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*Colorado WATF, 01-19-17, Denver*

COLORADO
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Department of Natural Resources

# Seasonal Outlook for Colorado

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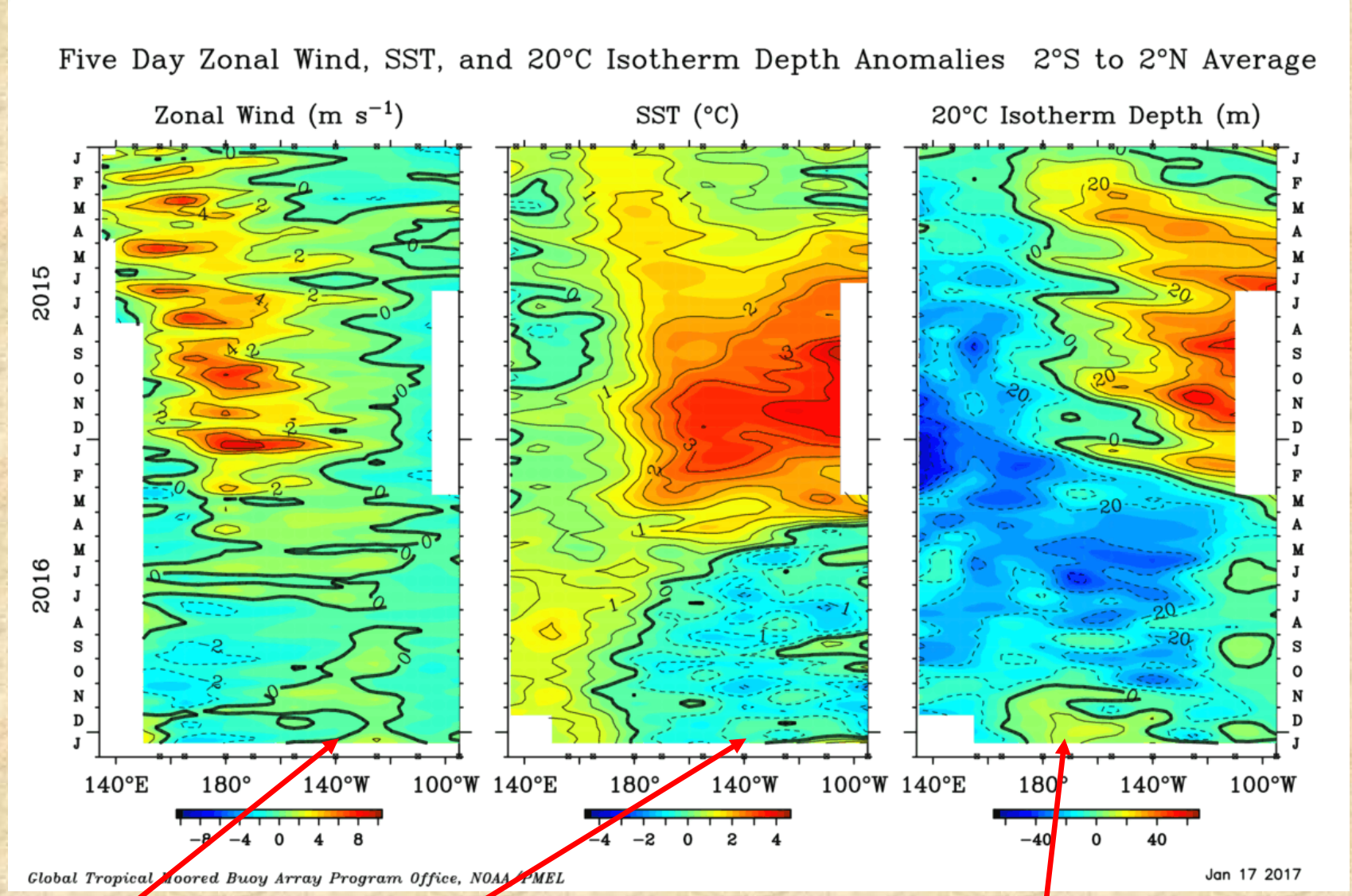
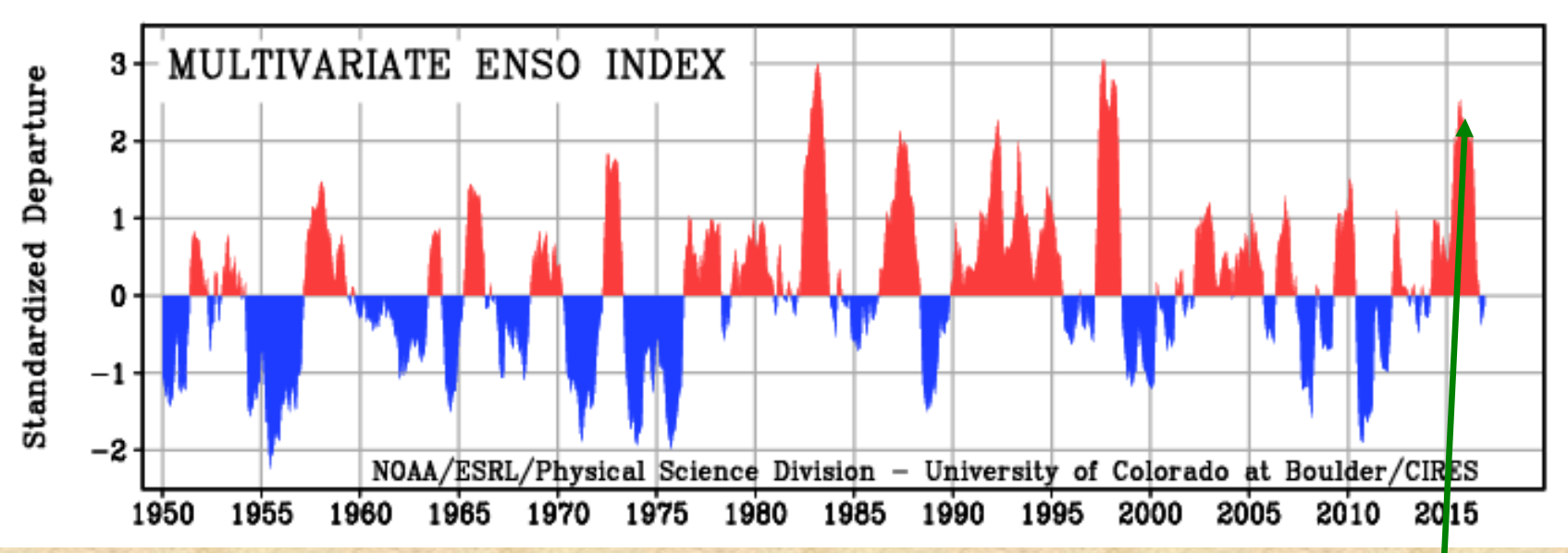
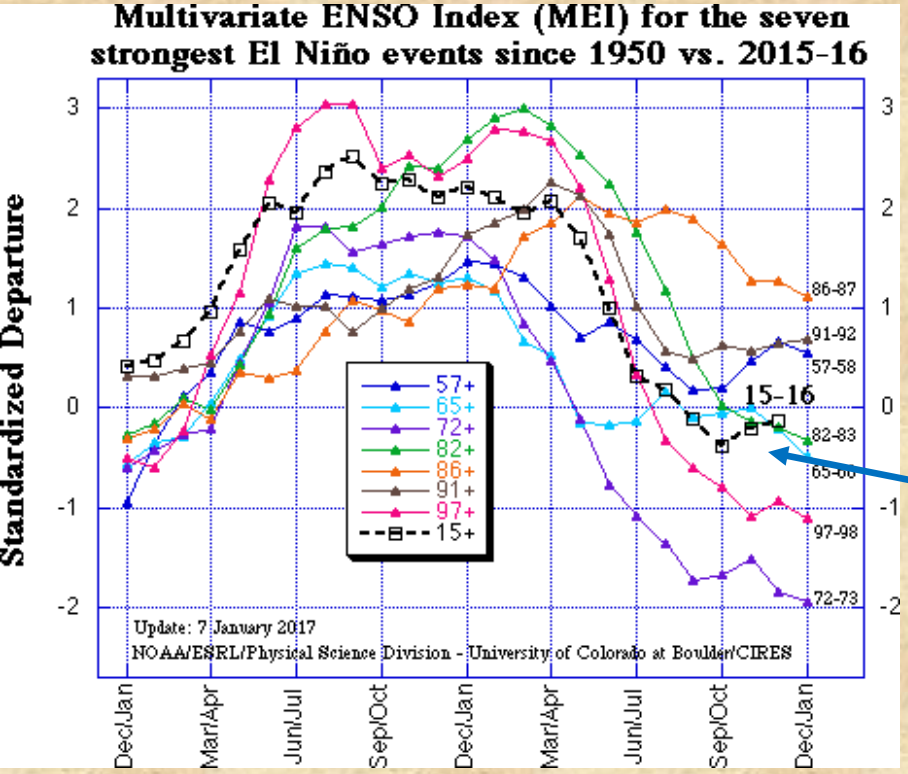
- ***Good-bye La Niña, nice knowing you – is that El Niño on the horizon?***
- ***Experimental forecast guidance thru March & Postmortem for Oct-Dec***
- ***Analogues (revisited)***
- ***CPC forecasts***
- ***Next week or two***
- ***Executive Summary (19 January)***




**El Niño was over half a year ago, but our recent La Niña is struggling in surface wind field (left), SST anomalies (middle), and subsurface heat content (right). It appears that the extratropical (American) footprint of this event is more impressive than its tropical heart/forcing.**

