

Climate Outlook 2016-17

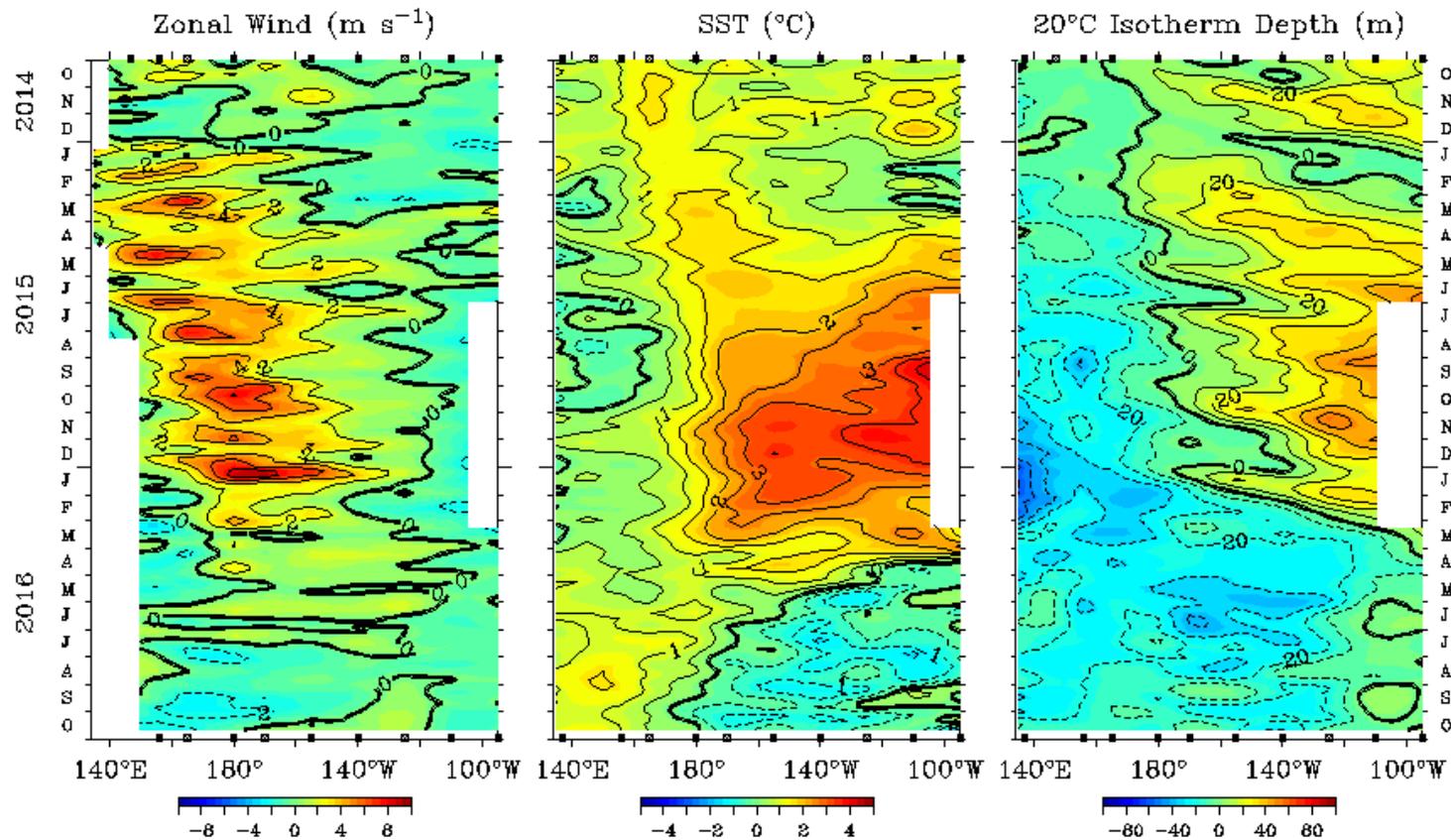
Klaus Wolter

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- *Good-bye El Niño / Not so fast La Niña!*
- *CPC forecasts*
- *Latest set of analogues (also for CO 1aprSWE)*
- *Experimental forecast guidance*
- *Executive Summary (25 October)*

Five Day Zonal Wind, SST, and 20°C Isotherm Depth Anomalies 2°S to 2°N Average

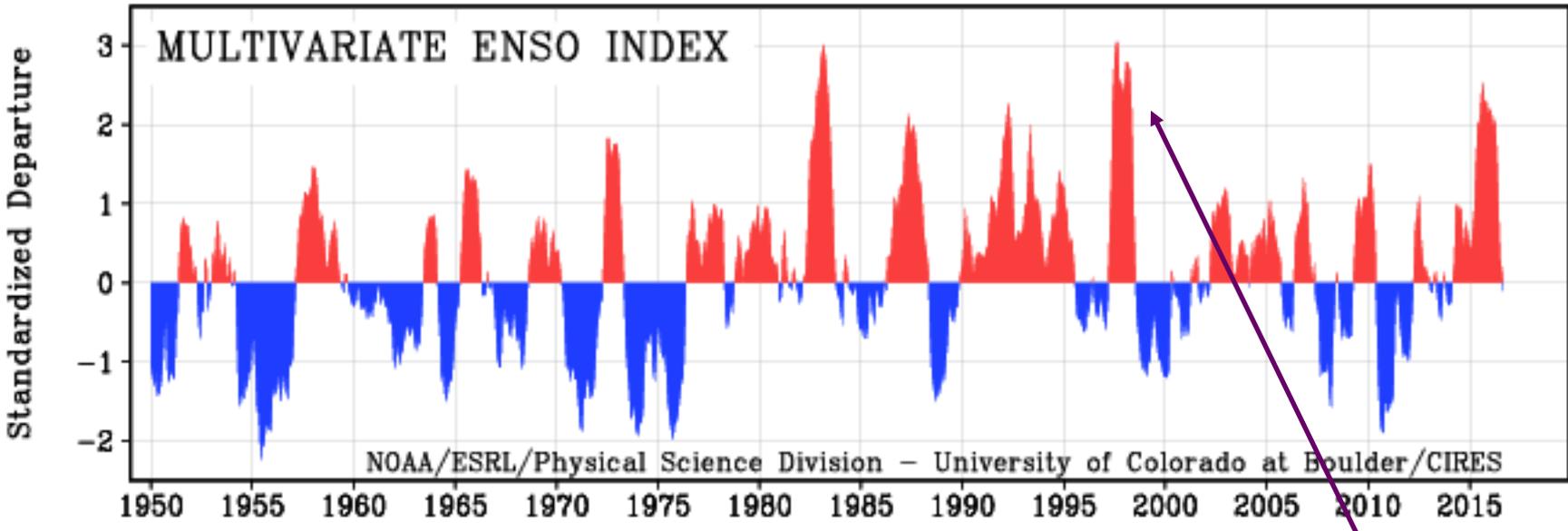


TAO Project Office/PMEL/NOAA

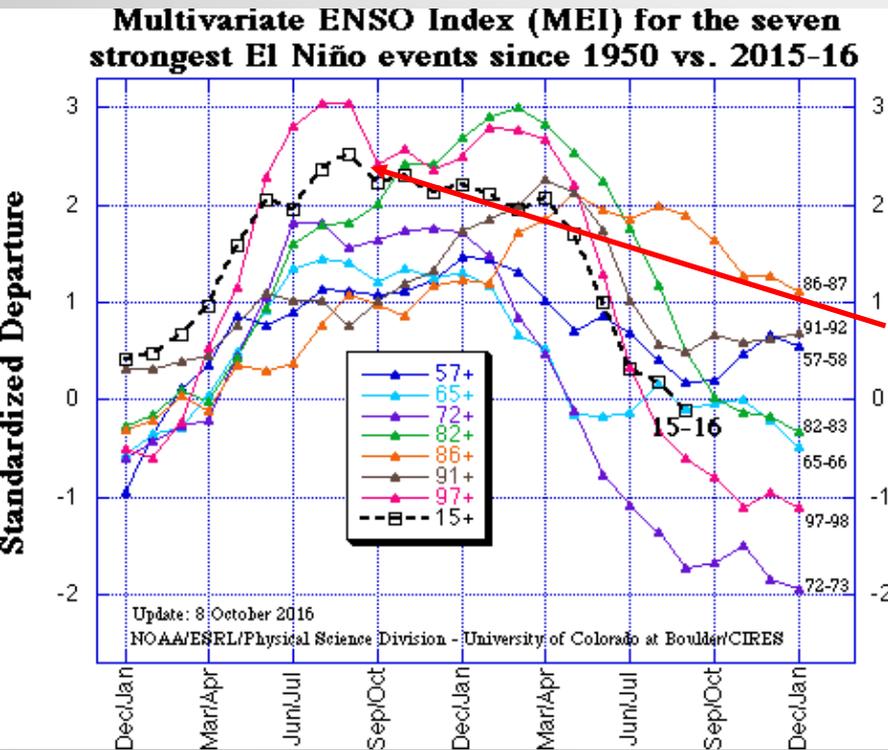
Oct 24 2016

El Niño is over, but has NOT really been replaced by La Niña in surface wind field (left), SST anomalies (middle), or subsurface heat content (right). However, there have been *short-lived glimpses* of La Niña behavior and footprints, most recently earlier this month when CPC re-hoisted their La Niña watch.

