Earth System Research Laboratory
Physical Sciences Division

CIRES
Cooperative Institute for Research in Environmental Sciences

Colorado WATF,
9-14-17, Denver

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Seasonal Outlook for Colorado

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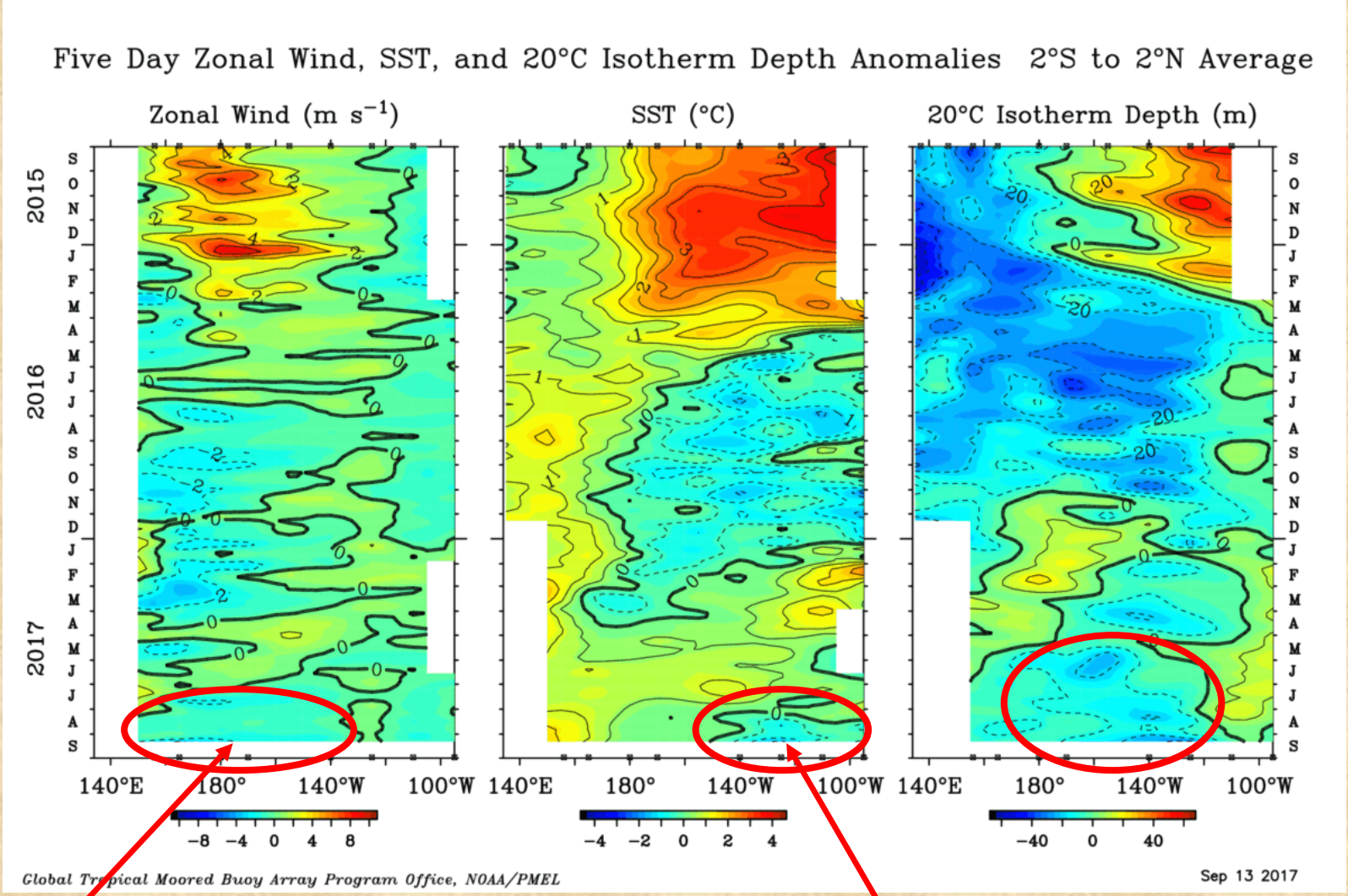
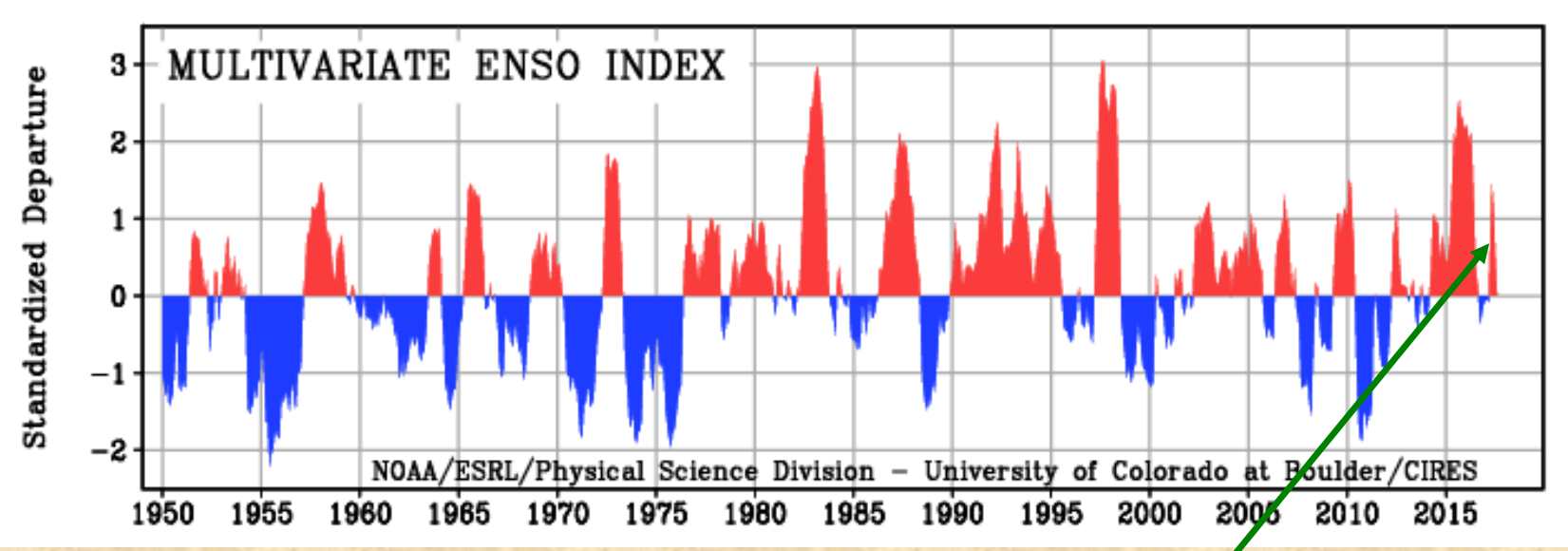
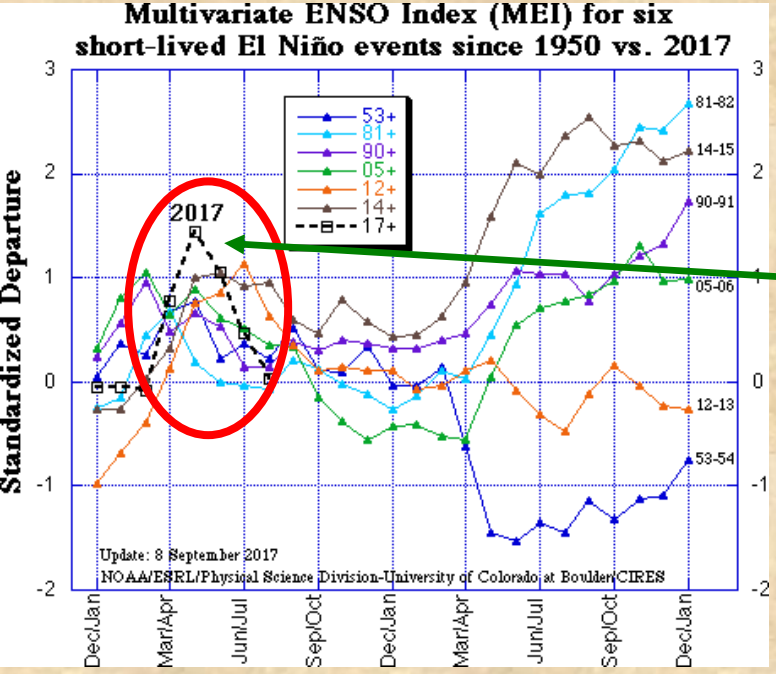
- ***El Niño: I hardly knew you! La Niña: Is that really you?***
- ***CPC/CFSv2 forecasts thru March 2018***
- ***Experimental forecast guidance & 'analogues'***
- ***Next two weeks***
- ***Executive Summary***


