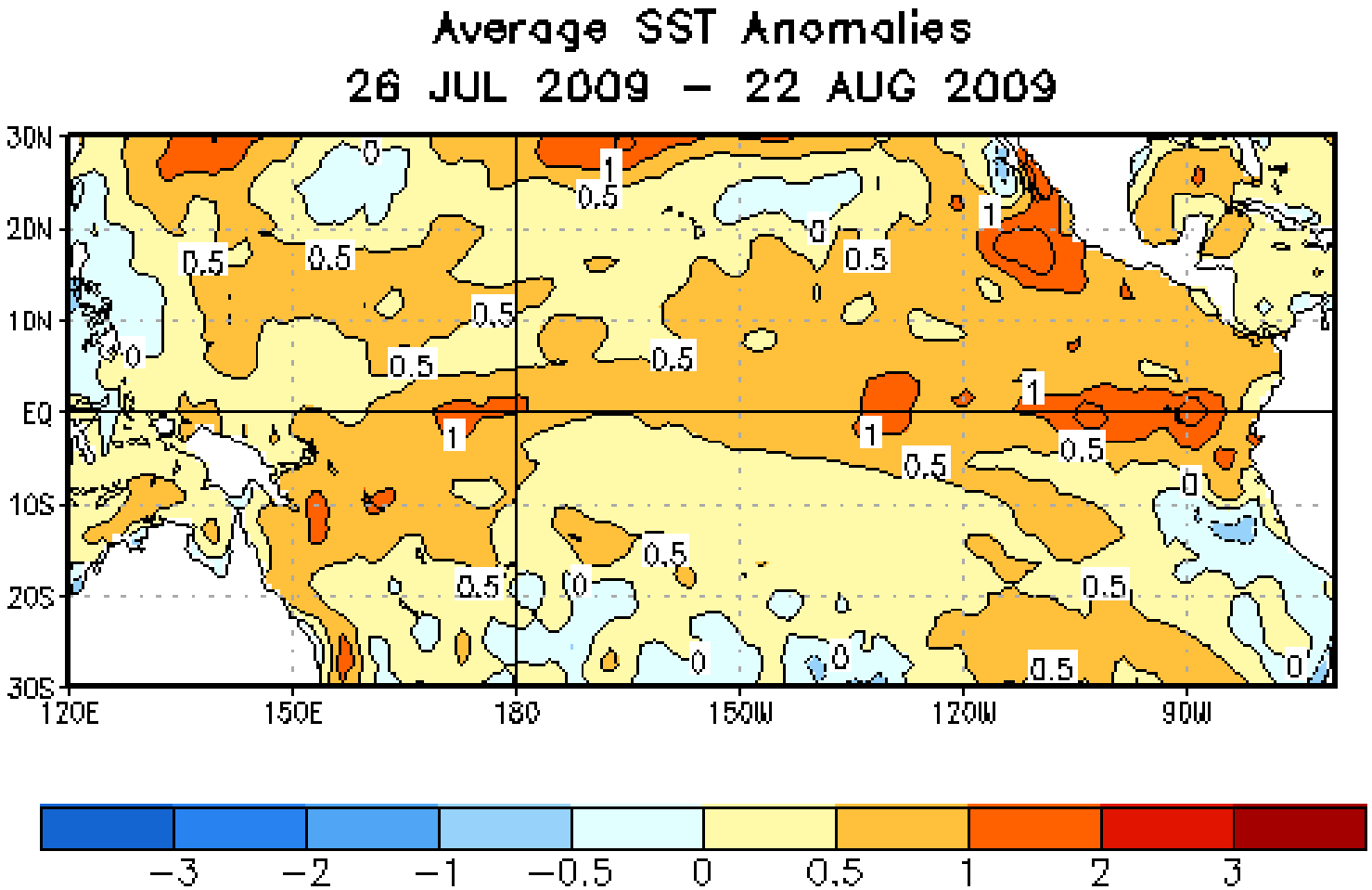
El Niño/La Niña and the Southern Oscillation Index (ENSO)



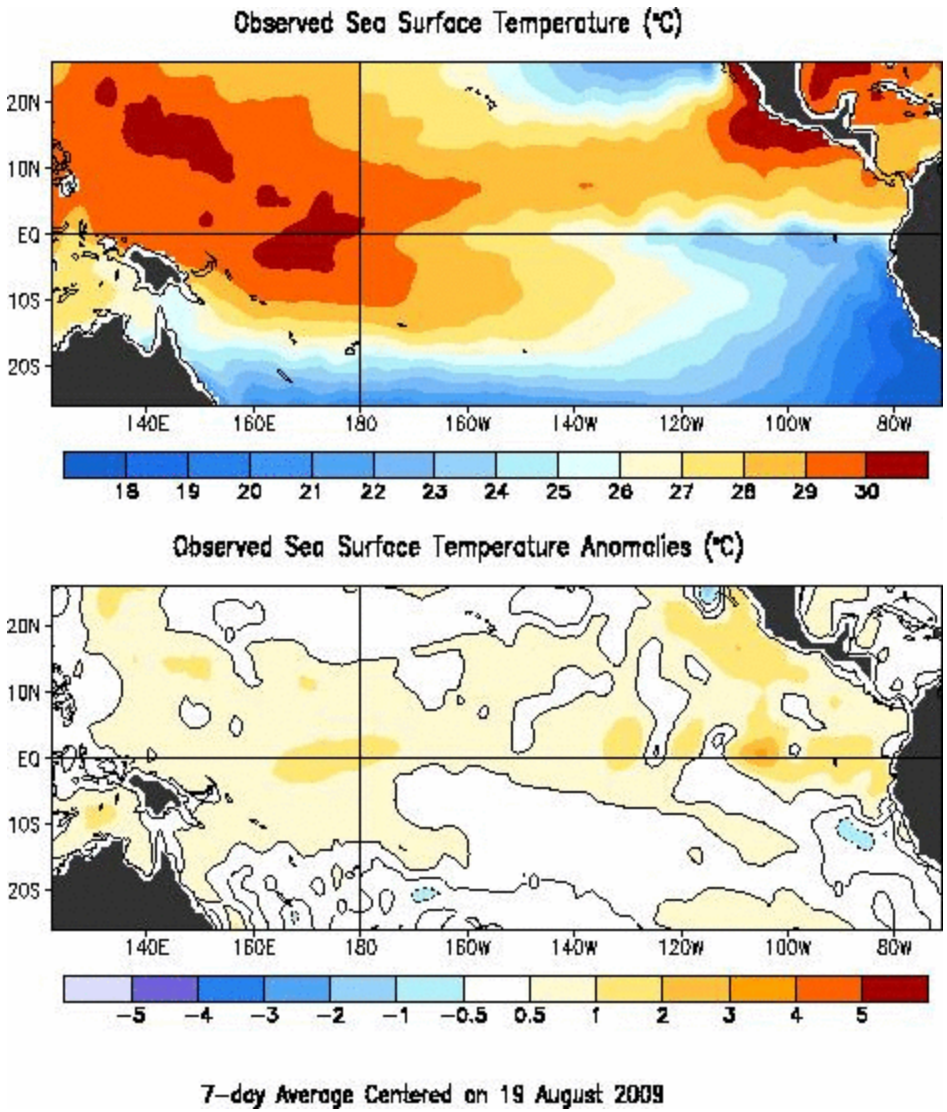
ENSO and Southern California Outline

- Current ENSO state and predictions
  - ENSO indices/predictions
  - Precipitation and temperature forecasts
- What is ENSO and how is it measured
  - Basic description of ENSO
  - Determination of ENSO
- ENSO statistics
  - Indices
  - Models
  - Southern California Observations