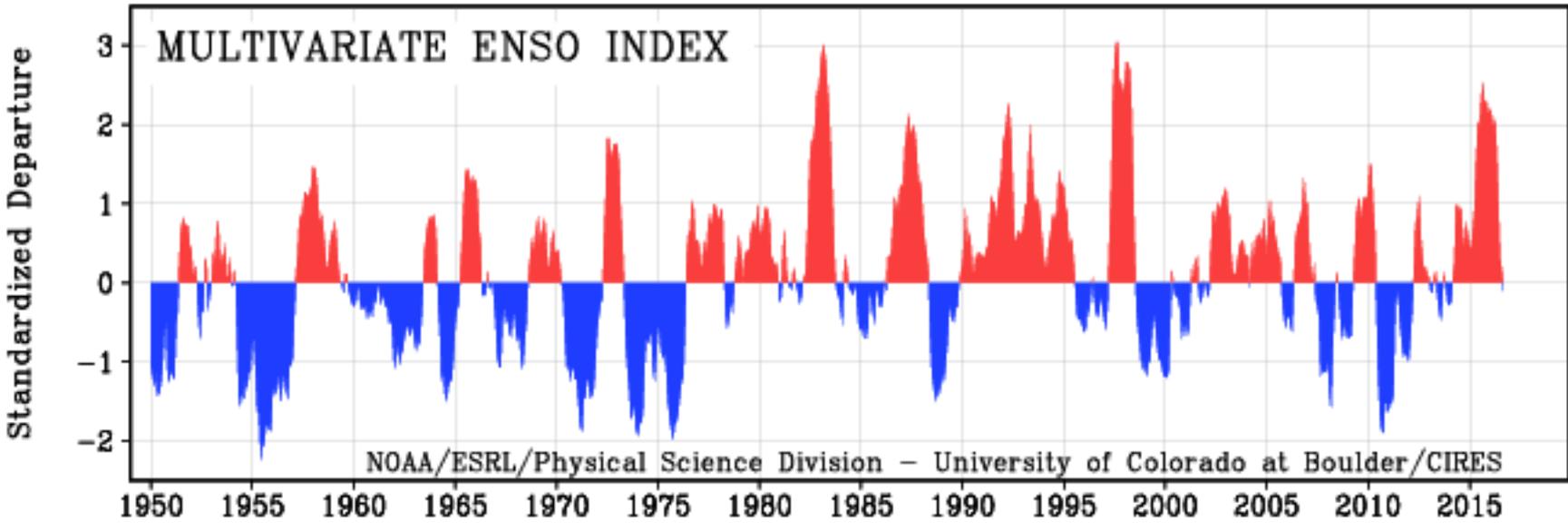
<http://www.pmel.noaa.gov/tao/jsdisplay/index.html>



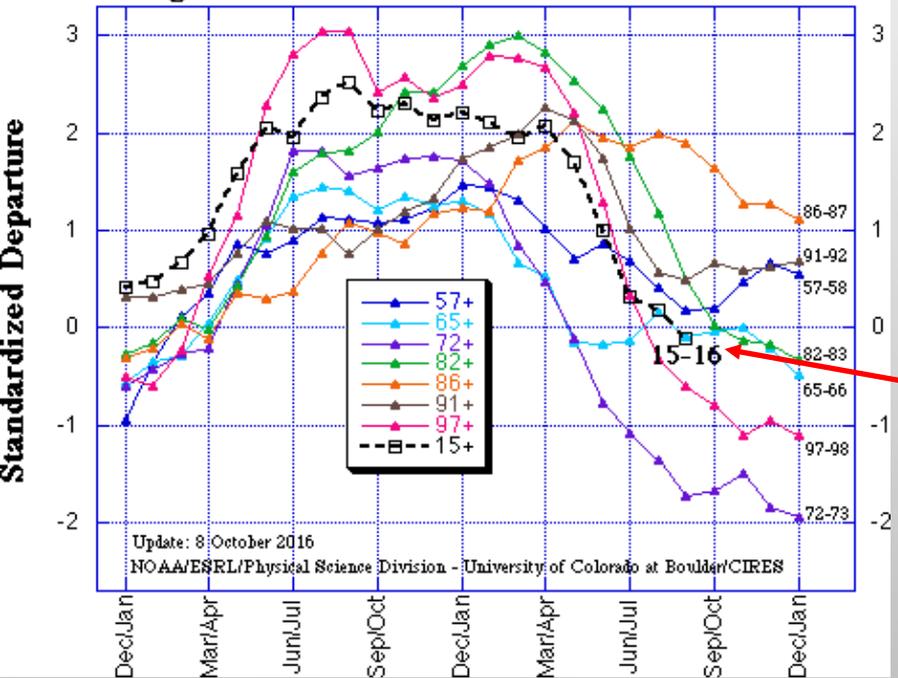
The **MEI** monitors ENSO based on all observed fields over the tropical Pacific (pressure, wind, temperatures, cloudiness). It is the 1st combined Principal Component, normalized with respect to the season. **El Niño peaked in Aug/Sep 2015 at +2.53, the largest MEI value since 1998.**



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



Multivariate ENSO Index (MEI) for the seven strongest El Niño events since 1950 vs. 2015-16

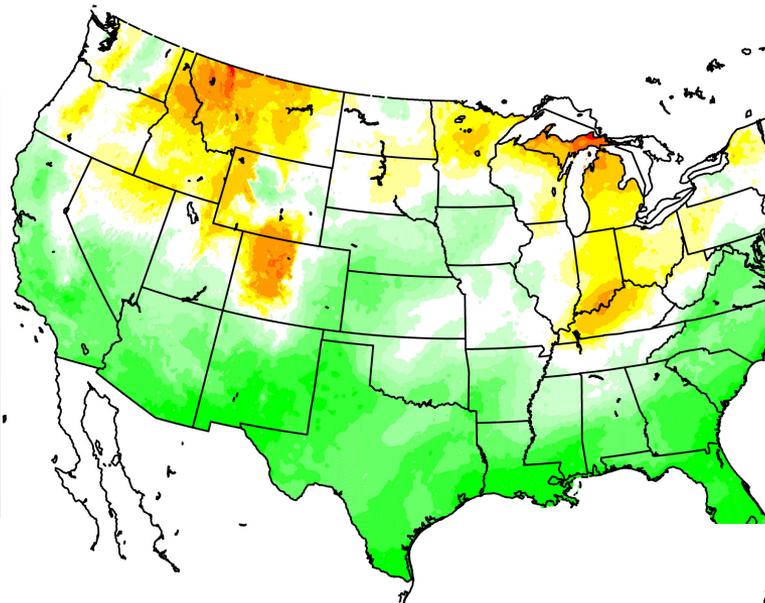


The **MEI** monitors ENSO based on all observed fields over the tropical Pacific (pressure, wind, temperatures, cloudiness). It is the 1st combined Principal Component, normalized with respect to the season. El Niño peaked in Aug/Sep 2015 at +2.53, the largest MEI value since 1998. *Since June-July 2016, I would classify it as ENSO-neutral, now lagging well behind 1998 in its trajectory towards La Niña.*

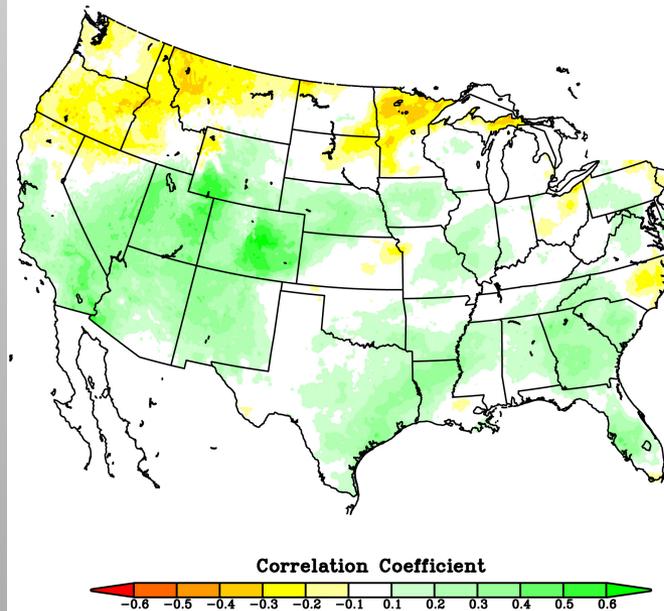
<http://www.esrl.noaa.gov/psd/enso/mei>

Why care about El Niño/La Niña?

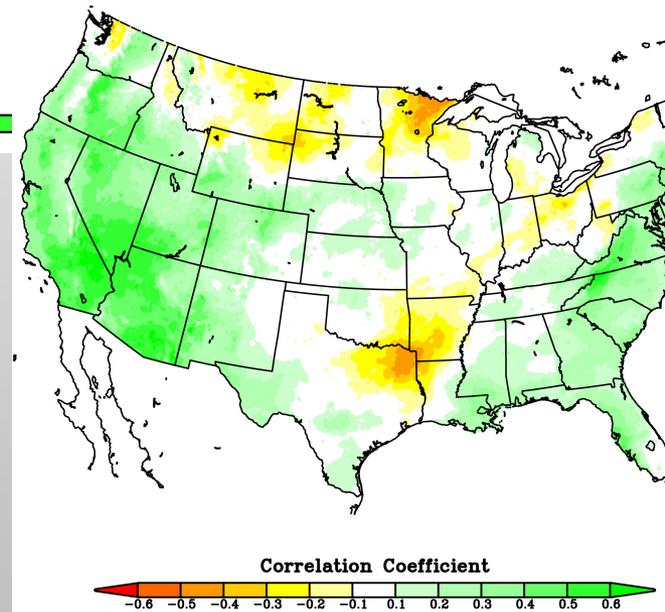
DJF PPT vs. MEI (1981–2010)



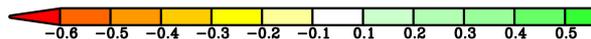
SON PPT vs. MEI (1981–2010)



MAM PPT vs. MEI (1981–2010)

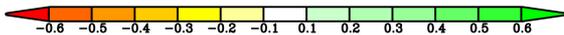


Correlation Coefficient

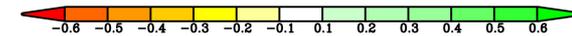


- (1) *It leaves a seasonally varying footprint in the US;*
- (2) *it is more predictable than any other climate feature!*

