Earth System Research Laboratory
Physical Sciences Division

CIRES
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Colorado WATF,
20 January 2016
Denver

Seasonal Outlook for Colorado

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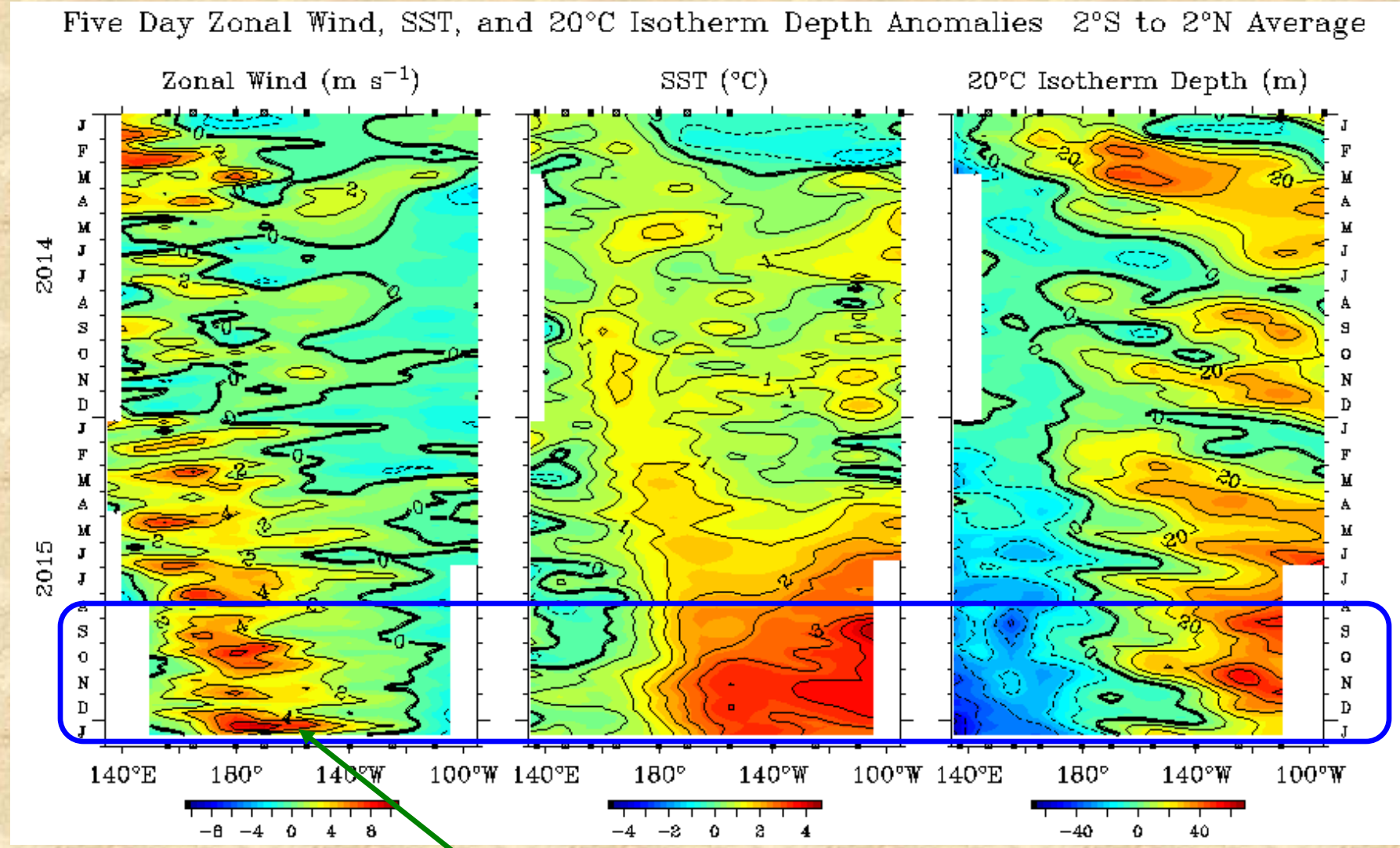
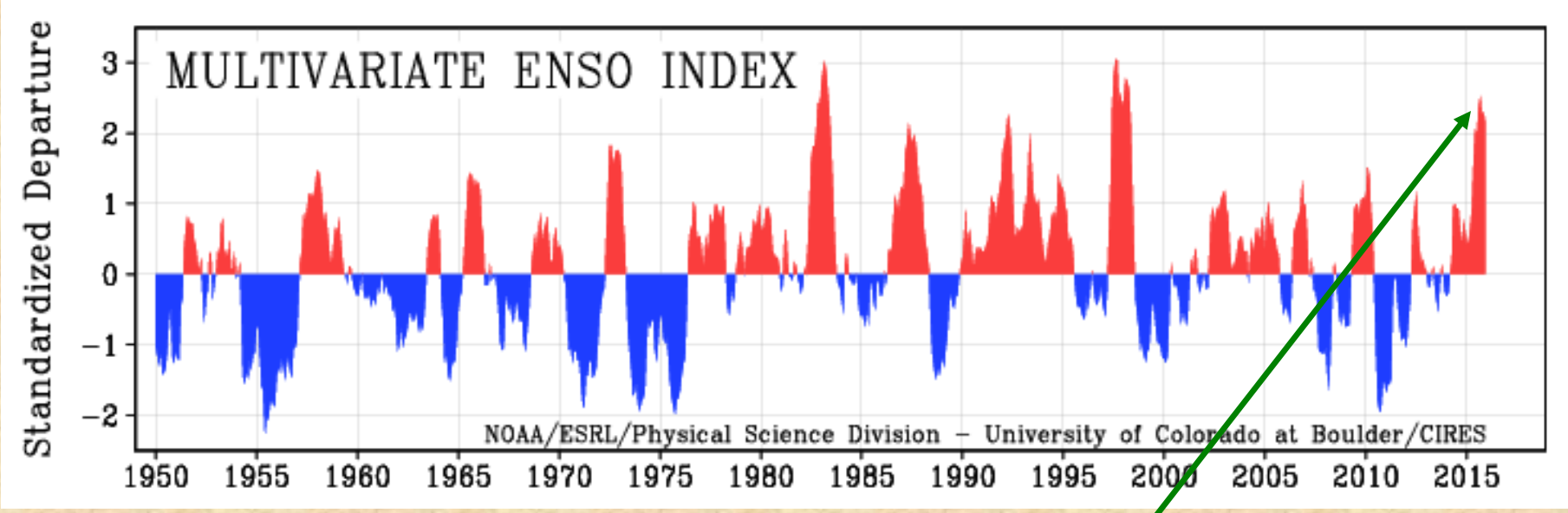
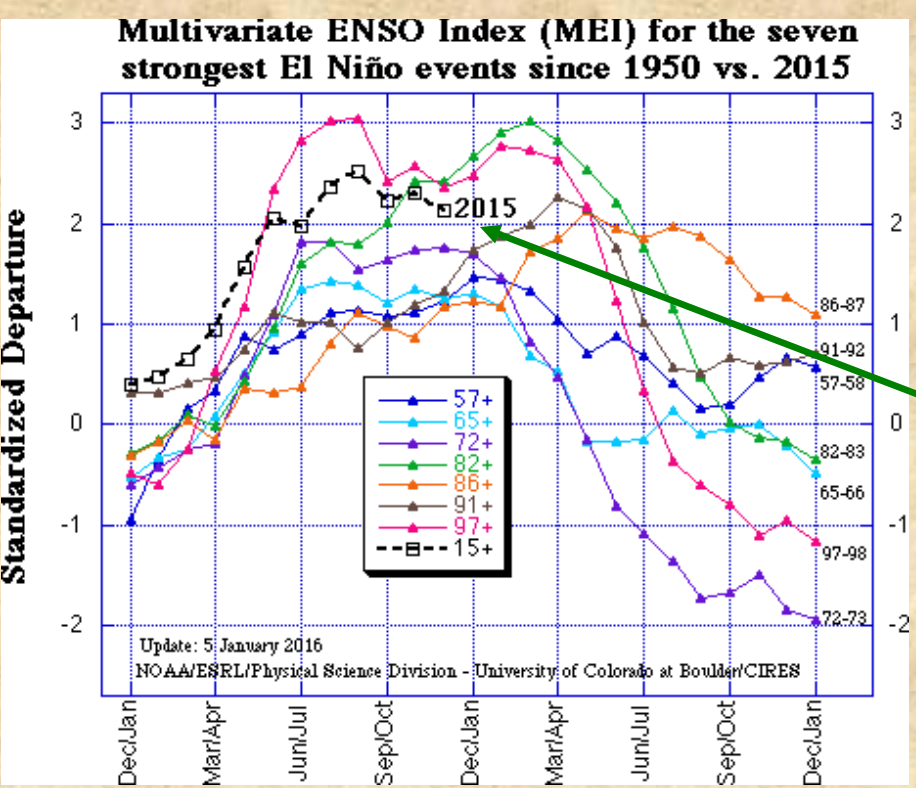
- ***Our Big Boy El Ninõ is alive and well?!***
- **Impacts so far & expected into mid-2016 (precip & SWE)**
- **CPC forecasts into late spring 2016**
- **Seasonal late winter forecast guidance for precipitation**
- **Executive Summary**



The last 4-5 months have seen SST anomalies in excess of +3C from 100W to about 160W (middle), solidifying 'Big Boy' El Niño status, most recently re-energized thru the strongest westerly wind anomalies near the dateline since 1997 (left). All in all, this wind event appears to have added renewed vigor to the El Niño of 2014-16...

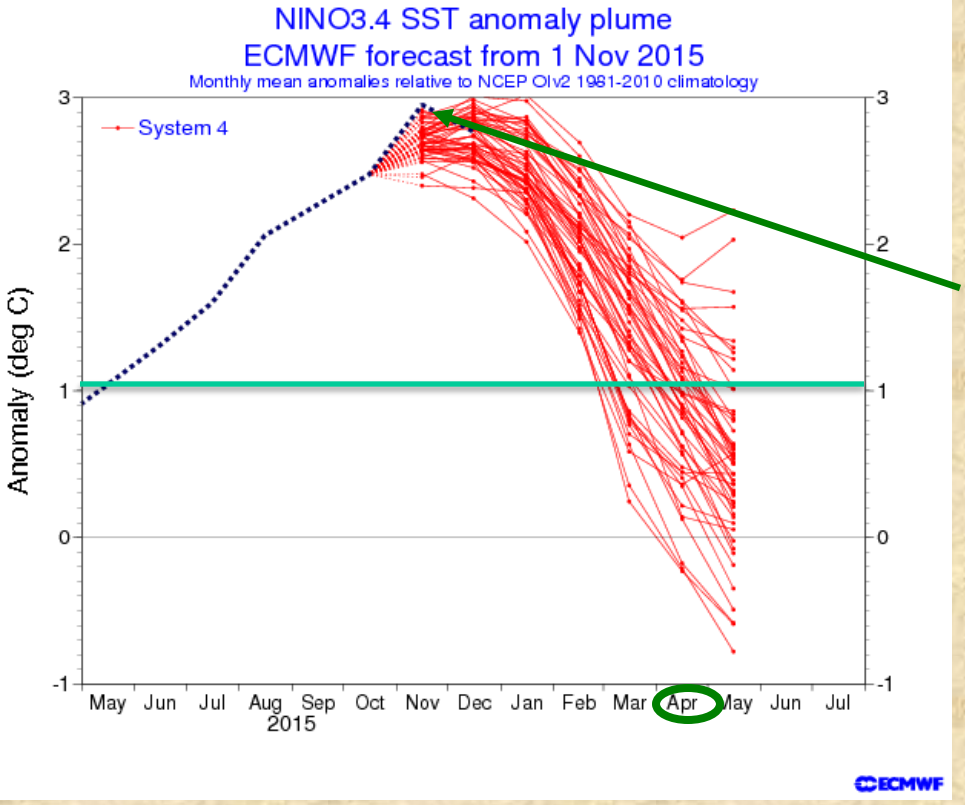
http://www.pmel.noaa.gov/tao/jsdisplay/index.html