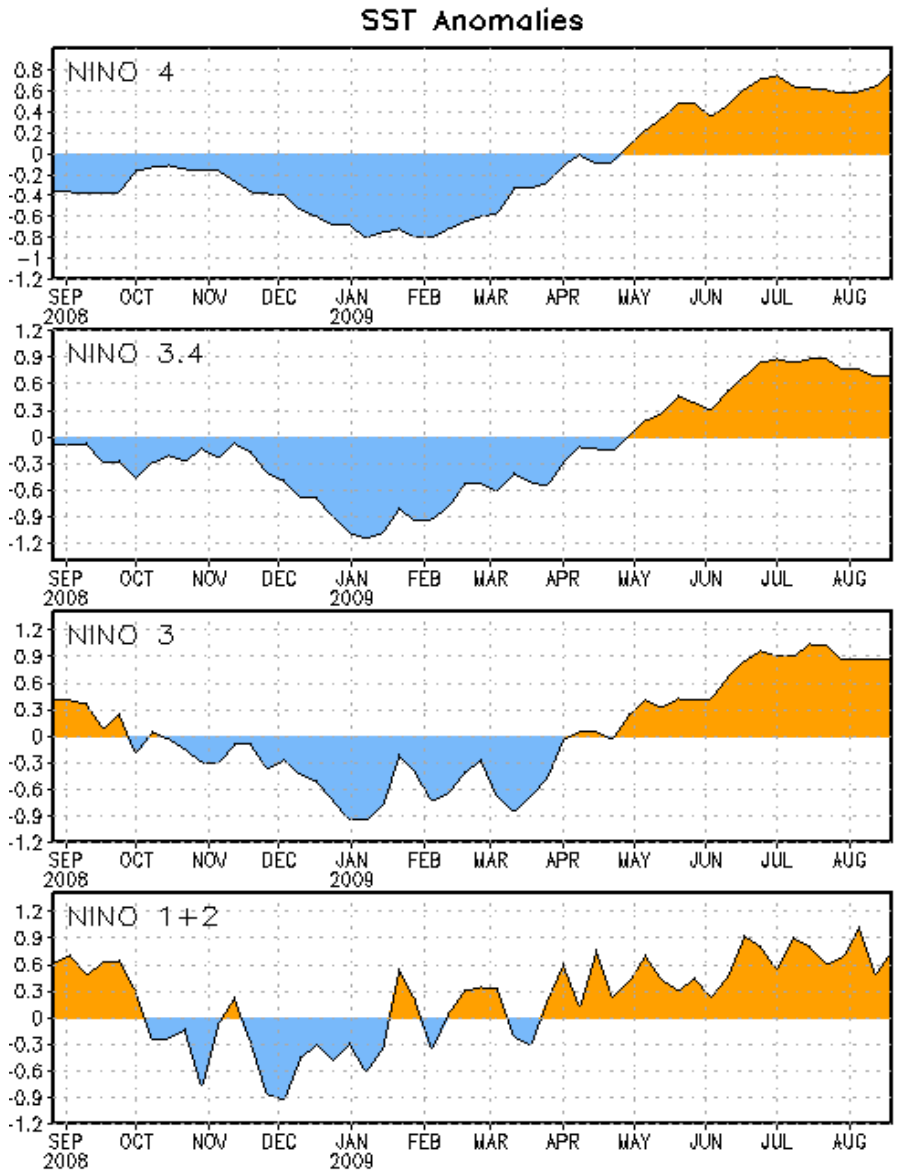
Current ENSO State

(August 6, 2009)

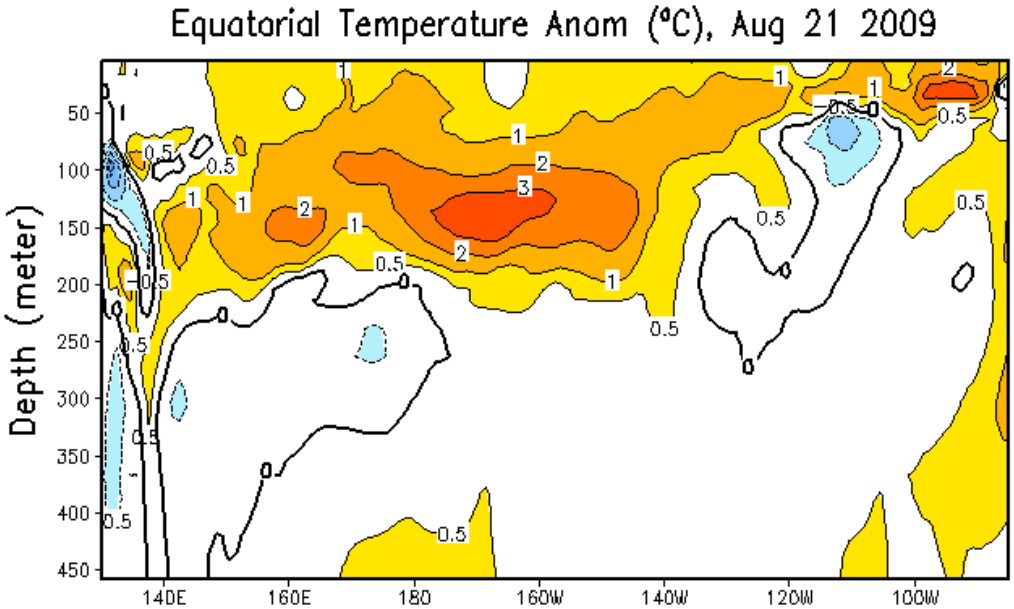
- ENSO Alert System Status: El Niño Advisory
- Positive Oceanic Niño Index (ONI = 0.6˚C; MJJ 2009)
  - http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml
- Forecast The models disagree on the eventual strength of El Niño (SST anomalies ranging from +0.5°C to +2.0°C), but a majority of the models indicate at least a moderate strength El Niño (greater than +1.0°C) during Nov 2009-Jan 2010.
- Near normal rainfall - next 30-90 days
- Near normal temperature - next 30 days
- Above normal temperatures likely - next 90 days

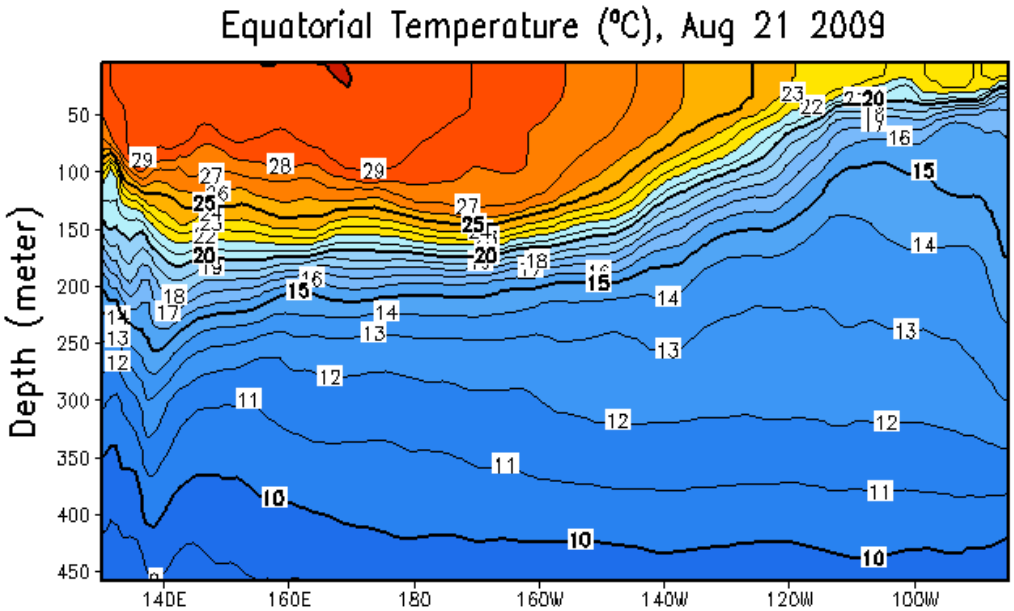


(top) Weekly sea surface temperature (SST) (˚C) centered on 19 August 2009. (bottom) Same as the top except for SST anomalies.

