Earth System Research Laboratory
Physical Sciences Division

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NIDIS
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Colorado WATF, 9-16-16, Denver

DNR
COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Seasonal Outlook for Colorado

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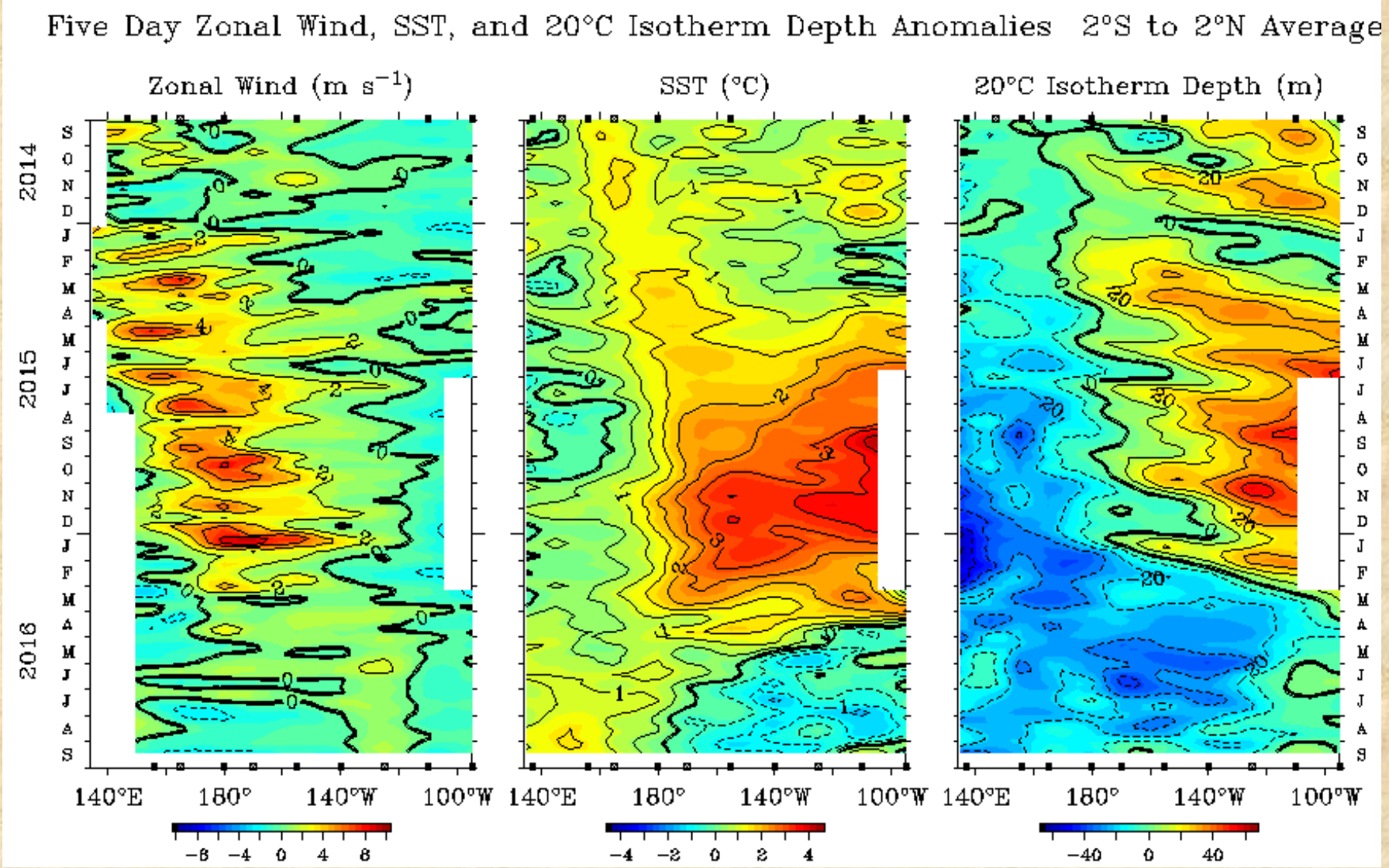
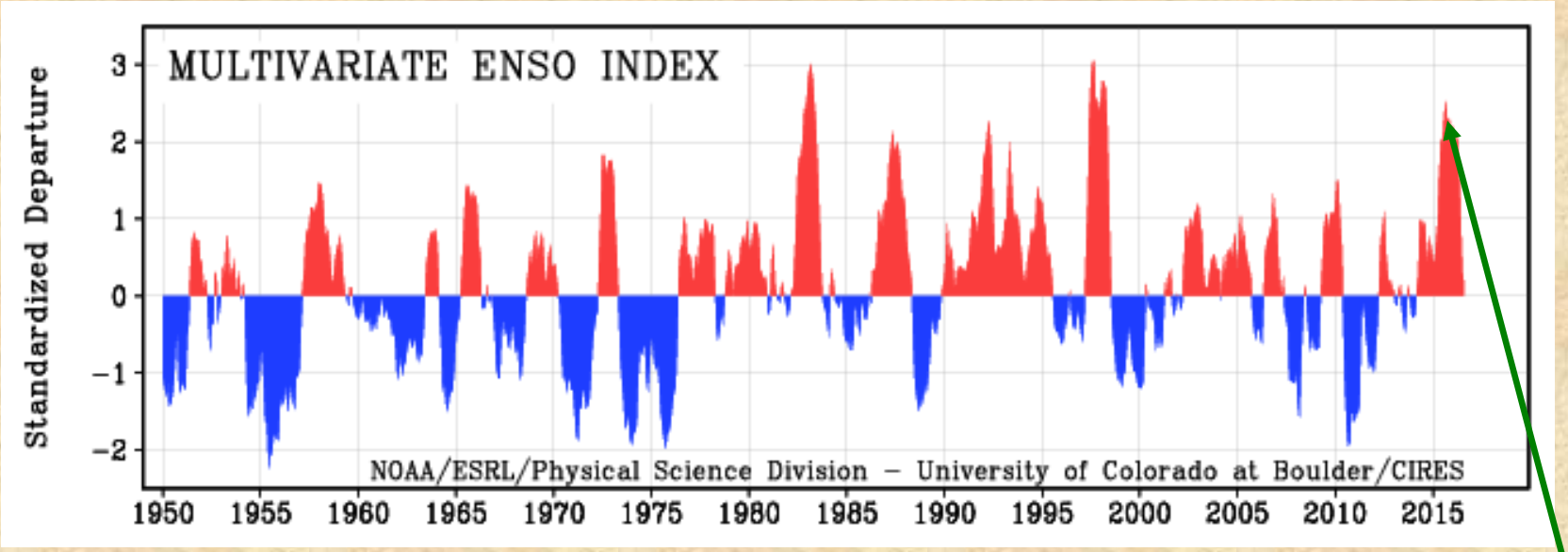
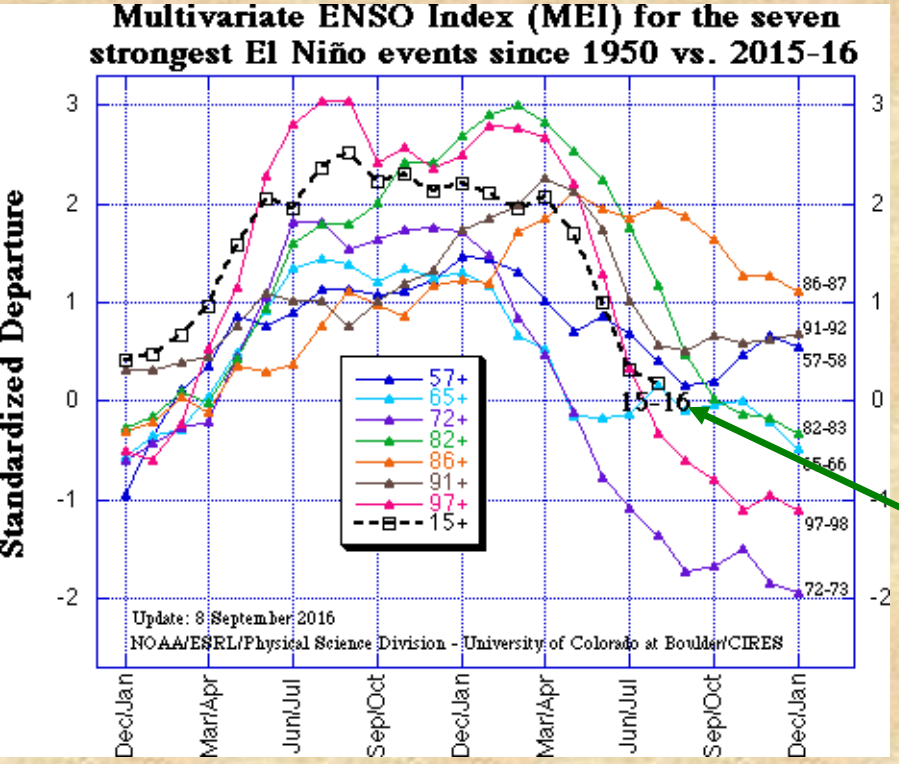
- ***El Ninõ done / Not so fast La Niña!***
- ***Postmortems***
- ***CPC forecasts***
- ***Experimental forecast guidance***
- ***Next week or two***
- ***Executive Summary (16 September)***



El Niño is over, but has NOT been replaced decisively by La Niña in surface wind field (left), SST anomalies (middle), or subsurface heat content (right). Furthermore, both SST anomalies and heat content are showing signs of weakening during last month. Enhanced trade winds could have made a difference, and might still do so over next few months.