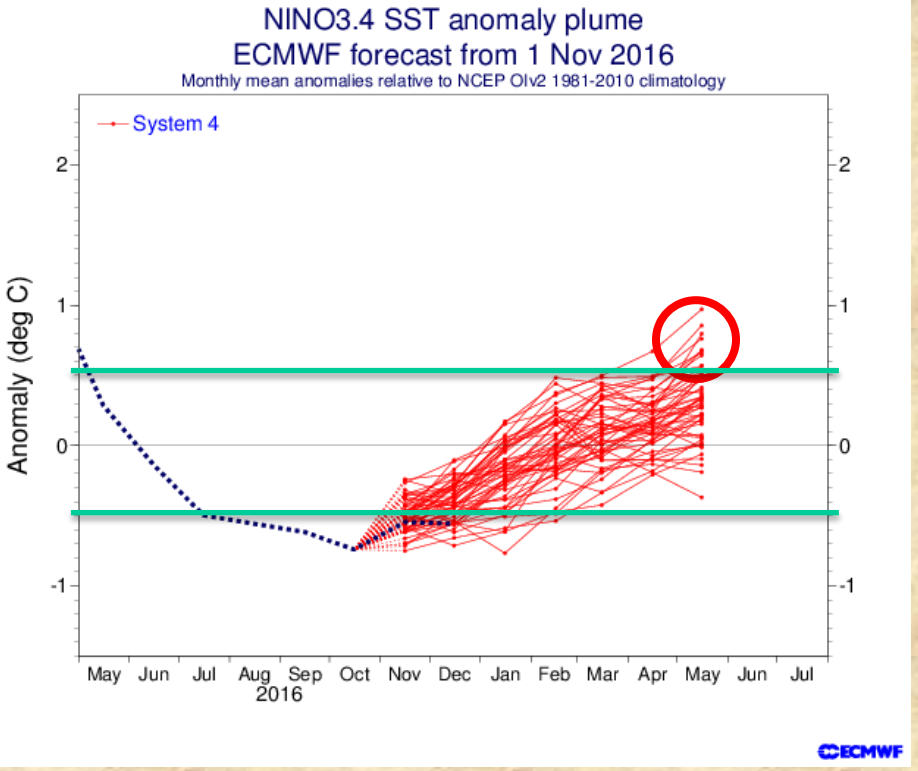
***http://www.pmel.noaa.gov/tao/drupal/assorted_plots/images/uwnd_sst_iso20_anom.gif***




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 its lowest value in Sep-Oct close to La Niña territory (Niño 3.4 was more gung-ho about La Niña than the MEI).

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

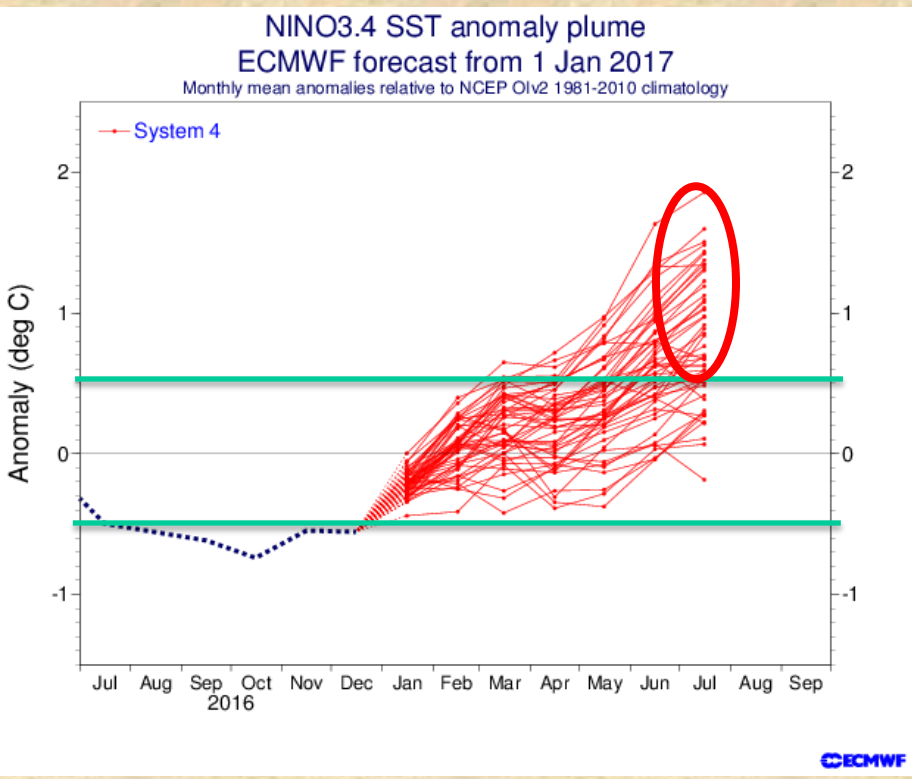



**The ECMWF November 2016 forecast (left) showed a steady climb from weak La Niña conditions to ENSO-neutral in late winter (+/- 0.5C; green bars), and about a 20% chance of El Niño by May.**

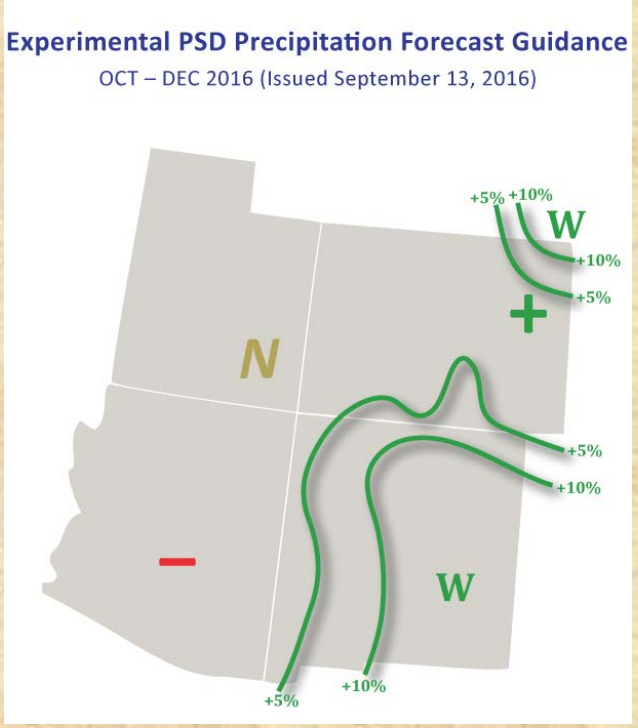
***http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/seasonal_range_forecast/***

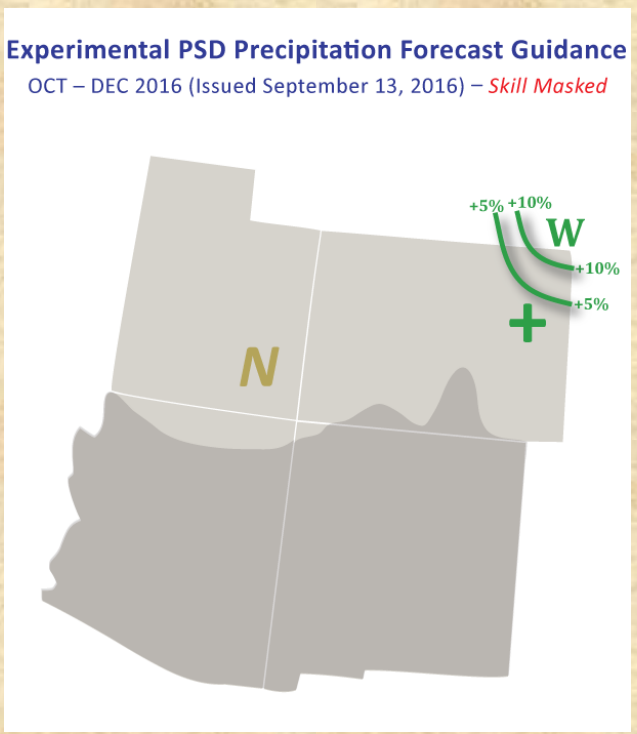
**The new ECMWF forecast (right) reaffirms increasing odds towards El Niño by May, reaching over 50% odds by June.** ***The 2016 La Niña (in the Niño 3.4 SST sense) was about as short-lived as they come, not unlike the aborted El Niño of 2012.***

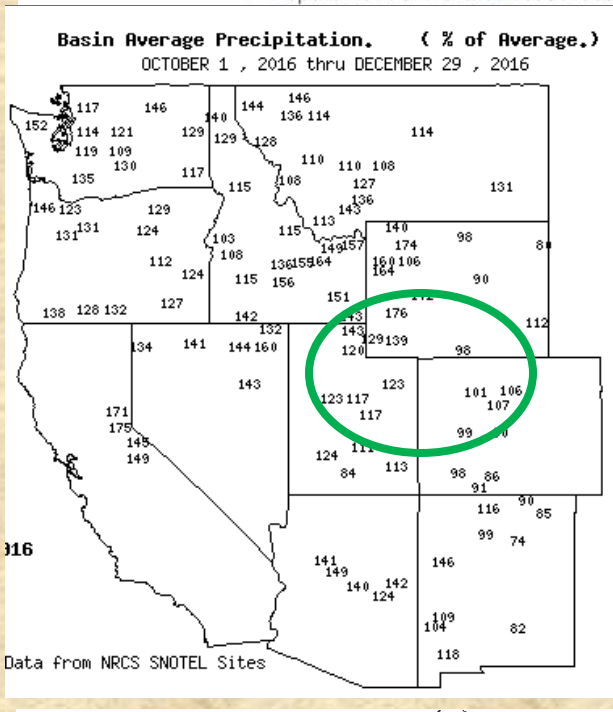
***PDO has rebounded above +1 in November and December.***