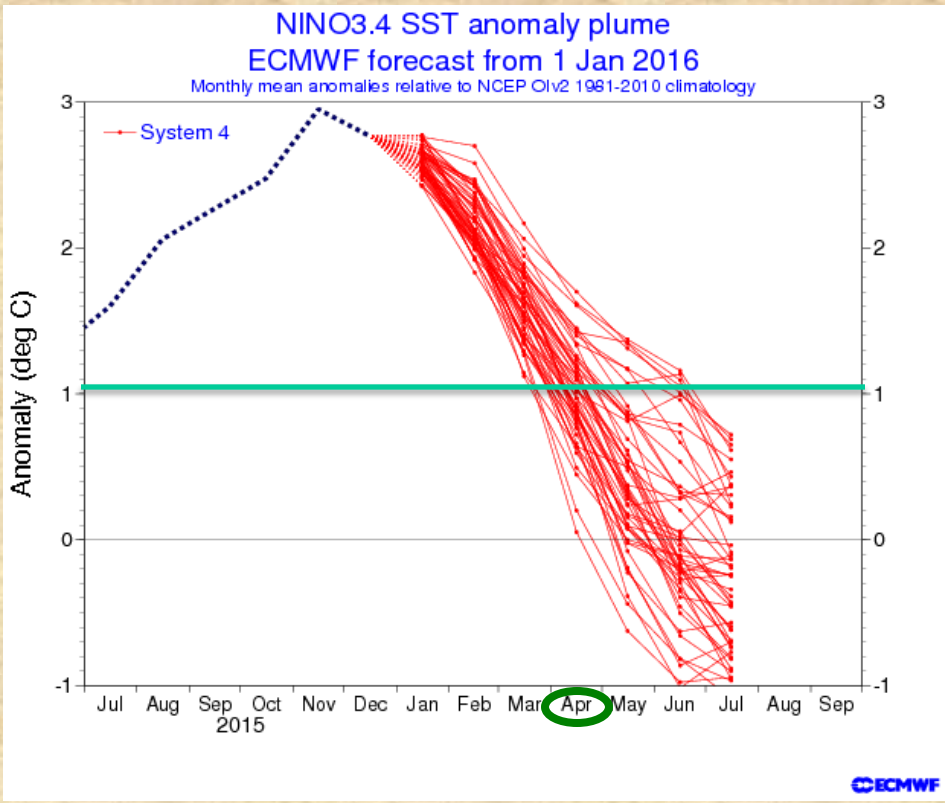


The **MEI** monitors ENSO based on all observed fields over the tropical Pacific (pressure, wind, temperatures, cloudiness). It is the 1st combined Principal Component, normalized with respect to the season. **The current El Niño peaked in Aug/Sep at +2.53, the largest MEI value since 1998**. The latest update remains 3rd strongest since 1950 for this time of year, and continues to mimic **1997-98**. Thus, a 2nd peak in next few months would not be surprising…

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



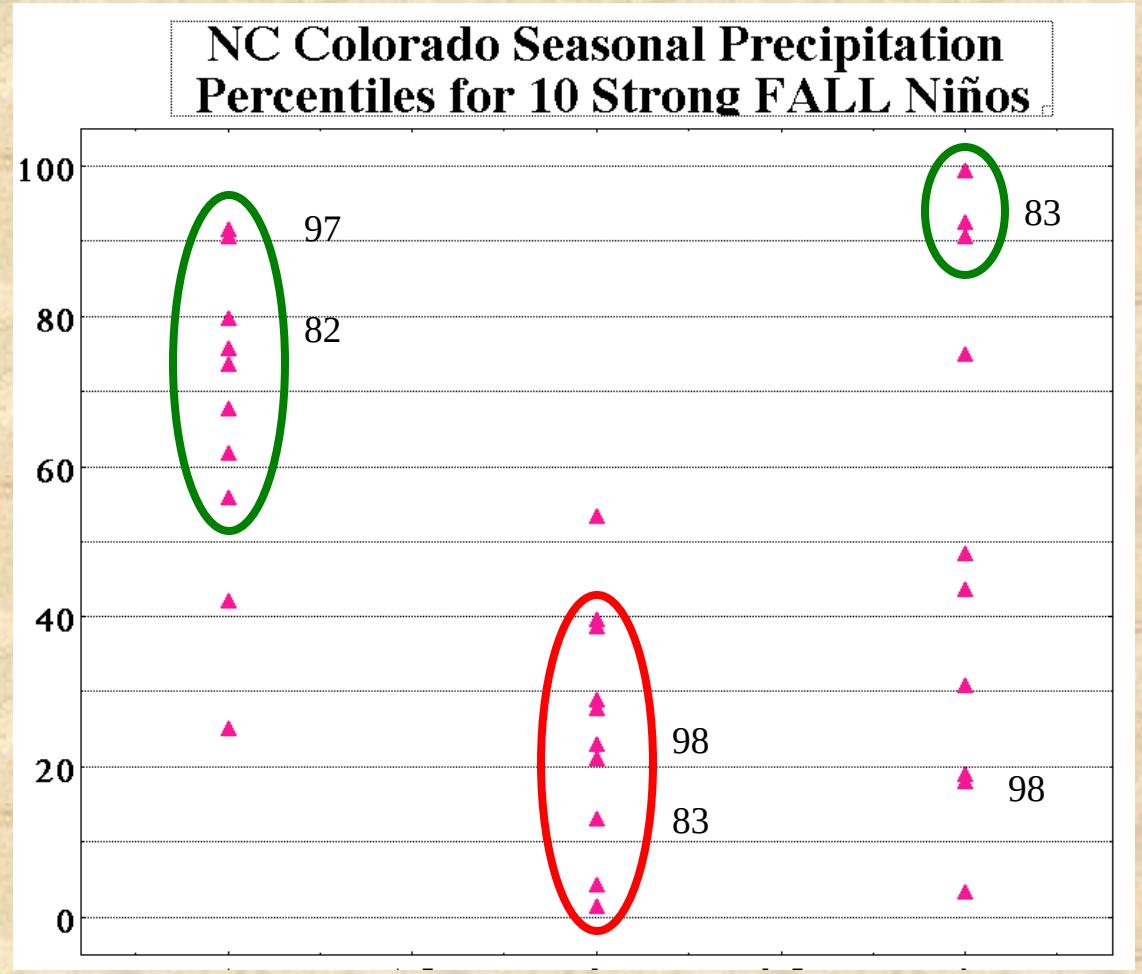
The ECMWF November 2015 forecast (left) showed a peak in December around +2.8˚ C. The observed (blue) Niño 3.4 SST ended up on the high end of the plume, especially in November. The range of possible outcomes by May reflected the typical northern spring uncertainties…
http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/seasonal_range_forecast/

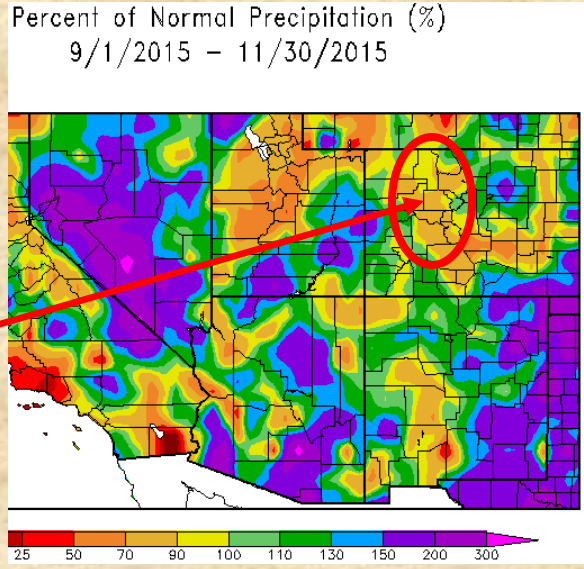


The updated ECMWF forecast (right) shows a reduced range of possible outcomes, but the most likely transition month to anomalies under +1C (moderate) remains April. By July, the majority of ensemble members has dropped below 0C.

New IRI plume similar (not shown) - a small majority of models switches to La Niña by early fall. FWIW, CPC's CFSv2 keeps it neutral.

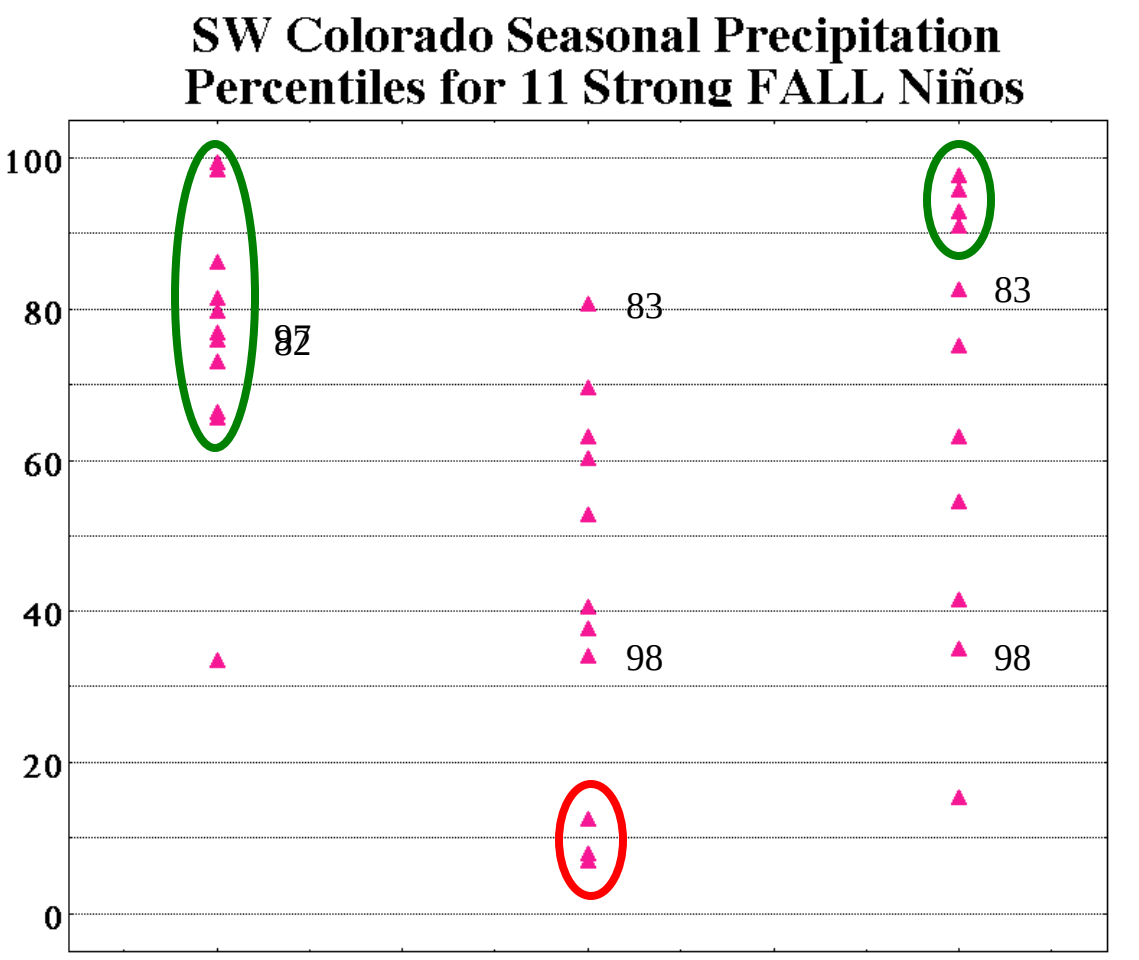
A closer look at the Upper CO Basin

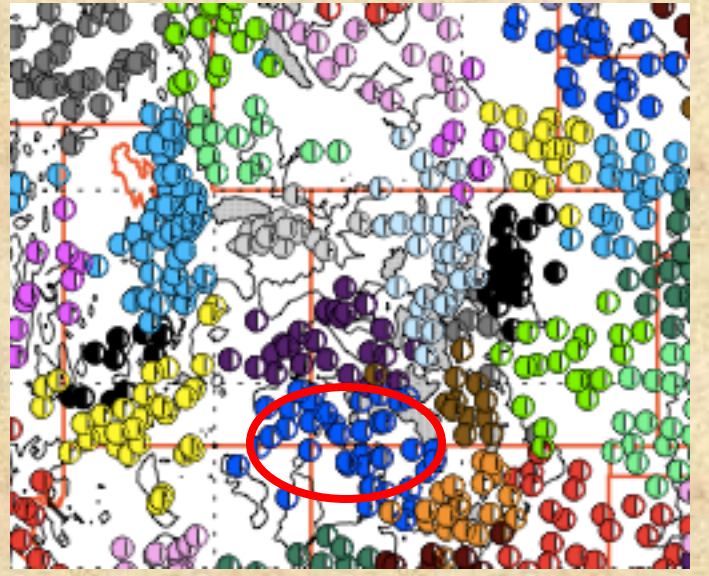


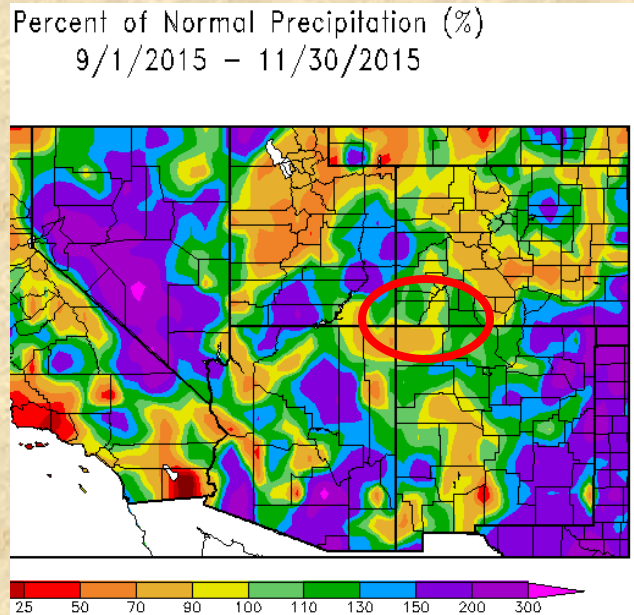


NC CO is favored during the Fall (8 of 10 > median – *2015 was on the low end*), strongly handicapped during Winter (9 of 10 under 40%ile – *on the high end so far*), and all over the place during spring, including three of the wettest ones.