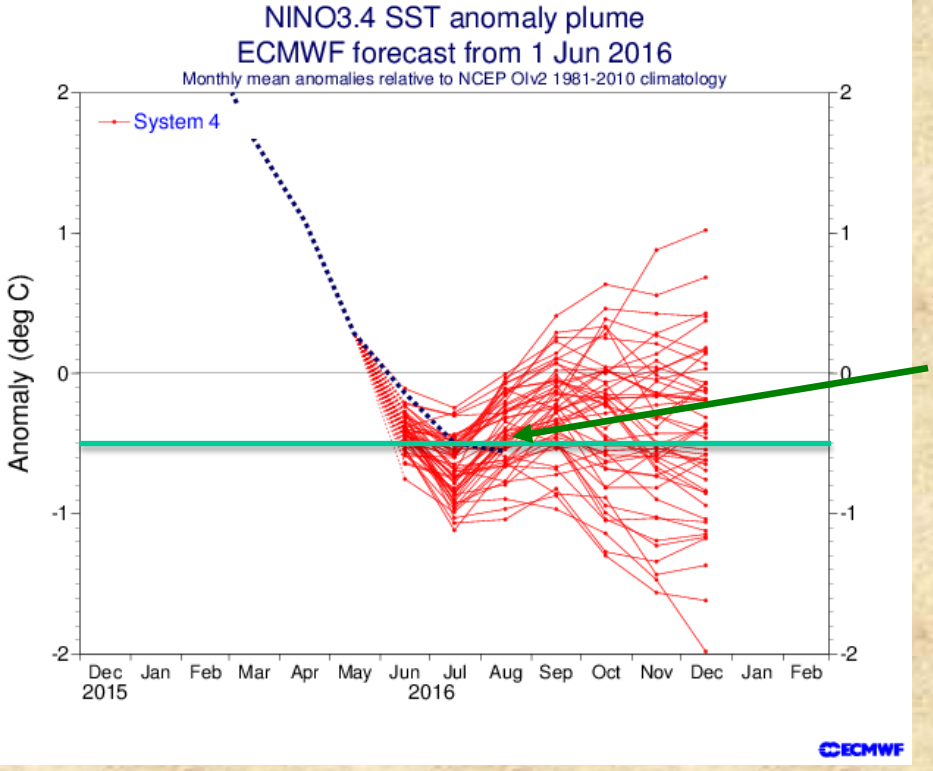
http://www.pmel.noaa.gov/tao/jsdisplay/index.html





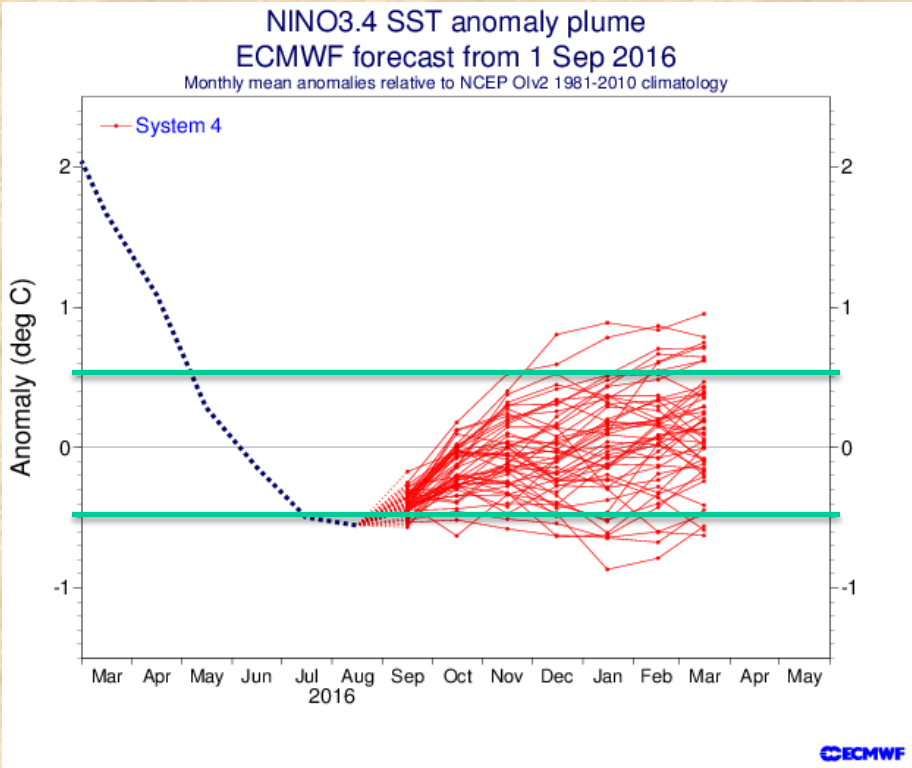
The **MEI** monitors ENSO based on all observed fields over the tropical Pacific (pressure, wind, temperatures, cloudiness). It is the 1st combined Principal Component, normalized with respect to the season. **The El Niño peaked in Aug/Sep 2015 at +2.53, the largest MEI value since 1998**. Since June-July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

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



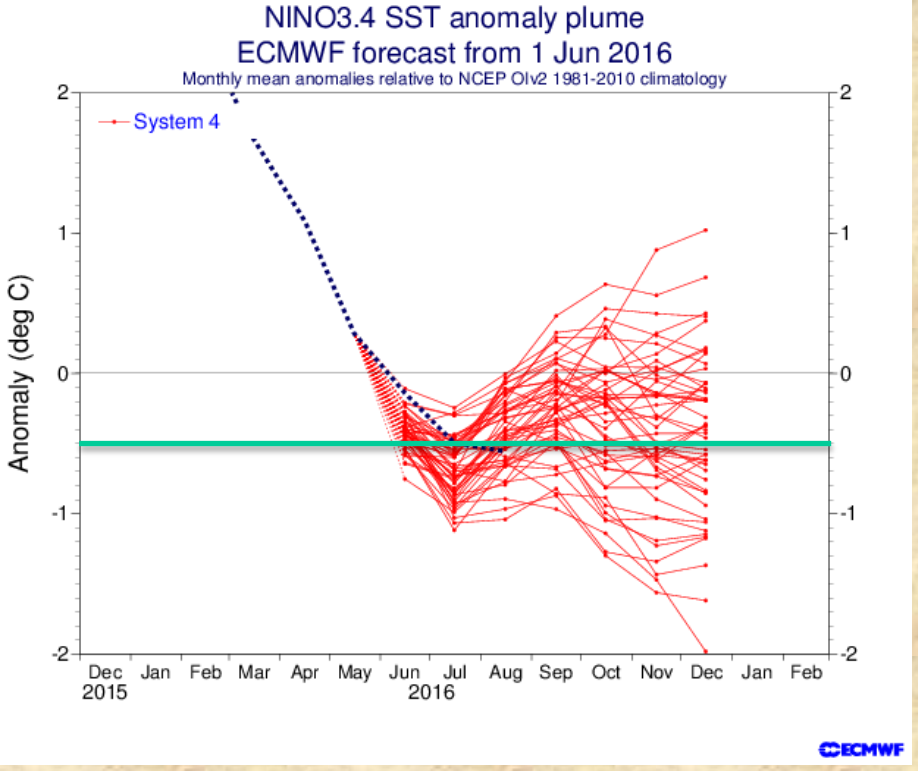
The ECMWF June 2016 forecast (left) showed a dip into weak La Niña (-0.5C; green bar) conditions during the summer, and a relaxation towards neutral afterwards, but with large uncertainties. The blue stippled line shows that Niño 3.4 stayed on the warm side of the plume.

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



The new ECMWF forecast (right) reaffirms a rebound to ENSO-neutral conditions this fall and into early next year, with only a handful of the 50 ensemble members indicating either El Niño or La Niña six months from now. I guess it is no surprise that CPC has canceled the La Niña watch it had hoisted a few months ago.

Meanwhile, the PDO has dropped from record-high values around +2.5 this spring to just +0.5 in August…



The ECMWF June 2016 forecast (left) showed a dip into weak La Niña (-0.5C; green bar) conditions during the summer, and a relaxation towards neutral afterwards, but with large uncertainties. The blue stippled line shows that Niño 3.4 stayed on the warm side of the plume.

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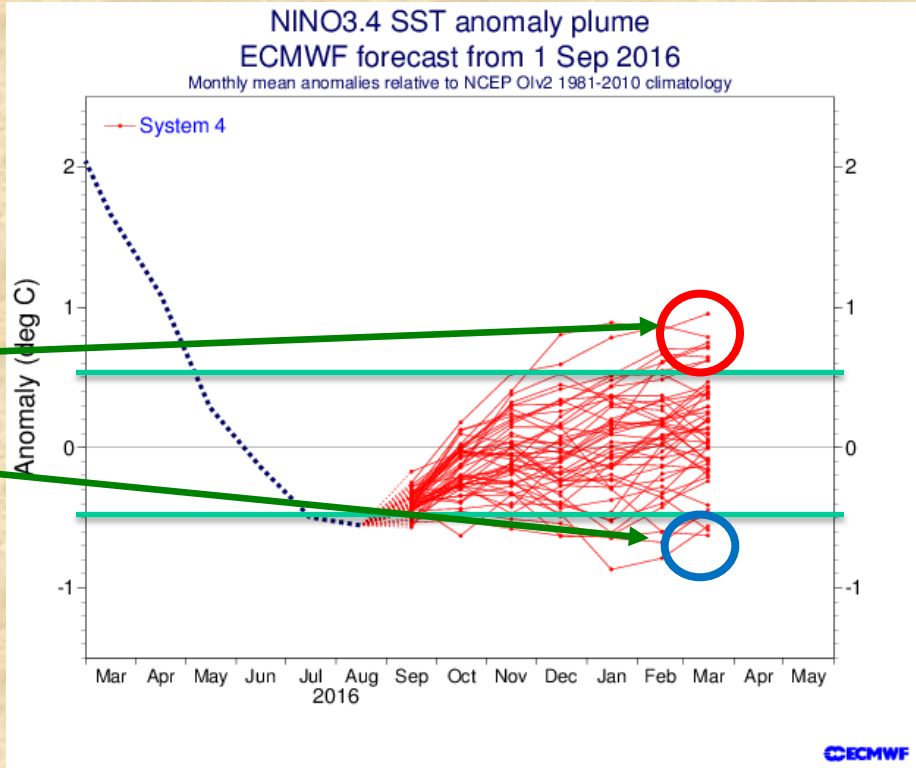

The new ECMWF forecast (right) reaffirms a rebound to ENSO-neutral conditions this fall and into early next year, with only a handful of the 50 ensemble members indicating either El Niño or La Niña six months from now. I guess it is no surprise that CPC has canceled the La Niña watch it had hoisted a few months ago.

