Earth System Research Laboratory
Physical Sciences Division

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Colorado WATF,
20 January 2015
Denver

Seasonal Outlook for Colorado

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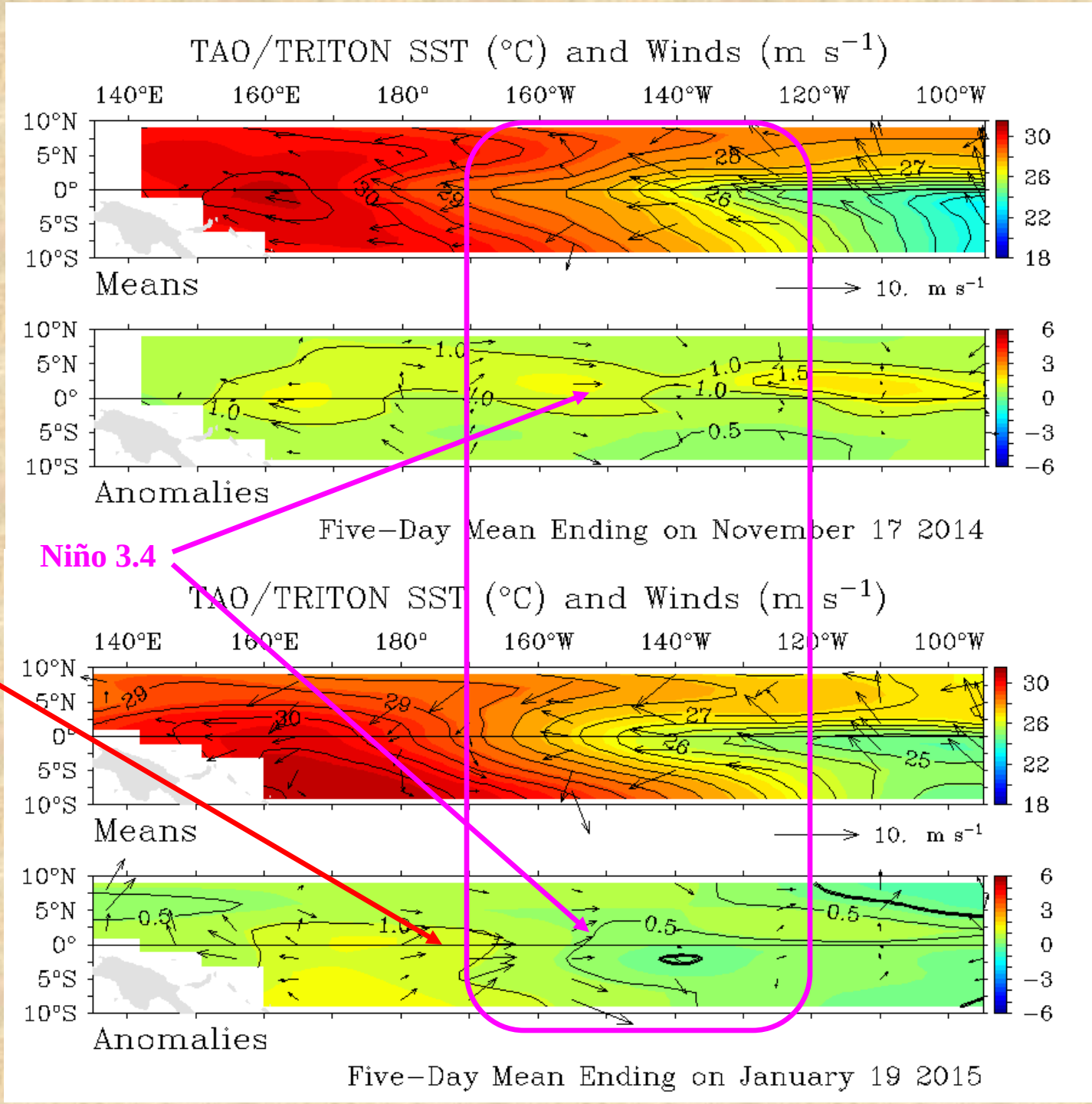
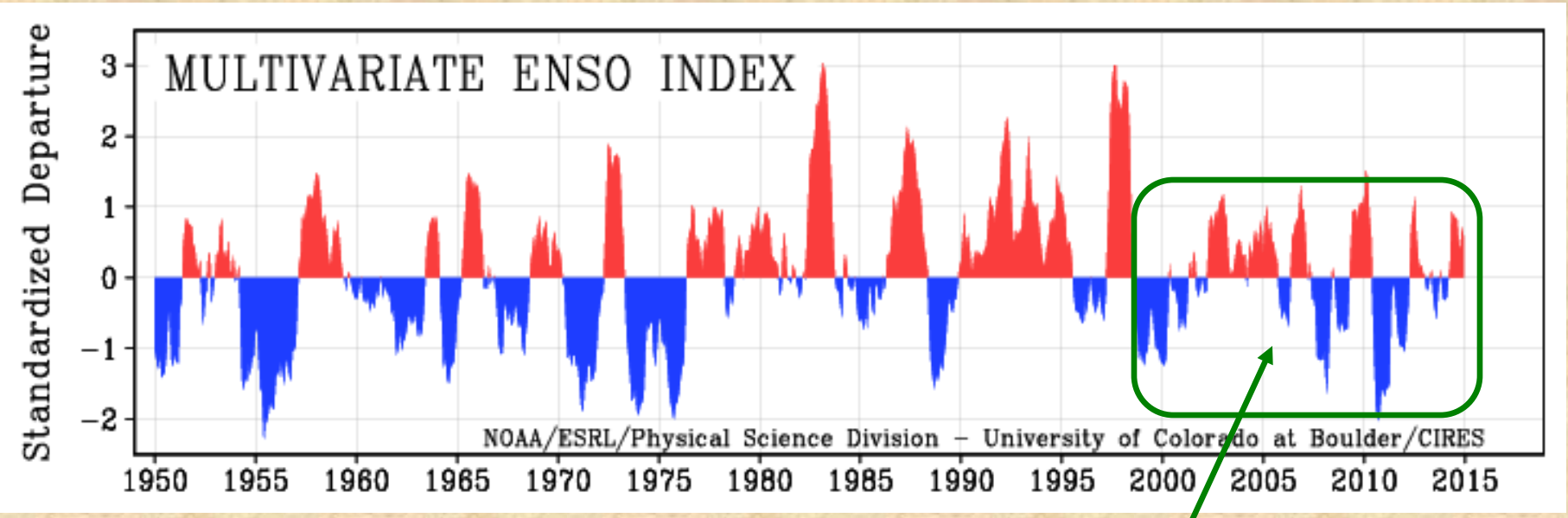
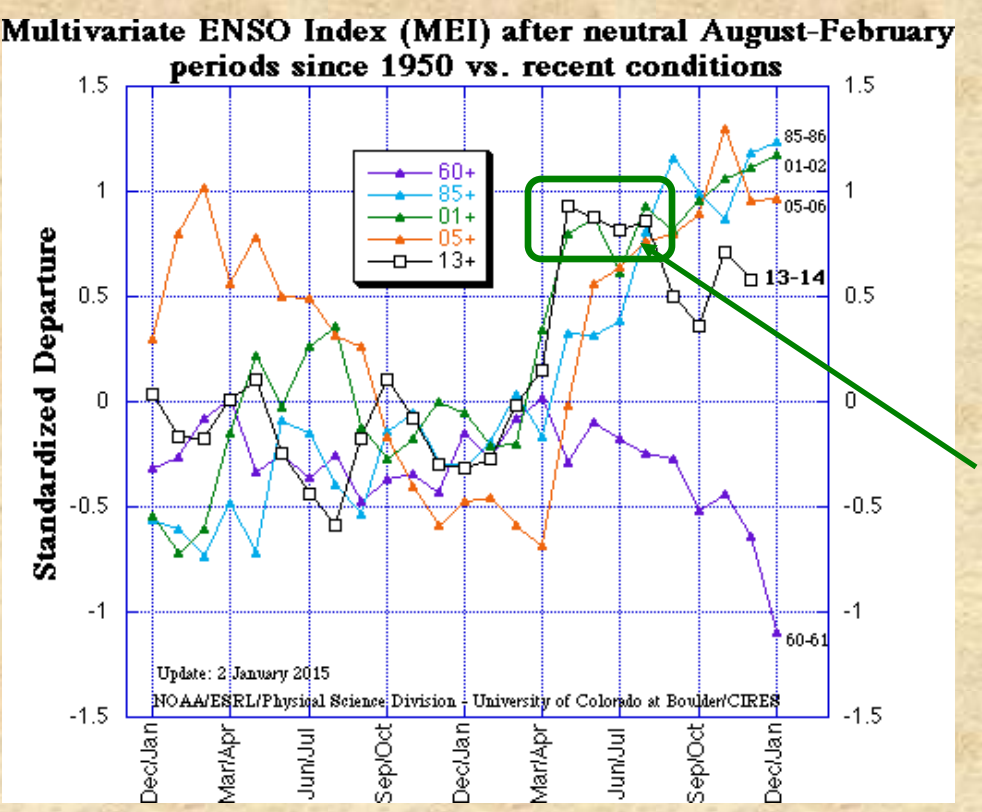
- **What has happened to ENSO(+), and what will happen next?**
- **CPC forecasts into spring**
- **Seasonal Forecast Guidance for precipitation and snowpack**
- **Executive Summary**

Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to November (top): Recent SST anomalies (Niño 3.4 is hovering at+0.5C) are borderline El Niño, while wind anomalies have just recently become more conducive to growth, after being unfavorable for much of this event.



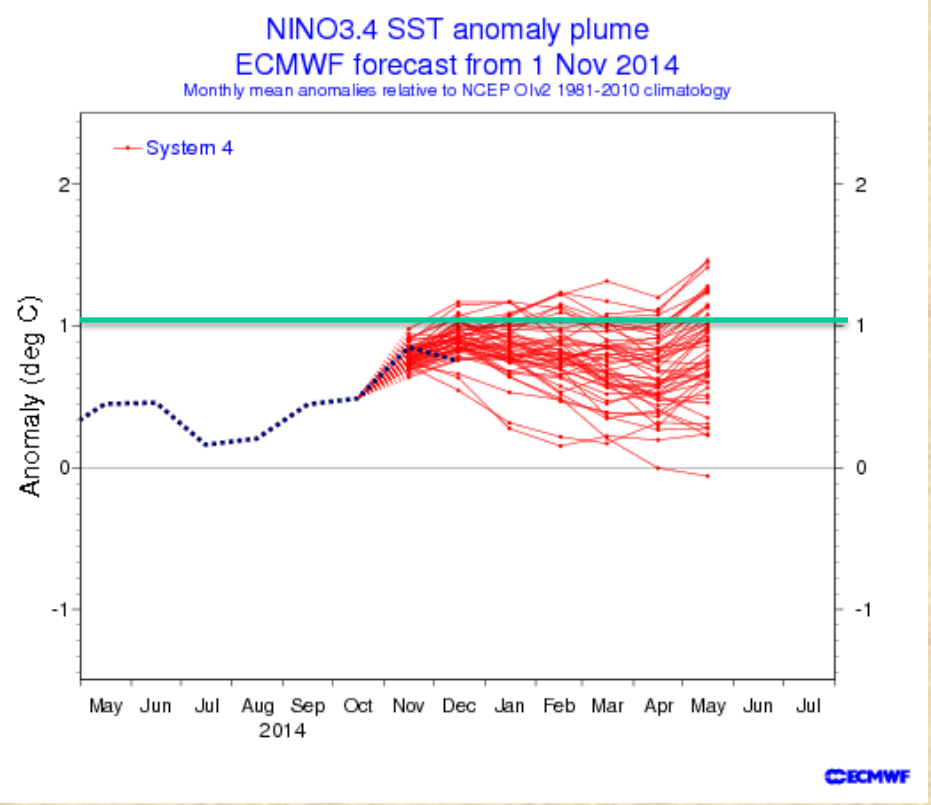




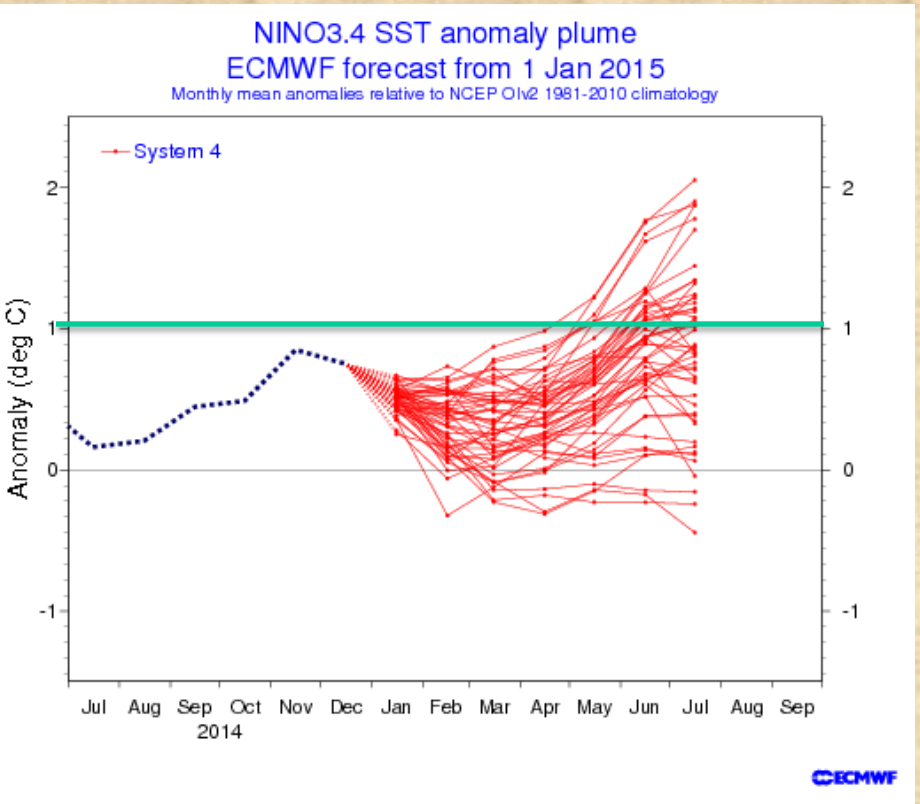
Since late 1998 we have been in a regime that favors La Niña, but does allow for occasional El Niño events, mostly of the weak-to-moderate variety.

ENSO conditions often change during our spring season. In 2014, towards El Niño indeed, and the MEI showed weak-to-moderate strength from April-May thru July-August. Instead of gaining strength during the fall season, this particular event weakened and has been only borderline El Niño, similar to Niño 3.4 SST.

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



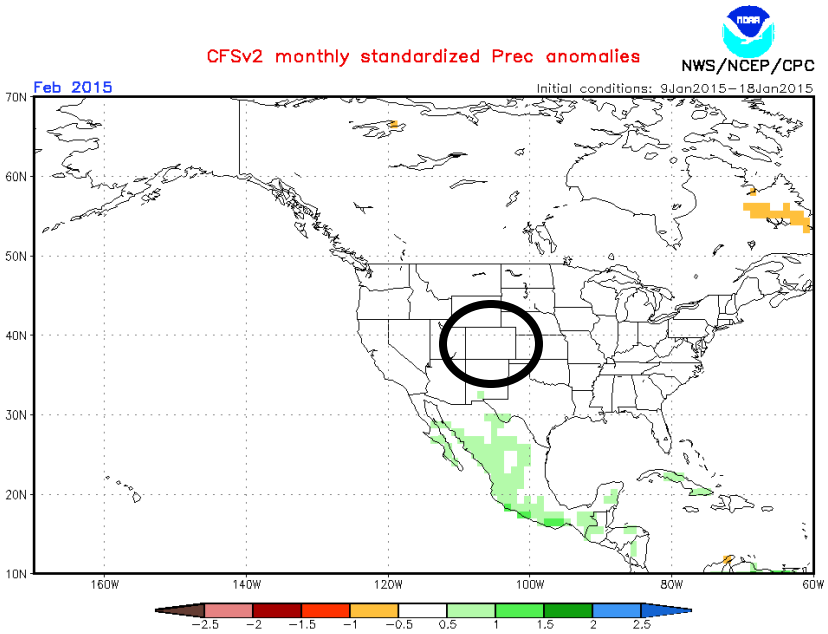
The ECMWF November 2014 forecast (left) continued a weakeneing trend of this model during late 2014, resigning us to a weak El Niño event this winter, with perhaps only a 10% chance of getting moderate (+1° C). *As noted two months ago, there was an interesting uptick towards spring in this model.*

