Earth System Research Laboratory
Physical Sciences Division

CIRES
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Colorado WATF,
17 March 2015
Denver

Seasonal Outlook for Colorado

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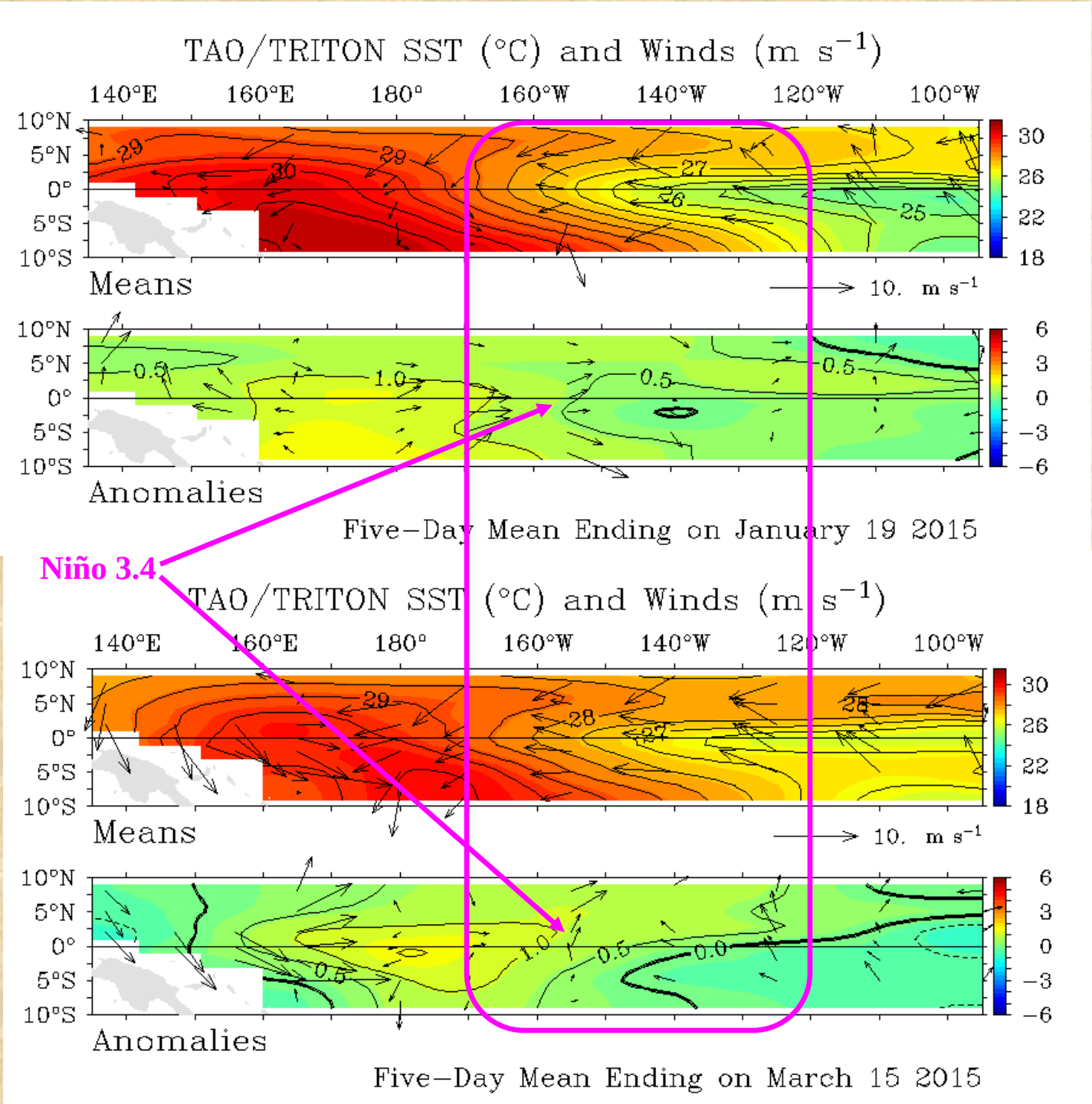
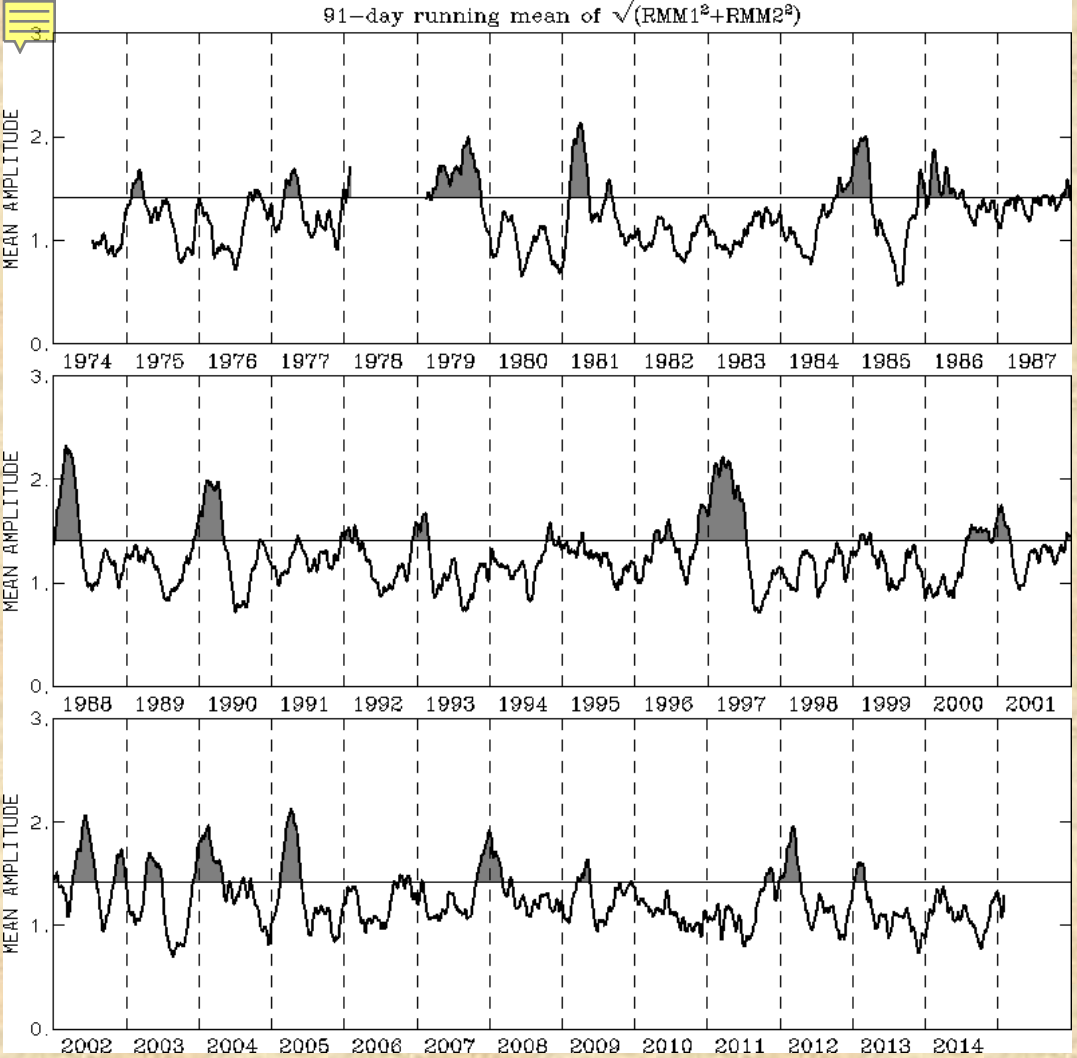
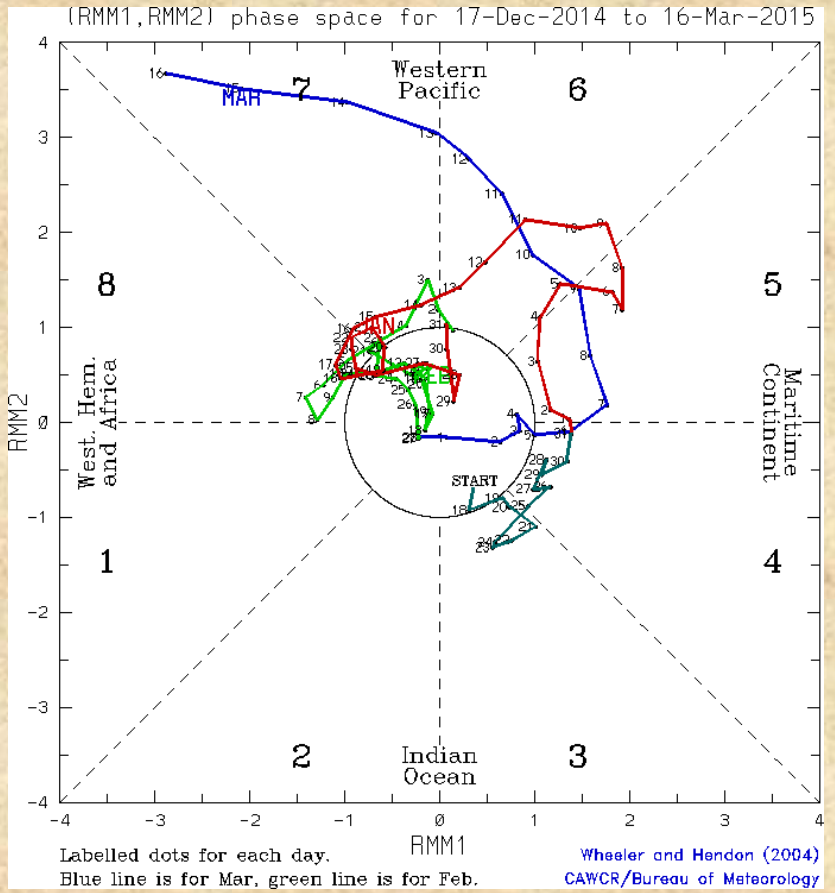
- **What has happened to ENSO(+), what will happen next, and what does that mean for us?**
- **CPC forecasts into summer**
- **Experimental precipitation guidance/Postmortem SWE**
- **Executive Summary**

