

# Impact of the 2009-10 El Niño Event on Precipitation Patterns in Texas and Oklahoma in Comparison to Earlier Events

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# Impact of the 2009-10 El Niño Event on Precipitation Patterns in Texas and Oklahoma in Comparison to Earlier Events.

In the fall of 2009, the 5th strongest El Niño event on record developed in the tropical Pacific and had a pronounced effect on weather in the U.S. during the winter and following spring. The changes in sea surface temperatures caused profound changes in atmospheric circulation patterns and produced a number of unusually strong winter storms tracking across the country. The related atmospheric anomaly patterns were reconstructed using data from the NOAA Reanalysis Model. These variables included, pressure, temperature, precipitation, vertical velocity, humidity and winds among others. Three extreme ENSO events were selected for detailed analysis, 1957, 1982-83, and 1997-98. The analysis produced a surprisingly complex pattern in which some parameters revealed interpretable results while some did not. One important impact was an increase winter precipitation across the southwest U.S. This is consistent with previous events and is an important input to the water resources of the region.

## What Are Reanalysis Data?

The key to the study is the so called “reanalysis” data. This data set is truly a tribute to modern technology. Reanalysis is a comprehensive global meteorological data set from 1948 until the present. It is based on both observational measurements and model calculations (also called the assimilation system). The observational data range from the usual surface observations, to upper air soundings from weather balloons to measurements from satellites. In fact, the variables are classified as "A" variables, based solely on observations, "B" variables based on primarily from observations but with a small component of model calculations, and "C" variables (such as precipitable water, and surface energy fluxes (energy transfers)) which are based solely on model calculations. Many published studies have demonstrated that the outputs are reliable estimates of actual meteorological conditions, and, even the ones with the greatest error are generally accurate within a 5 -10% range of error.

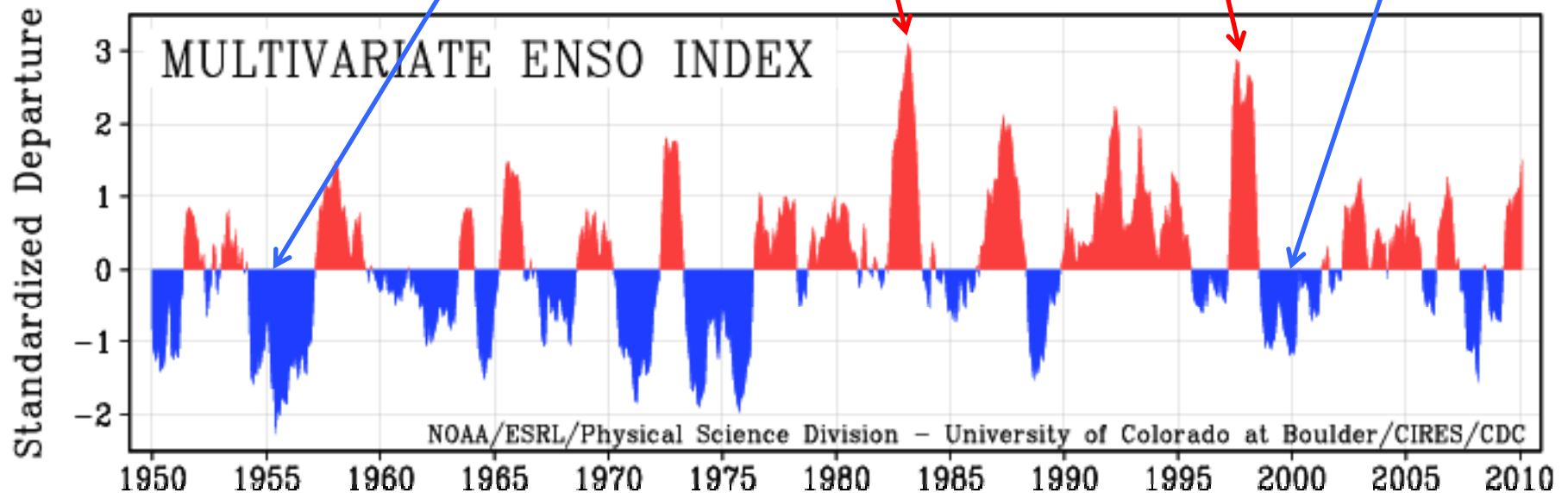
Since all of the data are processed through the same model, the results are directly comparable to each other.

# ENSO Variation 1950 – 2010

Strongest El Niños Were 1982 – 83 and 1997-98.

Strong La Niña 1952-56 Linked to Great Plains Drought.

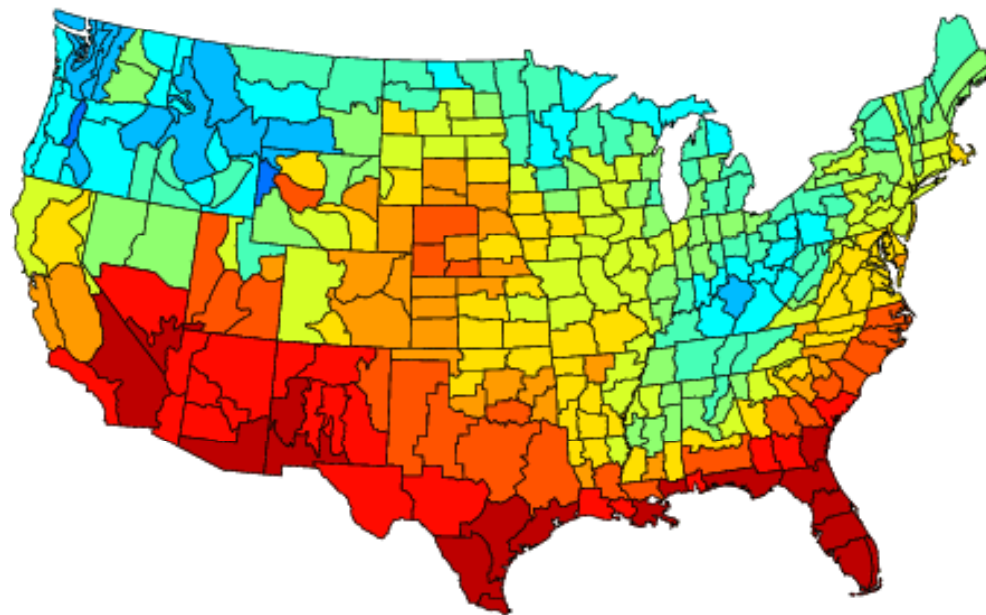
Another Strong La Niña Had Global Impacts 1998 – 2000.



ENSO events are highly variable in frequency and magnitude of occurrence. Their impacts are highly variable also.