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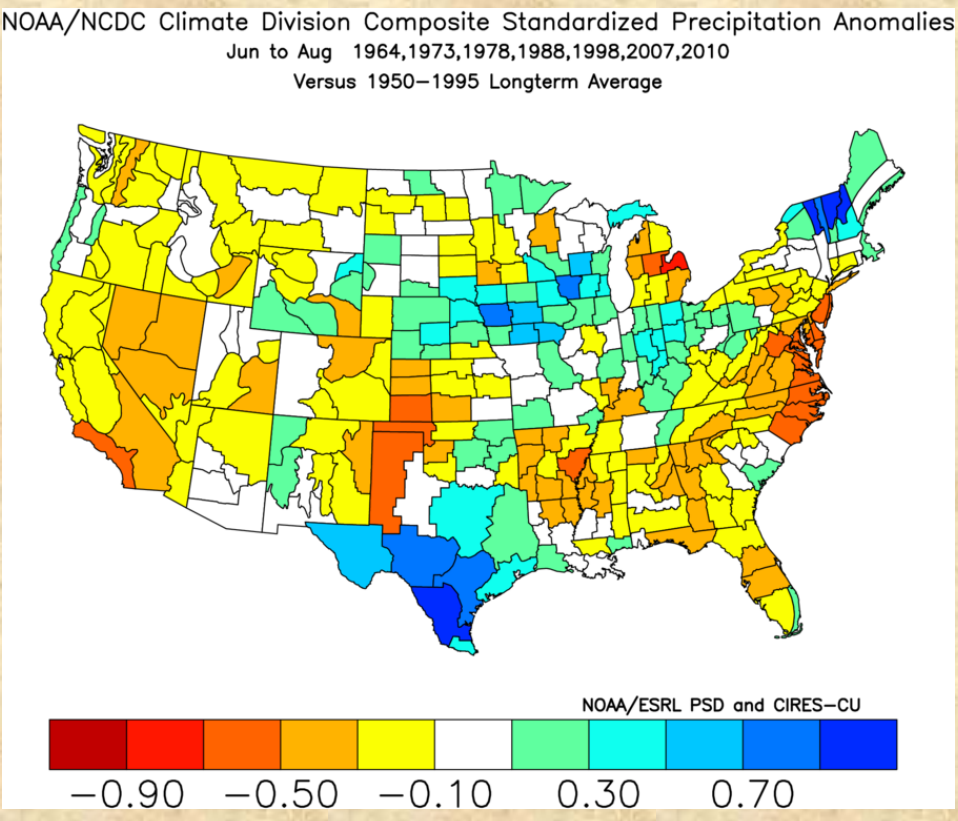
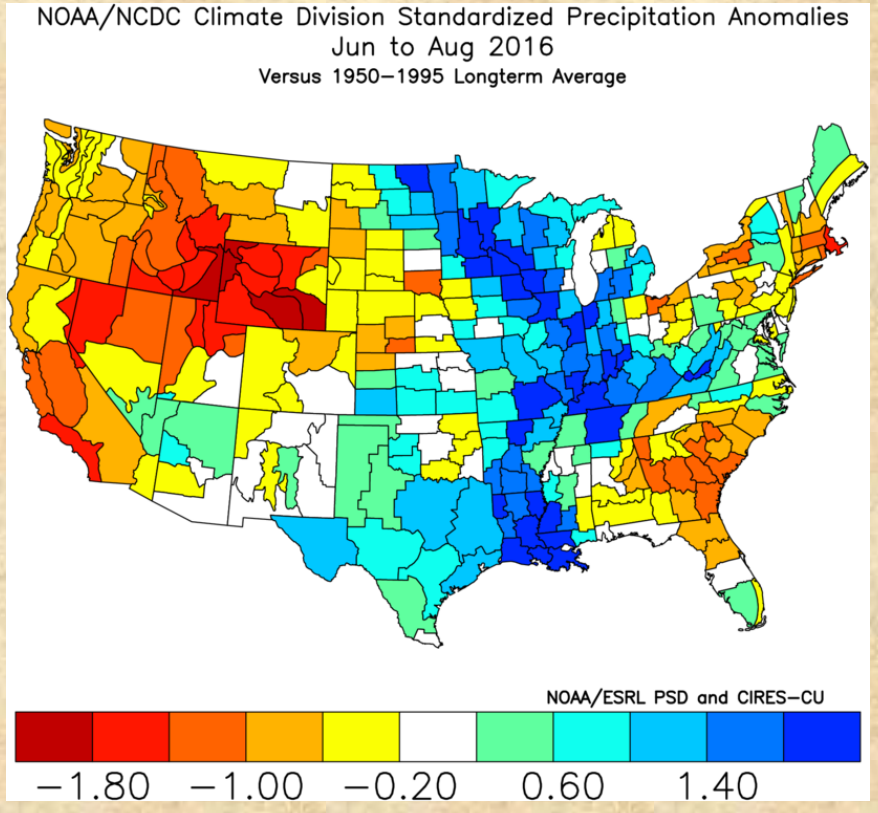
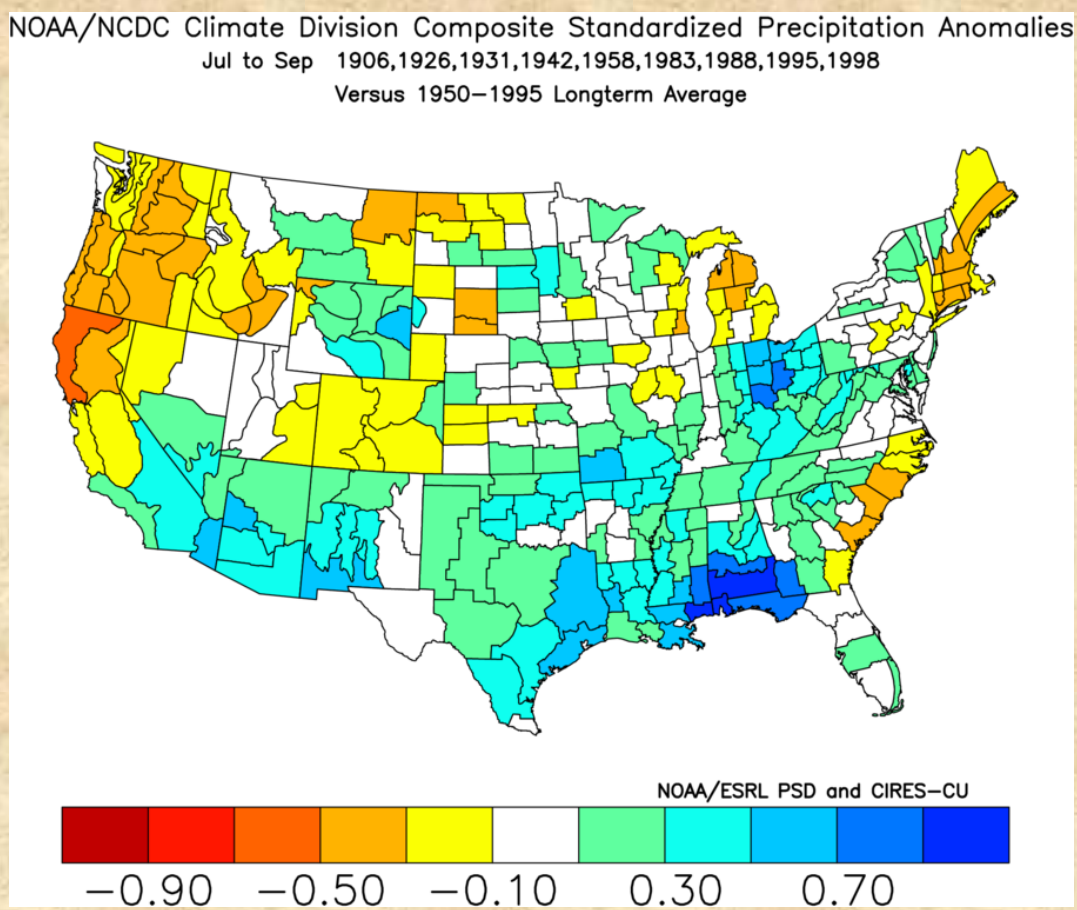
Typical summer precipitation during at least weak La Niña conditions AFTER El Niño winter



