Earth System Research Laboratory
Physical Sciences Division

CIRES
Cooperative Institute for Research in Environmental Sciences

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NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Was the increased areal extent in U.S. drought conditions predictable for 2012?

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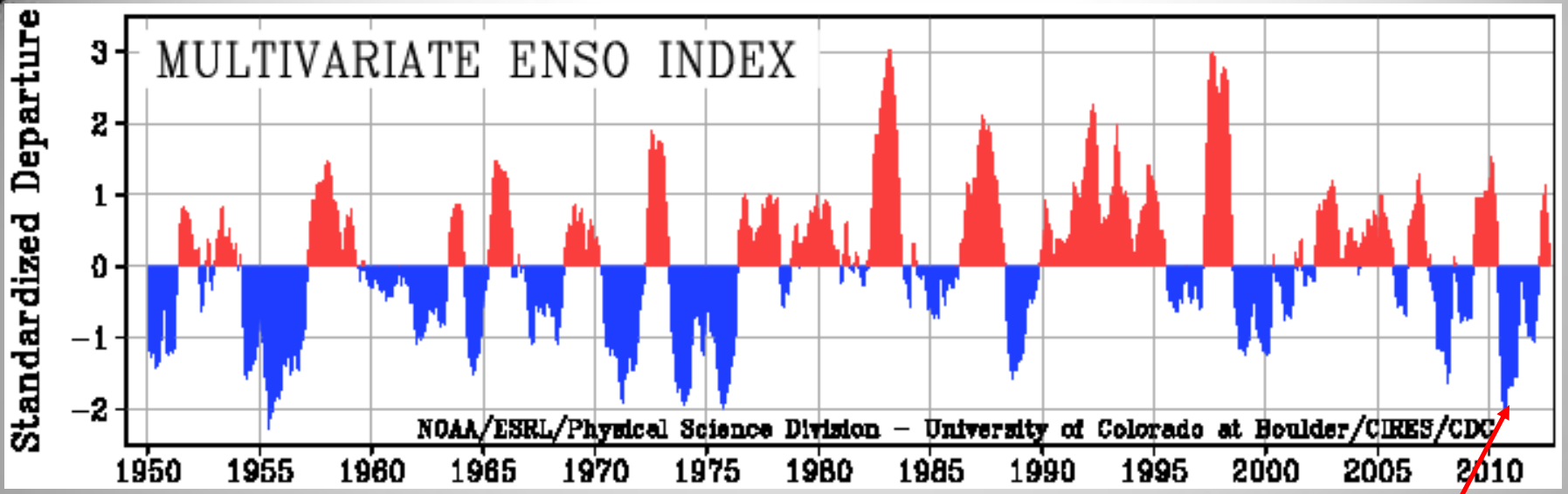
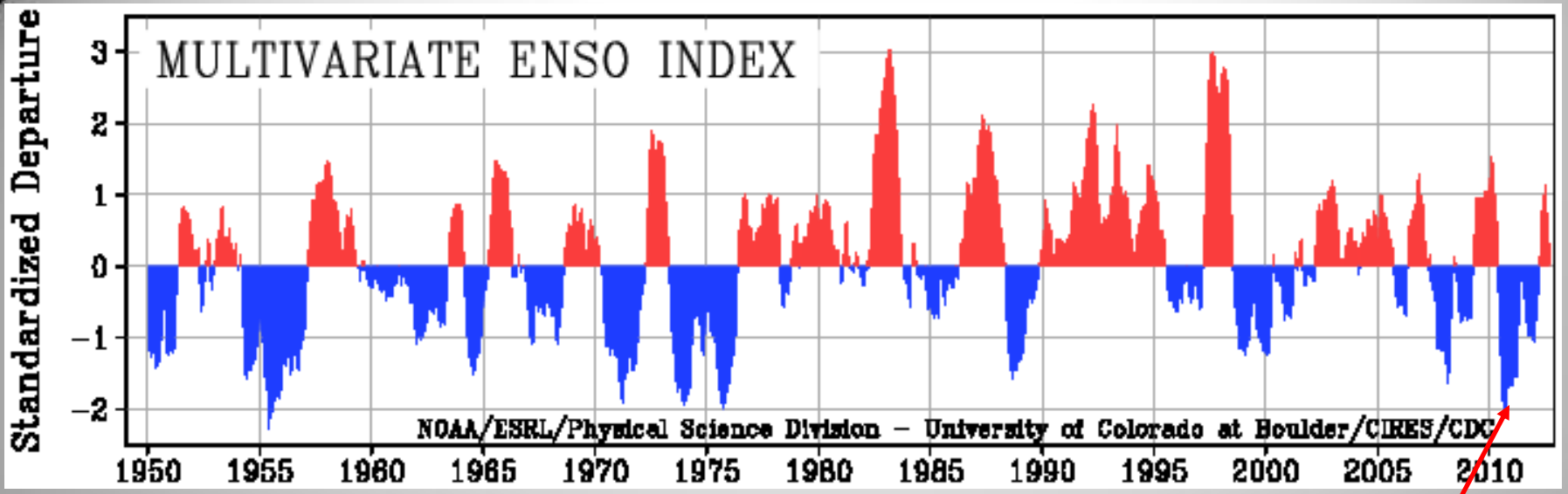
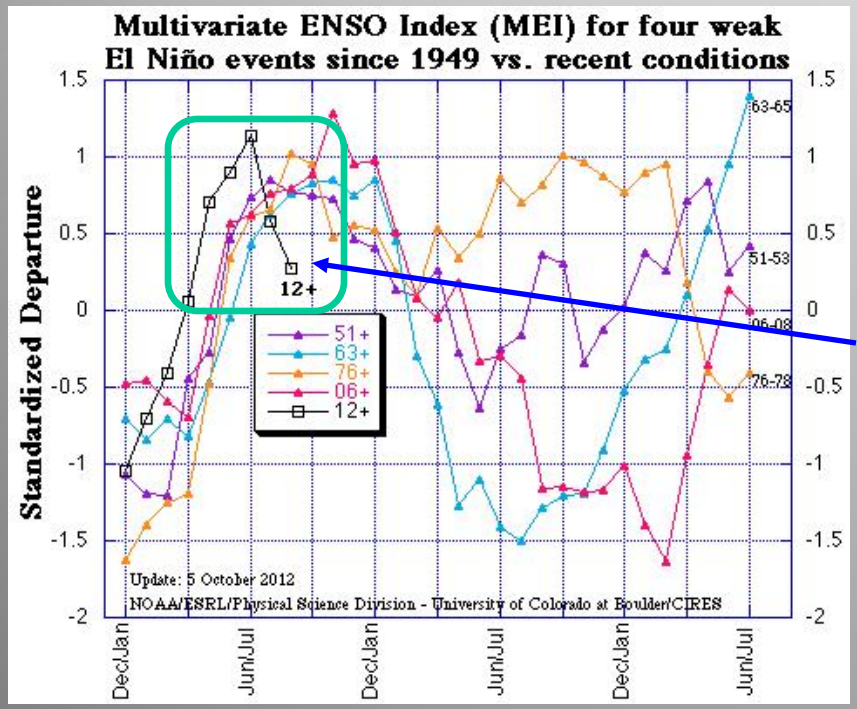
- **Double-dip La Niña of 2010-12: Forecast of Opportunity?**
- **Assessment of composites and experimental forecasts**
- **Potential 'spoilers': NAO, negative PDO/positive AMO**
- **Summary**



2010-12 La Niña event reached the biggest MEI peak since the mid-70s in late 2010, followed by a brief excursion to ENSO-neutral conditions during mid-2011; it reached a second peak last winter