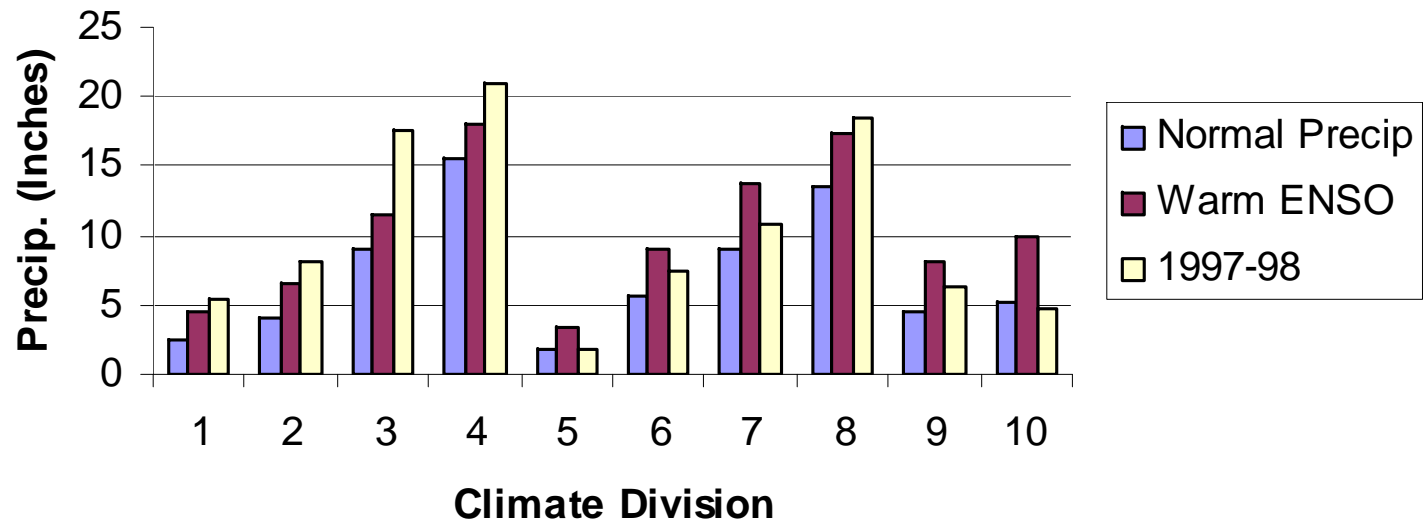
The Southwest and Southeast Show the Strongest Correlations with ENSO Conditions. The Strength of the Association Is Increased by Lagging U.S. Precipitation One Month Behind the ENSO Index.

Correlation Precipitation Nov to Mar  
With Oct to Feb Nino4 (index leads by 1 month)  
1949-04

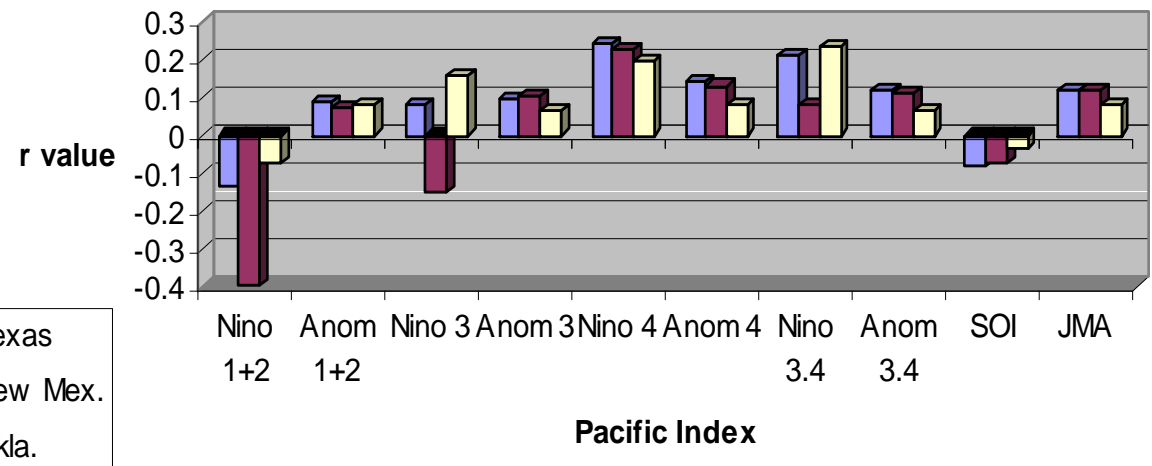


NOAA-CIRES/Climate Diagnostics Center

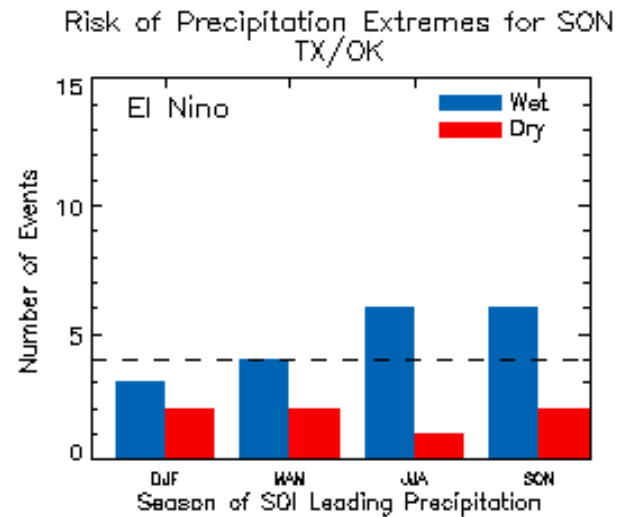
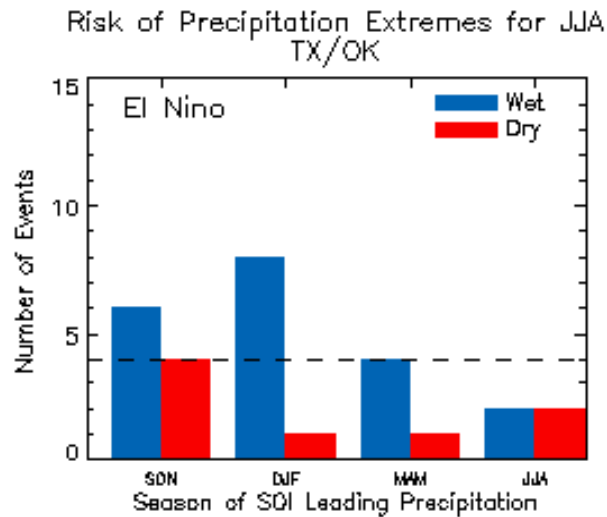
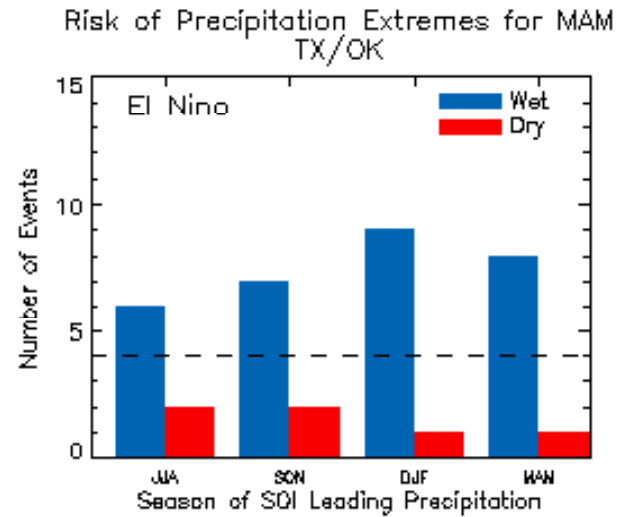
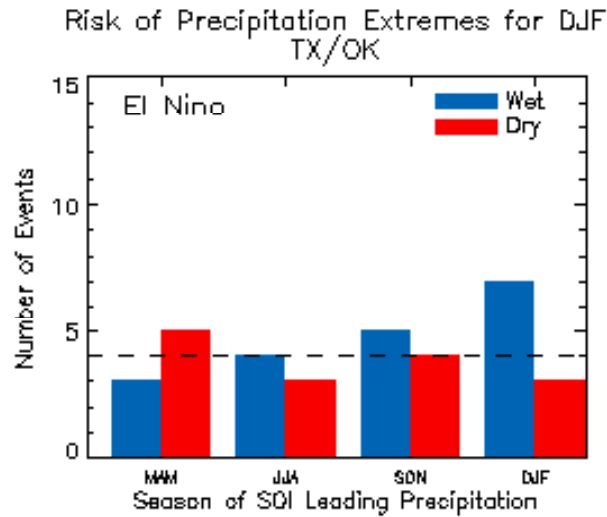
### Increase in Texas Precipitation, Warm Events, December to March