A closer look at the Upper CO Basin

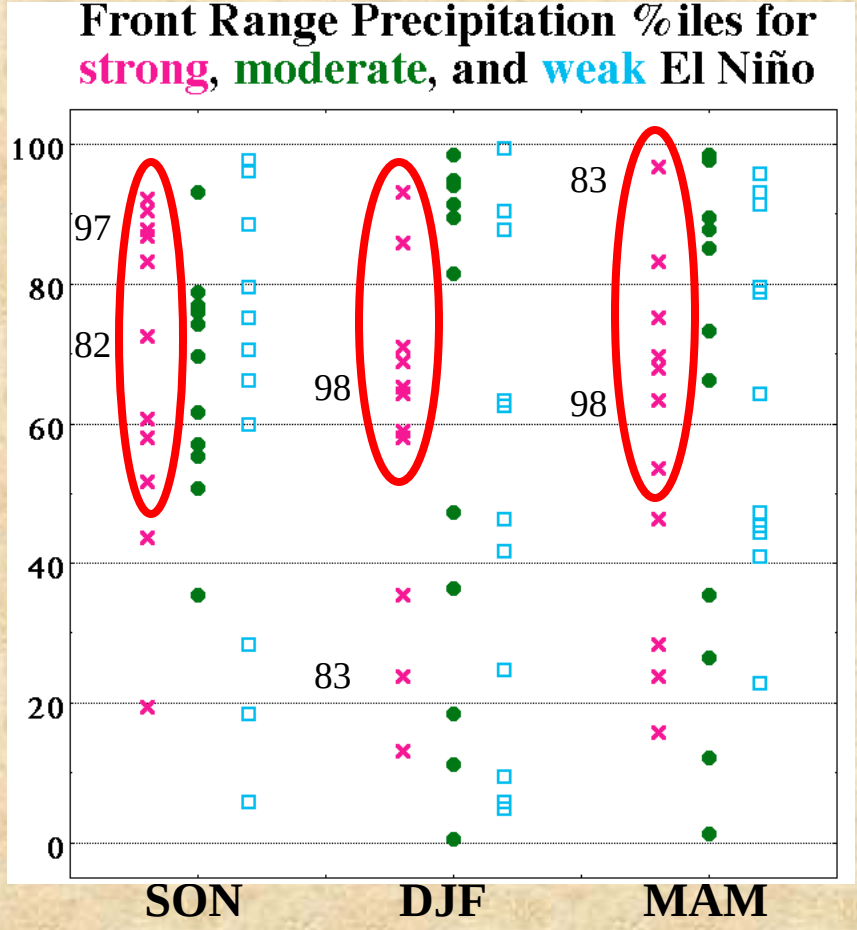


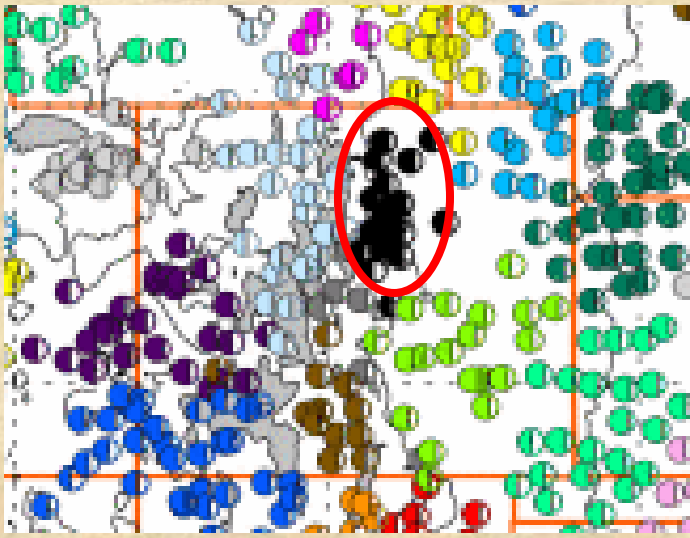


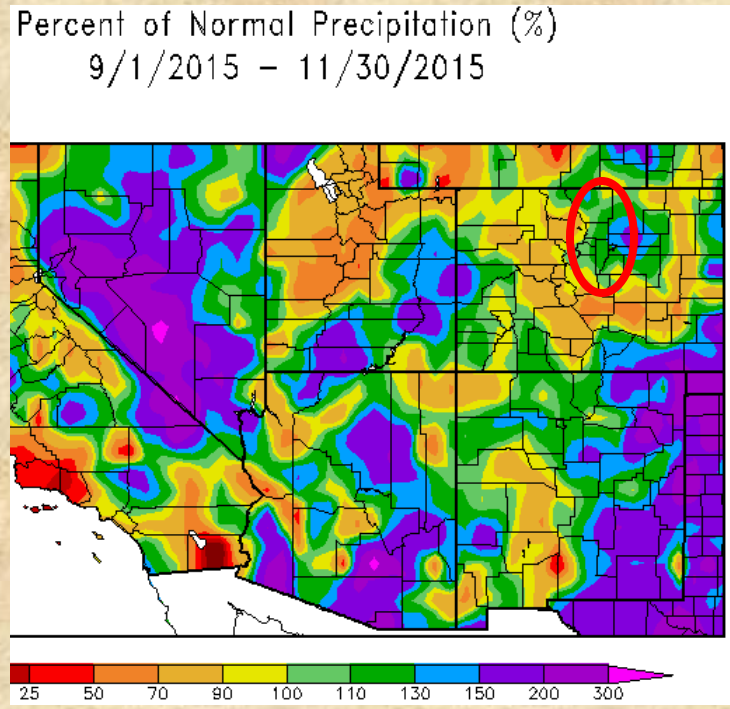


SW CO is also favored during Fall under strong El Niño (10 of 11 > 60%ile – *2015 low end, but wetter than NC CO*), Winter is much more benign than to the north *(2015-16 so far above average)*, and modestly wet during Spring (4* in top 10%ile).

A closer look at our neck of the woods (1901-2011)

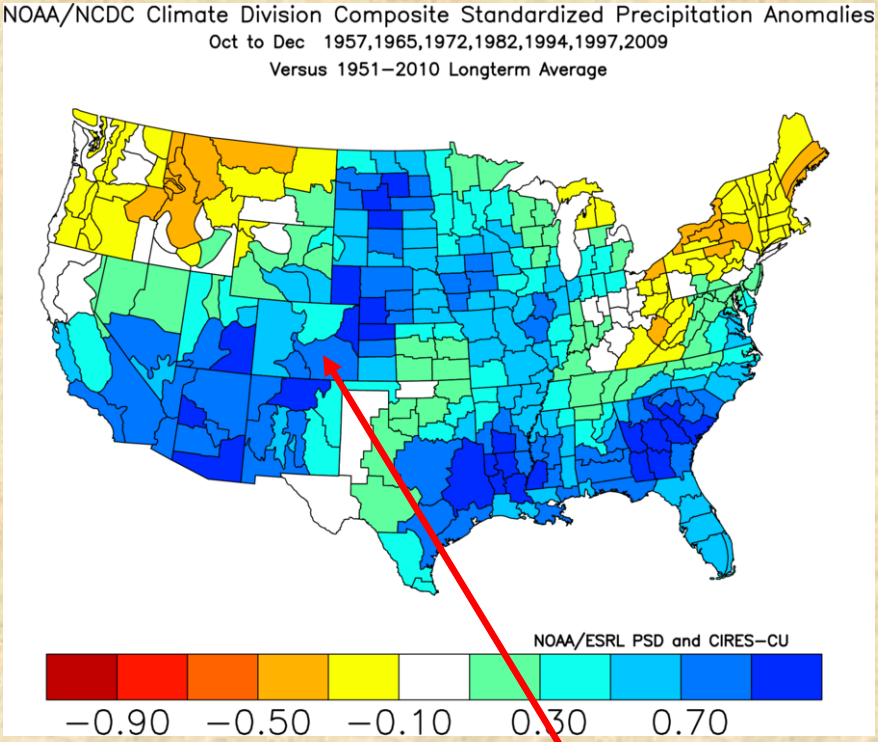


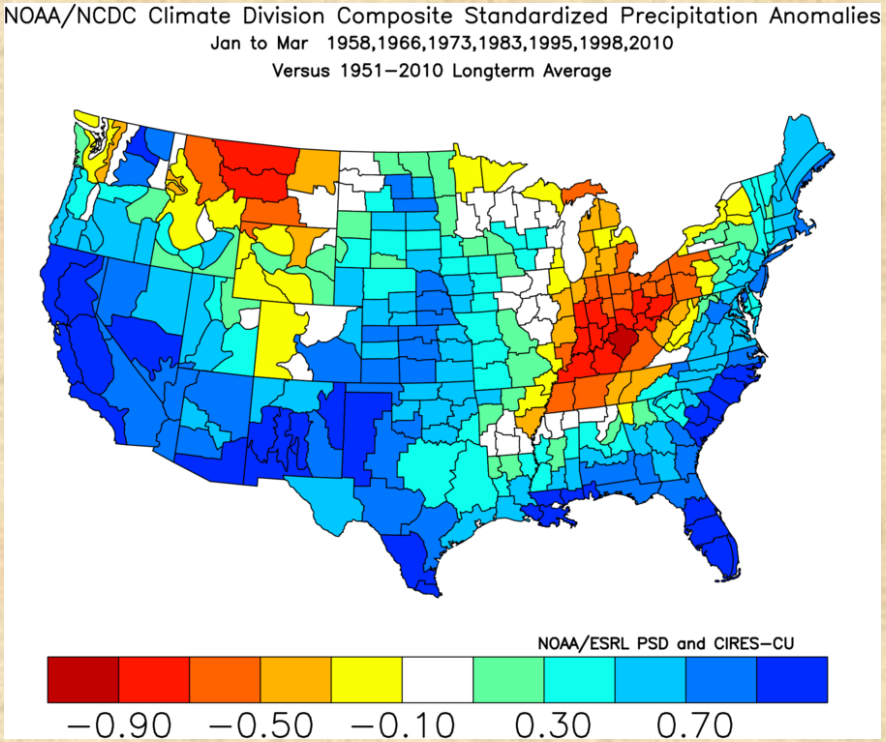


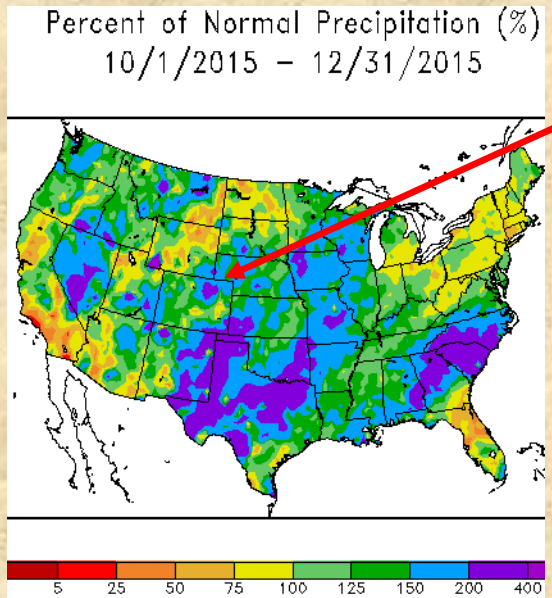


The northern Front Range is more likely to be wet than dry in all three seasons, especially during fall (9 out of 11 above median), but even in winter (8 of 11), and spring (7 of 11). ***After a dry start in September, October-November were wet enough to pull the seasonal total above the median. This wet trend has continued into the first half of winter (DJF).***