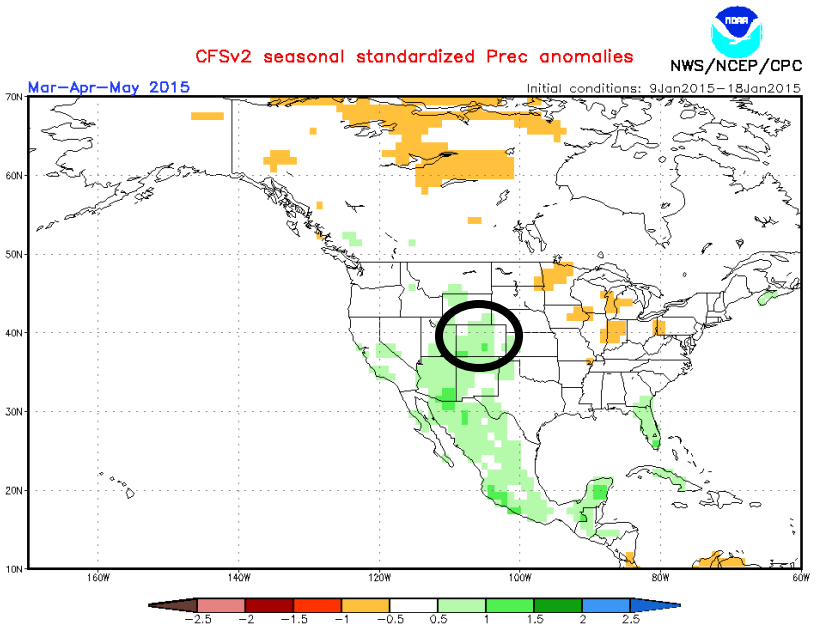


The ECMWF January 2015 forecast (right) keeps the current 'event' weak for the next few months, but shows a continued increase during late spring/early summer, supported by the majority of its 50 ensemble members – this bears watching! Several other models (not shown) are also supportive of this *'2nd El Niño wind'*.

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

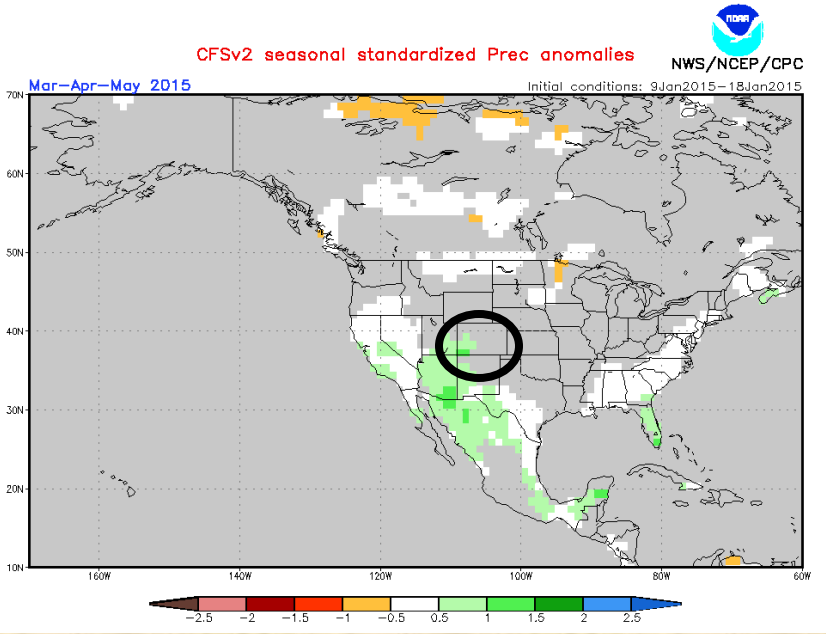
CPC Coupled Forecast System Version 2



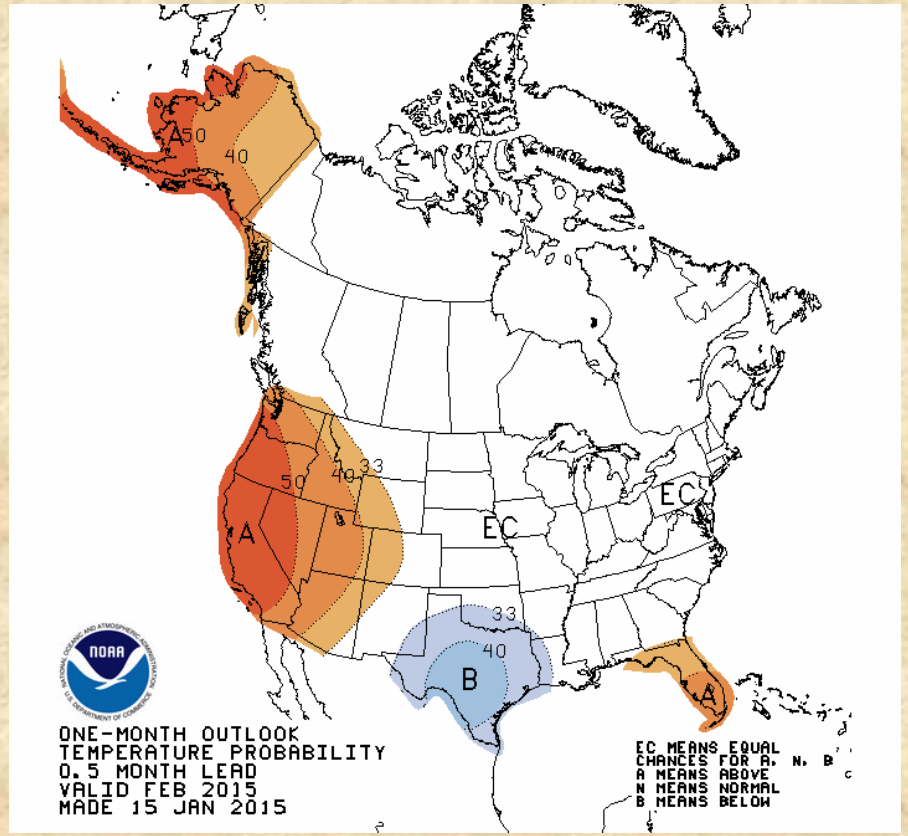


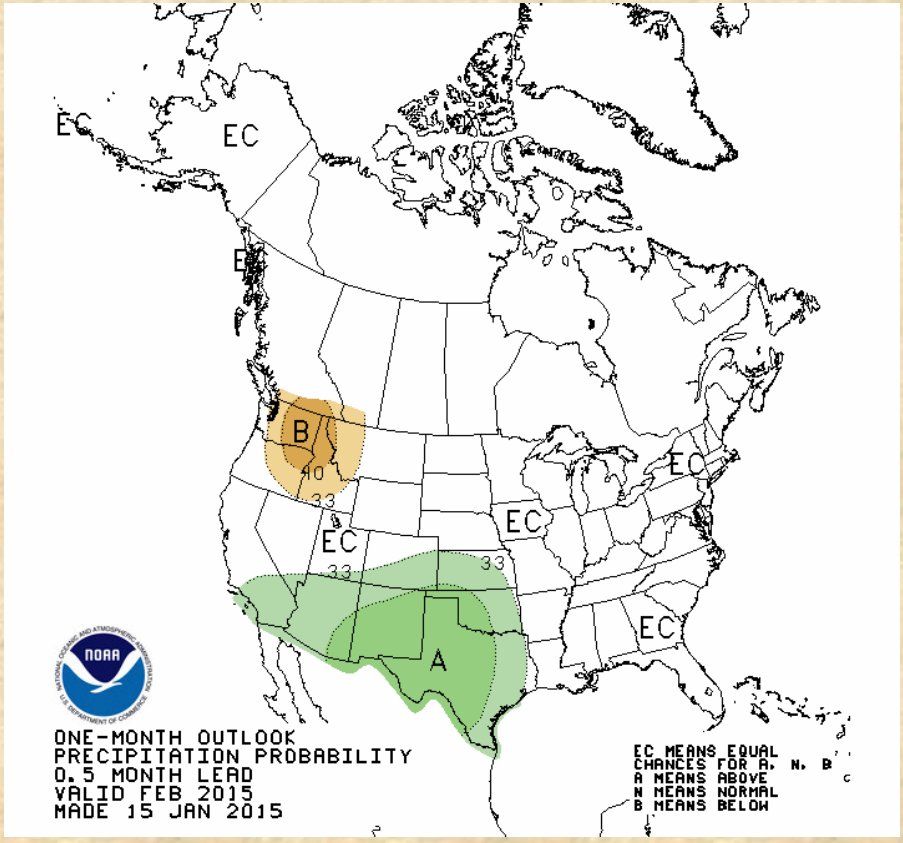
CFS forecasts for FEB (left) and MAR-MAY (right; top = standardized anomalies/bottom = same with skill mask) start out near-normal, but show a wet spring for us, unfortunately not supported by skill (bottom right).