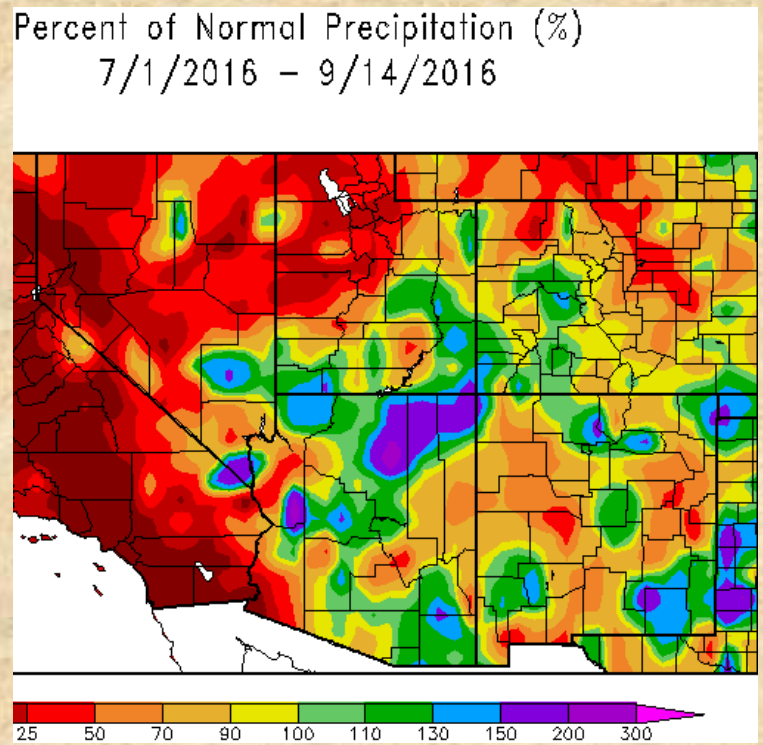


I showed the left composite back in April (left) which worked out pretty well for our state (right), namely not too far off from normal except right in the South Platte basin. This pseudo-La Niña has performed as if it had been a real one…

Typical late summer precipitation after high PDO values in spring, and past-peak Niños…



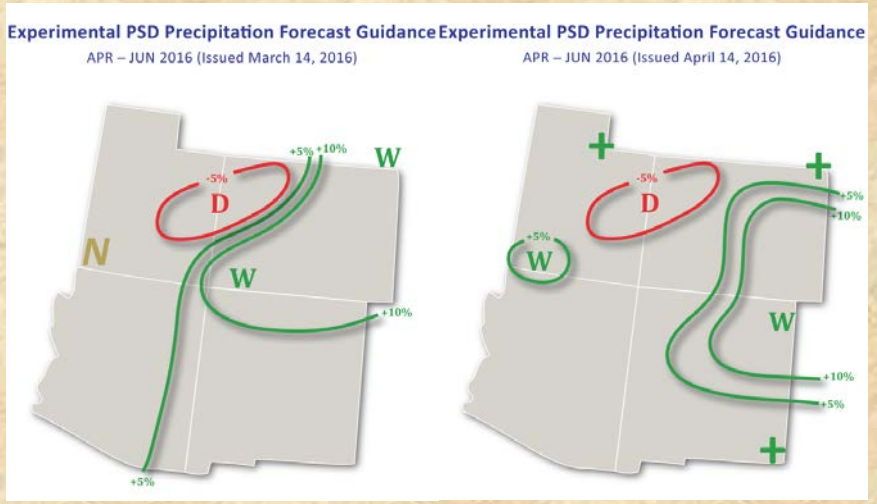
My other composite keyed in on the PDO, with a weak signal around here, but an enhanced monsoon towards Mexico (left). While there are hints of an enhanced monsoon south of here (right), it was overall drier than expected based on this scenario.

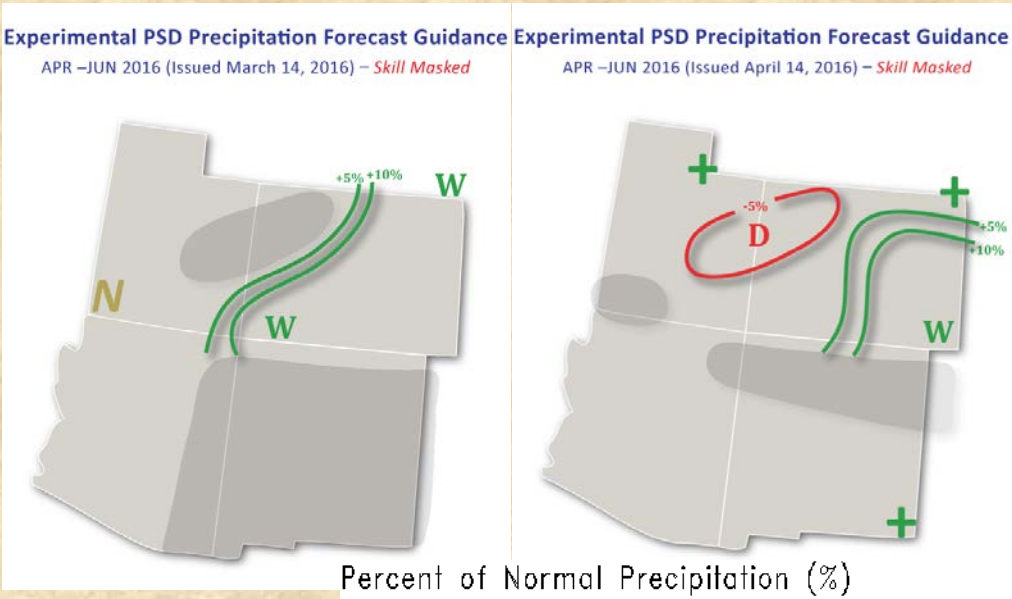


Postmortem for April-June 2016

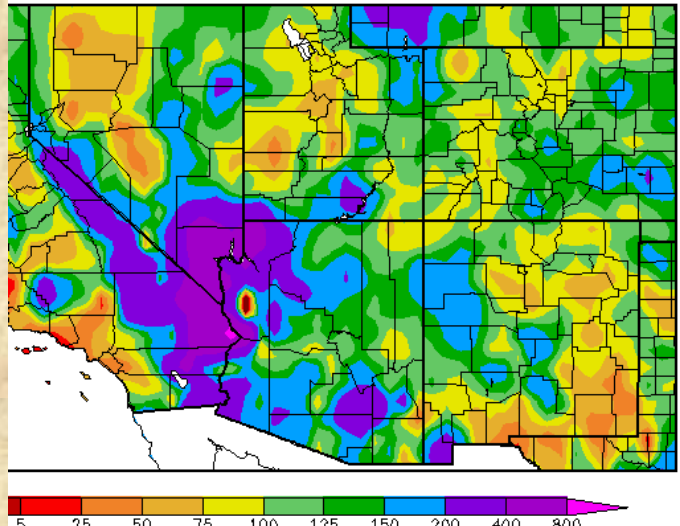
Colorado Water Conservation Board
Department of Natural Resources

Skill-masked maps





Percent of Normal Precipitation (%)
4/1/2016 – 6/30/2016



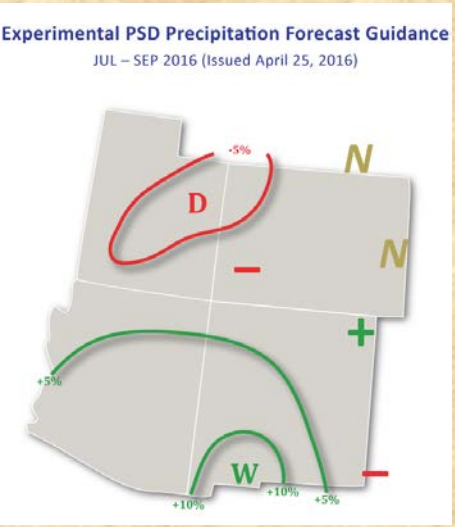
Late spring precipitation forecasts were bullish for eastern CO, but not over northwestern CO (left). ***The latter was not supported by any operational skill in the March initialization (2nd from right), but made it thru the skill mask in April (top right).***

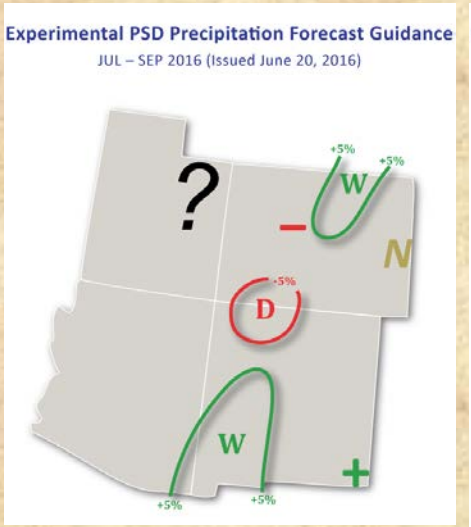
Looks like the wet forecast in eastern CO verified, while the dry forecast west of the Divide was a bit too pessimistic.