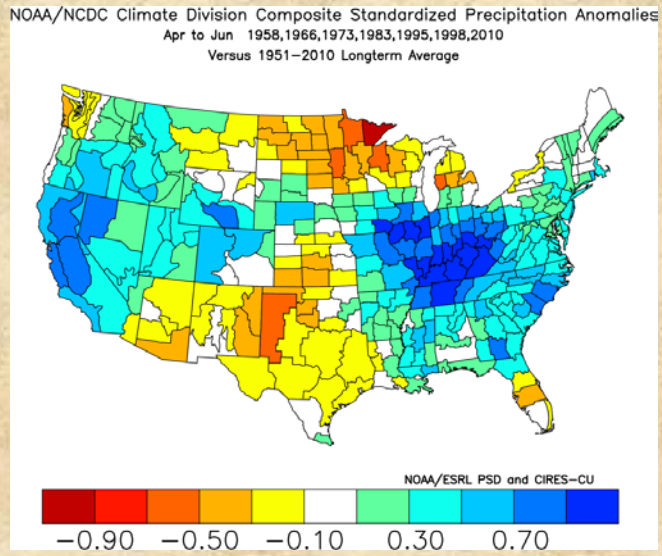
OND and JFM (strong Niño analogues discussed in November)







Oct-Dec (top left) ended up mostly wet in CO, consistent with composite expectations for our state. *Late winter (JFM; top right) looks encouraging for southeastern CO. Late spring (AMJ; right) keeps moisture right over our state.*



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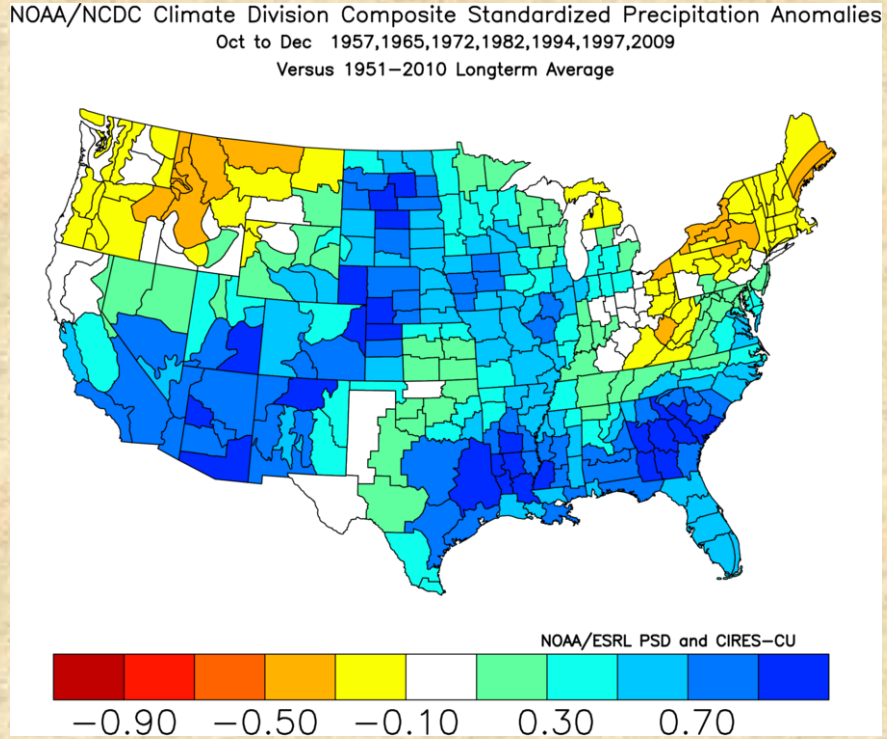

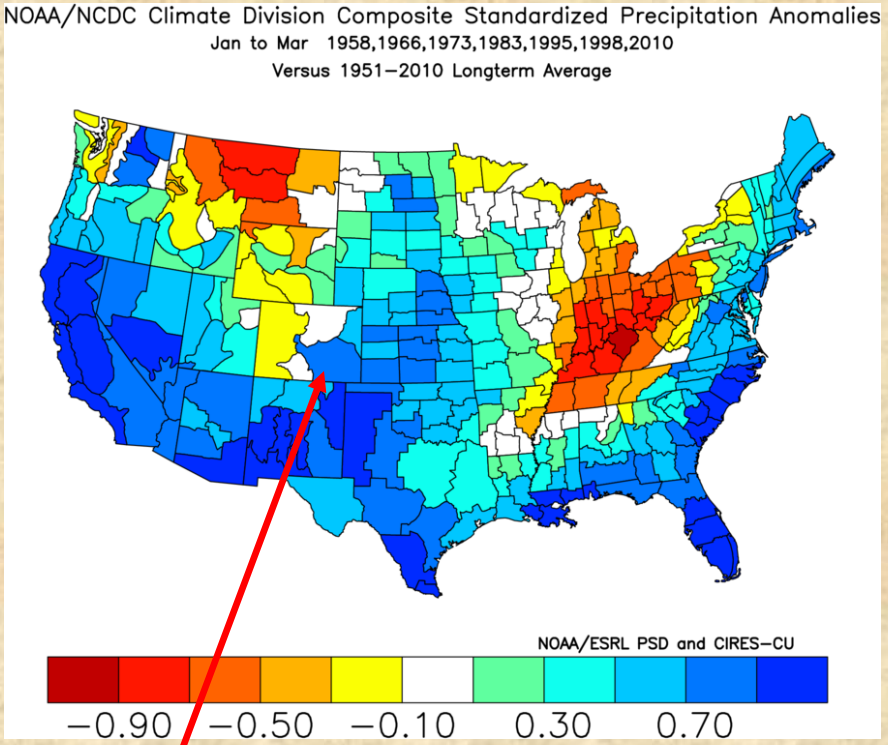

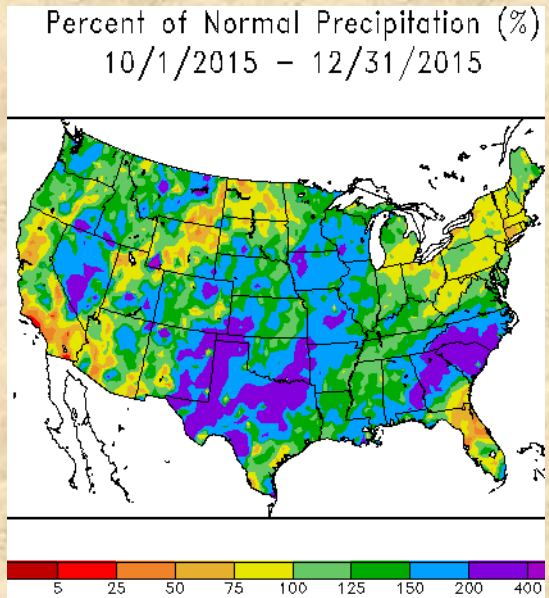

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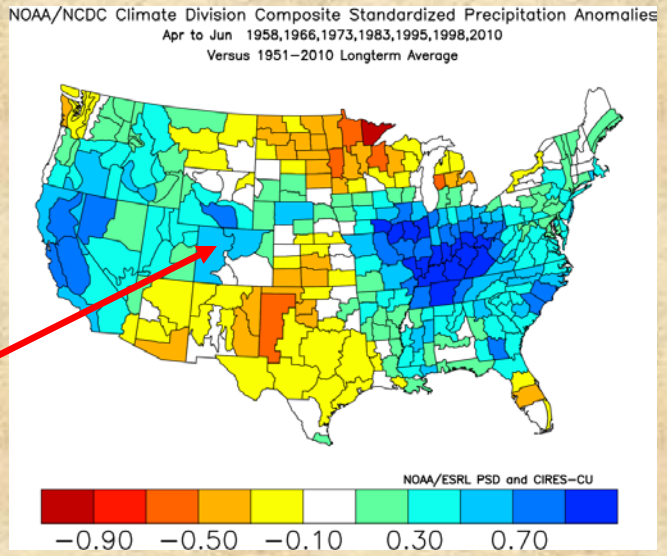
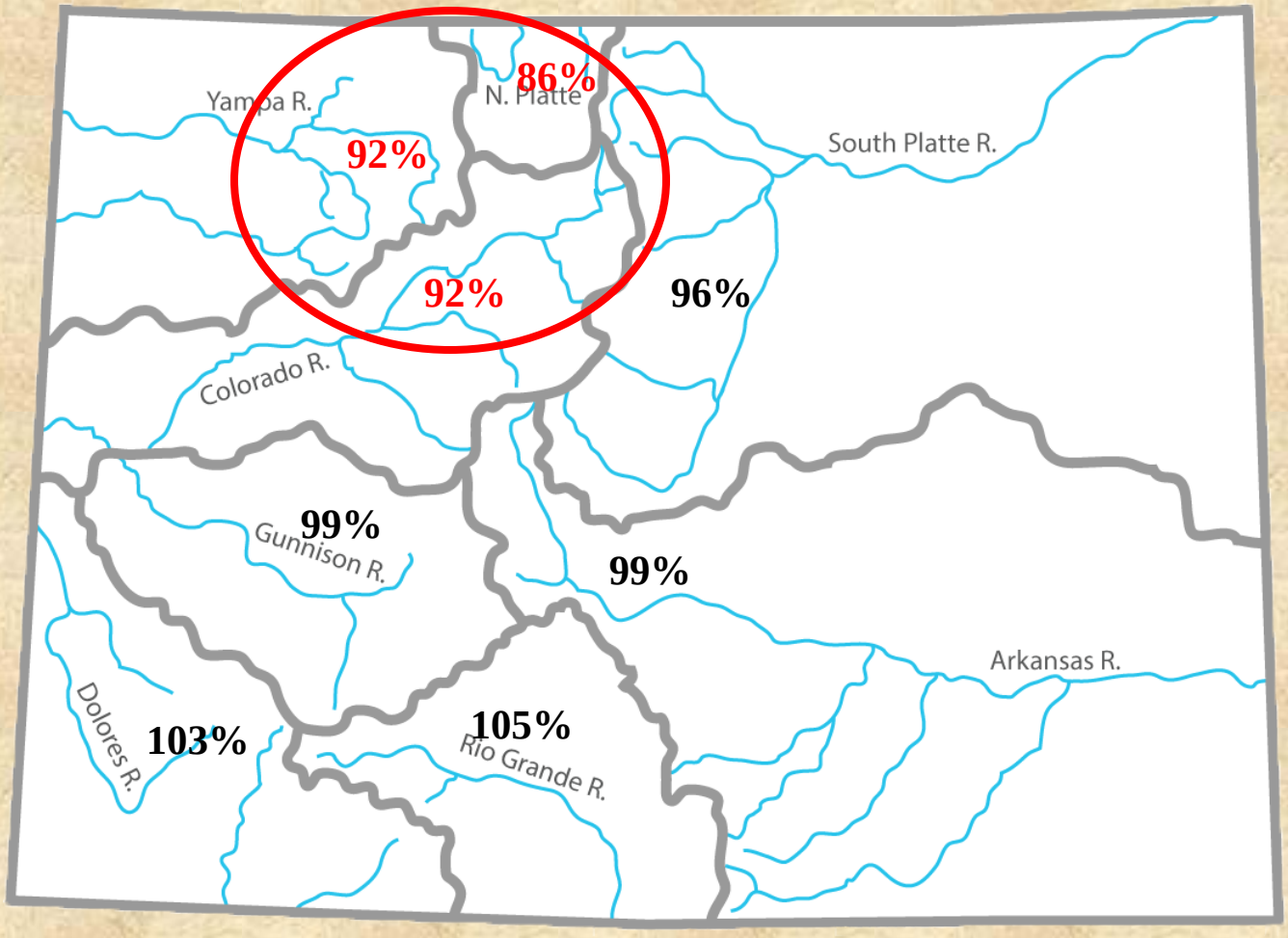