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



Climate Prediction Center Forecasts

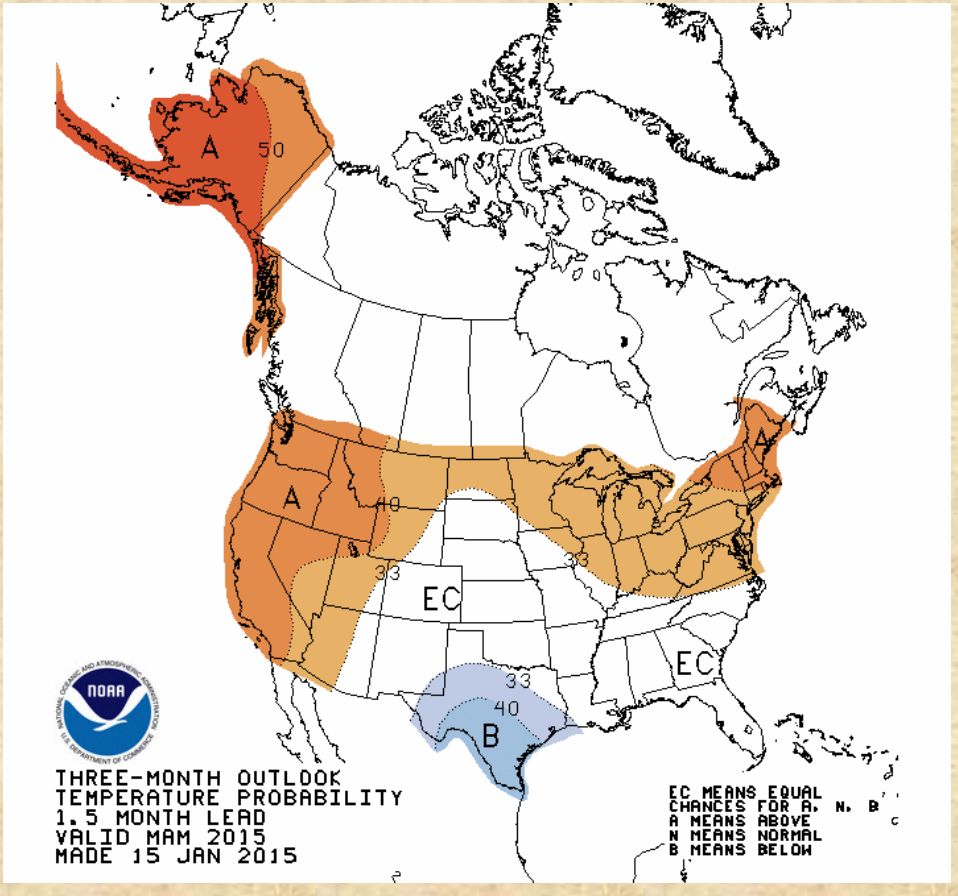


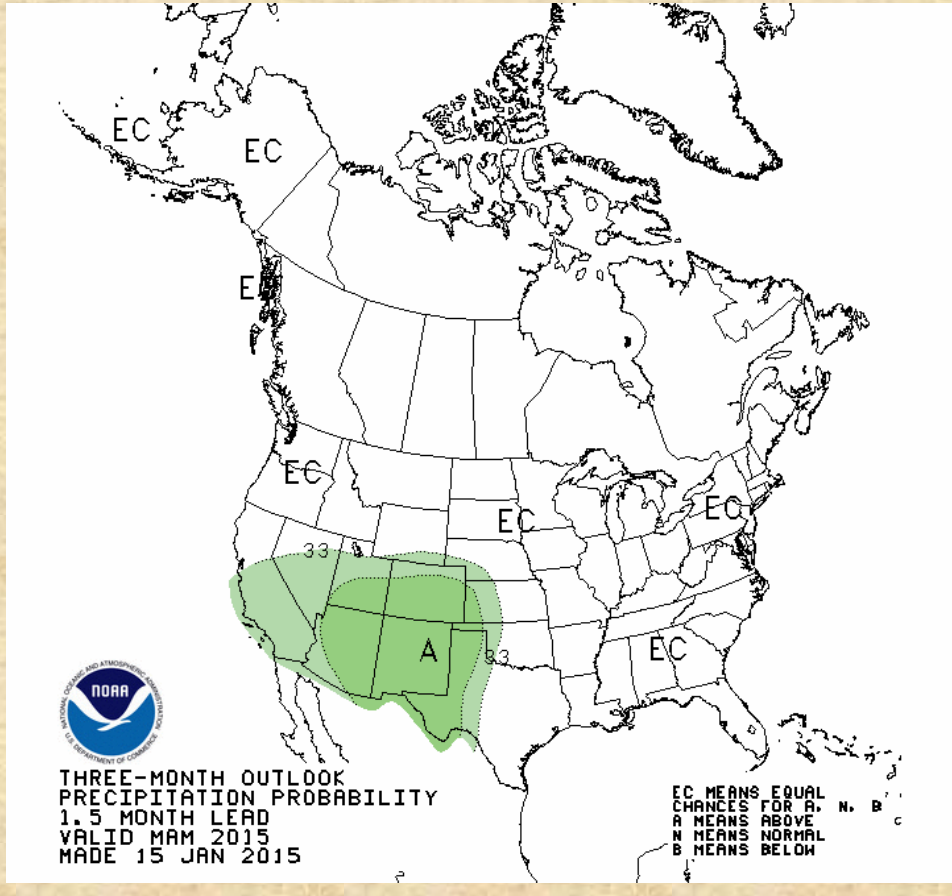


According to CPC, February looks warmer than normal to our west (left). Their moisture forecast for February (right) gives hope to the southern half of the state. This is mostly consistent with their own El Niño composites.

