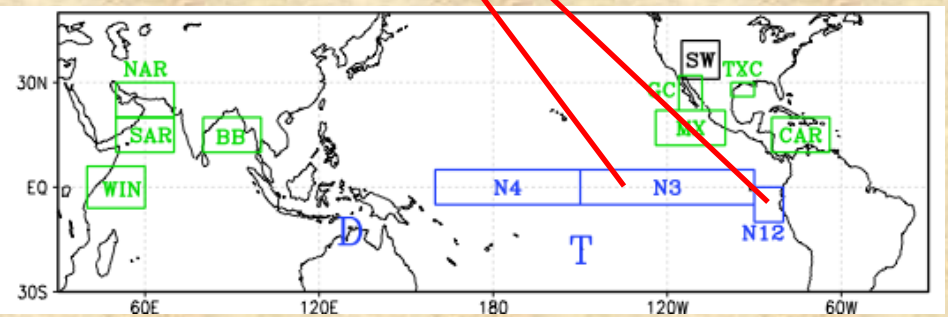
2002

2016: drier than normal?

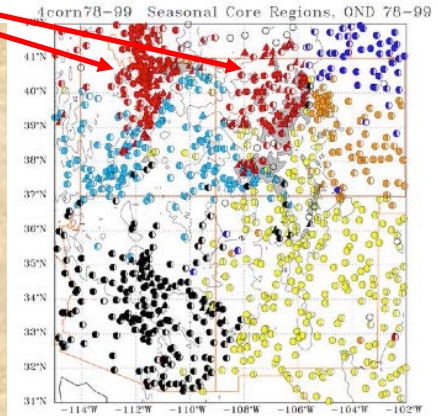
1983



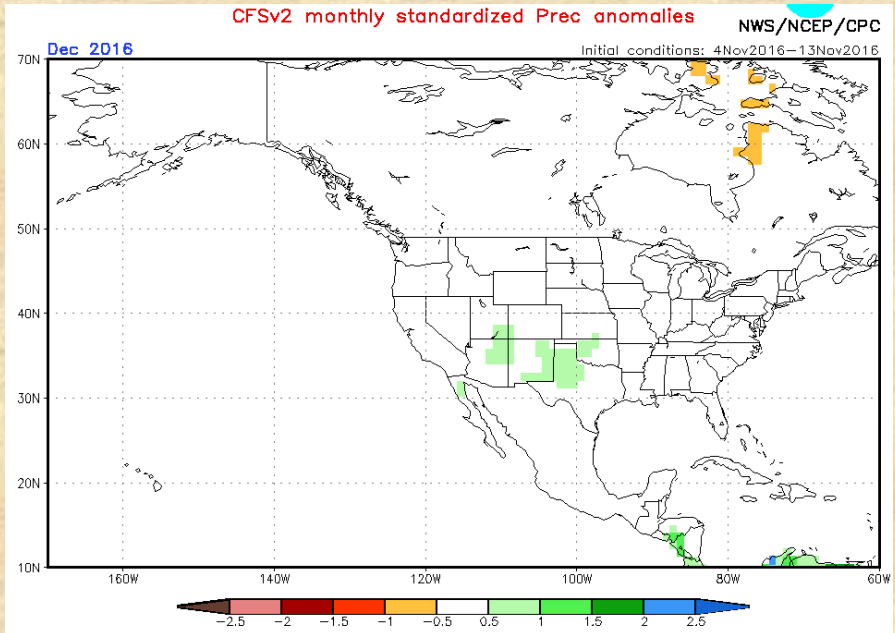
1976

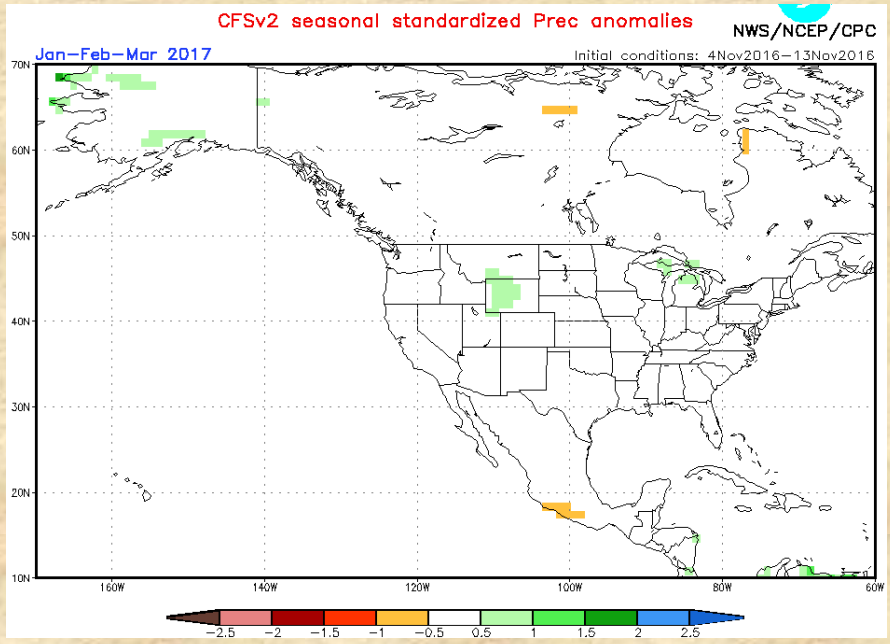


