

South-Central U.S. Droughts and La Niña

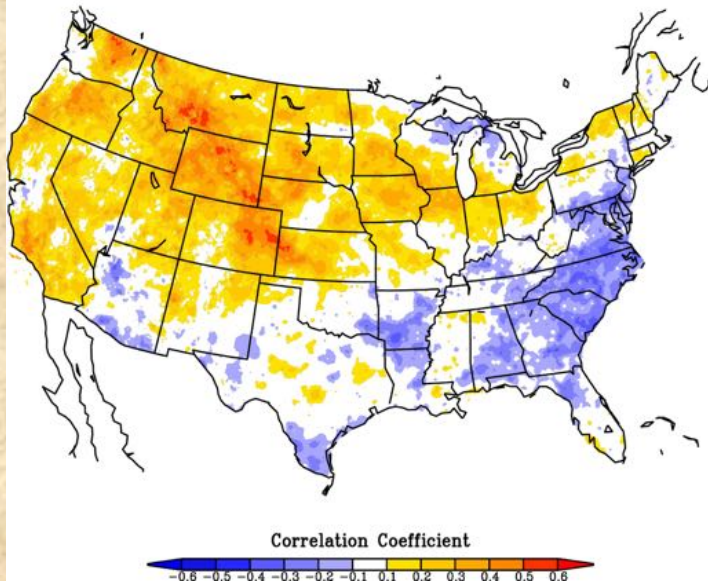
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<with help from Jon Eischeid>

- **South-central (TX) U.S. in last decade: *ENSO poster child!***
- **Current ENSO setup and outlook into early 2012**
- **Texas droughts and prospects for 2011-12 in this context**
- **Anything else? (*AMO, PDO, NAO*)**

JJA Precipitation versus MEI (1956–2005)



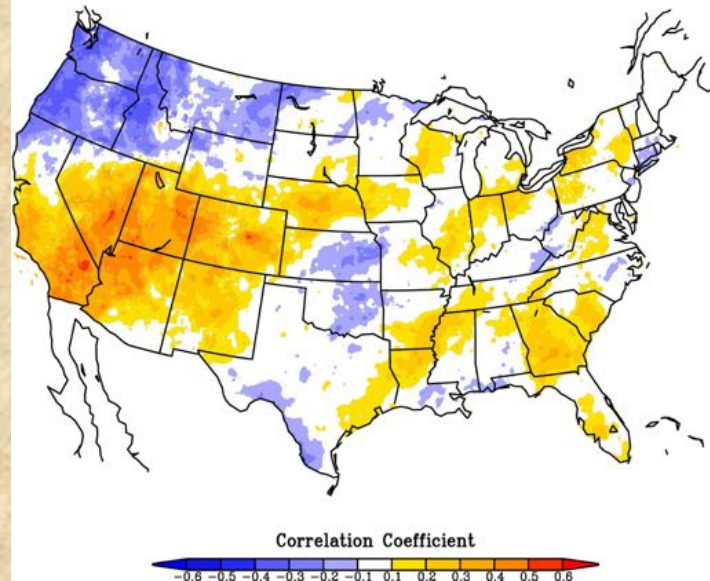
Seasonal cycle of ENSO impacts

New Mexico has positive correlations year-round, but most pronounced in winter and spring (bottom panels).

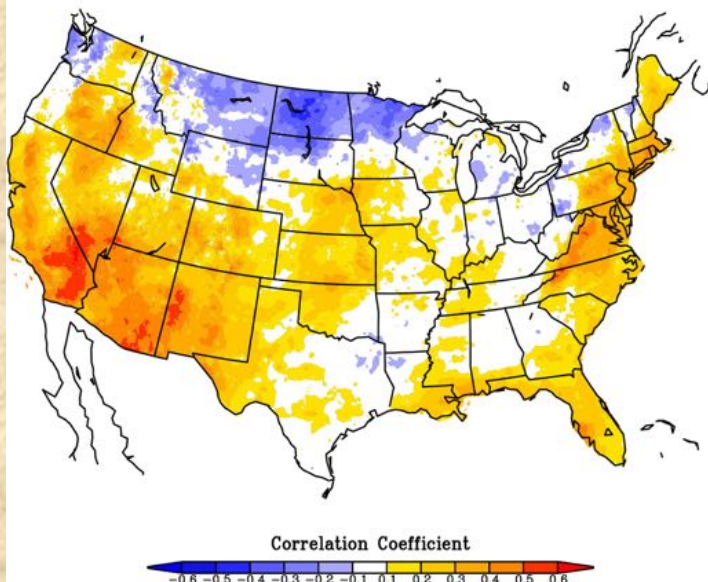
Texas correlates highest in winter (bottom right). Summer and fall are much less constrained by the phase of ENSO.

Louisiana shows negative correlations in summer (top left), while the other three seasons favor positive correlations, especially in winter.

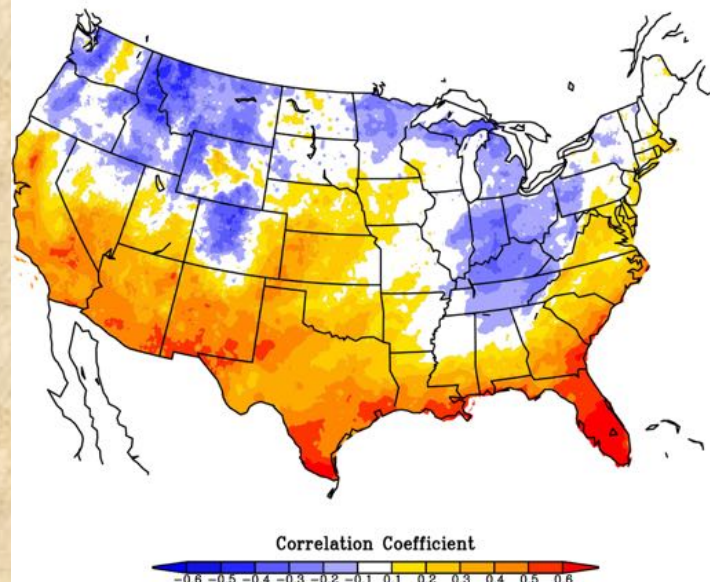
SON Precipitation versus MEI (1956–2005)



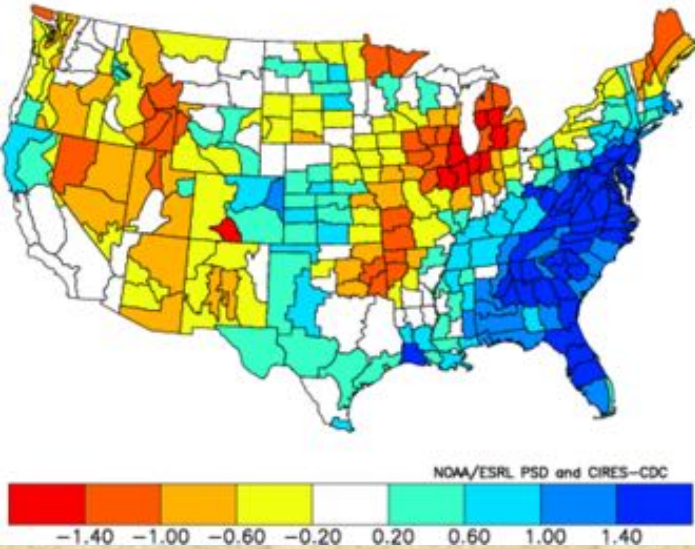
MAM Precipitation versus MEI (1956–2005)



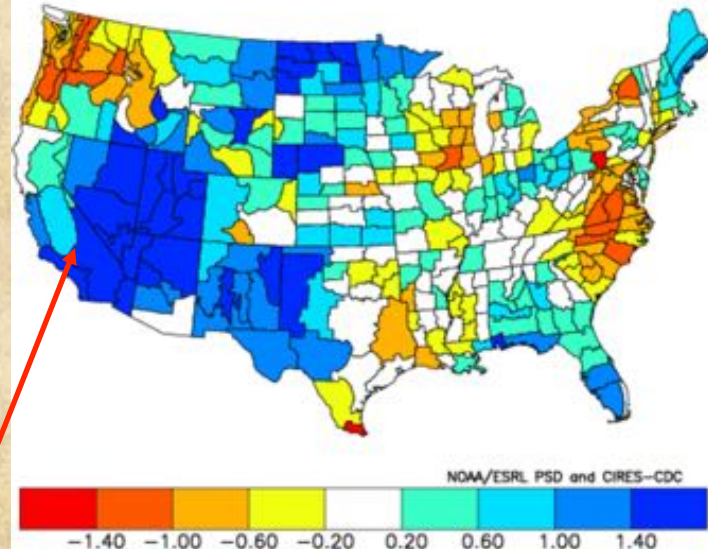
DJF Precipitation versus MEI (1956–2005)