Last month for people like me…



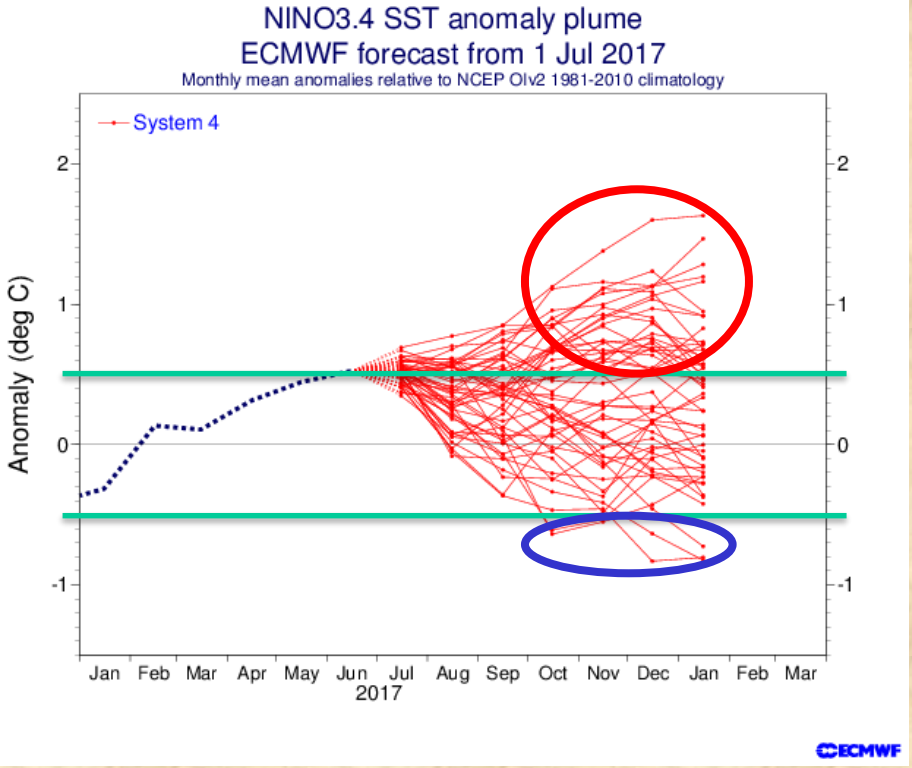
Wind anomalies (left) near the dateline have been very weak lately, warm SST anomalies (middle) have come and gone, tentatively replaced by negative anomalies during last month, and negative upper ocean heat content anomalies appear to be making a comeback near 140W (right). All in all, ENSO-neutral is the official designation, back in sync with the MEI (next slide). *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). **A few months ago, we had ourselves a brief El Niño "event" in 2017, not unlike 2012 in particular.** ***Analogous cases in the past ended up near-neutral in following winter – no comment about the prospects of a major El Niño next year.***

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

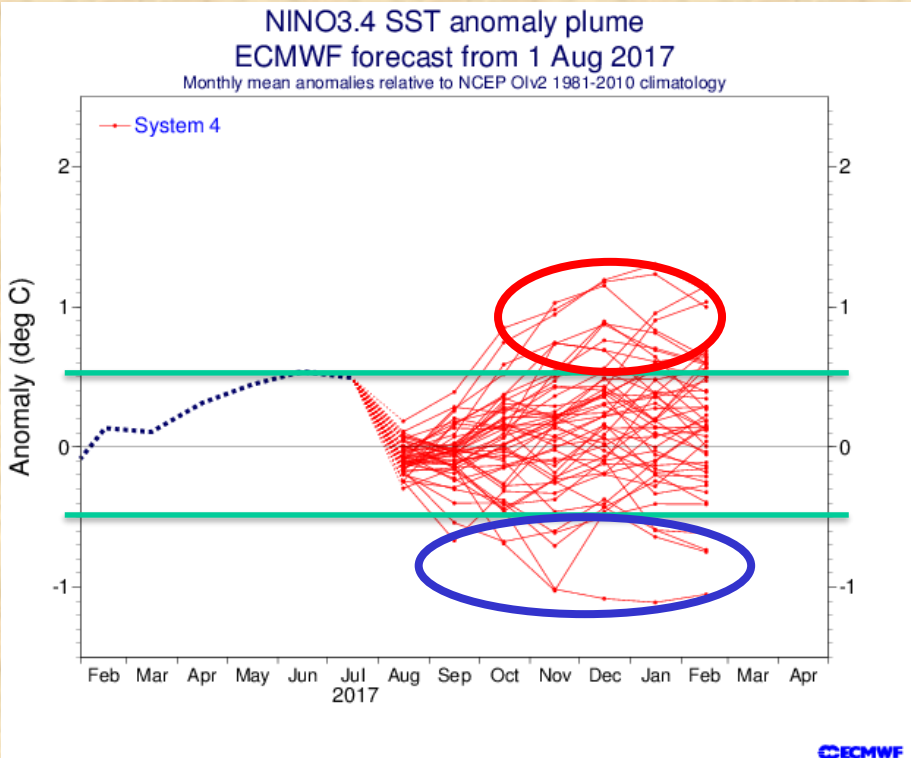


The ECMWF July 2017 forecast (left) showed a large range of possible outcomes, all the way from a few weak La Niña members to moderate El Niño by December. This was not nearly as much in favor of El Niño as earlier this year.

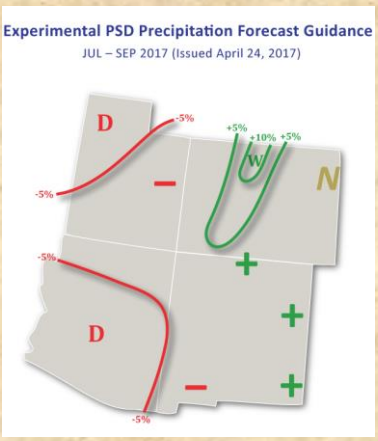
http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/

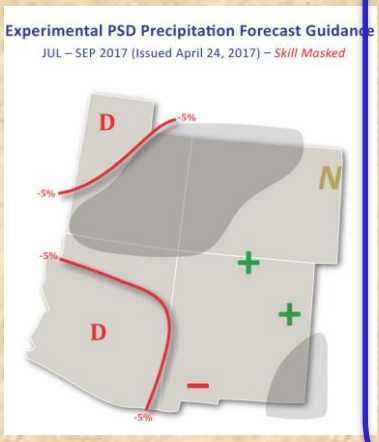
The August 2017 ECMWF forecast (right) has backtracked even further, with almost as many members advertising La Niña as El Niño. ***<u>Rumor has it that the September update (tomorrow) will show a decisive switch to La Niña.</u>***

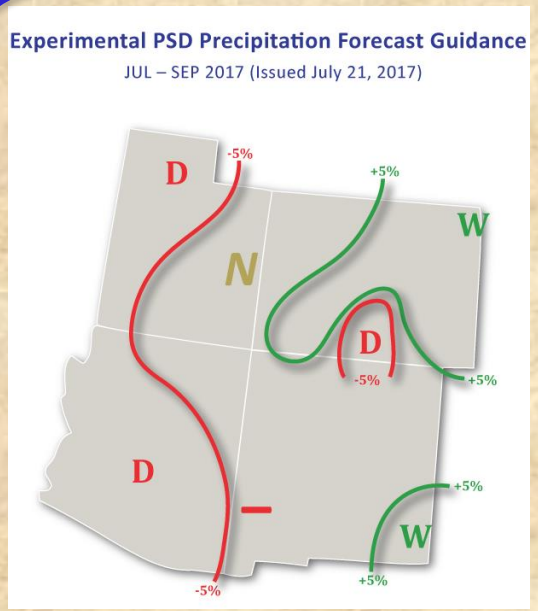
Other notable late summer onset La Niña events: 2016, 2007, 1995, 1984 (even later: fall), so this is not terribly unusual.