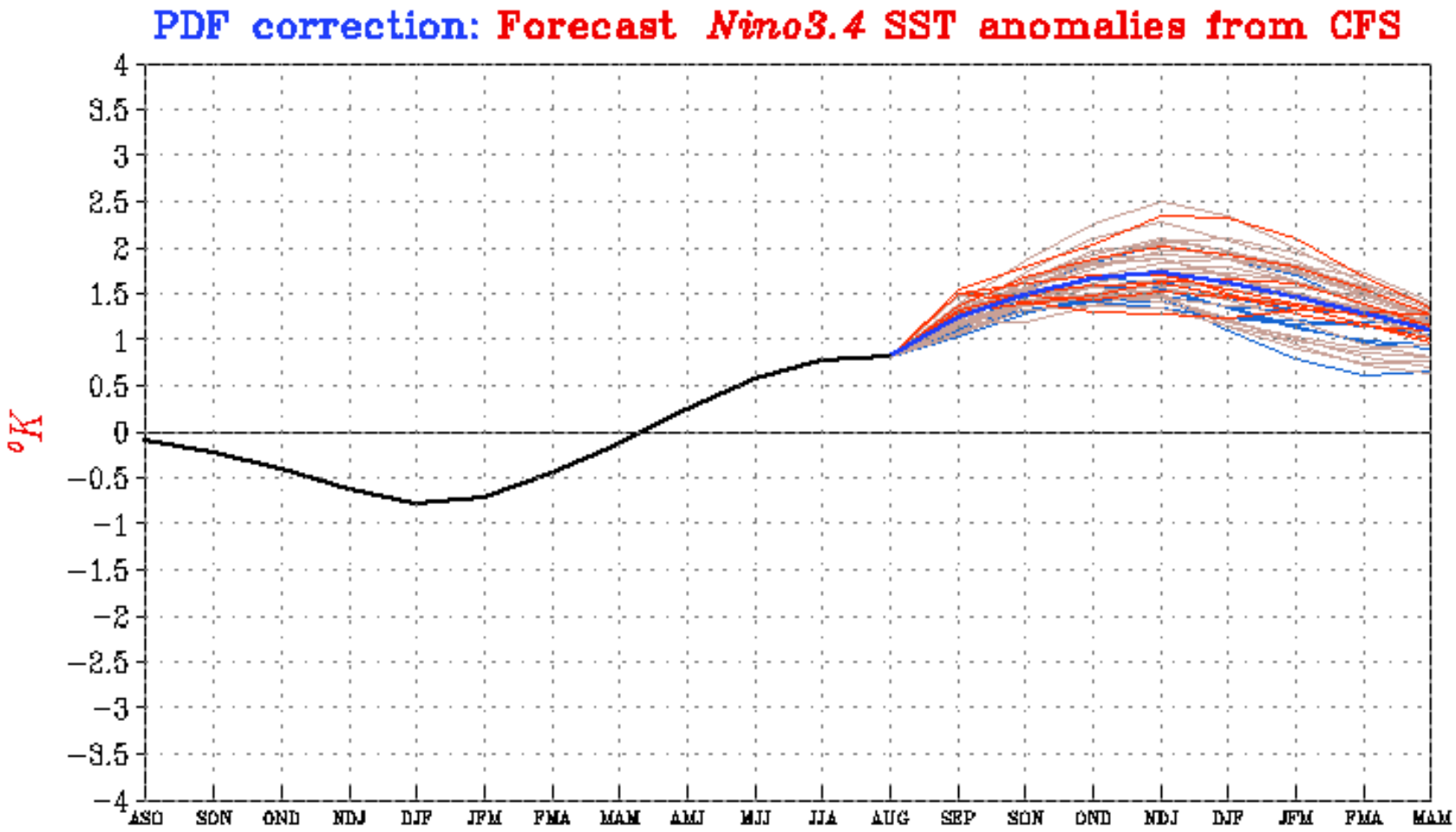


Time series of area-averaged sea surface temperature (SST) anomalies (˚C) in the Niño regions.


Equatorial Temperature Anom (°C), Aug 21 2009
Depth (meter)
50
100
150
200
250
300
350
400
450
14DE
160E
180
160W
140W
120W
100W

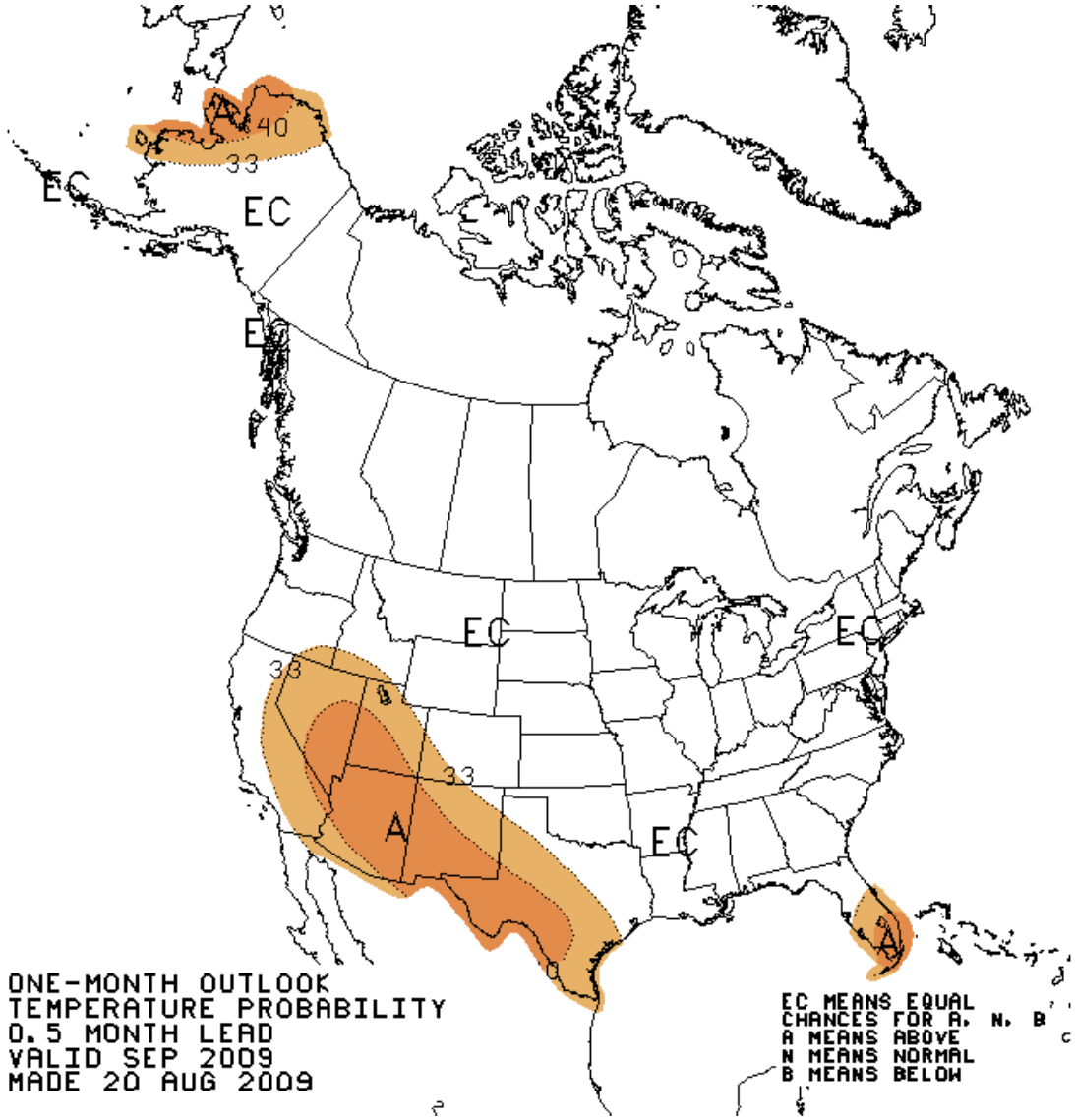

Equatorial Temperature (°C), Aug 21 2009
Depth (meter)
50
100
150
200
250
300
350
400
450
14DE
160E
180
160W
140W
120W
100W