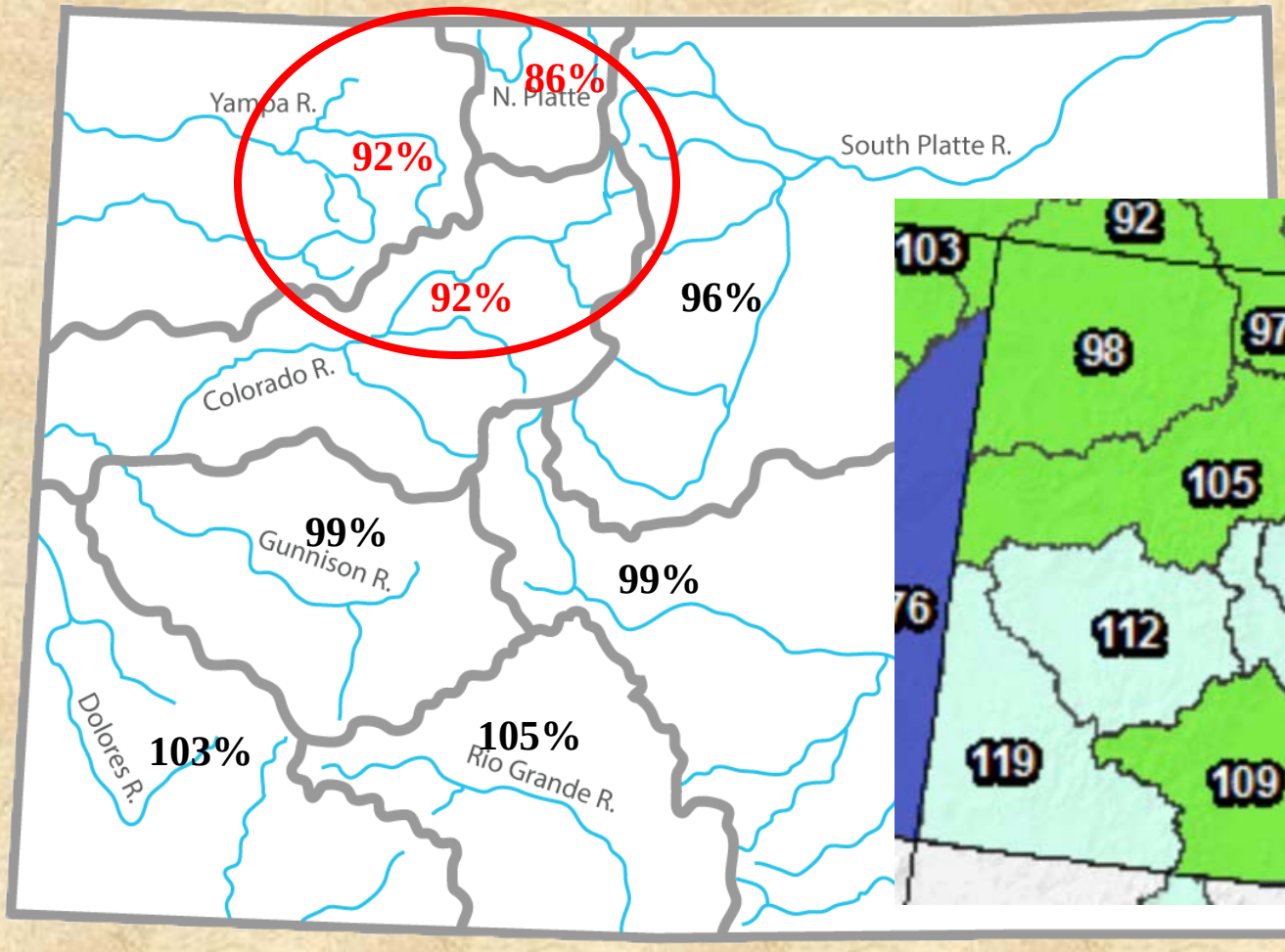
Based on Fall El Niño composites for 1febSWE



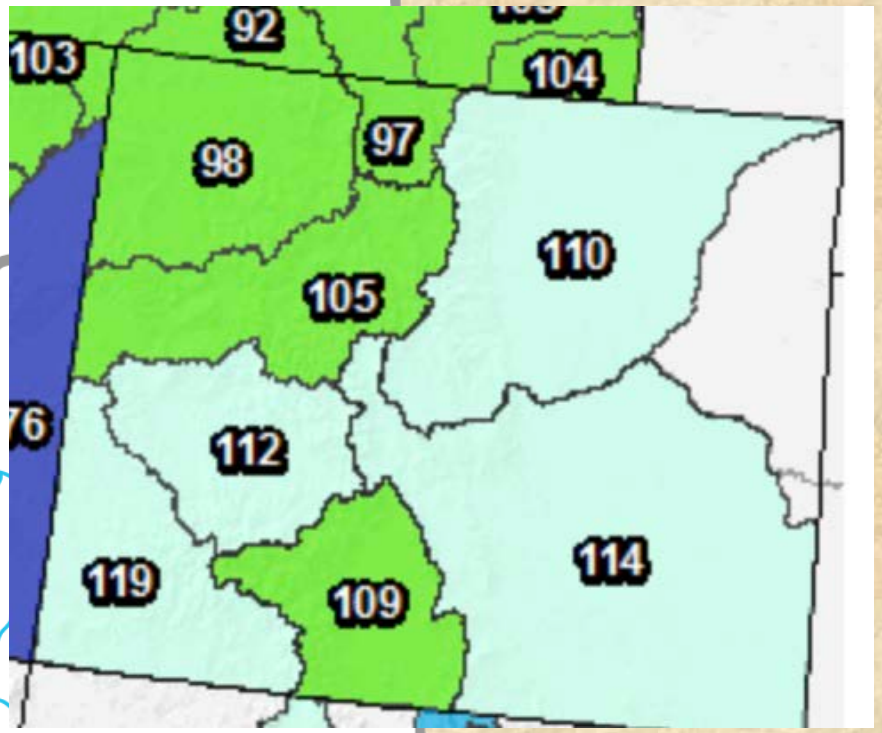
Median outcome for strong Los Niños since 1968
(after fall seasons: '72, '82, '87, '94, '97)

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/co/snow/?cid=nrcs144p2_063324

Based on Fall El Niño composites for 1febSWE

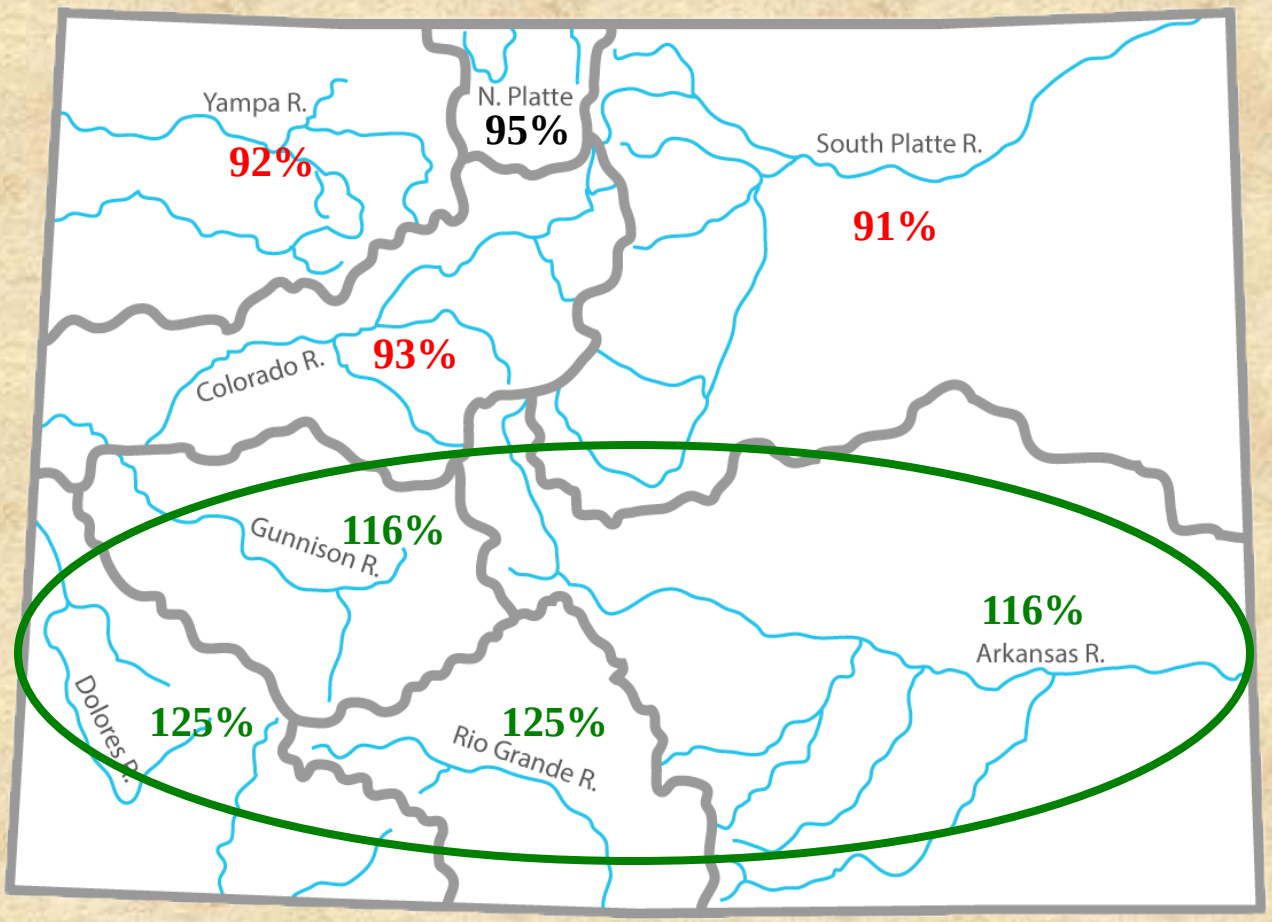


18janSWE



2016 is on track to end up above the median outcome for strong Niños, currently exceeding the target by more than 10% in all basins but the Yampa and Upper Rio Grande.

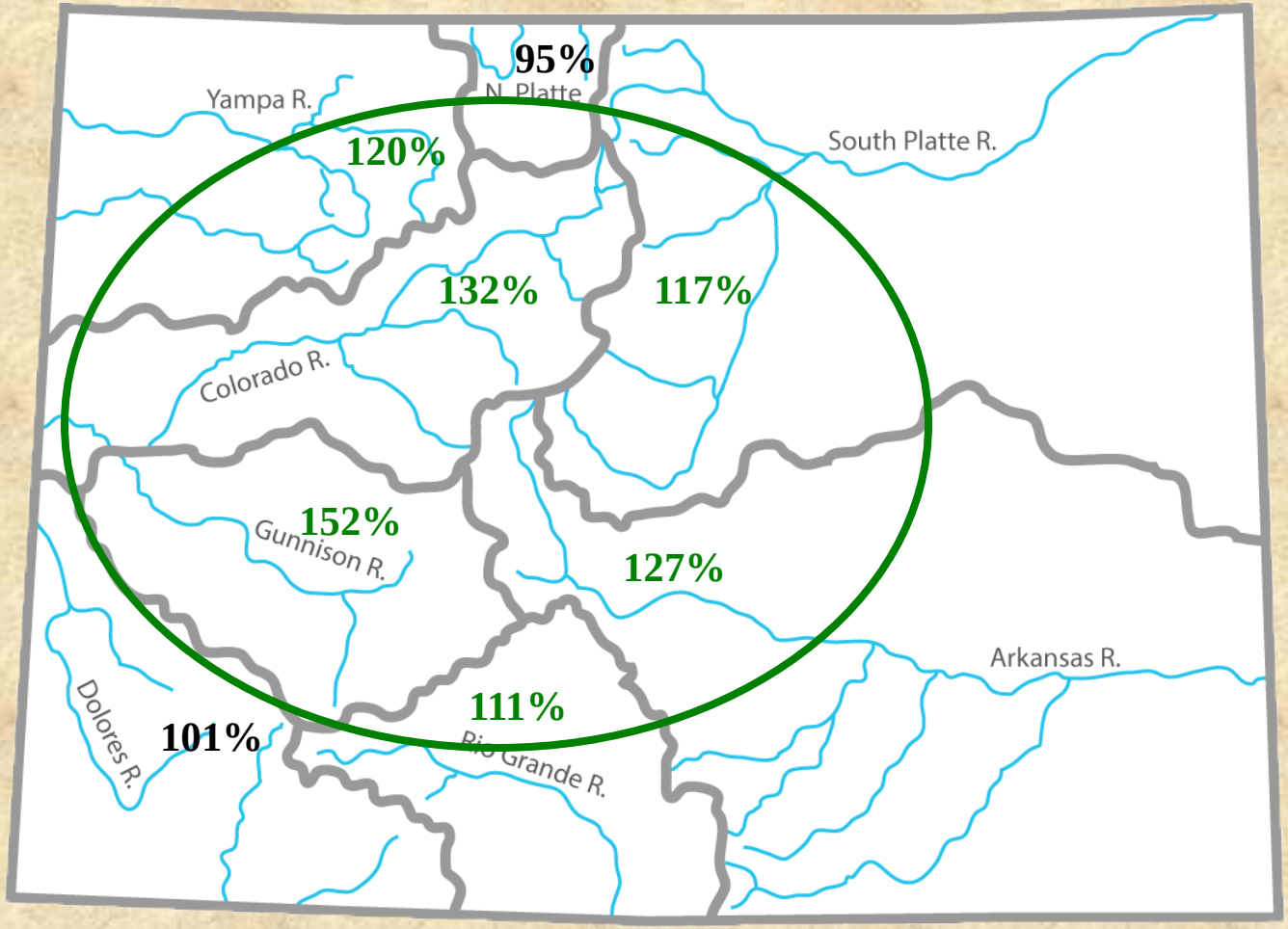
Strong Fall El Niño composites for 1apr SWE
(reproduced from November)



Median outcome for strong Los Niños since 1968
(after fall seasons: ‘72, ’82, ’87, ’94, ’97)

10-20% improvements over 1feb across the southern basins!