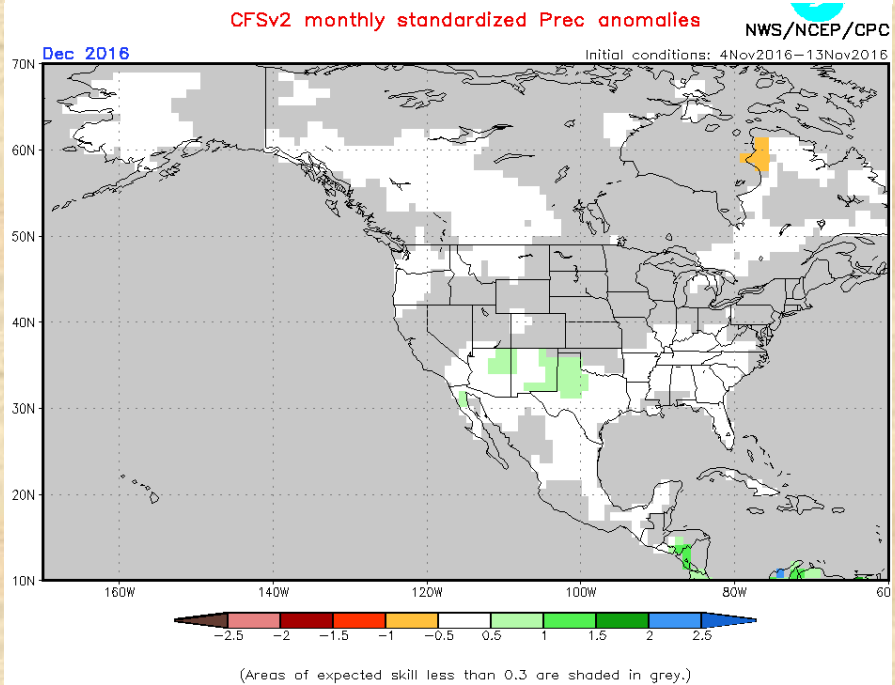
ENSO flavor favors decent runoff (left), while fall precip in Upper Colorado Basin "could have started better". ***I still hope for a near-normal outcome*** **(*right*).**