NCEP CFS Niño 3.4 SST Prediction

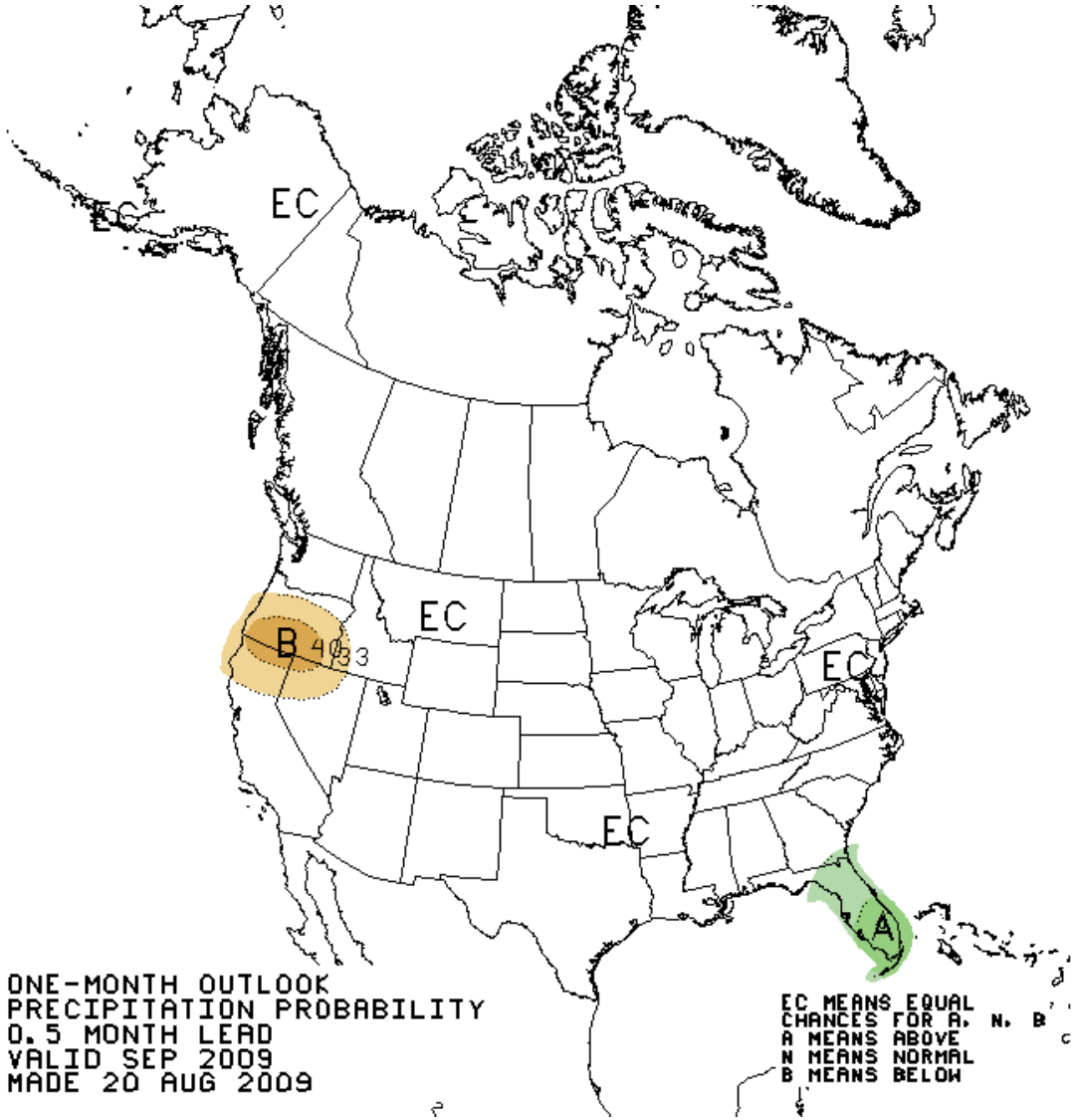


- **NCEP Climate Forecast System (CFS) Niño 3.4 SST prediction indicates El Niño conditions (ONI > 0.5) strengthening through the upcoming northern hemisphere fall 2009 and possible further strengthening into winter 2009-2010.**

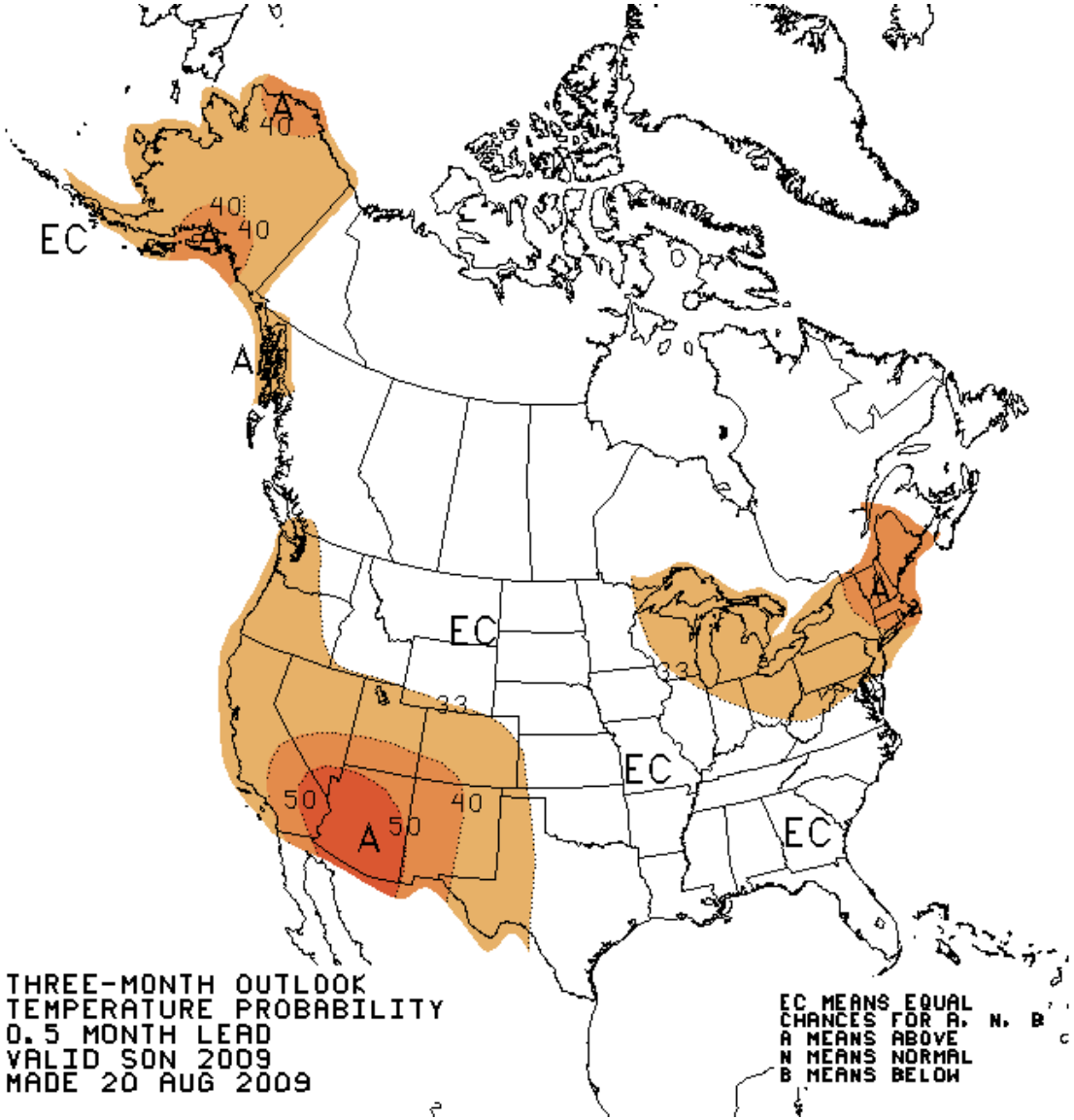
One Month Temperature Outlook: September 2009