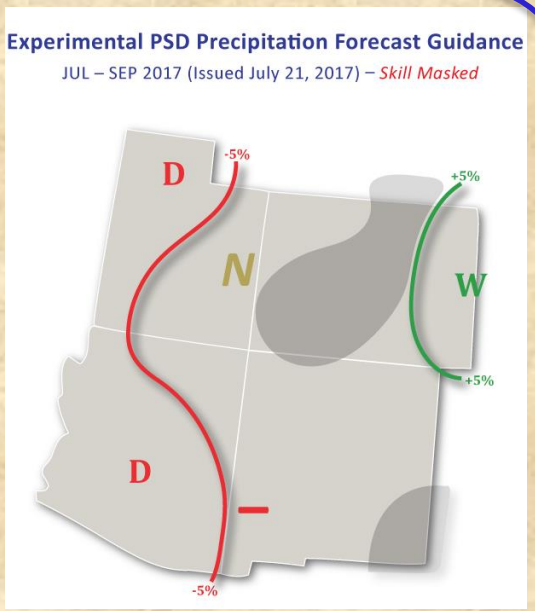


Postmortem July-September 2017





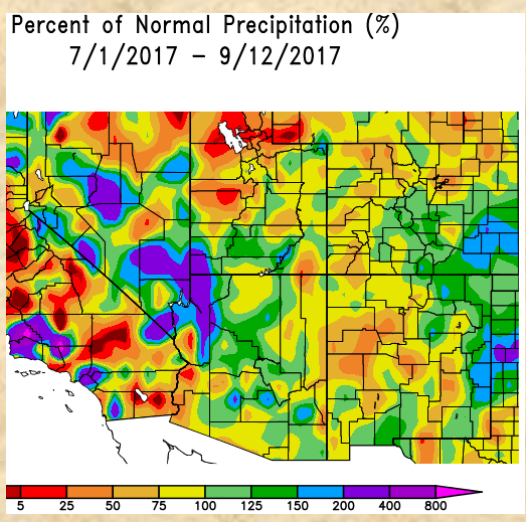




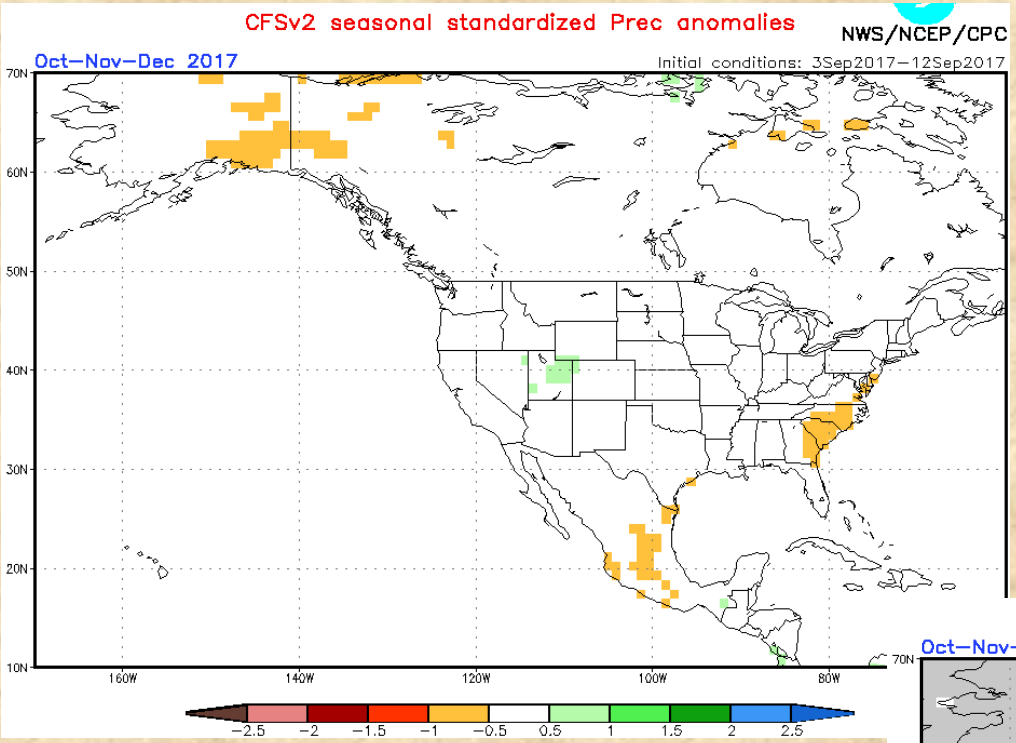
In April, my experimental July-September precipitation forecast (far left) was optimistic over our mountains, with little skill this far ahead (middle left). ***There was a general west-east gradient from more moisture east of the Divide to least in AZ and UT.***

The updated forecast maintained the general west-east gradient (middle right). The skill-masked version (far right) removed a lot of detail, but maintained a decent tilt towards wet conditions over the eastern plains.

The observed anomalies have actually matched expectations over eastern CO (mostly wet) and northern UT (dry).

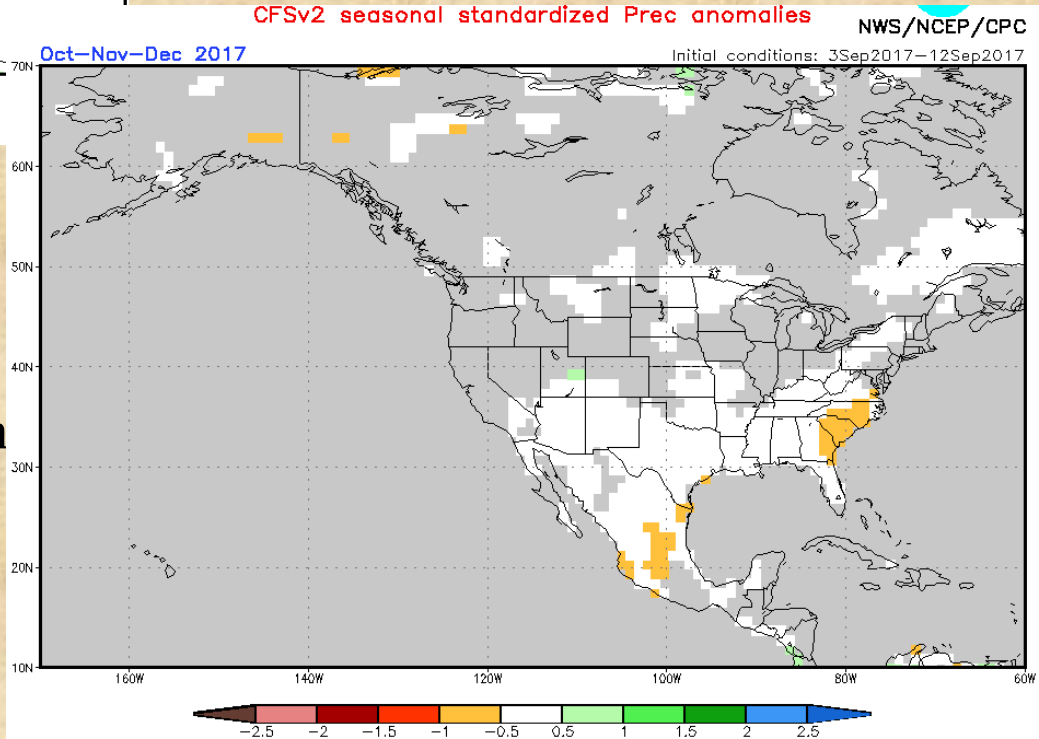


CFSv2 forecasts for October-December 2017

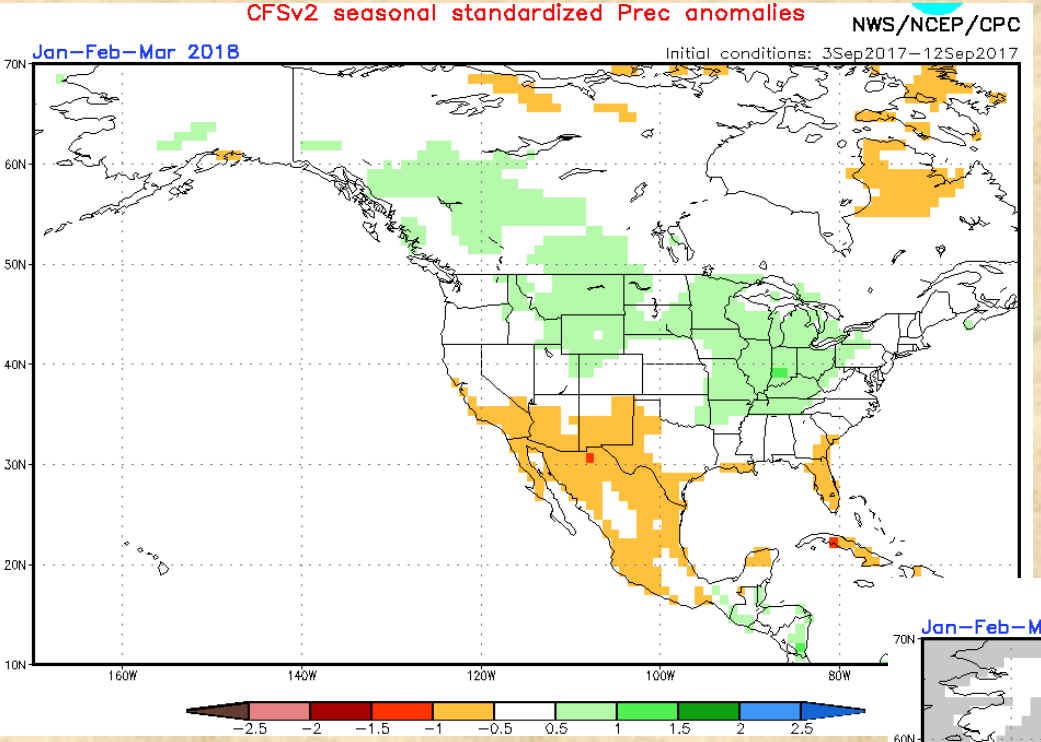


http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/

OND 2017 (top) shows a slight tilt towards a wet outcome from NE UT into NW CO. A small fraction of this even survives the skill mask in eastern UT (right).