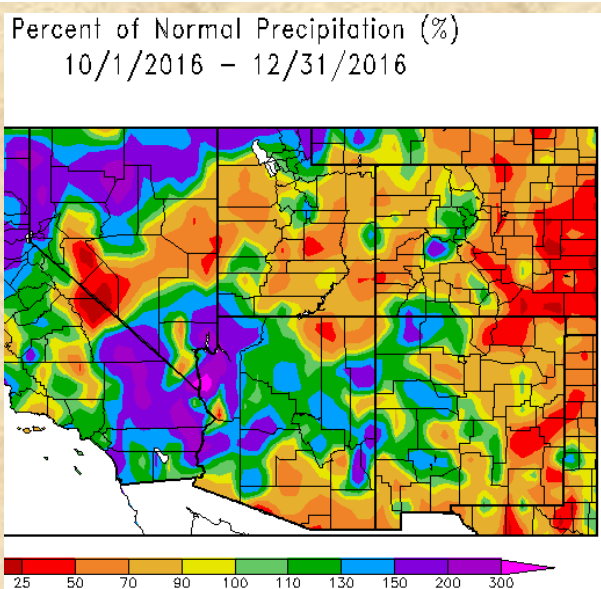


# Forecast for Oct-Dec 2016



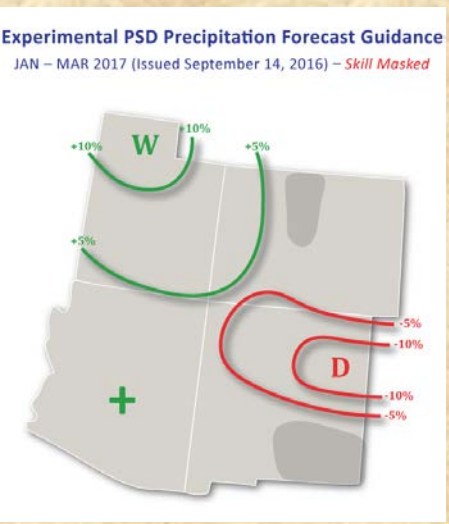



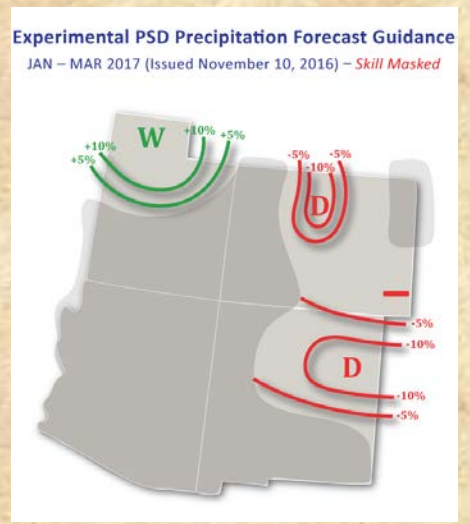



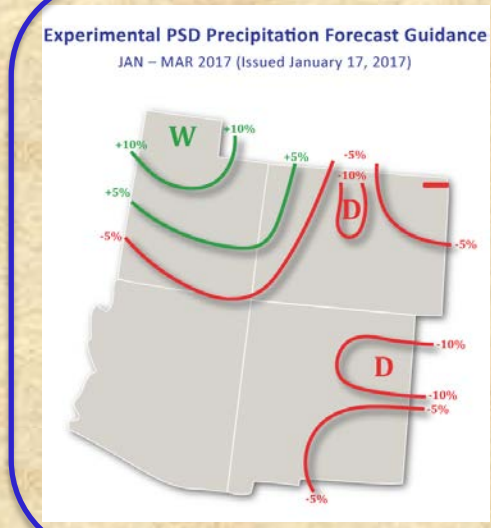



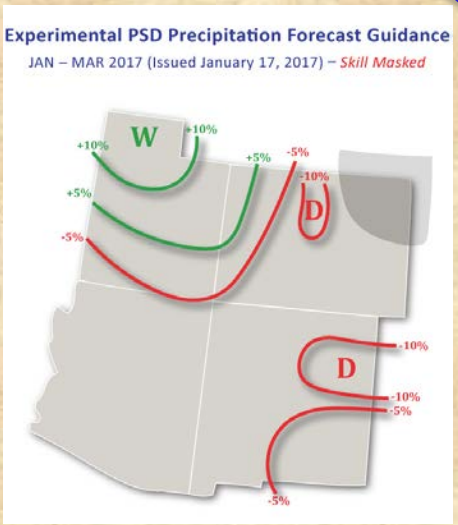

**My late fall precipitation forecast was either neutral or wet for Colorado (left), with best odds for wetness in northeast corner of the state. The skill-masked forecast (right) confirmed this for UT and CO. *Similar forecasts for the Upper Colorado Basin were slightly more favorable than near-normal in their outcomes.* *The higher elevations of northern UT and CO ended up ≥100% (top right), while the lower elevations of both states were mostly dry (lower right).***

# Forecast for Jan-Mar 2017

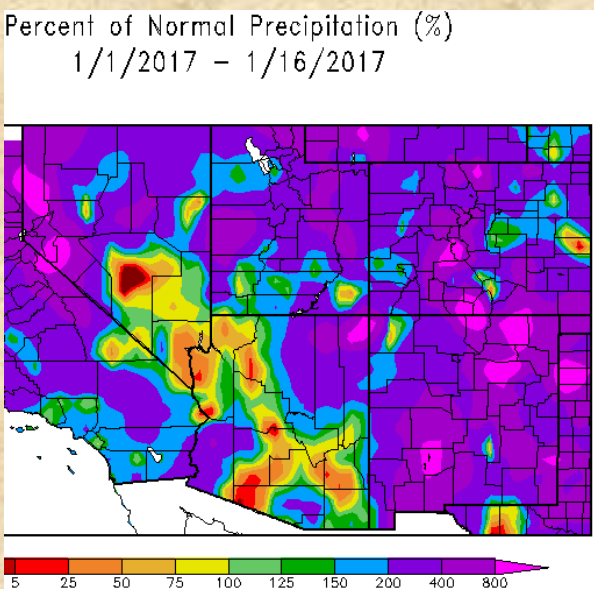


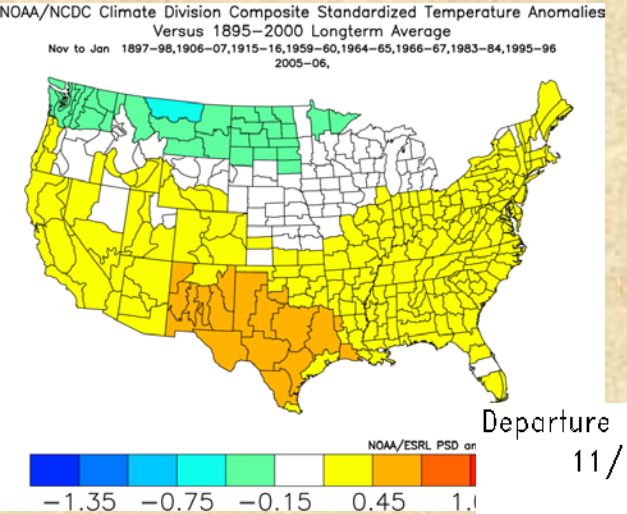



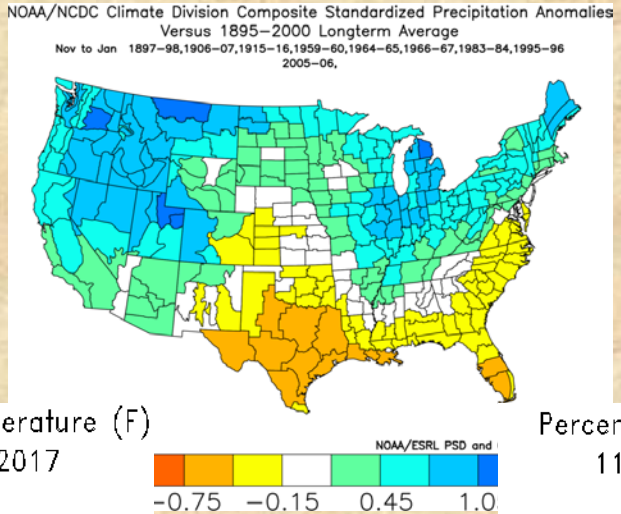

**My September winter precipitation forecasts kept anomalous moisture mostly to our west (left), leaving the best odds in our state for westernmost Colorado.** ***The November version (center left) was generally drier in Colorado, but also less skillful. The most recent forecast (full forecast center right, skill-masked top right) reintroduces better-than-average odds for westernmost CO, while keeping the mountains and most of the eastern plains drier than normal.*** **January so far has thus been surprisingly wet (bottom right) – note that we have still have 9-10 weeks to go…**