Correlation Coefficient

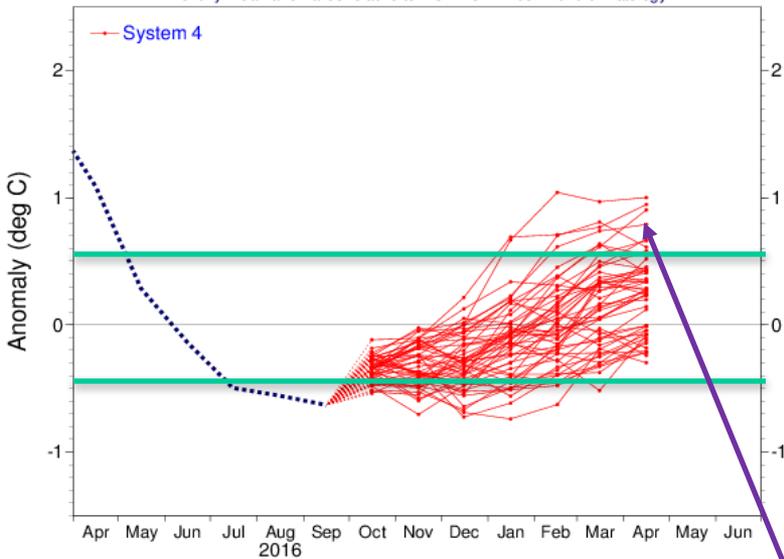


Correlation Coefficient



NINO3.4 SST anomaly plume
ECMWF forecast from 1 Oct 2016

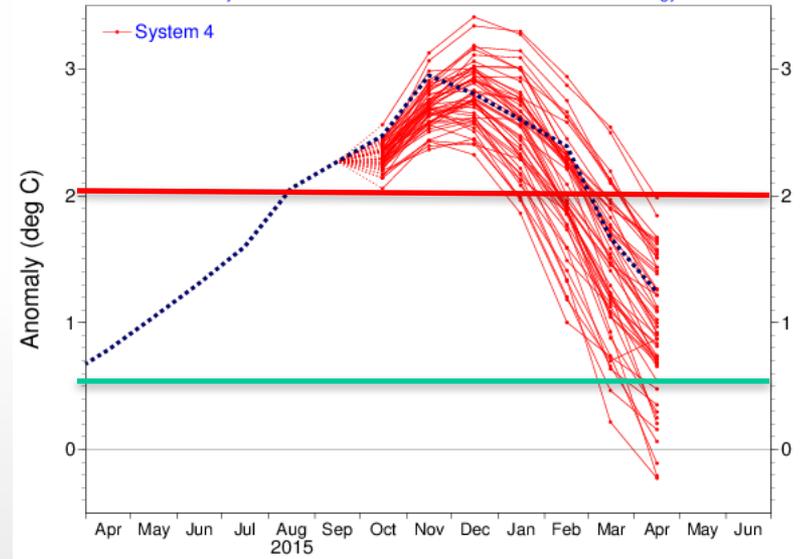
Monthly mean anomalies relative to NCEP OIv2 1981-2010 climatology



ECMWF

NINO3.4 SST anomaly plume
ECMWF forecast from 1 Oct 2015

Monthly mean anomalies relative to NCEP OIv2 1981-2010 climatology



ECMWF

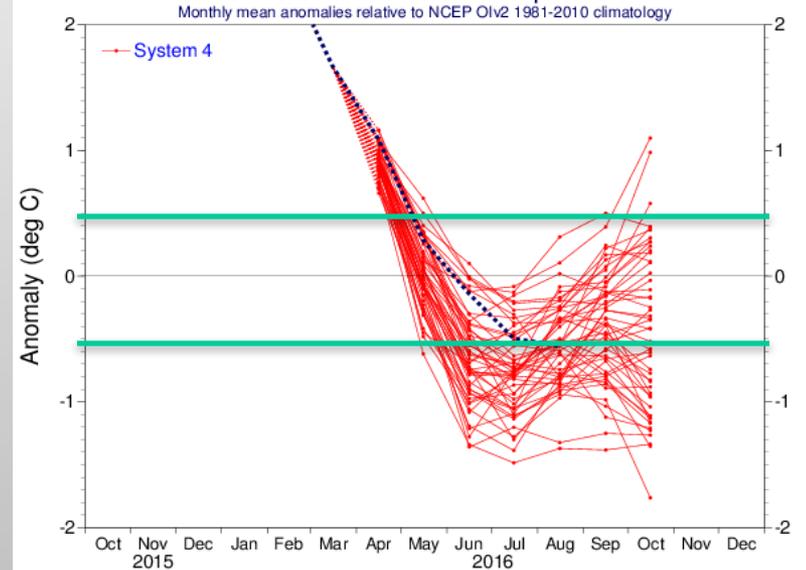
ECMWF 'anomaly plume' of Niño 3.4 from last fall (top right) did a good job handling the 2015-16 El Niño. This spring (bottom right), the ECMWF anticipated a brief dip into La Niña conditions.

The latest forecast (top left) shows a rebound to ENSO-neutral this winter, with a few of the 50 ensemble members bouncing back to a weak El Niño by next April.

<http://www.ecmwf.int/en/forecasts/charts/seasonal/nino-plumes-public-charts-long-range-forecast>

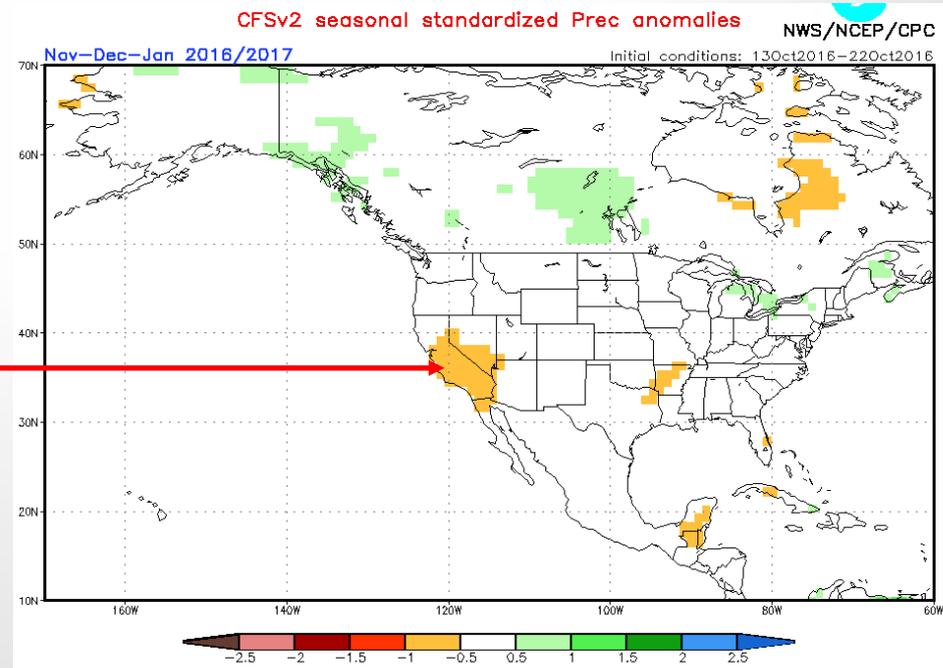
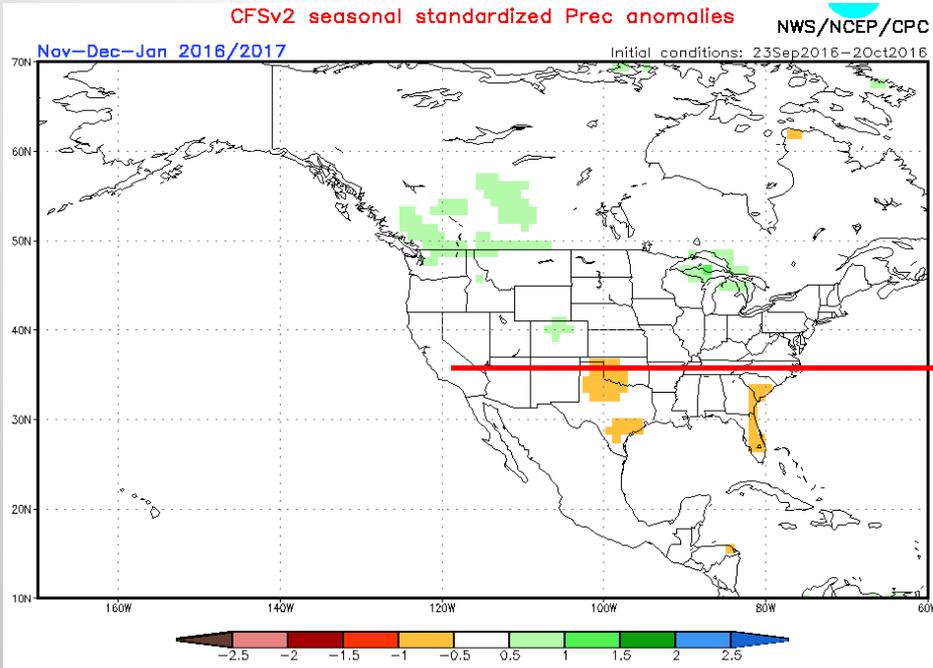
NINO3.4 SST anomaly plume
ECMWF forecast from 1 Apr 2016

Monthly mean anomalies relative to NCEP OIv2 1981-2010 climatology

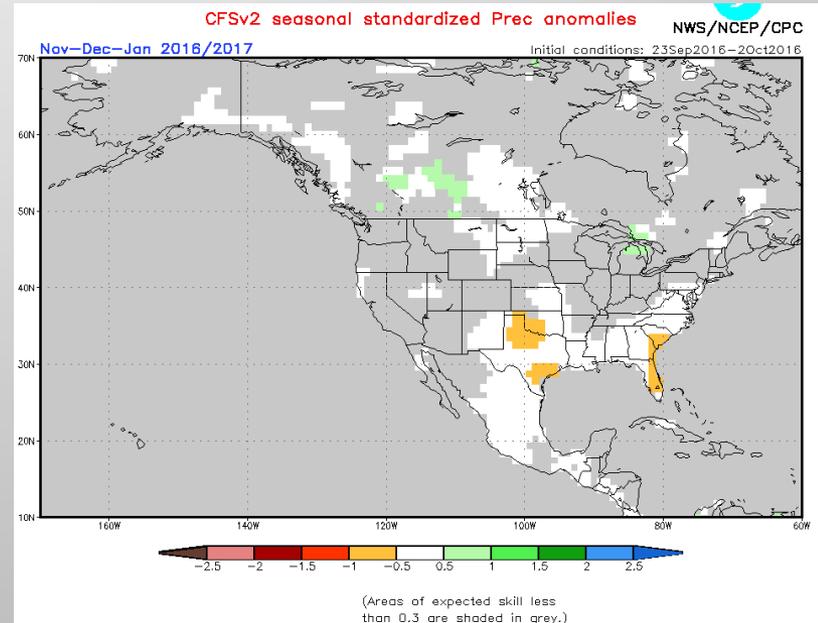


ECMWF

CFSv2 forecasts for this winter – a moving target



Normalized early winter (NDJ) precipitation forecast (top left) from 20-30 days ago and during the last 10 days (top right) shows a drying trend over CA in particular. However, there is little skill, so perhaps one should not overreact...