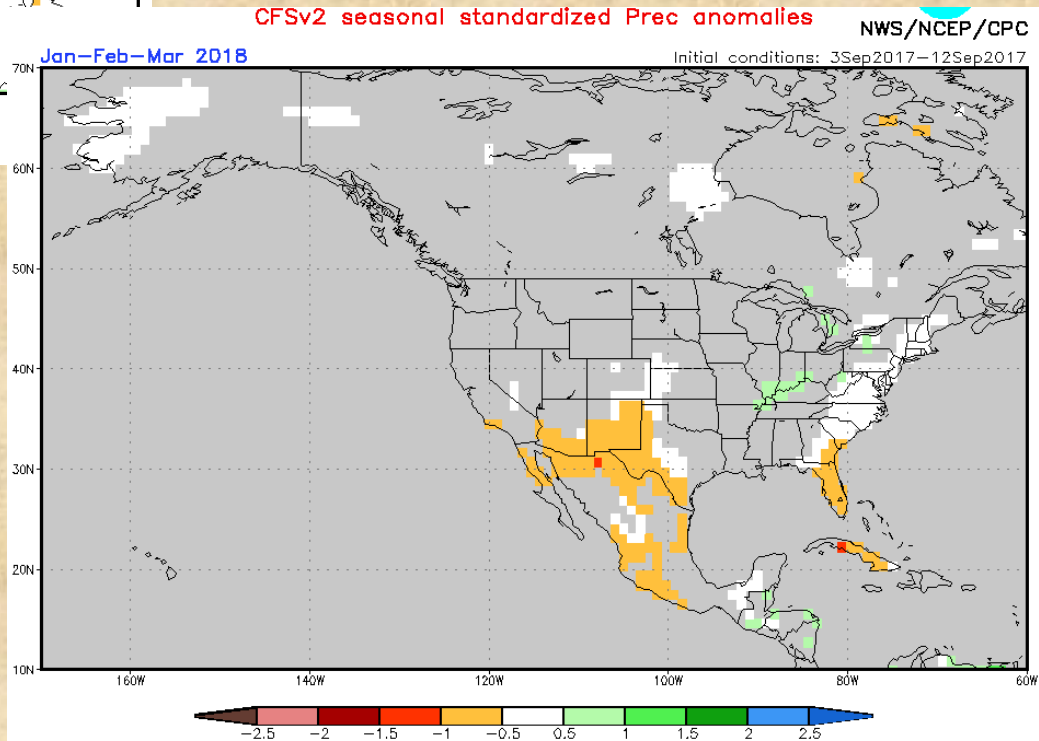


CFSv2 forecasts for January-March 2018

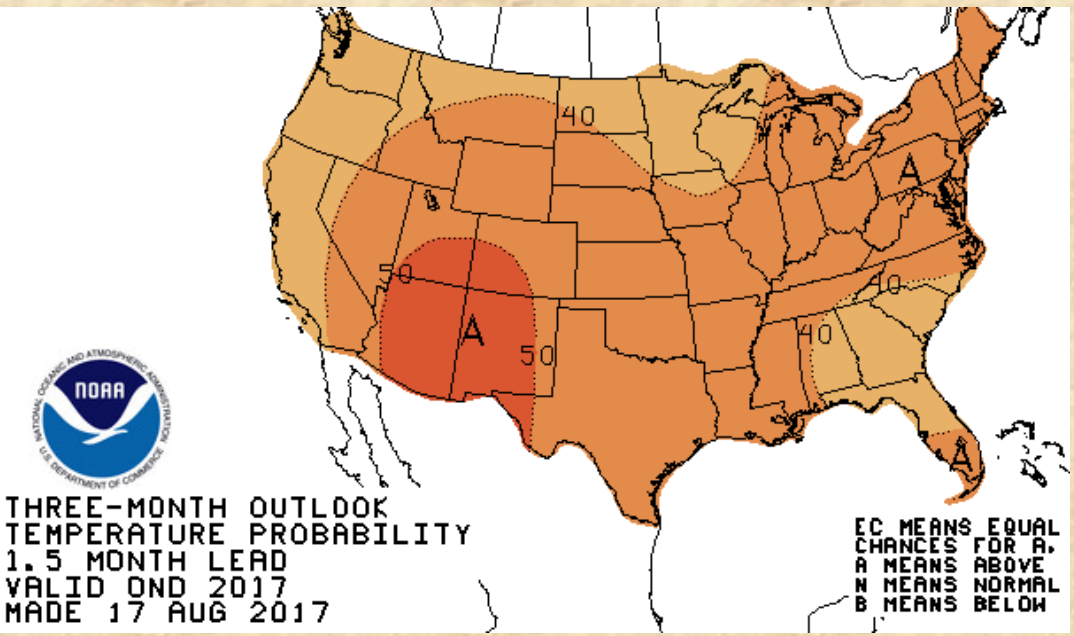


http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/

JFM 2018 (top) shows a decent tilt towards a wet outcome over NW CO. None of this survives the skill mask in eastern UT (right).

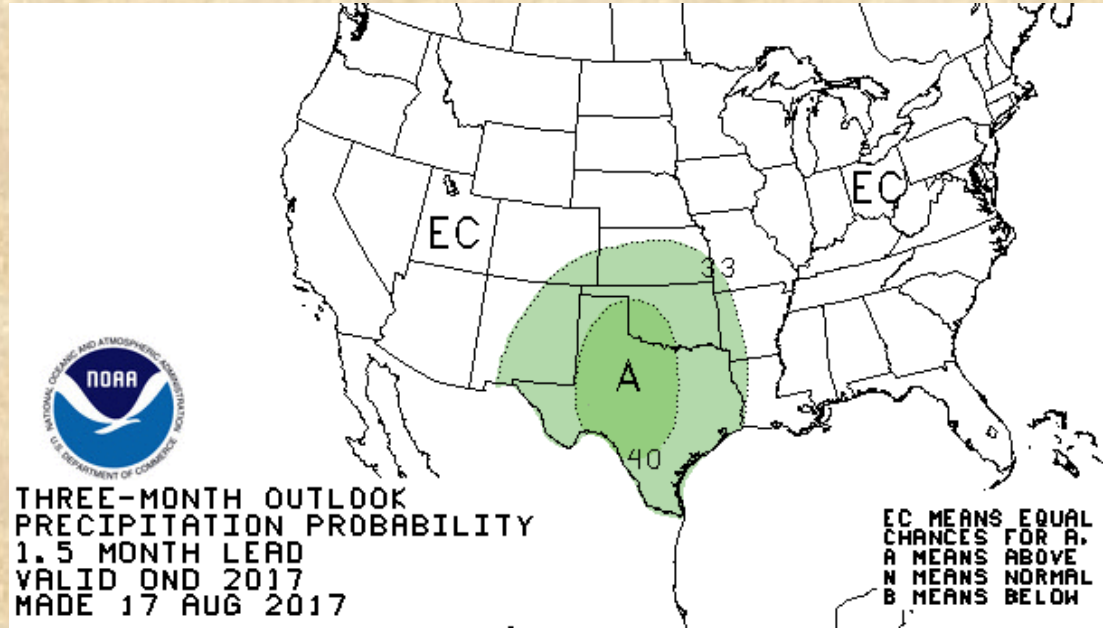


Climate Prediction Center Forecasts (OND)

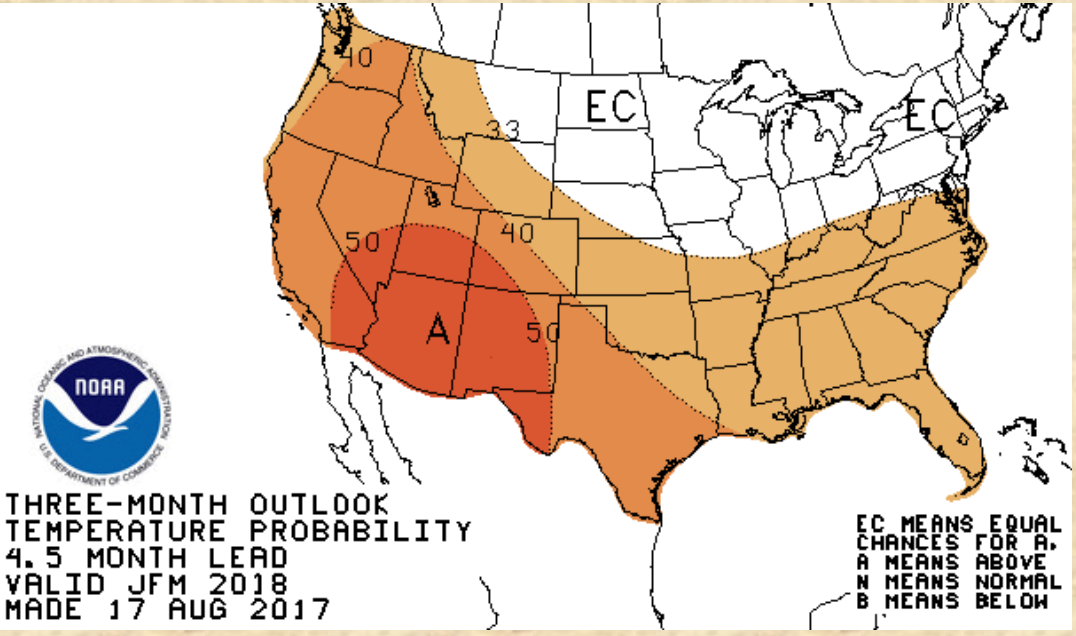


http://www.cpc.ncep.noaa.gov/products/predictions/

The latest CPC late fall temperature forecast (top left) is warm for the whole country, including CO, while the precipitation forecast is mostly 'EC' for our state, with tentalizing wetness lurking to our south and east (right). Given the lack of anticipated ENSO-forcing, both forecasts are mostly based on long-term trends.