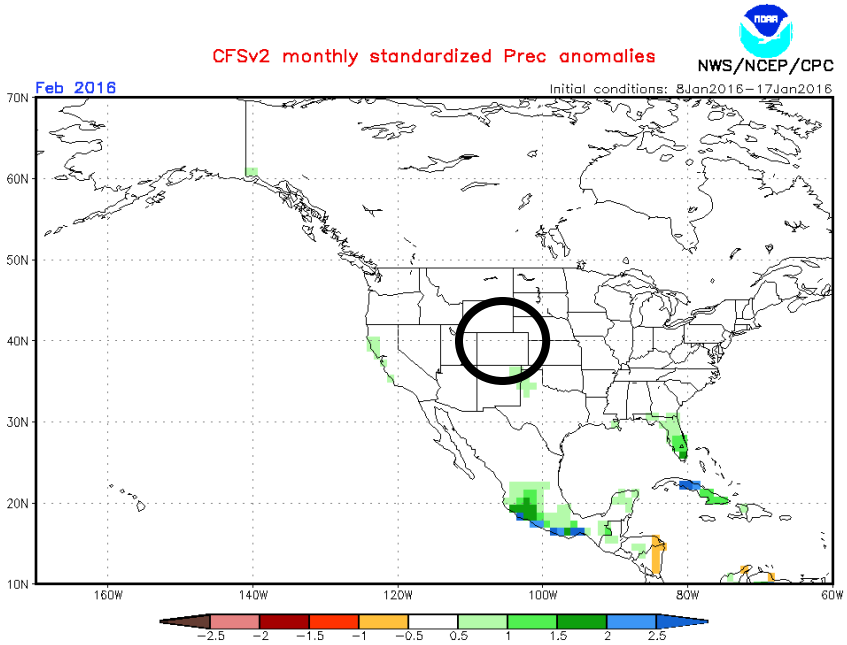
Based on Fall El Niño composites for 1may SWE
(reproduced from November)

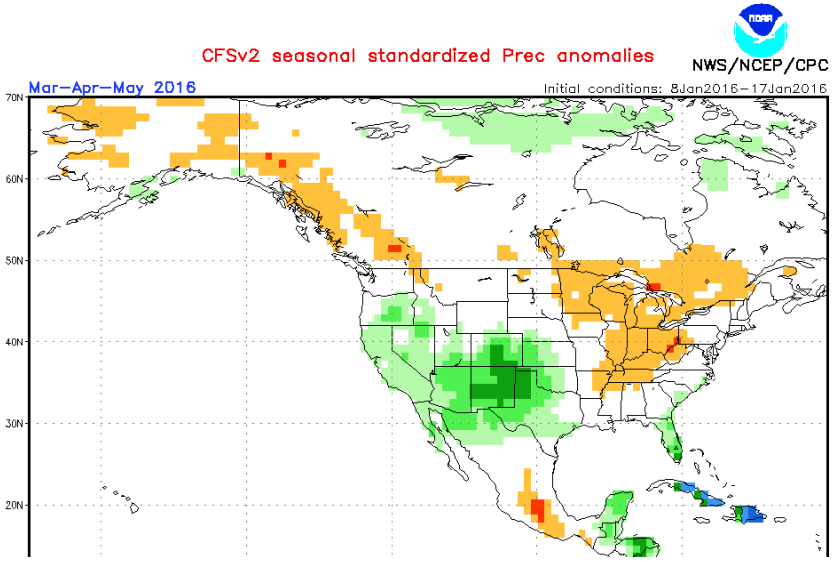


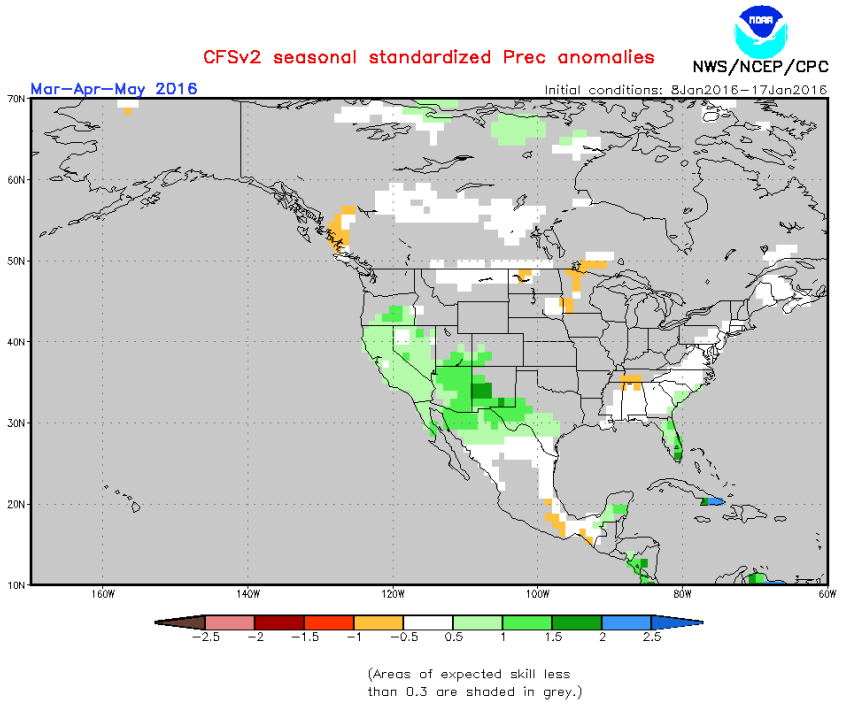
Median outcome for strong Los Niños since 1968
(after fall seasons: ‘72, ’82, ’87, ’94, ’97)

Increases over 20% from 1feb to 1may for all basins except for the North Platte, Upper Rio Grande, and Dolores basins

CPC Coupled Forecast System Version 2



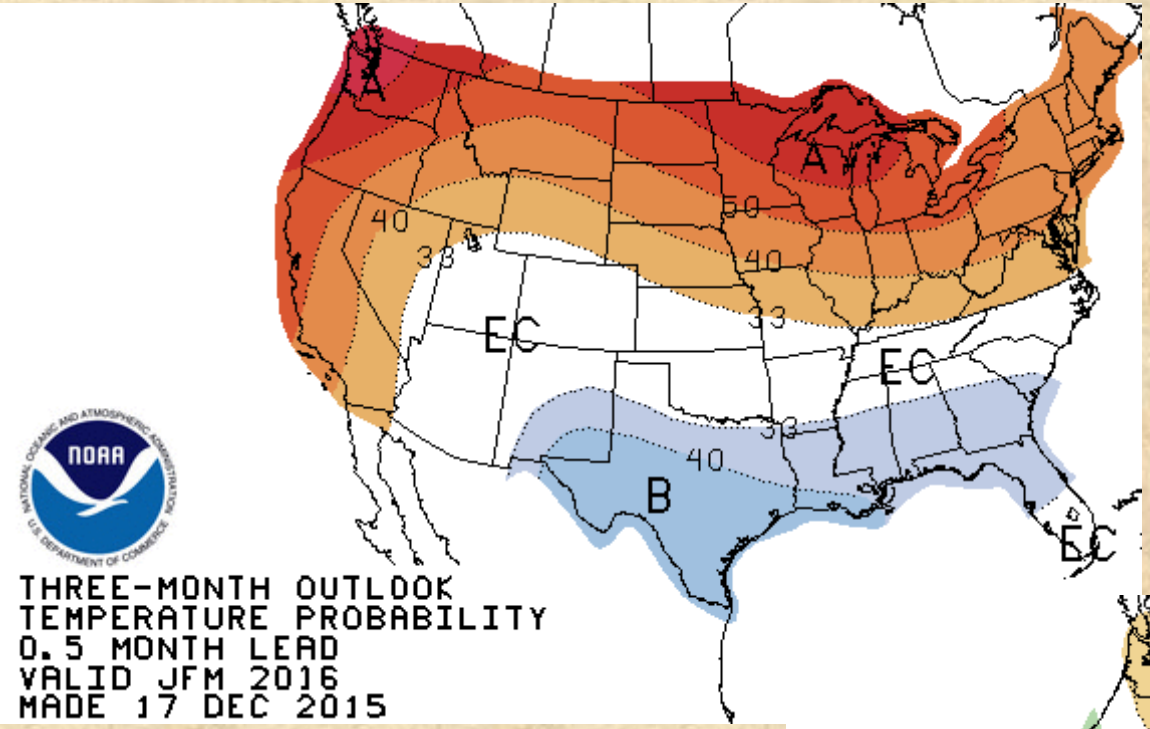




CFS forecasts for Feb (left) and MAM (right – top = normalized anomalies, bottom = with skill mask) – show no signal for February (this is actually an enigma for CA), and a wet spring for CO that does not survive the all-cases skill mask for most of our state.

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

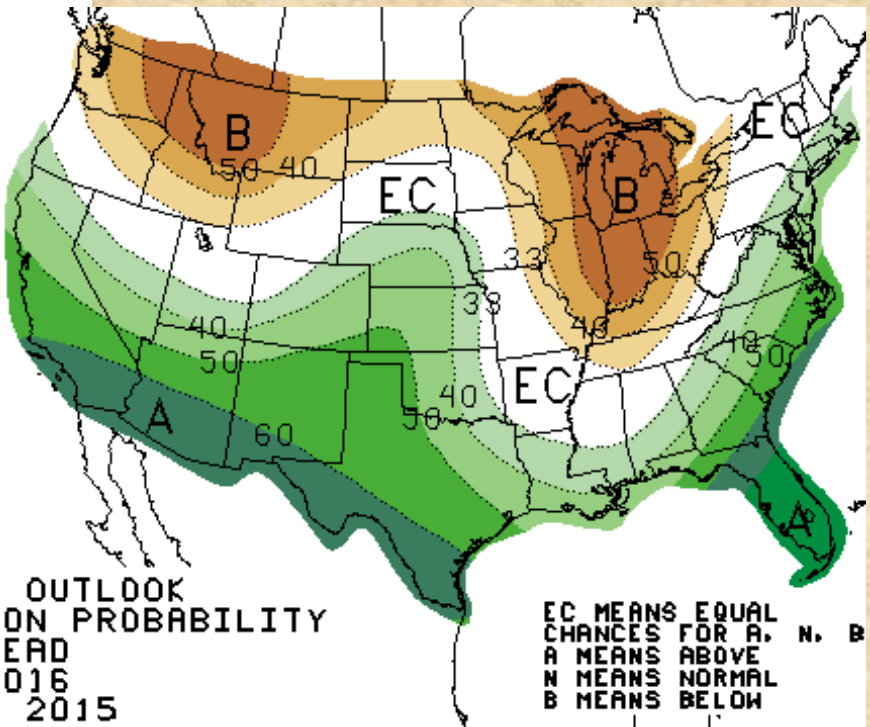
Climate Prediction Center Forecasts (Dec'15)



THREE-MONTH OUTLOOK
TEMPERATURE PROBABILITY
0.5 MONTH LEAD
VALID JFM 2016
MADE 17 DEC 2015

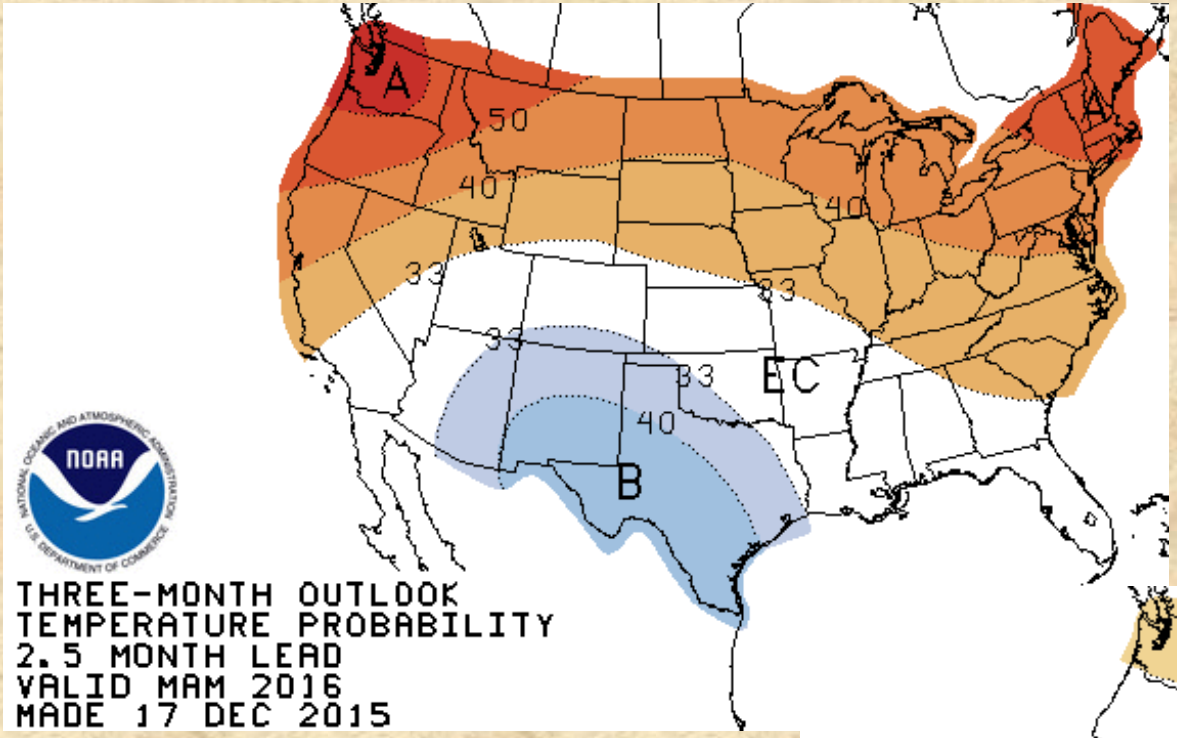
The late winter precipitation (right) and temperature (left) forecasts by CPC puts all but northwestern CO into surplus moisture, while keeping all of us 'undecided' (EC) for temperatures.