CFSv2 forecasts for Dec'16 and JFM'17



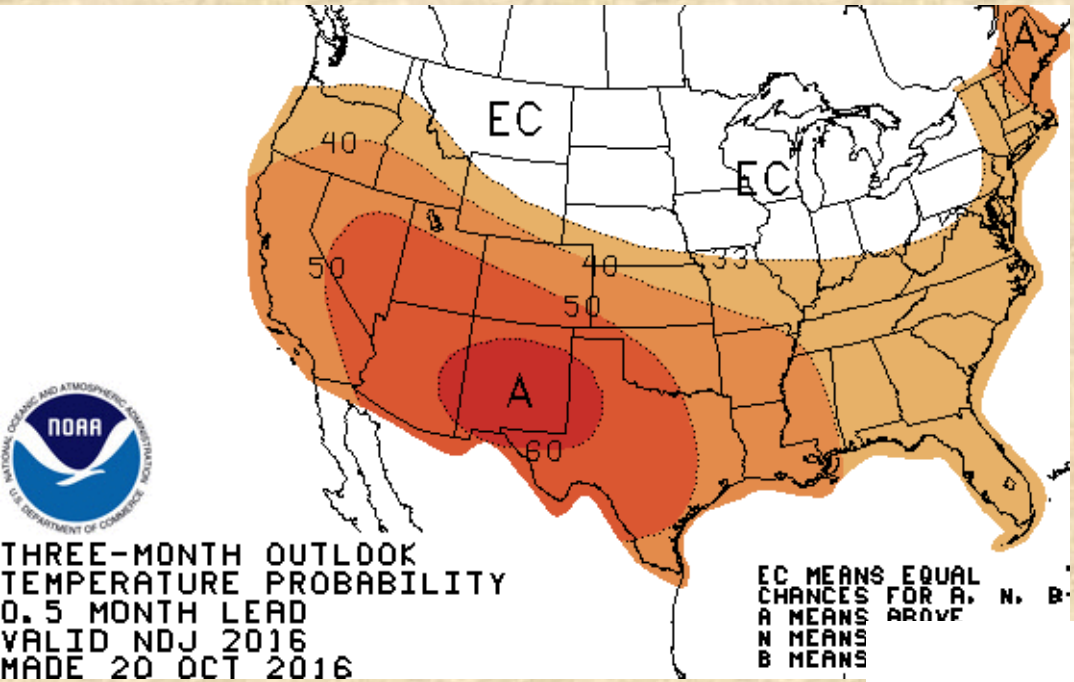




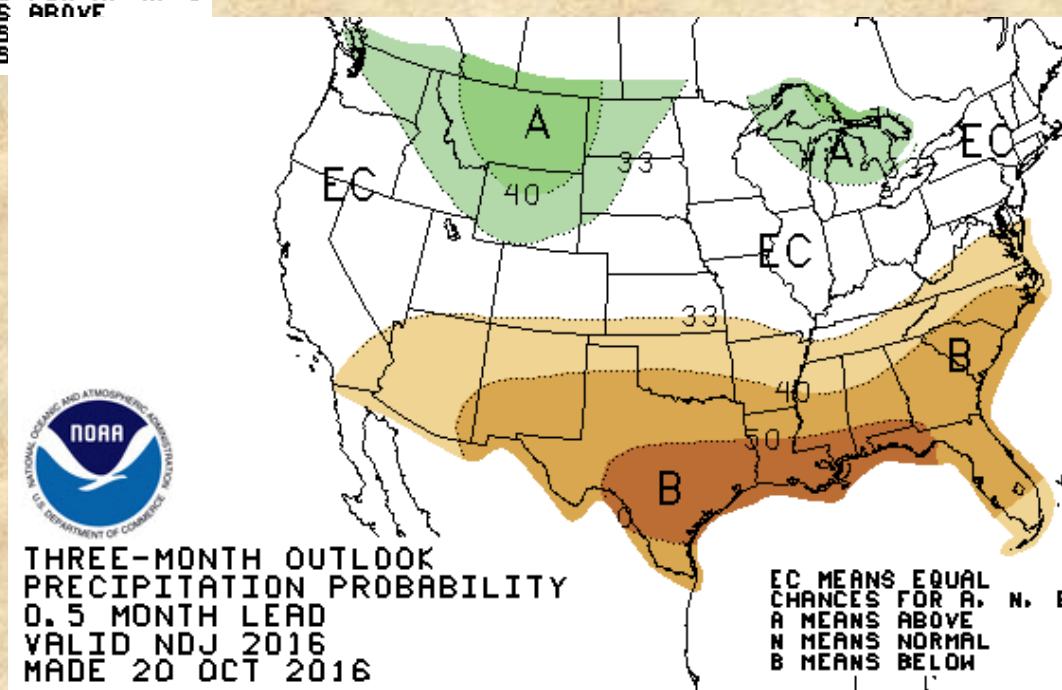
December (top left) and late winter (top right) look near-normal to isolated wet in CFSv2. If you require skill, only the December forecast (bottom left) shows a signal (wet to our south). ***Is La Niña pretending to be El Niño for one month?***