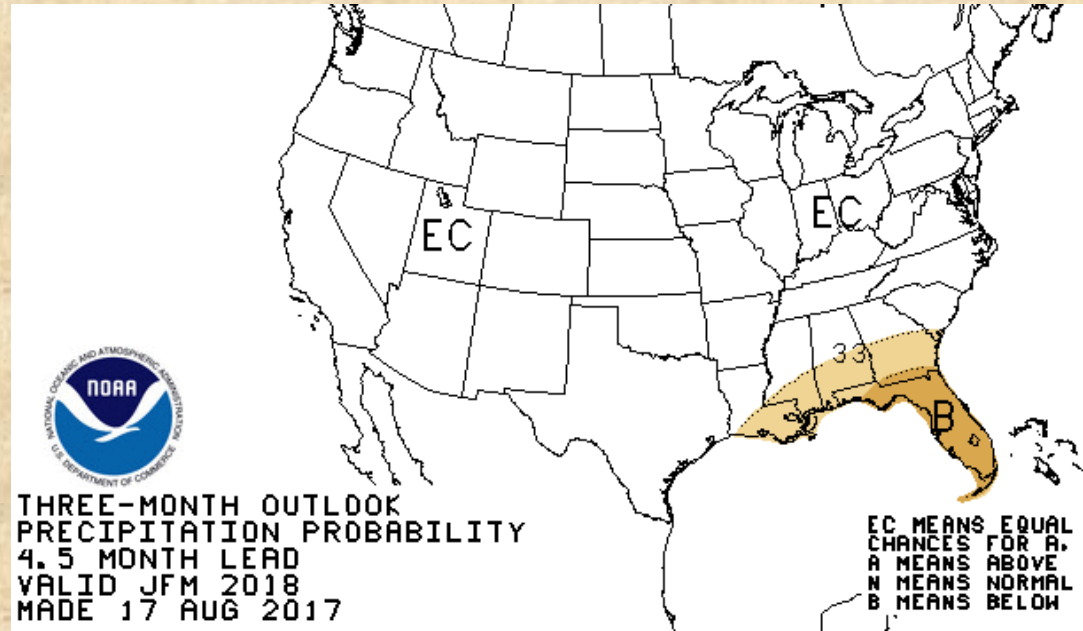
Climate Prediction Center Forecasts (JFM)



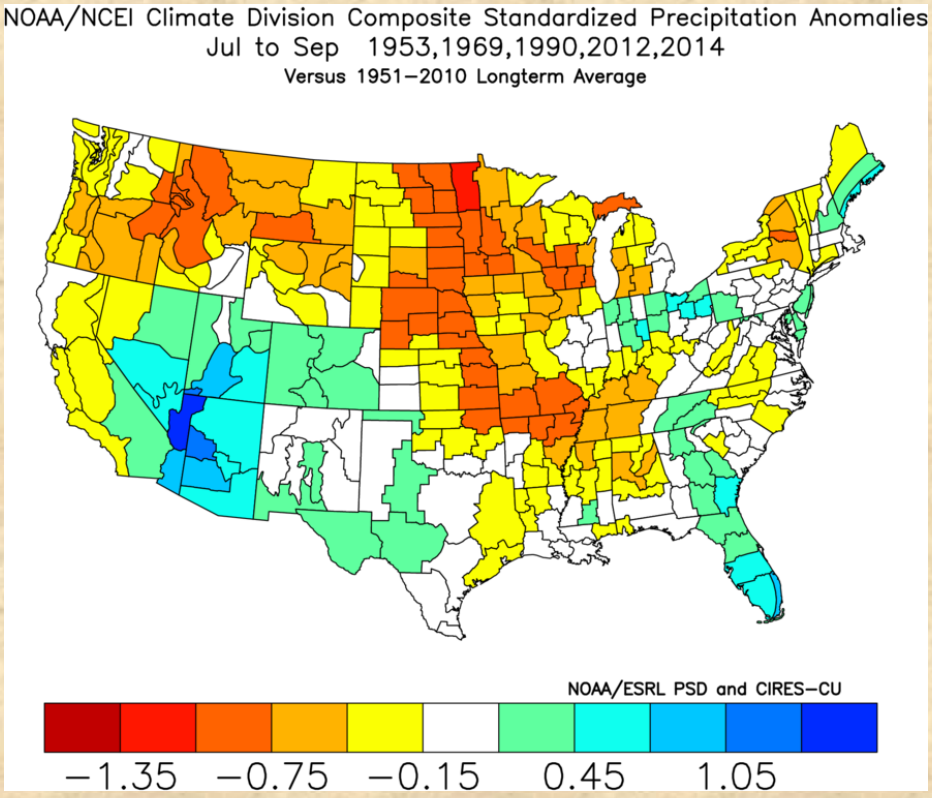
http://www.cpc.ncep.noaa.gov/products/predictions/

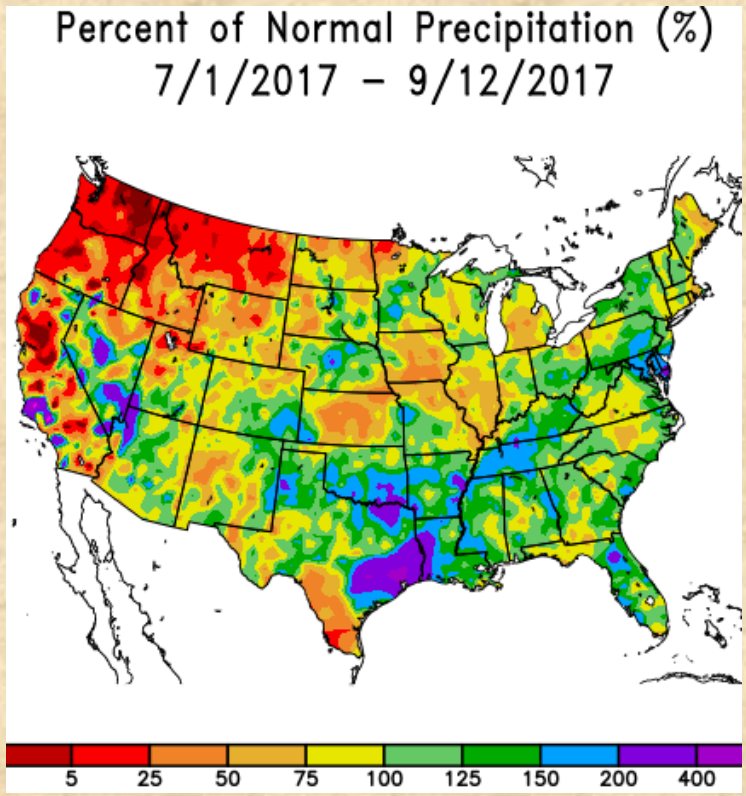
The latest CPC late winter temperature forecast (top left) is not quite as warm for the whole country, but still for CO, while the precipitation forecast (right) is 'EC'. Both forecasts are mostly based on long-term trends.

These forecasts will be updated in one week, may lean more towards La Niña



July set of analogues based on similar MEI rankings&evolution (revisited)



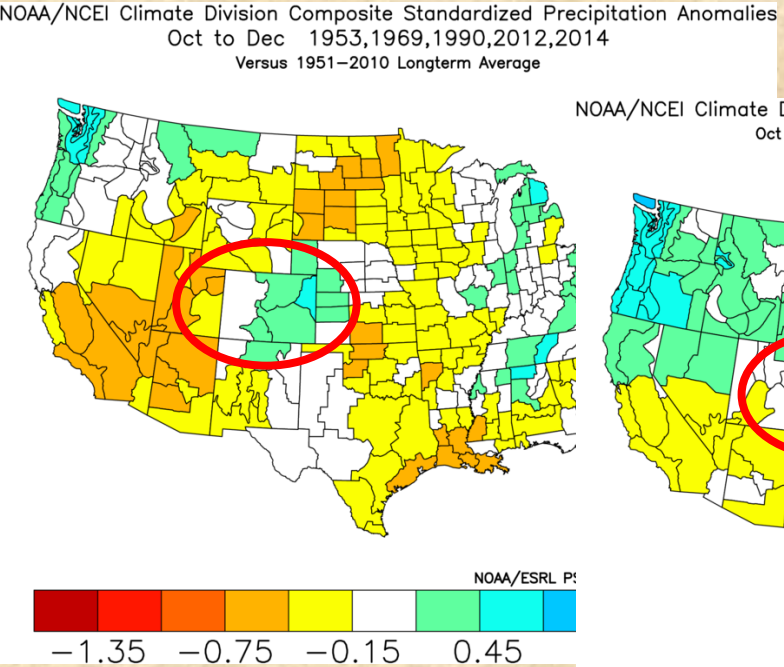


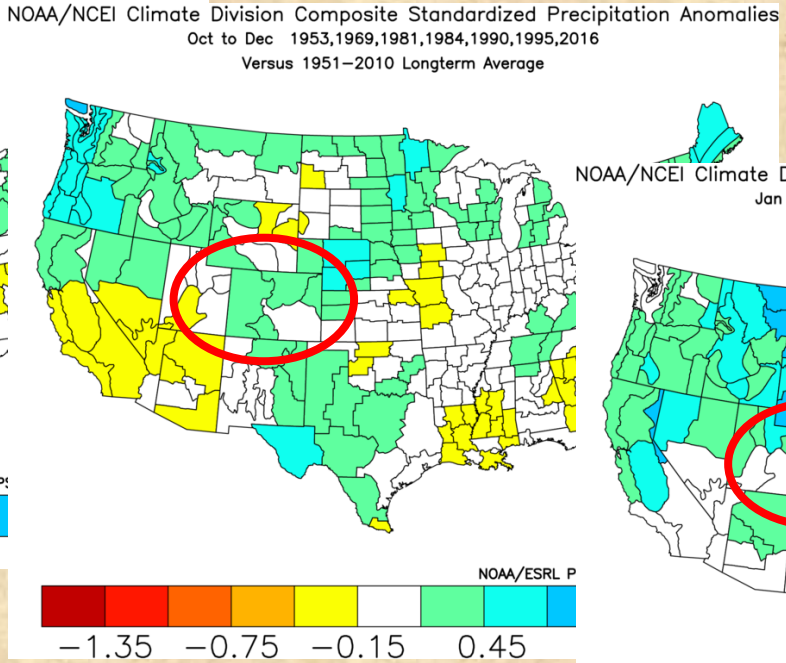
All five of the analogues showed a peak in the MEI in late spring or early summer, followed by a decline to (warm-)neutral conditions by end of year.