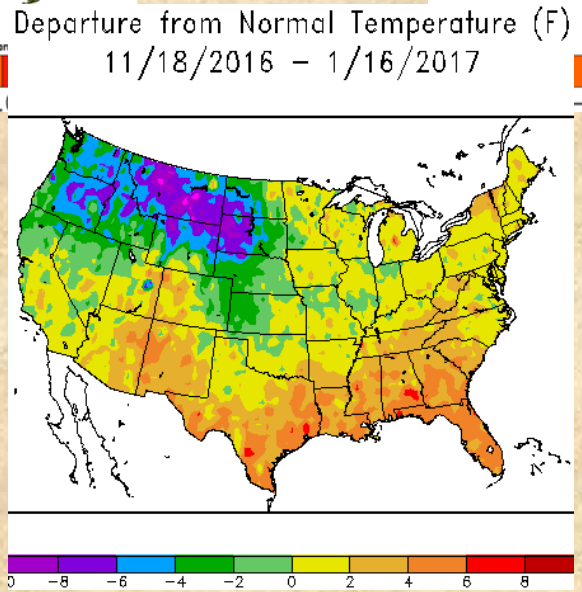


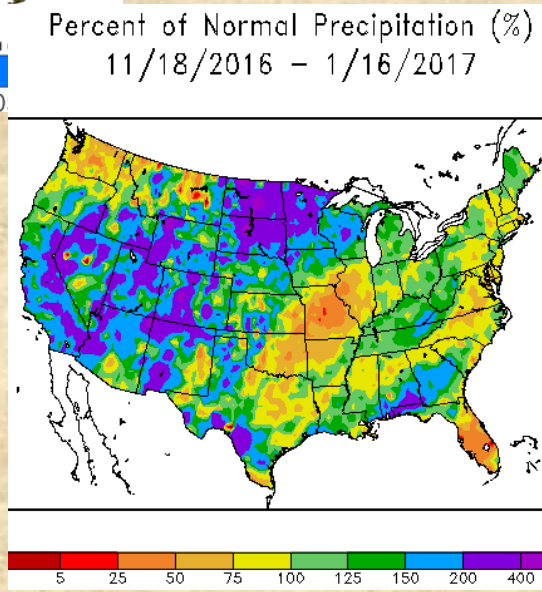

A moment of contentment
after a barrage of storms
© Ed Kopeschny 2015

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



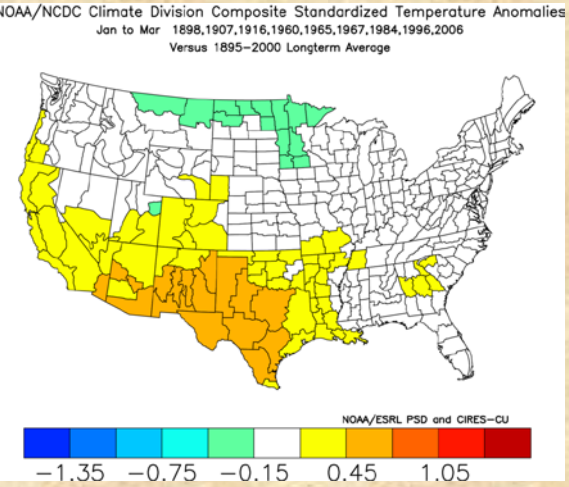



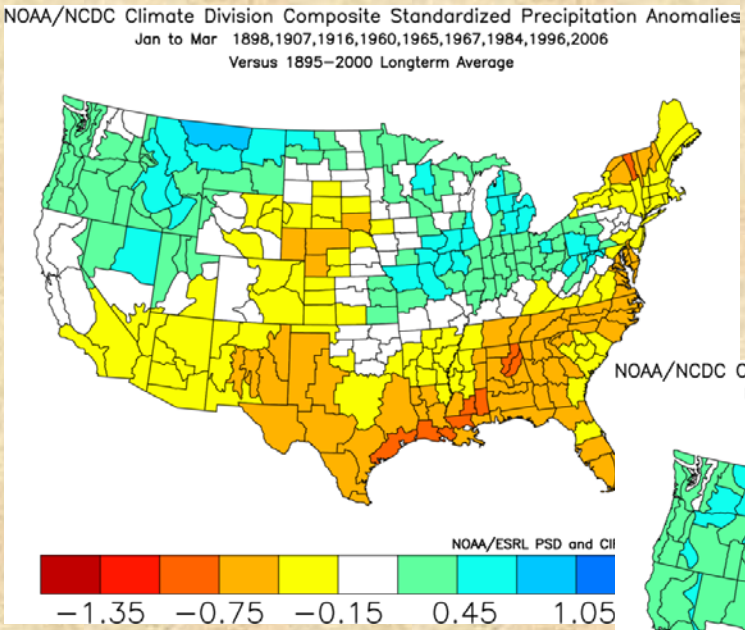



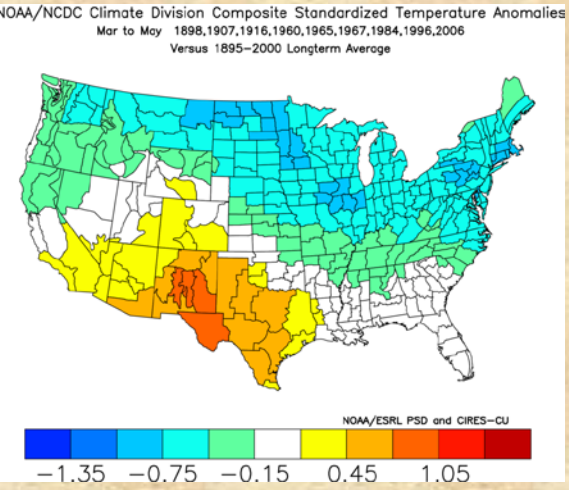

**My analogues were based on <u>rapid declines in the MEI and PDO from positive values without hitting major negative values in the following winter</u> for temperatures (left) and precipitation (right). With a sample size of nine, the 2nd color shade (+/-0.45 standard deviations) is considered 'significant'.** ***The temperature map anticipated a warm early winter over the southwestern US, while the wet signal for UT and western CO stood out on the positive side. With most of NDJ over, both 'forecast' maps appear to be on track for the western U.S.***

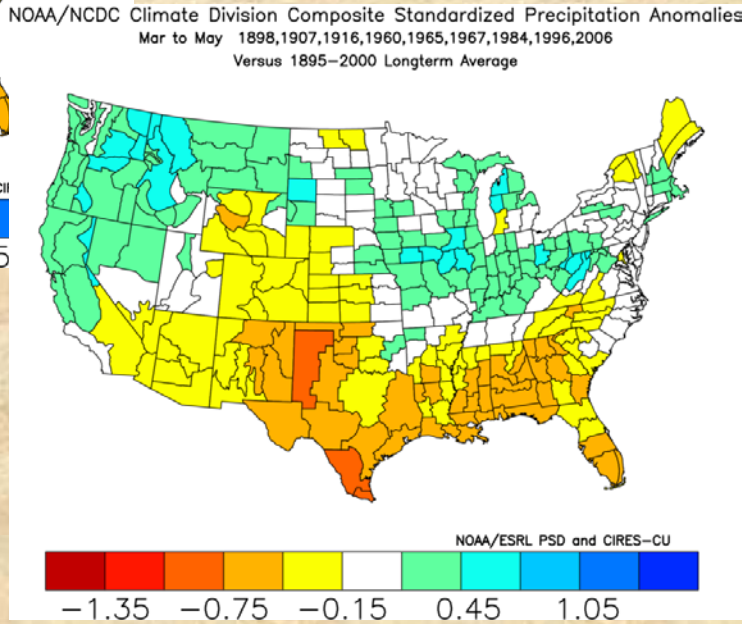
***http://www.esrl.noaa.gov/psd/data/usclimdivs/***

# *January-May Climate Analogue Guidance (@late Oct'16)*



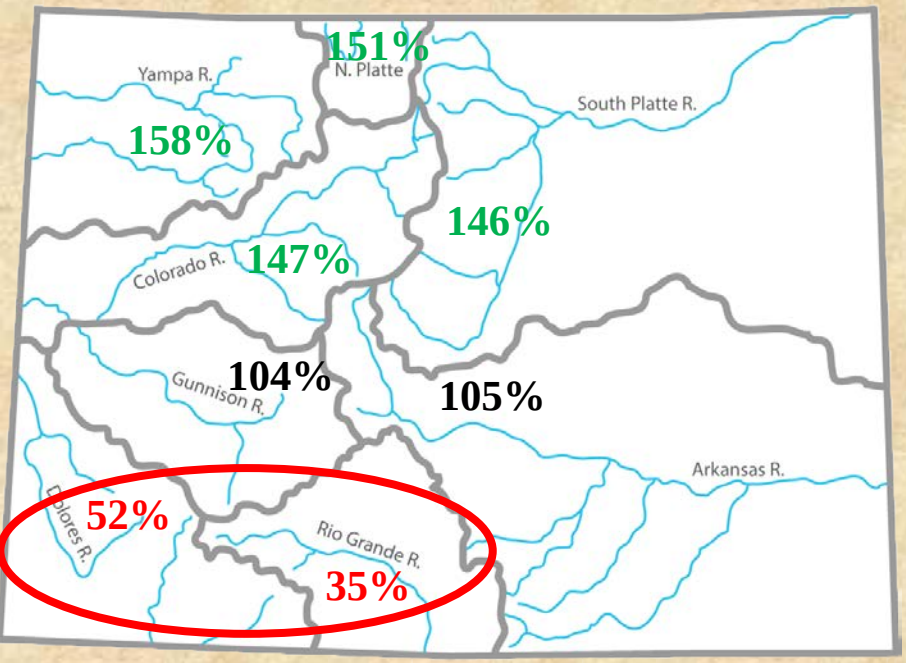

**Same set of analogues for temperatures (left) & precipitation (right) in JFM and MAM.**

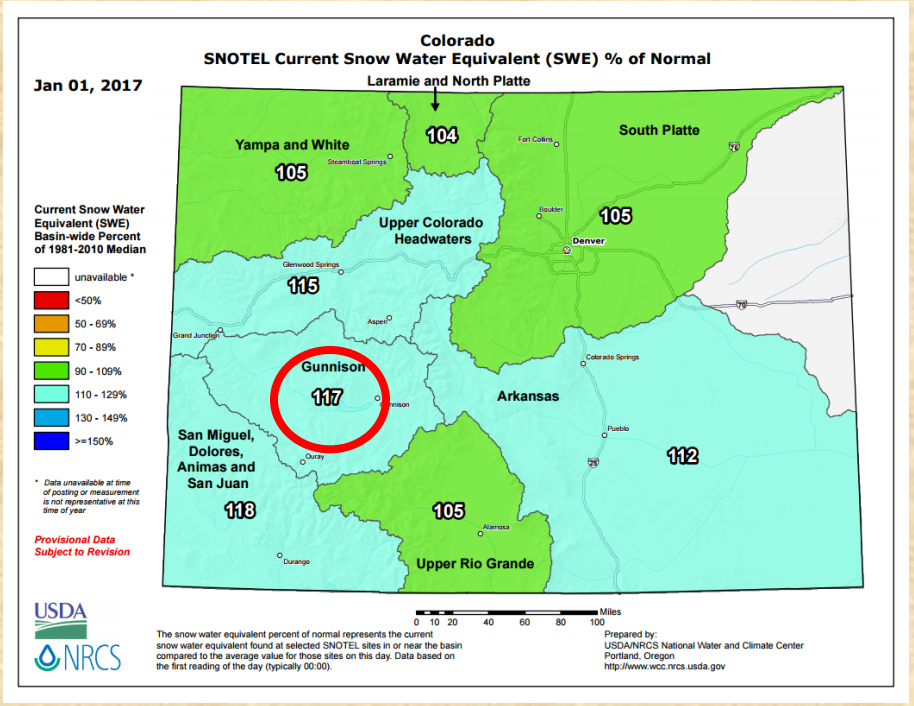
***Wet coverage in the West retreats to the northwest, but only NM shows a significant dry signal in the Interior Southwest. IOW, guarded pessimism is the word of the day…***