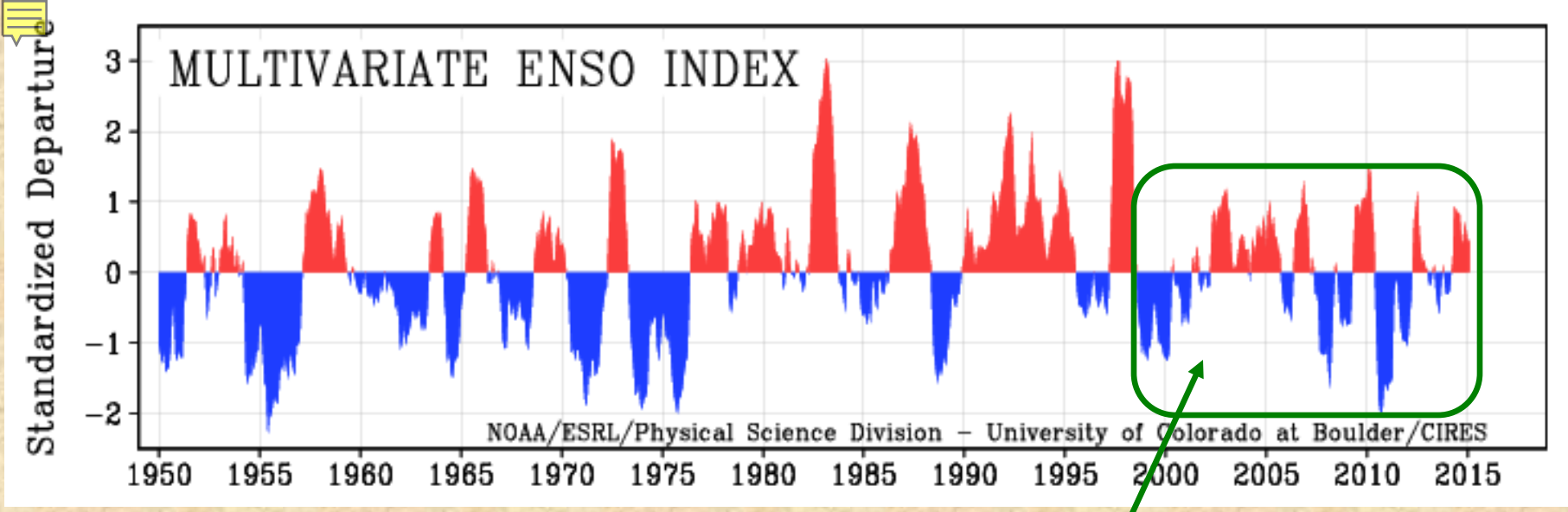
Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to January (top): Recent SST anomalies (Niño 3.4 still at+0.5C) are borderline El Niño, while wind anomalies keep teasing us, being just west of a perfect setup for El Niño growth.

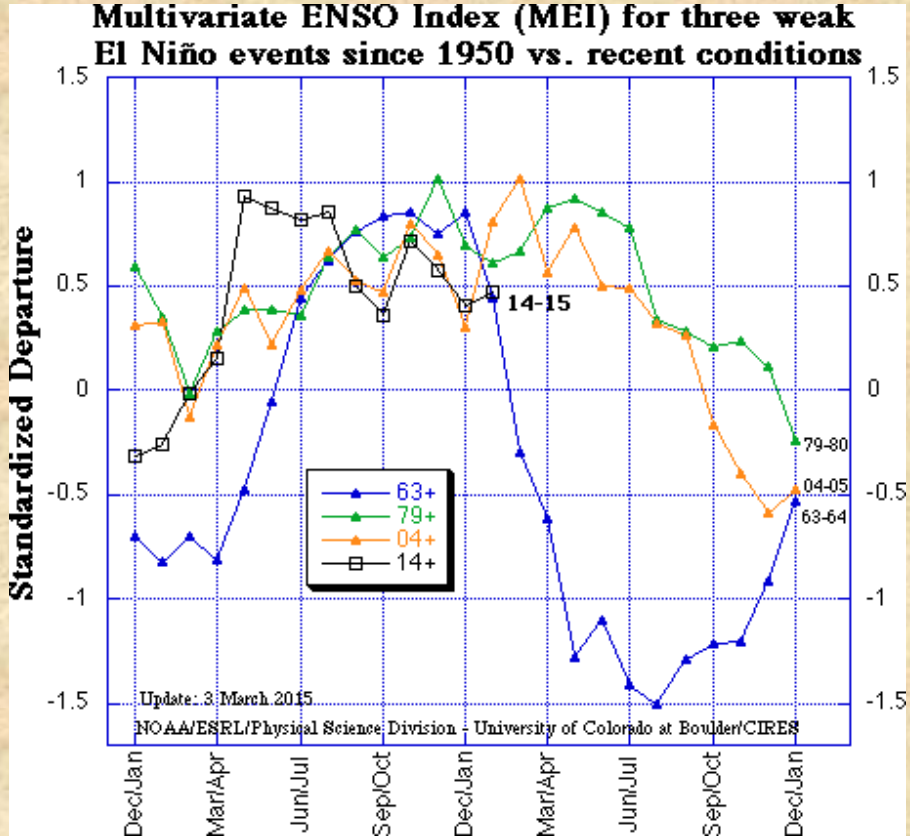






After a few years of being 'AWOL' (left), the MJO has returned to an 'active state' (right). ***I am not ready yet to call this the 'Jeb Bush' MJO.***

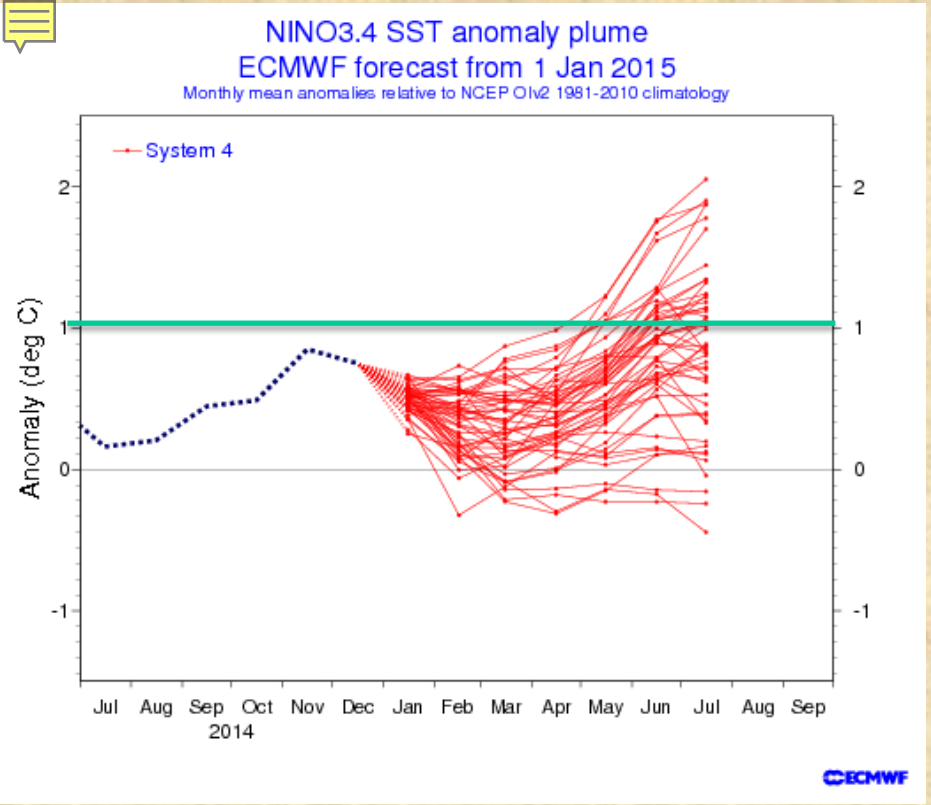




Since late 1998 we have been in a regime that favors La Niña, but does allow for occasional El Niño events, mostly of the weak-to-moderate variety.