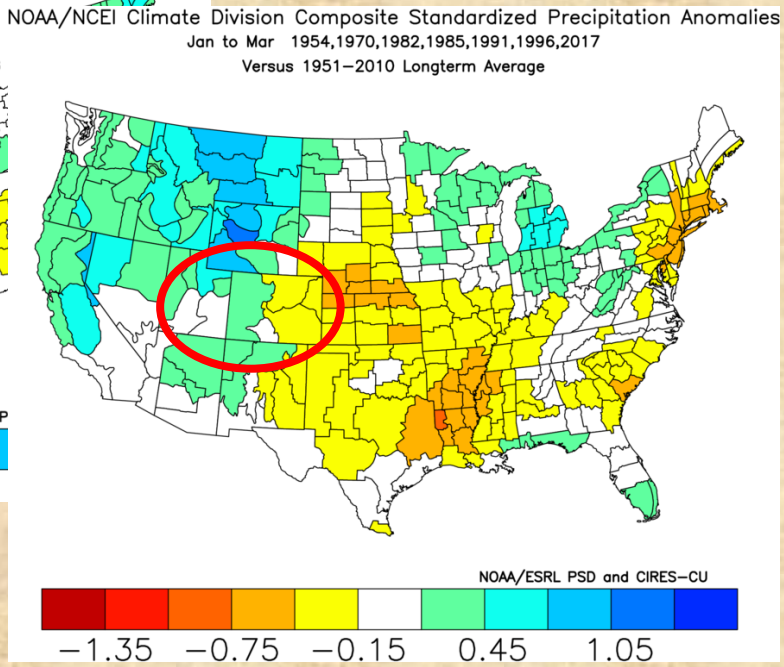
July-September (left) looked modestly encouraging for all of CO, with drought conditions lurking to the north and east. Overall not bad (no, this composite did not anticipate Harvey).

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

More analogues for fall and winter



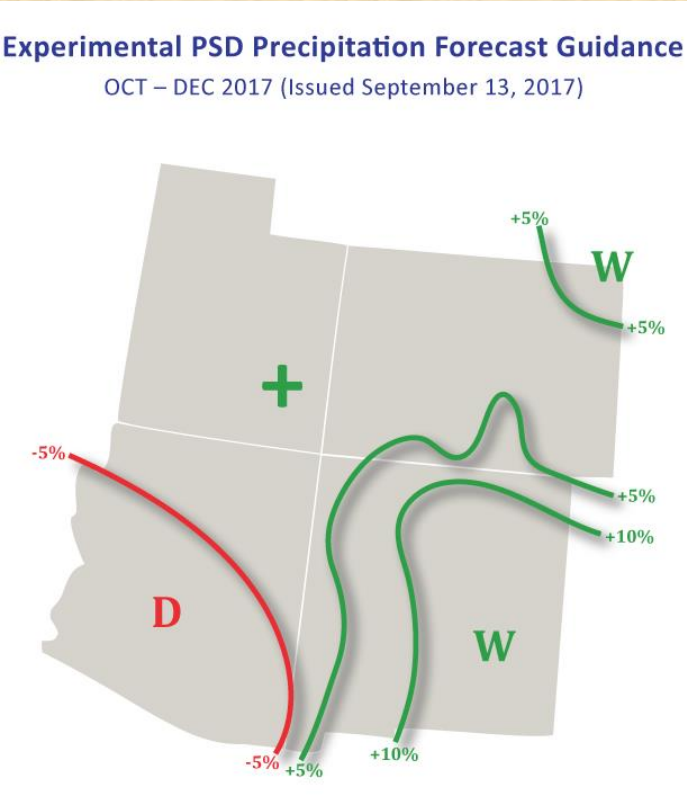


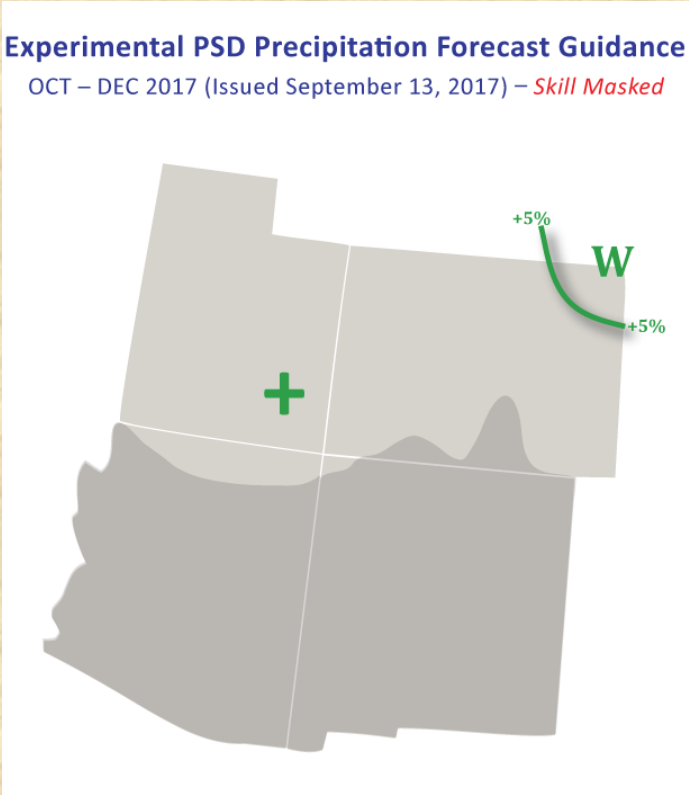


Original October-December composite (left) shifted wetter odds back to eastern CO. New composites (middle and right) refer to closer analog situations to the July-August MEI and its tendency – they show continued weak anomalies for our state, resembling La Niña in JFM.