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

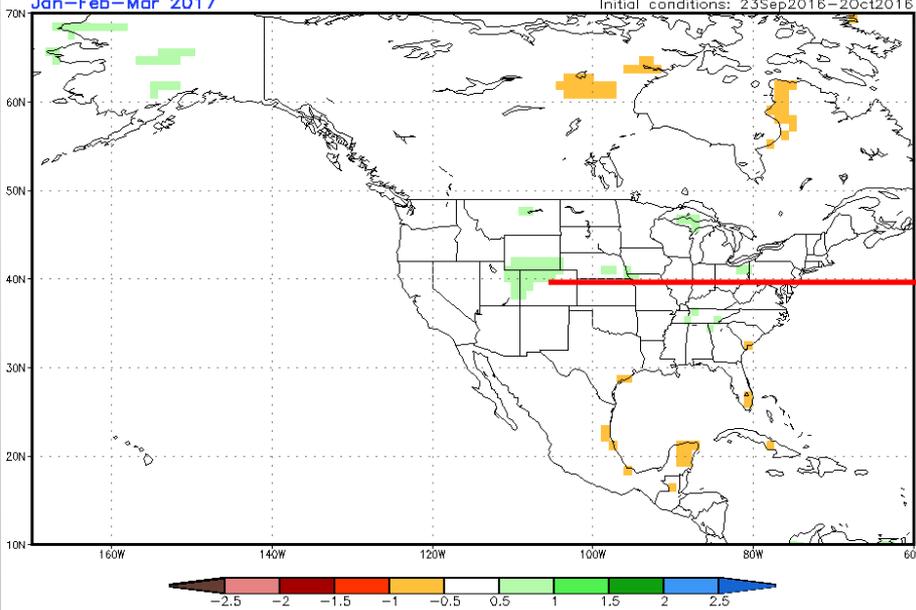
CFSv2 forecasts for this winter – a moving target

CFSv2 seasonal standardized Prec anomalies

NWS/NCEP/CPC

Jan–Feb–Mar 2017

Initial conditions: 23Sep2016–20Oct2016

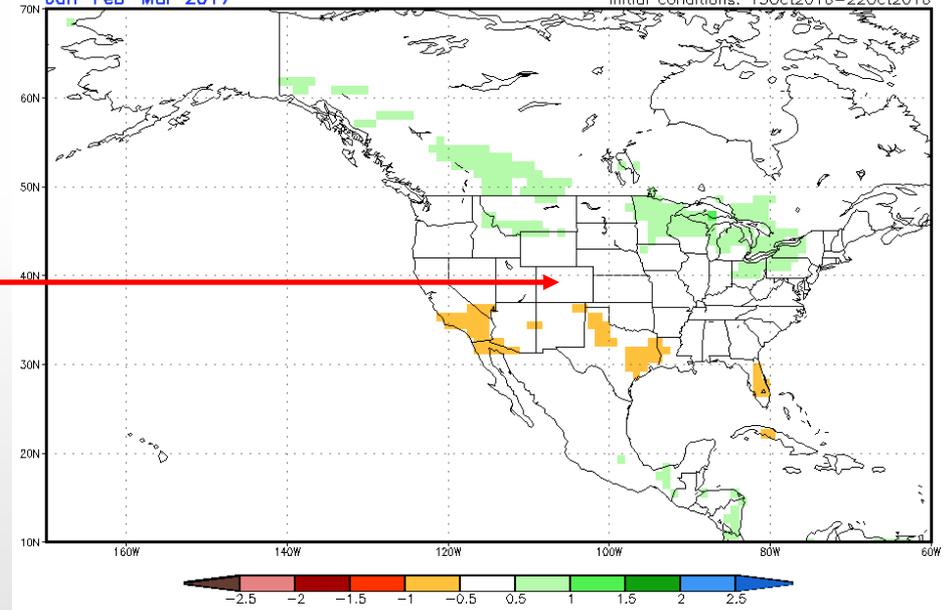


CFSv2 seasonal standardized Prec anomalies

NWS/NCEP/CPC

Jan–Feb–Mar 2017

Initial conditions: 13Oct2016–22Oct2016

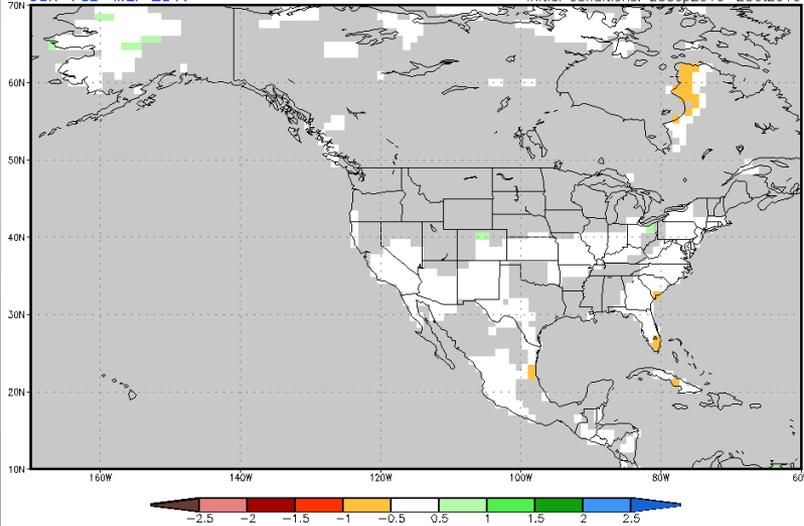


CFSv2 seasonal standardized Prec anomalies

NWS/NCEP/CPC

Jan–Feb–Mar 2017

Initial conditions: 23Sep2016–20Oct2016



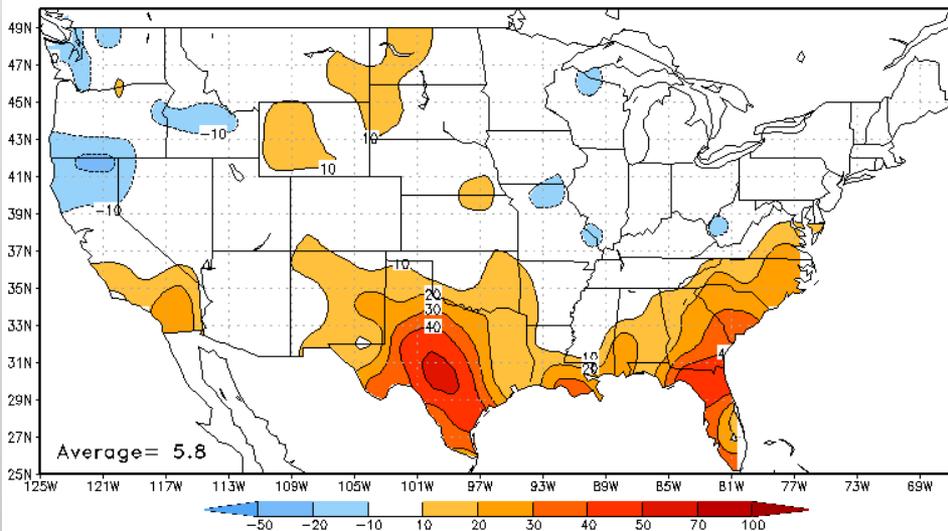
(Areas of expected skill less than 0.3 are shaded in grey.)

Normalized late winter (JFM) precipitation forecast (top left) from 20-30 days ago and during the last 10 days (top right) continues a recent drying trend in southwestern US. Again, there is little proven skill...

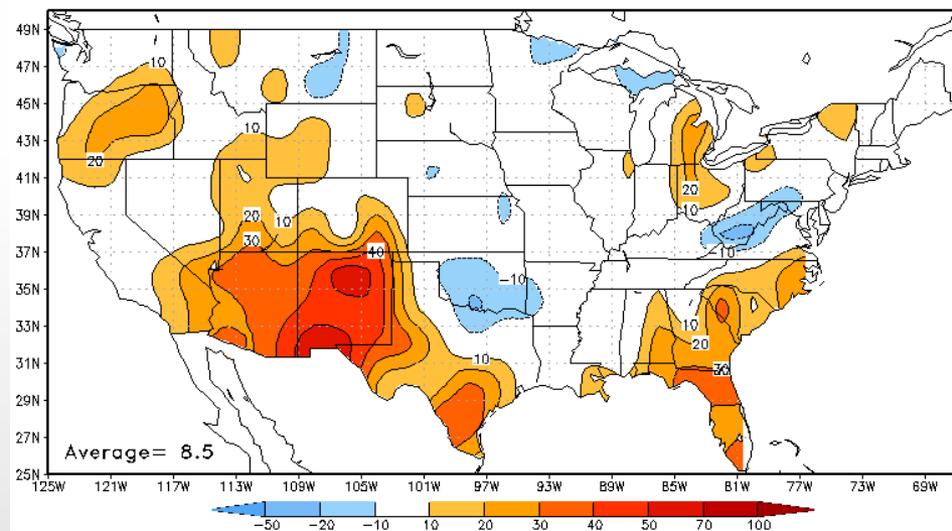
<http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/>

CPC Seasonal Precipitation Forecast Skill

Seasonal (Lead 0.5 Months) Precipitation Heidke Skill Score
NDJ Manual Forecasts From 1995 to 2015



Seasonal (Lead 0.5 Months) Precipitation Heidke Skill Score
JFM Manual Forecasts From 1995 to 2016

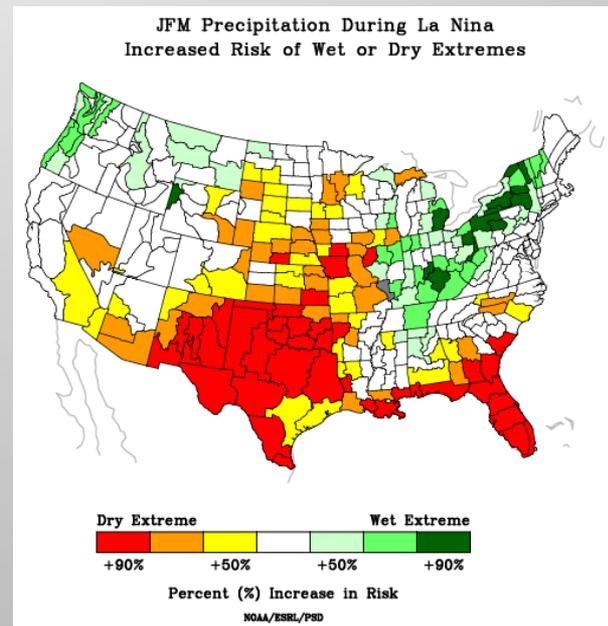


CPC's precipitation forecast skill for early winter (top left) and late winter (top right), showing little skill in Upper Colorado River Basin, especially in NDJ, but more skill to the south, especially over NM.