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



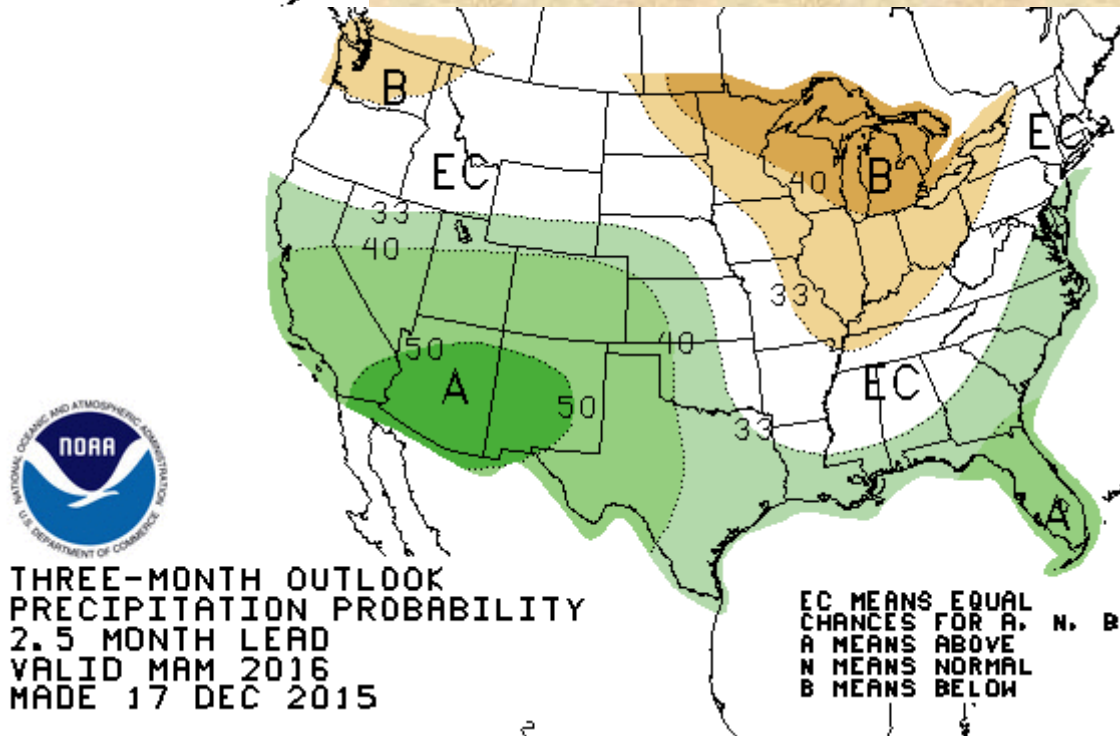
THREE-MONTH OUTLOOK
PRECIPITATION PROBABILITY
0.5 MONTH LEAD
VALID JFM 2016
MADE 17 DEC 2015

Climate Prediction Center Forecasts (Dec'15)

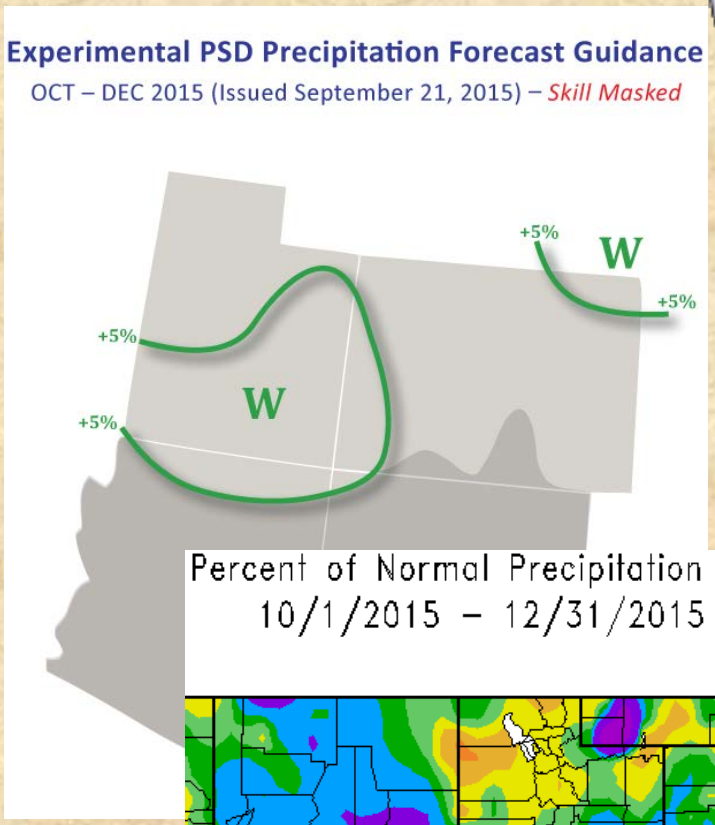


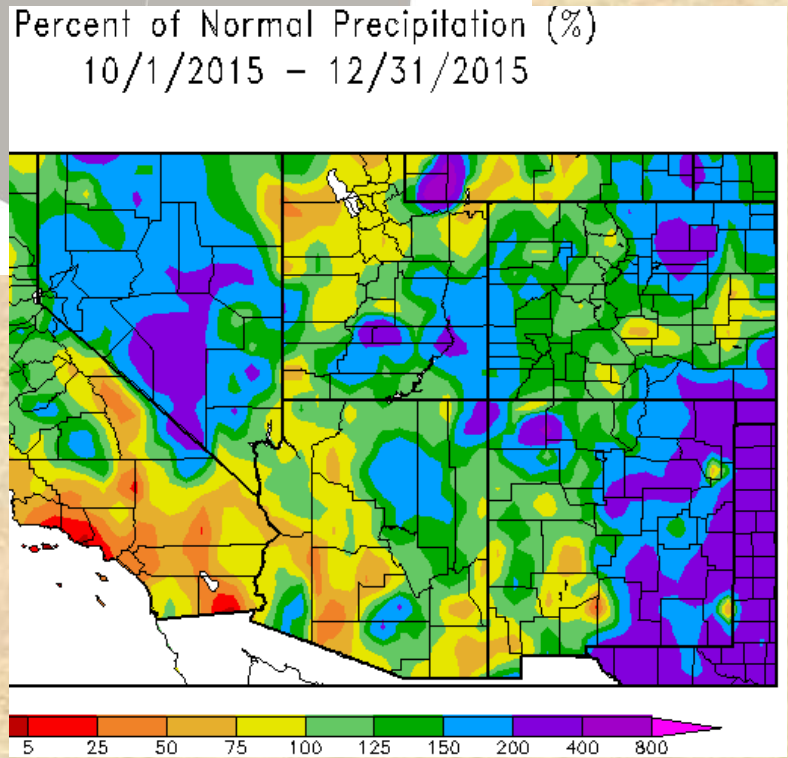
The spring precipitation (right) and temperature (left) forecasts by CPC covers all of CO under good odds for moisture, while leaving most of us EC for temperatures.

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



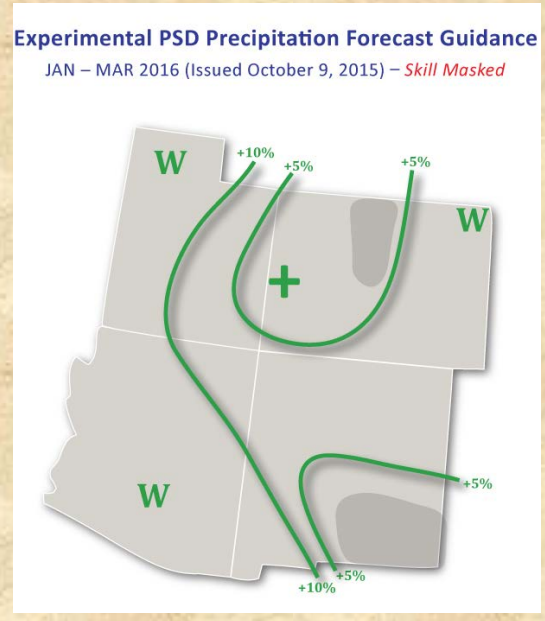
Postmortem for Oct-Dec 2015

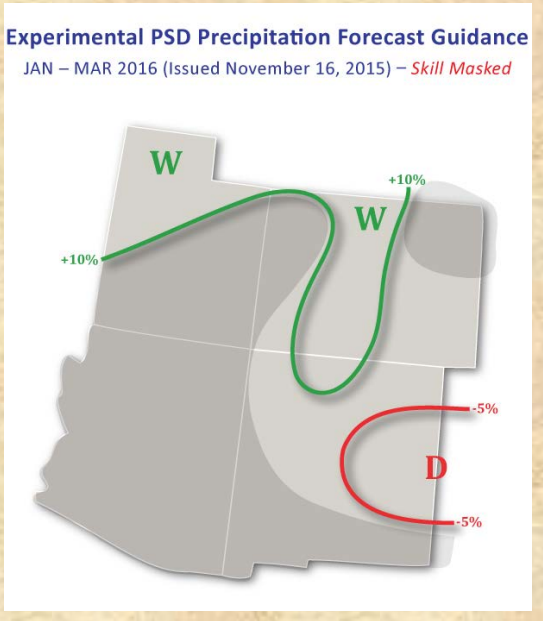


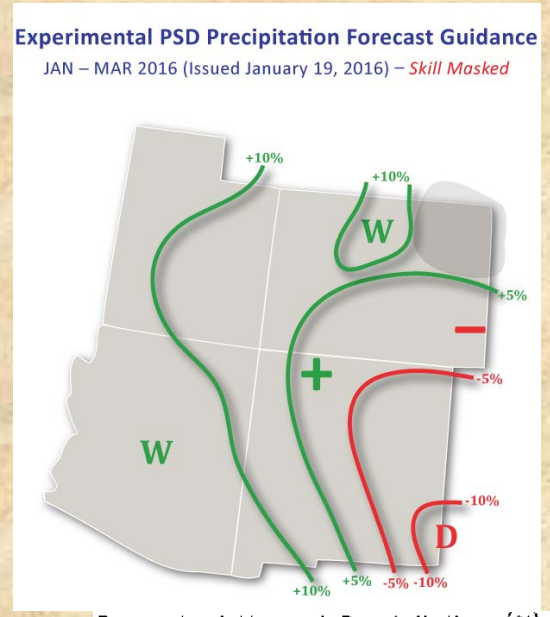


Fall forecast (left) was either neutral (mountains) or on the wet side for Colorado (SW and NE corner). The skill-masked forecast (top right) showed that the wet forecasts for CO were supported by operational skill (since 1999), while forecasts for AZ&NM were not. ***Looks like the wet forecasts verified nicely in UT, CO, and even NM, but less so in AZ.***