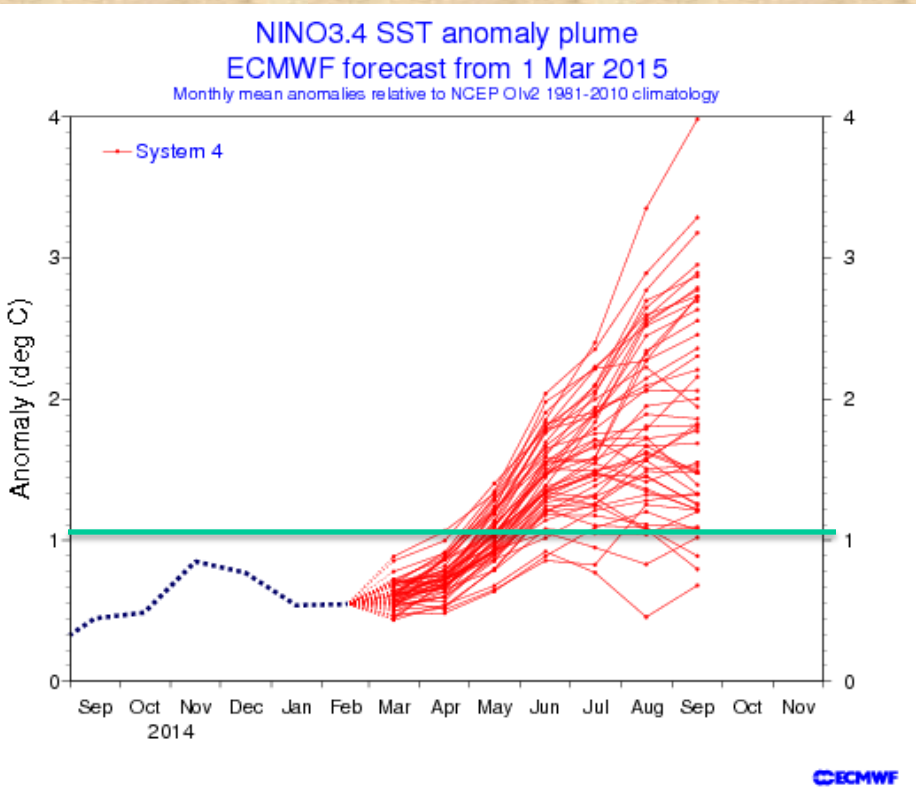
Since April-May 2014, the MEI has indicated El Niño-like conditions, similar to the 2004-05 event in particular. While 1979-80 shared this behavior as well, 1963-64 is a good counter-example of a weak El Niño that came out of La Niña and returned back to it as soon as it could. Working on MEI forecast...

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



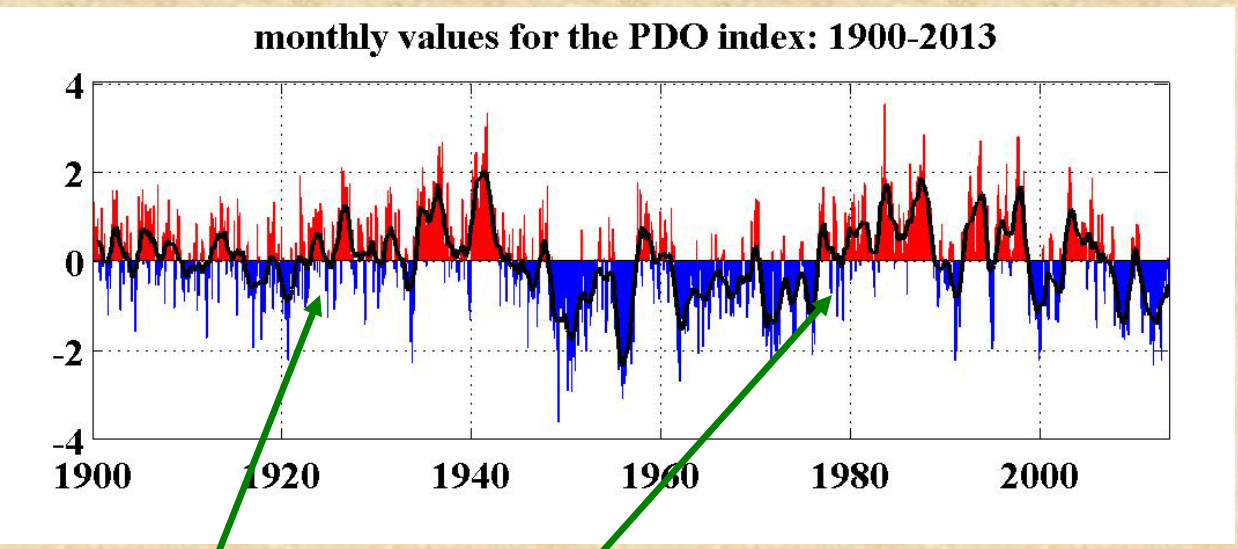
The ECMWF January 2015 forecast (left) kept the borderline event weak for a few more months, but showed an interesting uptick during late spring/early summer, with perhaps 20-30% of the ensemble members exceeding +1.0° C by July 2015.

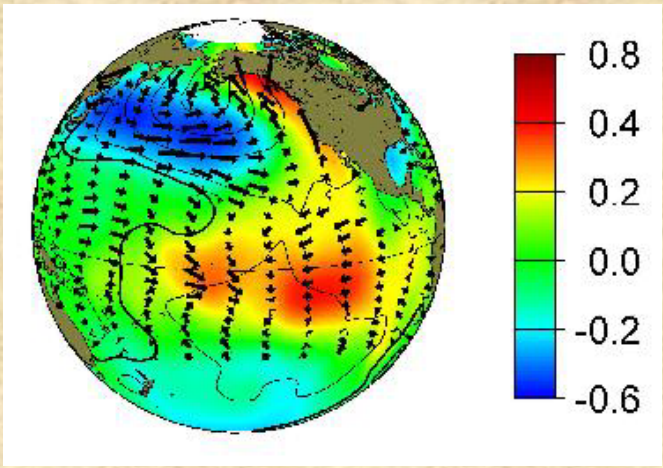
The ECMWF March 2015 forecast (right) is very bullish, with over 90% of the ensemble members exceeding +1.0° C! Of course, this brings back memories of last year's overpredicted event...



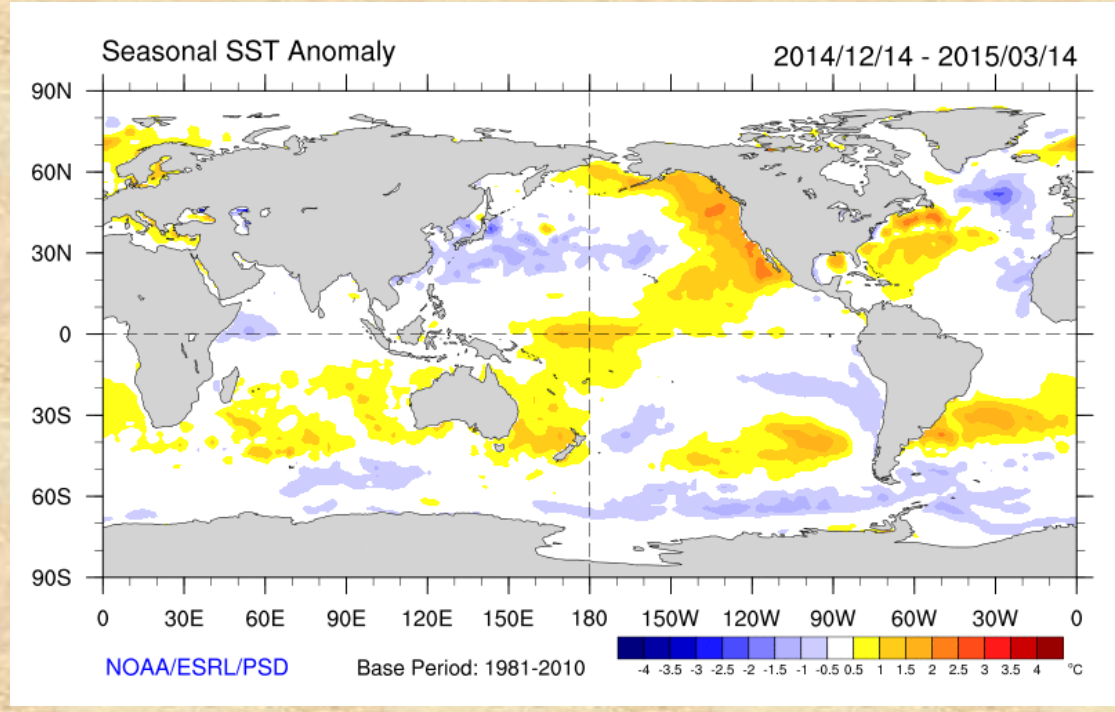
http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/seasonal_range_forecast/