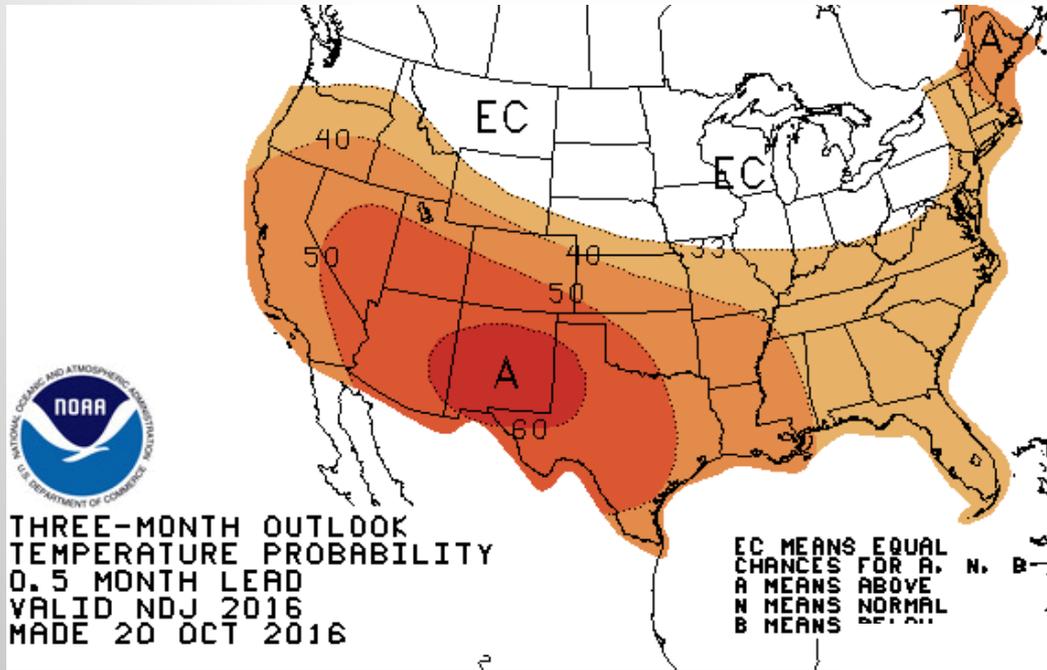
<http://www.cpc.ncep.noaa.gov/products/predictions/>

This matches well-known preferences for wet (dry) conditions during El Niño (La Niña) in that region, reproduced here on the right from:

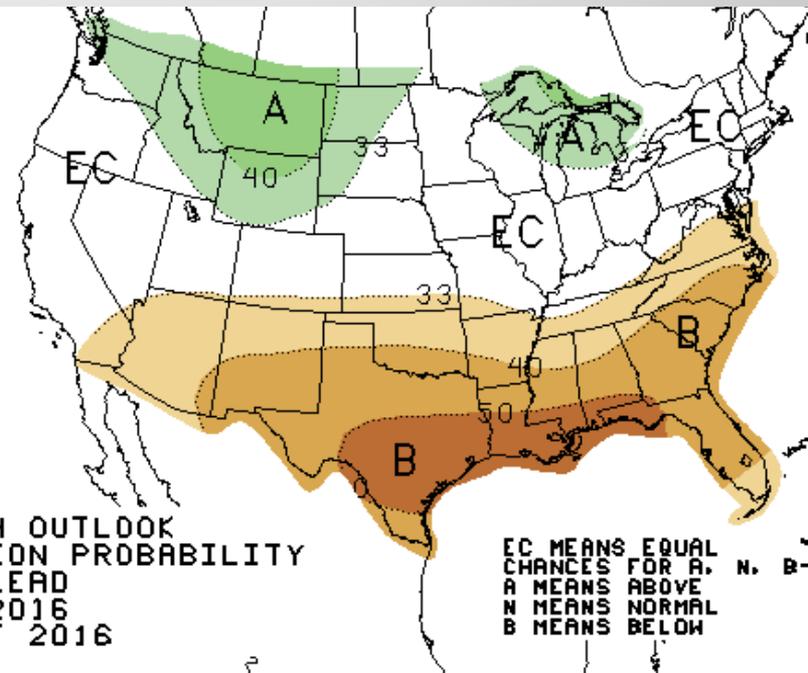
<http://www.esrl.noaa.gov/psd/enso/climaterisks/>



Climate Prediction Center Forecasts: Nov-Jan'17

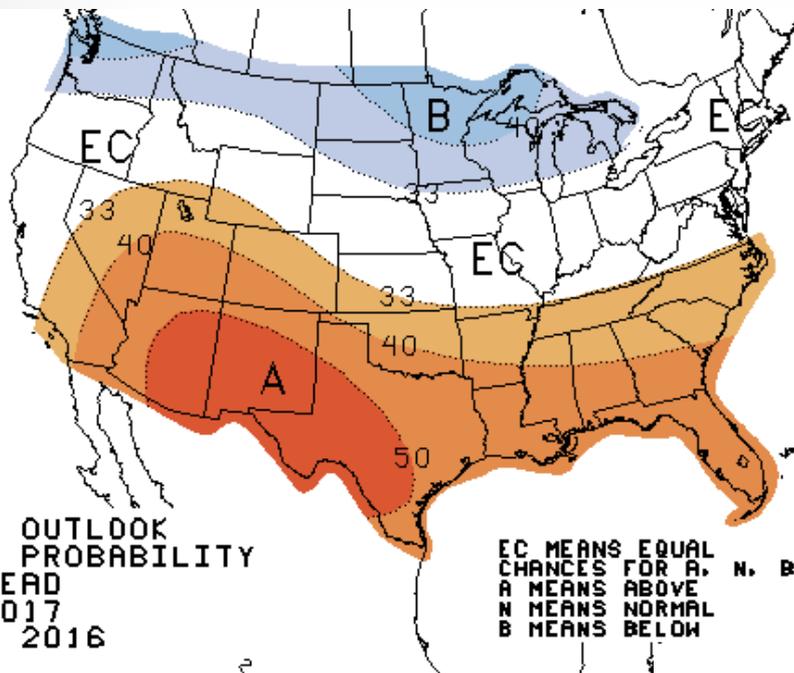


The CPC early winter temperature forecast (top left) is rather toasty, anchored by the CFSv2 (*not shown*). The precipitation forecast (bottom right) has a La Niña flavor to it, keeping most of the Upper Basin 'EC' (climatological odds), and drier over the Lower Basin.

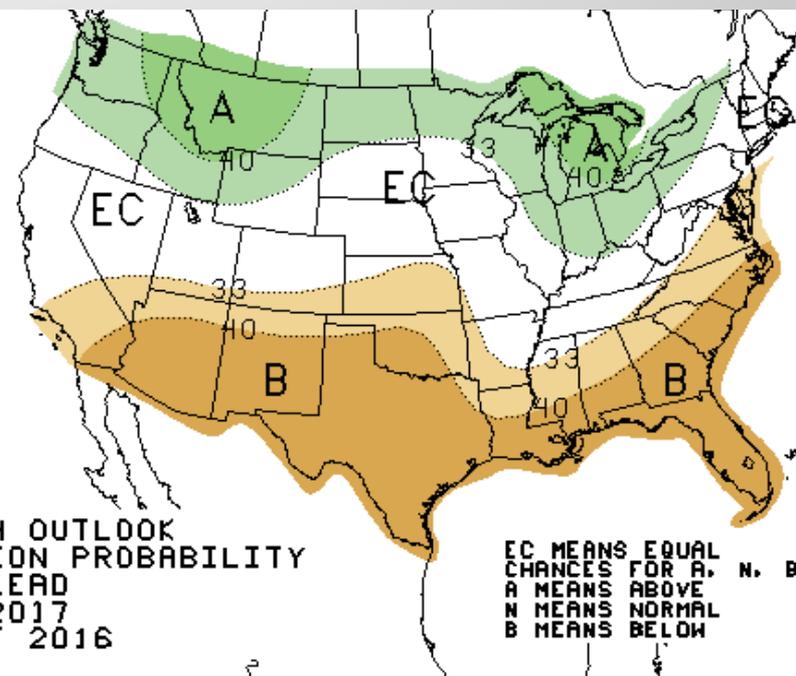


<http://www.cpc.ncep.noaa.gov/products/predictions/>

Climate Prediction Center Forecasts: Jan-Mar 2017



The CPC late winter temperature forecast (top left) keeps things warm again, both due to a warming trend and La Niña. The precipitation forecast (bottom right) again plays the La Niña card, which would again hurt the Lower Basin more than the Upper Basin.



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

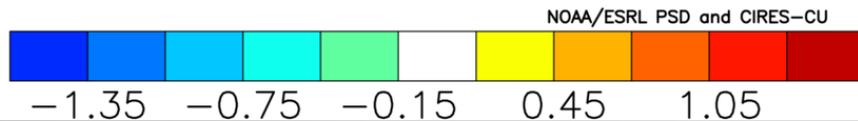
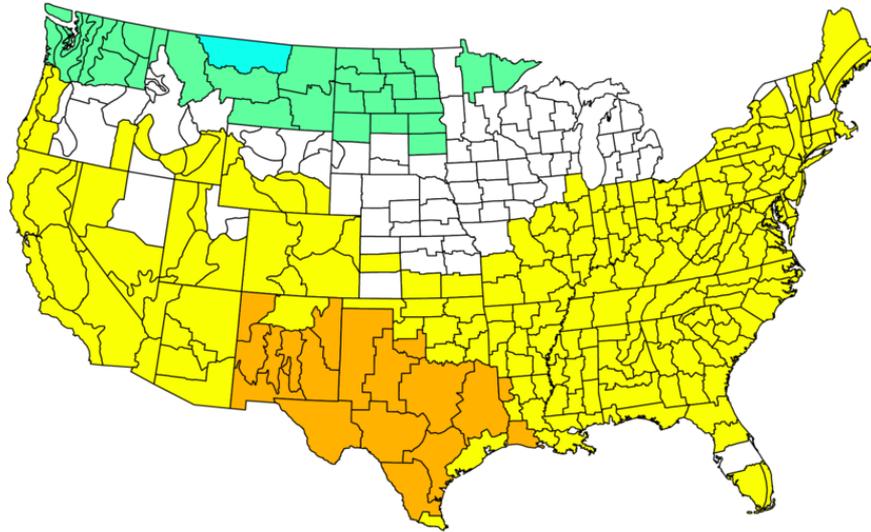


Is there anything else?