### Correlation between ENSO and Precipitation in Southwestern U.S. 1950-2001



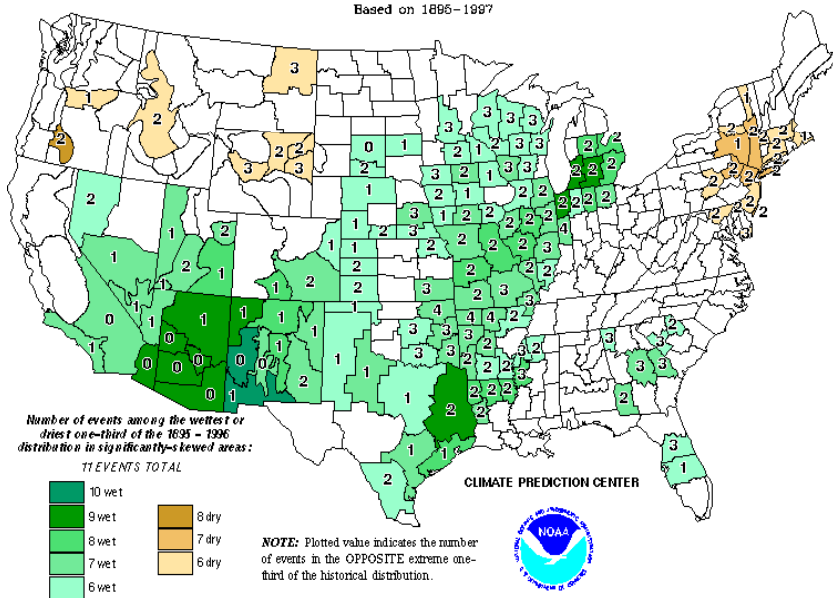
## El Niño Events in the Pacific Typically See an Increase in Precipitation in Texas and Oklahoma



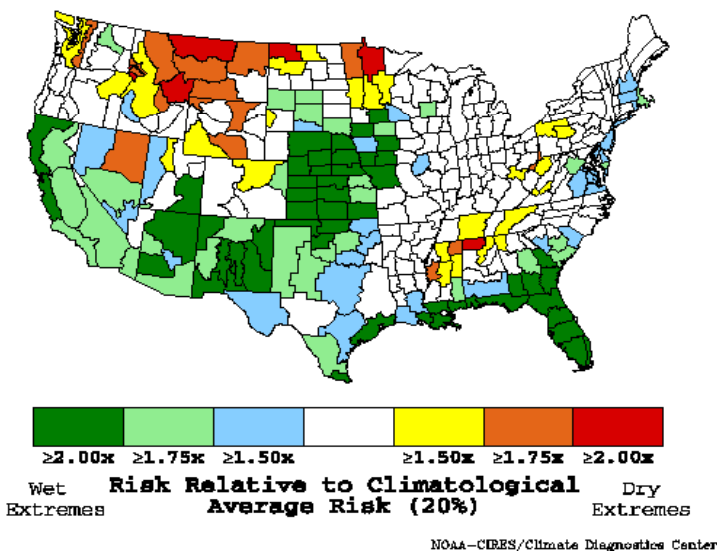
# El Niño Winters Typically Increase Precipitation in the Southwest

Significantly-Skewed El Niño Precipitation Distributions — October - December  
1914 1918 1941 1957 1963 1965 1972 1982 1987 1991 1994

Based on 1895-1997

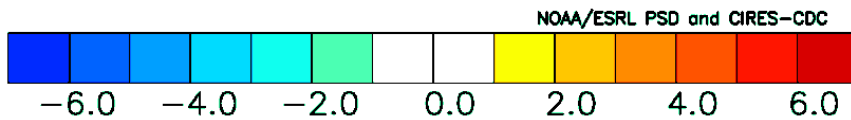
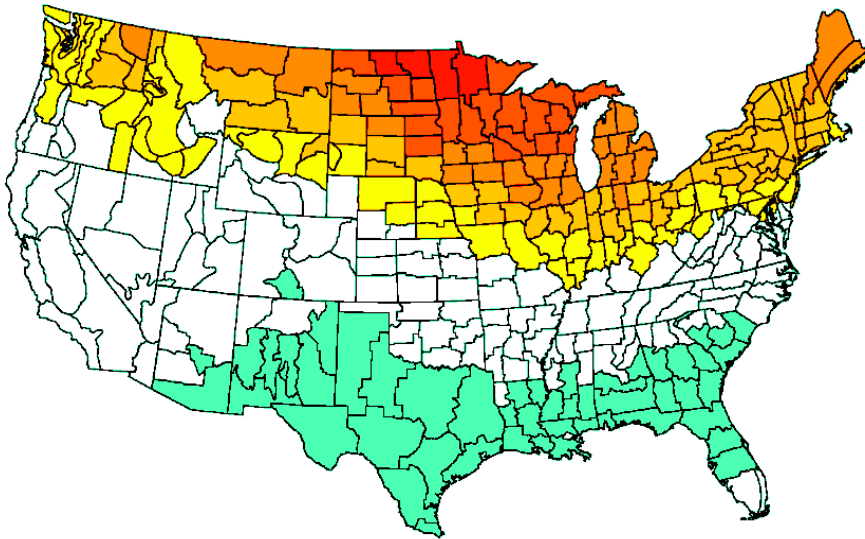


DJF Precipitation Extremes During El Niño  
Risk of Extreme Wet or Dry Years

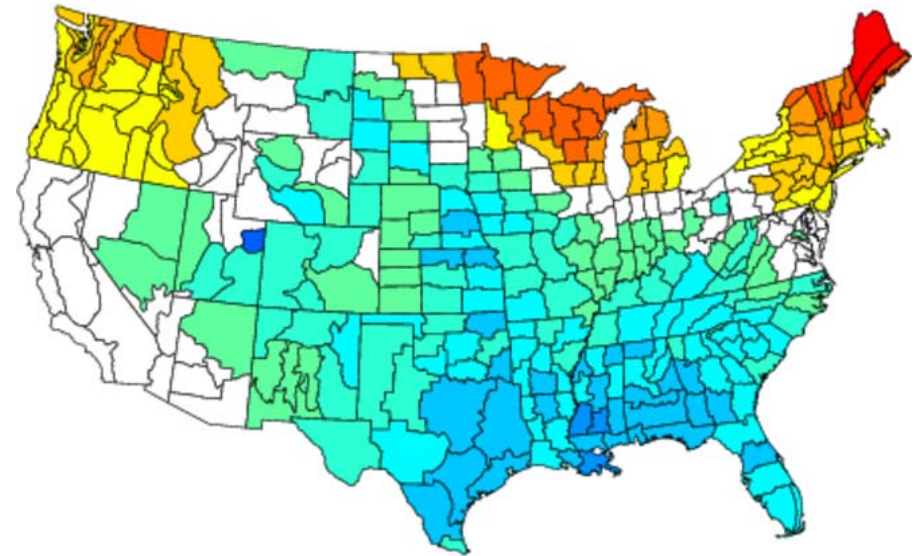


# El Niño Events Typically Lower Temperatures by about 2° F. During Winter 2009-10 Temperatures Were Somewhat Lower.

Composite Temperature Anomalies (F)  
Dec to Mar 1957-58, 1965-66, 1972-73, 1982-83, 1986-87, 1997-98, 2009-10  
Versus 1950-1995 Longterm Average