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

Statistical Outlook October-December 2017

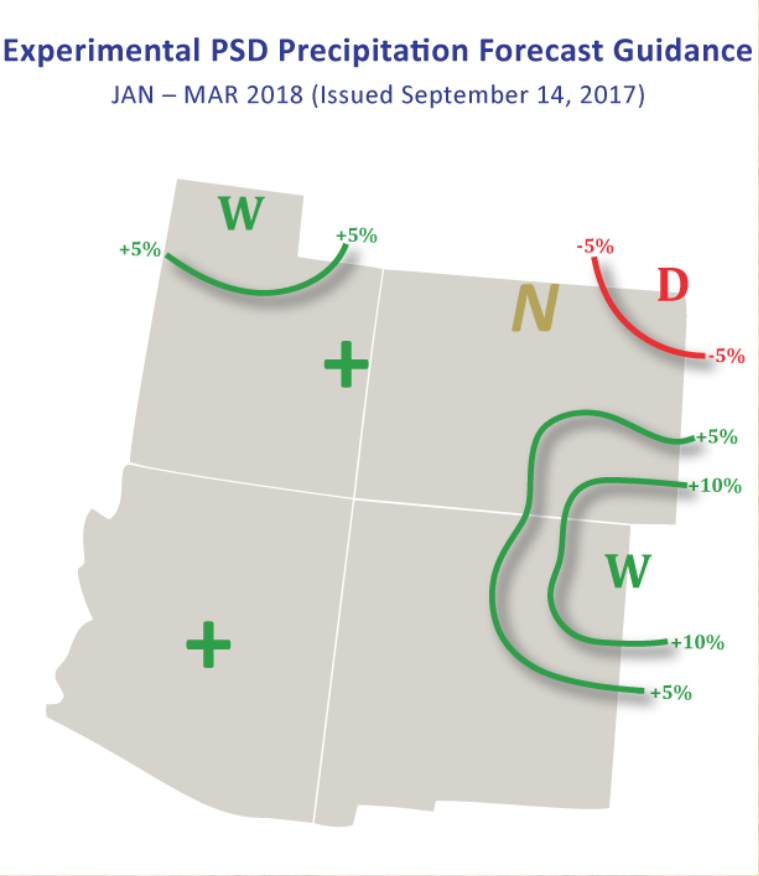


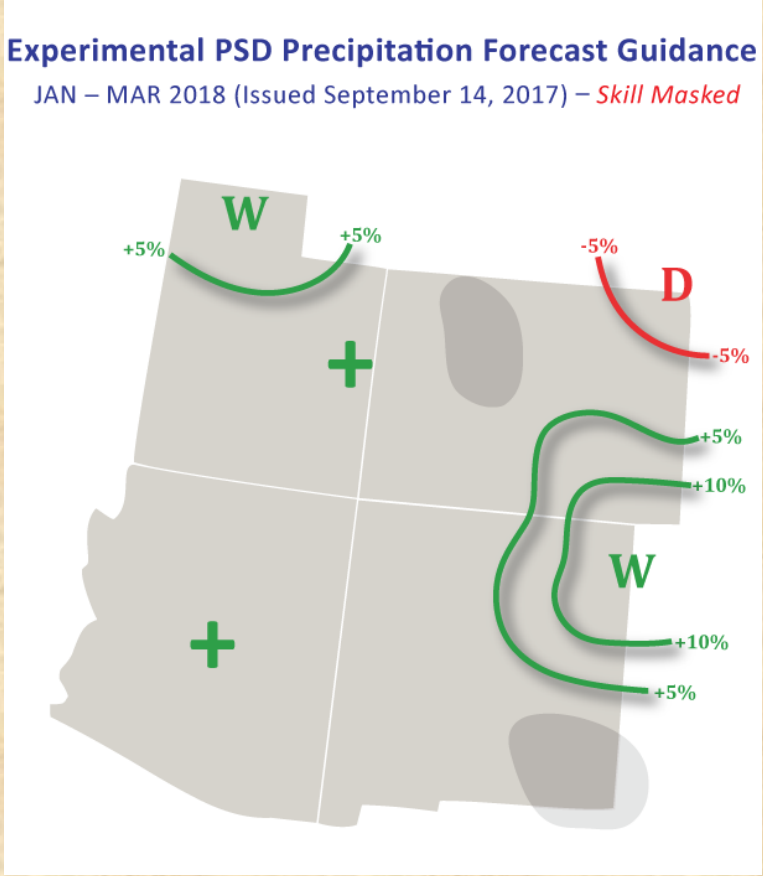


The 2017 fall outlook is either neutral or leaning towards wetter than average conditions in Colorado (left), most favorable towards Nebraska. Applying the skill mask (right) removes a lot of color from our neighboring states to the south, but hardly affects our state.

Perhaps not a big surprise that my statistical forecast "matches" the July-based analogue in particular.

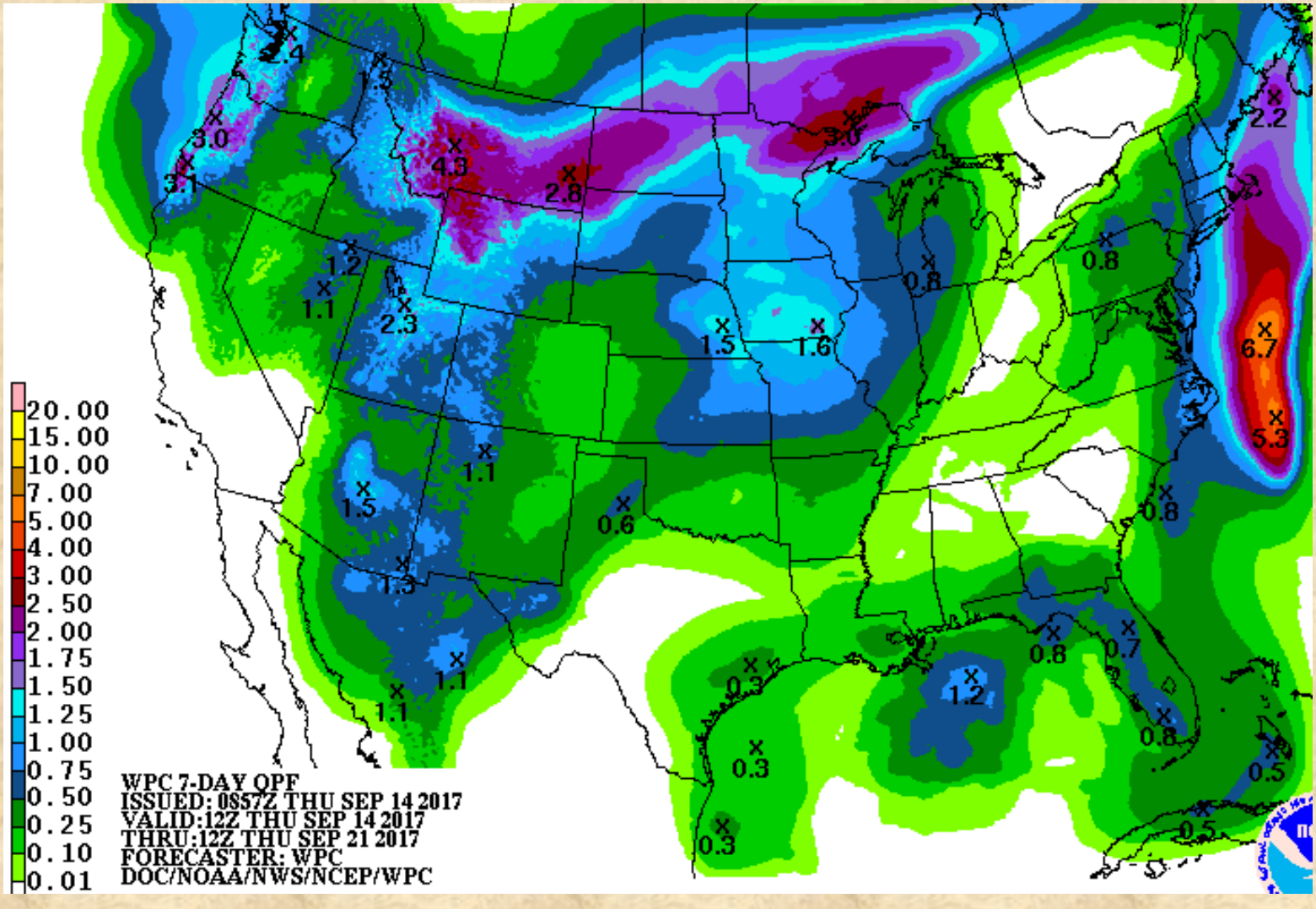
Statistical Outlook January-March 2018





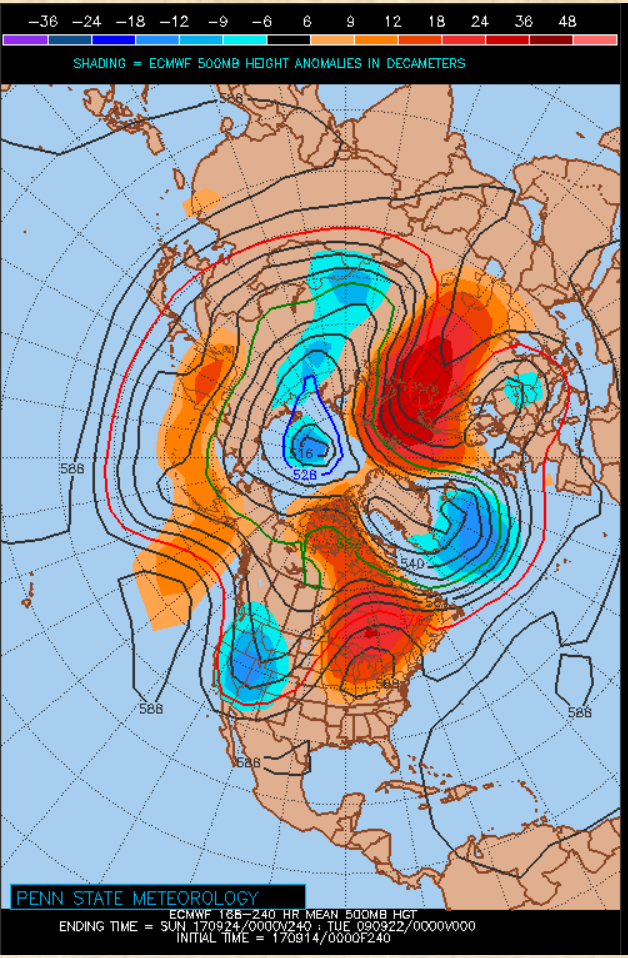
This early winter outlook (left) is neutral over northern mountains, otherwise either wet (especially in SE), or dry (towards Nebraska). Applying the skill mask (right) removes the northern mountains from consideration, otherwise no change.