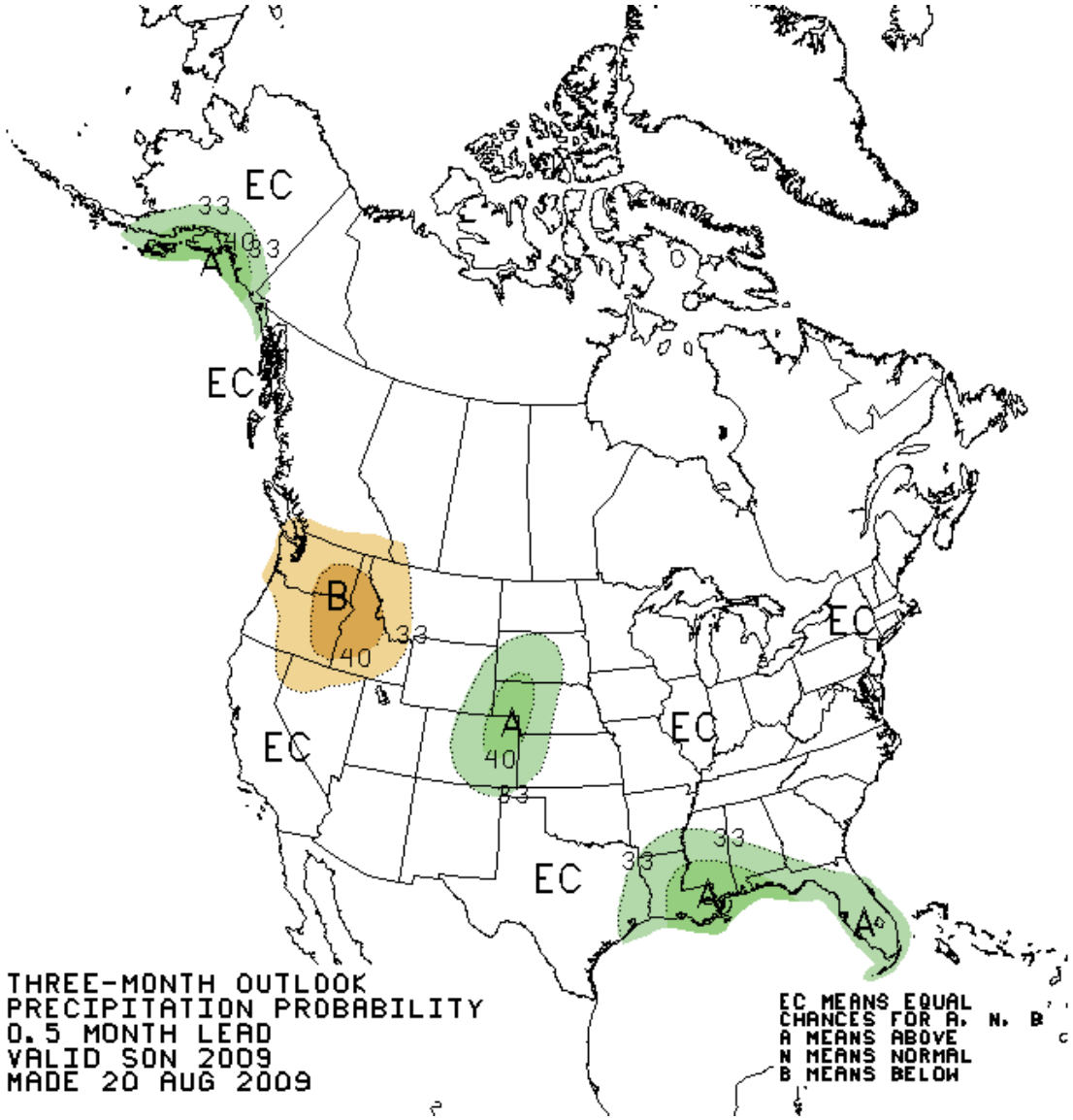
One Month Precipitation Outlook: September 2009



Three Month Temperature Outlook: SON 2009

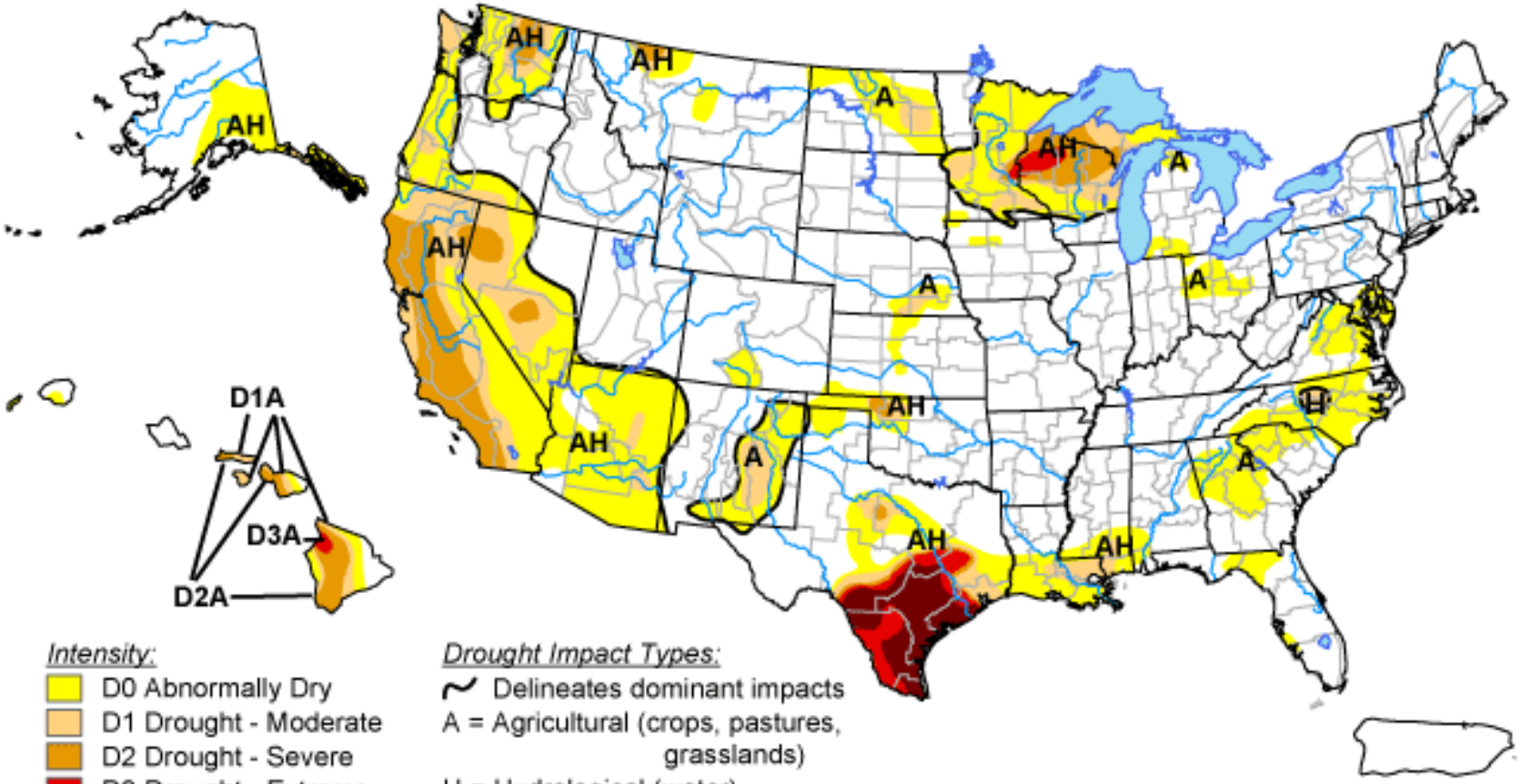


Three Month Precipitation Outlook: SON 2009



U.S. Drought Monitor

August 18, 2009
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:
- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