Standardized Precipitation Anomalies
Oct to Jun 2002-03
Versus 1971-2000 Longterm Average



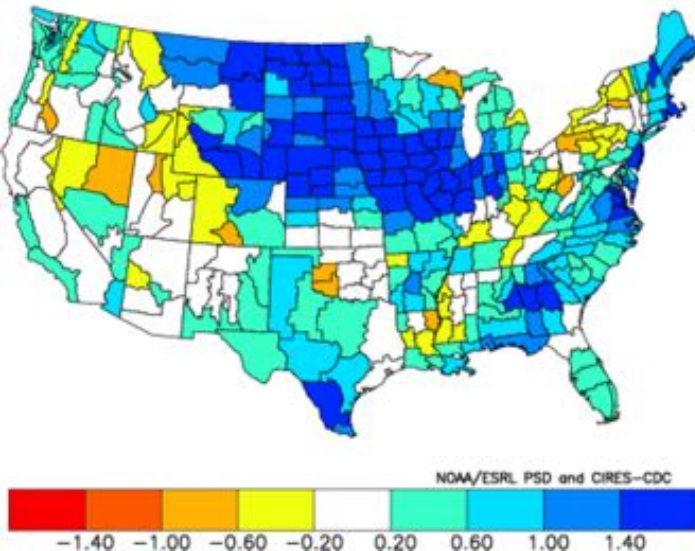
Standardized Precipitation Anomalies
Oct to Jun 2004-05
Versus 1971-2000 Longterm Average



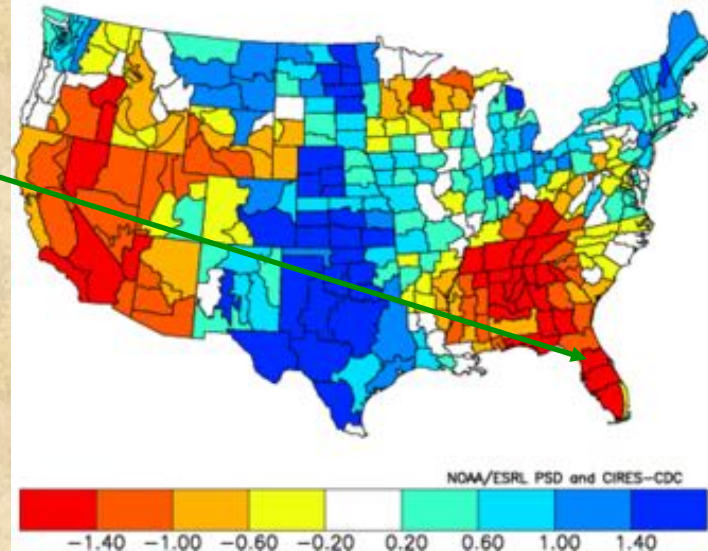
Los Niños since 2002

Last decade had more than its fair share of El Niño events, in 2002-03 (top left), 04-05 (top right), 06-07 (bottom right), and 09-10 (bottom left). However, the 1st three events were quite weak, with ‘quirky’ impacts in the U.S., except for TX where every single one of them ended up on the wet side (compare this to CA (only one wet) or FL (06-07 really dry), or even NM (dry in 02-03)).

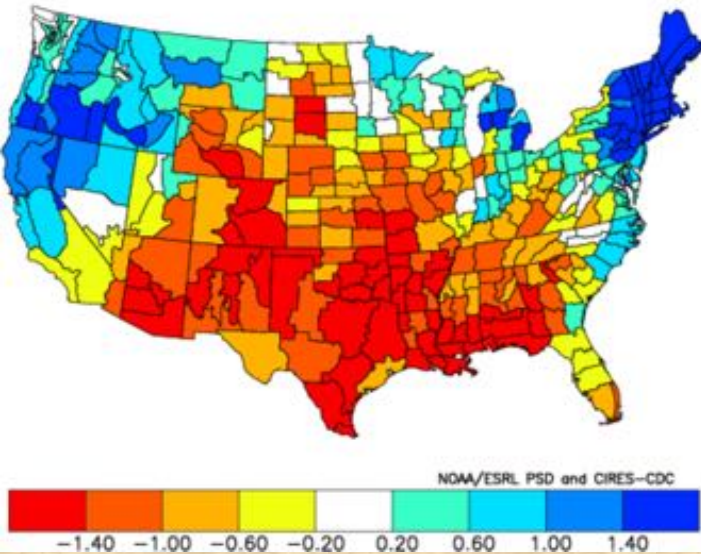
Standardized Precipitation Anomalies
Oct to Jun 2009-10
Versus 1971-2000 Longterm Average



Standardized Precipitation Anomalies
Oct to Jun 2006-07
Versus 1971-2000 Longterm Average



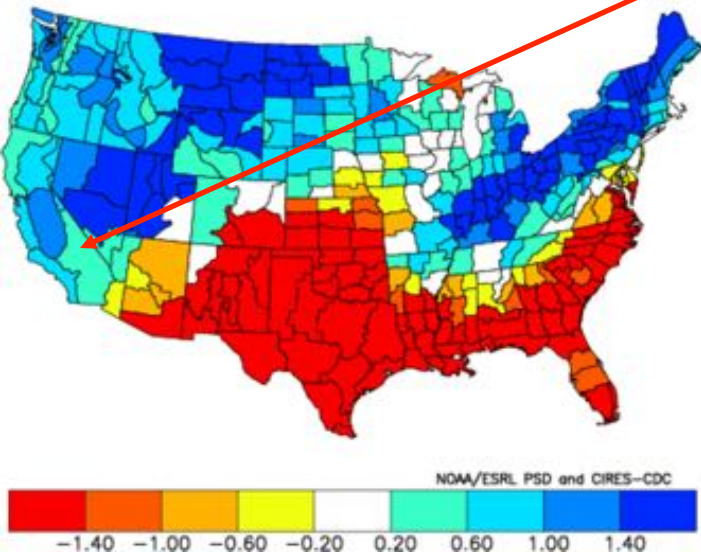
Standardized Precipitation Anomalies
Oct to Jun 2005–06
Versus 1971–2000 Longterm Average



Las Niñas since 2002

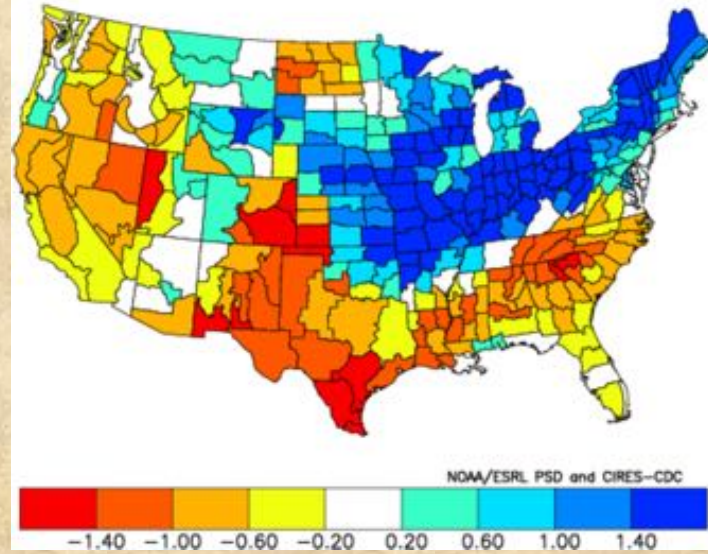
Last decade also had more than its fair share of Las Niñas, in 05-06 (top left), 07-08 (top right), 08-09 (bottom right), and 10-11 (bottom left): TX&LA were poster children for La Niña impacts, always dry, while southern CA ended up wet last year (*one 'AR' event in December was all it took*), and FL was close to normal in all but the last La Niña.

