Earth System Research Laboratory
Physical Sciences Division

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Colorado WATF,
23 September 2015
Denver

Seasonal Outlook for Colorado

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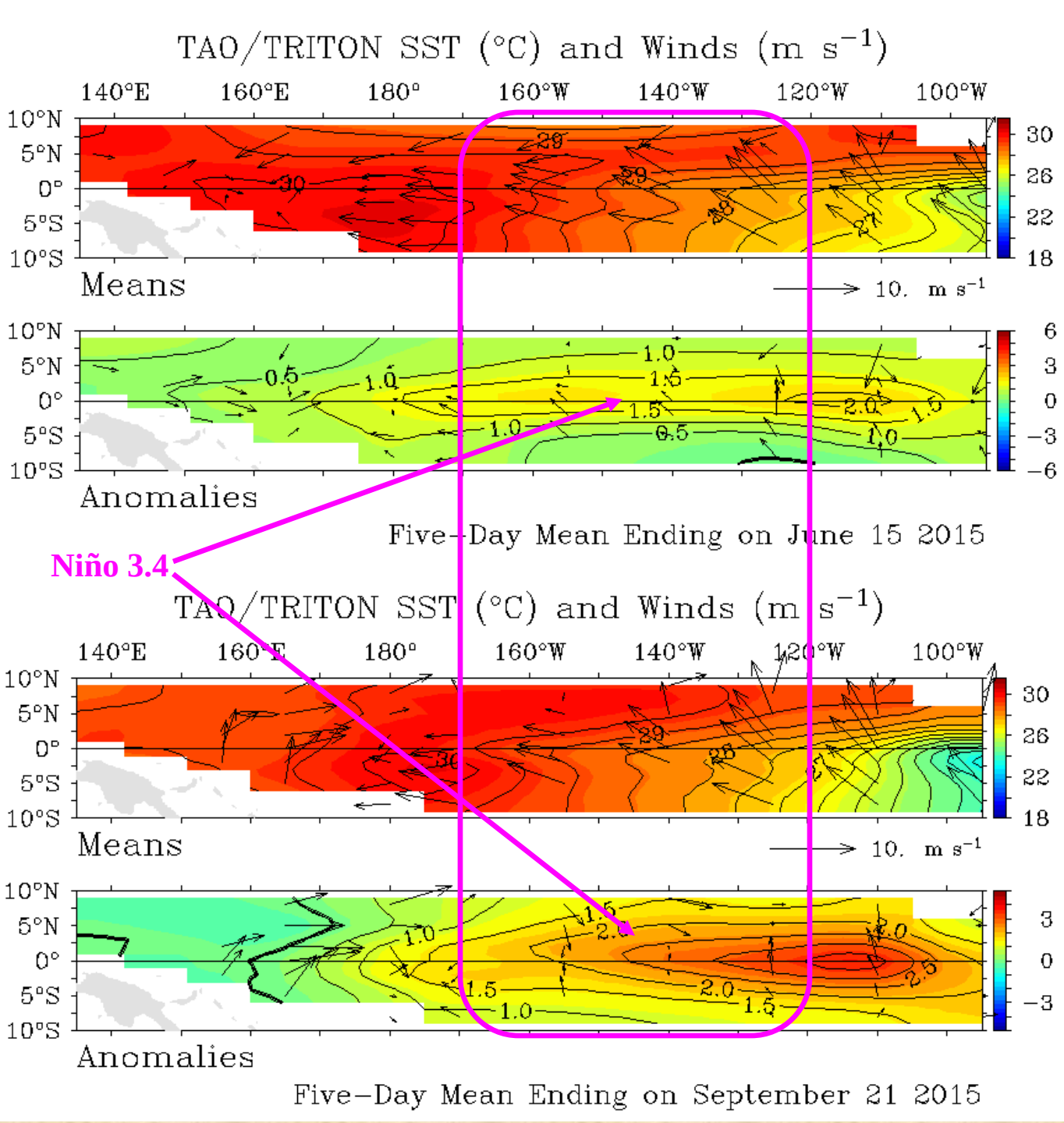
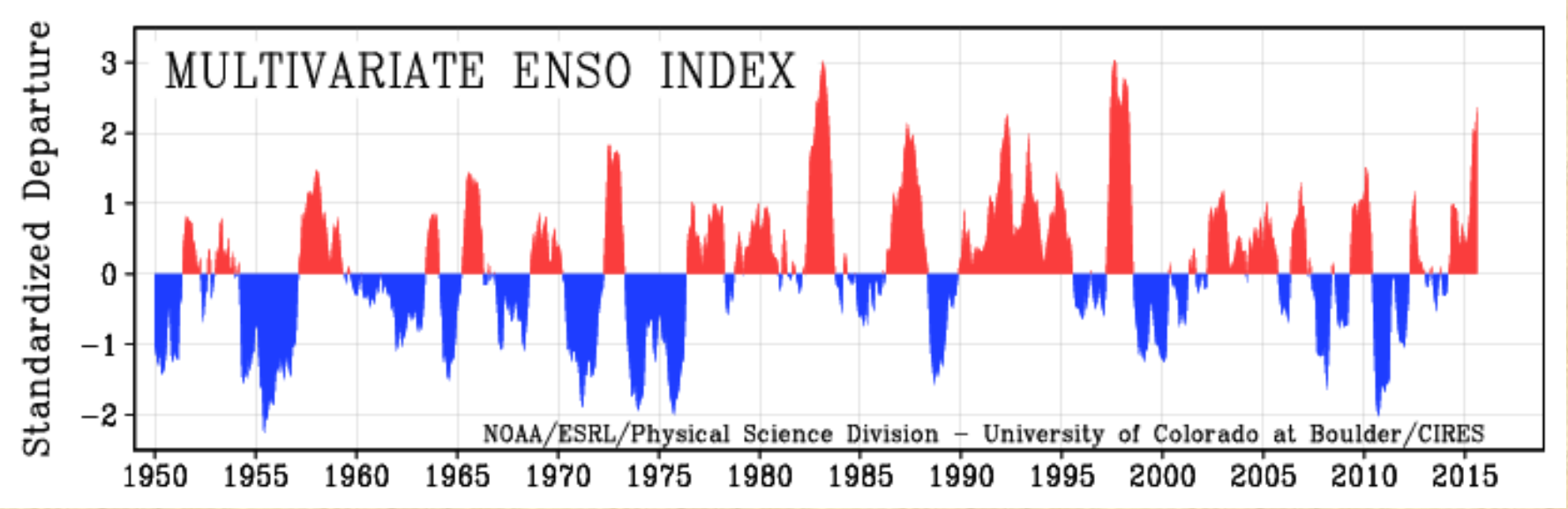
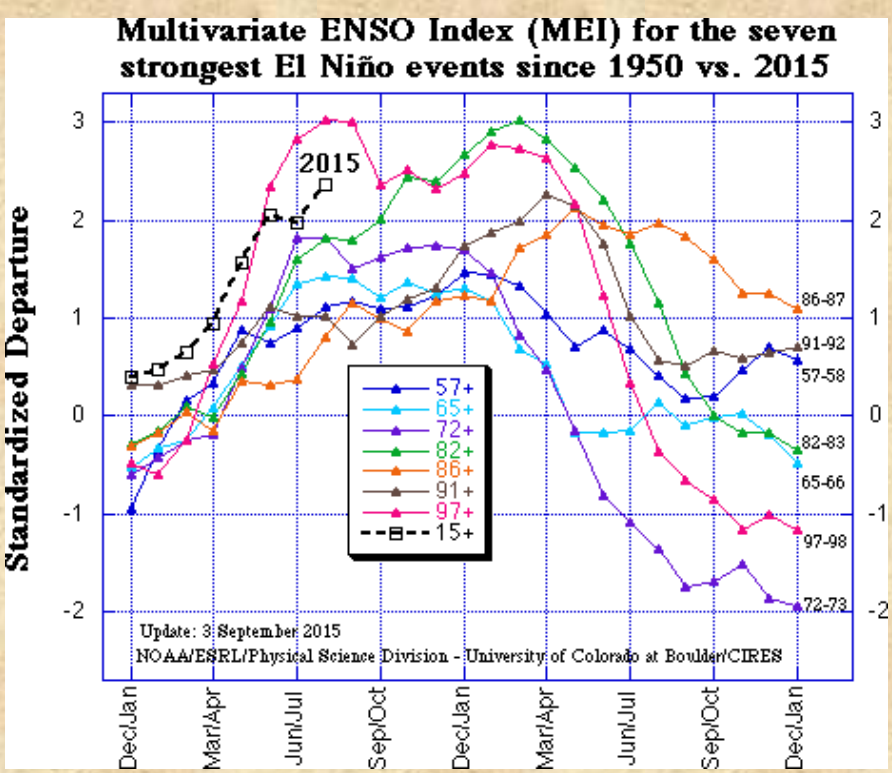
- *Is it a 'Godzilla Niño' yet?*
- **Does it make a difference for us? A look at precip&SWE**
- **CPC forecasts into early 2015**
- **Seasonal fall forecast guidance for precipitation**
- **Executive Summary**

Current state of El Niño/Southern Oscillation (ENSO) phenomenon (bottom), compared to last time (top): over the summer, SST anomalies have come up a lot along the Equator (weekly Niño 3.4 now at +2.3° C), while westerly wind anomalies have been in 'maintenance mode'. Unless we get a big westerly wind event, our El Niño may have reached its peak.