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

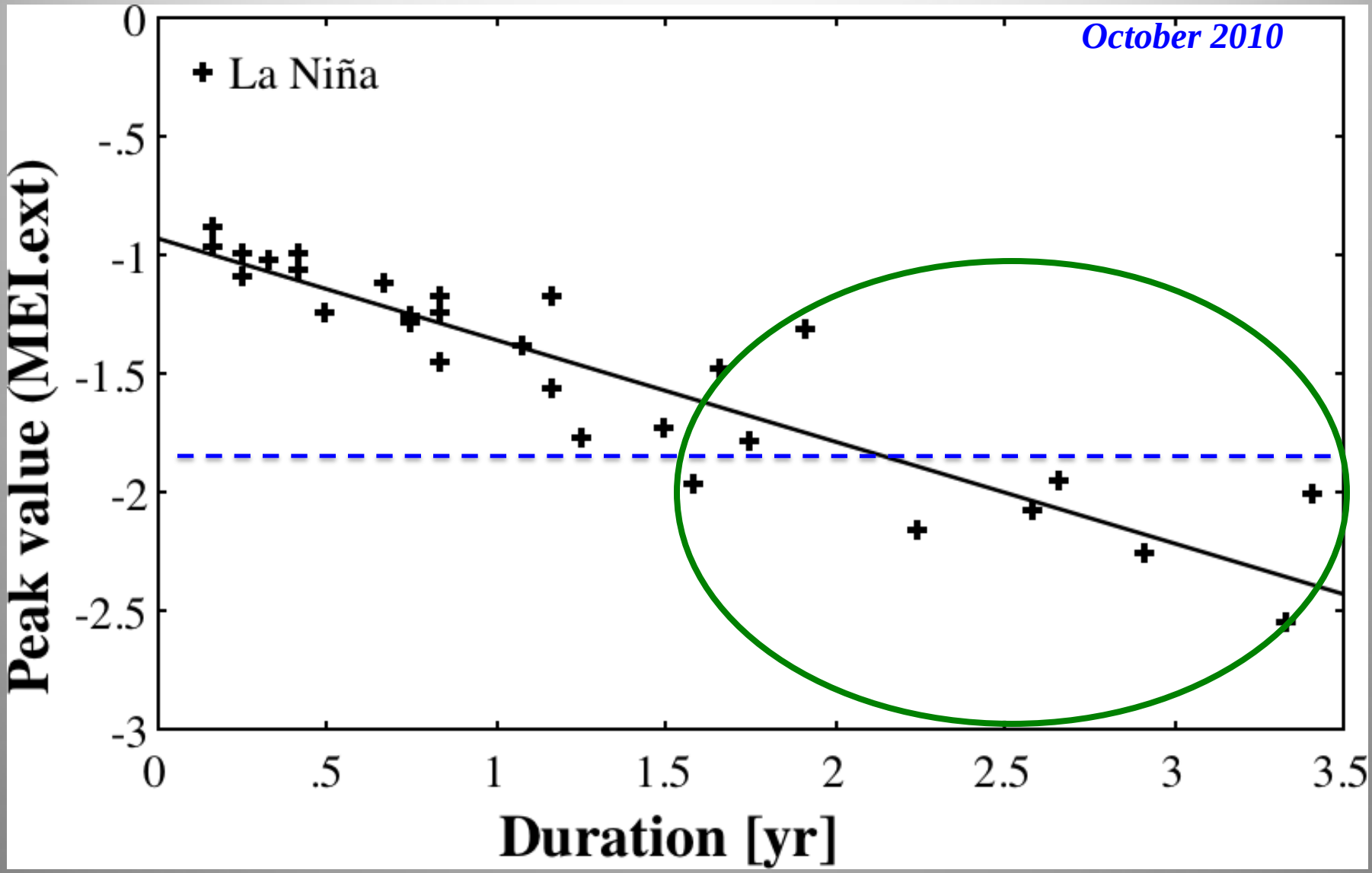




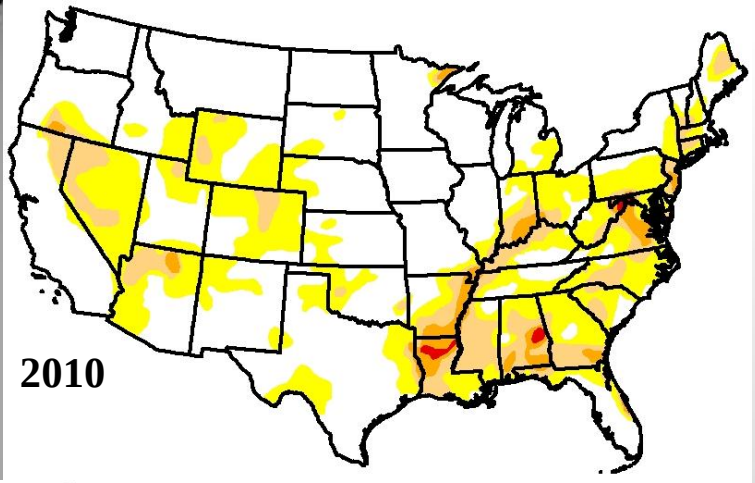
2010-12 La Niña event reached the biggest MEI peak since the mid-70s in late 2010, followed by a brief excursion to ENSO-neutral conditions during mid-2011; it reached a second peak last winter, and has been followed by a weak El Niño event that may already have come and gone.

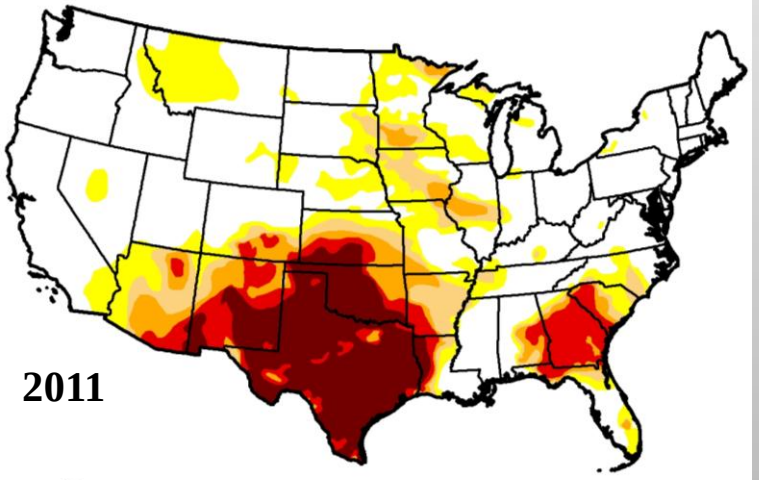
http://www.esrl.noaa.gov/psd/enso/mei

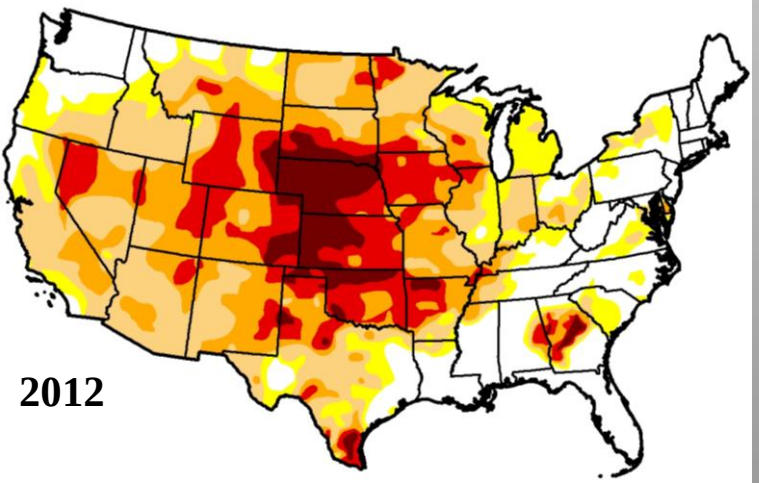
Based on size of La Niña in 2010, a 2yr event was anticipated as early as October 2010, a once-a-decade 'forecast of opportunity'



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







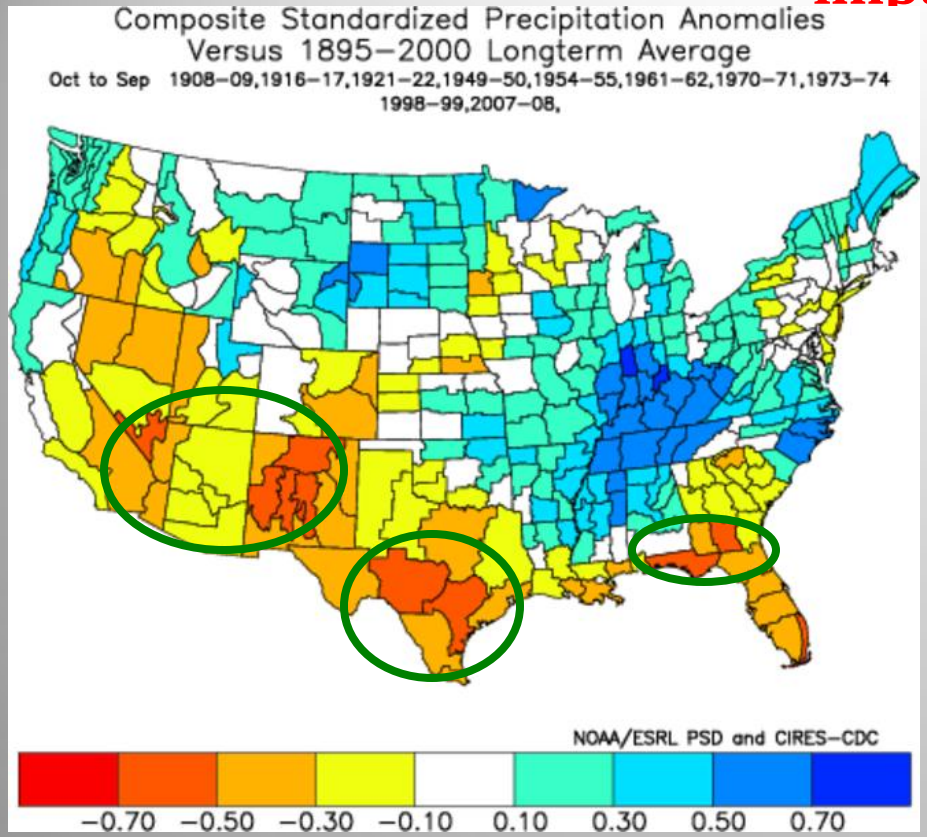
Two years ago (top left; U.S. Drought Monitor map of 28 September 2010), 'extreme' U.S. drought coverage was miniscule;