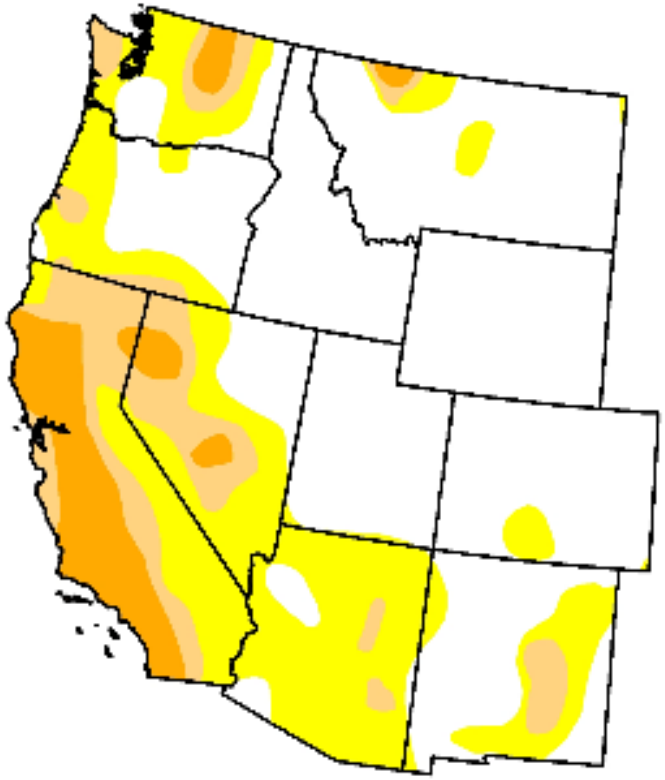
Released Thursday, August 20, 2009
Author: Laura Edwards, Western Regional Climate Center

U.S. Drought Monitor
West

August 18, 2009
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	57.5	42.5	17.0	7.2	0.0	0.0
Last Week (08/11/2009 map)	53.6	46.4	16.8	7.1	0.0	0.0
3 Months Ago (05/26/2009 map)	50.7	49.3	22.6	6.6	0.0	0.0
Start of Calendar Year (01/06/2009 map)	37.4	62.6	28.9	8.8	0.4	0.0
Start of Water Year (10/07/2008 map)	41.3	58.7	28.6	10.4	0.1	0.0
One Year Ago (08/19/2008 map)	34.7	65.3	29.8	9.7	0.2	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

http://drought.unl.edu/dm

Released Thursday, August 20, 2009

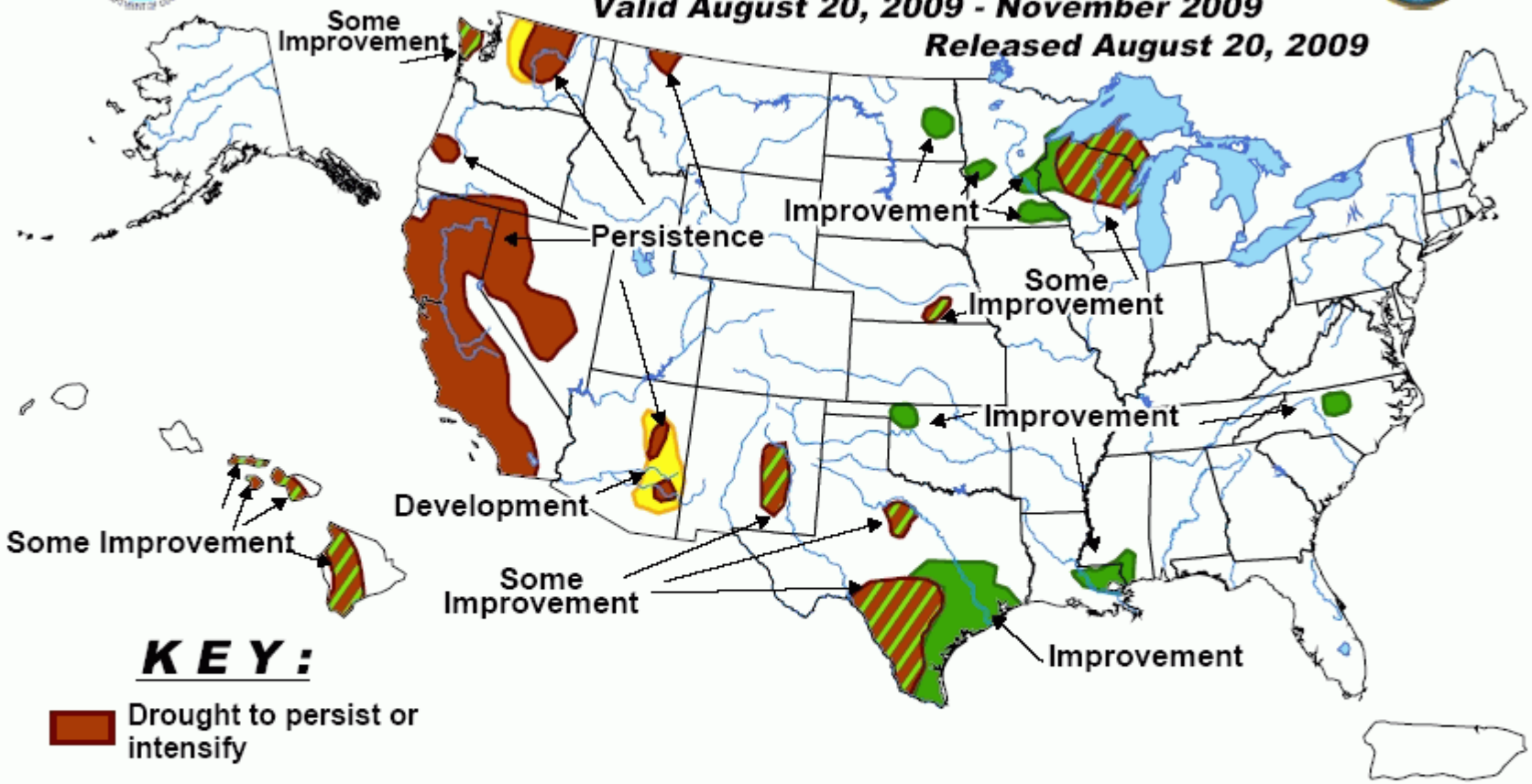
Author: Laura Edwards, Western Regional Climate Center

U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid August 20, 2009 - November 2009

Released August 20, 2009

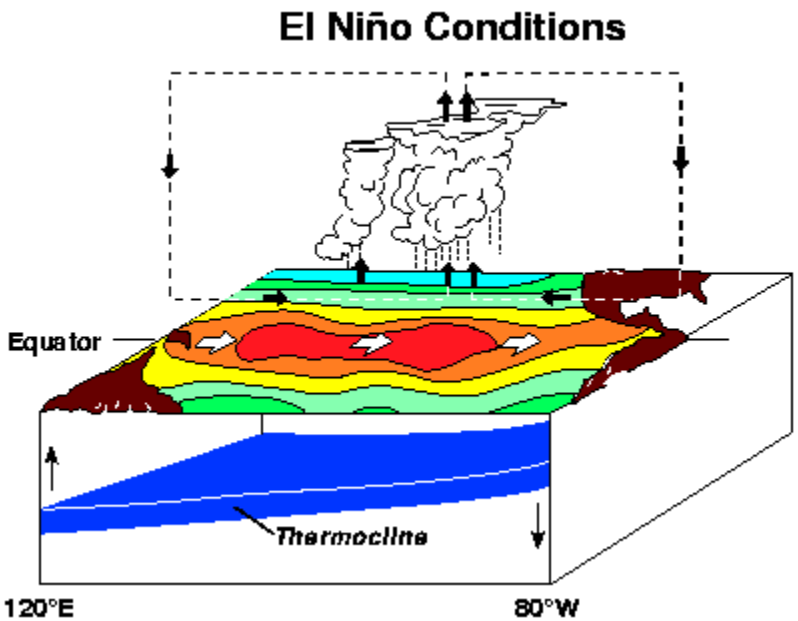


KEY:

- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more than a few days in advance. Use caution for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

What is ENSO and how is it monitored/measured?