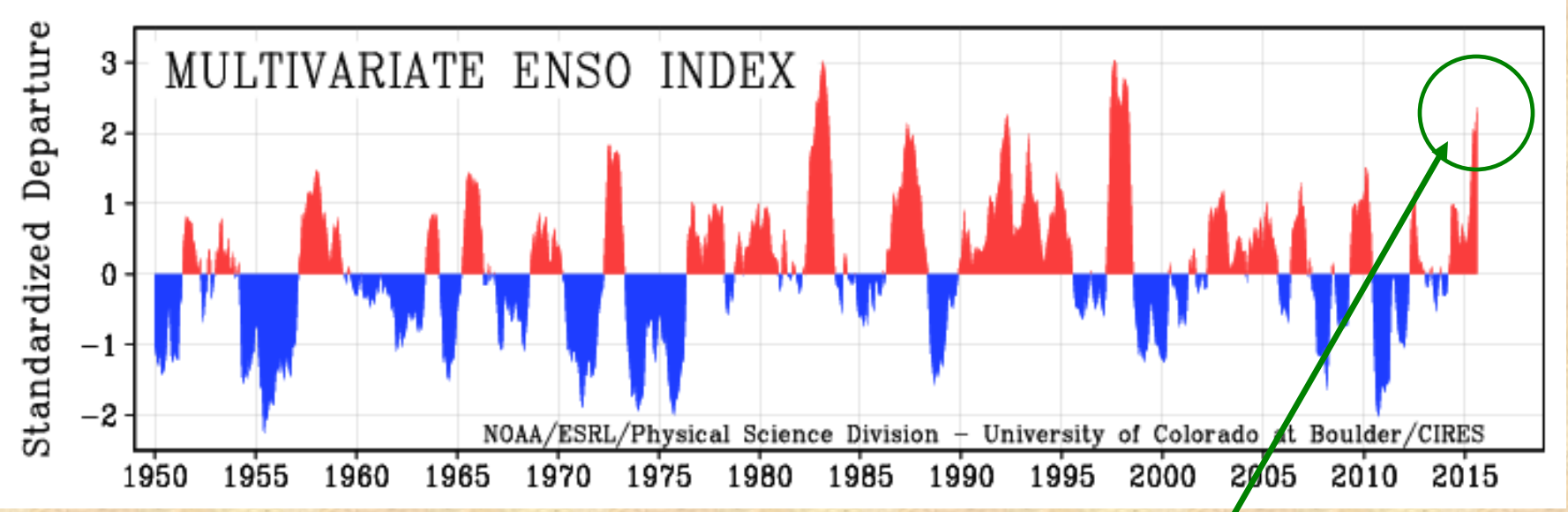


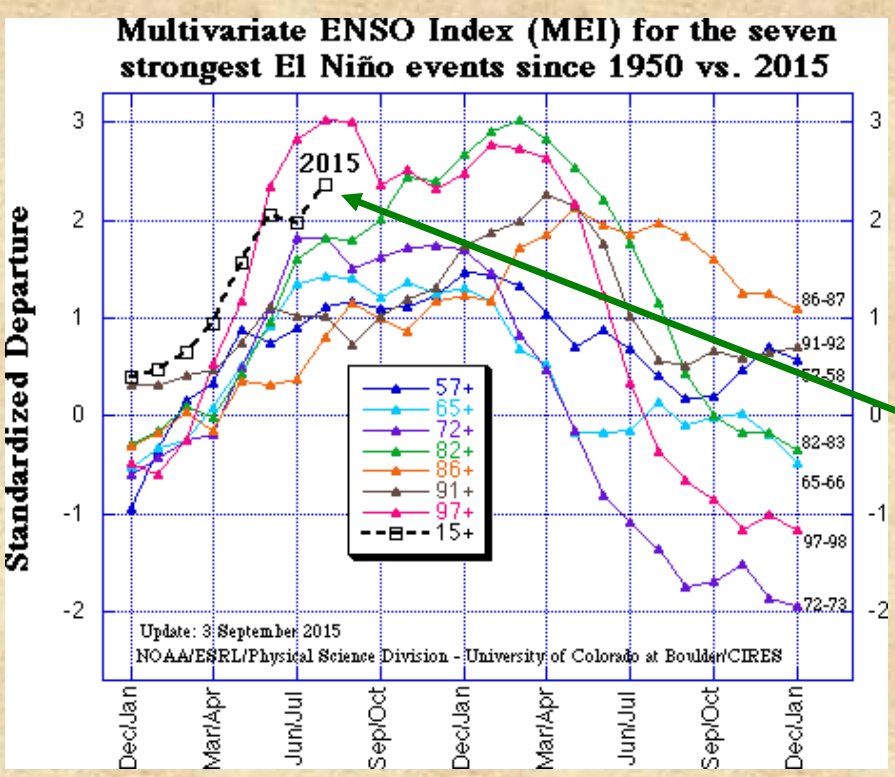




The **MEI** monitors ENSO based on all observed fields over the tropical Pacific (pressure, wind, temperatures, and cloudiness). El Niño events can reach up to +3 standard deviations, while La Niña events may dip down to -2 standard deviations. **The current El Niño has already reached +2.37, the largest MEI value since 1998**. If it continues to grow, it could become the third 'Super El Niño' in just over three decades - ***we will know it if we see it...***

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





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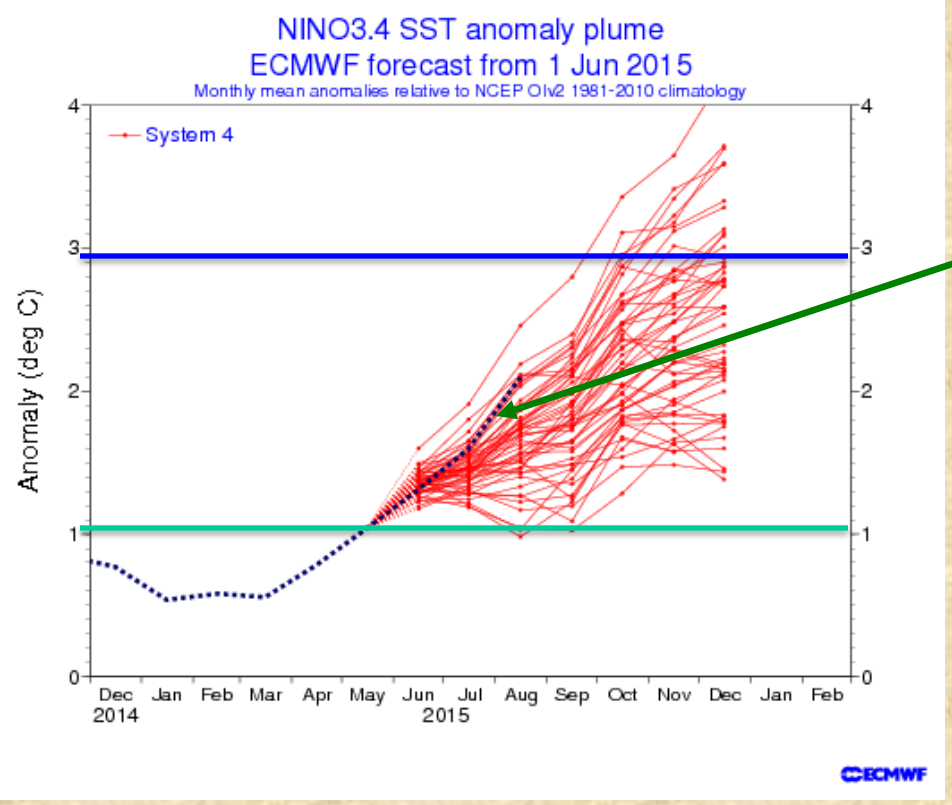
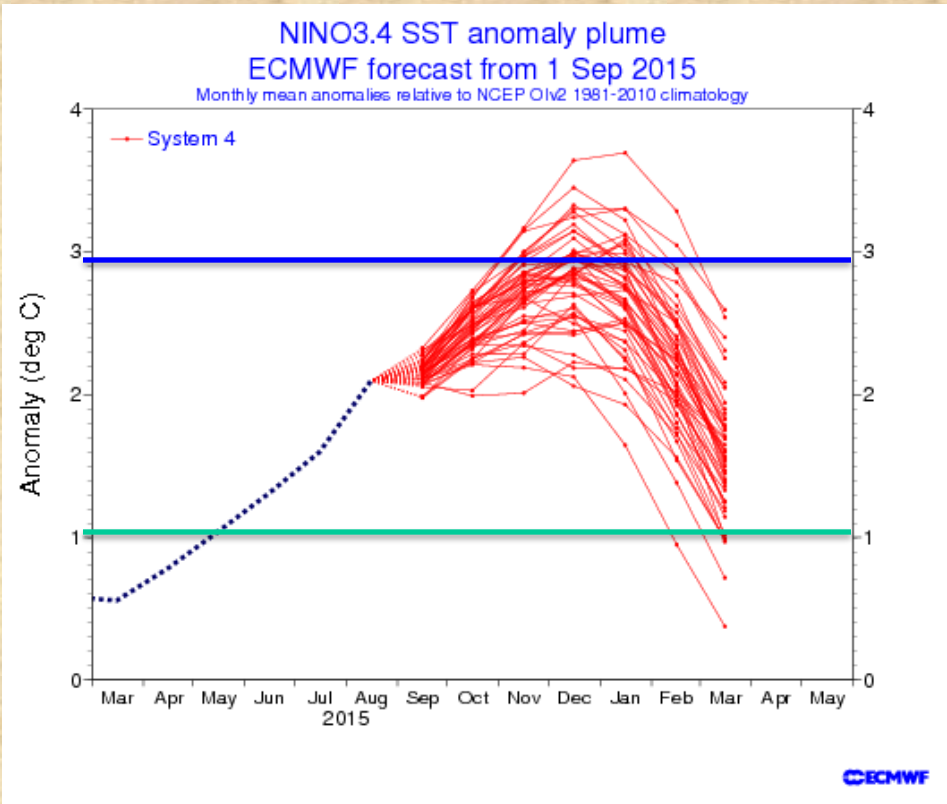