Standardized Precipitation Anomalies
Oct to Jun 2010–11
Versus 1971–2000 Longterm Average

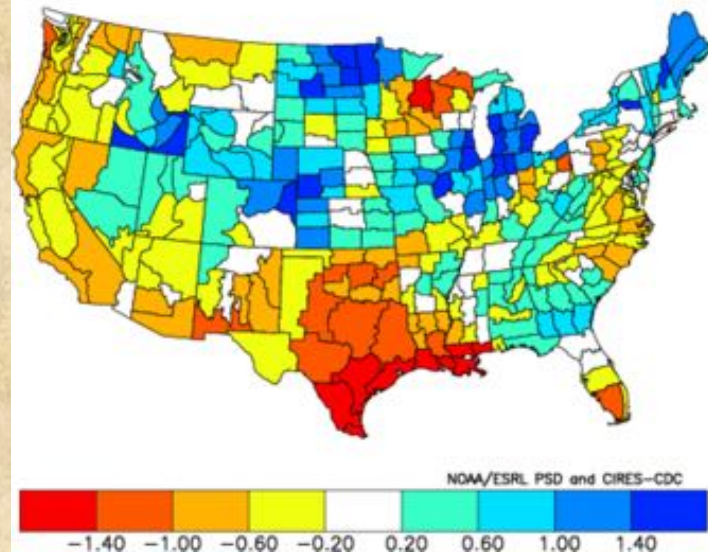


Silver lining: A switch back to El Niño in '12 could give TX a more predictable 'wet' response than others.

Standardized Precipitation Anomalies
Oct to Jun 2007–08
Versus 1971–2000 Longterm Average



Standardized Precipitation Anomalies
Oct to Jun 2008–09
Versus 1971–2000 Longterm Average



Multivariate ENSO Index (MEI) for six strong La Niña events since 1949 vs. recent conditions



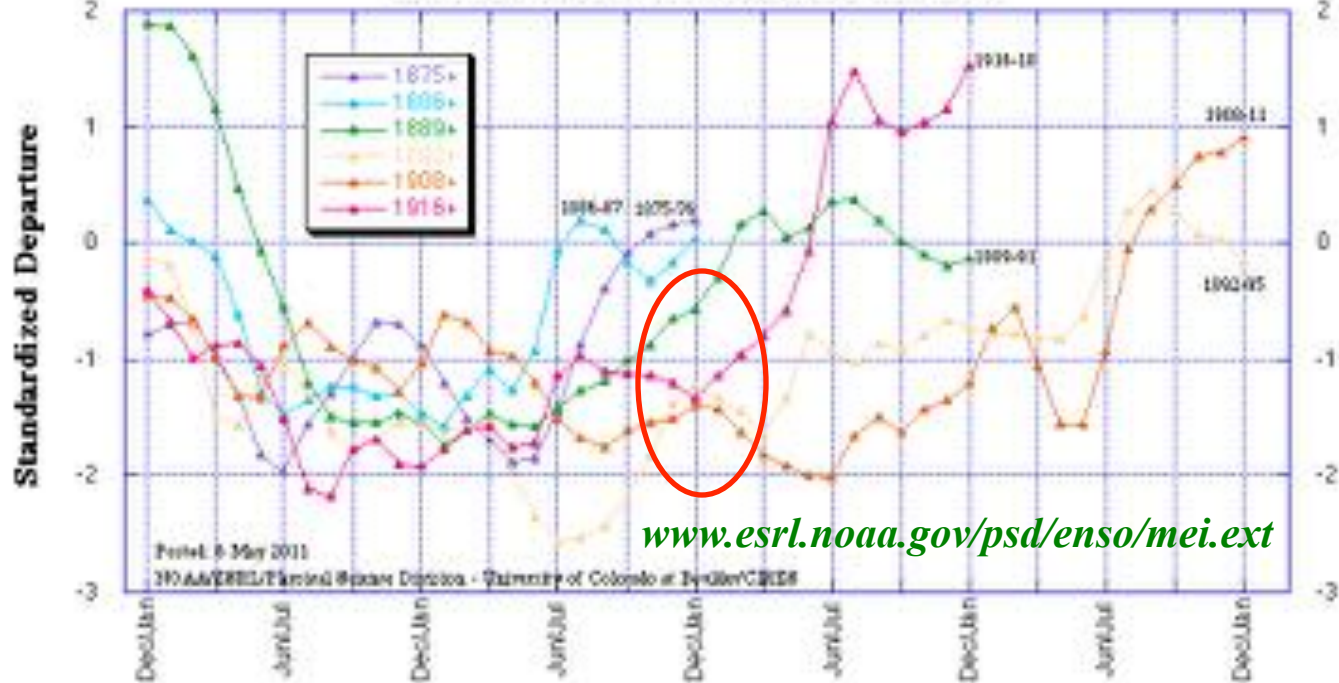
Old vs. 'New' Las Niñas

Only 1964-65 rebounded within a year!

Odds are about 2:1 for large Las Niñas to get double-dip (2nd year event), both pre-1950 and since then...

<not nearly as high for Niños – biggest ones 'self-destruct'>

Extended Multivariate ENSO Index (MEI.ext) for the six strongest La Niña events between 1871 and 1949