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

Climate Prediction Center Forecasts

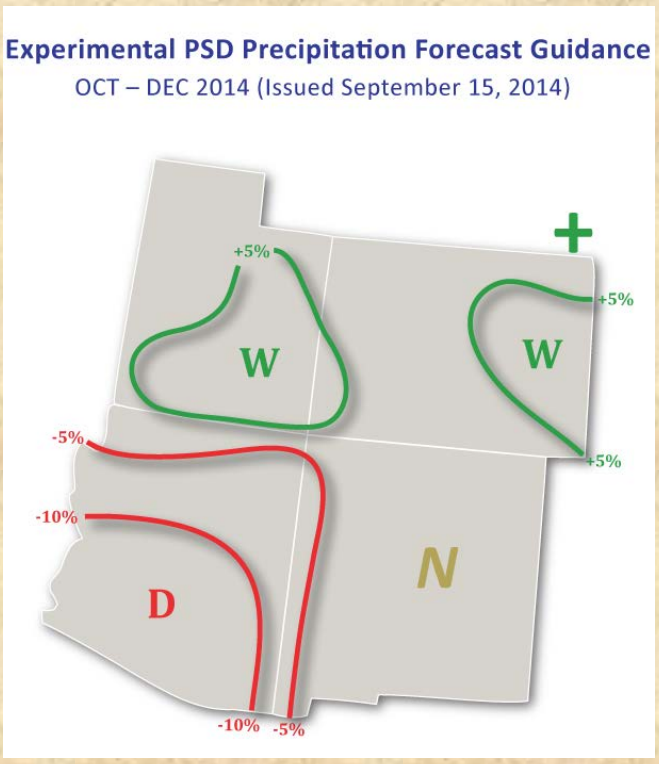


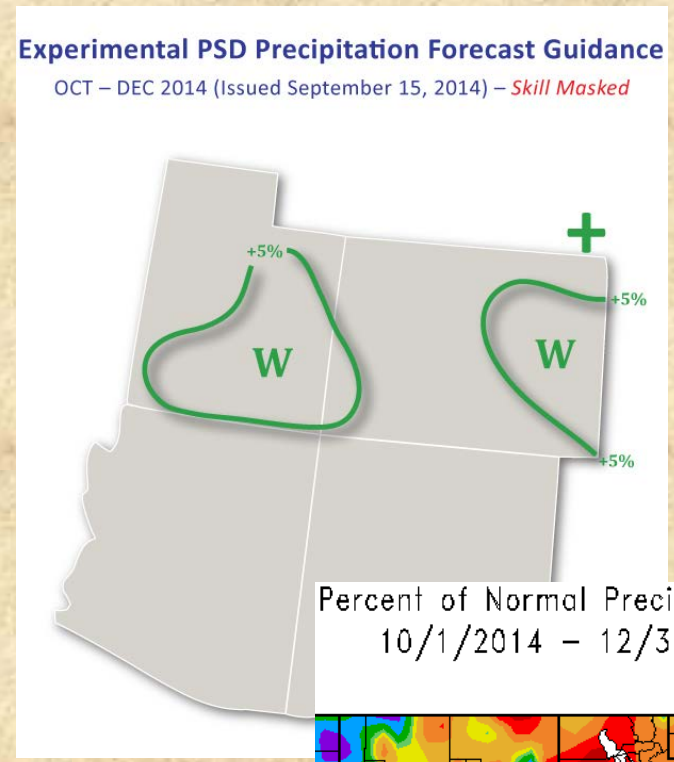


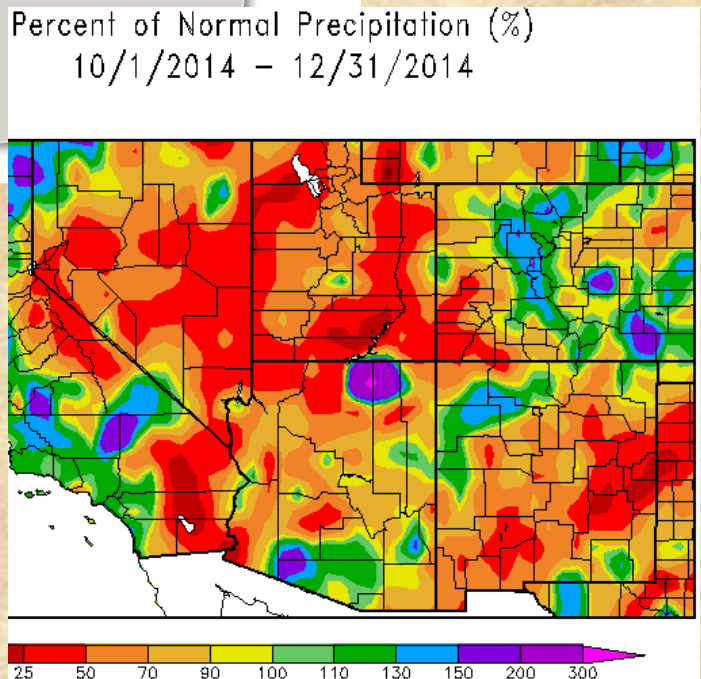
The spring temperature forecast by CPC (left) keeps Colorado undecided ('EC'). Their moisture forecast (right) is surprisingly bullish. This forecast hinges on a tendency for Colorado to have wet Marches in particular during El Niño conditions.

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

Statistical Forecast for Oct-Dec 2014

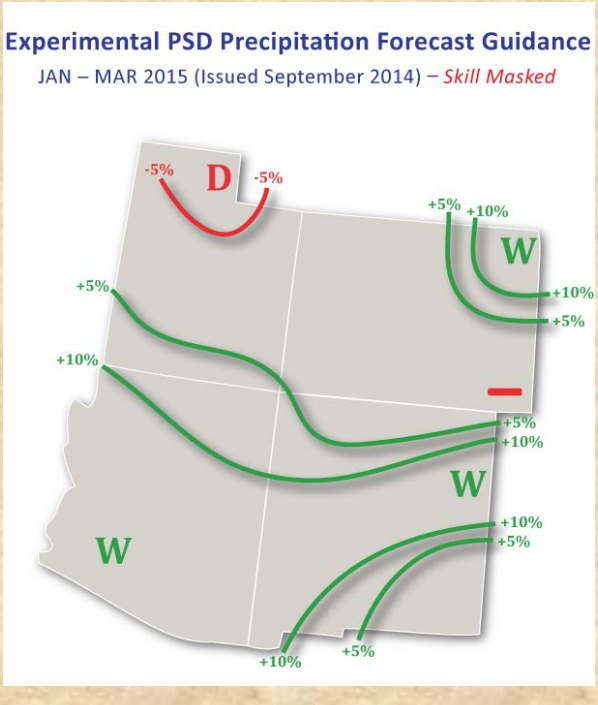


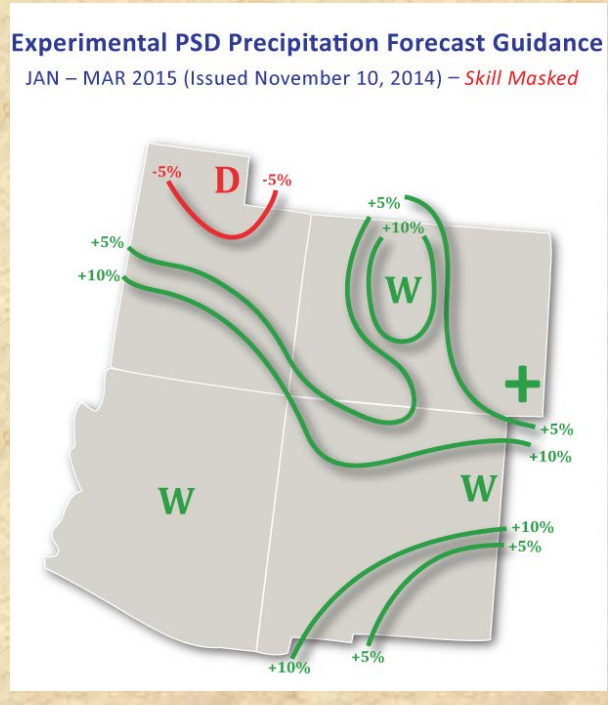


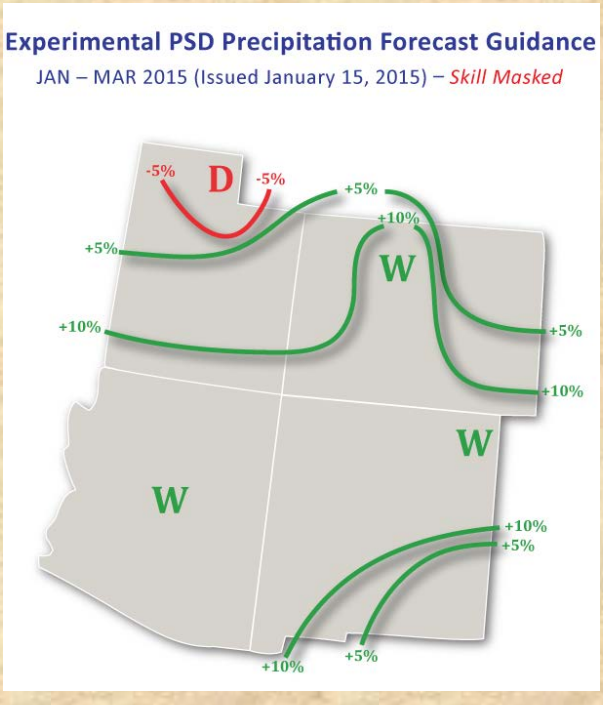


Fall forecast (left) was either neutral (mountains) or on the wet side for Colorado (mostly eastern plains). My skill-masked forecast (right) showed that the wet forecasts were supported by operational skill (since 1999), while forecasts for AZ&NM were are not. ***Clear winners and losers in this one: UT was a lot drier than expected, NM somewhat drier than 'N', AZ did somewhat better, and CO's north-central mountains won!***