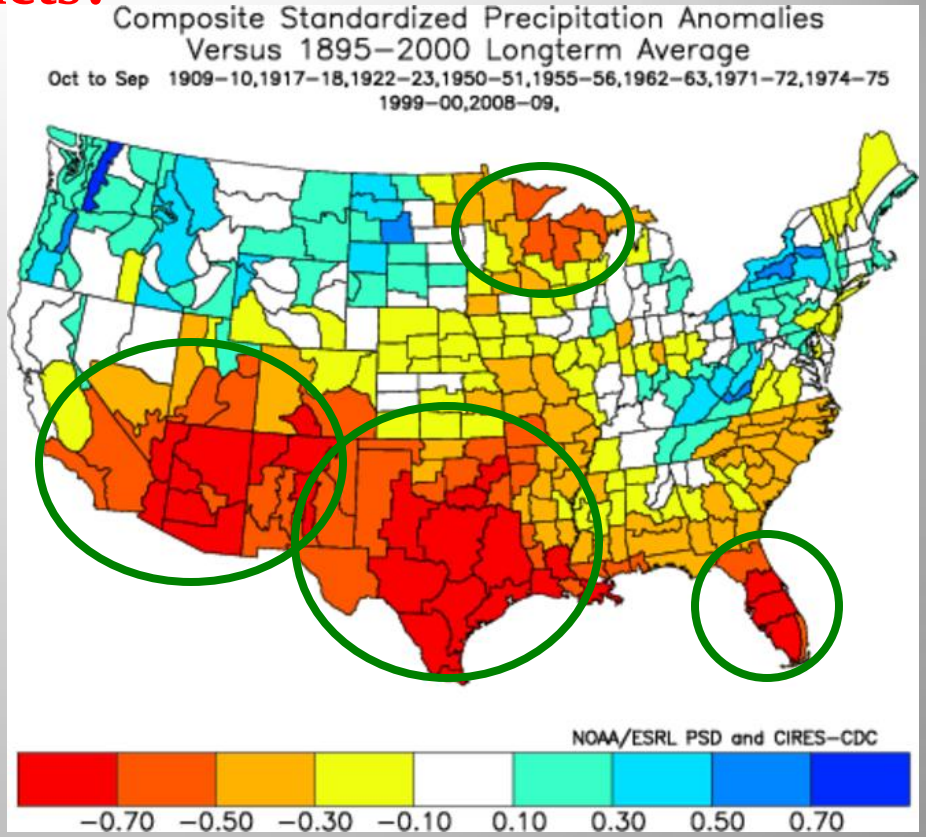
One year later (center left; 4 October 2011), 'extreme' and 'exceptional' drought was covering much of the south-central and southeastern U.S.

Three weeks ago (bottom left): moderate to exceptional drought covered more than half of the contiguous U.S., with its center of gravity shifted northward

Was this the predictable outcome of a two-year La Niña?

What are typical differences between 1st and 2nd yr La Niña impacts?





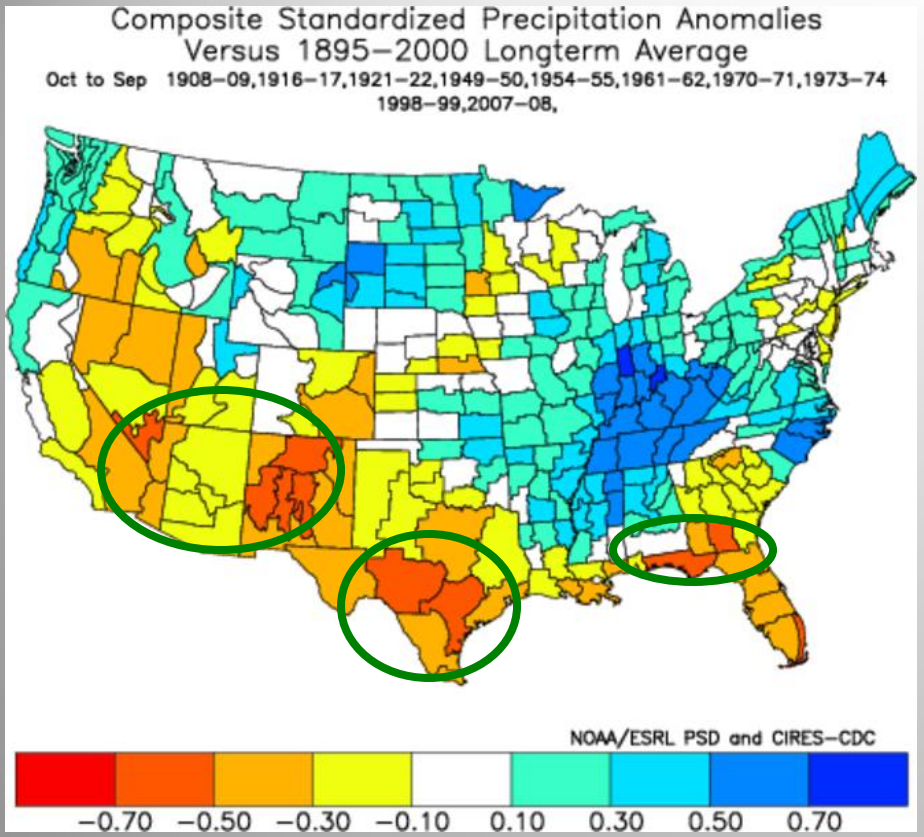
Focusing on upper and lower terciles (+/-0.43 sigma), 2nd year La Niña events tend to show a reduction in wet regions, and a large increase in dry regions in contiguous U.S.:

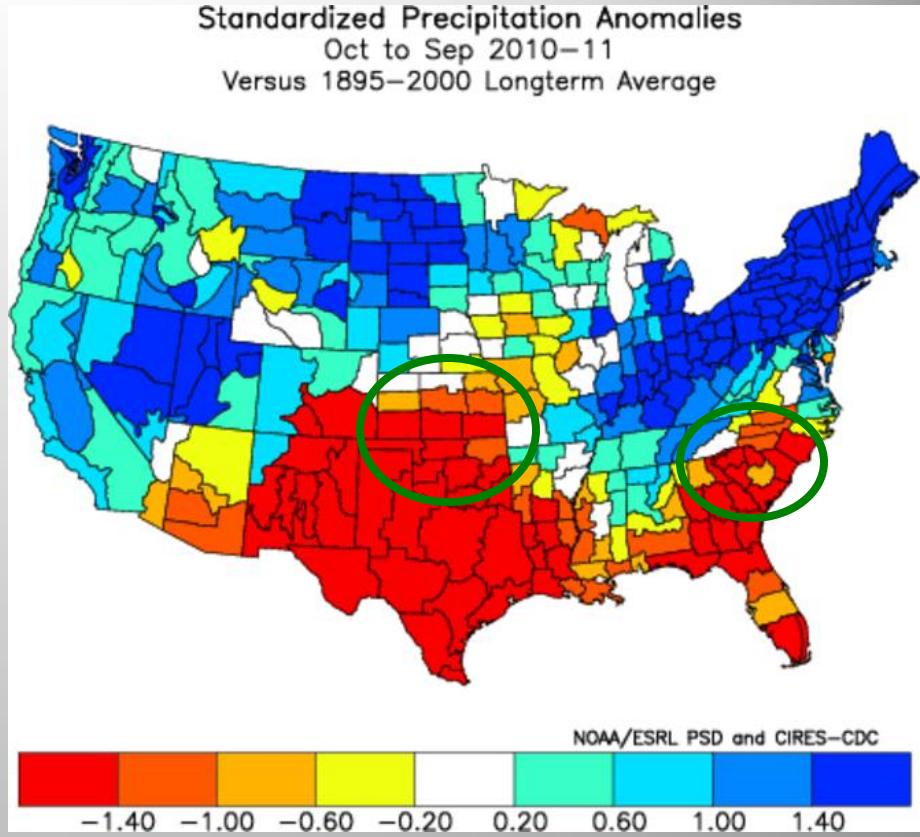
Year 1: 9.0% coverage in wet tercile
Year 1: 10.7% in dry tercile

Year 2: 2.6% wet (under 1/3)
Year 2: 32.1% dry (tripled coverage)

Assuming normal distribution and independent sampling, 11% would be expected coverage.

What happened in WY'11?