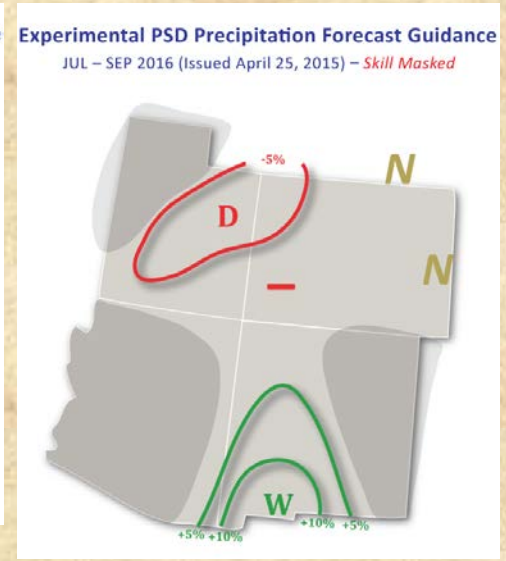
Postmortem for Jul-Sep 2016

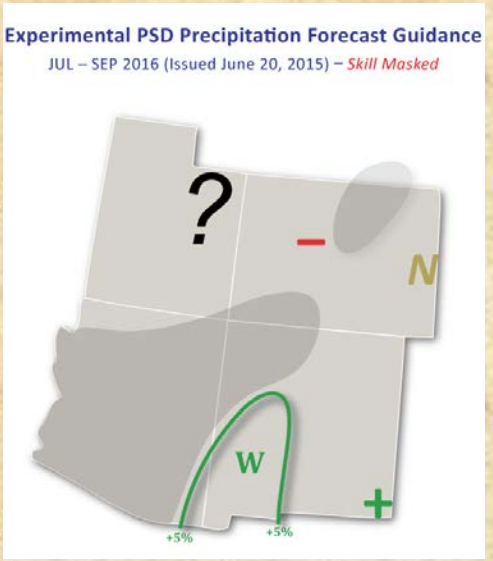
Colorado Water Conservation Board
Department of Natural Resources

Skill-masked maps



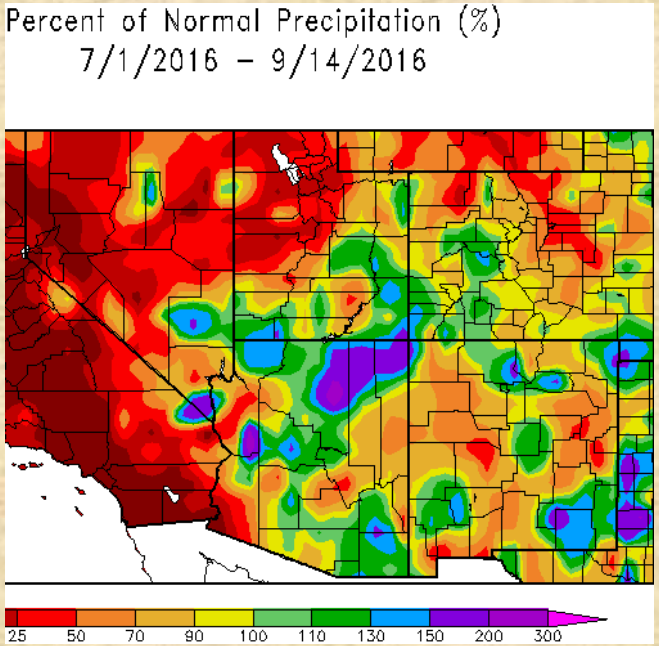




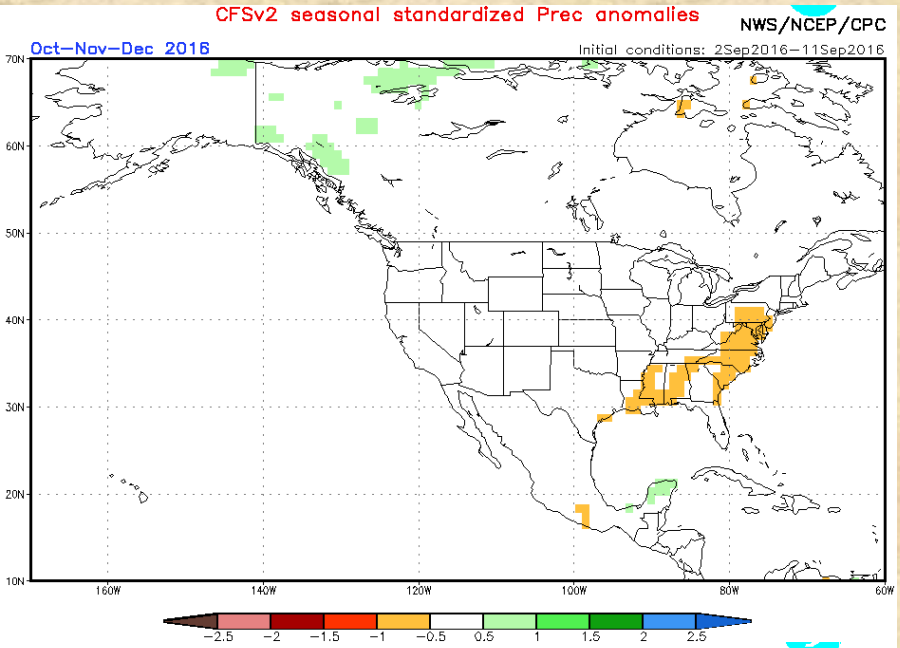


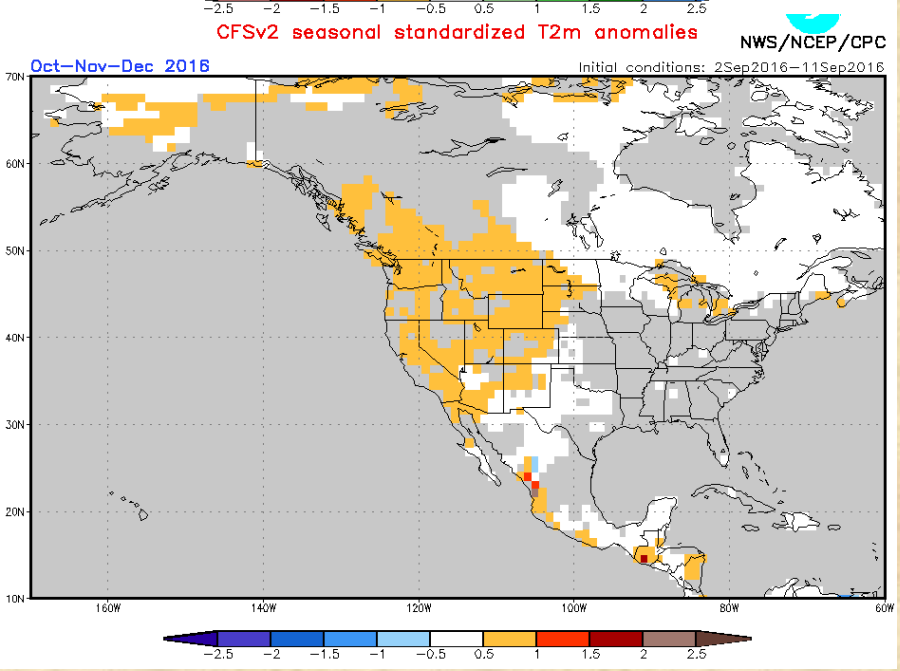
Late summer precipitation forecasts initially favored near-normal for eastern CO, and dry over western CO (top left). The updated forecast (left middle) was a bit more optimistic for the Front Range, but continued leaning dry southwest of here. *Skill-masked forecasts did not change the original forecast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

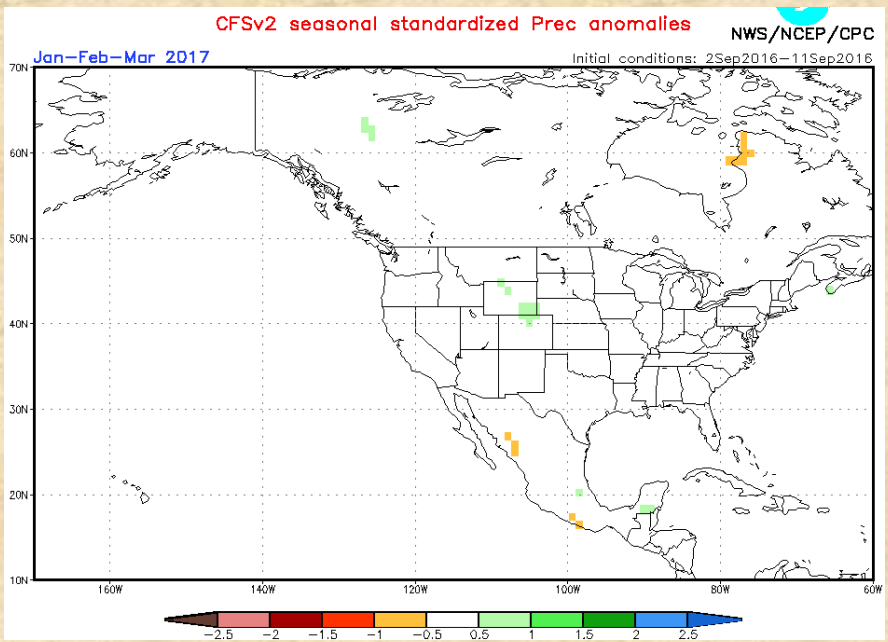
While the overall outcome was on the dry side (bottom right), eastern-most CO may indeed come out near-normal, and the skill-mask proved prescient.