Statistical Forecast for January-March 2015





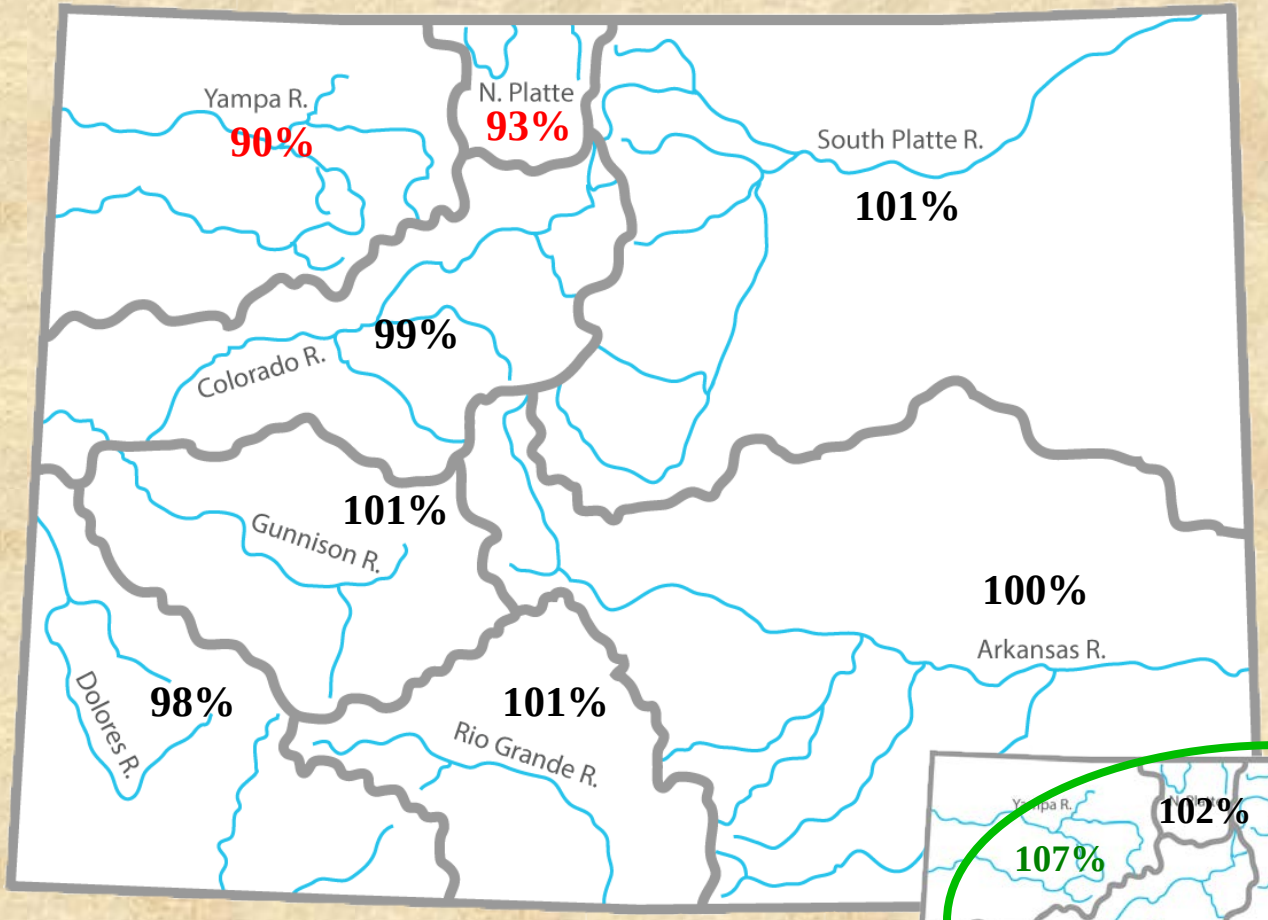


The skill-masked winter forecasts (latest on the right) continue to show a wet tilt for most of CO. The only CO region not covered by skillful forecasts is the northeast corner.

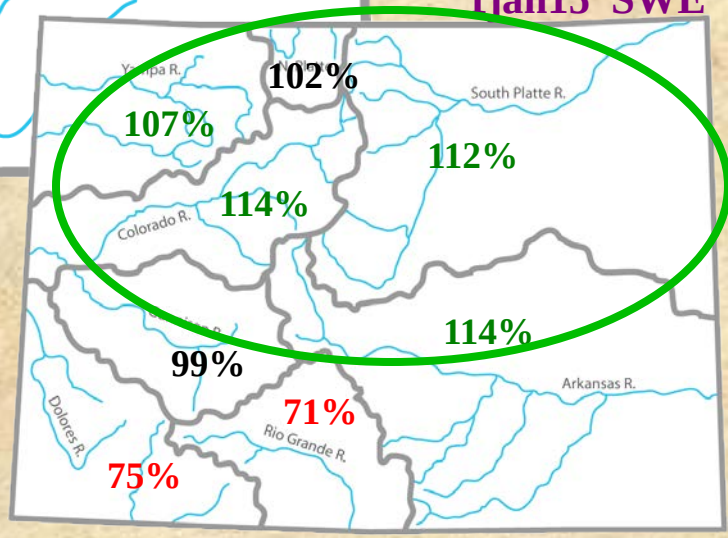
Note: Considering the unusual nature of this El Niño event, I believe that this forecast has a slimmer chance of verifying to the extent hoped for.

El Niño composites for 1jan SWE

(shown in Sept'14)