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

Climate Prediction Center Forecasts: Nov-Jan

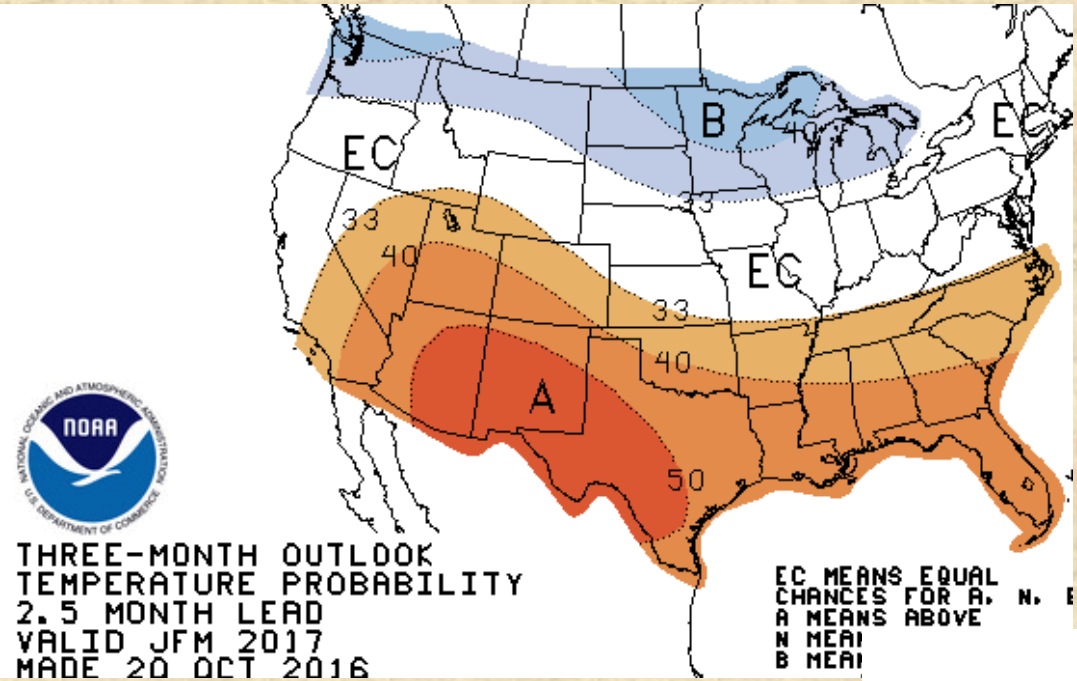


The CPC NDJ temperature forecast (top left) is rather toasty, continuing a warm year. The precipitation forecast (bottom right) has a La Niña flavor to it, but keeps our region 'EC', with climatological odds.