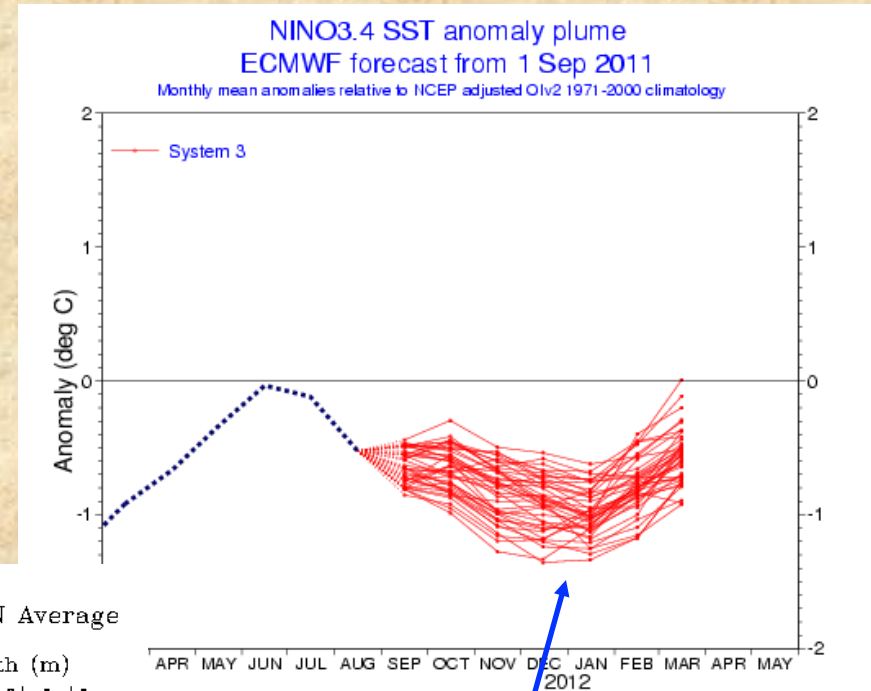


Current ENSO situation and outlook

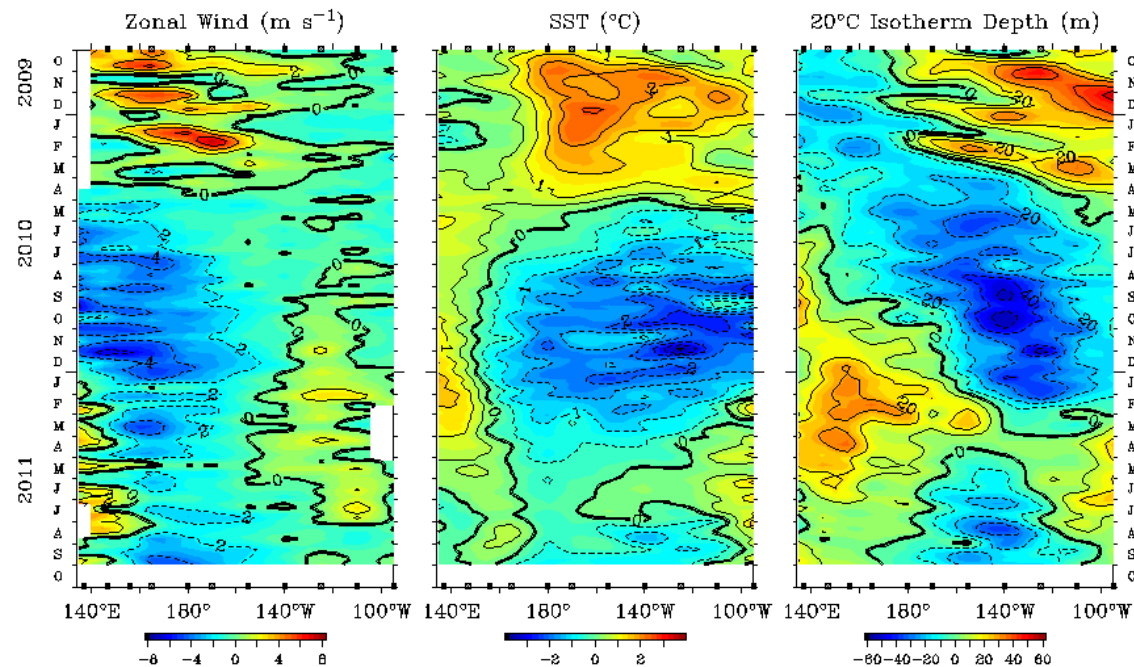
Recent tropical Pacific wind anomalies (bottom left) have maintained a La Niña ‘profile’, i.e., easterly anomalies near the dateline right thru the ENSO-neutral period of this summer;

SST anomalies (middle) are currently weak, but consistently negative where it counts;

subsurface heat content (bottom right) went thru a brief warming period in late spring/early summer, only to relapse into negative anomalies in late summer.



Five Day Zonal Wind, SST, and 20°C Isotherm Depth Anomalies 2°S to 2°N Average

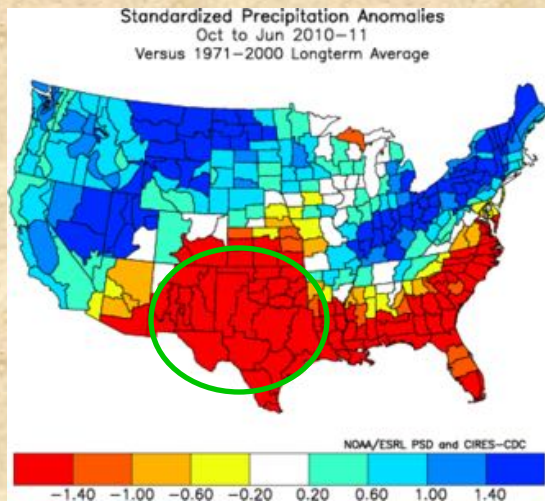
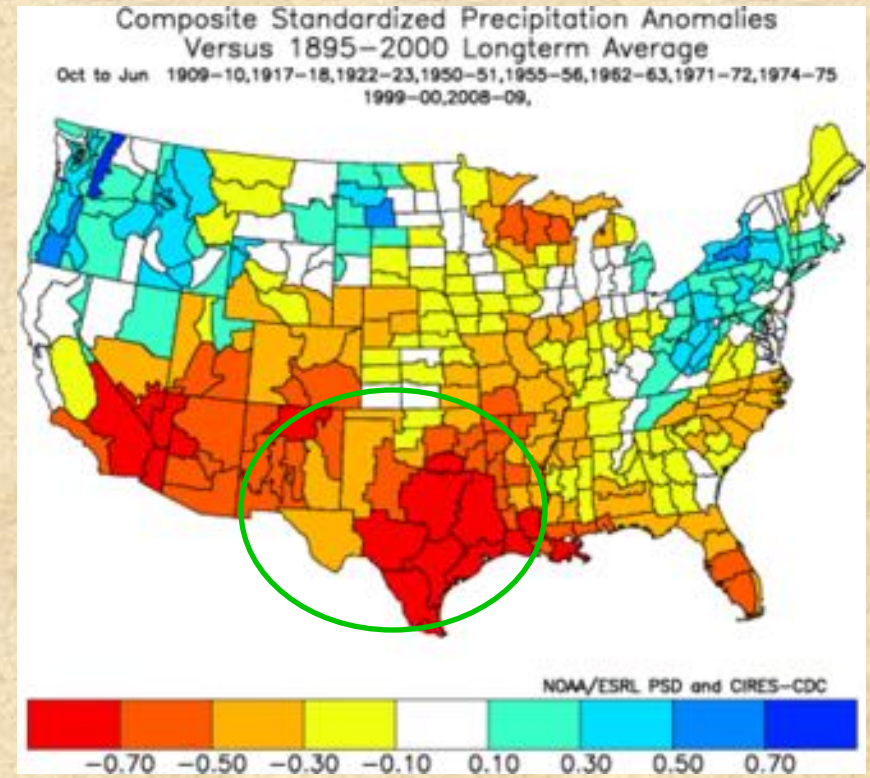
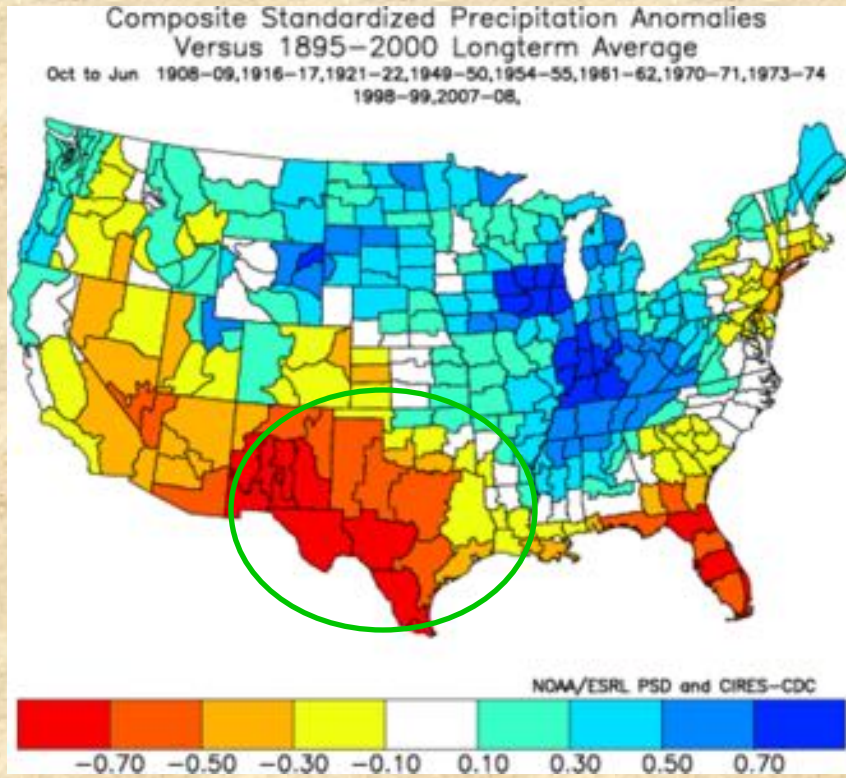


date: 15 Sep 2011

ECMWF

(top right) ECMWF (Tony’s ‘gold standard’ model) goes for weak-moderate event this winter, confirming previous slide

1st vs 2nd Yr La Niña composites for October-June

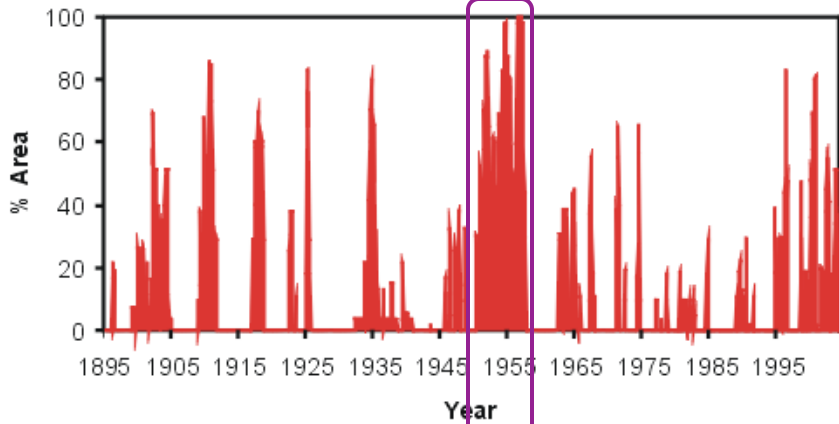


Similar to the average outcome of 1st year La Niña seasons (top left), Oct-Jun 2010-11 (bottom left) saw below average rainfall in the south-central U.S.