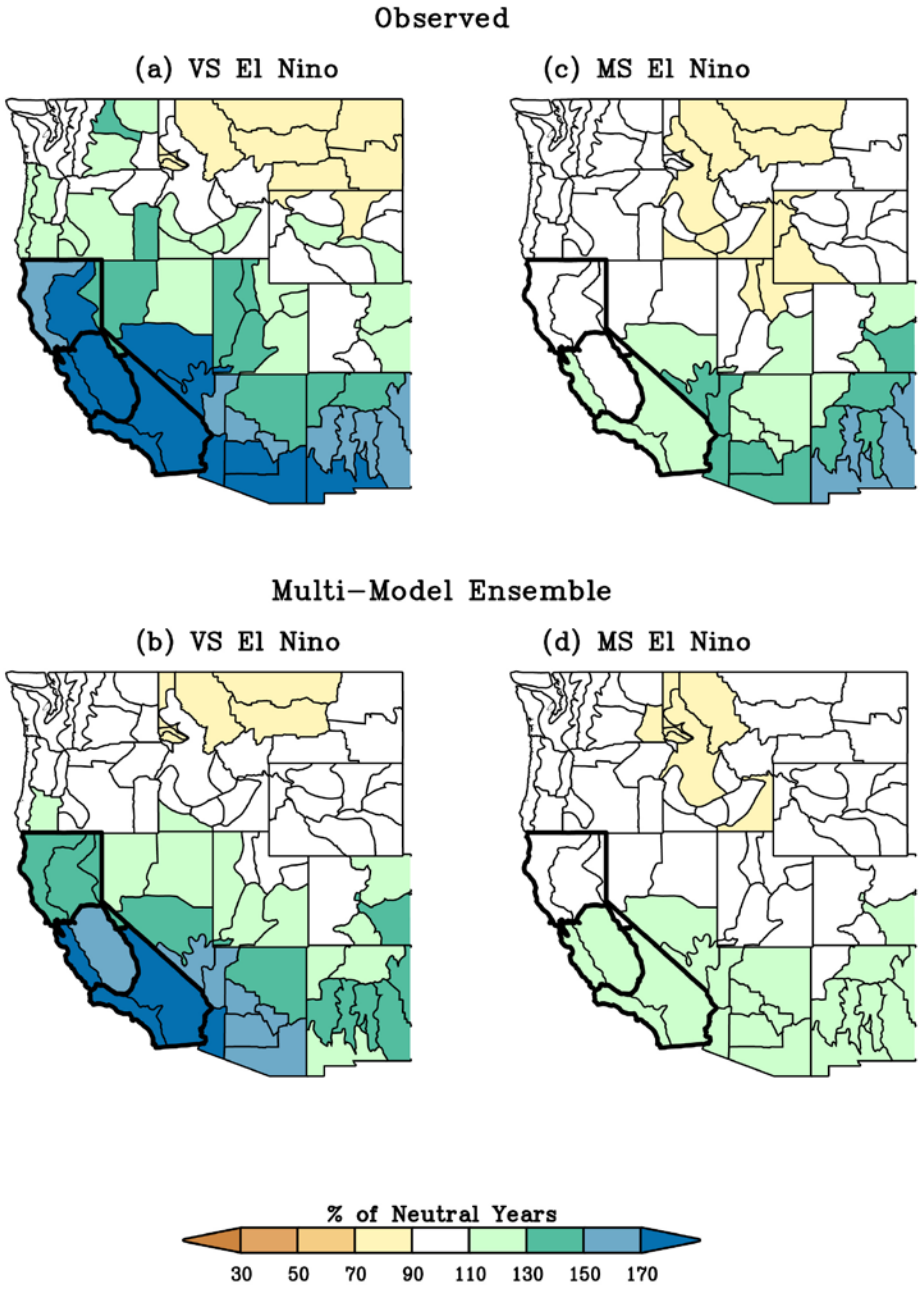
The ECMWF June 2015 forecast (left) was bullish with a wide range. The observed (blue) Niño 3.4 SST ended up on the high end of the plume in July and August. Peak expected value were mostly between 2-3° C, with outliers on both sides...

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



The updated ECMWF forecast (right) shows a more compact plume, with a peak perhaps a bit closer to +3° C (was even higher in August plume). A peak ≥2.5° C would be considered a *'Super-El-Niño'* (record: +2.8° C in Jan'83).

New IRI plume similar, not shown here.

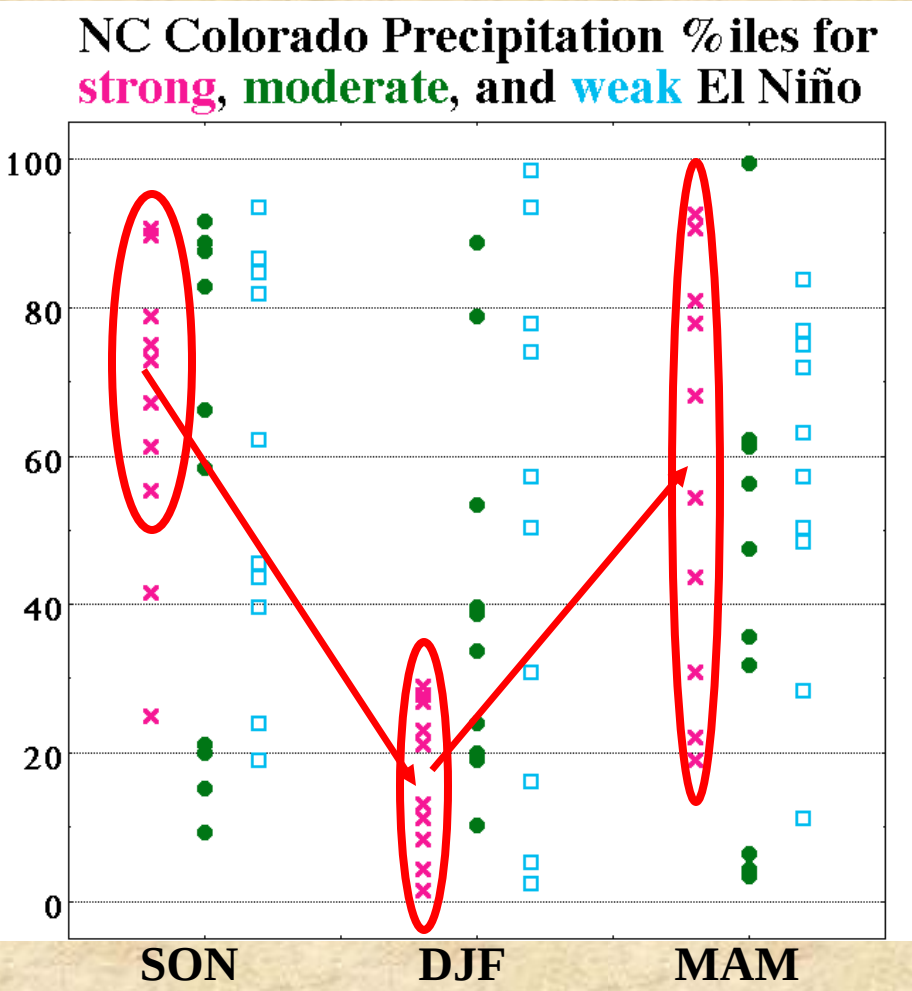


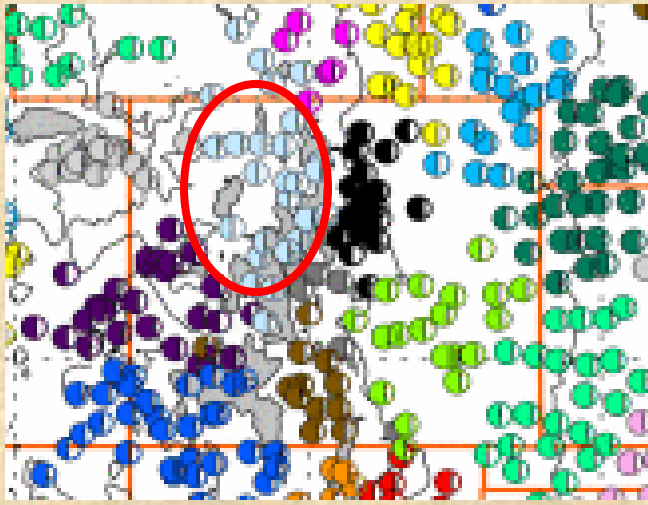
Does size matter? **Strong hint in models (3 models, 130 ensemble members) and data that it does (for Nov-Apr, based on 2 Super vs 16 mod-strong events since 1900).**

Perhaps the evidence is not as clear-cut over CO as for CA.