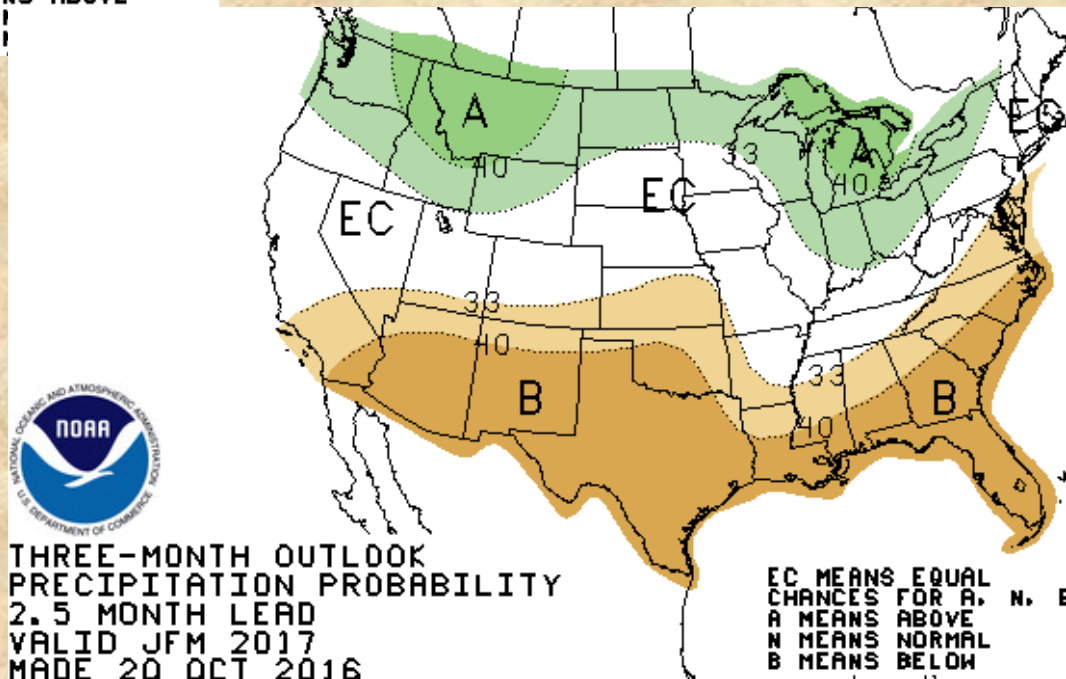


http://www.cpc.ncep.noaa.gov/products/predictions/

Climate Prediction Center Forecasts: Jan-Mar 2017

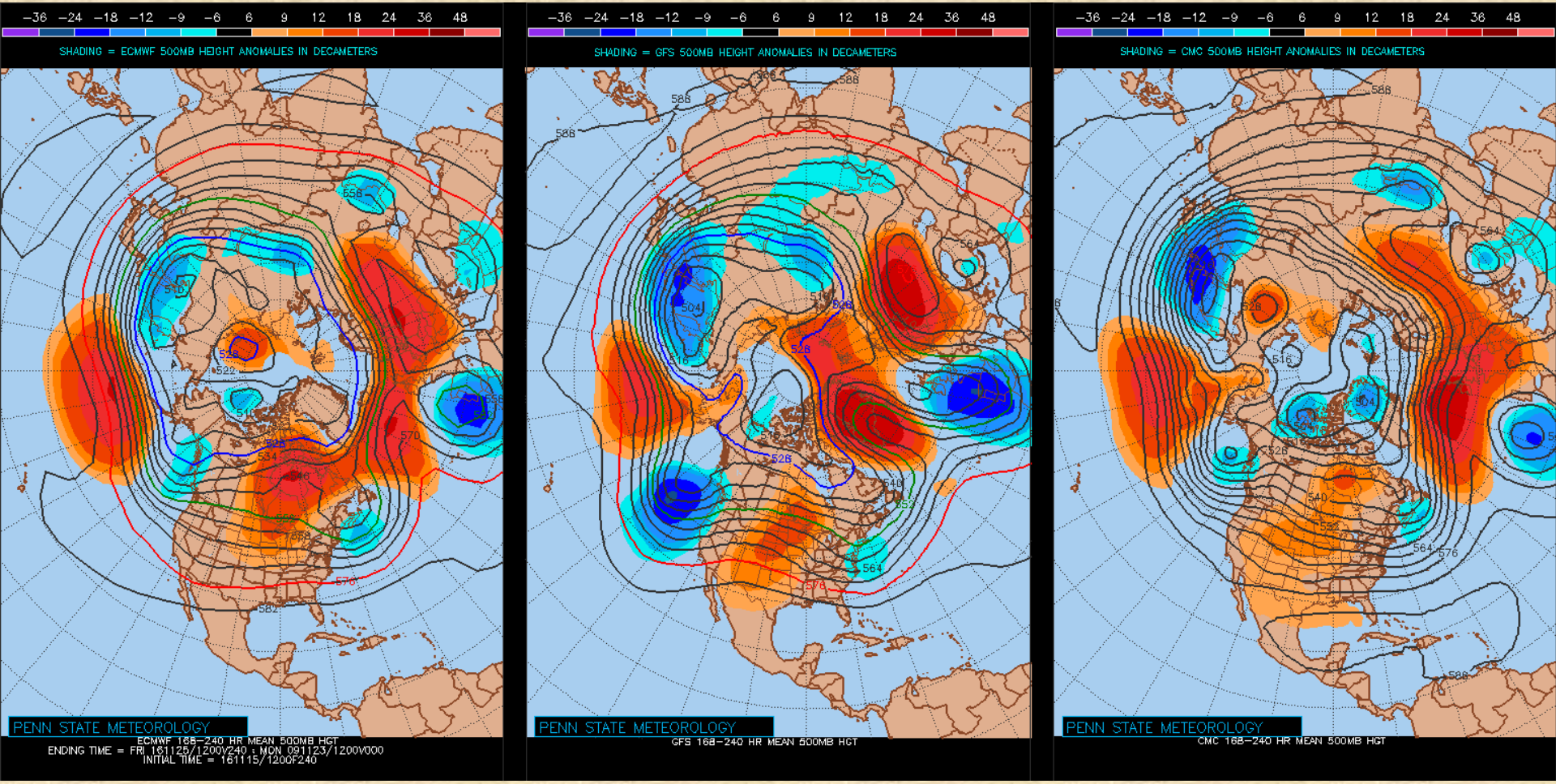


The CPC late winter temperature forecast (top left) resembles a La Niña-based forecast *(La Niña watch is back on)*. Given an overall warming trend, a warm forecast for us is not surprising. The precipitation forecast (bottom right) is again 'EC', with dry conditions encroaching from the south.



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

What can we expect by end of next week?



European ECMWF (left), American GFS (middle,) and Canadian CMC (right) forecast models show continued ridging (high pressure) to our north and east, with the European model being closest to near-normal for us. The good news is that we should see occasional storms come in, perhaps one-two per week. The bad news is that it does not look wetter than normal. ***Snow on Thursday is a good possibility along the Front Range, finally.***

Executive Summary (15 November 2016)

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- **La Niña snuck in, it is weak, and may very well be on its way out by early next year. Precipitation impacts in Colorado have been consistent with a switch to La Niña for several months now.**

- **In a time of weak Pacific forcing (even the PDO has been barely above 0 for three months in a row), tilts in the odds of the experimental forecast guidance are not impressive for either fall or winter, with the update for late winter showing more of tilt towards dry than before. *However, analogues based on recent behavior of the PDO & MEI slightly favor a wet early winter (Nov-Jan) for our north-central mountains.***