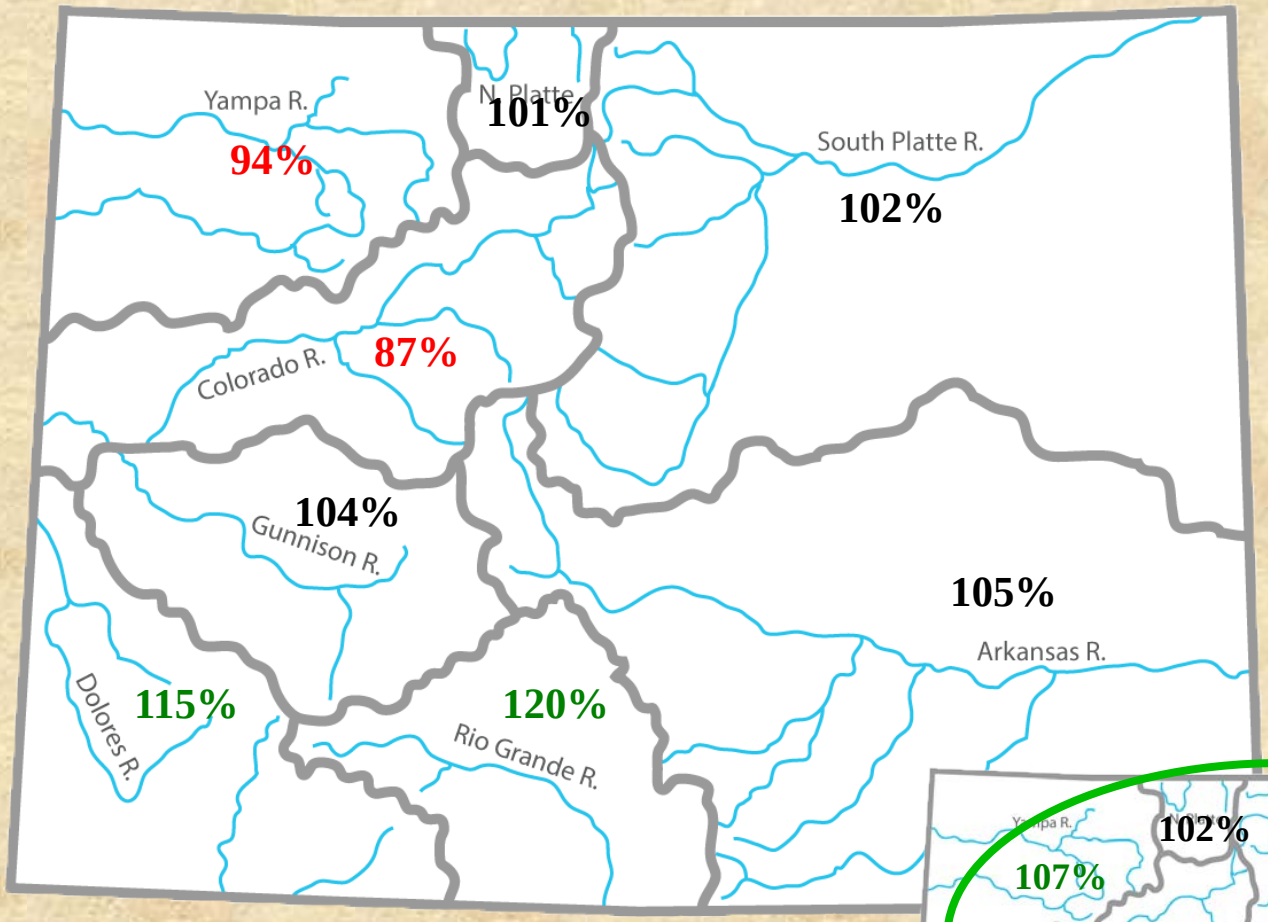
1jan15 SWE



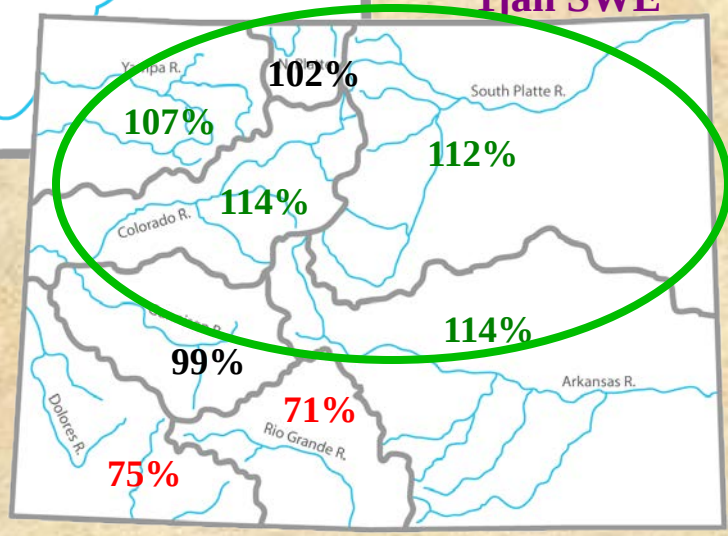
Median outcome for weak-to-moderate Los Niños since 1980 (top; fall seasons: '86, '91, '93, '02, '06, '09)

The north-central basins did better than expected, the southwestern mountains (much) worse!

Median Forecast 1jan SWE

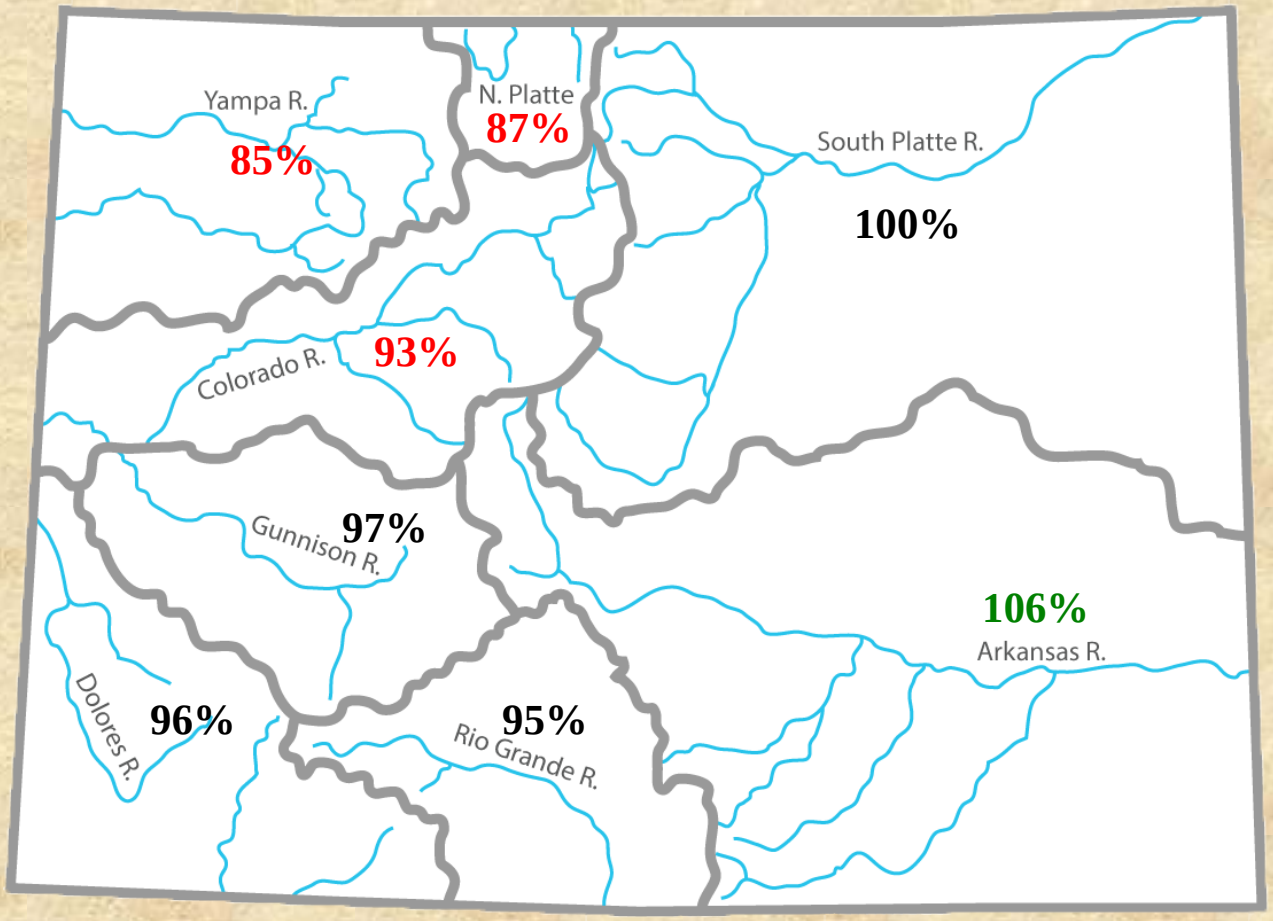


1jan SWE



Median forecast (top) based on SWE forecast initialized in September 2014 (same methodology as last year):
The north-central basins did better than expected, the southwestern mountains (much) worse!