http://research.jisao.washington.edu/pdo/



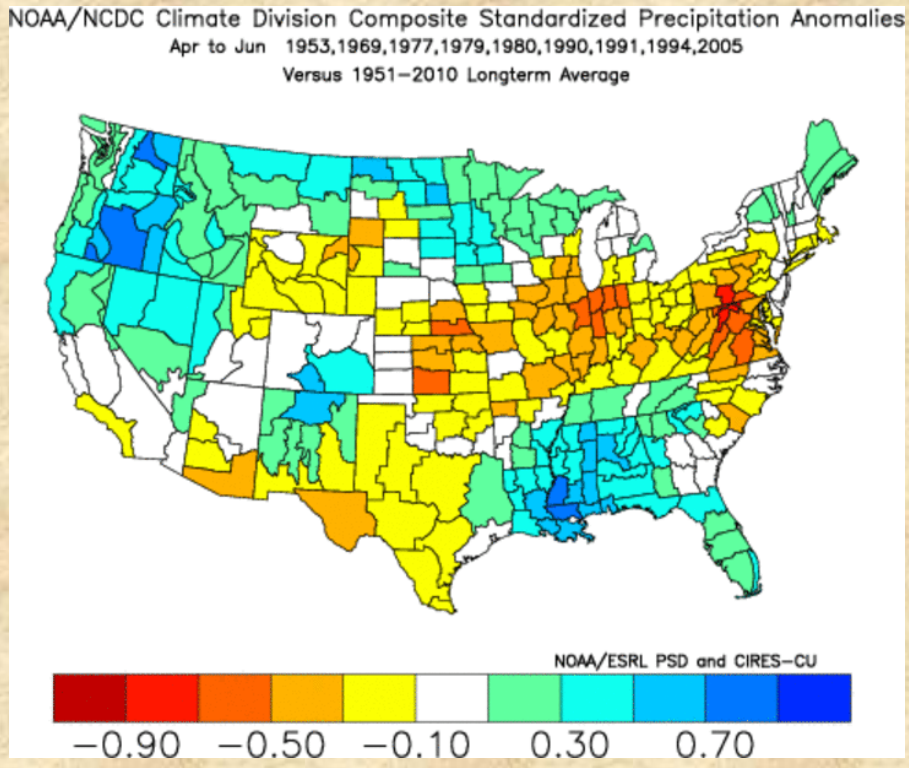


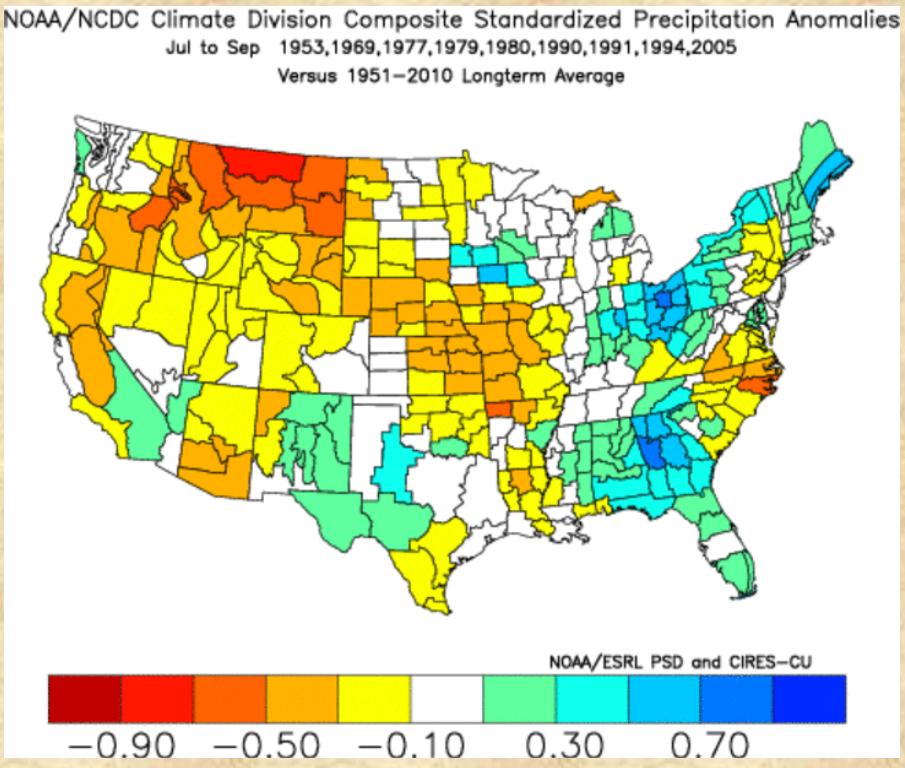
The PDO had a negative run over the last decade, but has been continuously positive since January 2014, in fact the last three monthly values are the highest on record. Previous transitions to the positive phase of the PDO (around 1925+ and 1976+) were characterized by several years of 'flip-flopping', while there can also be fake transitions to the positive phase during an overall negative regime, such as around 1959 and 2003.



In the absence of reliable PDO predictions, the jury is still out on this

MEI-based analog cases



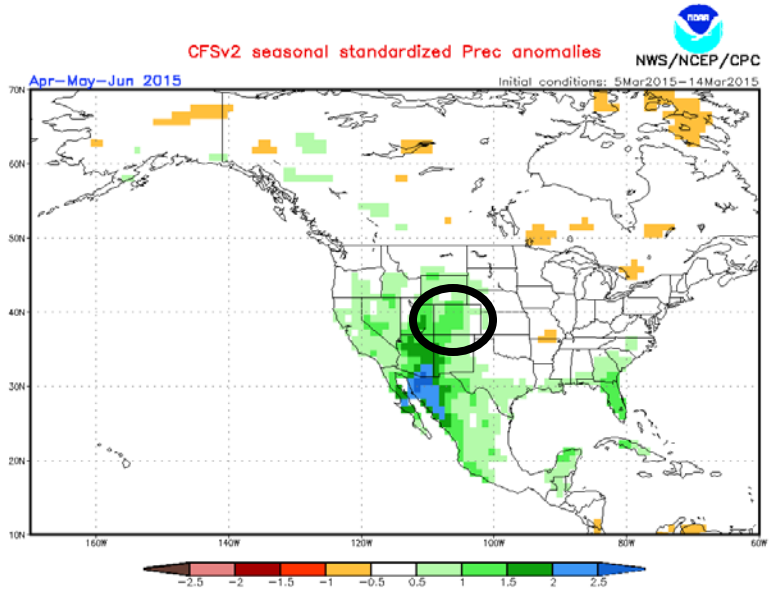


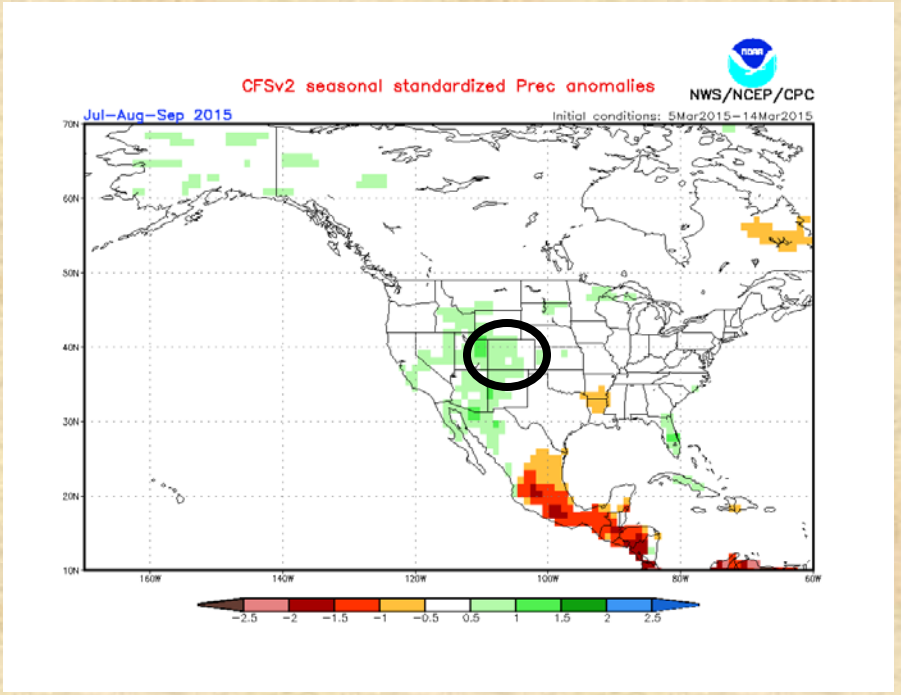
Weak El Niño composites for April-June (left) and July-September (right) favor wet spring in SE Colorado, neutral odds elsewhere. ***Keep this in mind when we look at my independent statistical forecast.*** **Meanwhile, a first peek at the summer is 'vanilla-lemon' flavored'...**