Hoell et al. (2015, submitted)

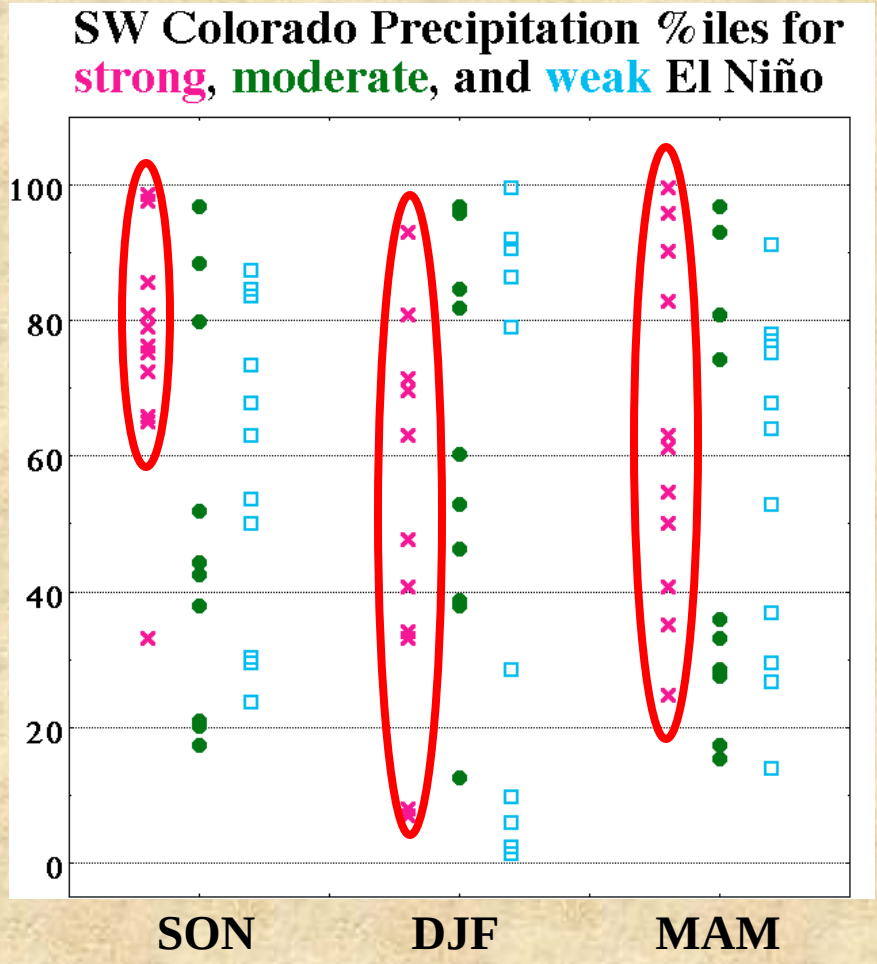
A closer look at Northwest Colorado (1910-2011)

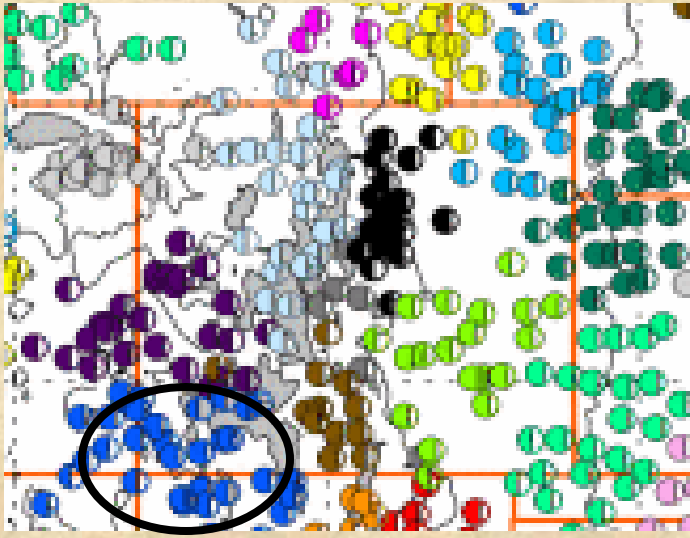




The northern mountains from the Elk to the Park Range are favored this fall under strong El Niño conditions (red), severely handicapped during winter (ALL 10 cases in lowest 30%), and only slightly favored during spring. Thus, fall season is critical – only one dry fall came out ahead in the end: 1994-5; while only one wet fall was followed by dry winter&spring: 1965-6. *Plan B: Weaken El Niño during winter and rebound in spring!*

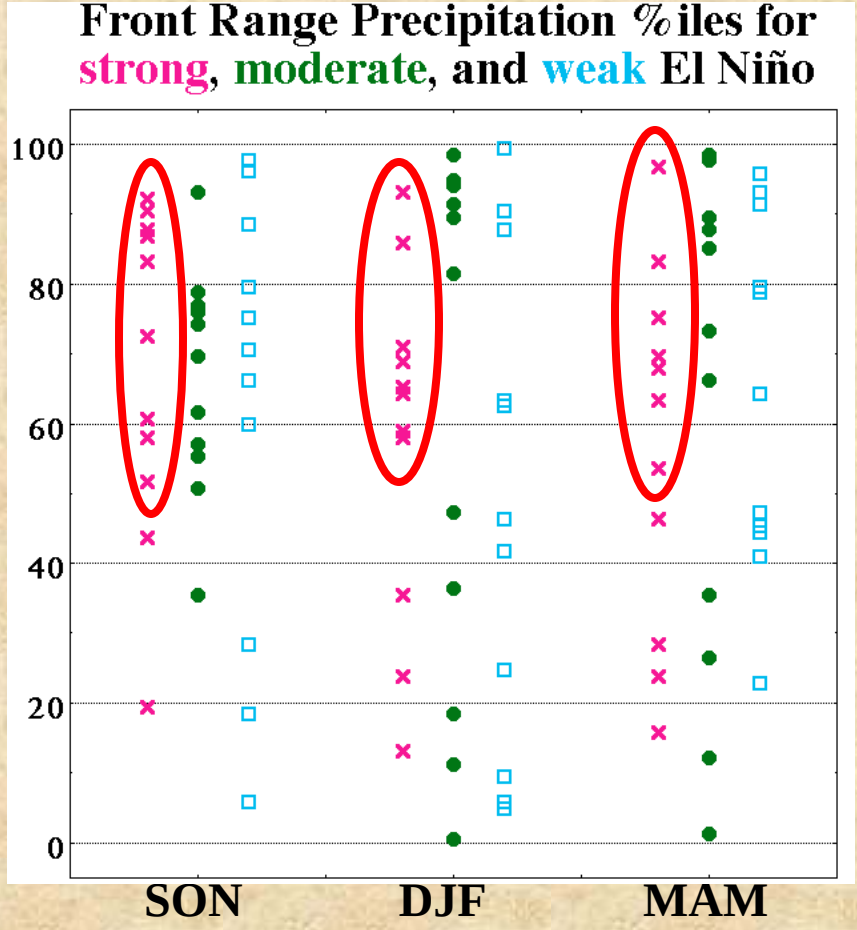
A closer look at Southwest Colorado (1905-2011)

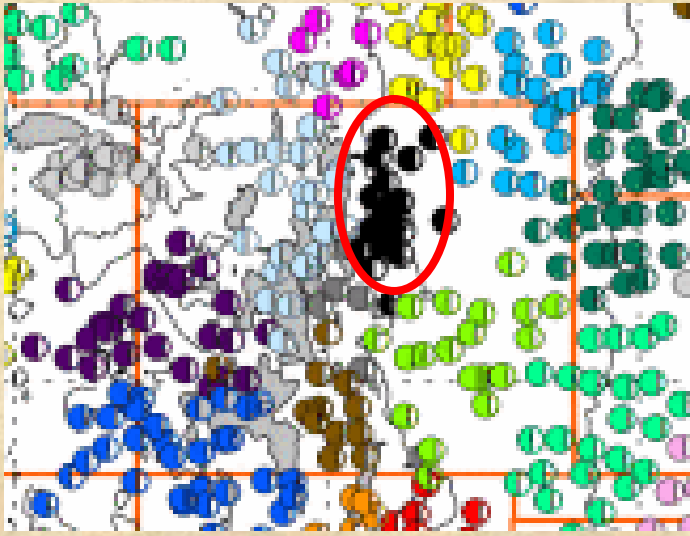




The San Juans and SW Colorado are more favored during strong El Niño than further north, especially lopsided in the fall (10 of 11 above 60%ile), about equal chances during winter, and slightly favored during spring (none below 20%ile). On average, a strong El Niño gives this region a wetter outcome than a weaker one, especially during fall and spring.