ENSO Talking Points

ENSO Alert System

- **El Niño or La Niña Watch**
  - Issued when conditions are favorable for the development of El Niño or La Niña conditions within the next three months.
- **El Niño or La Niña Advisory**
  - Issued when El Niño or La Niña conditions are observed and expected to continue.
- **Final El Niño or La Niña Advisory**
  - Issued after El Niño or La Niña conditions have ended.
- **NA:** ENSO Alert System is not active

General El Niño Talking Points

- El Niño refers to a particular climatological condition and not a specific weather event.
- The term El Niño refers to the large-scale ocean-atmosphere climate phenomenon linked to a periodic warming in sea surface temperatures across the central and east-central equatorial Pacific.
- El Niño represents the warm phase of the El Niño/Southern Oscillation, or ENSO, cycle, and is sometimes referred to as a Pacific warm episode.
- Can work to enhance our typical storms.
- Has greatest impact on Southwest U.S. in the northern Hemisphere winter.
- Typical El Niño effects include warmer-than-average temperatures over the western and northern United States and wetter-than-average conditions over portions of the U.S. Gulf Coast, California, and Florida, while drier-than-average conditions can be expected in the Ohio Valley and the Pacific Northwest.

Southern California El Niño Talking Points

- The majority of past strong El Niño's have a history of much above normal winter rainfall in Southern CA. Weak El Niño's typically bring wetter-than-average conditions but not always. Moderate El Niño's typically result in near or slightly above normal conditions. Some El Niño's have even been drier than normal.

- El Niño brings an increased threat of heavy rain events, resulting in flooding, debris flows, and higher than normal surf.

- The debris flow project will continue with the most sensitive areas being this and last year's fires. Details on this project can be found at:

- http://www.wrh.noaa.gov/lox/main.php?suite=hydrology&page=debris-flow_project

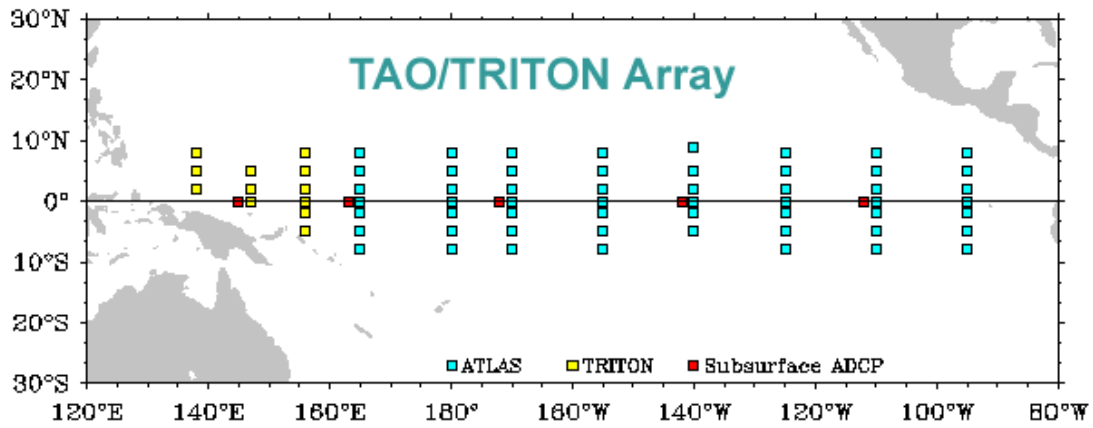
Southern California El Niño Talking Points Continued

- El Niño has a repeat cycle of **2-7** years. **Avg. = 4 yrs**.
- The recent past strong El Niño's (57'-58', 65'-66', 72'-73', 82'-83', 91'-92' and 97'-98') have a history of much above normal winter rainfall in Southern CA.
- **Strong El Niño's**
  - Most dramatic effect on local rainfall.
  - Seasonal totals **average 150-200% of normal.**
  - Less predictable effect in the mountains than at lower elevations for reasons that are not clear.
  - ENSO index stronger than 1.4
- **Moderate El Niño's**
  - Feature more normal to slightly above normal rain than weak or strong El Niño's.
  - Seasonal totals **average 100-120% of normal.**
  - ENSO index 1.0-1.4
- **Weak El Niño's**
  - Feature an **earlier start** to the rainy season.
  - Seasonal totals **average 120-150% of normal.**
  - The reason weaker El Niño's tend to have a greater effect is poorly understood at this point.
  - ENSO index 05.-0.9

Southern California El Niño Talking Points Continued

- Weak and strong El Niño's have produced more rain than moderate El Niño's.
- Less consistency exists with regard to temperature.
- Seasonal rainfall correlations are still being fine tuned as the database of El Niño events continues to develop.
- Forecasts produced by CPC (Climate Prediction Center) are the official long range forecast.
  - Telephone # 301-763-8000

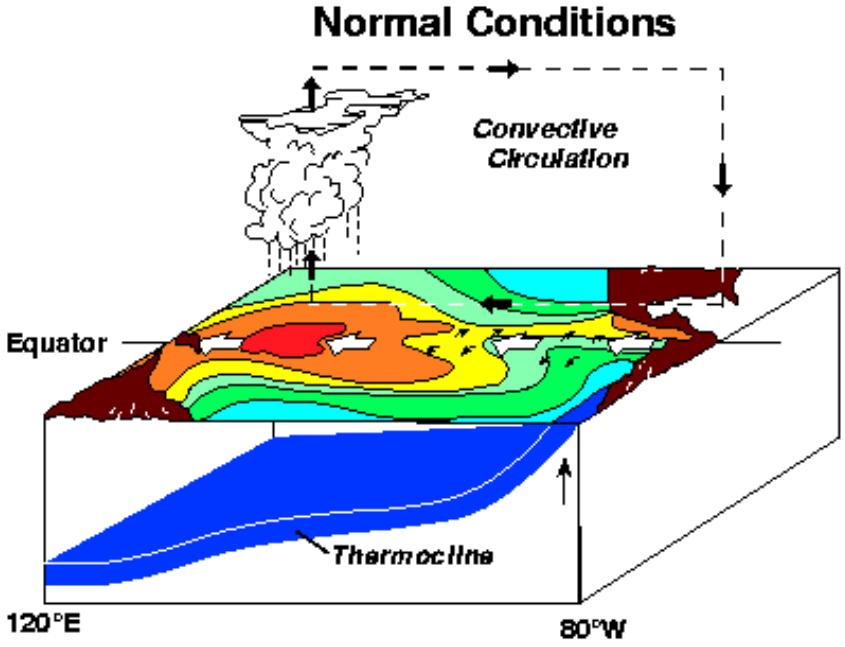
ENSO Monitoring



- El Niño is an oscillation of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe.
- Atmospheric and oceanic conditions in the tropical Pacific are monitored by the Tropical Atmosphere Ocean Project maintained by NOAA's Pacific Marine Environmental Lab (PMEL) that consists of an array of moored buoys shown above