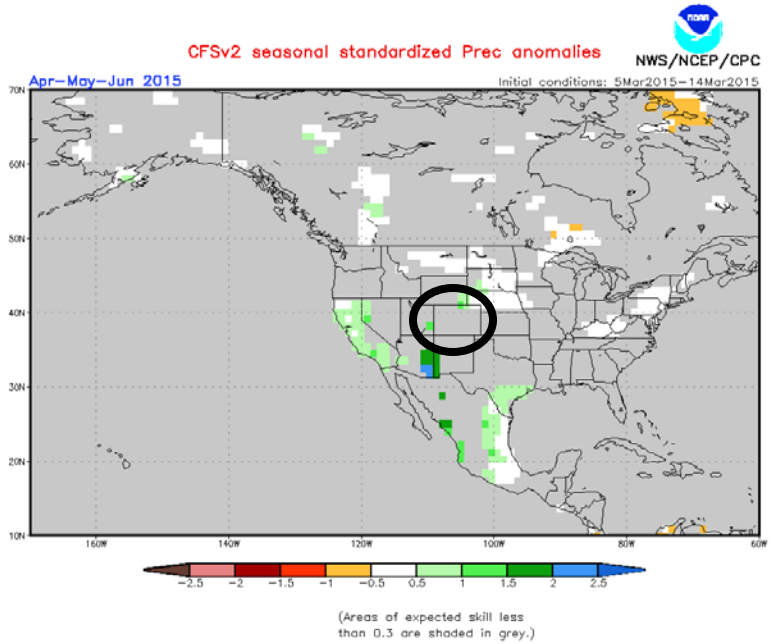
Factoring in positive PDO conditions reinforces the spring outlook (but only 5 cases), while favoring a drier monsoon. ***I will have a real forecast for that season next month.***

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

CPC Coupled Forecast System Version 2



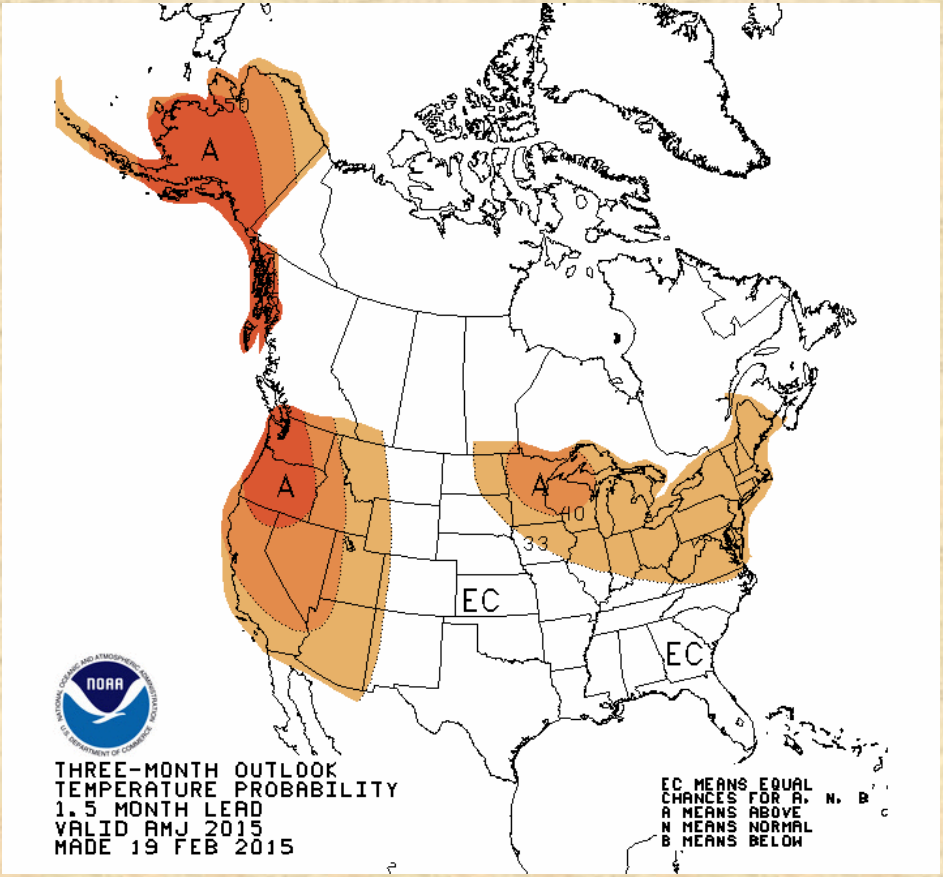


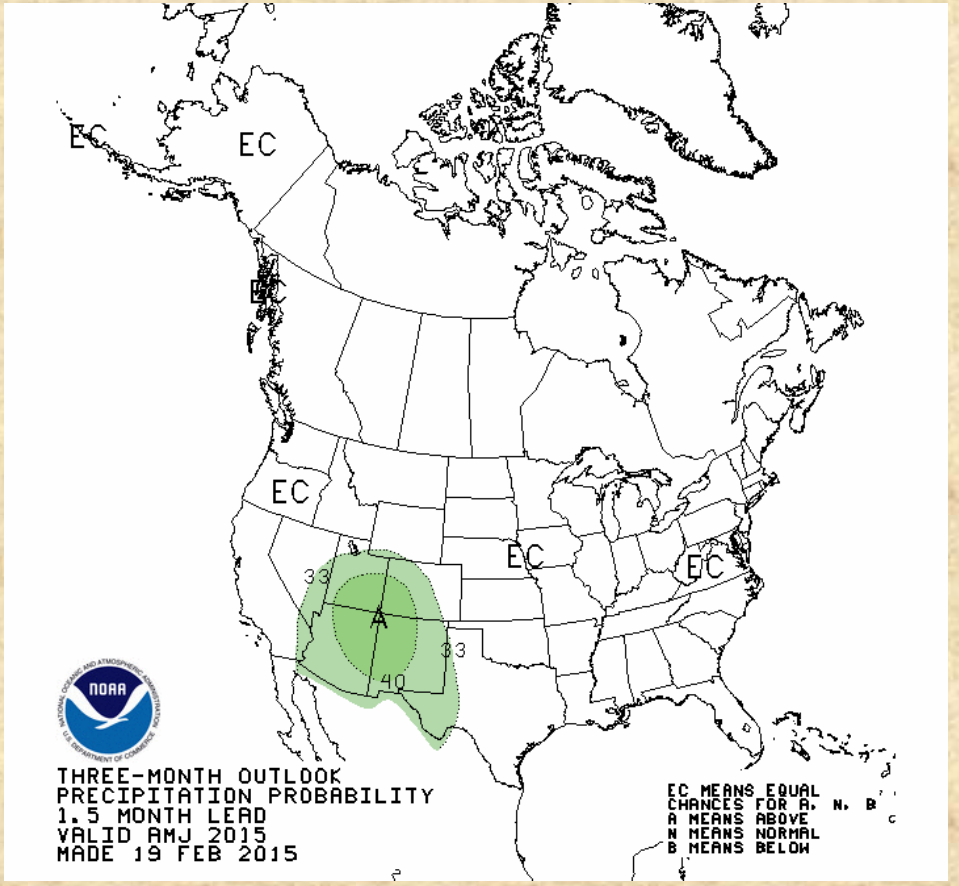


CFS forecasts for April-June (left) and July-September (right; top = standardized anomalies/bottom = same with skill mask) favor wet spring and summer conditions, unfortunately with NO skill during summer, and teasing us with marginal skill during spring – just outside Colorado.