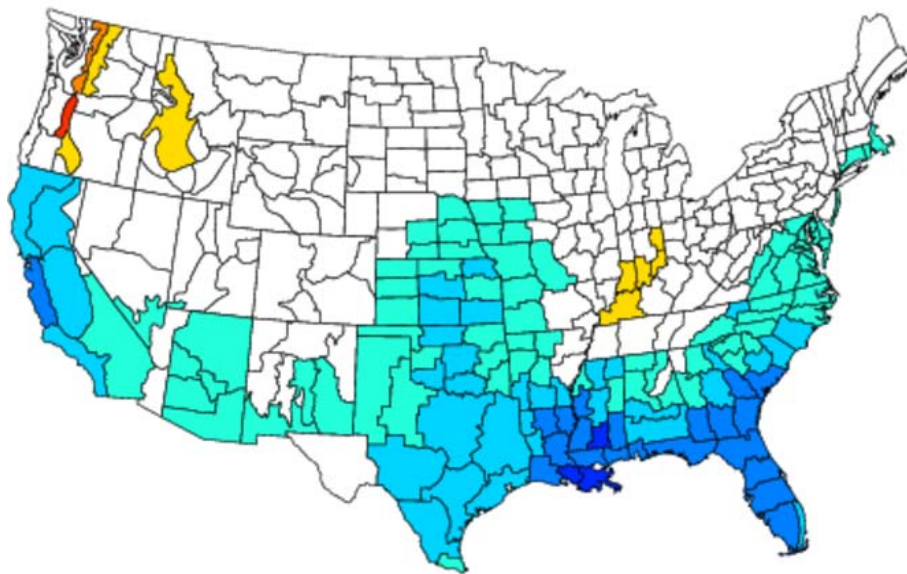


Temperature Anomalies (F)  
Dec to Mar 2009-10  
Versus 1950-1995 Longterm Average

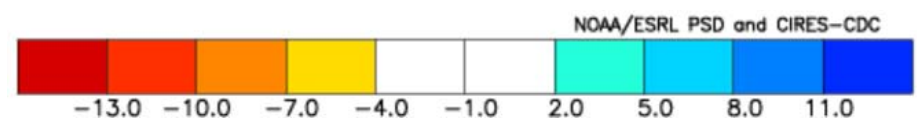
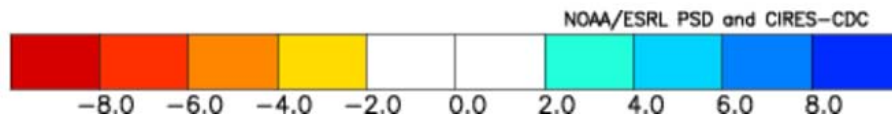
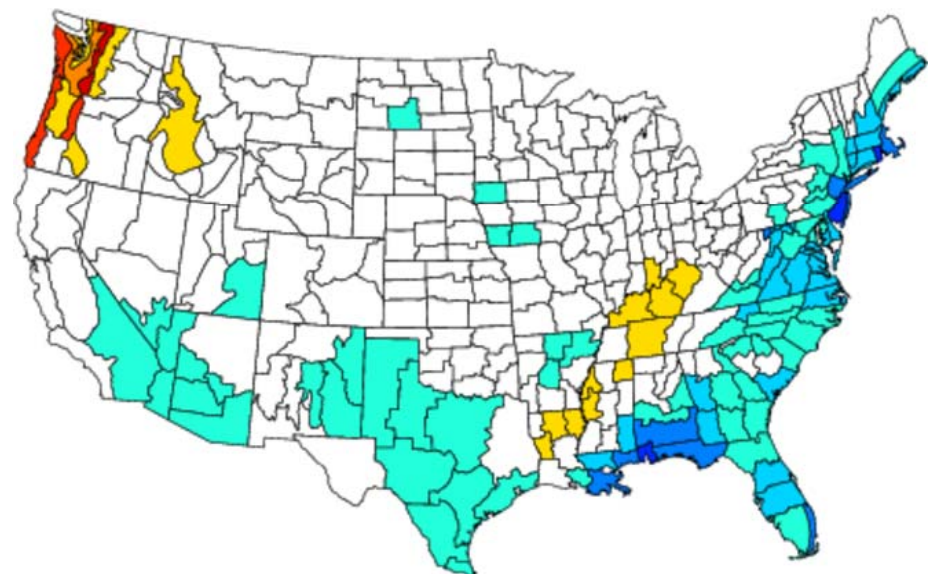


# Precipitation Amounts during Winter 2009-10 Were Higher than Normal But Less Than Typical for an El Niño

Composite Precipitation Anomalies (inches)  
Dec to Mar 1972-73, 1982-83, 1986-87, 1991-92, 1997-98  
Versus 1950-1995 Longterm Average



Precipitation Anomalies (inches)  
Dec to Mar 2009-10  
Versus 1950-1995 Longterm Average



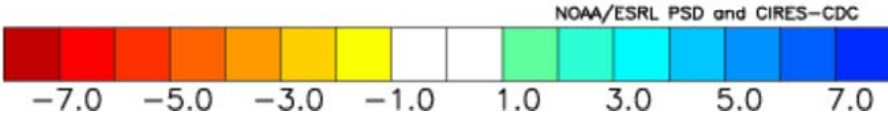
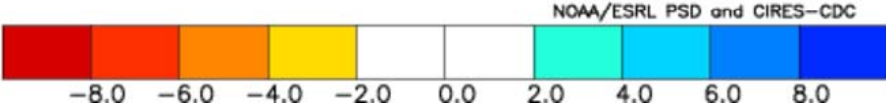
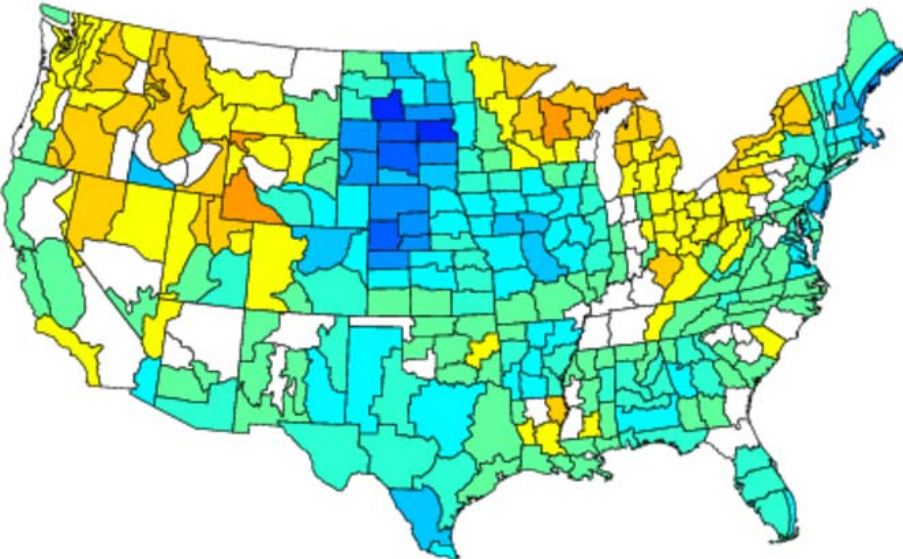
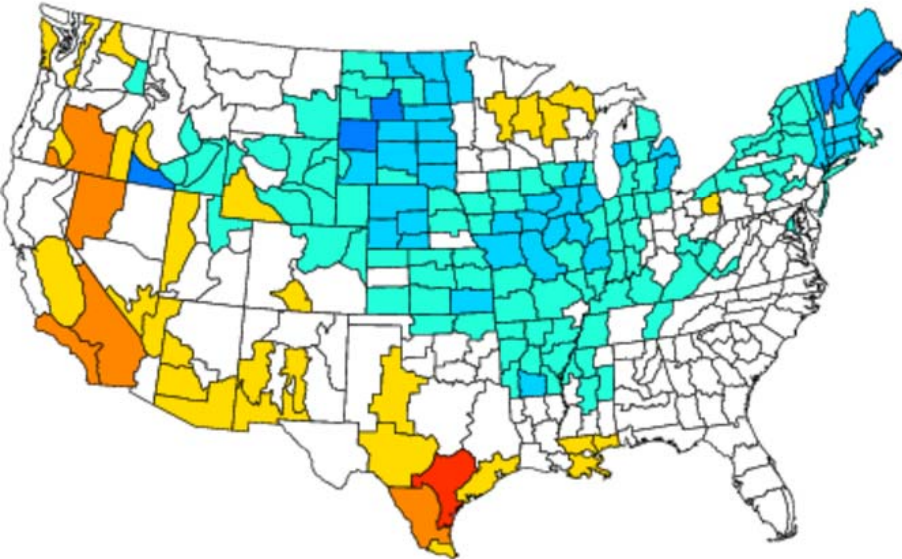
# TOTAL PRECIPITATION AND ANOMALY FOR DECEMBER 2009 TO MARCH 2010