November-January Climate Analogue Guidance

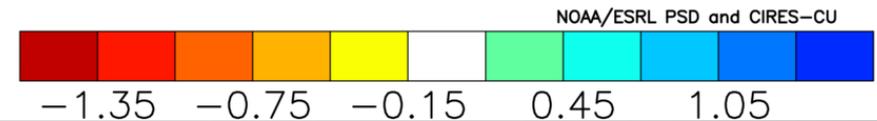
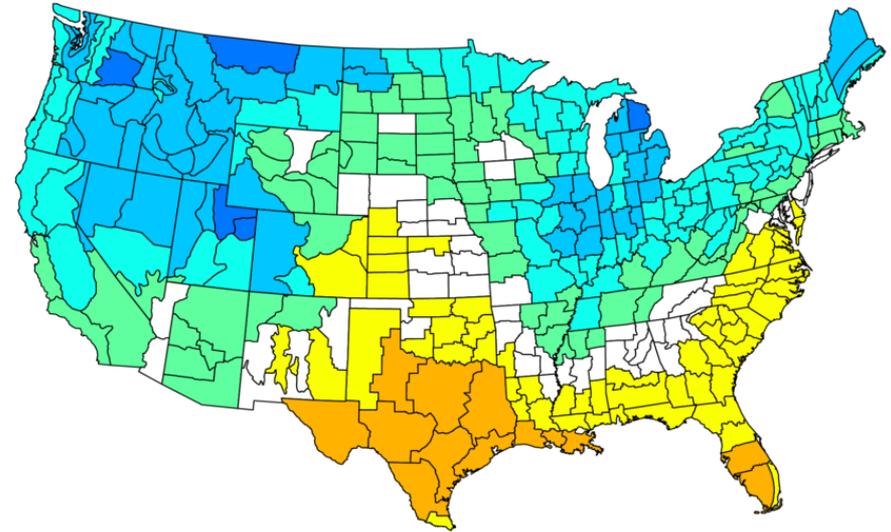
NOAA/NCDC Climate Division Composite Standardized Temperature Anomalies Versus 1895–2000 Longterm Average

Nov to Jan 1897–98,1906–07,1915–16,1959–60,1964–65,1966–67,1983–84,1995–96
2005–06,



NOAA/NCDC Climate Division Composite Standardized Precipitation Anomalies Versus 1895–2000 Longterm Average

Nov to Jan 1897–98,1906–07,1915–16,1959–60,1964–65,1966–67,1983–84,1995–96
2005–06,



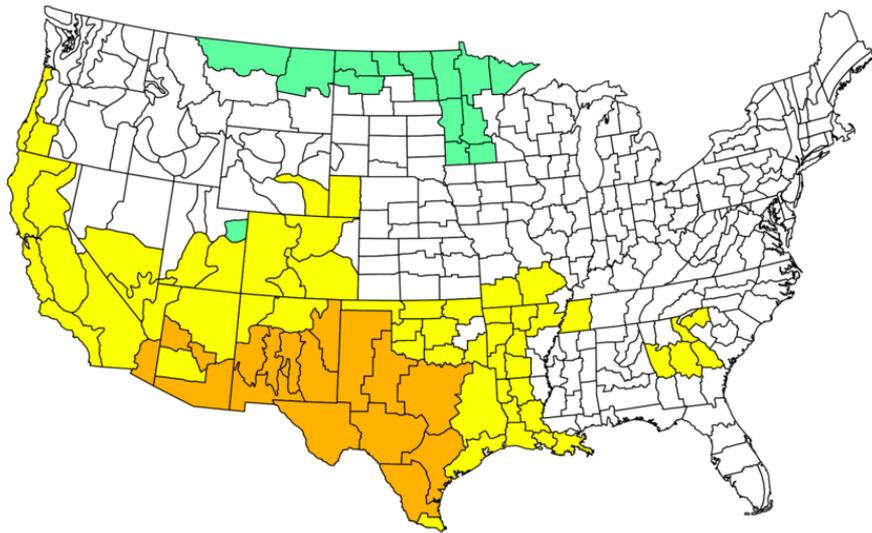
These analogues are based on rapid declines in the MEI and PDO from positive values without hitting major negative values for the full last 120 years for temperatures (left) and precipitation (right). With a sample size of nine, the 2nd color shade (beyond +/-0.45 standard deviations) is considered 'significant'. *The temperature map reinforces the idea that it will be a warm winter over NM in particular, while the wet signal for UT and western CO stand out on the positive side.*

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

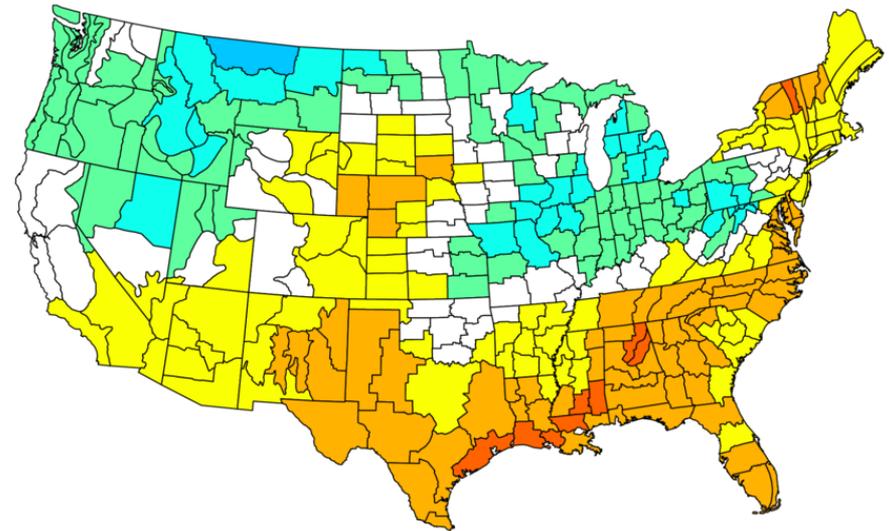
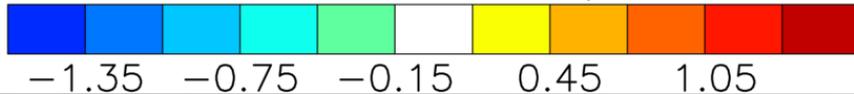
January-March Climate Analogue Guidance

NOAA/NCDC Climate Division Composite Standardized Temperature Anomalies Jan to Mar 1898,1907,1916,1960,1965,1967,1984,1996,2006 Versus 1895–2000 Longterm Average

NOAA/NCDC Climate Division Composite Standardized Precipitation Anomalies Jan to Mar 1898,1907,1916,1960,1965,1967,1984,1996,2006 Versus 1895–2000 Longterm Average



NOAA/ESRL PSD and CIRES-CU

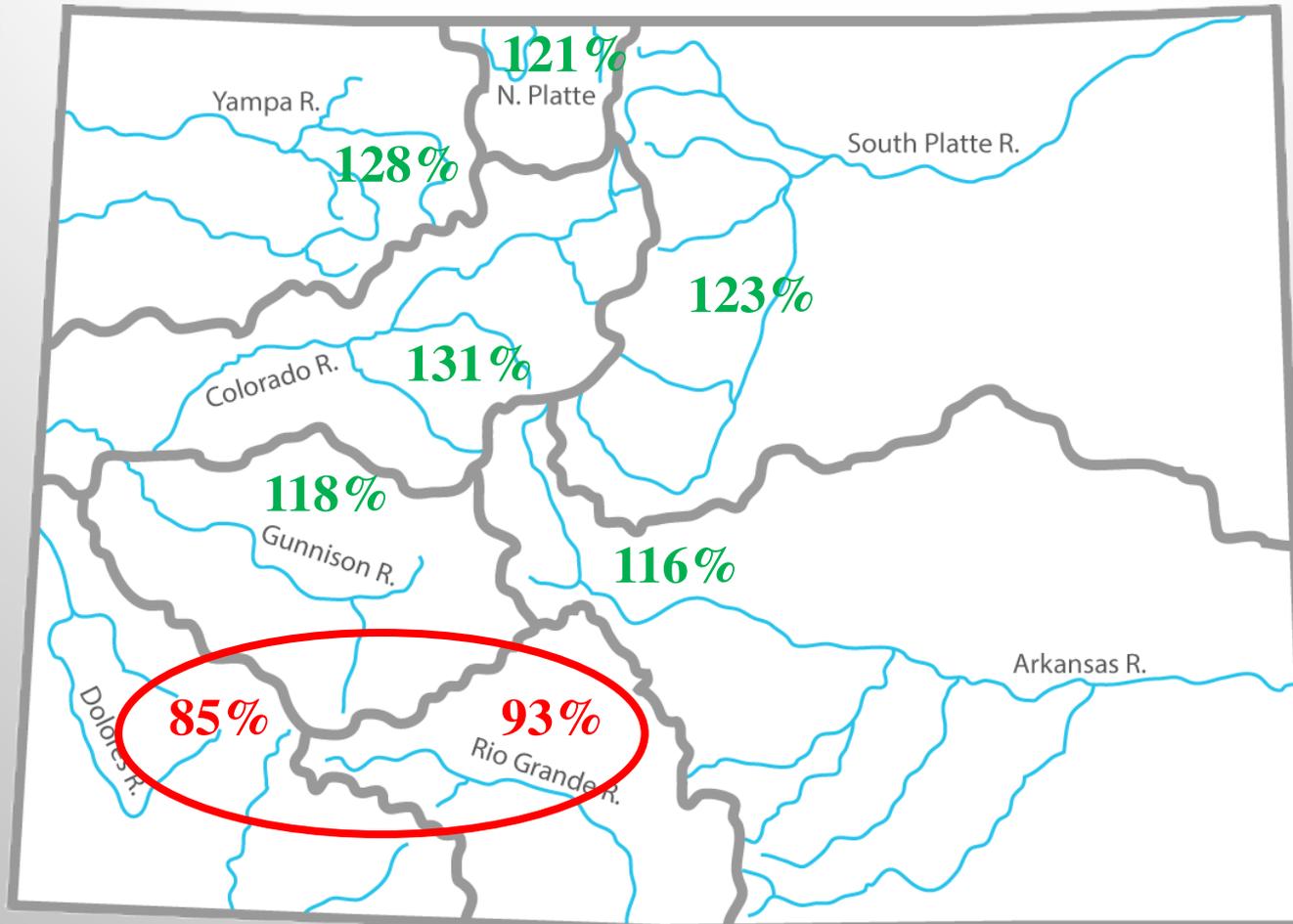


NOAA/ESRL PSD and CIRES-CU



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 north, but only NM showing a significant dry signal. Biggest departure from CPC appears to be the lack of a consistent cold signal to the north.