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

Climate Prediction Center Forecasts

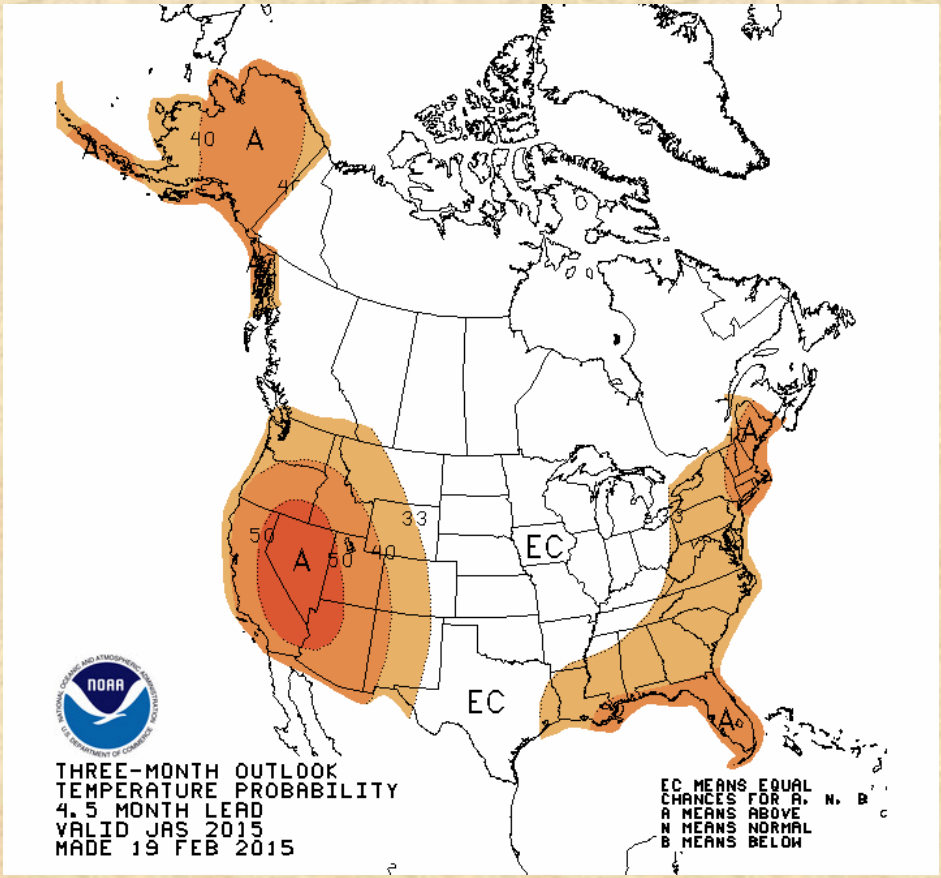


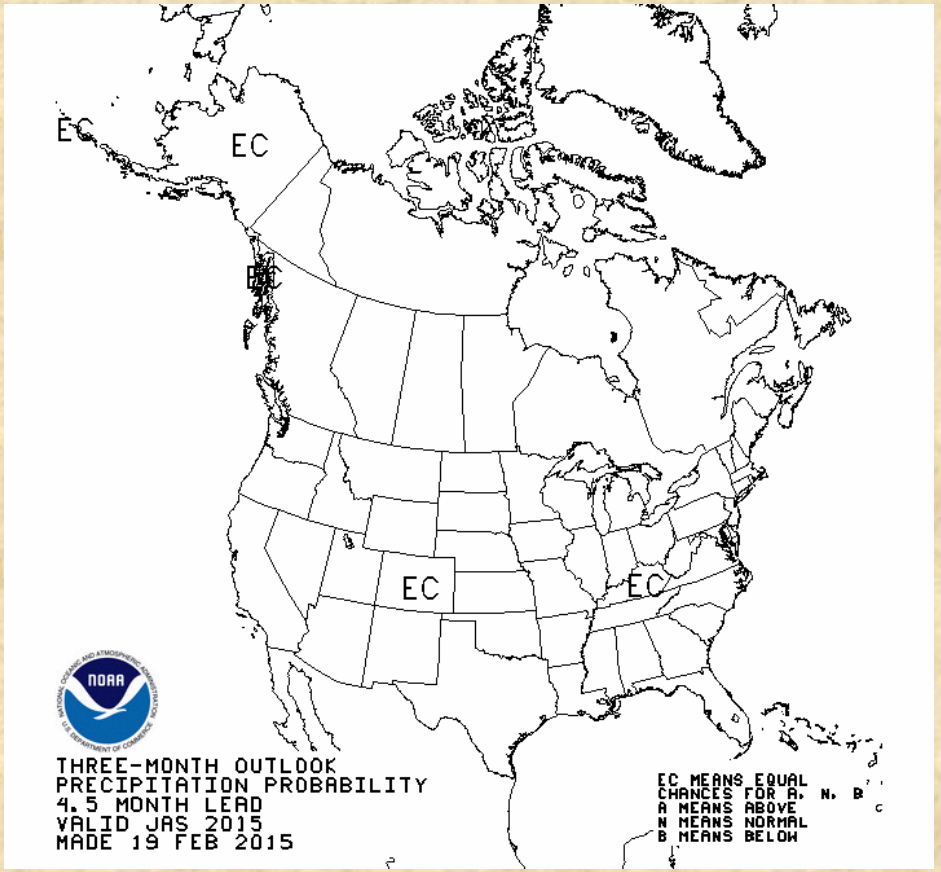


The spring temperature forecast by CPC (left) keeps Colorado undecided ('EC'). Their moisture forecast (right) continued surprisingly bullish. The updated forecast will come out in two days…

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

Climate Prediction Center Forecasts

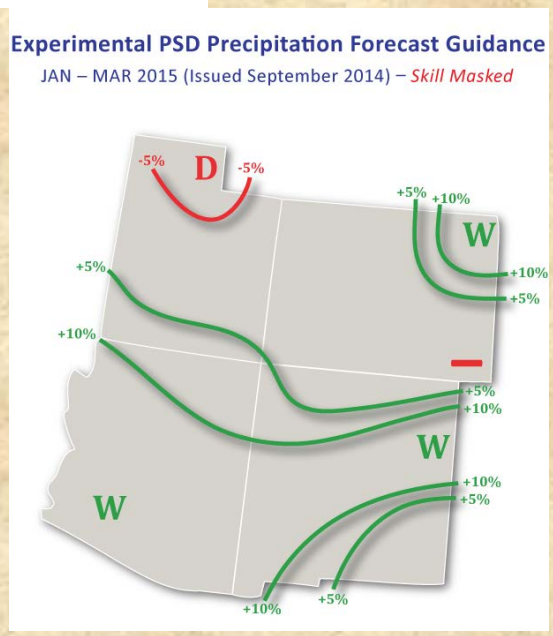


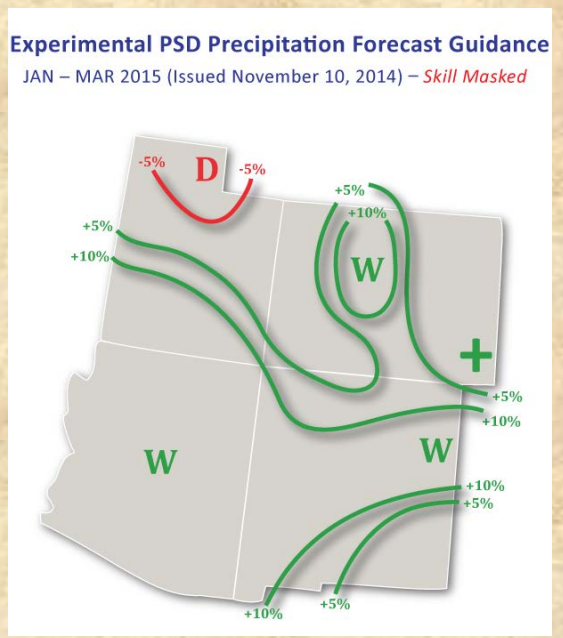


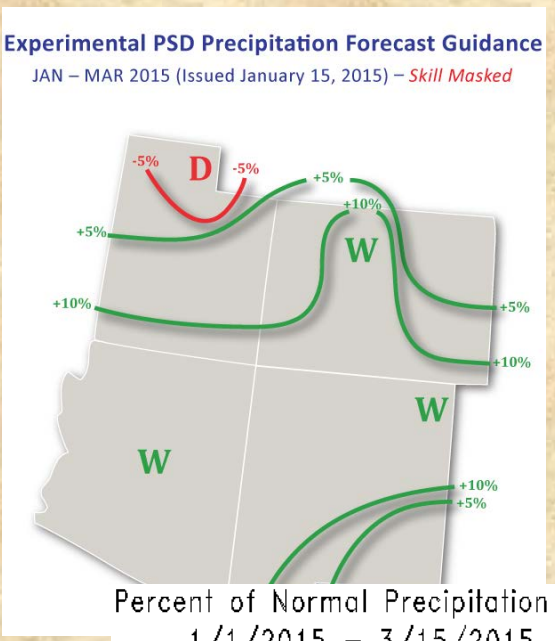
The summer temperature forecast by CPC (left) puts Colorado on the edge of a big warming trend to our west, as has been the case for quite a few seasons. Their moisture forecast (right) punted last month <insert comment here>... The updated forecast will come out in two days…