| State      | Number | Division | Total (in) | Anomaly (in) | Name                   |
|------------|--------|----------|------------|--------------|------------------------|
|            |        |          |            |              |                        |
| New Mexico | 29     | 1        | 4.71       | 1.54         | Northwestern Plateau   |
|            | 29     | 2        | 4.23       | 1.07         | Northern Mountains     |
|            | 29     | 3        | 4.20       | 2.39         | Northeastern Plains    |
|            | 29     | 4        | 3.37       | 0.57         | Southwestern Mountains |
|            | 29     | 5        | 1.59       | -0.16        | Central Valley         |
|            | 29     | 6        | 5.85       | 2.11         | Central Highlands      |
|            | 29     | 7        | 4.64       | 2.94         | Southeastern Plains    |
|            | 29     | 8        | 4.03       | 1.39         | Southern Desert        |
|            |        |          |            |              |                        |
| Oklahoma   | 34     | 1        | 3.65       | .78          | Panhandle              |
|            | 34     | 2        | 3.60       | -1.38        | North Central          |
|            | 34     | 3        | 8.56       | -0.19        | Northeast              |
|            | 34     | 4        | 4.71       | 0.23         | West Central           |
|            | 34     | 5        | 6.43       | -0.60        | Central                |
|            | 34     | 6        | 8.49       | -2.21        | East Central           |
|            | 34     | 7        | 3.71       | -1.49        | Southwest              |
|            | 34     | 8        | 8.72       | -0.06        | South Central          |
|            | 34     | 9        | 14.05      | -0.33        | Southeast              |
|            |        |          |            |              |                        |
| Texas      | 41     | 1        | 5.86       | 3.32         | High Plains            |
|            | 41     | 2        | 7.31       | 3.26         | Low Rolling Plains     |
|            | 41     | 3        | 12.26      | 3.66         | North Central          |
|            | 41     | 4        | 14.55      | -0.50        | East Texas             |
|            | 41     | 5        | 3.01       | 1.26         | Trans Pecos            |
|            | 41     | 6        | 8.94       | 4.05         | Edwards Plateau        |
|            | 41     | 7        | 12.35      | 3.76         | South Central          |
|            | 41     | 8        | 15.52      | 2.29         | Upper Coast            |
|            | 41     | 9        | 8.76       | 4.30         | Southern               |
|            | 41     | 10       | 9.57       | 4.81         | Lower Valley           |

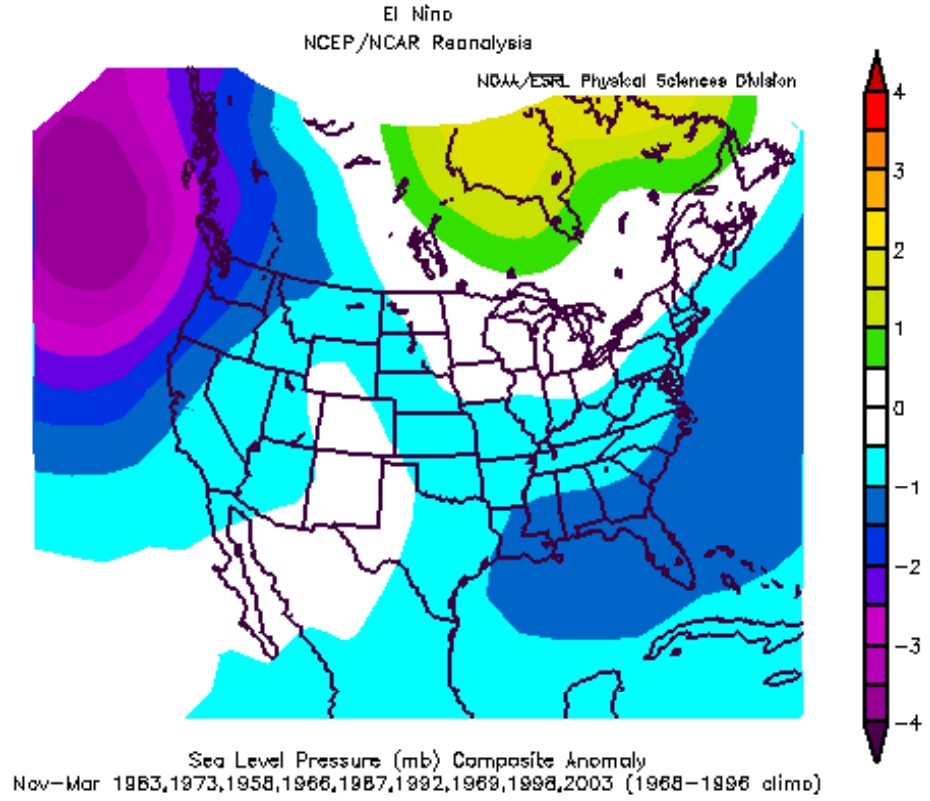
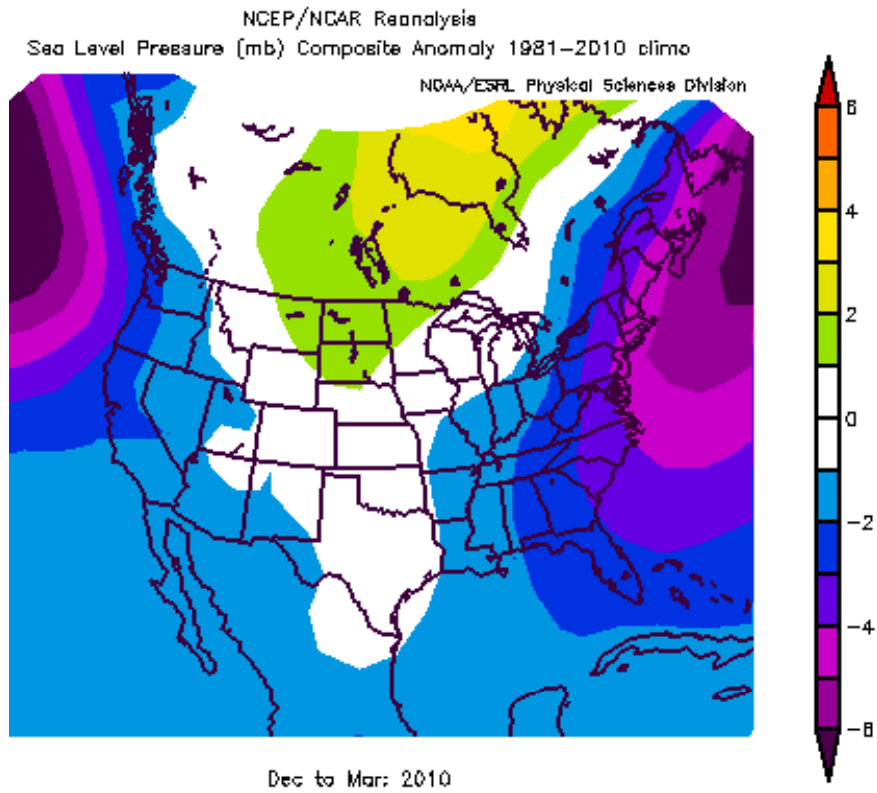
PDSI Showed Drought Conditions Over Half of Texas in July 2009. By April 2010 All of the State Was Moderately Wet.