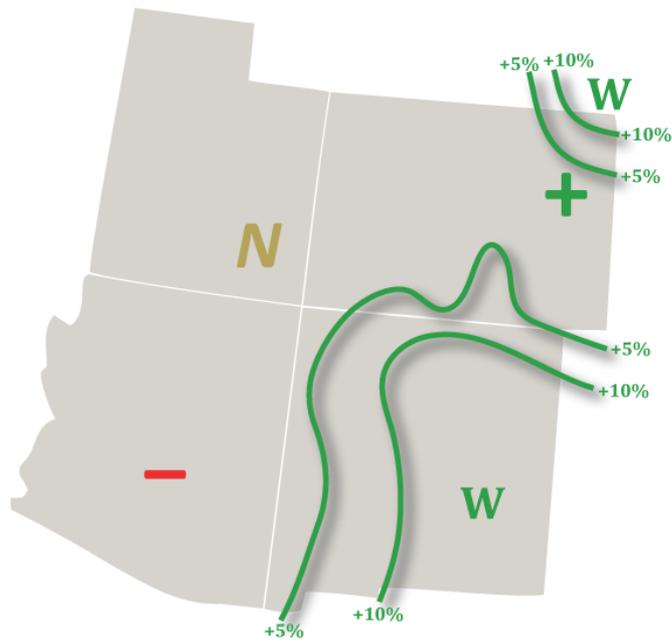
Six analogue SWE for 1apr



Median outcome for Colorado snowpack based on 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).

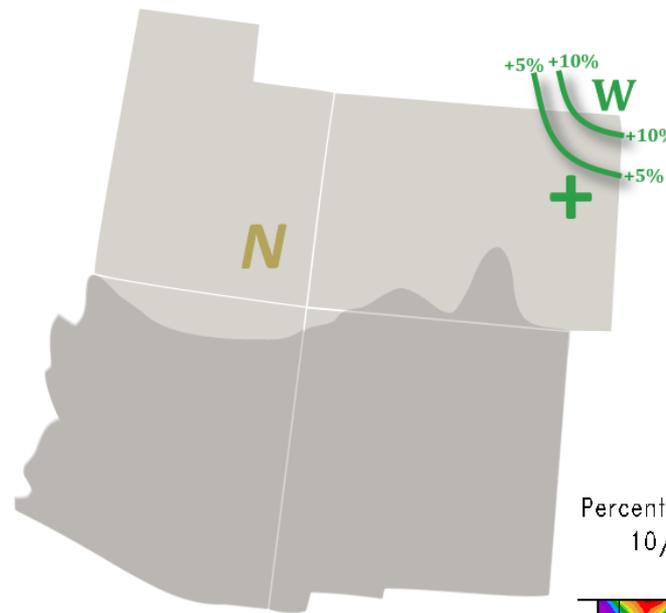
Experimental PSD Precipitation Forecast Guidance

OCT – DEC 2016 (Issued September 13, 2016)



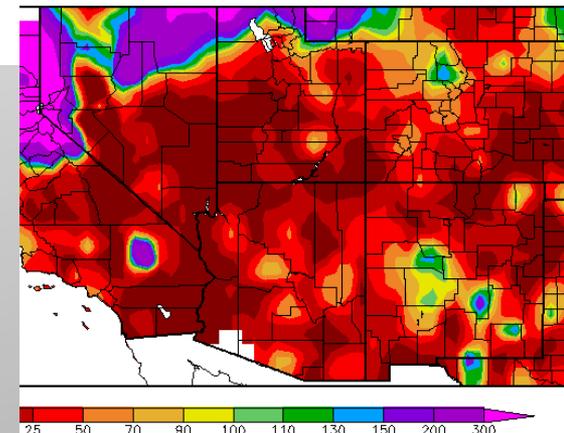
Experimental PSD Precipitation Forecast Guidance

OCT – DEC 2016 (Issued September 13, 2016) – *Skill Masked*



<http://cwcb.state.co.us/public-information/flood-water-availability-task-forces/>

Percent of Normal Precipitation (%)
 10/1/2016 – 10/23/2016

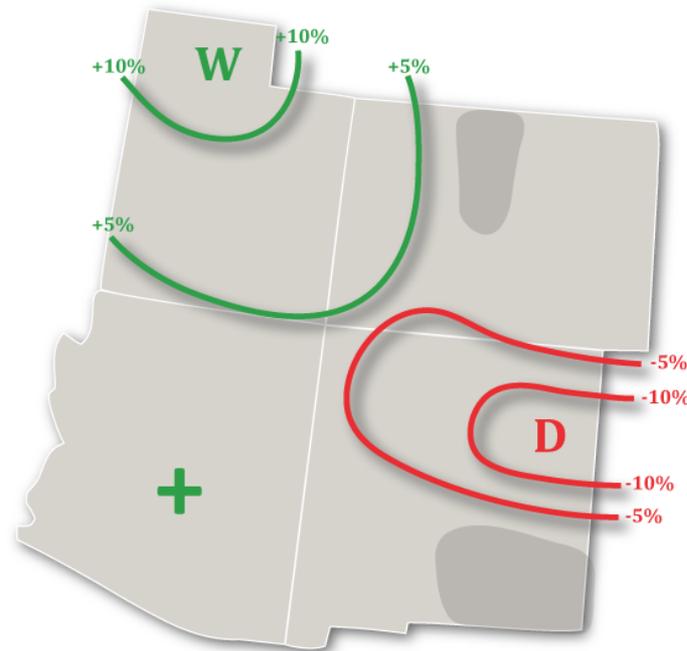
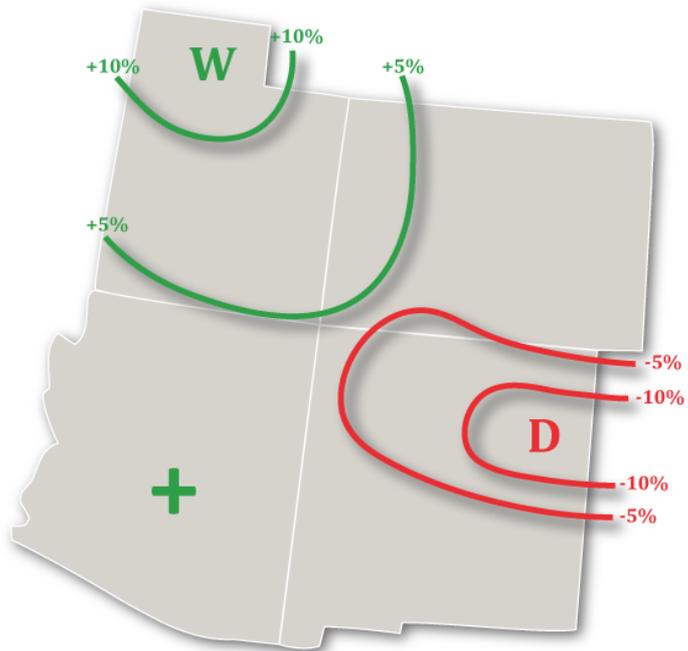


My late fall precipitation forecast was either neutral or wet for all but AZ (left), with best odds for wetness in northeast CO. The skill-masked forecast (right) maintained climatological odds over the Upper Colorado basin, and more likely wet conditions for the northeastern plains. *Similar forecasts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

Experimental PSD Precipitation Forecast Guidance Experimental PSD Precipitation Forecast Guidance

JAN – MAR 2017 (Issued September 14, 2016)

JAN – MAR 2017 (Issued September 14, 2016) – *Skill Masked*



<http://cwcb.state.co.us/public-information/flood-water-availability-task-forces/>