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

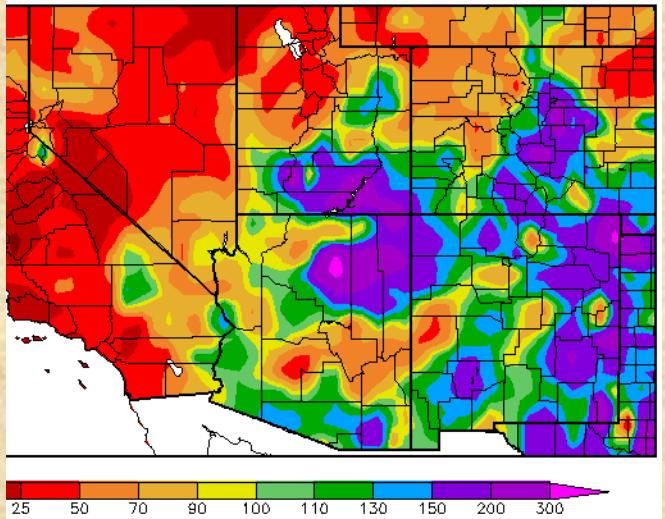
‘Postmortem’ January-March 2015







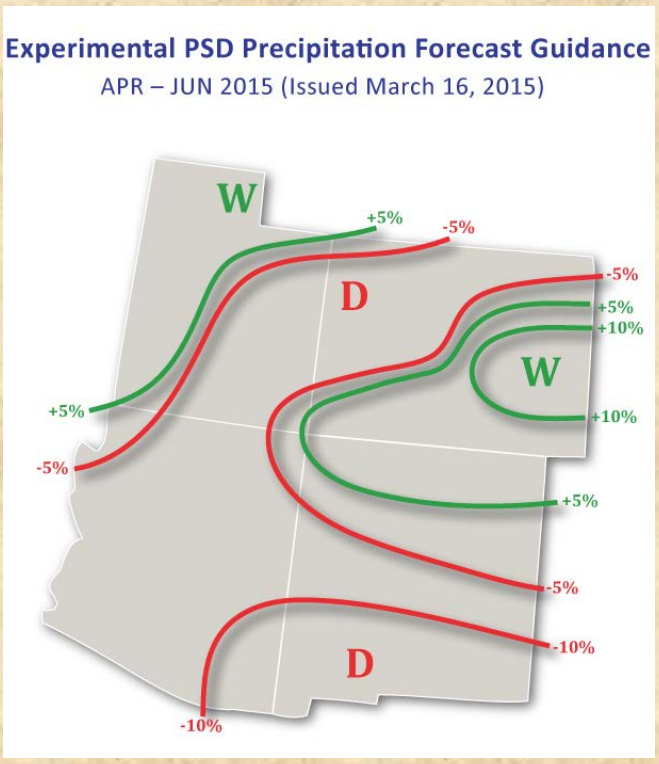
Percent of Normal Precipitation (%)
1/1/2015 – 3/15/2015

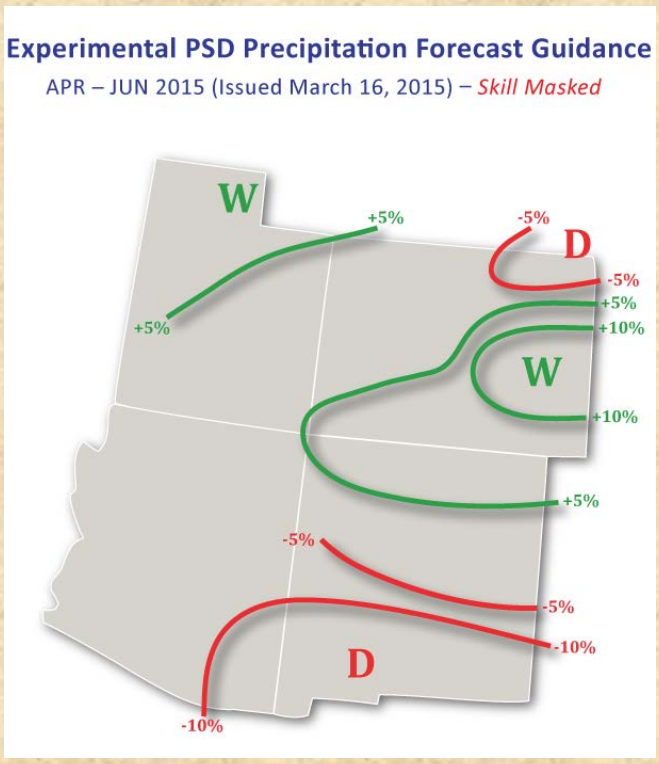


The skill-masked winter forecasts (latest on the right) showed a wet tilt for most of CO. The only CO region not covered by skillful forecasts in last two updates was in the northeast corner.

From a broader perspective, note the persistent tilt towards drought conditions in northern Utah. Unfortunately, the latter ended up extending all the way into NW Colorado. But the overall skill score will end up positive, thanks to last month...

Statistical Forecast for April-June 2015





Spring forecast is wet for southeastern half of CO, dry(ish) for the northwestern half, the latter being in a region with low skill over last 15 years.

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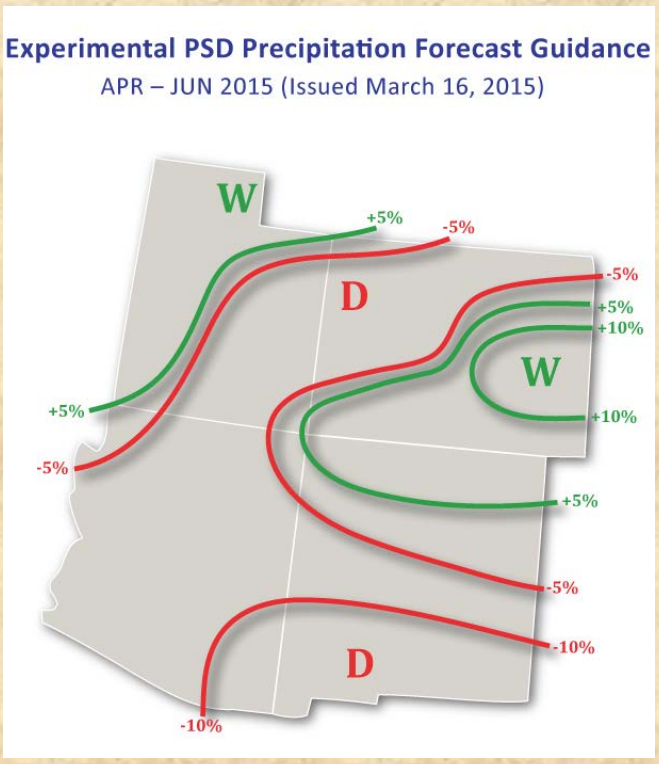