***P.S.: Updated analogues based on Nov-Dec MEI do not change this outlook.***

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

# Three analogue SWE for 1jan

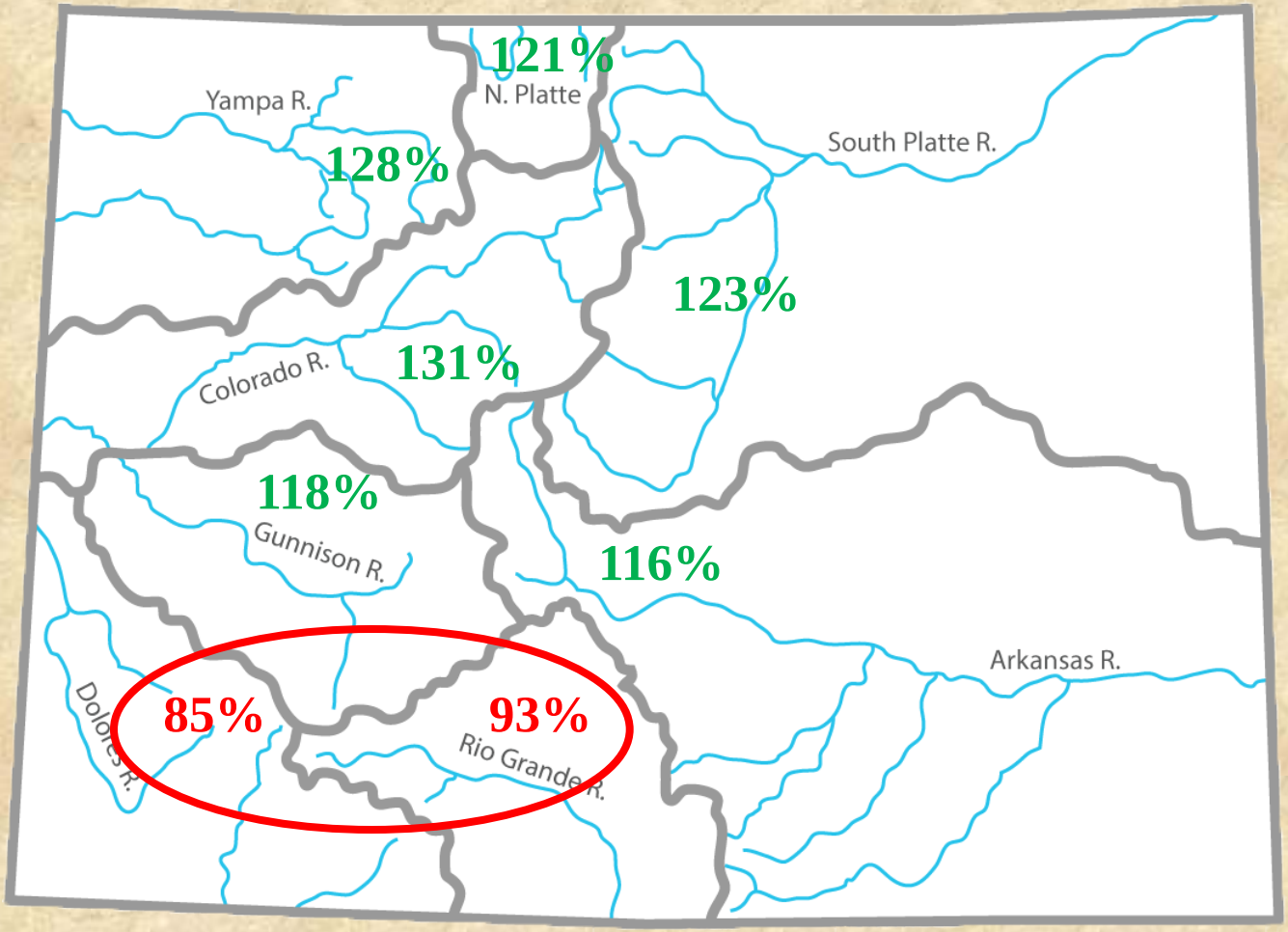



***Median outcome for Colorado snowpack based on the subset of three analogue cases since 1980: favorable in the northern, central, and Front Range mountains. Poor in San Juans (again, based on 1984, 1996, 2006). More variable outcome due to smaller sample. Average for state about 110%+, close to actual outcome this year…***

***Note: 1jan SWE in Gunnison basin is best predictor for CO River runoff, not bad this year!***

# Six analogue SWE for 1apr

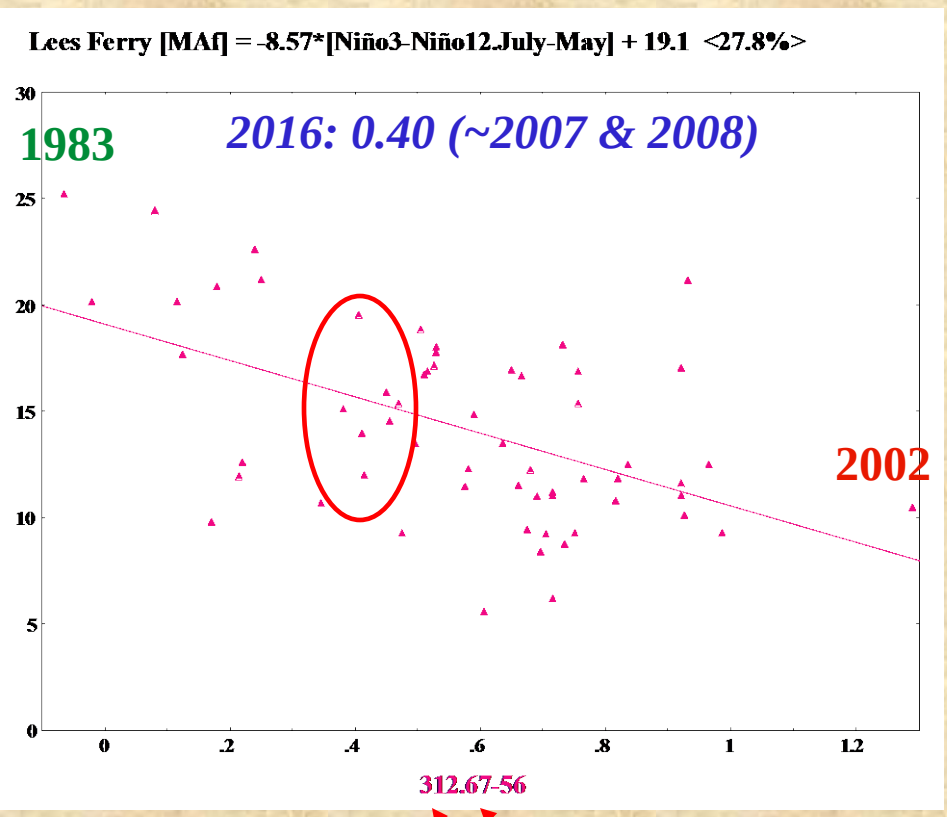


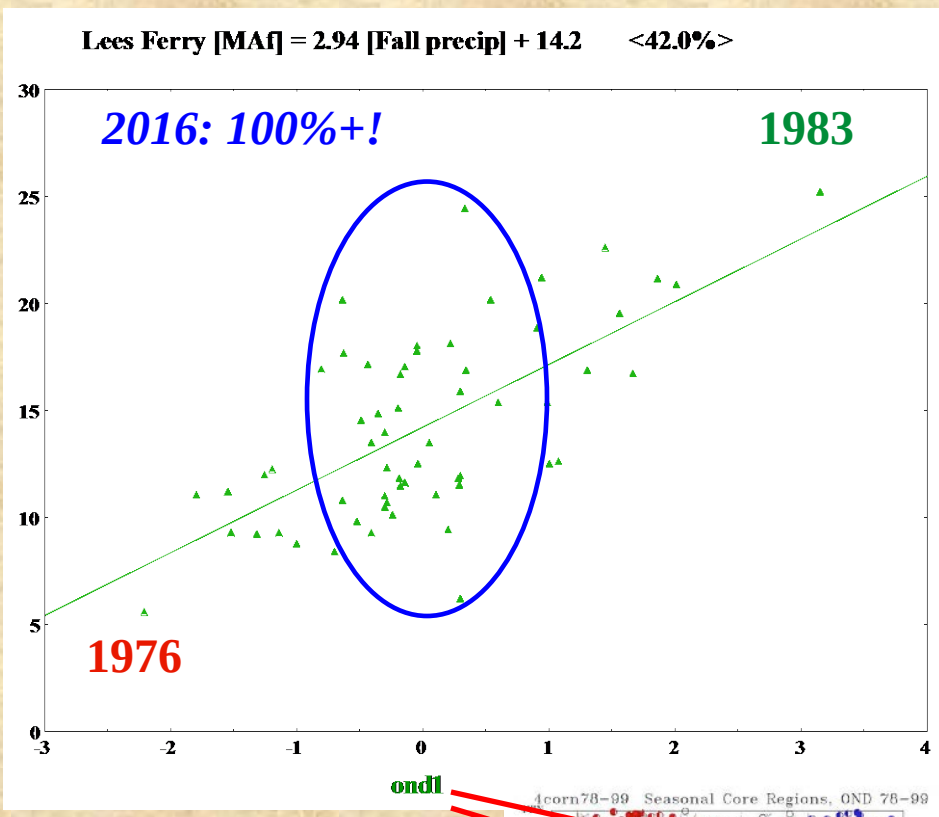

***Median outcome for Colorado snowpack based on the subset of six analogue cases since 1950: favorable in the northern, central, and Front Range mountains. Poor in San Juans (cases: 1960, 65, 67, 84, 96, 2006).***