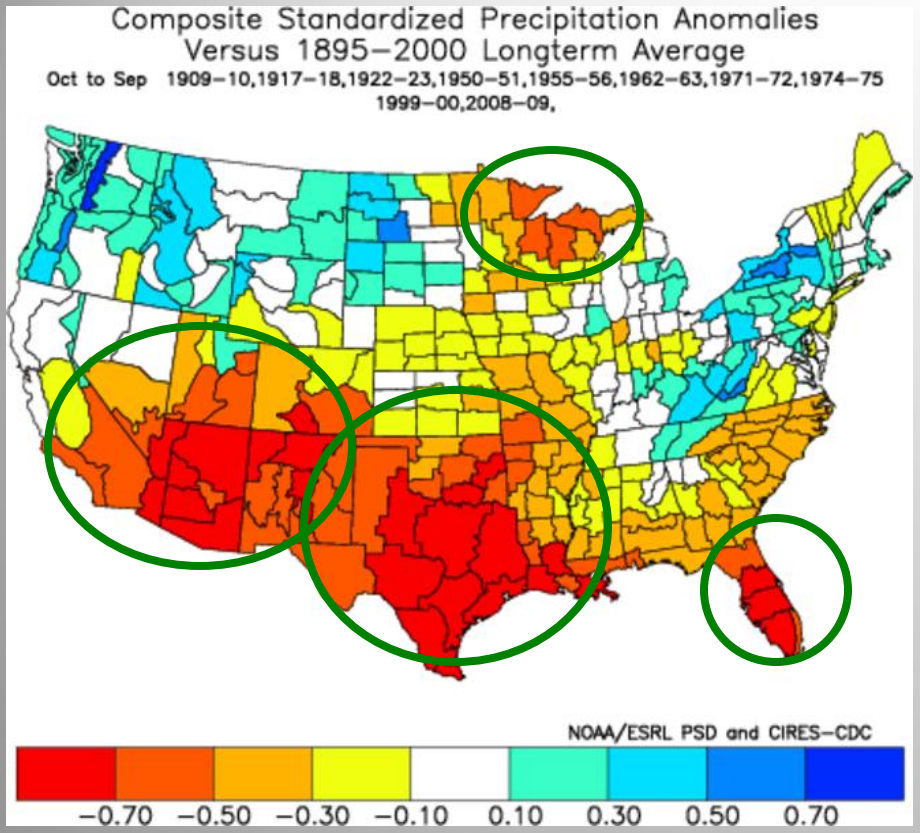


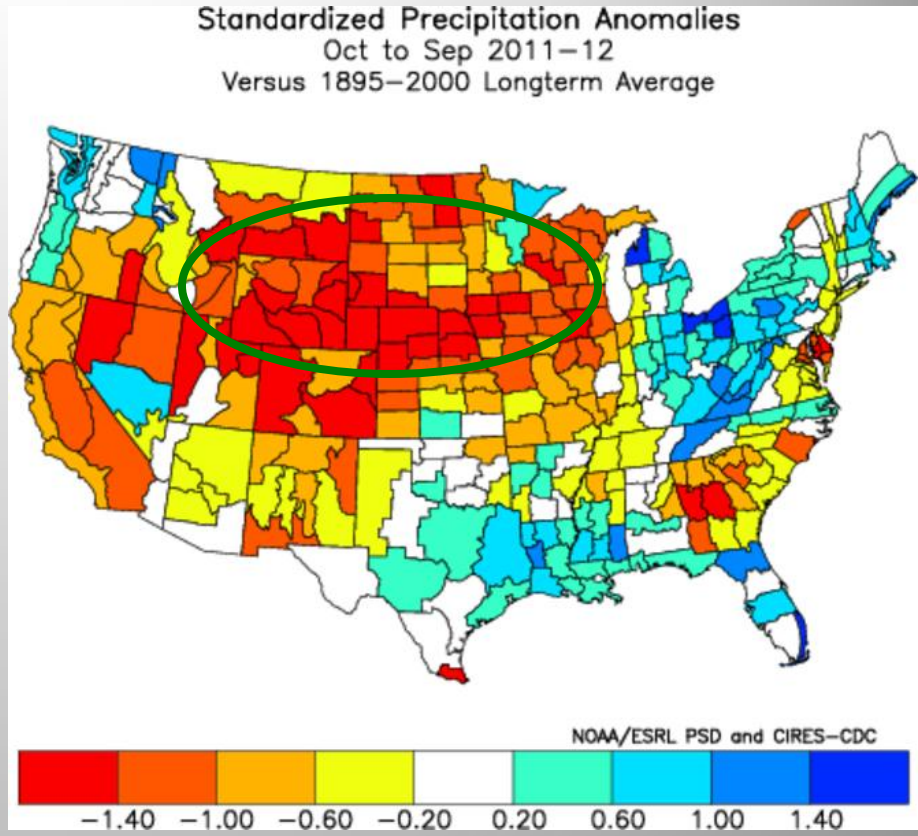


2010-11 ended up matching 67% of the anticipated wet regions and 86% of the anticipated dry regions, 'as good as it gets' in terms of fulfilled expectations.

Dry regions reached further north than is typical, almost a foreplay of what was to come in 2011-12, especially east of Colorado and into the mid-Atlantic states. Total coverage of dry tercile was 33%.

What happened in WY'12?