The upcoming 2011-12 season does not look like much a reprieve (top right). *This is based a set of double-dip Las Niñas that spans the last century, based on MEI and MEI.ext*

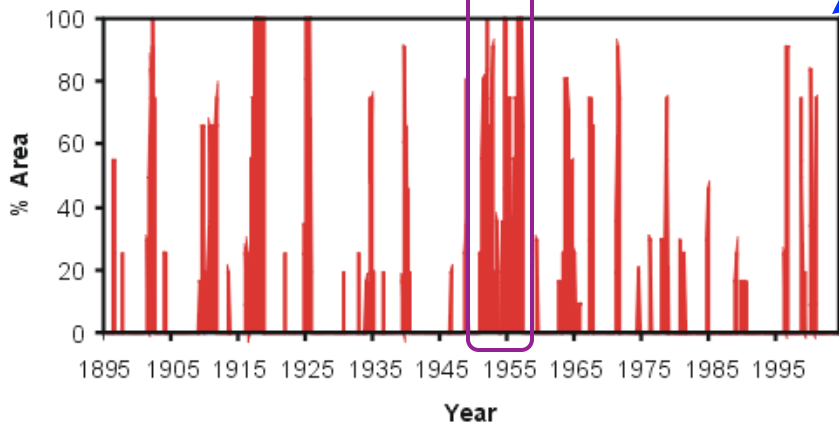
Percent Area of the Rio Grande Basin Experiencing Severe to Extreme Drought

January 1895–March 2004



Percent Area of the Texas Gulf Basin Experiencing Severe to Extreme Drought

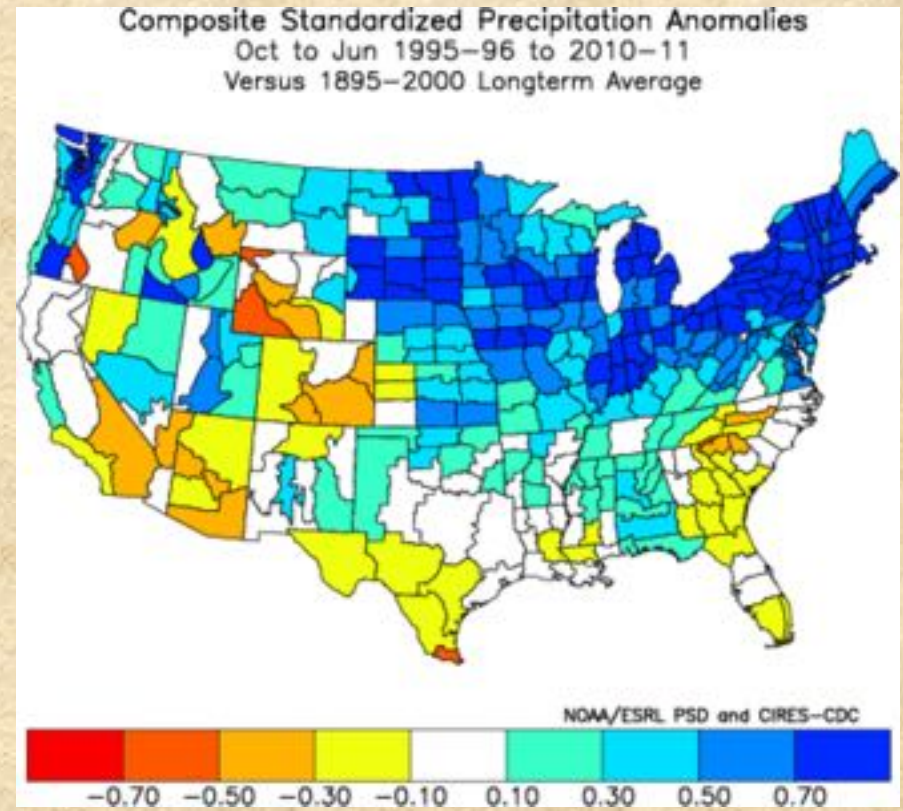
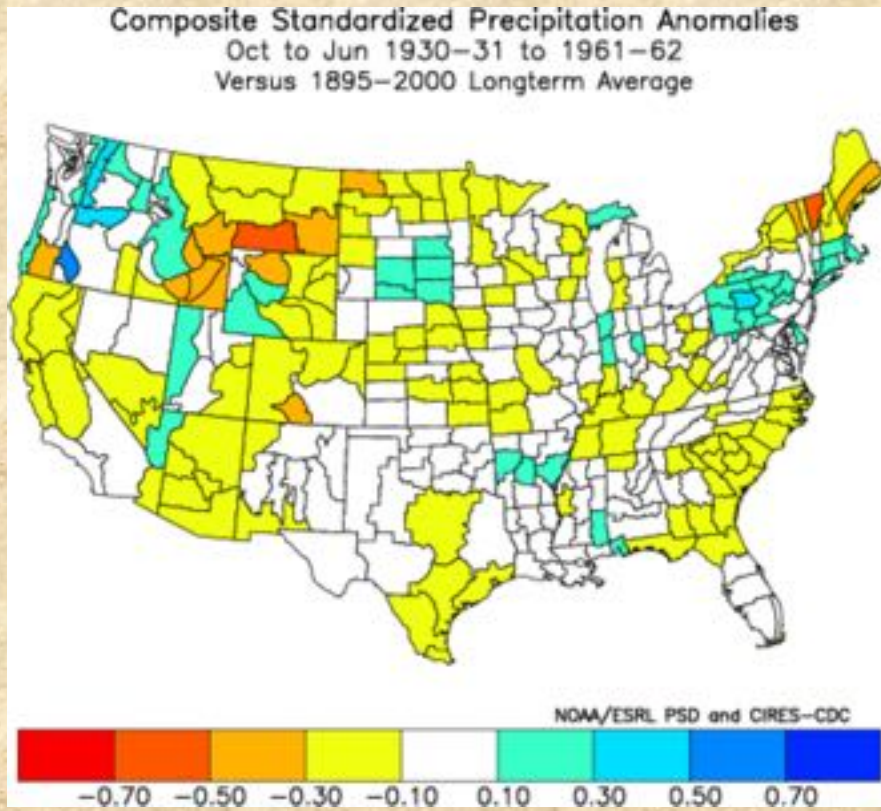
January 1895–March 2004



A quick look at Texas drought history: the 1950s ‘Drought of the Century’ was anchored by repeated La Niña conditions, and was much more severe and prolonged than other droughts of the last century.