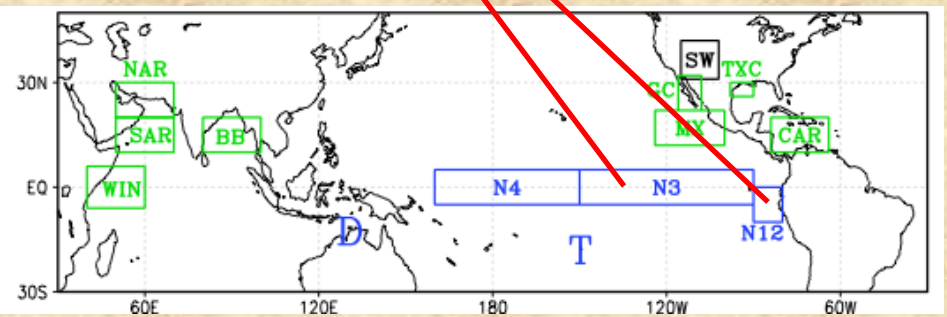
***<I showed this figure two months ago>***

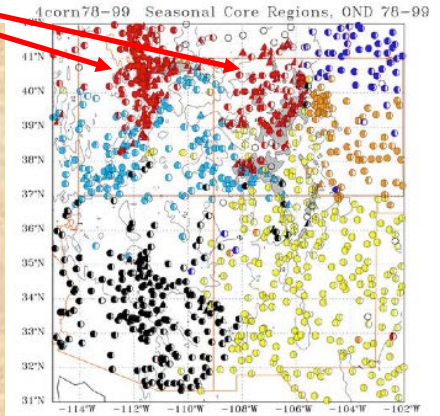
# Lees Ferry Naturalized Runoff in Water Year 2017

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



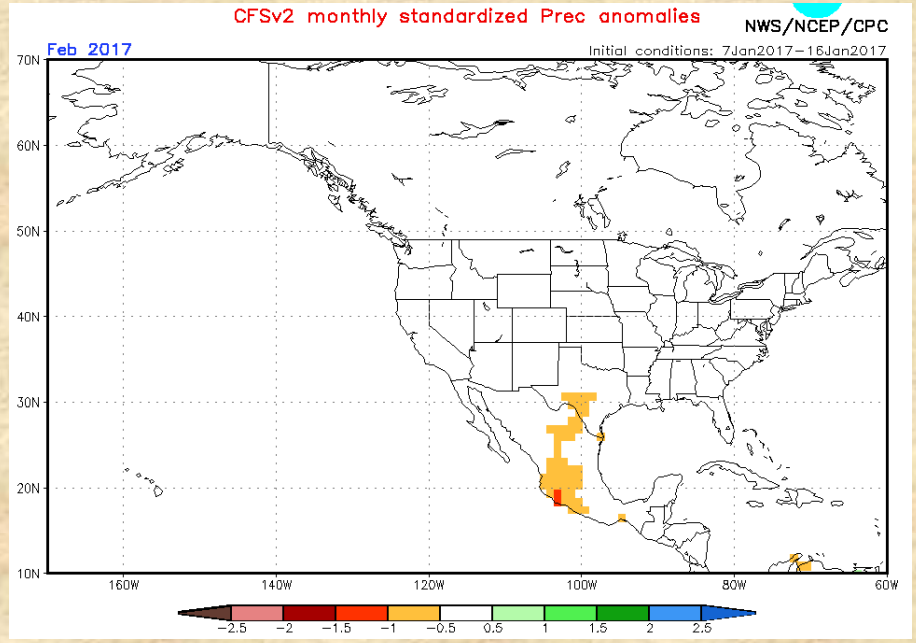



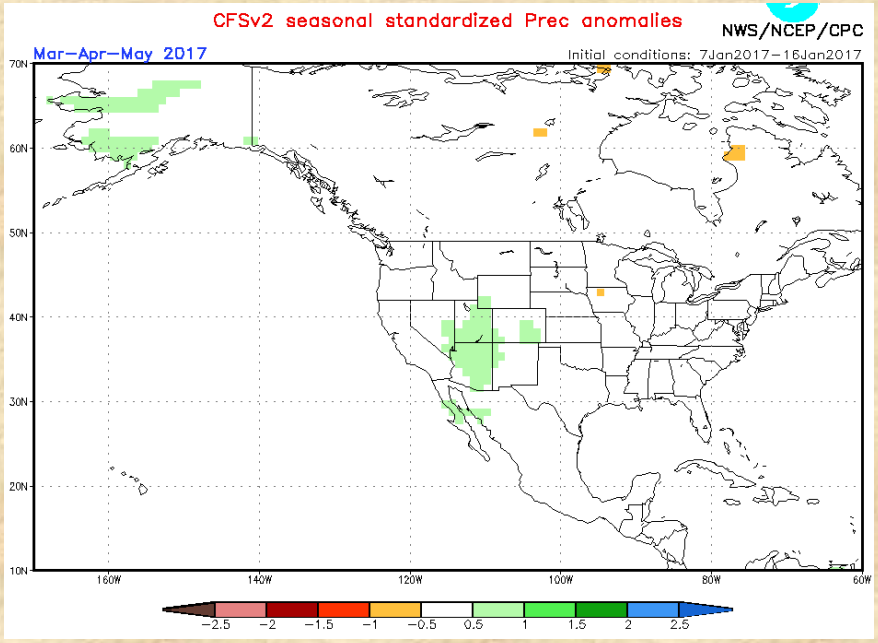




**ENSO flavor favors decent runoff (left), while fall precip in Upper Colorado Basin "could have started better".** ***Looks like we got the hoped-for near-normal outcome (right; slide 5).***

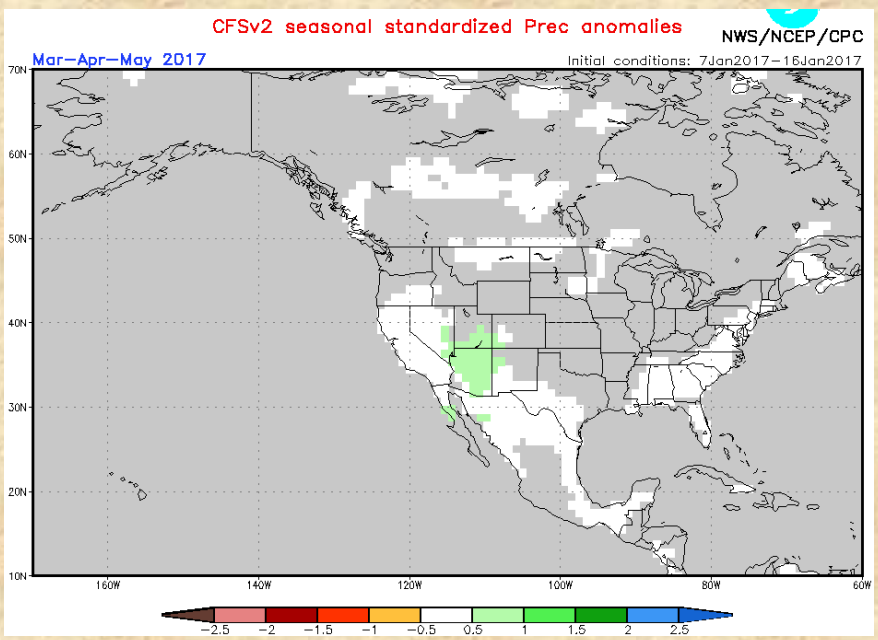
# CFSv2 forecasts for Feb'17 and MAM'17



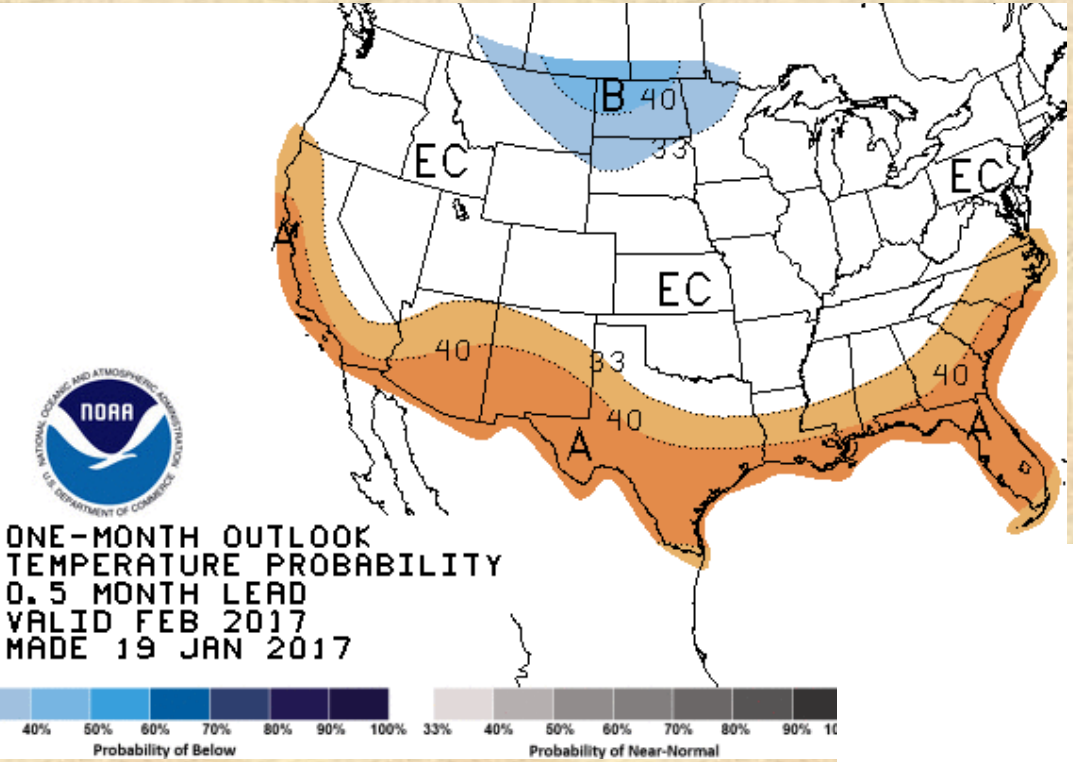




**February (top left) and spring (top right) look near-normal to somewhat wet in CFSv2. If you require skill, only the spring forecast (bottom right) shows a signal (wet to our southwest).** ***The wet spring forecast is more consistent with El Niño than with La Niña!***