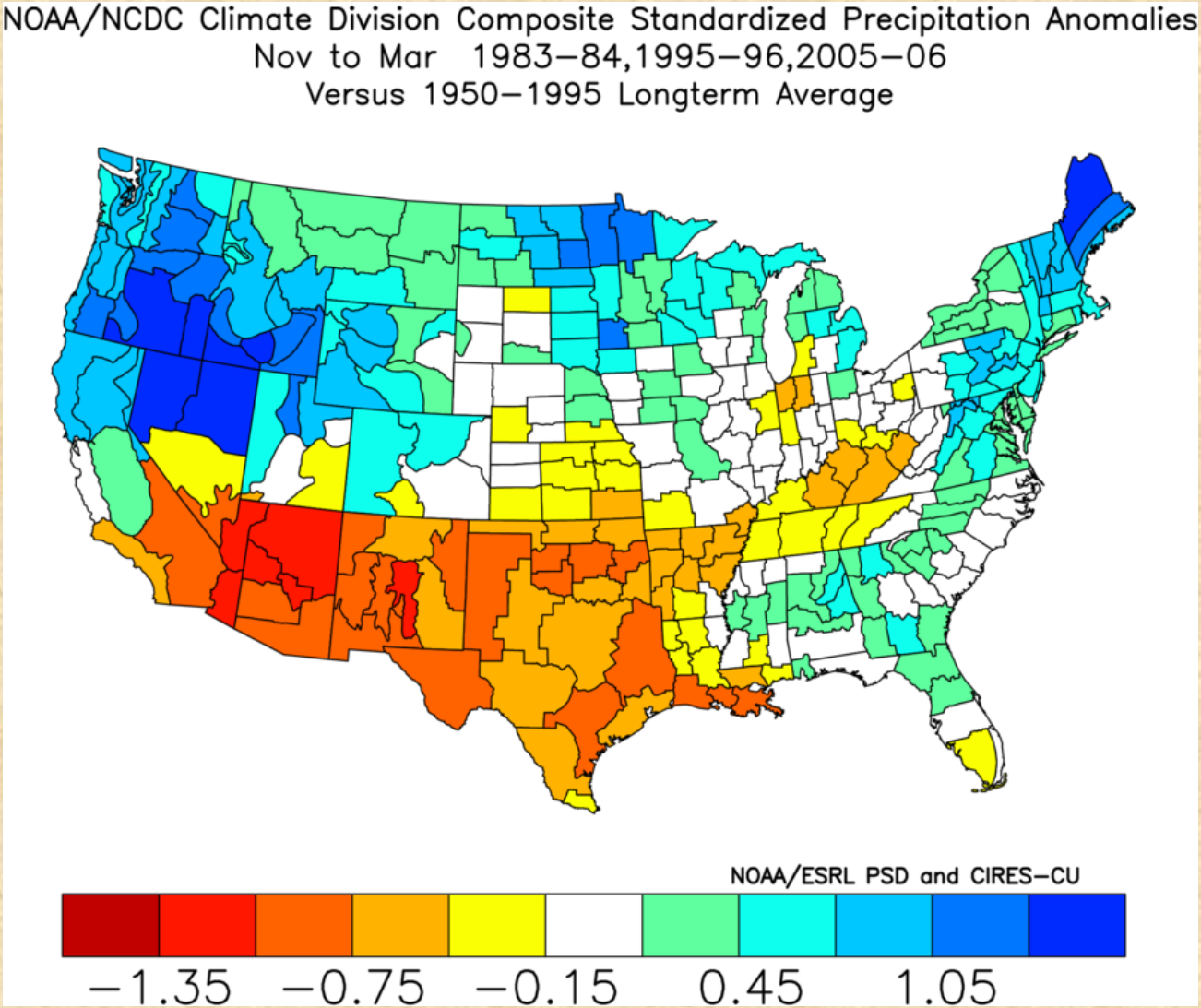
- **Forecasts from CPC are 'EC' through late winter, with dryness encroaching from the south by then. CFSv2 has been vacillating in last few months, but holds out for extra moisture in December which just might prevent the January 1 snowpack from falling of a cliff…**

- **The next two weeks look more active than recent weeks. In fact, I would say it's time to put away the shorts, and put your winter tires on if you travel into the mountains at all.**

- **BOTTOMLINE: Weak La Niña should favor our northern mountains in next three months, not so much at lower elevations, or in southern Colorado. The best case scenario beyond that would be to go straight into an El Niño by next spring, too early to tell. *Stay tuned!***

And that's my story, I am sticking to it!

November-March Climate Analogue Guidance (@late Oct'16)



We should be so lucky…

http://www.esrl.noaa.gov/psd/data/usclimdivs/