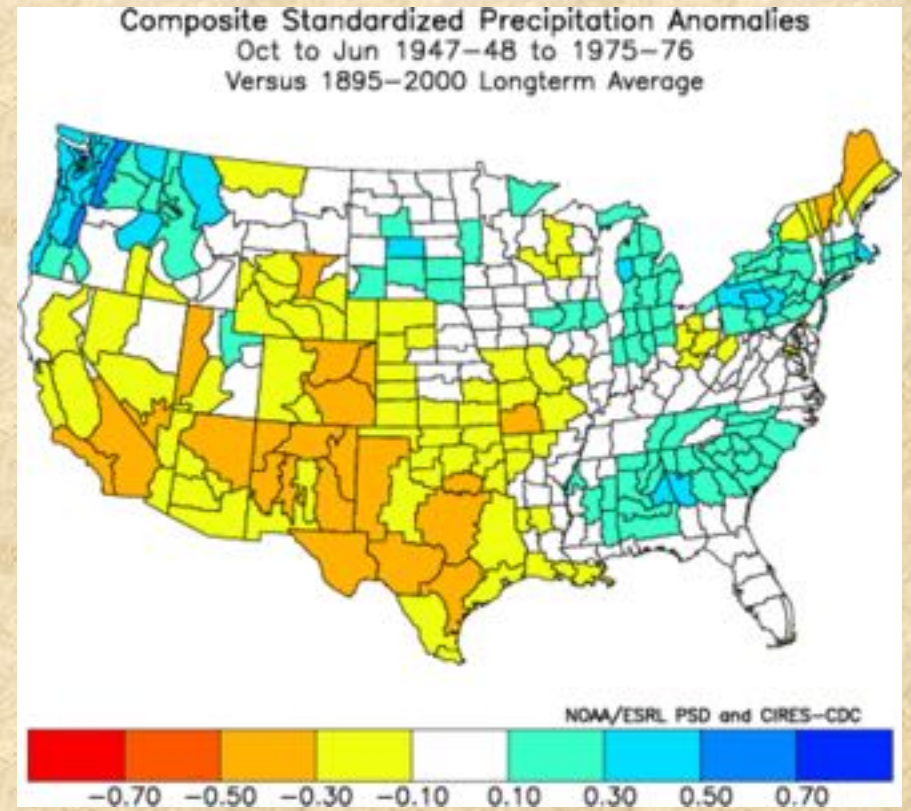
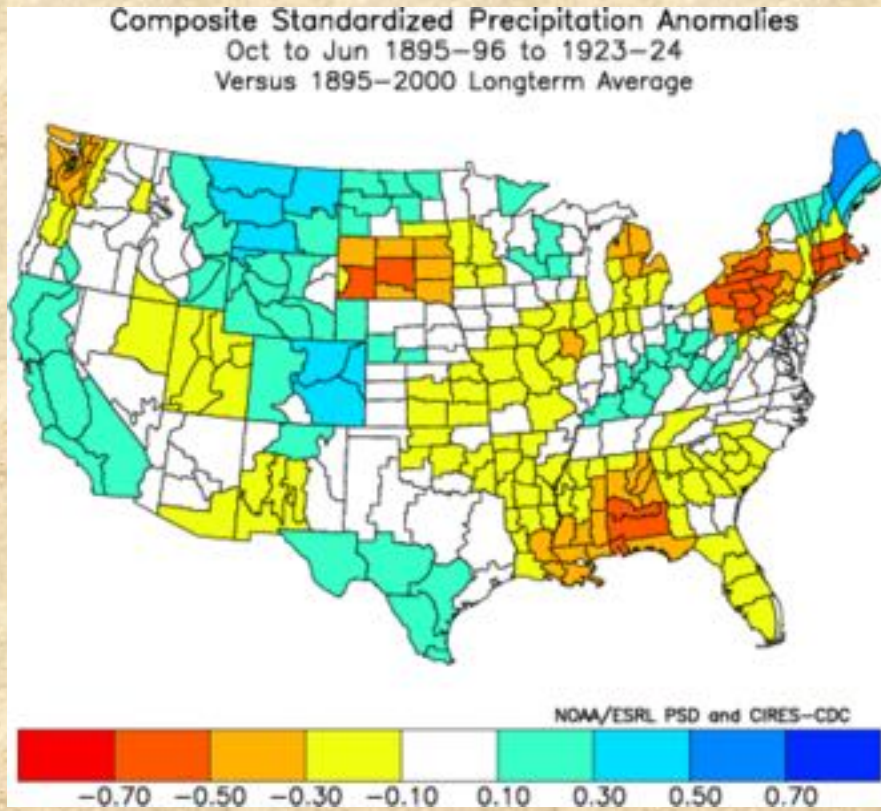
Top ten TX droughts (Oct-Jun) were ALL associated with La Niña (2011, 1925, 1956, 1971, 1996, 1917, 1967, 1918, 1951, 2006)!

Anything else? Positive AMO phase



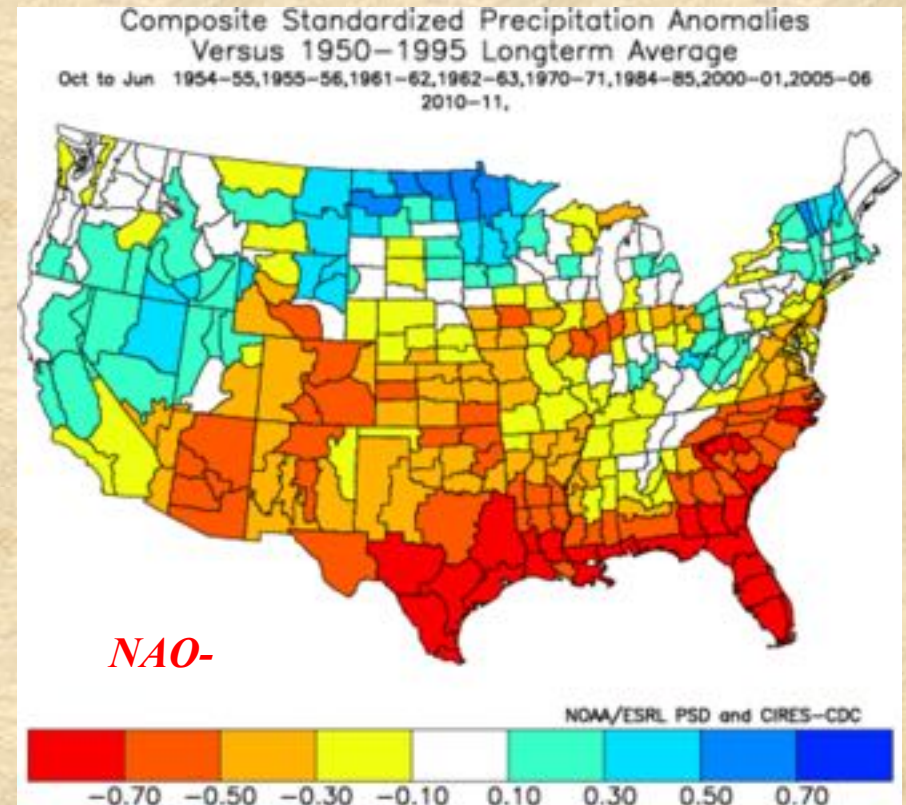
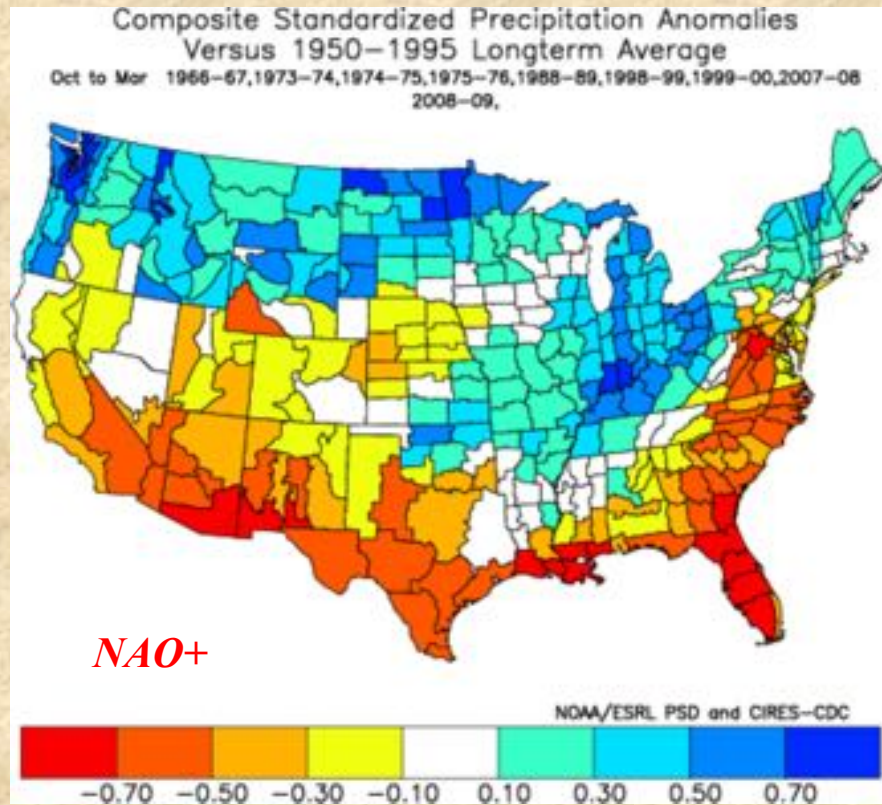
If there is an AMO signal over Texas, it is not as simple as just using the current positive phase to favor drought (or wetness).

Anything else? Negative PDO phase



If there is a PDO signal over Texas, it appears to reinforce the La Niña footprint (especially, if you trust the recent period more than the early Climate Division record).