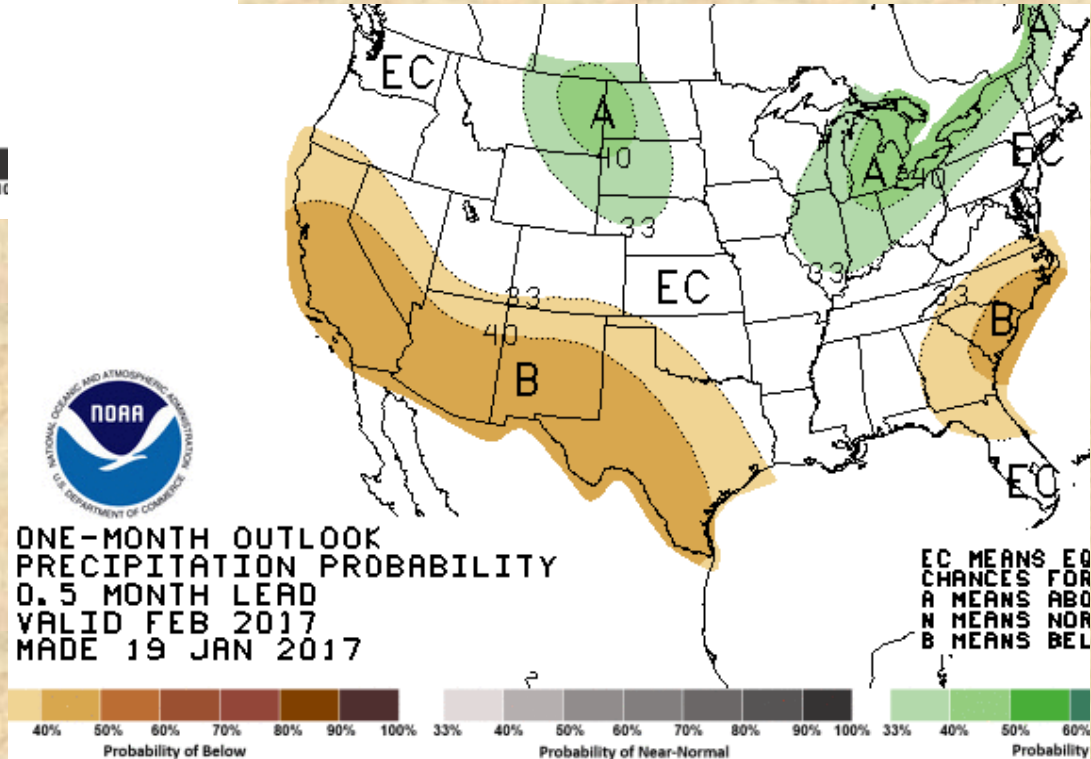
***http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/***



# Climate Prediction Center Forecasts: FEB

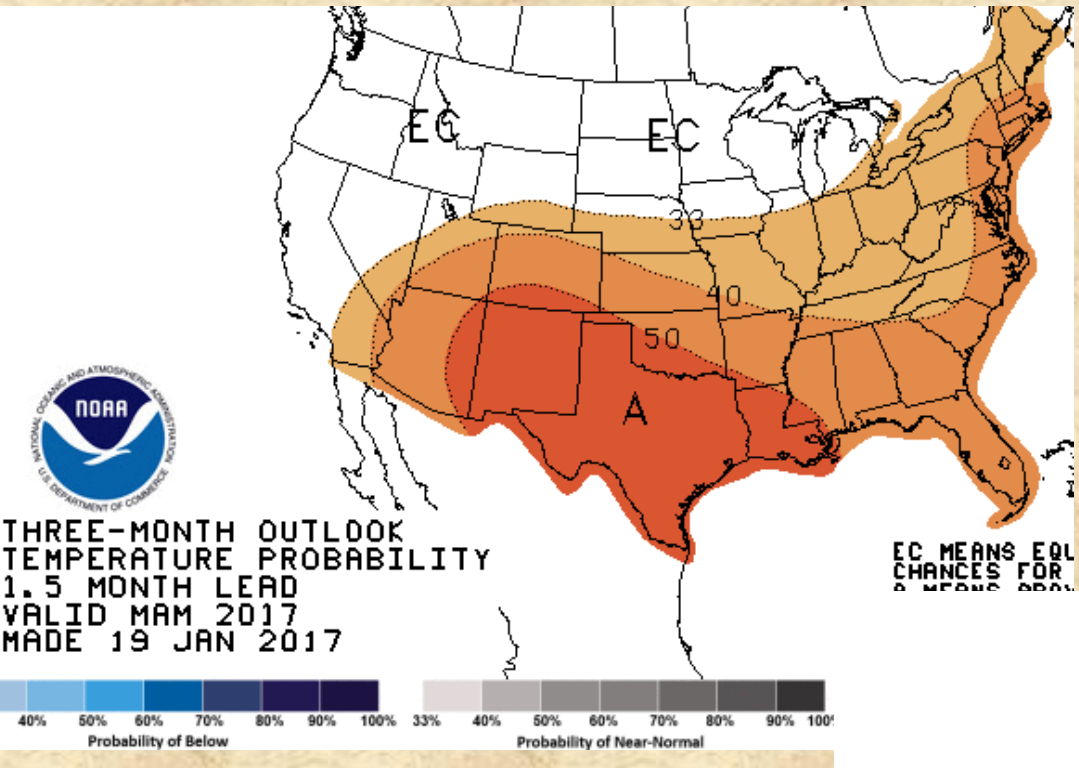



**The CPC February temperature forecast (top left) is 'EC' for us, actually a departure from a long string of warm forecasts. The precipitation forecast (bottom right) has a La Niña flavor to it, but keeps our region 'EC', i.e., climatological odds.**