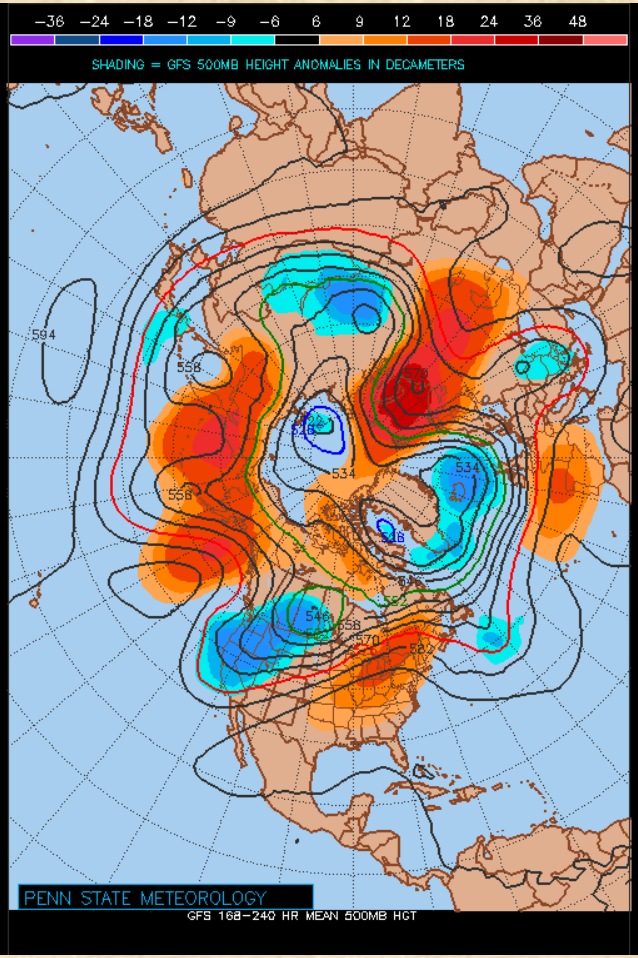
What can we expect in next seven days?

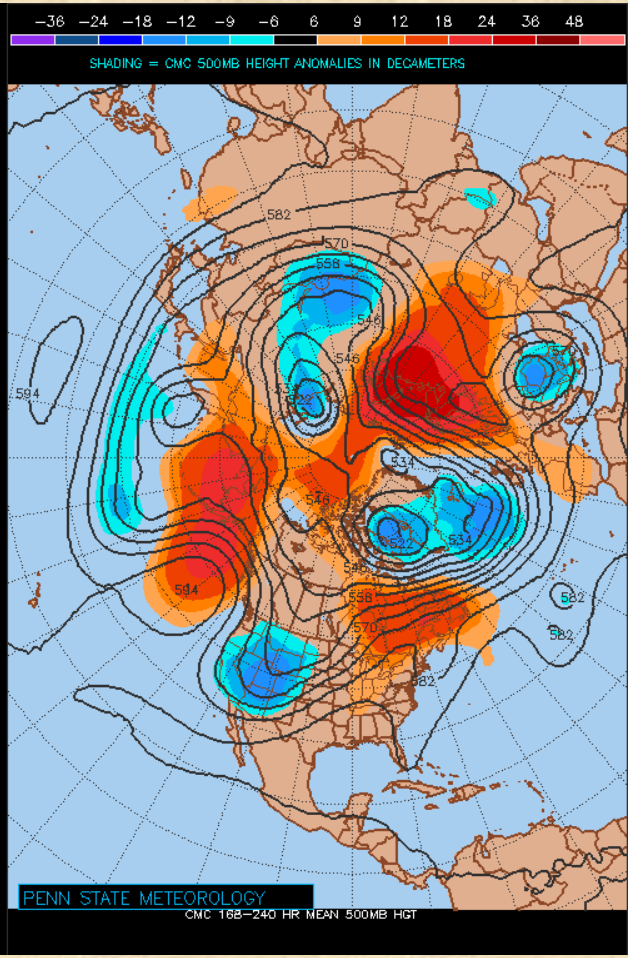


Big storm that passes thru one state to our north – if not drought-breaking, definitely a nice reversal from drought conditions all summer long in MT. Highest elevations in CO might see first snow of season. José is currently kept offshore…

What can we expect next week (7-10 days out)?

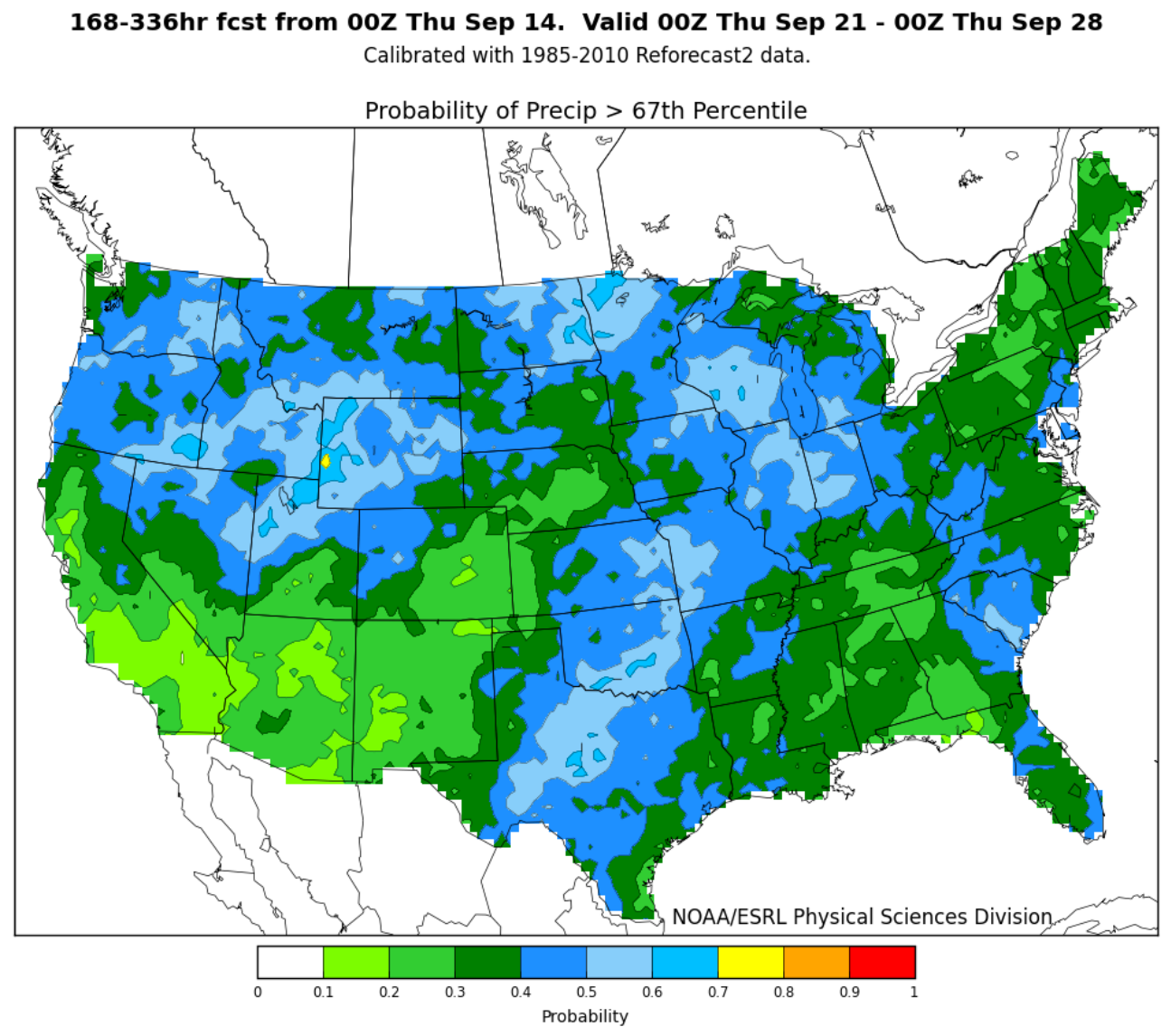






ECMWF (left), GFS (middle,) and CMC (right) show a trough of low pressure to our west, with ridging northeast of us. Not bad, definitely a reversal from high pressure ridging to our west. This is more favorable to western CO than over the eastern plains, and should bring first snow of the season to higher elevations before end of month, about middle of next week.

What can we expect during Week 2?



Continued chances for above-normal moisture in western CO/below-normal for us, perhaps least favored in SE CO.

Executive Summary (14 September 2017)

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- **A weak La Niña snuck in last fall, behaved as if it were much bigger, and was briefly replaced by El Niño-like conditions in late spring. Can we do this again? Apparently, yes - at least the La Niña part!**
- **Experimental forecast guidance for late summer verified reasonably well (eastern plains wet/dry conditions to our west). New forecasts for fall&winter are mostly neutral/with perhaps a hint of wetness in NE CO during fall and in SE CO during winter. *Analogue forecasts corroborate a "vanilla-flavored" outlook.***
- **Forecasts from CPC are mostly 'EC', have not caught up with La Niña thinking just yet. Coupled model forecasts are 'EC' in fall, favor northern mountains in winter, consistent with La Niña scenario.**
- **We are currently undergoing a big change in circulation regime with trough of low pressure getting established over western US to put an end to many fires across the region. *Some model runs carve off a cutoff-low to give us some decent moisture, too, but that is currently not the most likely outcome.***
- **BOTTOMLINE: Here we go again, sliding back into La Niña (officially declared odds as of this morning: 55-60%), with a neutral PDO running less interference than last winter. Typical impacts would include more mountain snow during winter, more windstorms along the Front Range, and wide swings in temperature. Final tally (1 April SWE) will be handicapped by degree of dryness in early season.**