Anything else? (N)AO & La Niña



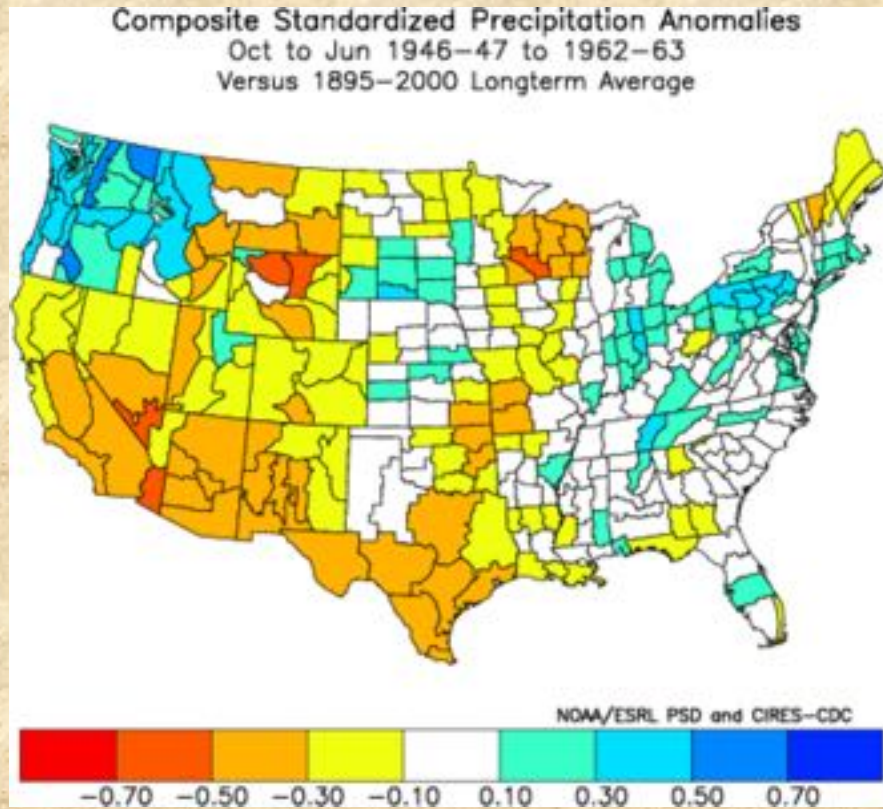
Issues: we don't predict (N)AO seasonally, the footprint is actually quite seasonal, and there is the choice of index: AO vs. NAO, NAO (SLP) vs. NAO (700/500mb)...

For the NAO, there is a hint of persistence from summer to winter, but it appears not reliable; *FWIW, 2011 was one of the most negative NAO summers on record!*

Summary

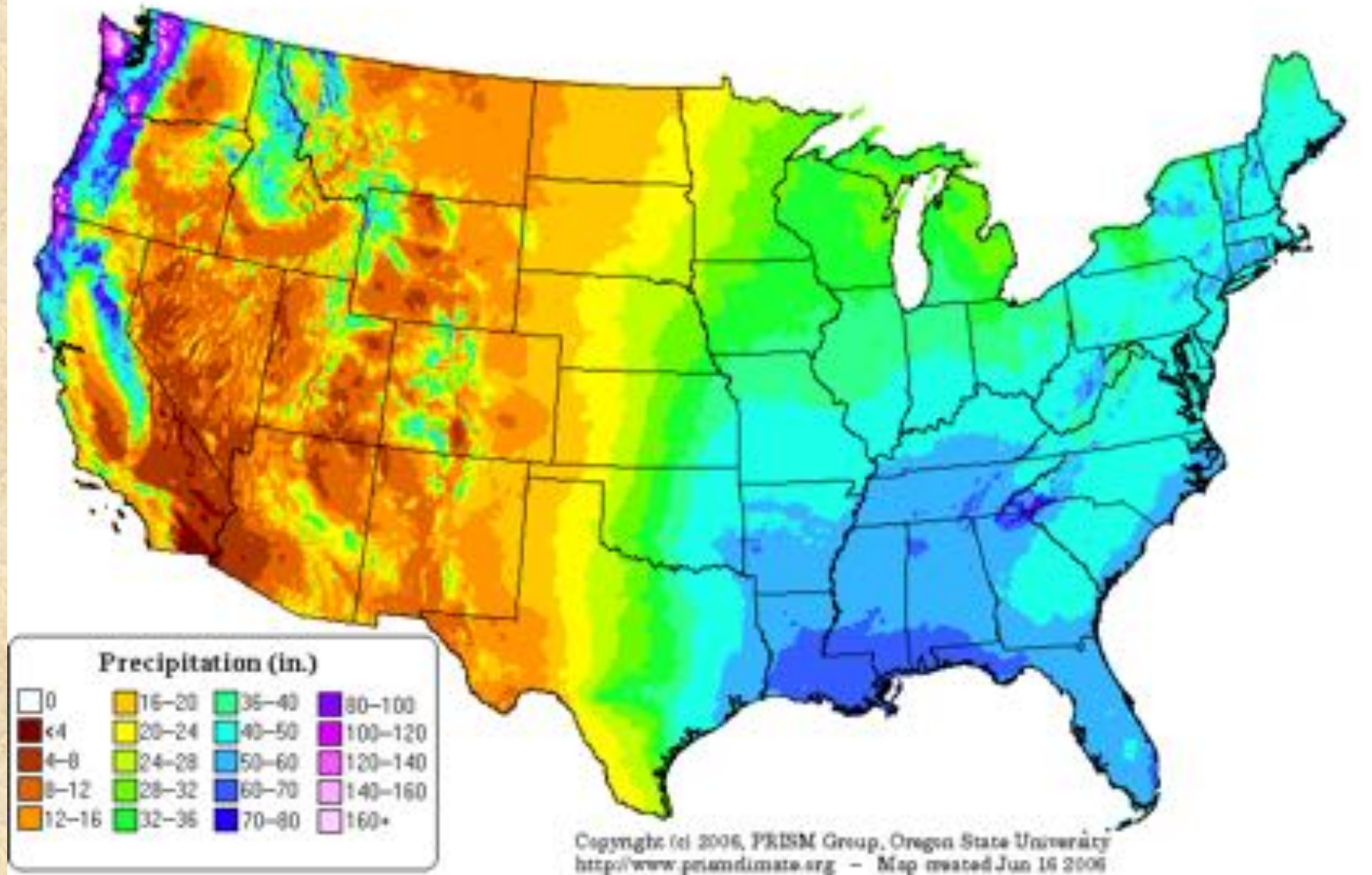
- **As long as we stay in La Niña, there is not much hope for breaking out of current drought pattern in south-central U.S.; *at least the odds for a 3rd year La Niña winter are not enhanced.***
- **Negative PDO phase appears to reinforce La Niña signal, ditto for negative NAO, if it were to materialize this winter. Two of the least dry extended La Niña events (1973-76 and 1998-2001) featured positive NAO phase winters.**
- **Tropical storms could help out near the coast, but that season is winding down for 2011.**
- **If we were to switch to El Niño next summer, the record of the last decade would indeed favor an end of the 2010-12 drought.**
- **However, we still have no handle on what made the 1950s drought so long-lived. That means we cannot exclude the possibility of its recurrence.**

Positive AMO & Negative PDO phase

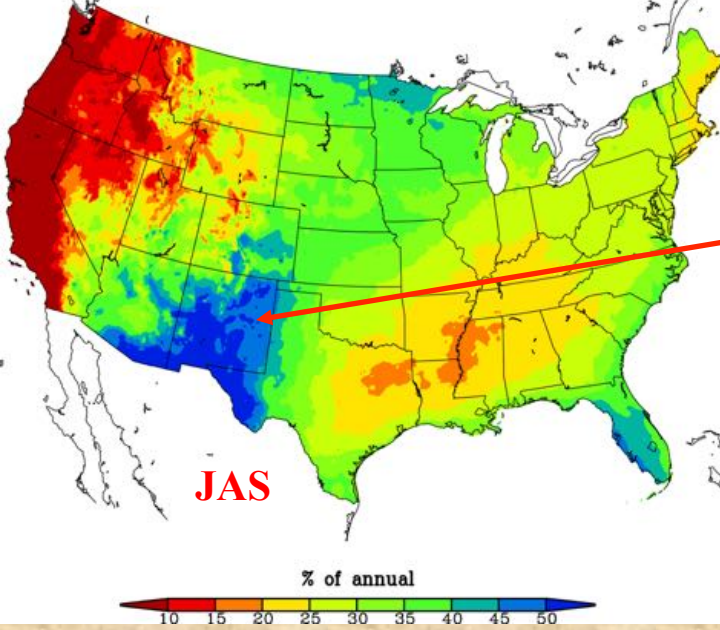


The one extended period of both of these phase coinciding was from mid-1940s to early 60s: looks like La Niña dominated that footprint.