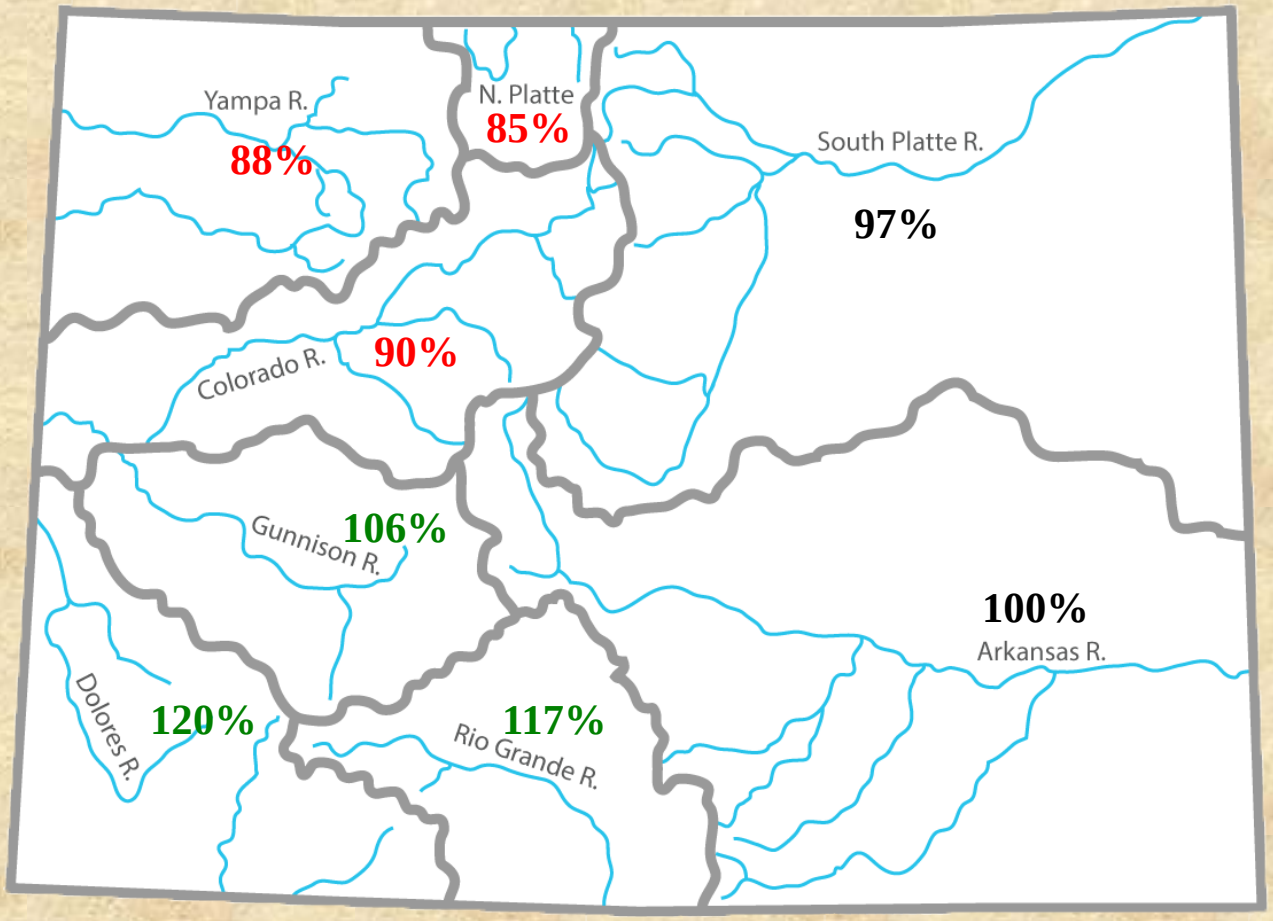
A closer look at our neck of the woods (1901-2011)





The northern Front Range is more likely to be wet than dry in all three upcoming seasons, especially during the fall (9 out of 11 above median), but even in winter (8 of 11), and spring (7 of 11). ***Heads-up for school closures: last time BVSD closed down schools for snow (rather than cold) was in October 2009 (El Niño) – the odds for a 'Top 10' snowstorm are more than doubled from Denver to Fort Collins under El Niño conditions, perhaps even better than that for strong Niños a la 1982-83 and 1997-98!***

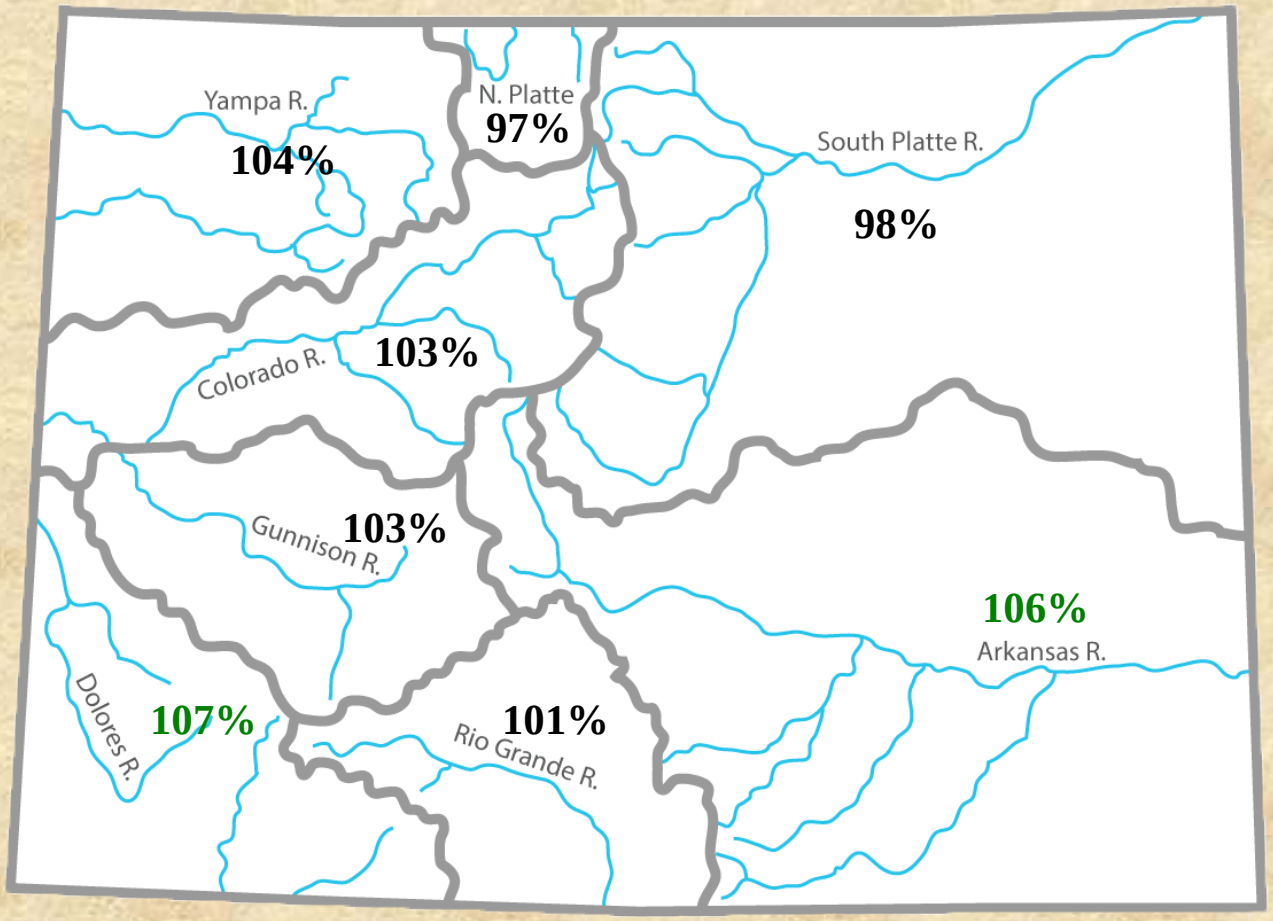
Strong Fall El Niño composites for 1jan SWE



Median outcome for strong Los Niños since 1980
(during fall season: ’82, ’87, ‘91, ’94, ’97)
Lees Ferry: 11.1-23.7MAF (50%ile: 17.0MAF = 97-98)

Southwest CO appears favored in the mean, consistent with fall and early winter precipitation!