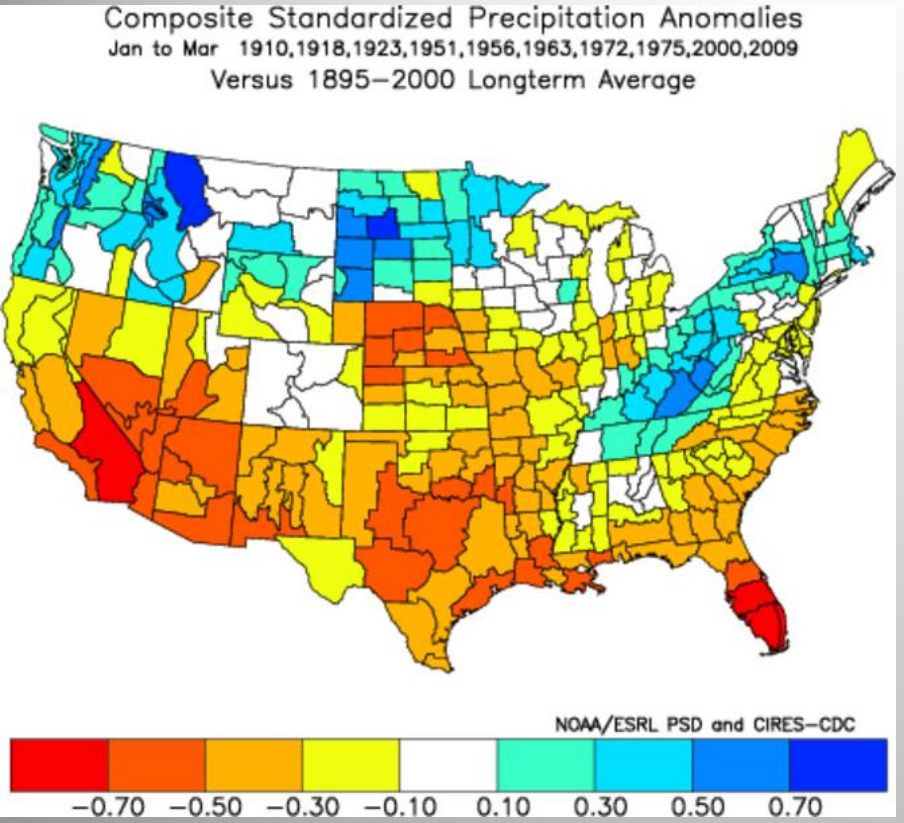


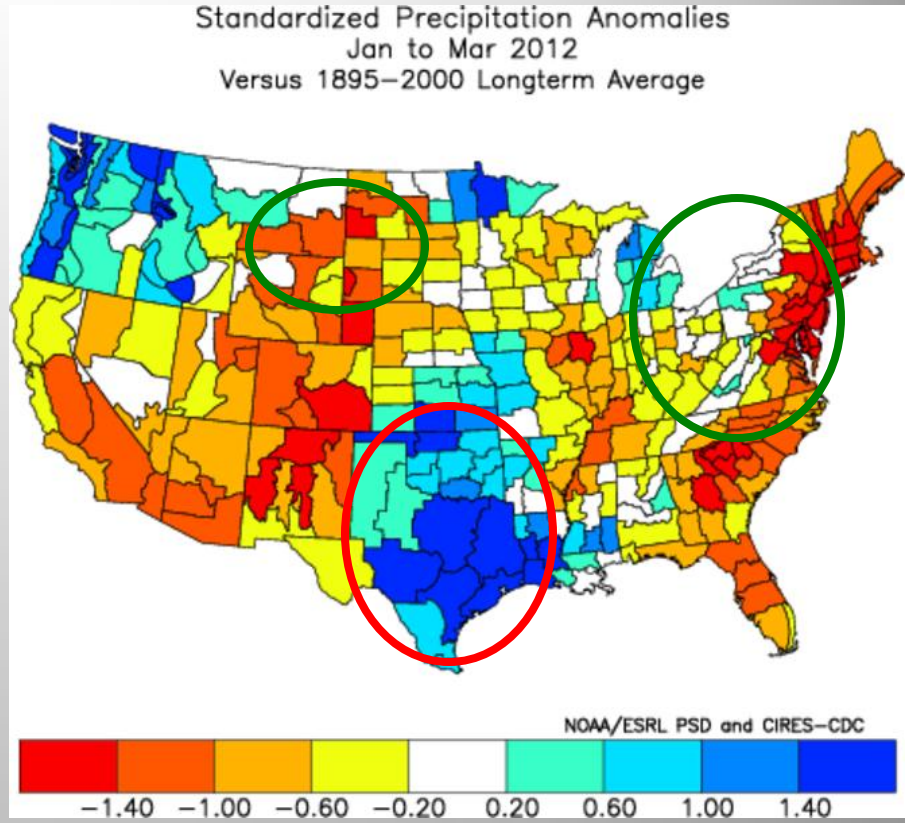


2011-12 ended up matching only 7% of the anticipated wet regions and 41% of the anticipated dry regions, not nearly as good a match between 'forecast' and observations as in 2010-11.

Dry tercile coverage (54%) exceeded expectations, especially in the Great Plains while the Gulf Coast states got a 'break' last Water Year. The general notion of a northward expansion of drought conditions verified, but it 'overshot' and left original drought regions behind.

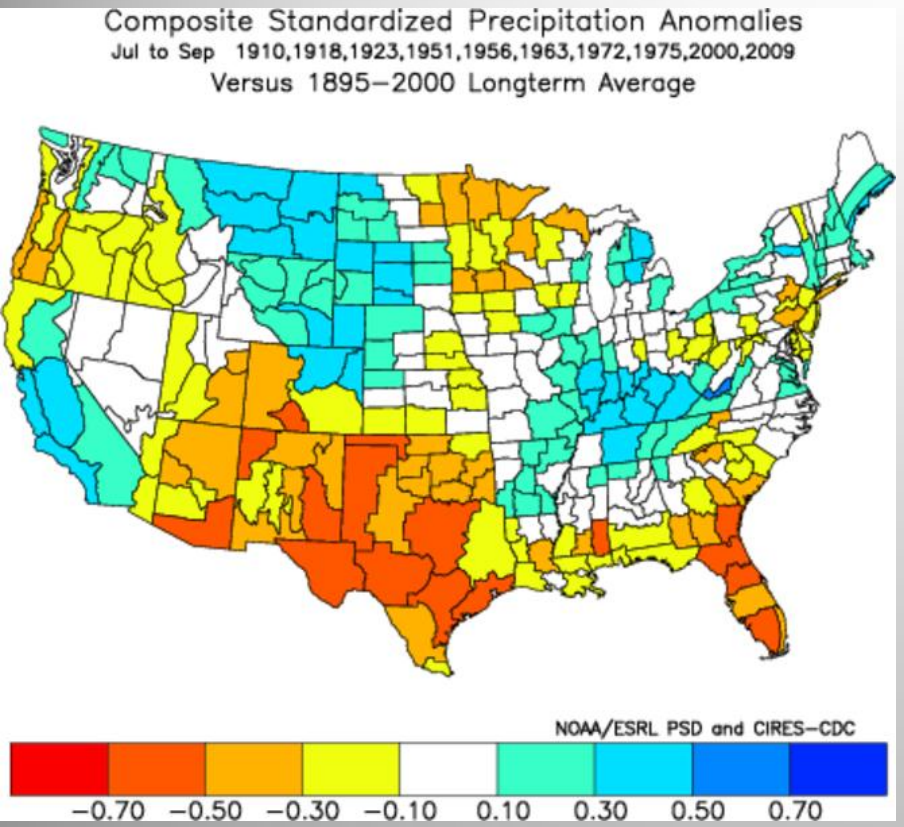
What happened in WY'12 – a look at January-March 2012

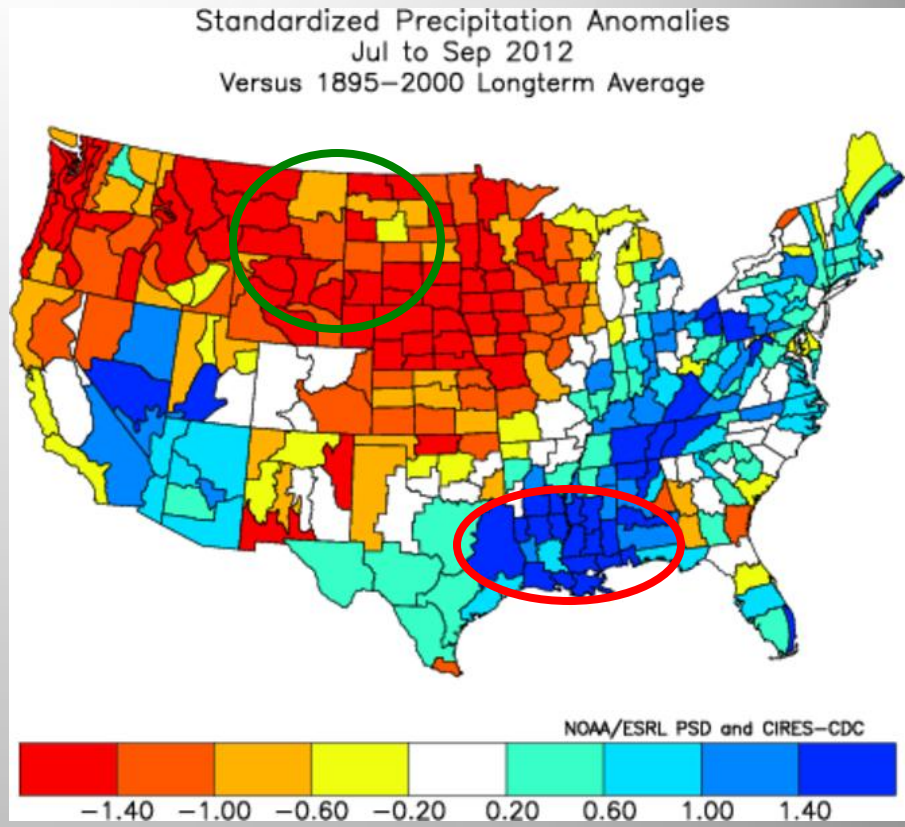




Despite serious mismatches in south- and north-central, as well as northeastern U.S., January-March 2012 ended up verifying 41% (51%) of anticipated wet (dry) regions, the best seasonal match between Year 2 La Niña composite anomalies and observed conditions in WY'12.

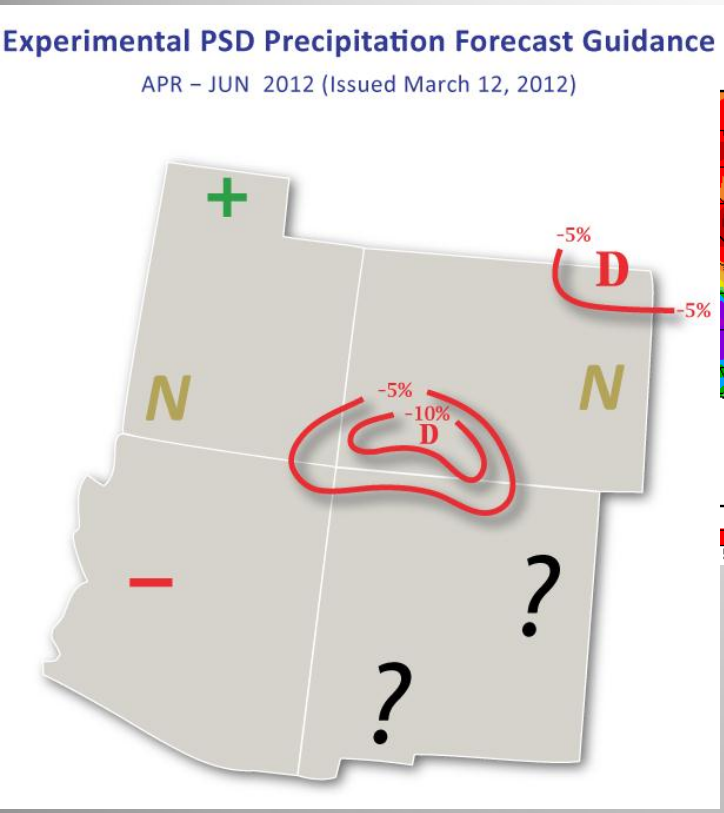
What happened in WY'12 – a look at late summer