Palmer Drought Index  
Jul 2009

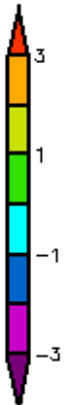
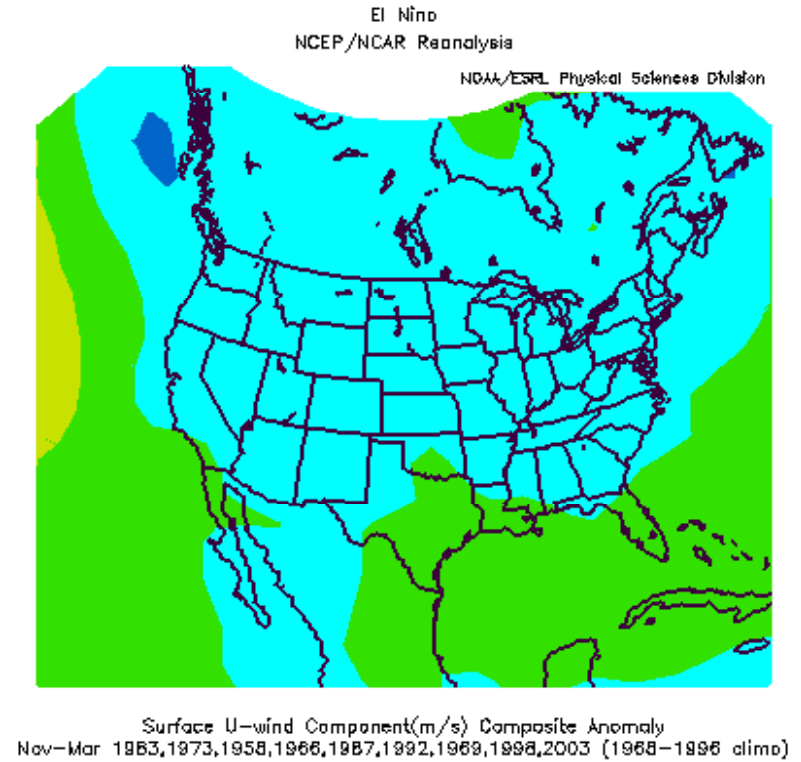
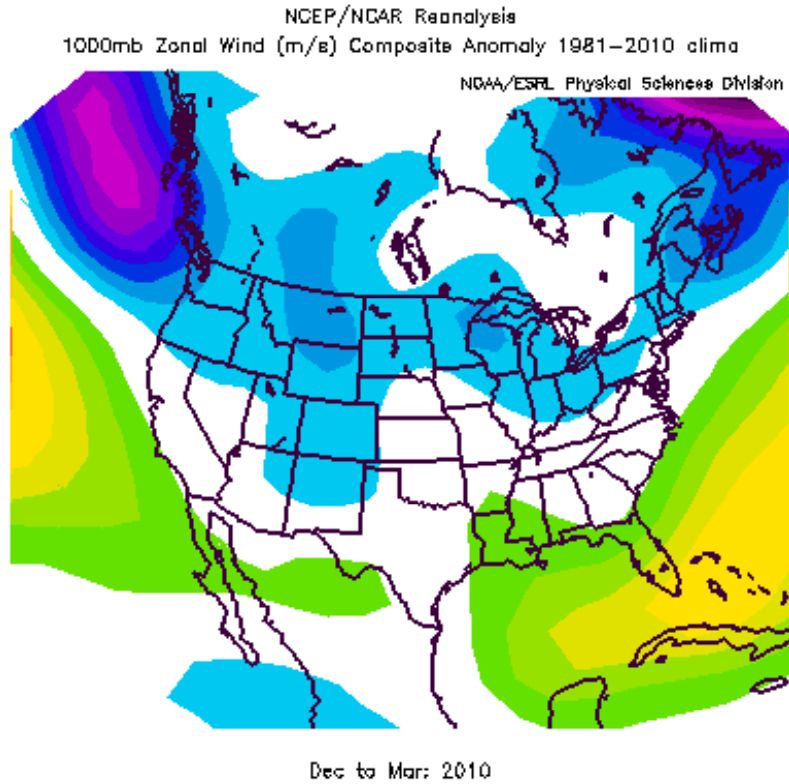
Palmer Drought Index  
Apr 2010