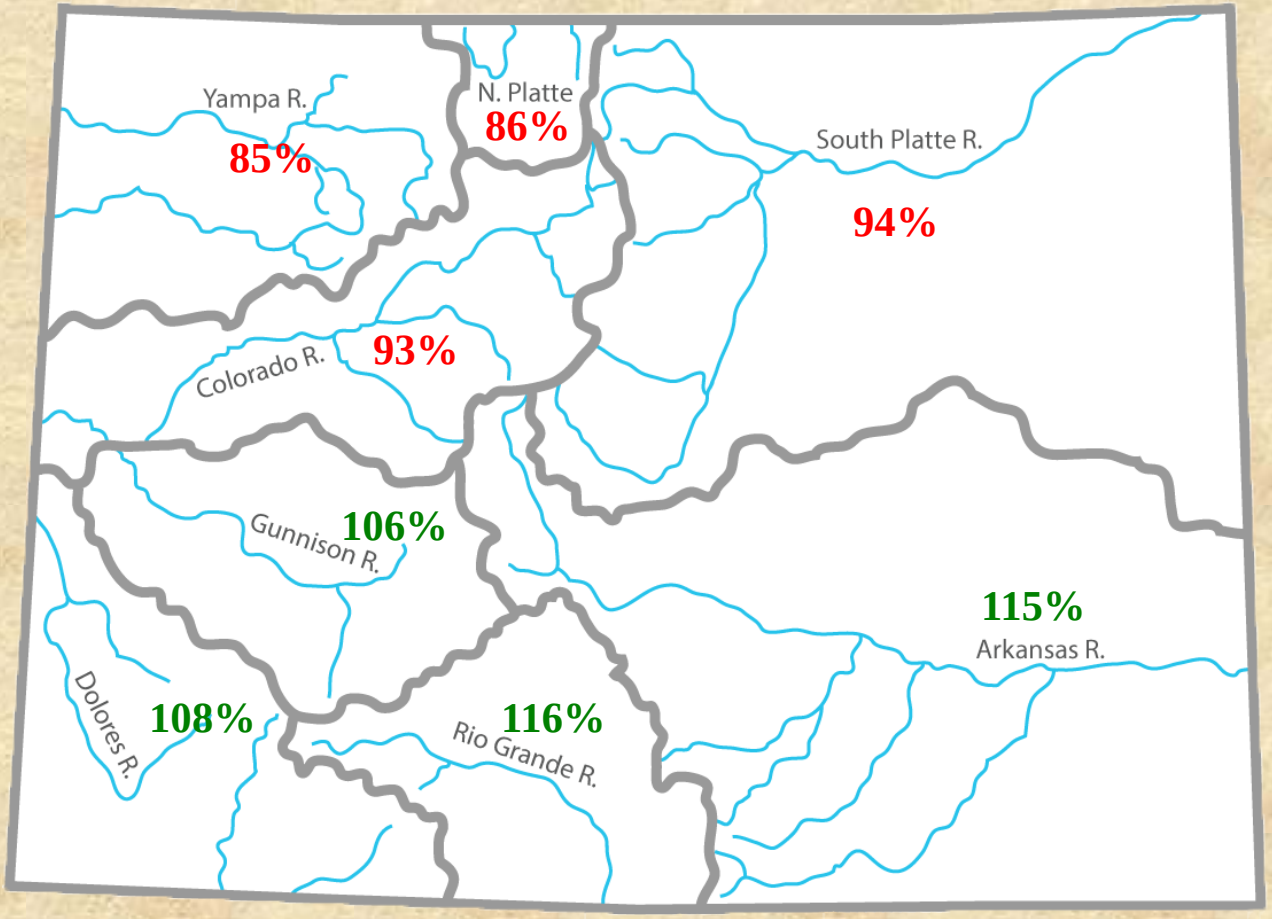
Strong Fall El Niño composites for 1apr SWE



Median outcome for same set of strong Los Niños since 1980 (during fall season: ’82, ’87, ‘91, ’94, ’97)

Main improvements over 1jan: Yampa +16%, Colorado River +13%, and North Platte +12%; main decline for Dolores: -13%, and Rio Grande: -16%

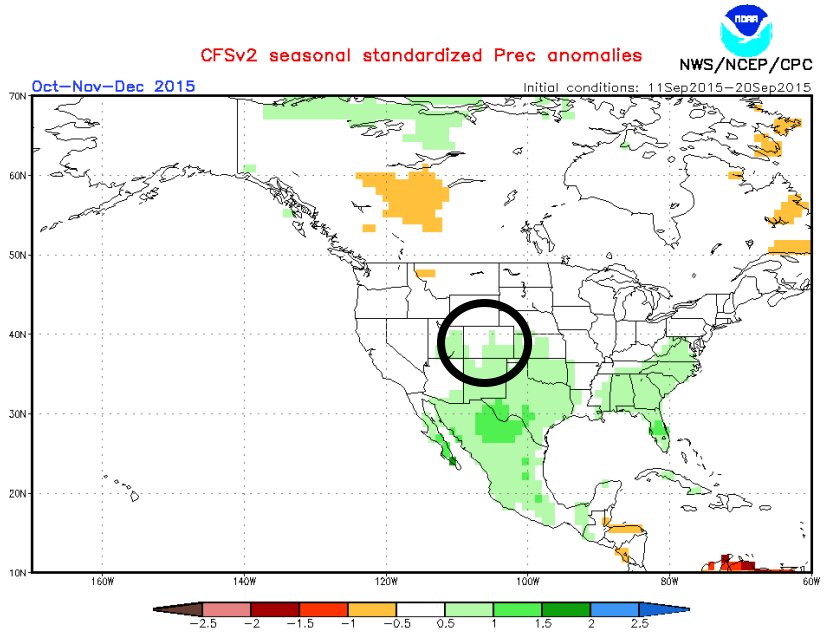
Strong Winter El Niño composites for 1apr SWE

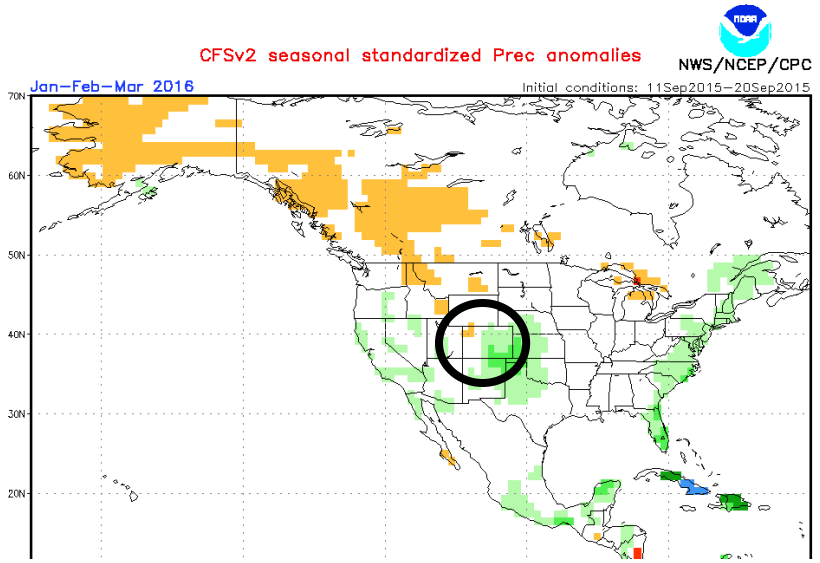


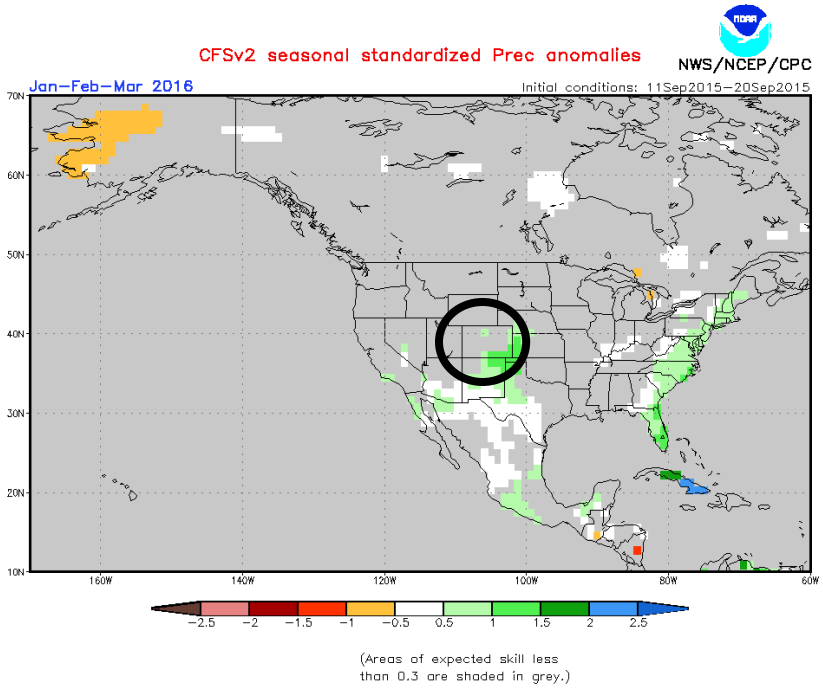
Median outcome for analogous set of strong Los Niños since 1980
(during winter season: ’83, ’87, ‘92, ’98, ’10)
Lees Ferry: 11.1-23.7MAF (50%ile: 16.5MAF = 86-87)

Main change compared to fall-based composites: Yampa, N Platte, and Upper Colorado River loose ground by 10-19%, while Rio Grande and Arkansas gain from 9-15%.