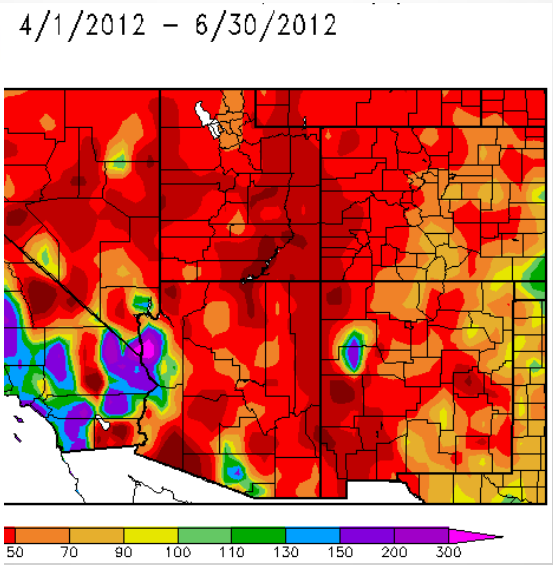


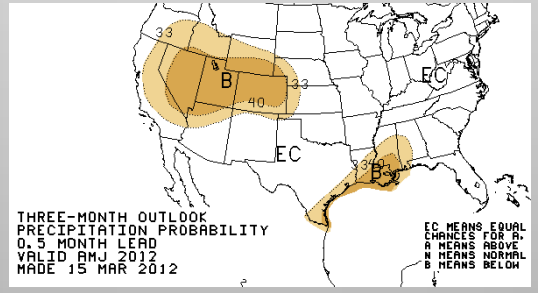


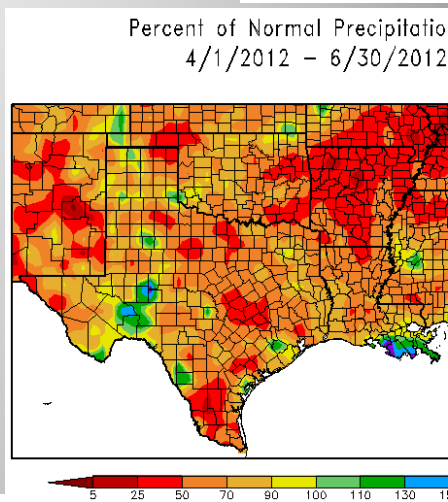
July-September 2012 is the season with the worst match between Year 2 composites and observations: 16% of the anticipated wet regions and 20% of the anticipated dry regions suggests a negative skill score, raising the question what caused this.

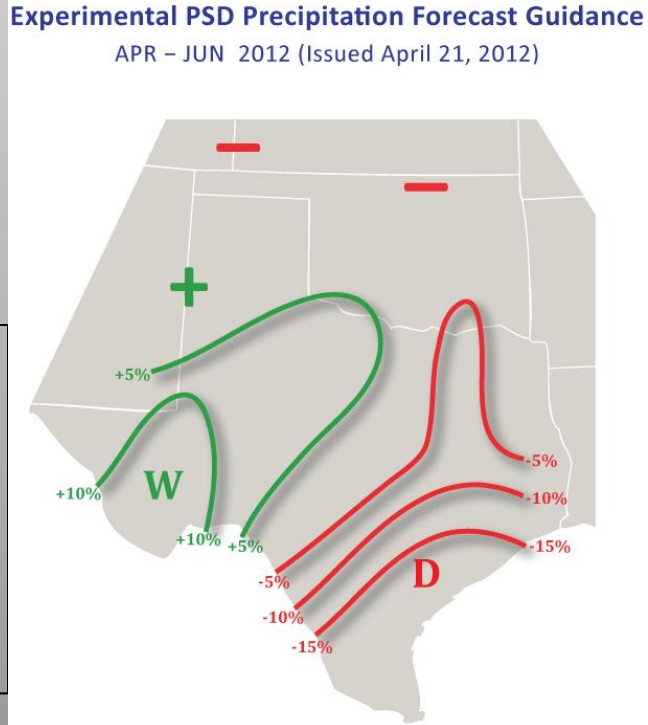
How about CPC, my SWcast, or its new cousin, SCcast?







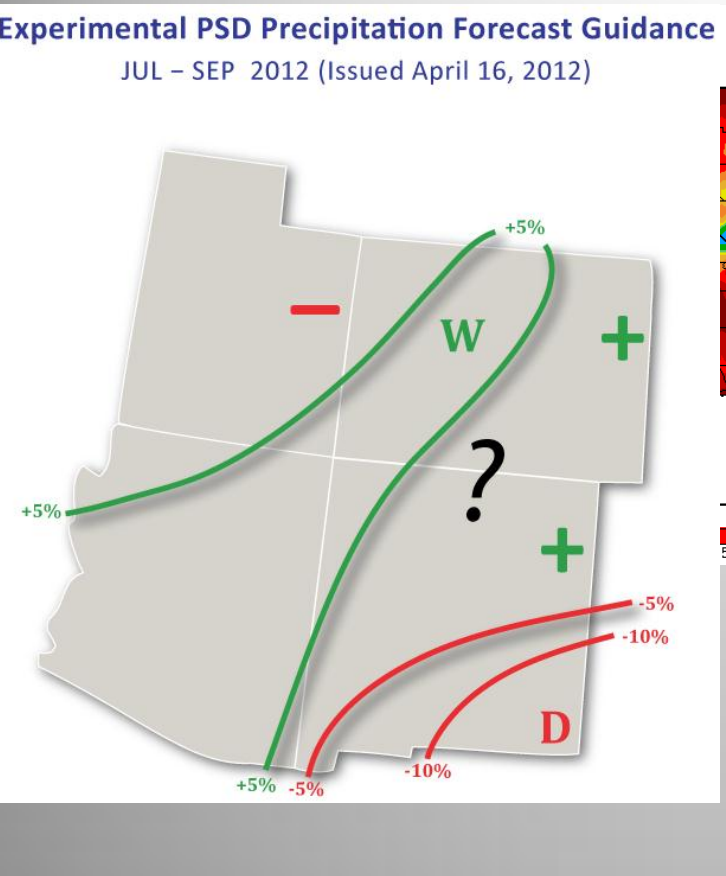


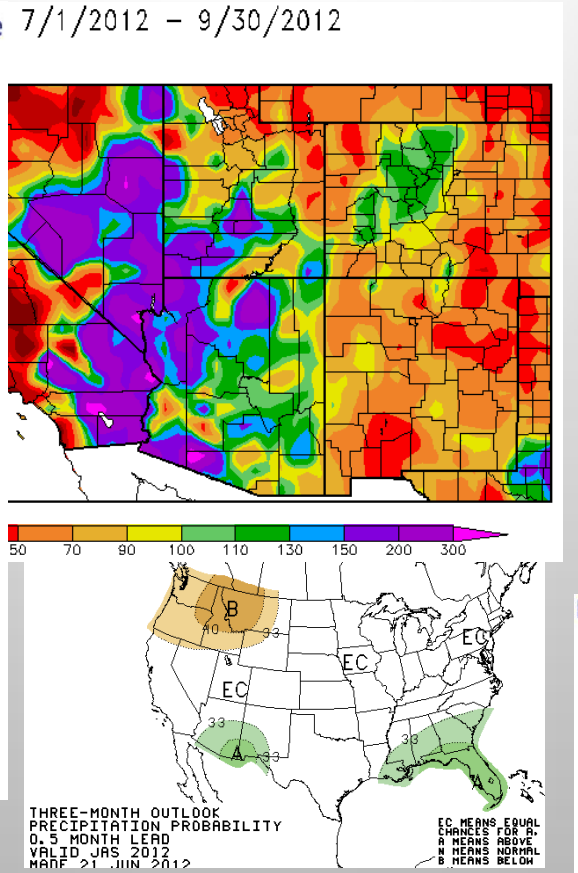


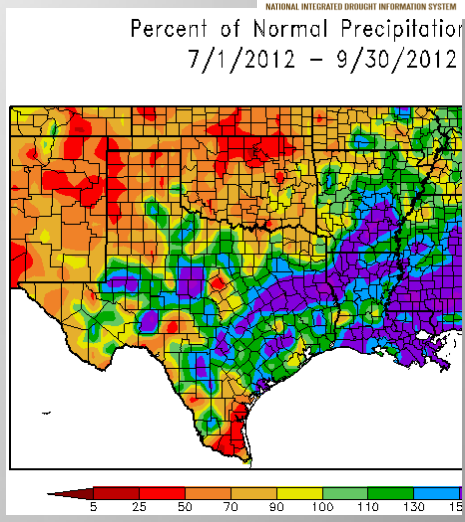
April-June 2012 reminded Texas that the drought was not over just yet, and brought an early start to a vicious wildfire season to the southwestern U.S.