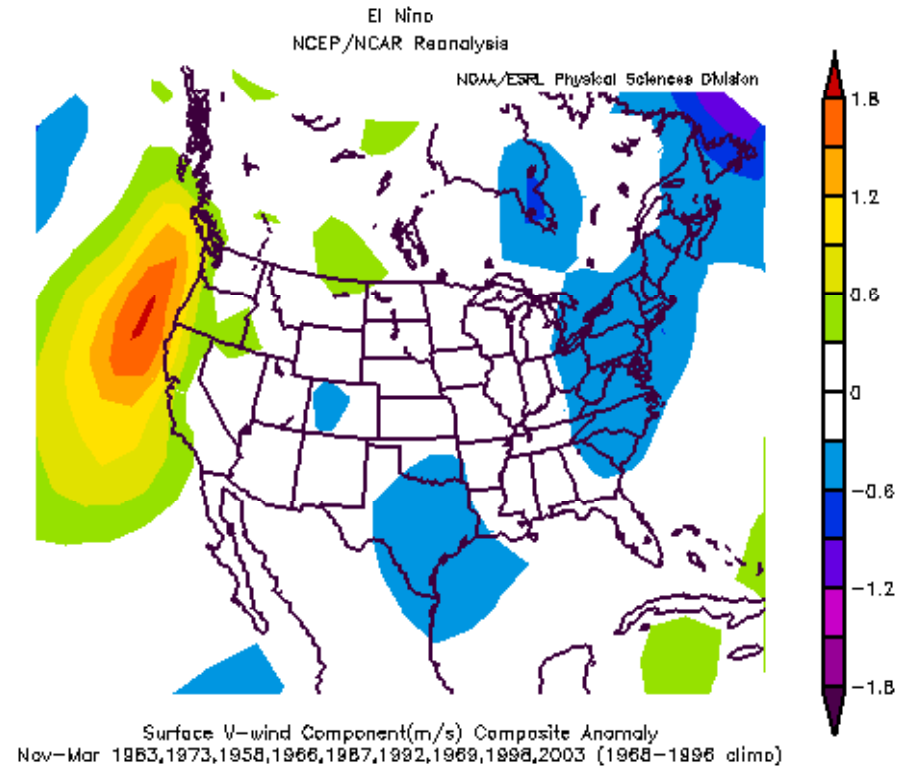
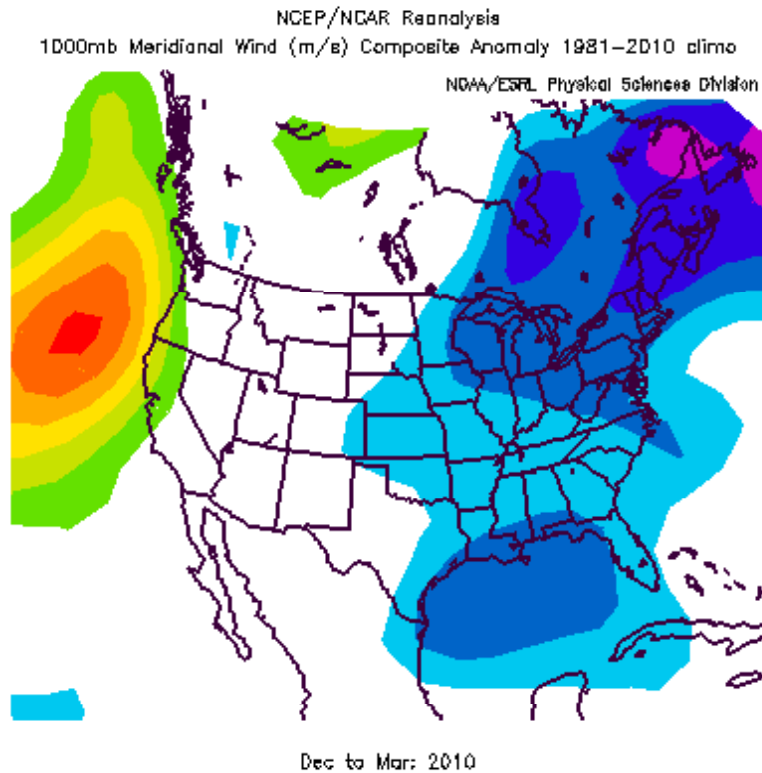
# Sea Level Pressure Anomalies in 2009-10 and El Niño Winters



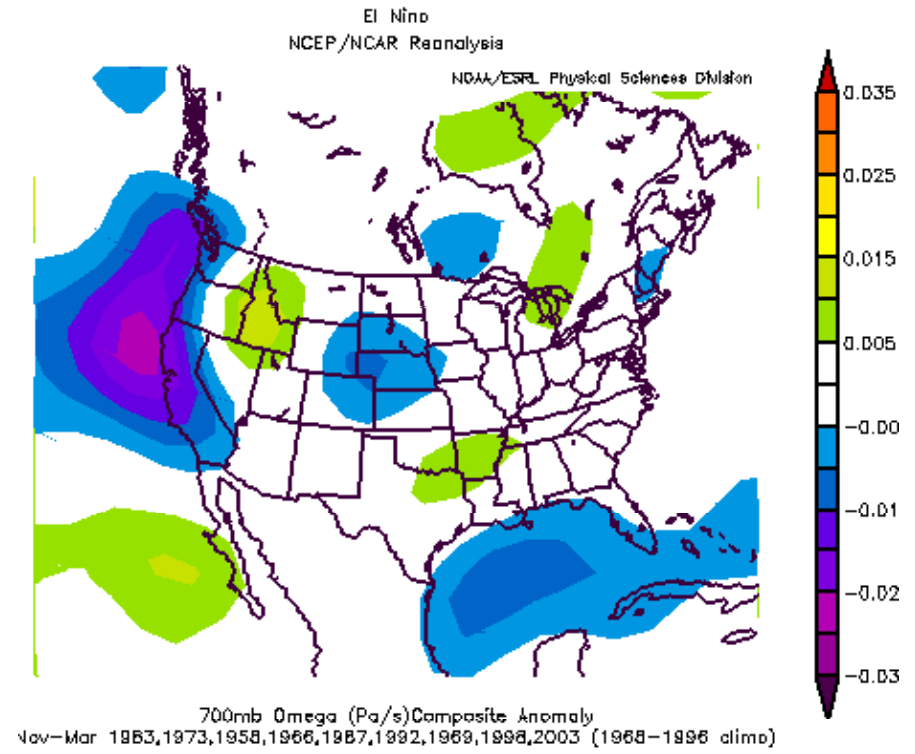
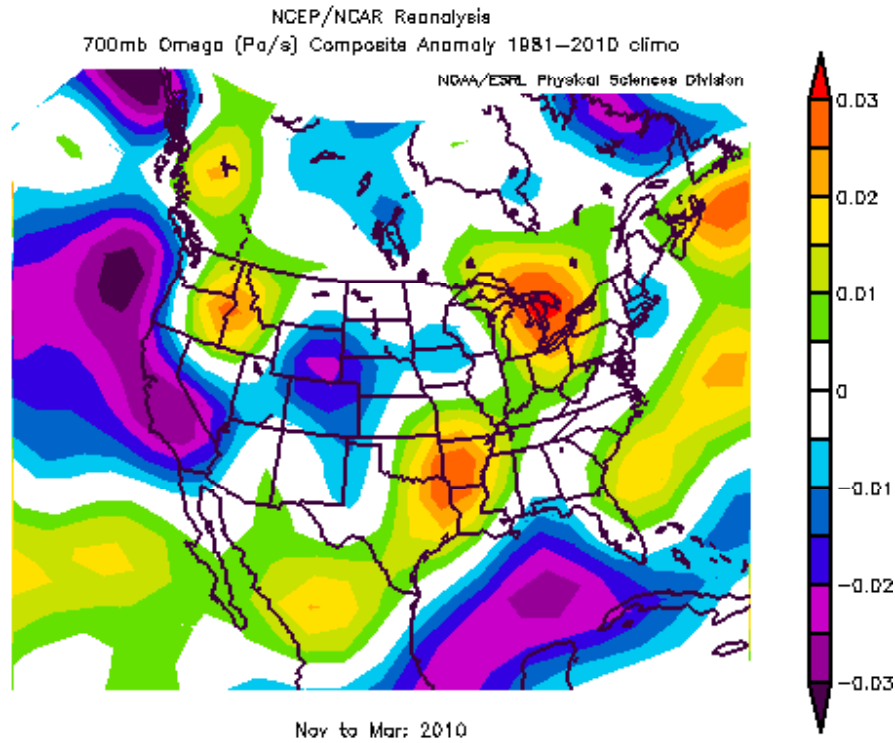
# Zonal Wind Anomalies in 2009-10 and El Niño Winters