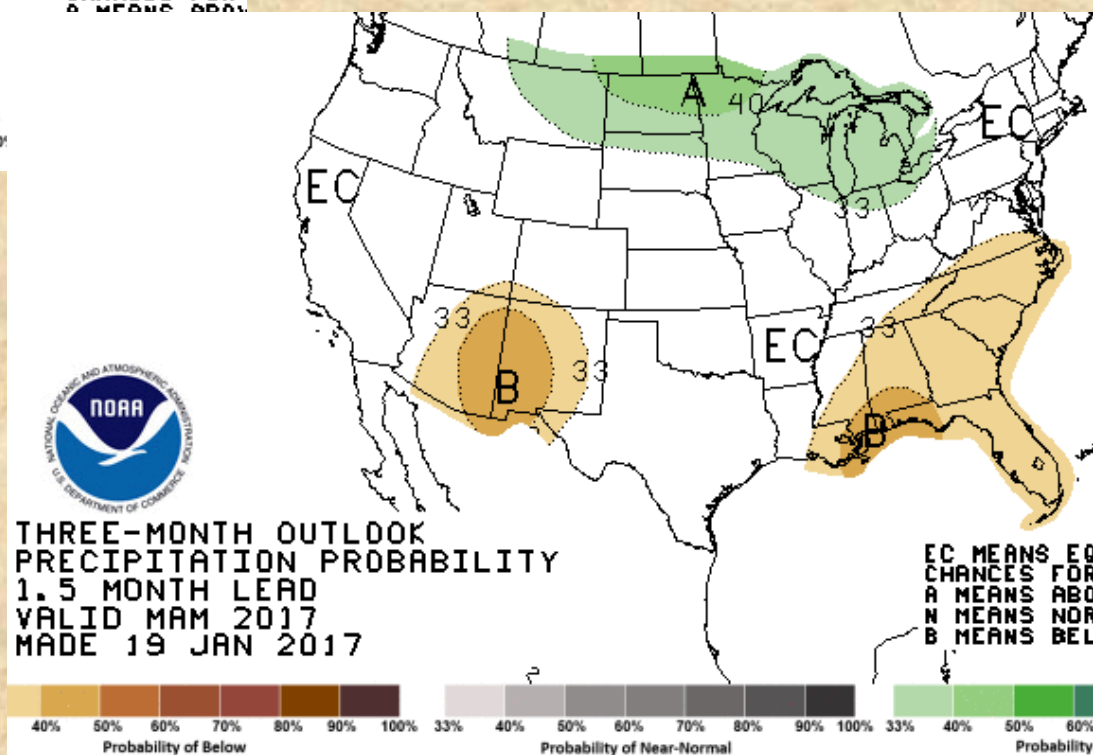



***http://www.cpc.ncep.noaa.gov/products/predictions/***

# Climate Prediction Center Forecasts: MAM 2017

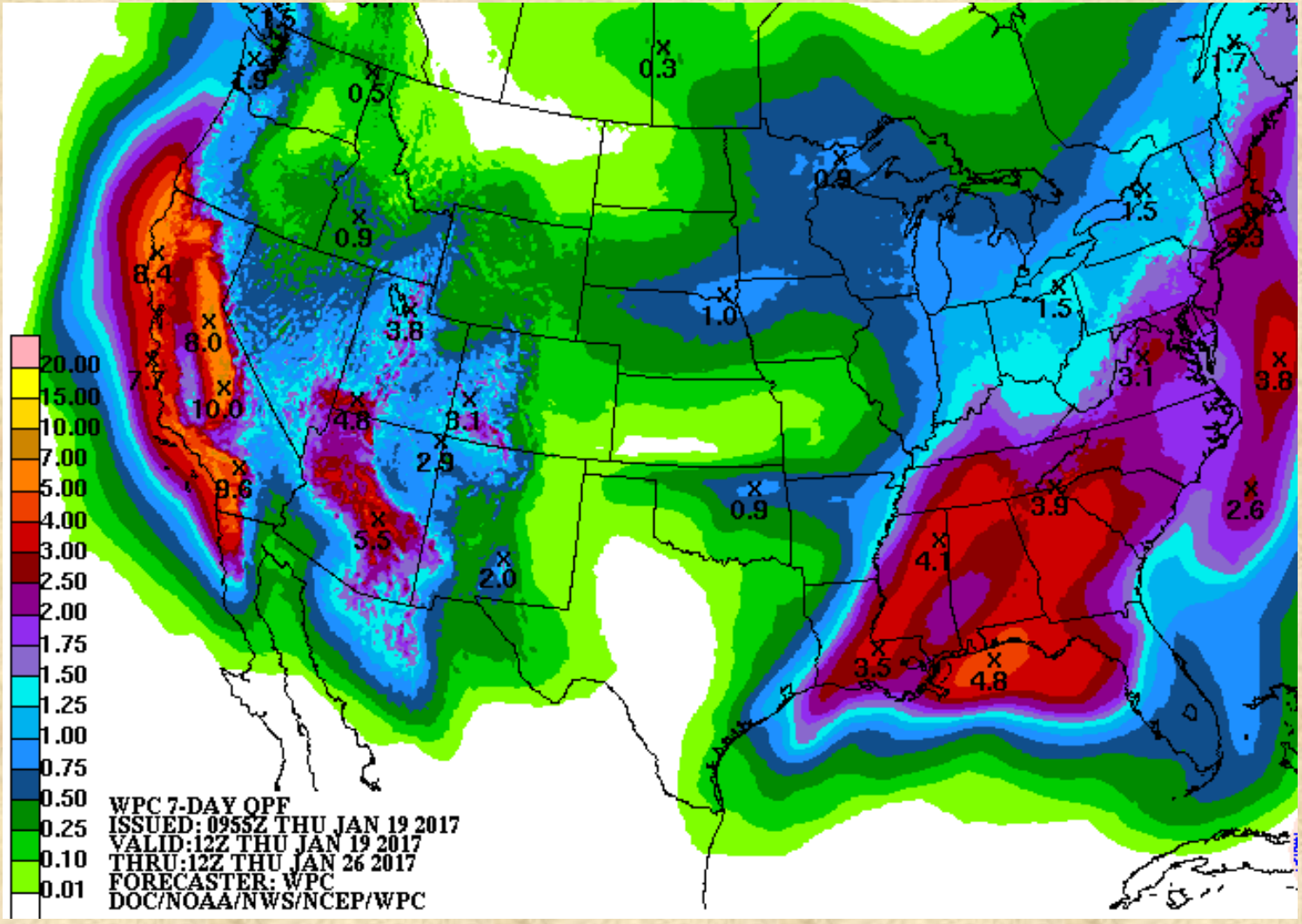



The CPC spring temperature forecast (top left) still looks like a La Niña-based forecast. Given an overall warming trend, a warm forecast for us is not surprising. The precipitation forecast (bottom right) is 'EC', with dry conditions encroaching from the south, again in line with La Niña vestiges (as well as my analogues).



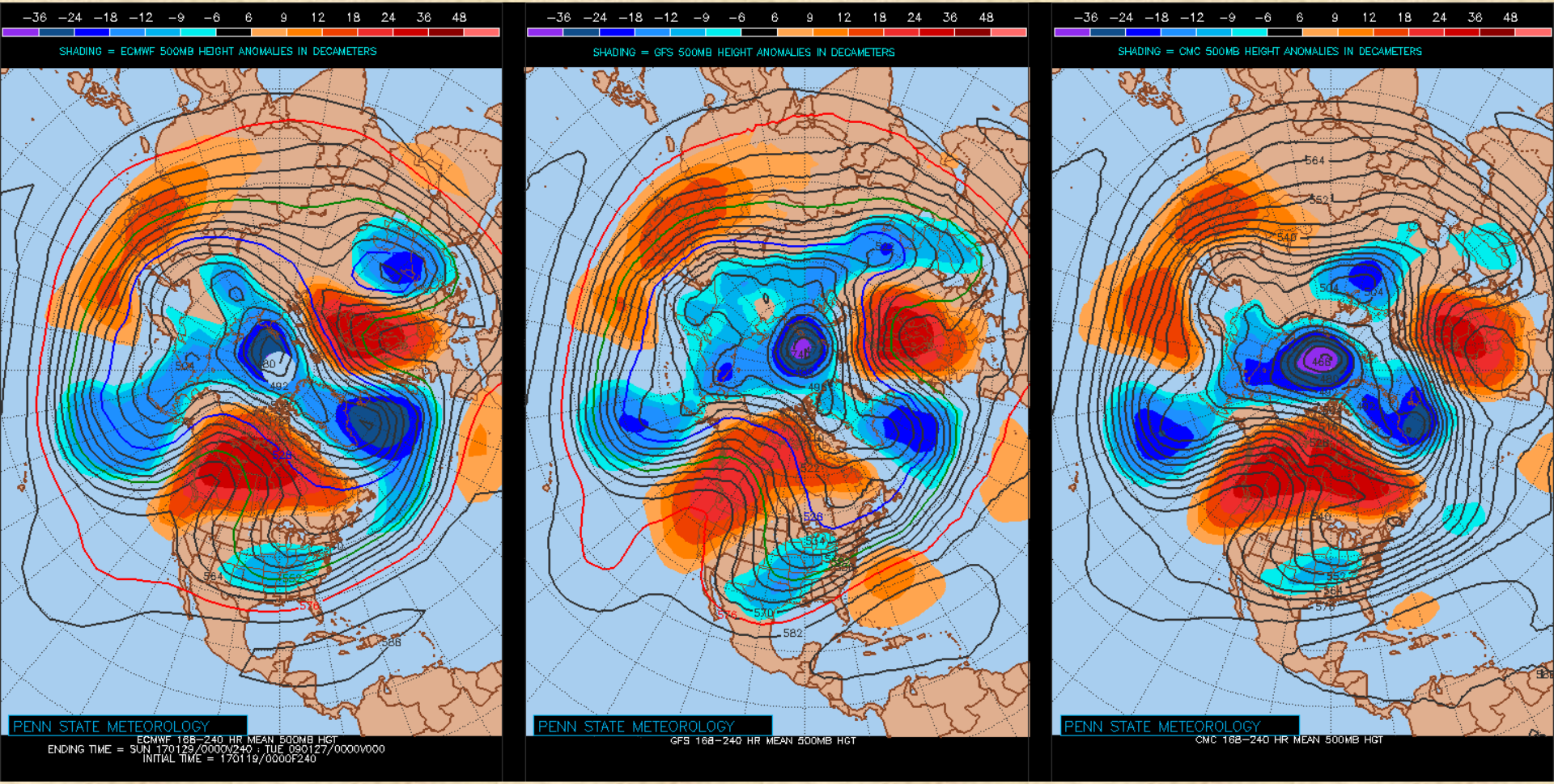

*http://www.cpc.ncep.noaa.gov/products/predictions/*

# *What can we expect by over the next 7 days?*




*The "Weather Prediction Center" (WPC, aka "HPC") anticipates yet another round of storms for CA that should is a bit on a southern storm track, benefitting our southern mountains more than to the north. Given the overall expectation of drier conditions to the south in next few months, this is good news!*

# What can we expect by end of next week?




***European ECMWF (left), American GFS (middle,) and Canadian CMC (right) forecast models show a building ridge (high pressure) to our north and west, and below normal heights to our south and east. Cool is the message of the day for the end of next week, with lingering moisture early on (Week 2 looks dryish).*** ***The weather pattern overall is perhaps more typical during El Niño than La Niña…***

# Executive Summary (19 January 2017)

*klaus.wolter@noaa.gov*

- **La Niña snuck in, was weak, and is indeed on its way out in very near future. Precipitation impacts in Colorado have been consistent with a switch to La Niña during the fall and early winter months (but exaggerated in its early dryness as well as recent wetness).**
- **Tilts in the odds of the experimental forecast guidance were not impressive for either fall or winter, with the biggest wet tilt for OND over NE Colorado not working out at all. *However, analogues based on recent behavior of the PDO & MEI correctly favored a wet early winter (Nov-Jan) for our mountains. They also confirm a guardedly pessimistic outlook for late winter and spring, while hanging on to a positive 1apr SWE outlook for most of our state.***
- **Forecasts from CPC are 'EC' through spring, with dryness encroaching from the south by then. CFSv2 is a bit more optimistic, in line with a developing El Niño in that (and other) model(s).**
- **Next week looks wet for our mountains after taking a break this week. However, the overall regime appears to switch to a less active pattern for us through the rest of January.**
- **BOTTOMLINE: We may have milked the early winter "wetness-with-La-Niña' pattern for all of its worth. Beyond that we can only hope that we switch back into El Niño with a vengeance (similar to 2015, 1997, 1982, 1957…) because that would increase our odds for a wet spring. *Stay tuned!***