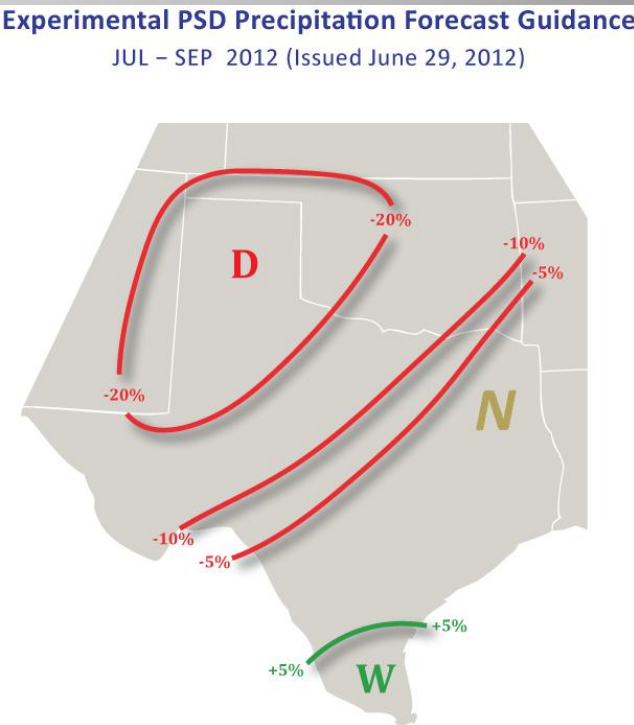
<u>All of the dry forecasts were 'hits',</u> while wet forecasts verified near-normal at best.

How about CPC, my SWcast, or its new cousin, SCcast?





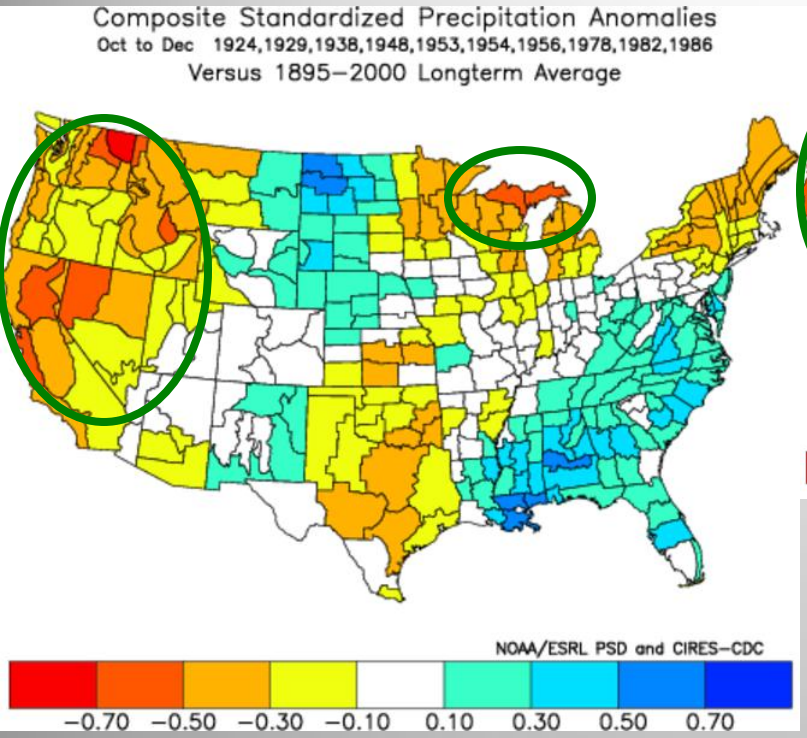


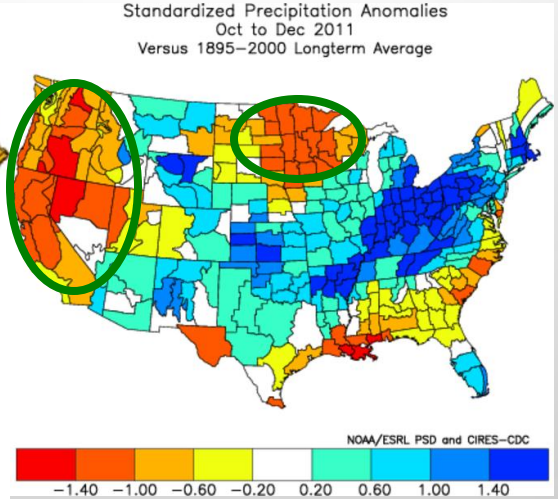


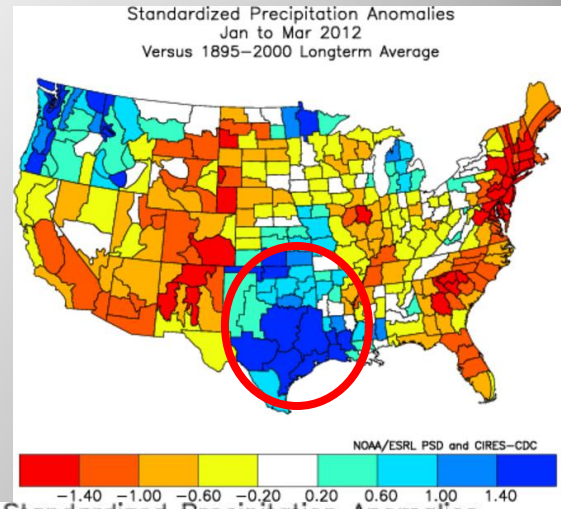
July-September 2012 saw a westward-shifted southwest monsoon, stretching from AZ into north-central CO. It was wet from southern TX into LA, while drought conditions remained entrenched from NM into OK.

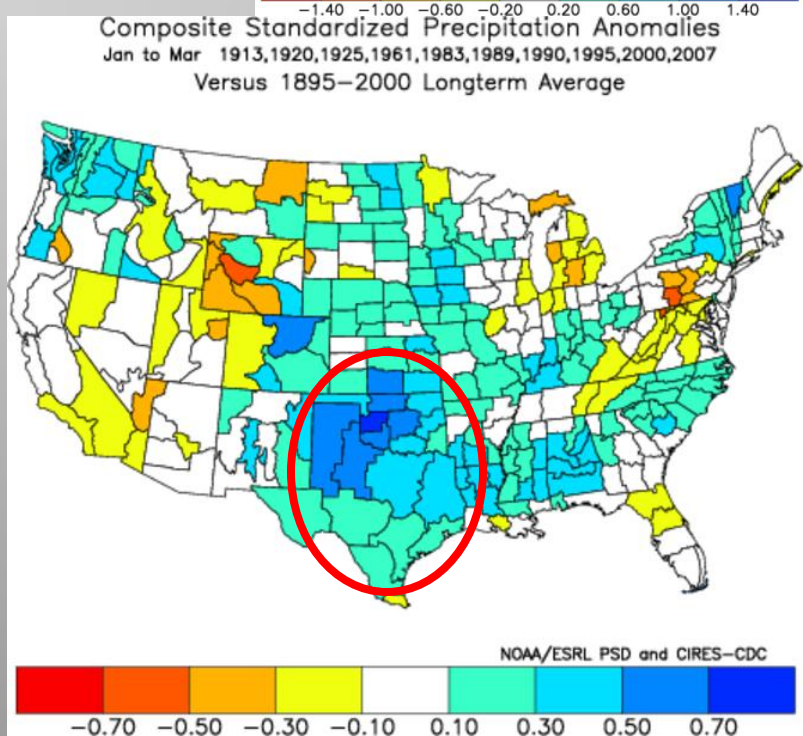
A fair amount of this was anticipated by my regional forecasts, except for excessive dryness in eastern CO.