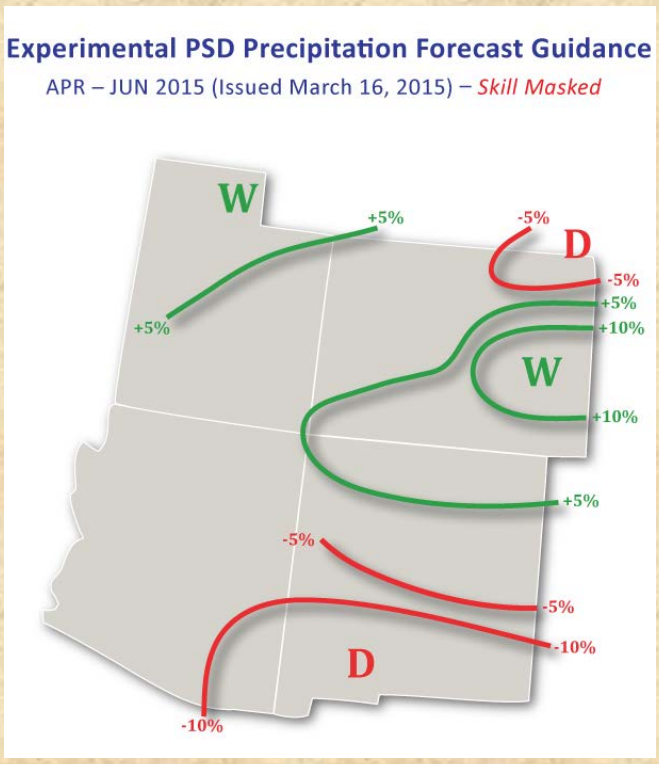

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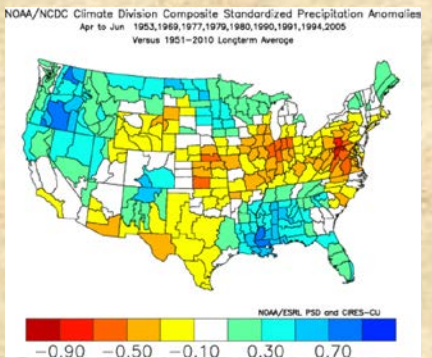
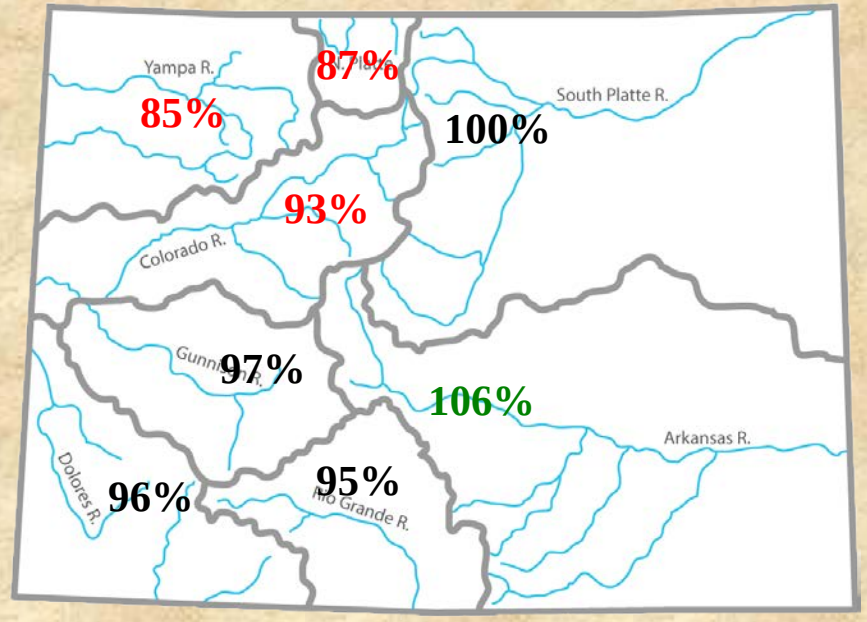
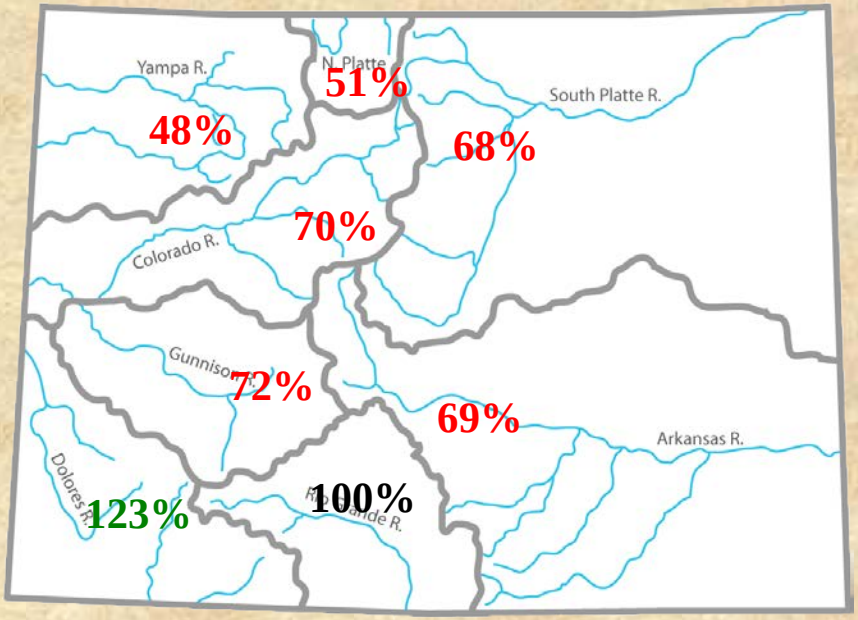
Flashback to weak El Niño composite:

√



El Niño composites for SWE
1apr: left / 1jun: right

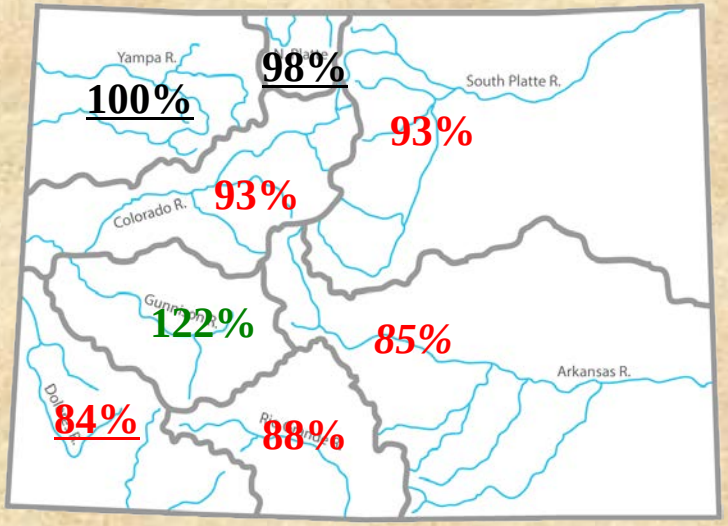


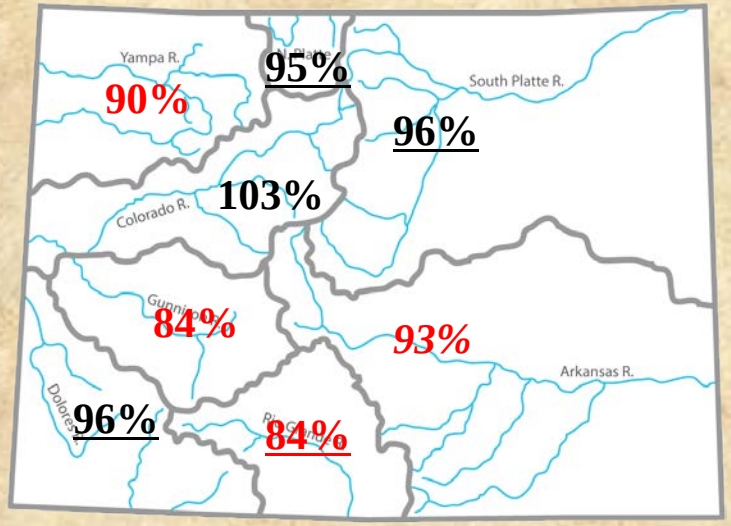


Median outcome for same set of weak-to-moderate Los Niños since 1980 (during fall season: ‘86, ‘91, ‘93, ’02, ‘06, ‘09)

I showed the left composite last September

Median Forecast 1apr SWE
October (left) & January (right)

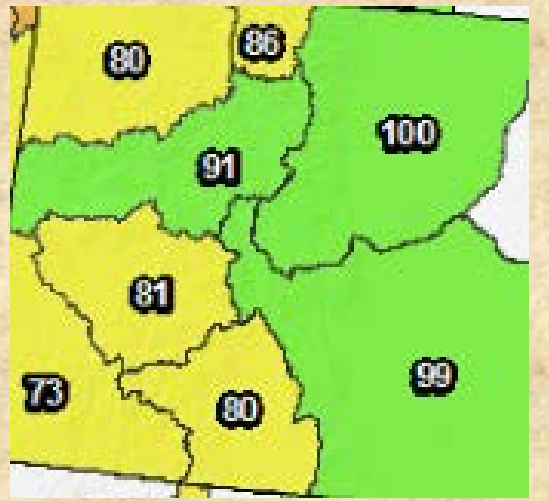




Forecasts issued five and two months ago were somewhat pessimistic (5/4 times under 95%), but appear to have picked the correct negative anomaly sign for five/six of eight basins.

Depending on the next two weeks, pessimistic outlook may actually verify even worse. El Niño composites were helpful this year.

16mar15: SWE (% median)



Notes on flooding risks in 2015

SNOWMELT-RELATED:

- ***Moderate/low snowpack is not increasing snowmelt-related flooding risk (for now)***
- ***Very low dust load does not threaten to increase the speed of snowmelt – so far!***
- ***This season has seen more stationary circulation patterns than last year, thus increasing the risk of 'heat waves' that could trigger an early melt surge (coming close right now).***

FLASHFLOOD-RELATED:

- ***Some of the most prominent examples of flash-flooding occurred during El Niño summers – perhaps not quite as pronounced as last year's onset case.***
- ***Soil moisture and water table have remained high in regions hit by floods in Sep'13. Natural reservoirs appear not quite as full as last year (backyard observations), but still above normal. Last year, a lot of temporary fixes to our infrastructure were tested by decent rainfall events both in late May and in July, and appear to do just fine. That is good news, but should not be considered as something in the 'rearview mirror' just yet.***

Executive Summary (17mar2015)

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- **A weak El Niño is expected to gain strength over the next few months. The usual caveats around spring ENSO predictions apply. However, positive PDO conditions are working to 'prop up' El Niño expectations.**
- **CPC's forecasts favor a *wet* spring (April-June) for Colorado, with warm temperatures anchored to our west for occasional visits, as seen over the last week, early February, ...**
- **Experimental precipitation forecasts are supportive of a wet forecast in SE half of state during the next three months, also consistent with new El Niño composites.**

  Since late fall, we seem to be on the edge of the stormtrack which allows for occasional wet spells to balance things out, especially along the Front Range. IOW, *don't put away your snow tires just yet.*
- **Bottomline: This year's confusing ENSO situation translated into confusing guidance with regard to our seasonal precipitation and snowpack outlook. Some of this could be elevation-related (*El Niño events tend to be wetter at lower elevations during the winter season, while the highest elevations are often dry*). Compared to last year's flood threat, this year appears to be at lower risk, but still elevated compared to average years. Drought conditions may be 'nibbled at' in particular in the Arkansas basin, but I don't foresee a wholesale removal any time soon.**