CFSv2 forecasts for OND'16 and JFM'17



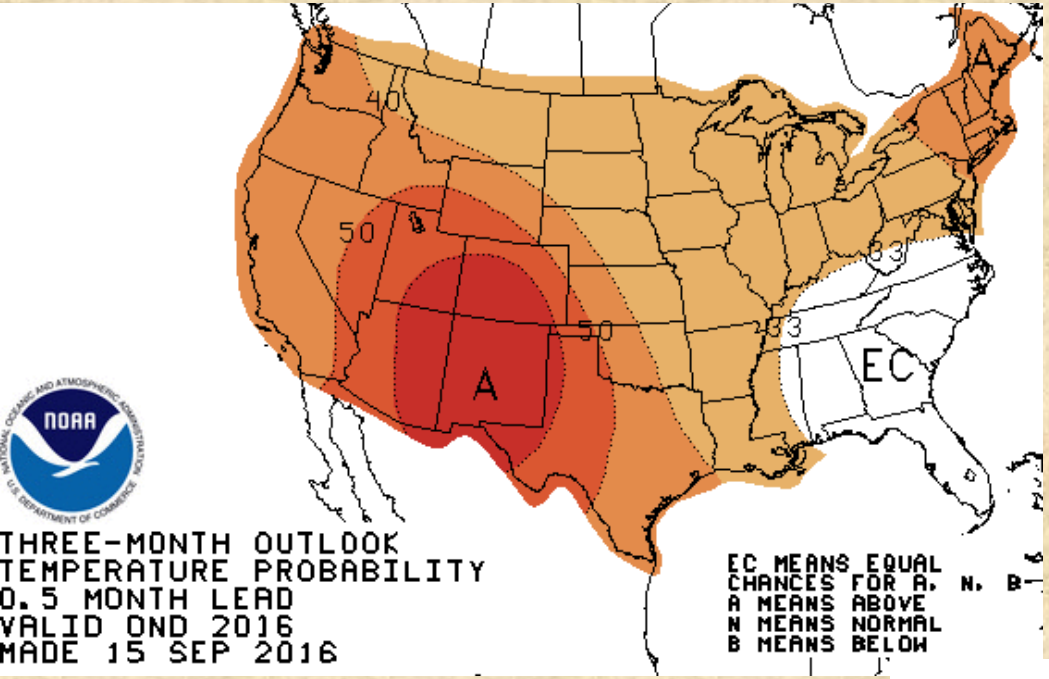




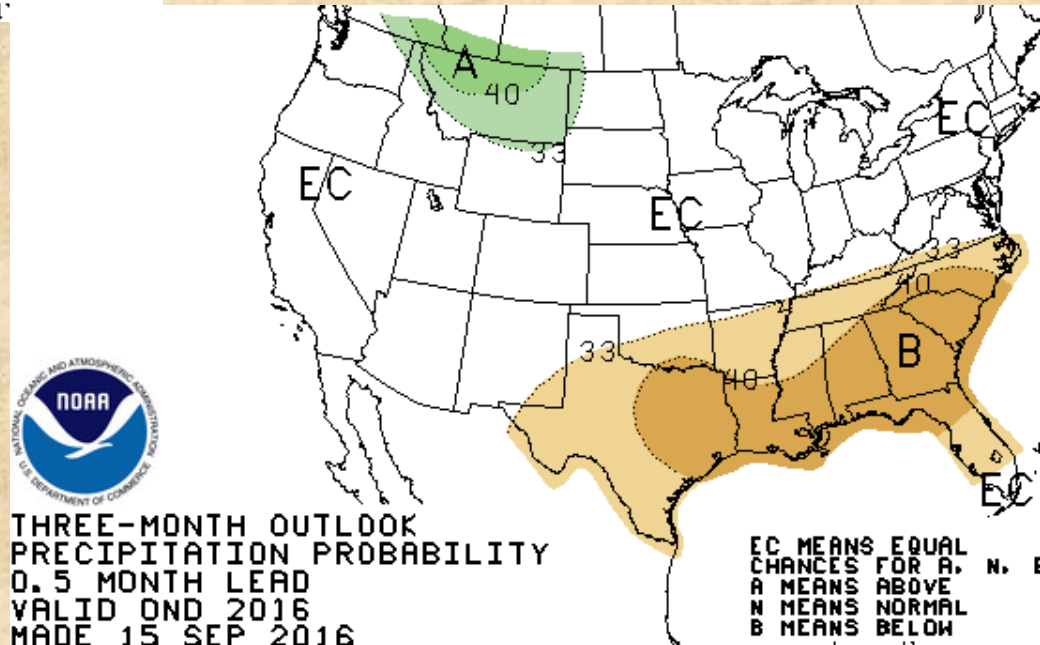
Fall (top left) and Winter (top right) look near-normal to isolated wet in CFSv2. If you require skill, only the fall forecast for temperatures (bottom left) shows a signal (warm, surprise!). ***A weak signal, perhaps due to weak Pacific forcing!***

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

Climate Prediction Center Forecasts: Oct-Dec 2016

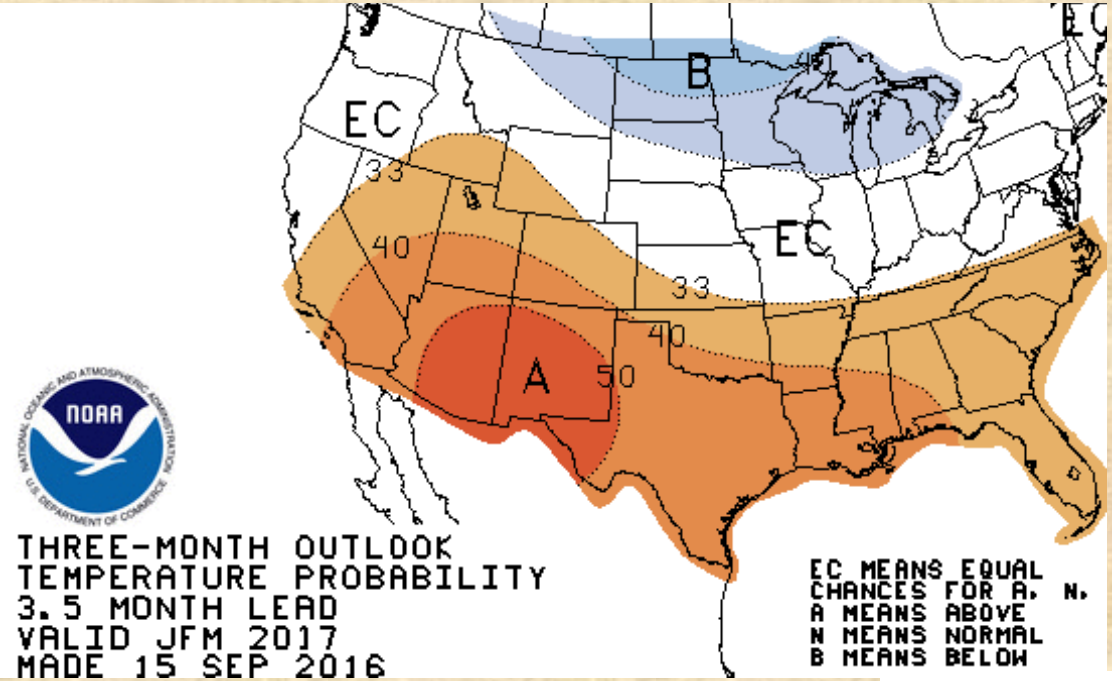


The CPC fall temperature forecast (top left) is rather toasty, certainly anchored by the CFSv2. The precipitation forecast (bottom right) has a bit of a La Niña flavor to it, but keeps our region 'EC', with climatological odds.