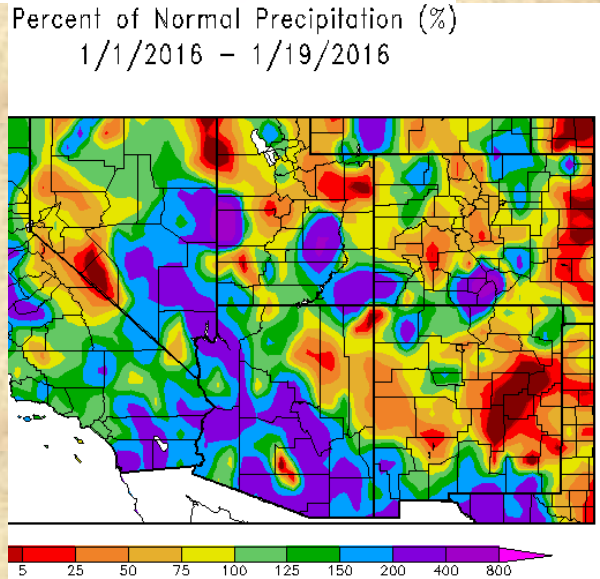
Statistical Forecasts for Jan-Mar 2016







Winter forecasts have been fairly bullish for most of Colorado since September. The latest skill-masked forecast (right) is least promising over the northeast corner (no operational skill) and slightly tilted towards dry conditions in the southeast corner. The rest of the state shows tilts of at least +5% towards a wet outcome. ***So far, January has been driest over eastern New Mexico (√) and wettest over southern Arizona (√)...***



Executive Summary (20jan16)

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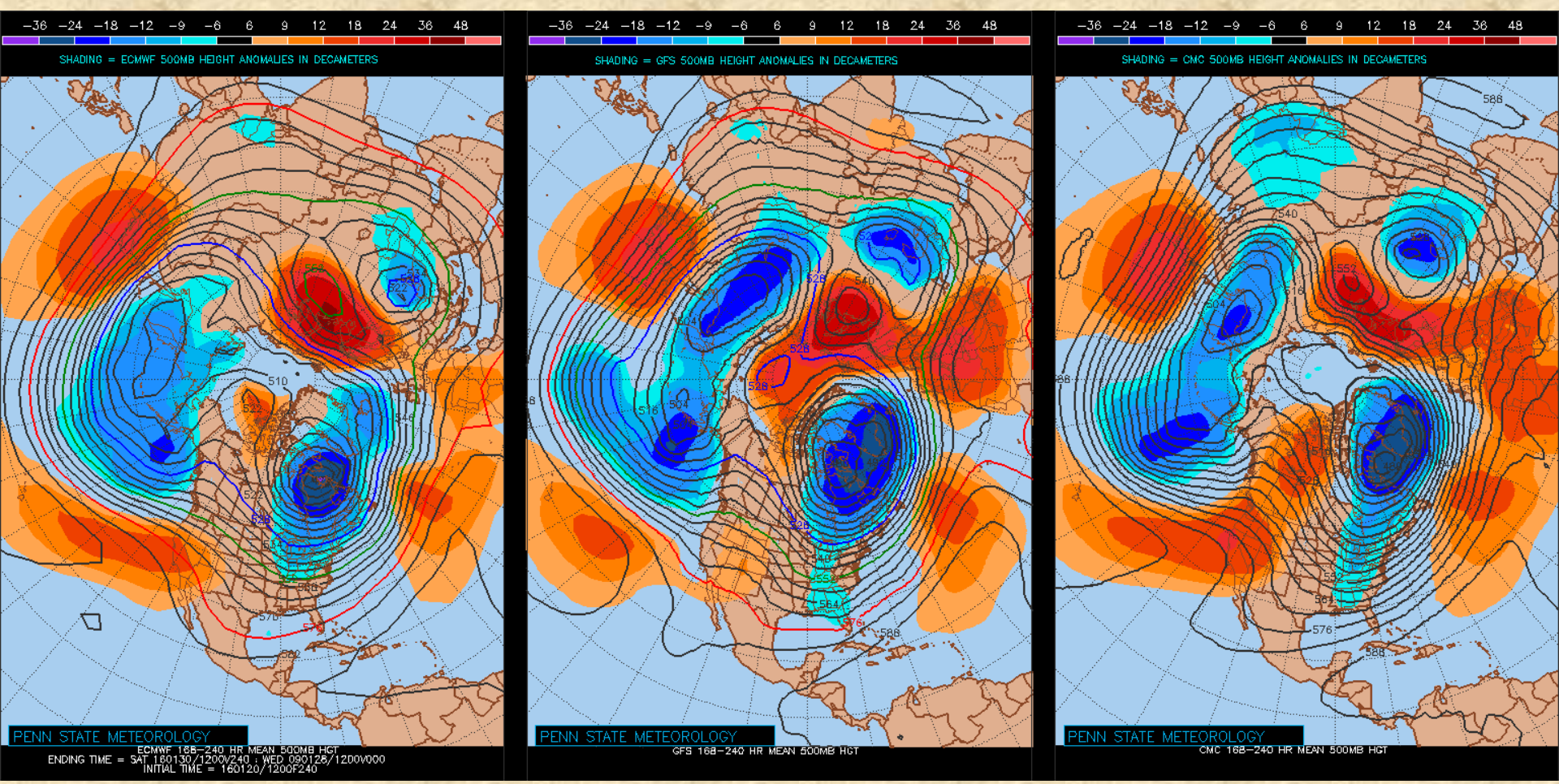
- **El Niño is here, it is strong (I still call it 'Big Boy'), and it should continue through spring. It might have gotten another shot in the arm from westerly wind bursts in last few weeks, so it might get a 2nd peak soon. *Too early to tell whether we go back to La Niña by end of 2016, but it is more likely than not.***

- **Our state caught up in the moisture department over the last few months, *consistent with El Niño*. In fact, our wet December in particular was sufficient to put snowpack numbers above the median strong El Niño outcome for the 1st of February, although one should not celebrate too soon.**

- **CPC's forecasts favor our state during spring, consistent with my own expectations. However, their forecast for MAM is undermined by poor performances during previous (non-ENSO) years. My experimental forecast guidance remains optimistic for January through March over the higher elevations of our state.**

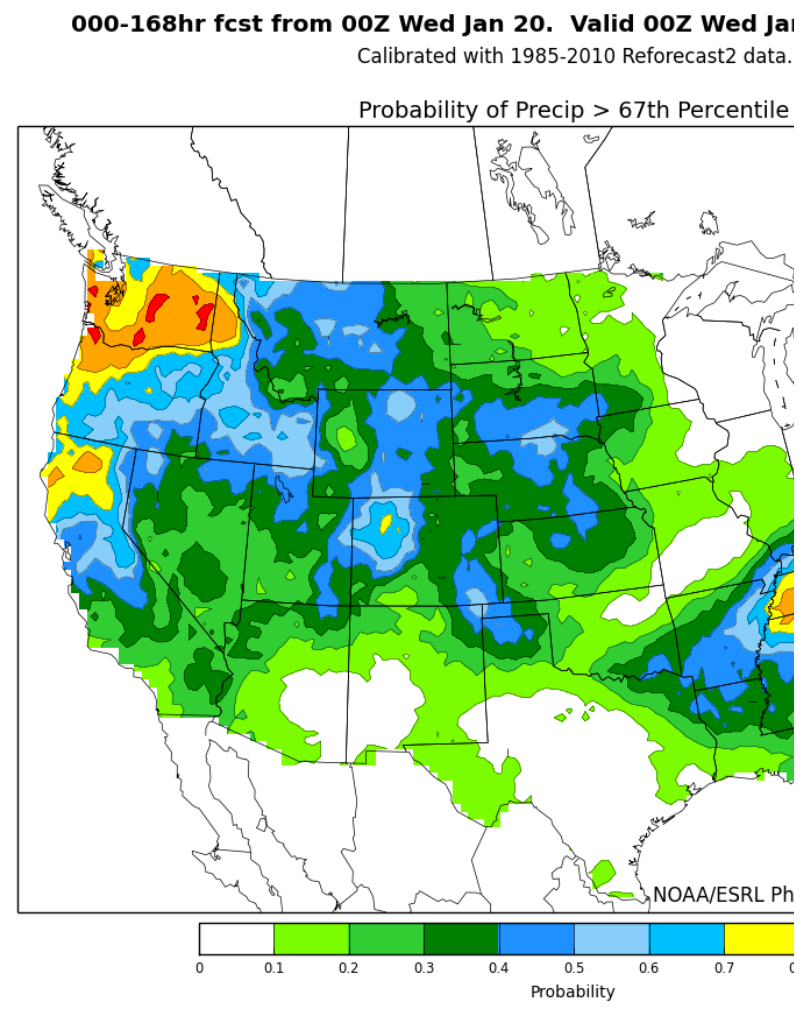
- **Precipitation chances will increase the most in March and April, if this El Niño plays out as expected. If we don't transition to La Niña too fast, precipitation odds may remain elevated into early summer. This translates into good chances for above-normal snowpack and runoff later this spring. Meanwhile, we should continue to see relatively few windstorms, severe cold snaps and/or warm spells.**

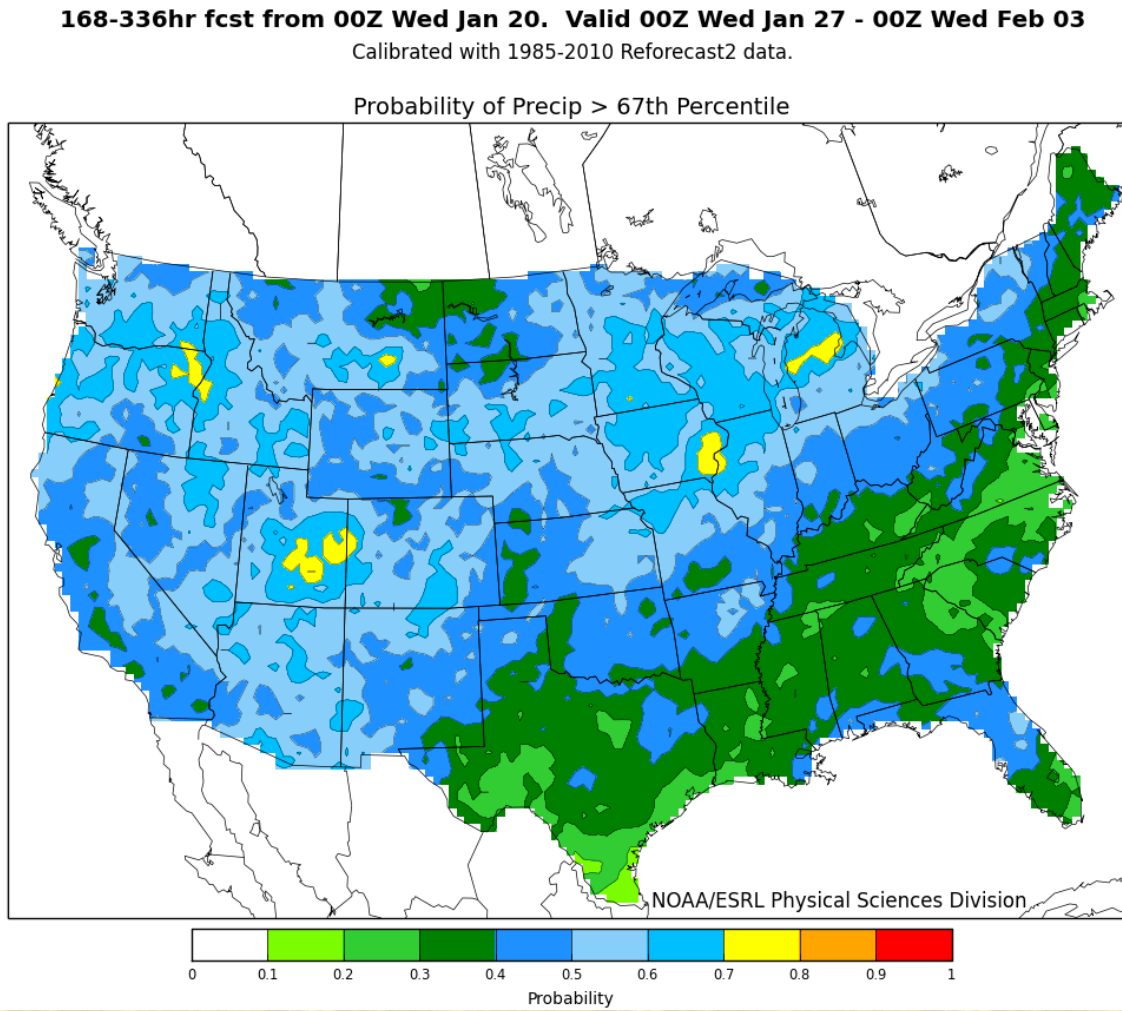
What can we expect towards the end of next week?



ECMWF (left), GFS (middle,) and CMC (right) show (hopefully) transient ridging over western U.S., in a stark departure from recent conditions. Should be short-lived...

What can we expect for next two weeks?





Reforecast is encouraging for Western CO during the first week (left), while the second week covers all of our state with slightly enhanced odds.