# Meridional Wind Anomalies in 2009-10 and El Niño Winters



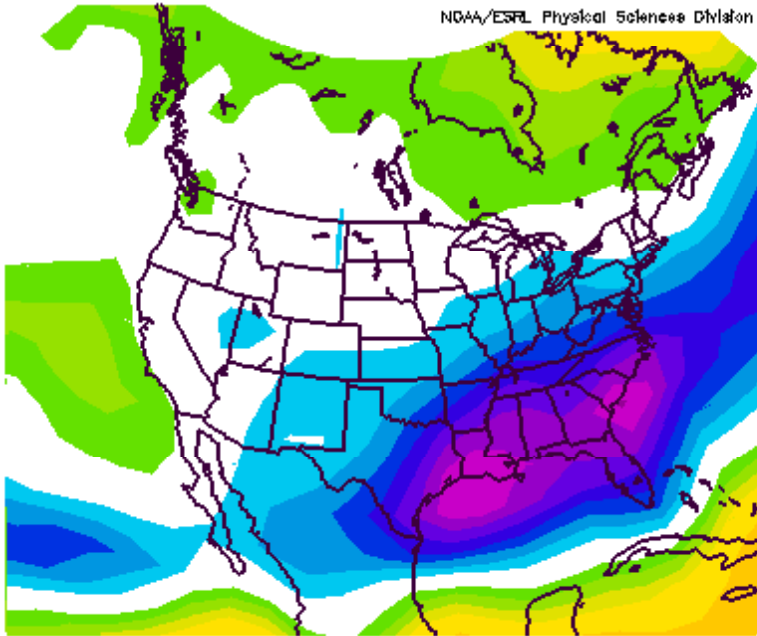
# 700mb Omega Anomalies in 2009-10 and El Niño Winters



# Precipitable Water Anomalies in 2009-10 and El Niño Winters

NCEP/NCAR Reanalysis  
Surface Precipitable Water (kg/m<sup>2</sup>) Composite Anomaly 1981–2010 clima

NOAA/ESRL Physical Sciences Division

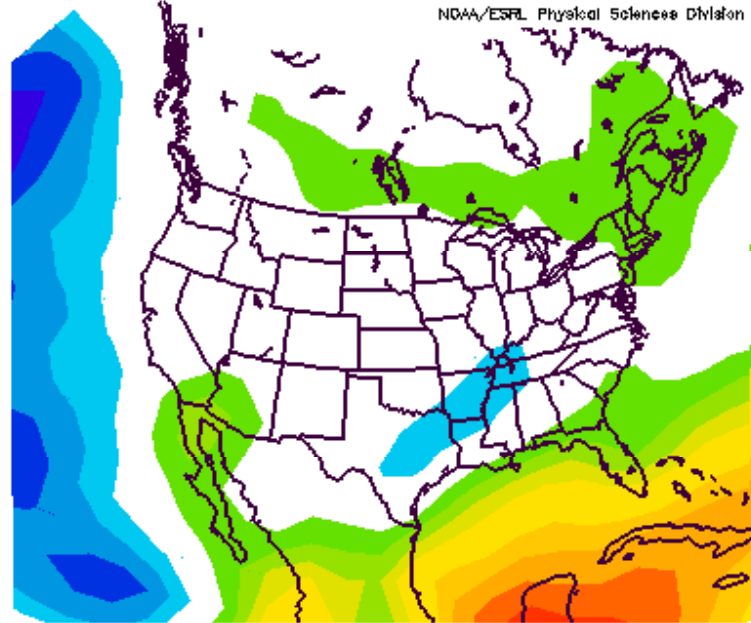


Dec to Mar: 2010



NCEP/NCAR Reanalysis  
Surface Precipitable Water (kg/m<sup>2</sup>) Composite Anomaly 1981–2010 clima

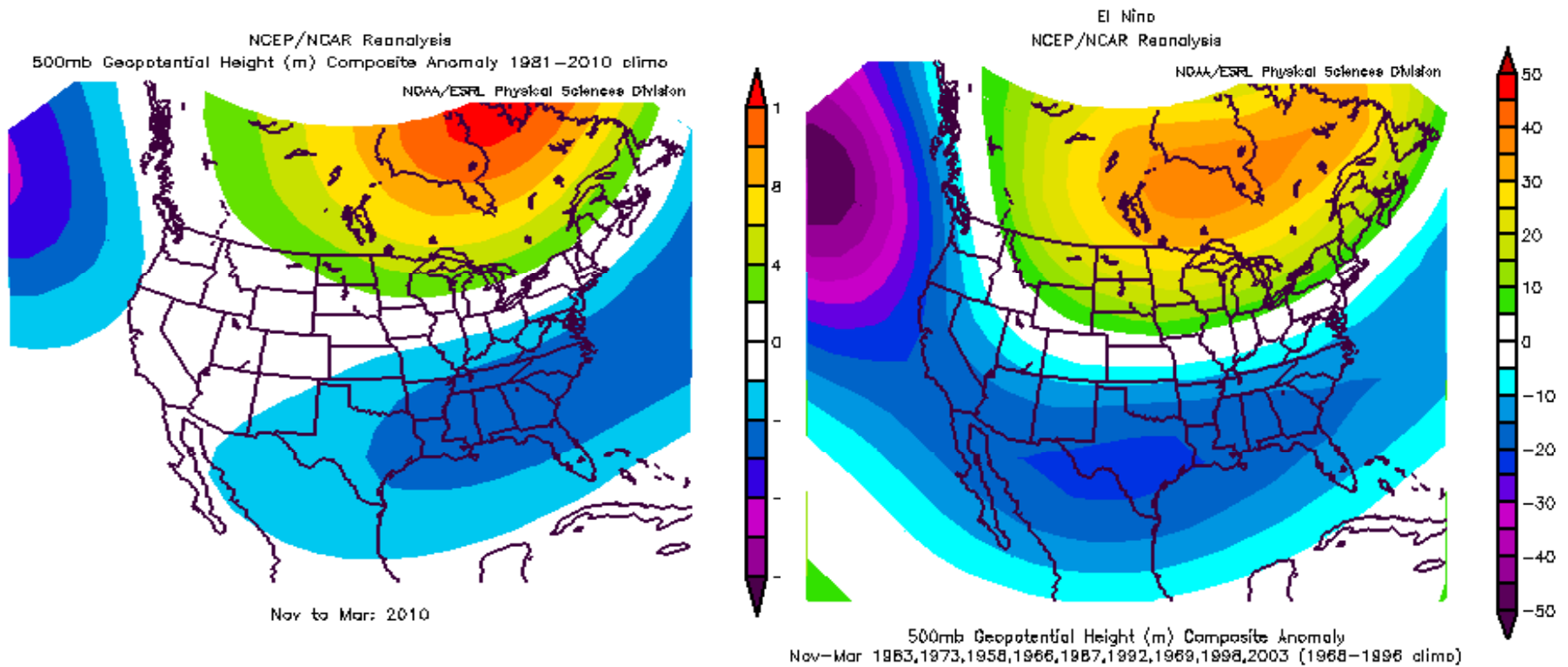
NOAA/ESRL Physical Sciences Division



Nov to Mar: 1958, 1966, 1969, 1973, 1983, 1987, 1992, 1998, 2003



# 500mb Geopotential Anomalies in 2009-10 and El Niño Winters



# Conclusions

The El Niño event of winter 2009-10 was the 5<sup>th</sup> strongest on record.

The precipitation increases were fairly typical across most of the region.

The drought conditions of summer 2009 disappeared during the following winter and moderately wet conditions prevailed by April 2010.

The lag time between development of El Niño conditions in the Pacific and the increase in precipitation in the Southwest has important implications for water resource management decisions in the region.

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