What happened in WY'12 – The role of the NAO





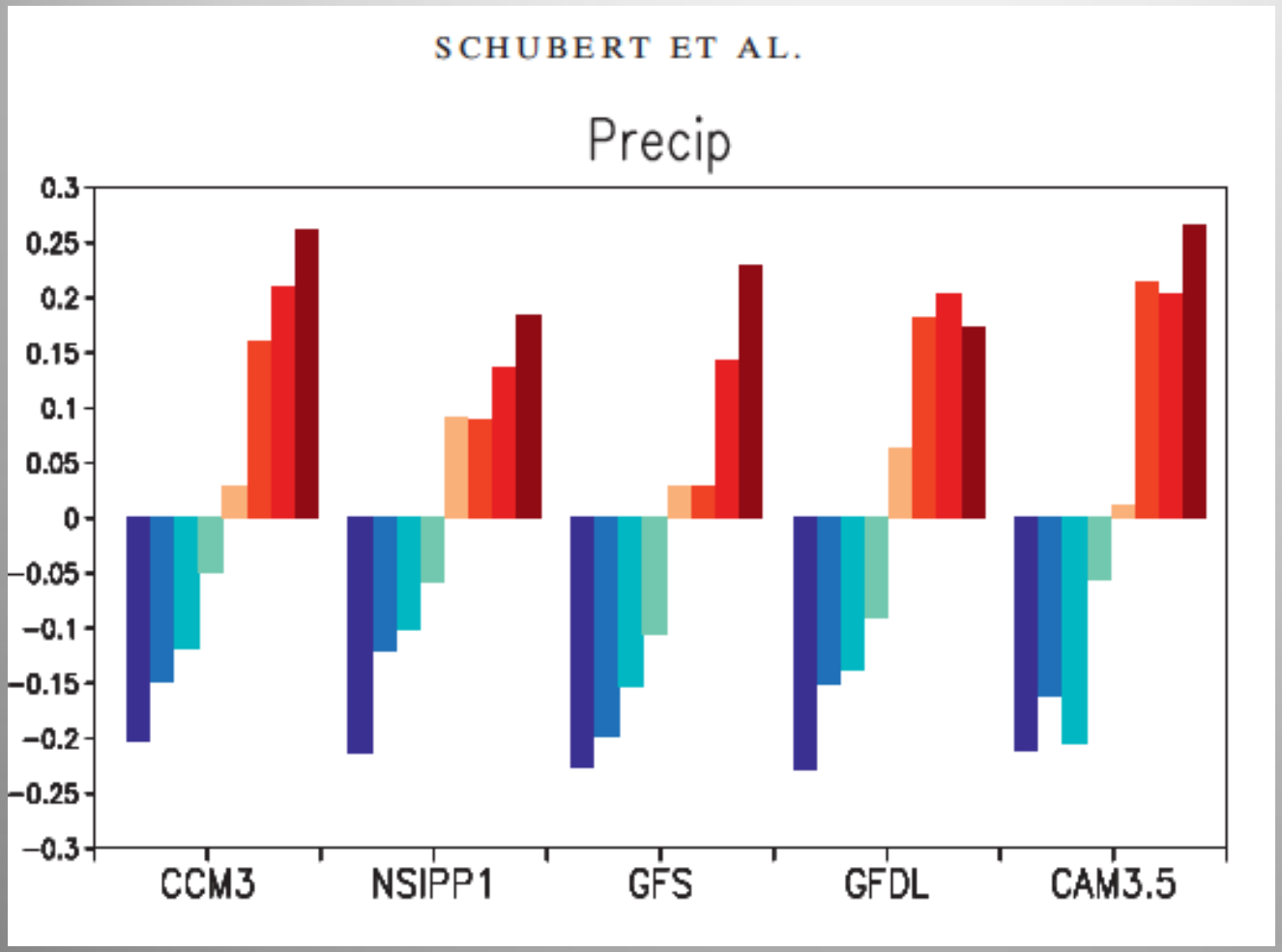




Both fall and winter of 2011-12 were characterized by large positive anomalies of the NAO, seasons when its footprint would have been much bigger for the negative NAO phase.

Coverage for dry regions in OND'11 reached 76% of the composite positive NAO result, while the coverage of wet regions in JFM'12 matched 58% of the composite, to the great benefit of TX and OK.

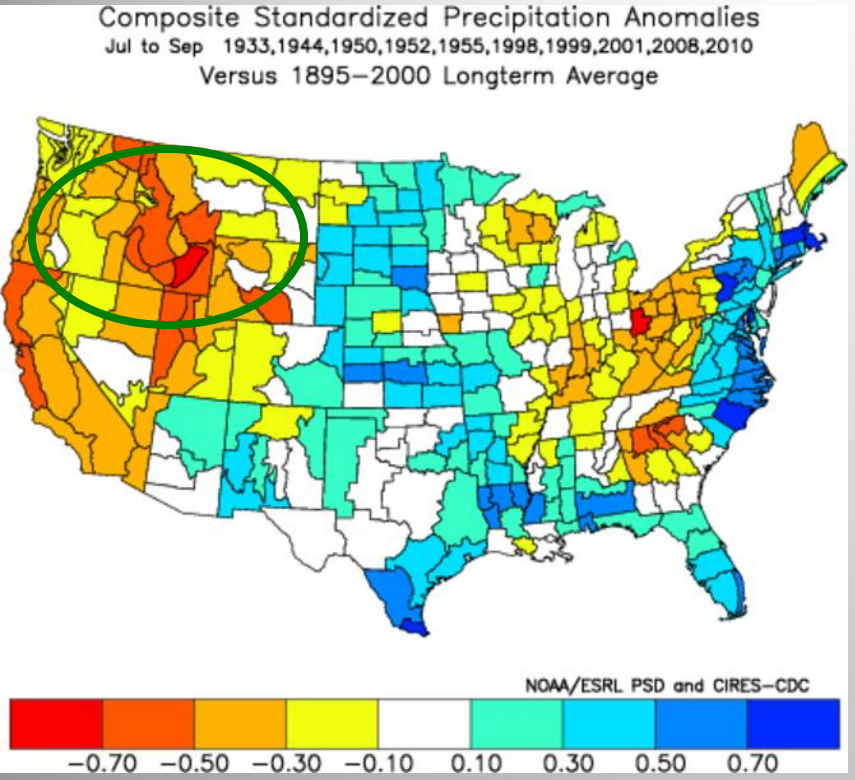
Role of contrast of Atlantic vs. Pacific, or PDO-AMO

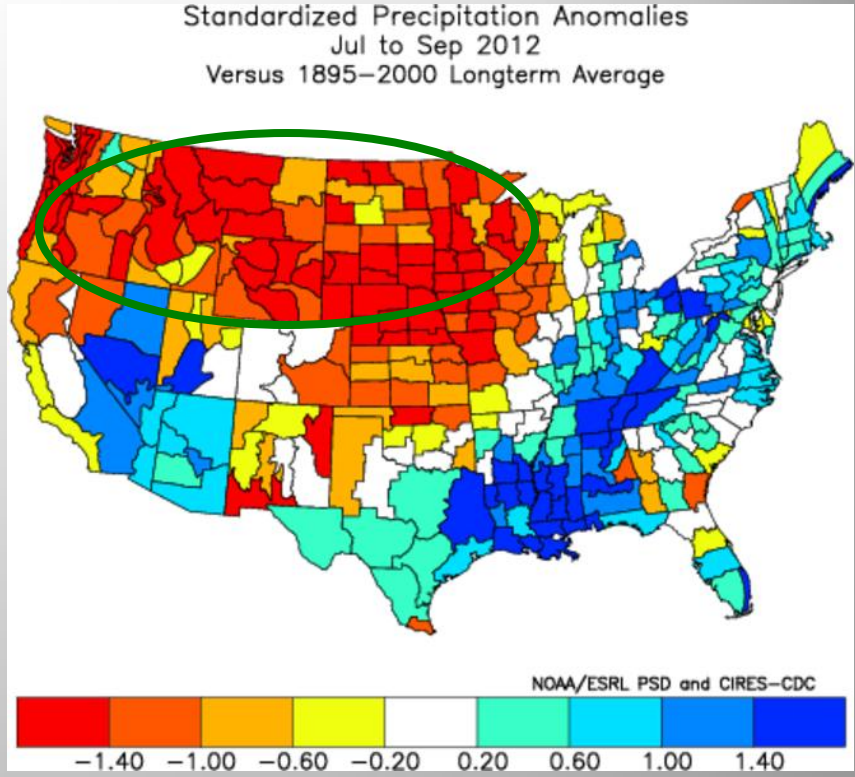


Schubert et al. (J. Climate, 2009)

In five different GCMs, a cold Pacific combines with a warm North Atlantic to produce most pervasive drought conditions in continental U.S.

What happened in WY'12 – Persistently negative PDO-AMO





After being consistently low for much of the last decade, the difference in normalized anomalies between PDO and AMO reached its lowest value on record this summer. It appears that its impact was also strongest during that season, with 43% of the 'wet' climate divisions and 68% of the 'dry' climate divisions that matched expectations.

The opposite phase of the PDO-AMO difference (warm Pac-cold Atl) would have had an even greater impact on the U.S., covering 41% of it with 'wet' composites – unfortunately, we are a long way off from that scenario for now.

Summary

1. **A major La Niña event began in 2010, opening the door to a long-lead forecast of La Niña conditions into 2012 (*which was not anticipated by the current generation of forecast models*). Double-dip Las Niñas occur about once a decade, but come in clusters about twice as often during negative PDO stages.**

1. **The expansion of drought conditions during the last two years is somewhat consistent with expected impacts from such a long-lasting La Niña (match better during the winter half year than in summer).**

1. **Both NAO and PDO/AMO appear to have influenced precipitation anomalies in WY'12 – a predictive capacity for both would be very helpful, on the seasonal time scale for NAO and multi-year to decades for PDO/AMO.**

2. **Based on experience with careful composites, SWcasts, and now SCcasts, regional seasonal to annual forecasts can skillfully supplement current CPC forecast on national scale. CPC should consider to provide longer duration forecast periods (half-year to annual) to address stakeholder needs in the drought and water management communities.**