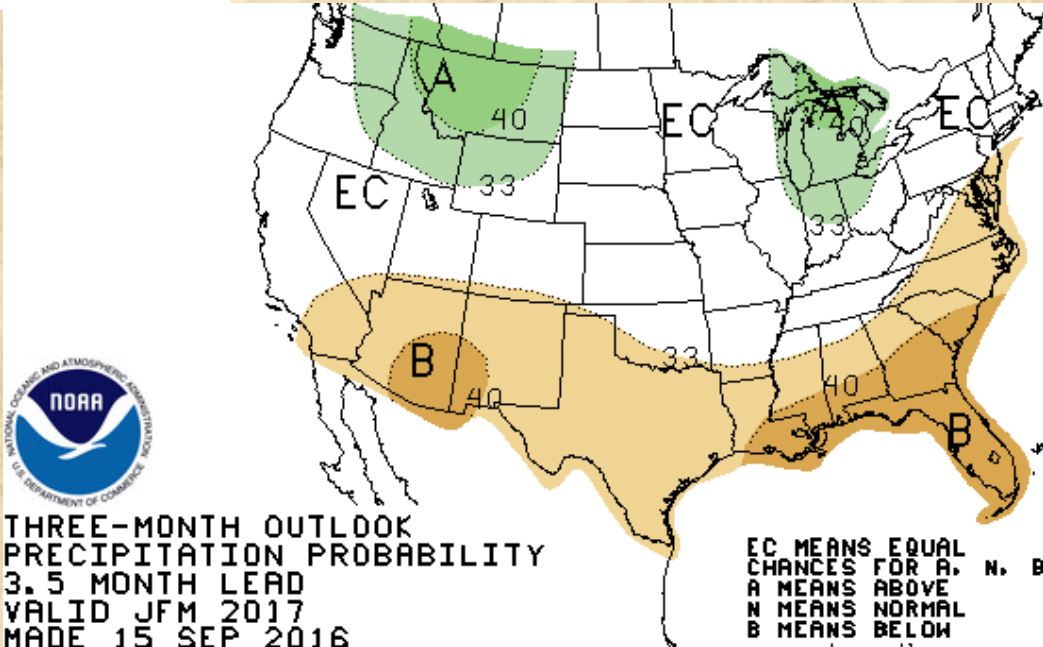


http://www.cpc.ncep.noaa.gov/products/predictions/

Climate Prediction Center Forecasts: Jan-Mar 2017

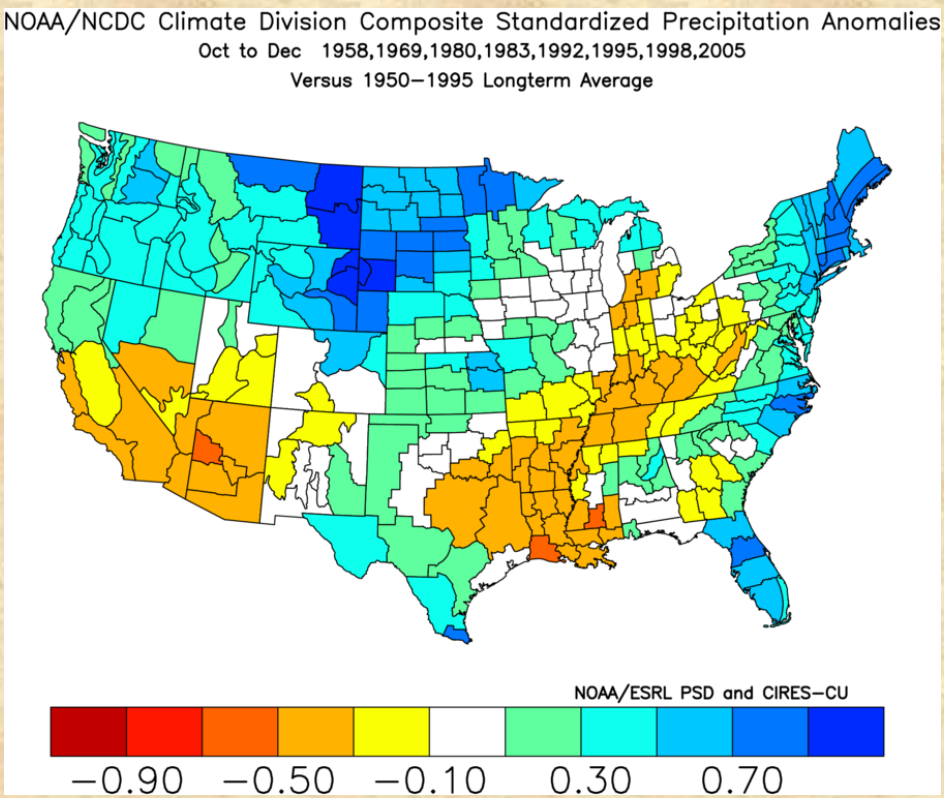


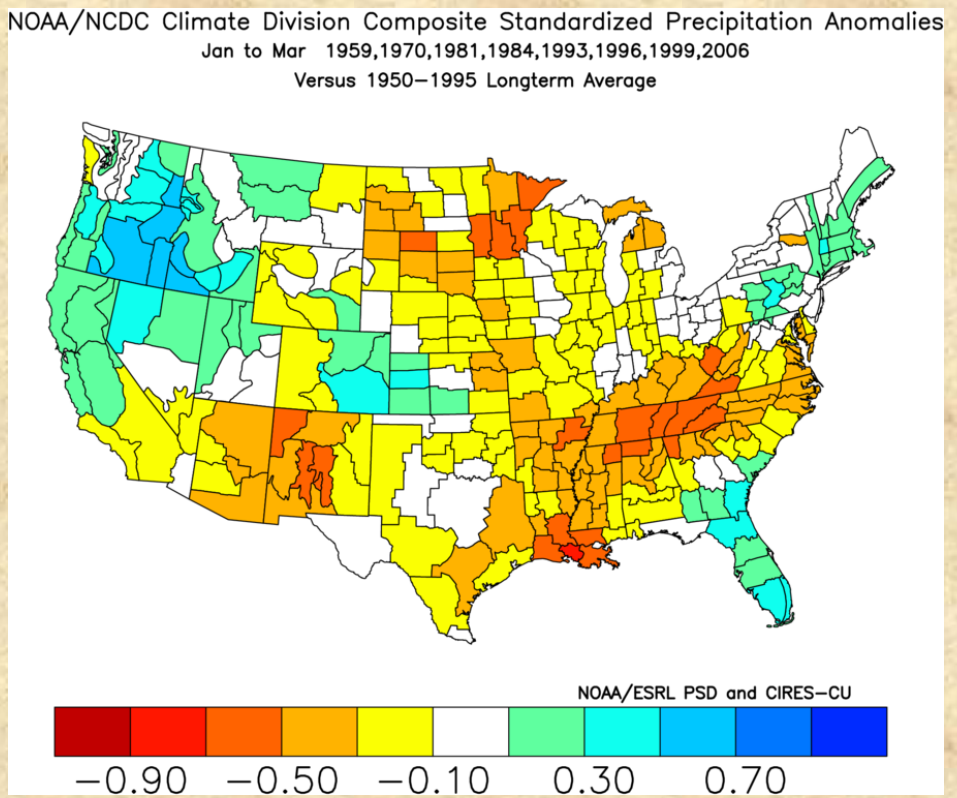
The CPC winter temperature forecast (top left) resembles a La Niña-based forecast despite ENSO-neutral assumptions. Given an overall warming trend, a warm forecast for us is not surprising. The precipitation forecast (bottom right) keeps our region mostly 'EC', again playing the La Niña card, given that it is more likely than El Niño.



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

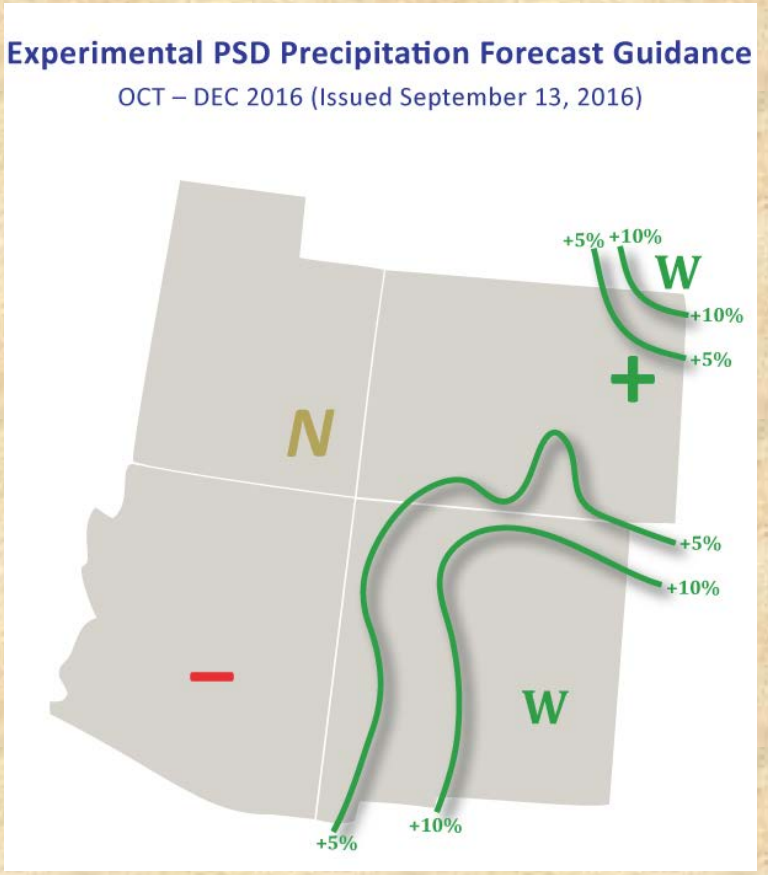
Analogue forecast based on similar MEI rankings for last 8 months

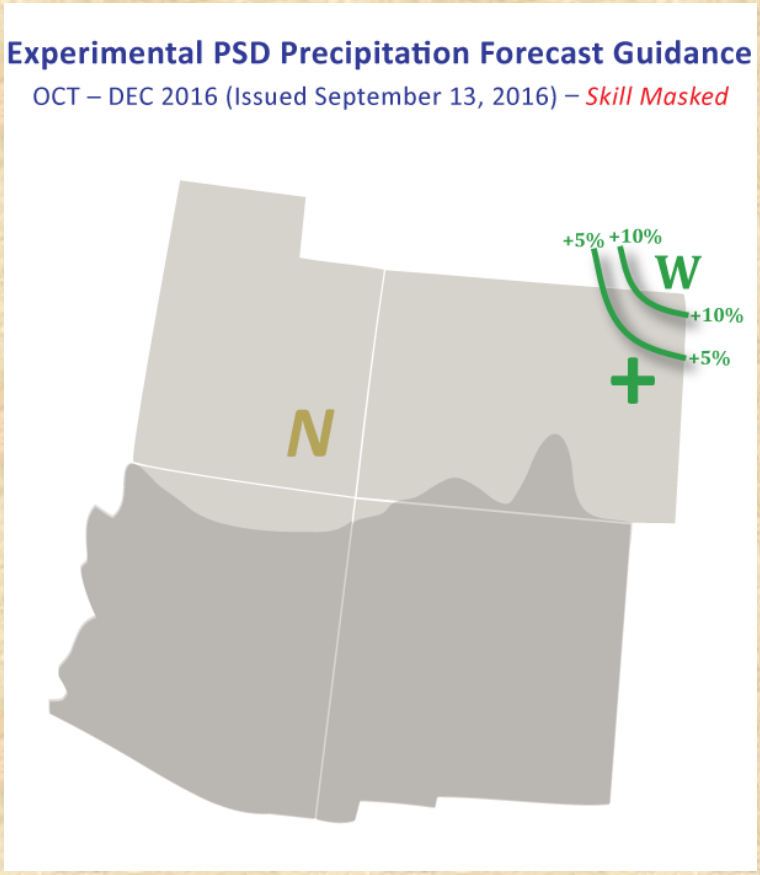




The eight analogues used here had the most similar MEI rankings for the current year through July-August, requiring El Niño at the beginning and closer to ENSO-neutral by mid-year. Some cases became La Niña by winter (95-96, 98-99, and 05-06), some rebounded to El Niño (58-59, 92-93), the rest stayed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