CPC Coupled Forecast System Version 2



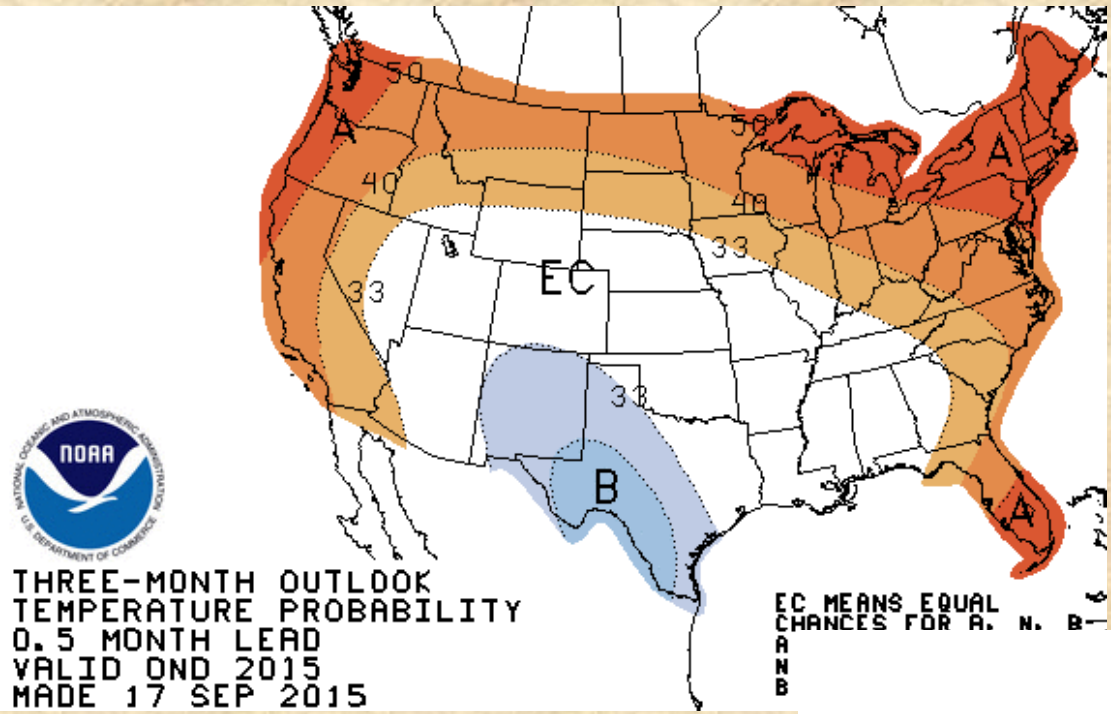




CFS forecasts for OND (left) and JFM (right – top = normalized anomalies, bottom = with skill mask), hint at wet fall in southern CO that retreats from eastern CO for the skill-masked case (not shown), and a wet late winter for eastern CO that also struggles to survive after applying the all-cases skill mask.

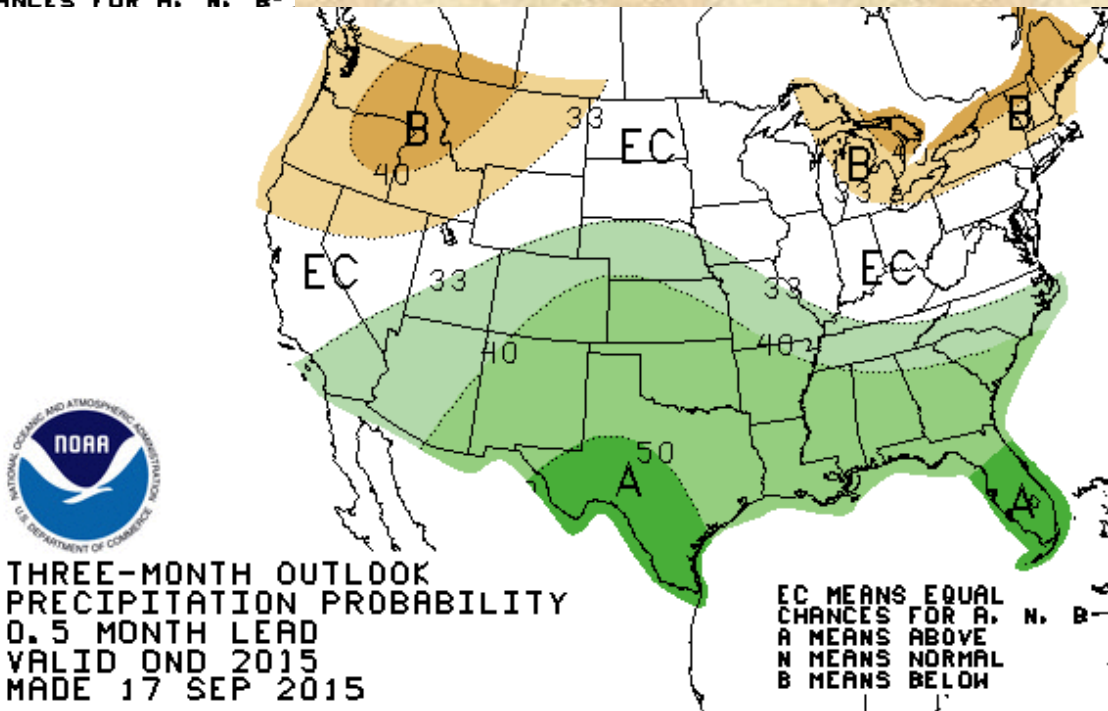
http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/index.pri.html

Climate Prediction Center Forecasts



The late fall precipitation (right) and temperature (left) forecasts by CPC appear wet for us, while keeping the coldest air to our south.

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



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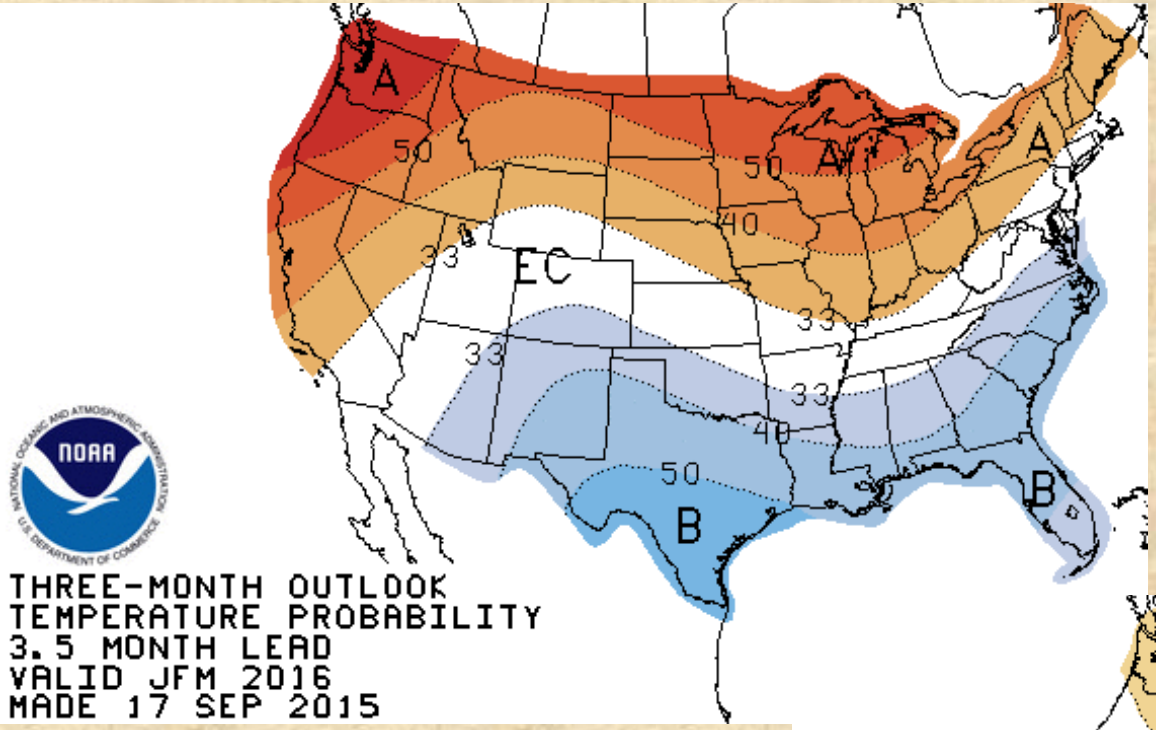
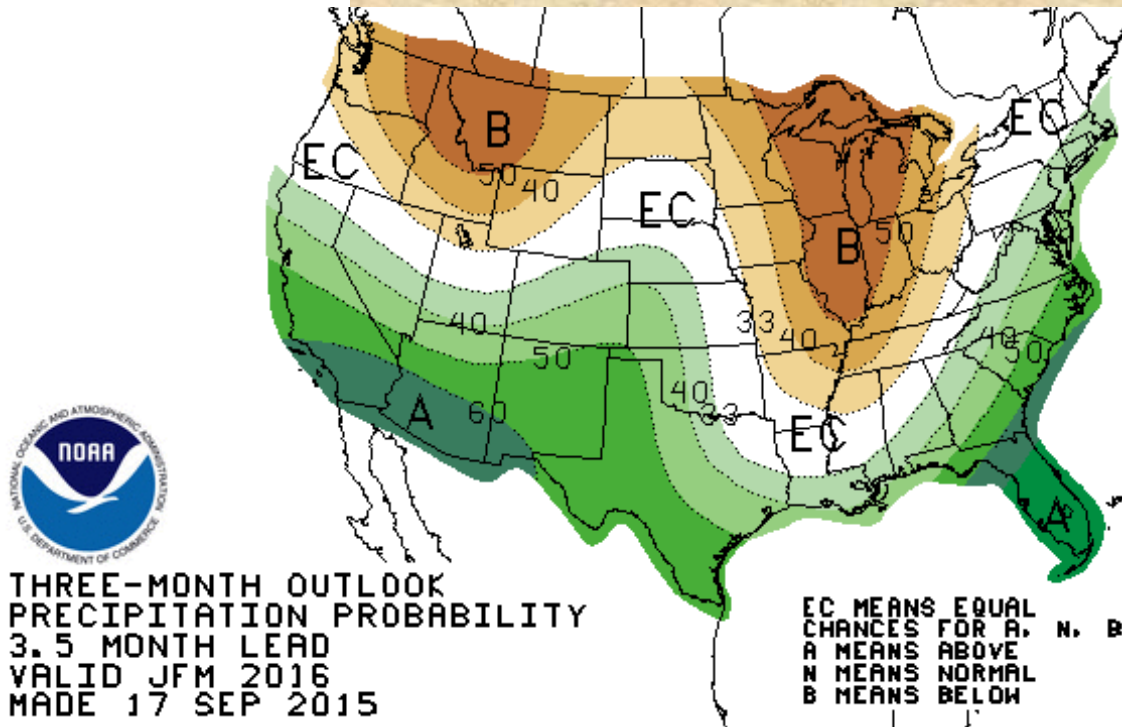
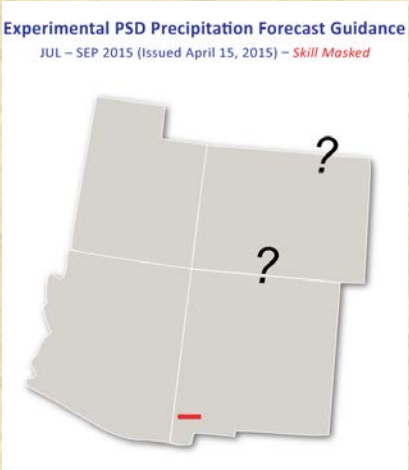