Precipitation: Annual Climatology (1971–2000)

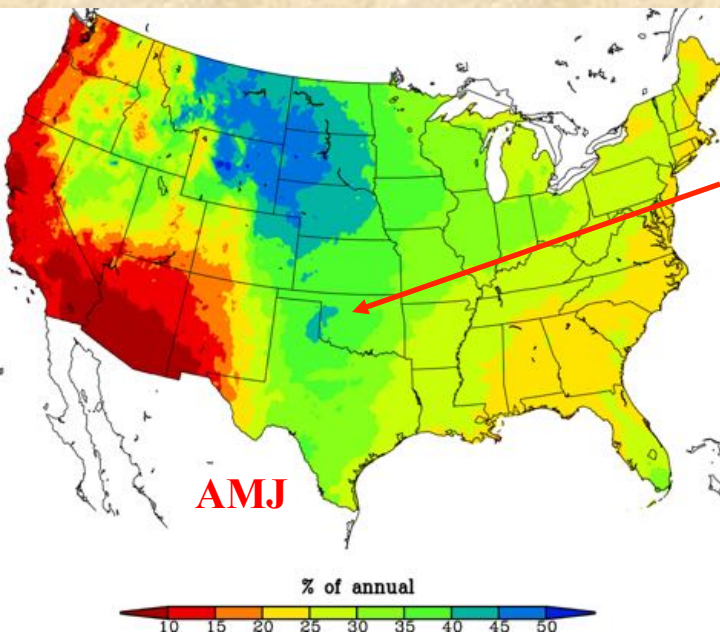
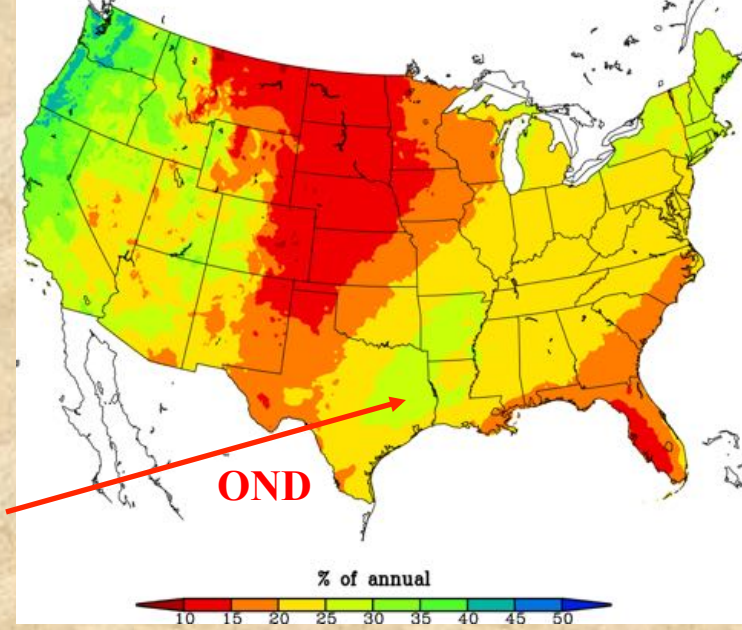


Semi-arid NM/Western TX vs. moist Eastern TX/LA: from less than 8" near the Four Corners to over 60" in Louisiana – a deficit of, say, 10" in a year or two near the Gulf Coast carries less impact than further west...

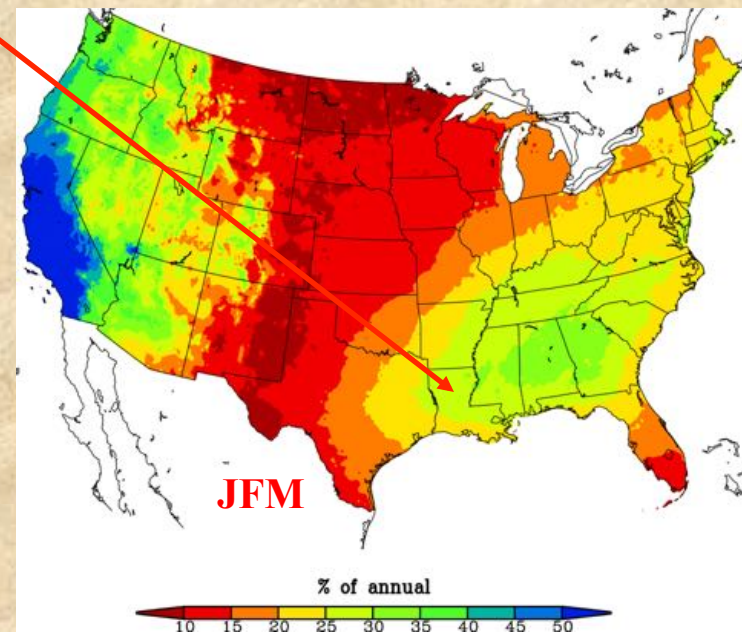


Seasonal cycle

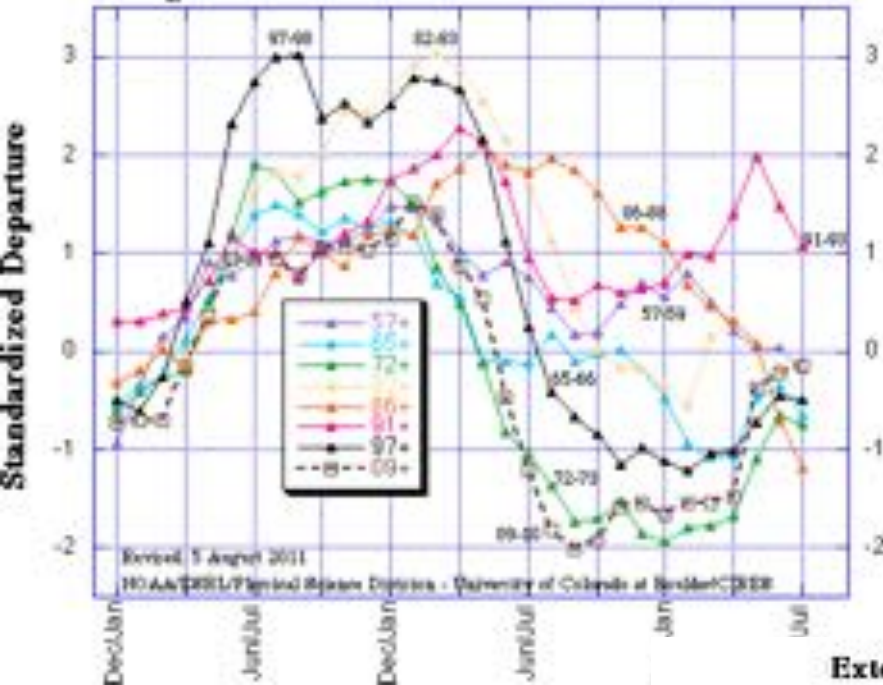
Summer monsoon (top left) contributes up to 50% of the annual precipitation in NM, but is quite unimportant from eastern TX into LA; fall season (top right) contributes $> \frac{1}{4}$ of annual totals over eastern TX; winter (bottom right) is most important in LA; spring (bottom left) is key season from eastern NM eastwards.



NOTE: It is easiest to get into or out of droughts during the wettest season of the year!



Multivariate ENSO Index (MEI) for the seven strongest El Niño events since 1950 vs. 2009-10



Old vs. 'New' Los Niños

Big Los Niños 'self-destruct' within just over one year!

Odds are about 1:1 for large Los Niños to give double-dip (2nd year event), both pre-1950 and since then...

SO, an El Niño can be longer than one year, but not as common as for La Niña (check out odds I computed)

Extended Multivariate ENSO Index (MEI.ext) for the six strongest El Niño events between 1871 and 1949