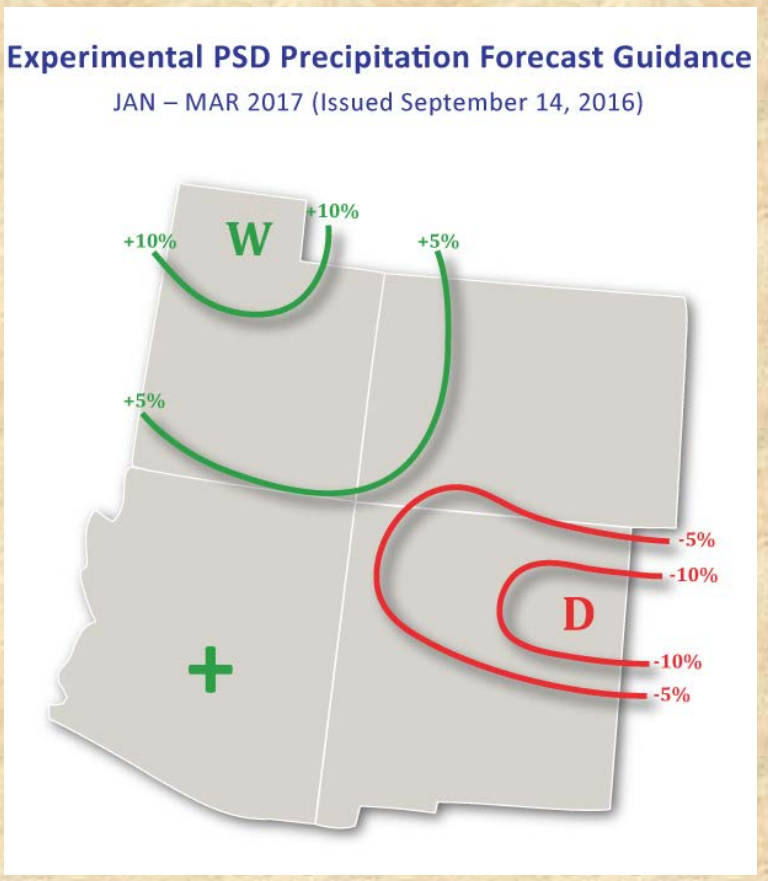
Forecast for Oct-Dec 2016

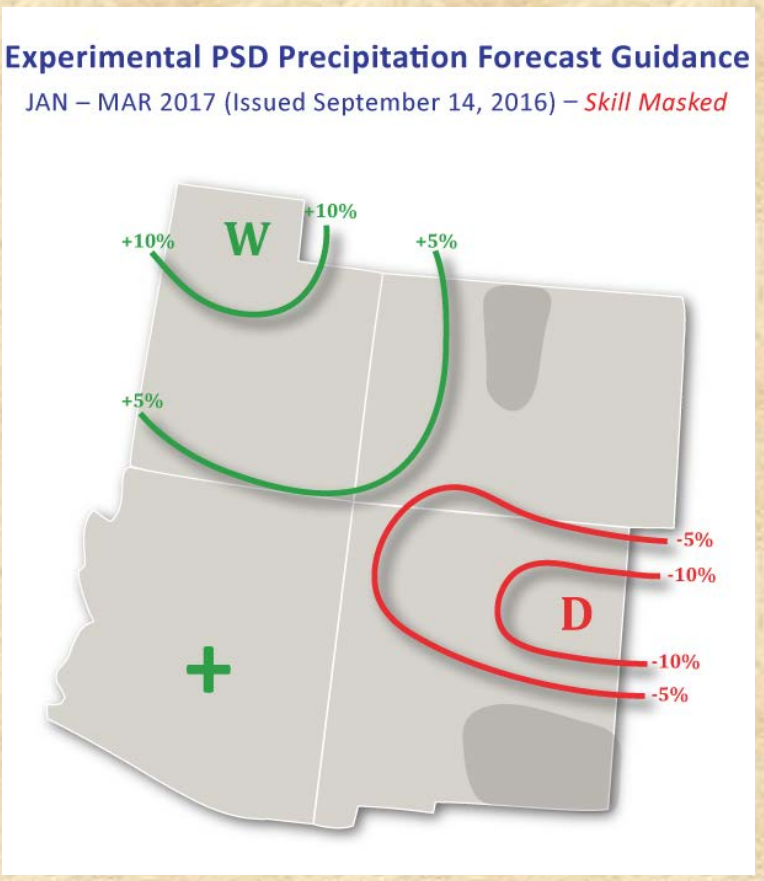




My late fall precipitation forecast is either neutral or wet for Colorado (left), with best odds for wetness in northeast corner of the state. The skill-masked forecast (right) maintains climatological odds west of here, and more likely wet conditions for the northeastern plains.

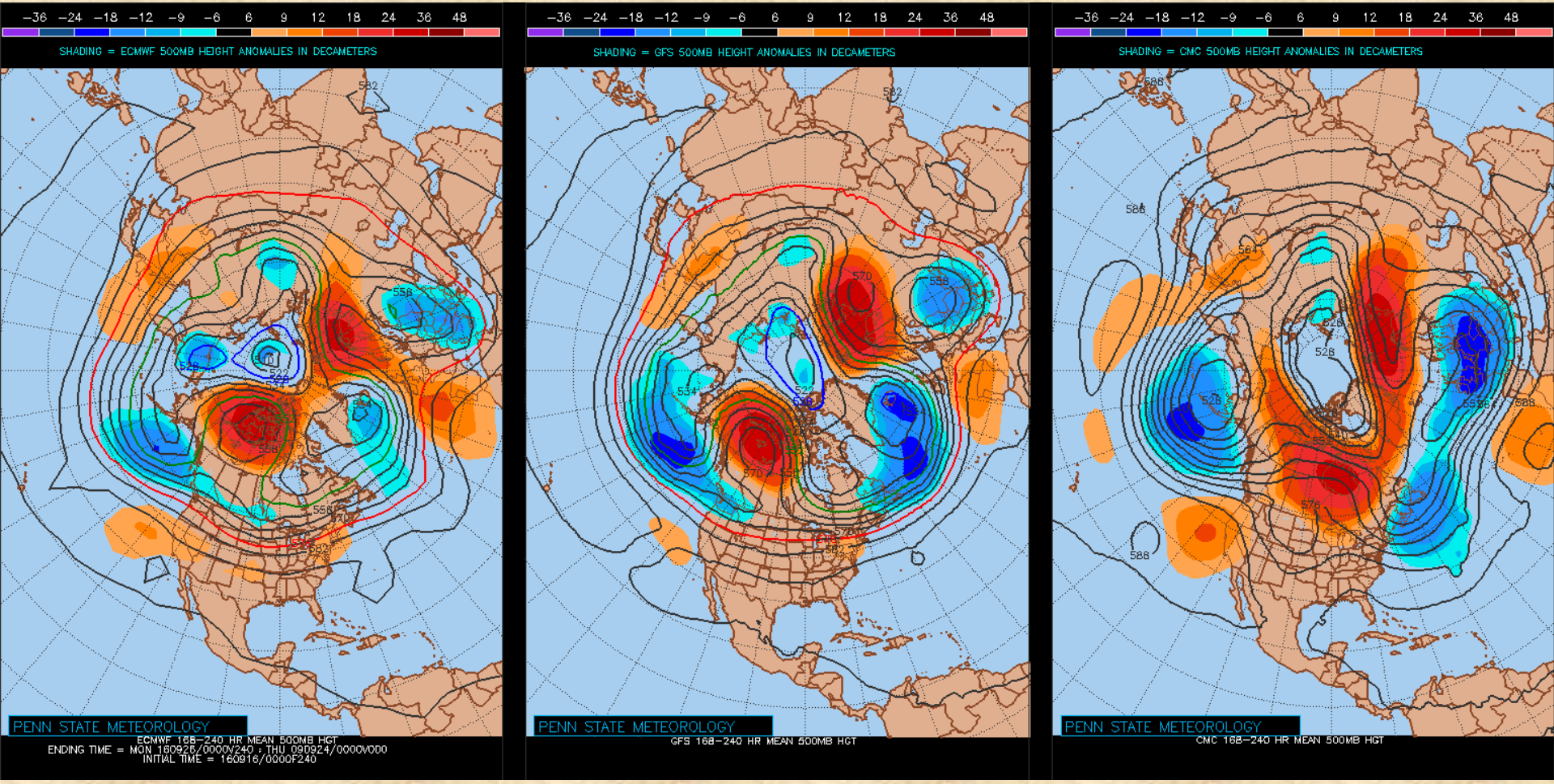
Forecast for Jan-Mar 2017





My late winter precipitation forecast keeps anomalous moisture mostly to our west (left), leaving the best odds in our state for westernmost Colorado. The skill-masked forecast (right) looks very similar, since there is proven skill for this season and lead-time.

What can we expect by end of next week?



European ECMWF (left), American GFS (middle,) and Canadian CMC (right) forecast models show a weak tendency for ridging near CA (hopefully transient for them) and nothing unusual near us. This should allow for occasional incursions of cooler air, along with early season light snows in the mountains, but no 'PSA-worthy' storm on our horizon yet.

Executive Summary (16 September 2016)

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- **El Niño is over, it was fun (and often wet) while it lasted. As I wrote three months ago, it remains unclear whether La Niña will get a firm foothold or wither on the vine.**

- **Colorado dried out over last few months as the El Niño disappeared, possibly helped along by hazy skies from persistent forest fires from North Park towards the Pacific Northwest.**

- **In a time of weak Pacific forcing (even the PDO has come off its high horse), odds 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. Analogue forecasts show more wetness over eastern CO than in the west for both seasons. Forecasts from CPC are 'EC' through both seasons.**

- **The next two weeks look dry, but also not too hot either. There are occasional model runs that promise an early season snowstorm for the Front Range (foothills), but none of these scenarios has been advertised for more than a few runs yet.**

- **BOTTOMLINE: A lot of uncertainty this time around, let's hope that 1983-84 carries the day among those eight analogues, and not 1980-81. *Stay tuned!***