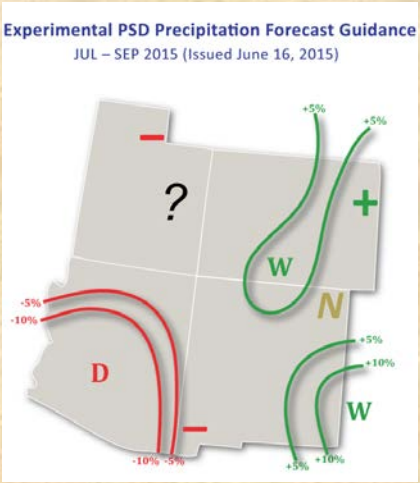
The late winter precipitation (right) and temperature (left) forecasts by CPC puts all but northwestern CO into surplus moisture and southern CO more likely to be cold than warm.

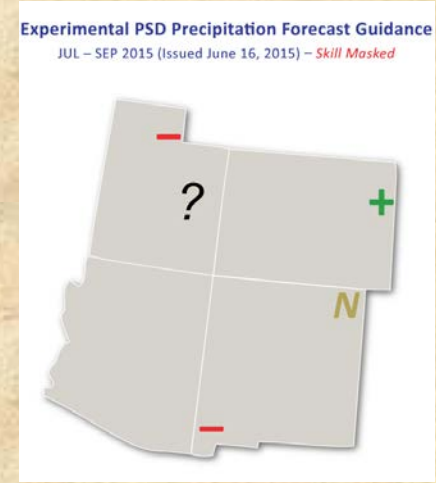
http://www.cpc.ncep.noaa.gov/products/predictions/



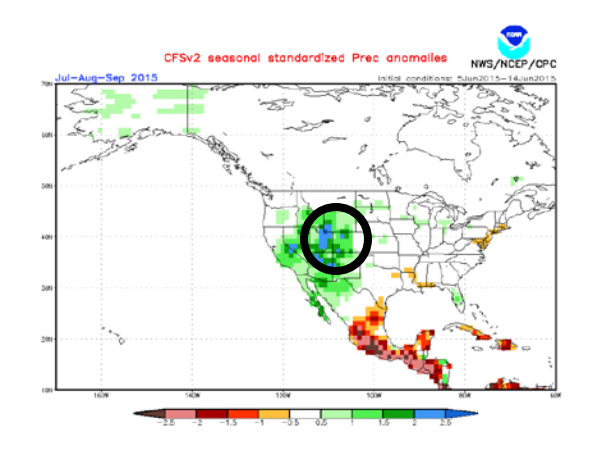
Statistical Forecast for July-September 2015

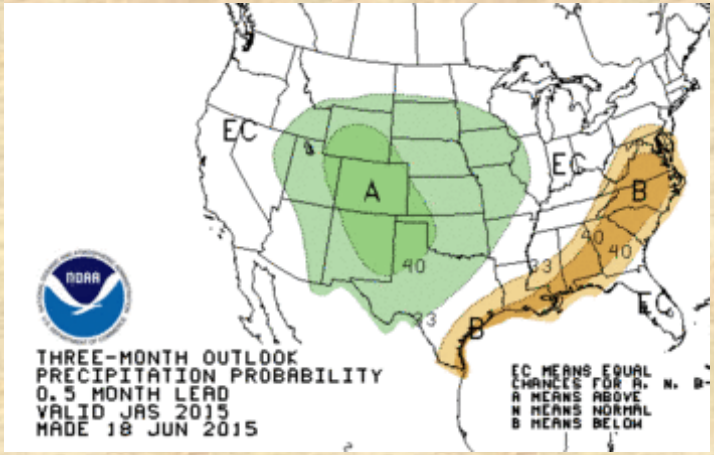


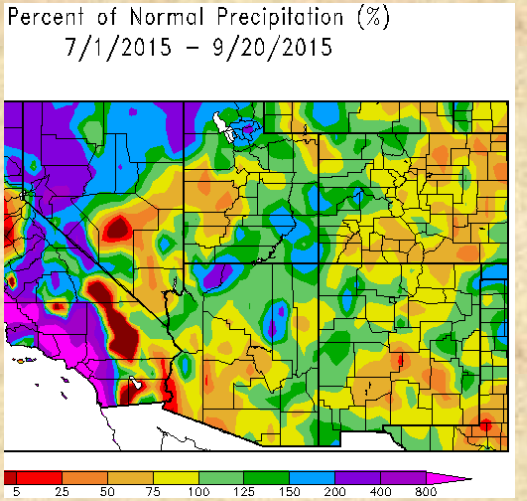




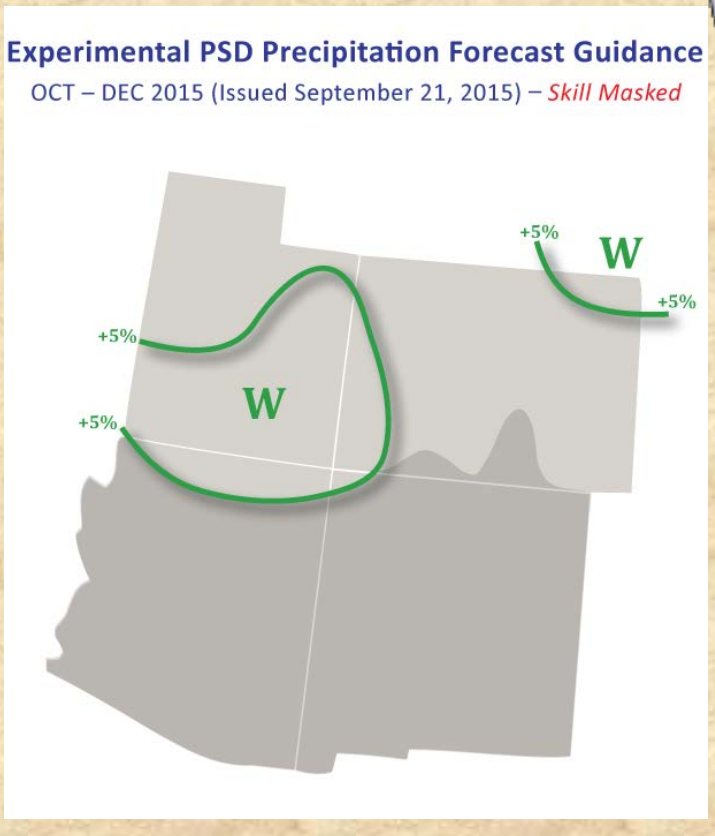
Experimental summer forecast was ambiguous back in April (left), while June version (middle = full forecast; right = only skill-masked regions) showed a hint of wet monsoon season over eastern half of Colorado (this was NOT nearly as bullish as CPC or CFS2 (bottom left/middle)). ***With the monsoon essentially petering out for us (not helped by smoke pollution from out-of-state, my forecast did not work out (bottom right)...***







Statistical Forecast for Oct-Dec 2015



Fall forecast (left) is either neutral (mountains) or on the wet side for Colorado (SW and NE corner). The skill-masked forecast (right) shows that the wet forecasts for CO are supported by operational skill (since 1999), while forecasts for AZ&NM are not. *Looking more carefully at north-central CO & northwest UT reveals a slight tilt towards dry, too small to be detected with the current forecast scheme. This is of concern given this region's disproportionate influence on CO river runoff.*

Executive Summary (23sep2015)

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- **El Niño is here, it is strong (perhaps not quite 'Godzilla', but 'Gorilla'?), and it should continue through winter. If it gets another shot in the arm from westerly wind bursts over next few months, it could rival 1997-98. *Place your bets!***

- **Our wet spring and early summer have been consistent with ENSO, and our state has a good chance for above-normal moisture this fall. If the event stays strong, we will face much less favorable odds during winter for the central and northern mountains. In addition to the fall season, the net outcome for the runoff season will depend on spring – *too early to tell!***

- **CPC's forecasts favor our state more than my statistical forecast for October-December. This is based on their new coupled model that has been too optimistic for us since July, perhaps due to more imported smoke in the air than expected.**

- **While a strong El Niño in the fall season is more favorable for us than a weaker one, the best combination would be it for it to weaken over the winter, and then come back in spring – we should be so lucky! *Stay tuned for November forecast!***