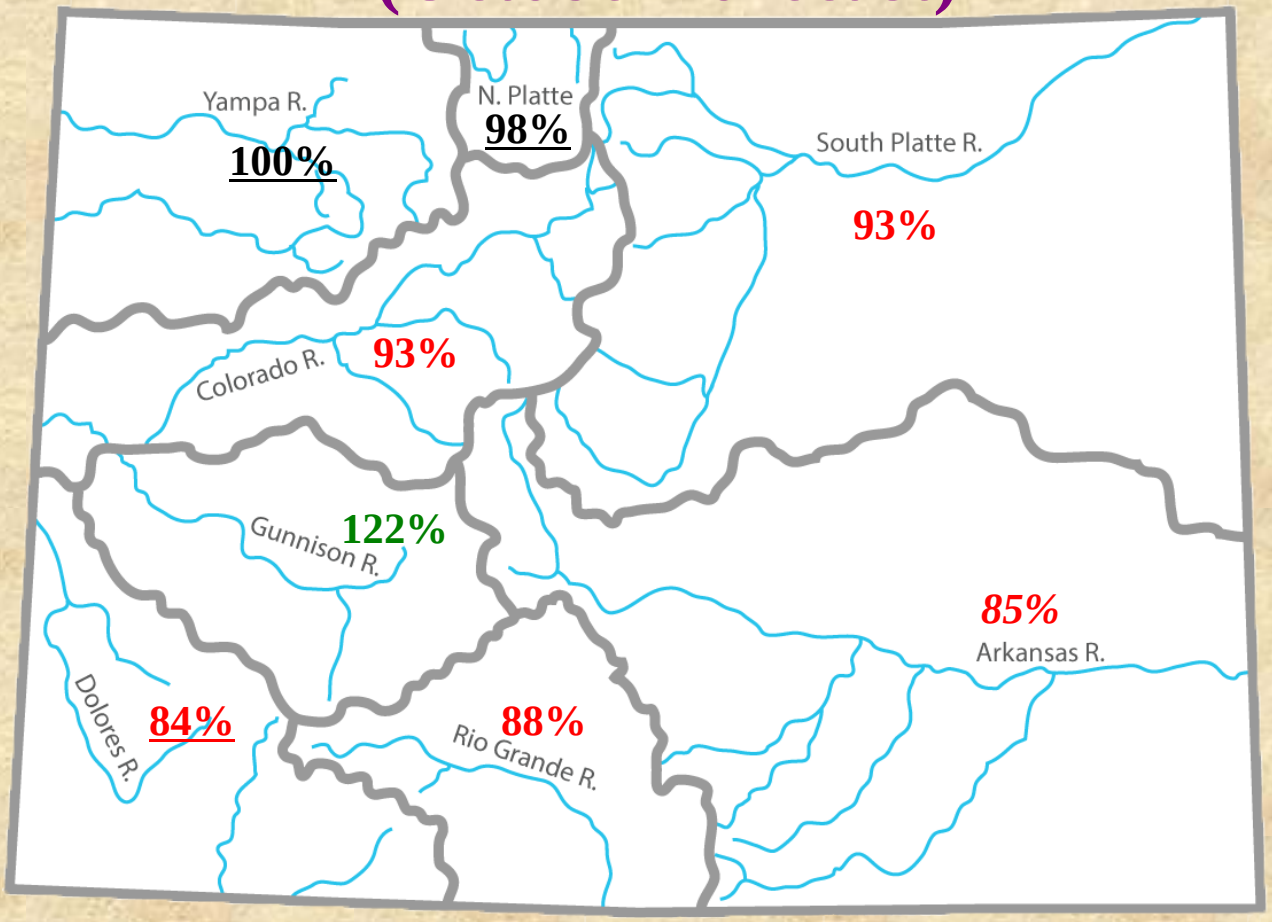
El Niño composites for 1apr SWE



Median outcome for same set of weak-to-moderate Los Niños since 1980 (during fall season: ‘86, ‘91, ‘93, ’02, ‘06, ‘09)

This is what I showed back in September!

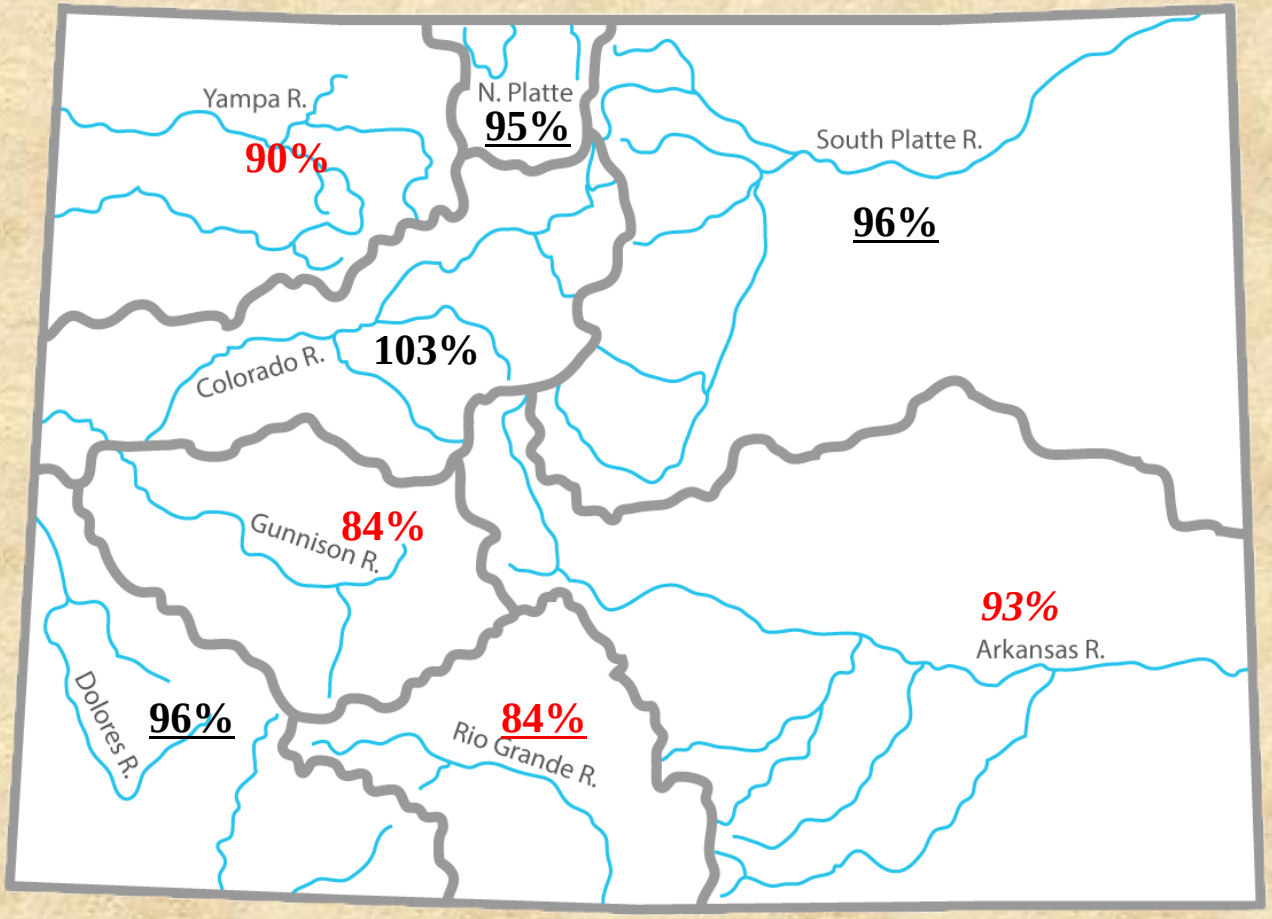
Median Forecast 1apr SWE (October forecast)



Median outcome based on SWE forecast initialized in October 2014 – 1st of its kind, ***caveat emptor!*** ***This was not looking good, except for the Gunnison basin.***

Low skill in training period leaves number in italics, while high training period skill is underlined; I ran some forecast without sea ice information, and the Dolores+ basin is the only one where it makes a big difference (107% w/o sea ice!).

Median Forecast 1apr SWE (updated)



Median outcome based on SWE forecast initialized this month. Biggest drop from old forecast in Gunnison basin, biggest gain in western San Juans and Colorado River. Compared to 1jan observations which are factored into this forecast, only the Western San Juans have to get above-normal snowfall to achieve the forecast value.

Low skill in training period indicated in italics, while high training period skill is underlined.

Executive Summary (20jan2015)

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- **A weak El Niño is expected to continue at similar strength for the next few months. While the next six weeks are fairly uncertain, more widespread moisture is typical in March with this condition. Positive PDO conditions are working to 'prop up' El Niño expectations.**
- **There appears to be a good chance for rejuvenated El Niño conditions by late spring that could extend this event right into the 2nd half of 2015. This would be good news for Colorado, especially during spring and summer. My own MEI forecast from December supports this scenario.**
- ***The winter so far has been unusual for an El Niño, with sharp temperture swings, and more snow in the northern Rockies than the south.***
- **CPC's forecasts favor a *wet* spring (March-May) for Colorado.**
- **Experimental precipitation forecasts have been unusually bullish for this winter, while the snowpack forecast for 1apr SWE is not nearly as optimistic.**
- **Bottomline: This year's confusing ENSO situation has translated into confusing guidance with regard to our seasonal precipitation and snowpack outlook. While statewite drought conditions are not likely, the more optimistic scenarios appear to be linked to stronger El Niño conditions than we have seen so far. *Near-normal snowpack in the Gunnison basin on 1jan15 as well as my new runoff forecast for Lees Ferry favor a near-normal outcome for the Colorado River, while the San Juans face the greatest threat of drought in the near-term.***