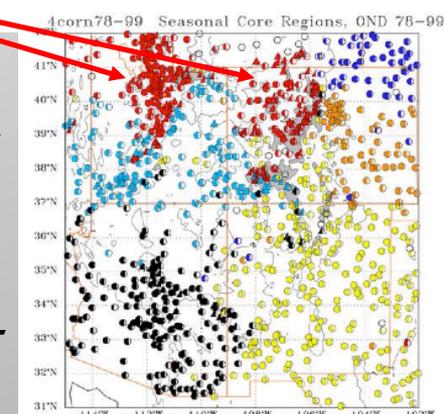
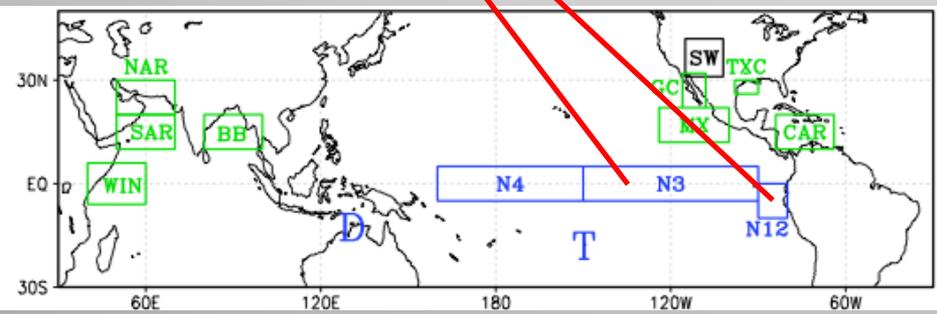
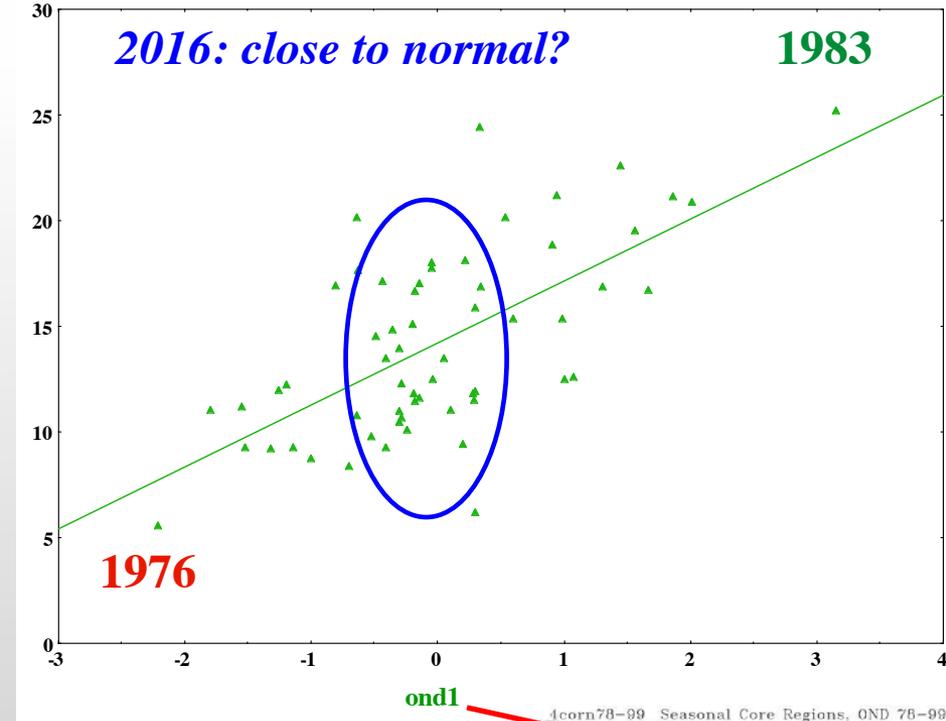
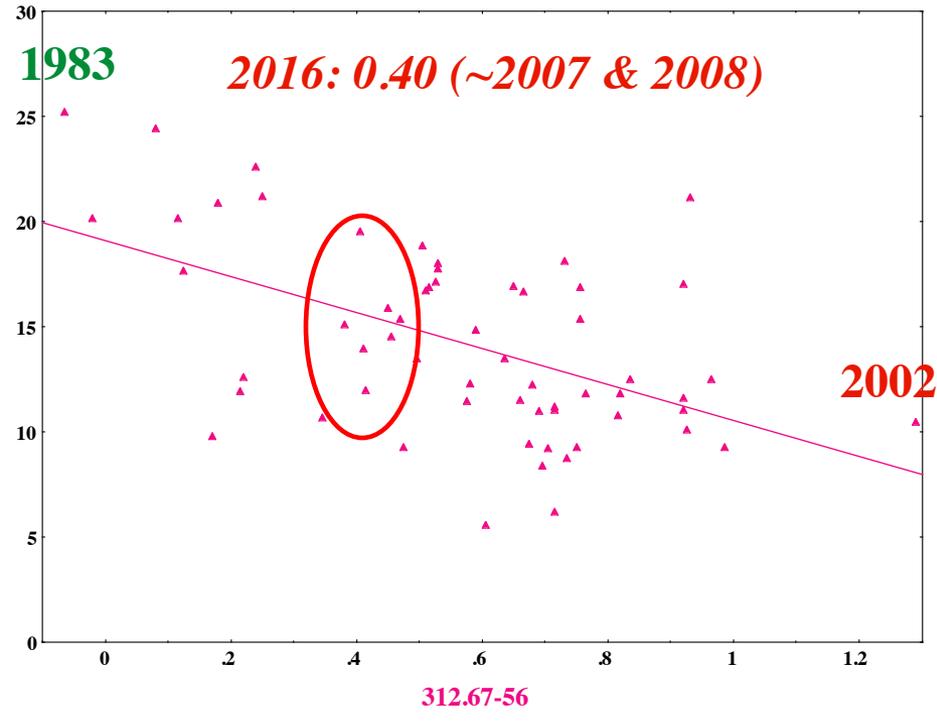
My late winter precipitation forecast from last month kept anomalous moisture mostly west of the Four Corners (left). The skill-masked forecast (right) looks very similar, since there has been proven skill for this season and lead-time during 2000 through 2016, except for SE NM and the north-central mountains of CO. However, the latter still show a small tilt towards when one examines similar forecasts and their outcomes.

Lees Ferry Naturalized Runoff in Water Year 2017

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

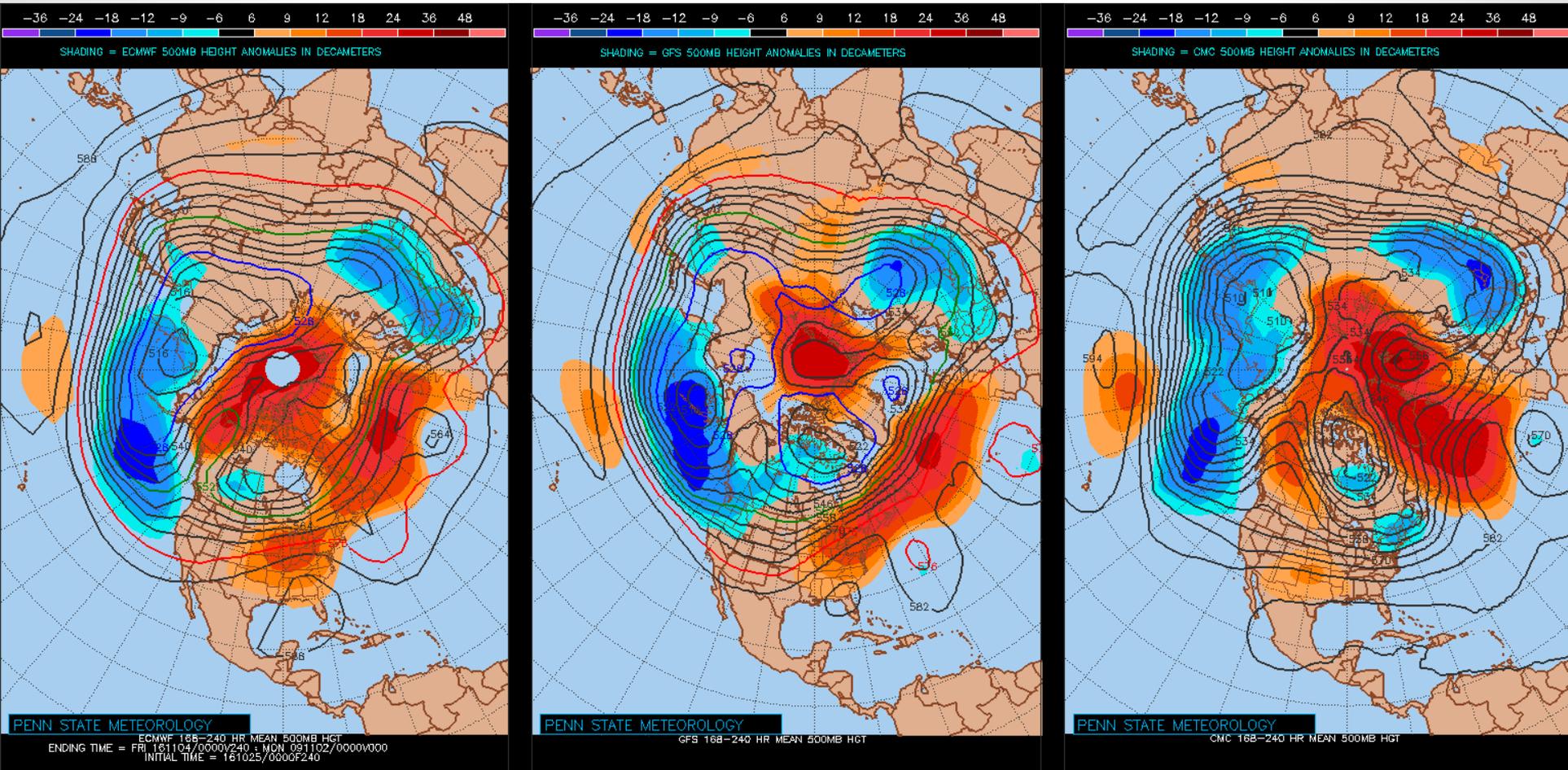
Lees Ferry [MAf] = $-8.57 \times [\text{Niño3-Niño12, July-May}] + 19.1$ <27.8%>

Lees Ferry [MAf] = $2.94 \times [\text{Fall precip}] + 14.2$ <42.0%>



ENSO flavor favors decent runoff (left), while fall precip in Upper Colorado Basin could have started better. *I lean towards near-normal (right).*

What can we expect by end of next week?



European ECMWF (left), American GFS (middle,) and Canadian CMC (right) forecast models show a tendency for troughing mostly offshore, and ridging to our east – perhaps a transient feature as we finally break down a very persistent dry regime for the Interior Southwest?! There are hints in the models beyond Day 10 that we finally get some more interesting weather.

- **Weak La Niña conditions are still trying to become established, while a return to ENSO-neutral is not off the table, especially later this winter.**
- **In a time of weak Pacific forcing (even the PDO has come off its high horse), tilts in the odds of the experimental forecast guidance are not impressive for either fall or winter, with NE CO having the best shot at above-normal moisture this fall, and the western valleys during the winter. During the latter season, UT looks most favored, while NM has to brace for drought. *Analogues based on recent behavior of the PDO & MEI slightly favor a wet fall and winter in the Upper Colorado basin, not to the south.* Forecasts from CPC are remarkably similar, except for being less bullish for UT and western CO.**
- **The next ten days look fairly dry, consistent with typically dry conditions in October during La Niña. As we transition into November, odds during La Niña-like conditions become more favorable, peaking in January. Perhaps we will see some ‘interesting weather’ around Election Day...**
- **BOTTOMLINE: While the odds are not strongly tilted one way or the other, I believe they are slightly more favorable for a wet snow accumulation season in the Upper Colorado than a dry one. However, a shift towards wet conditions later this fall will be critical for that. *Stay tuned for my November update at the next WATF!***

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