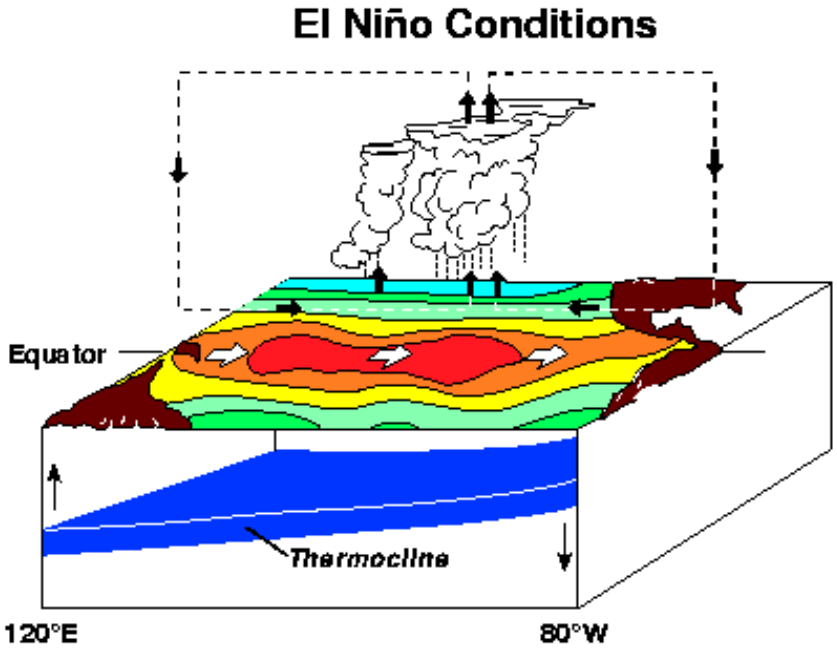
Normal Oceanic Conditions

- Warm sea surface temps are common in the western Pacific (Australia, Indonesia, etc.)
- Thermocline depth is deep in the Western Pacific and shallow in the Eastern Pacific
- Upwelling of cool, nutrient rich ocean water are common in the Eastern Pacific (South America) creating a productive fishery region.
- Updrafts and thunderstorms form over the Western Pacific with little activity over the Eastern Pacific.



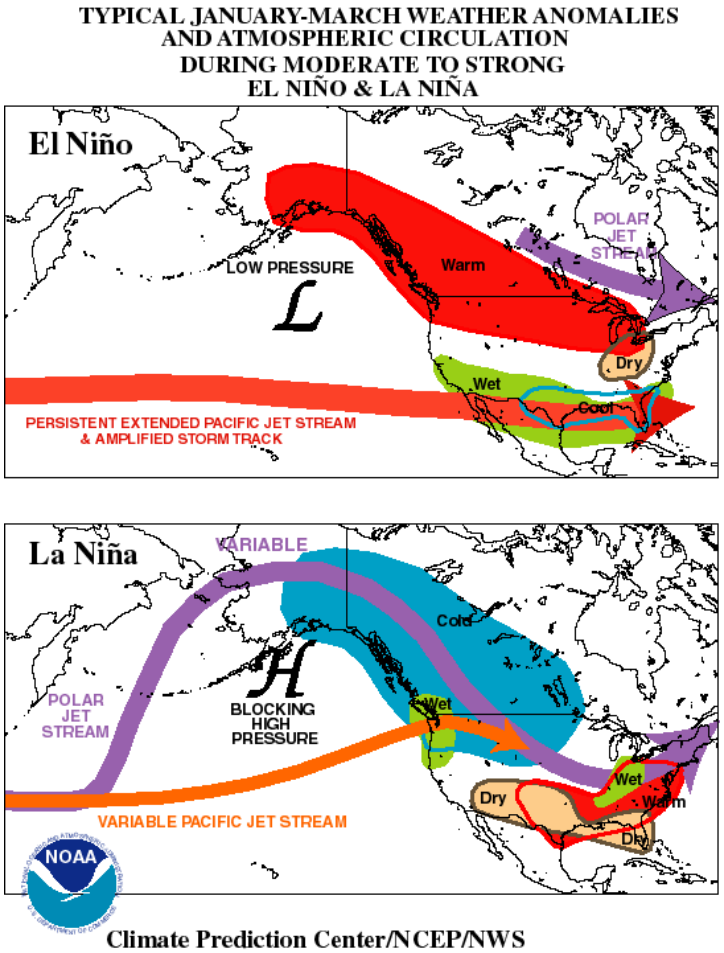
El Niño Oceanic Conditions

- Warm sea surface temps spread across the entire Pacific via the leading front of an oceanic wave.
- Thermocline begins to deepen across the Pacific reducing and/or shutting off the upwelling of cool, nutrient rich ocean water along the South American coast reducing fishery productivity with possible fish kills occurring.
- Convective events and thunderstorms generation shift eastward over the Central Pacific.
- This influences a subtropical jet stream over southern U.S. with storm tracks that normally occur over the Pacific Northwest to be shifted to the south over CA



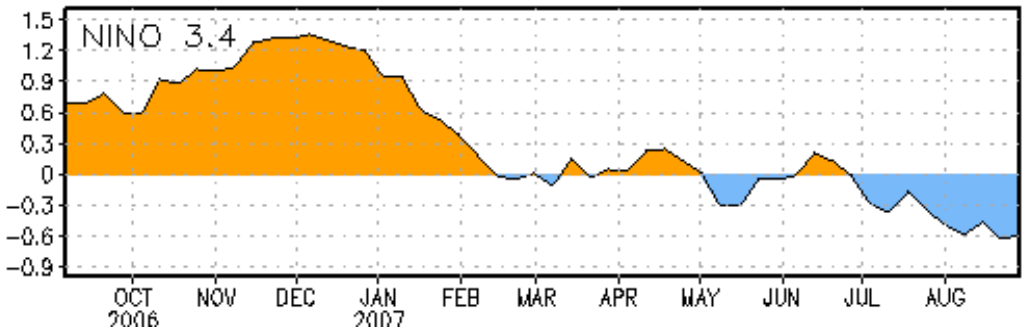
El Niño/La Niña Jet Stream

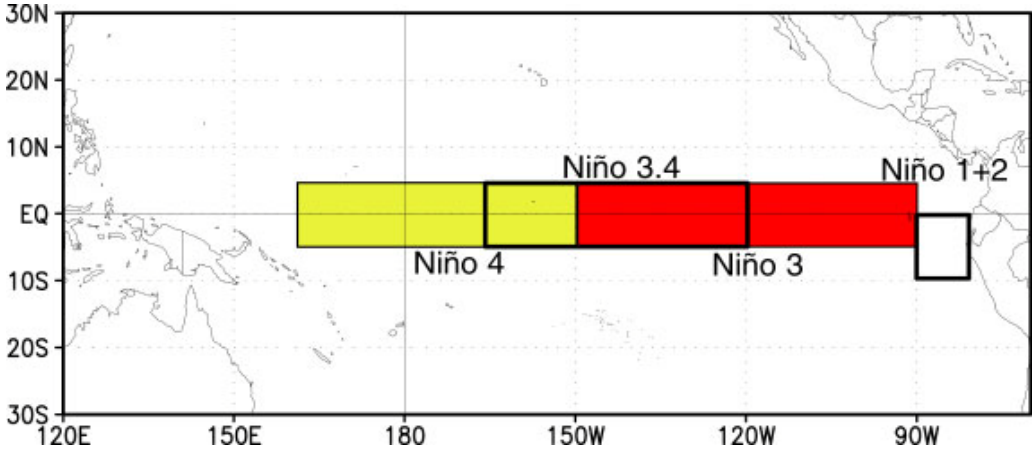
- El Niño produces a near horizontal jet stream causing wet conditions in the Southwest
- La Niña produces a arching jet stream to the north producing wetter conditions in the Pacific Northwest



El Niño/La Niña Classification

- Key to defining the strength of a El Niño/La Niña event is the Sea Surface Temperature Anomalies (SSTA).
- The main monitoring location for SSTA along the equator is the Niño 3.4 region.
- CPC classifies an El Niño with an anomaly of 0.5 degrees or higher for 5 consecutive months
- CPC classifies a La Niña with an anomaly of -0.5 degrees or lower for 5 consecutive months.



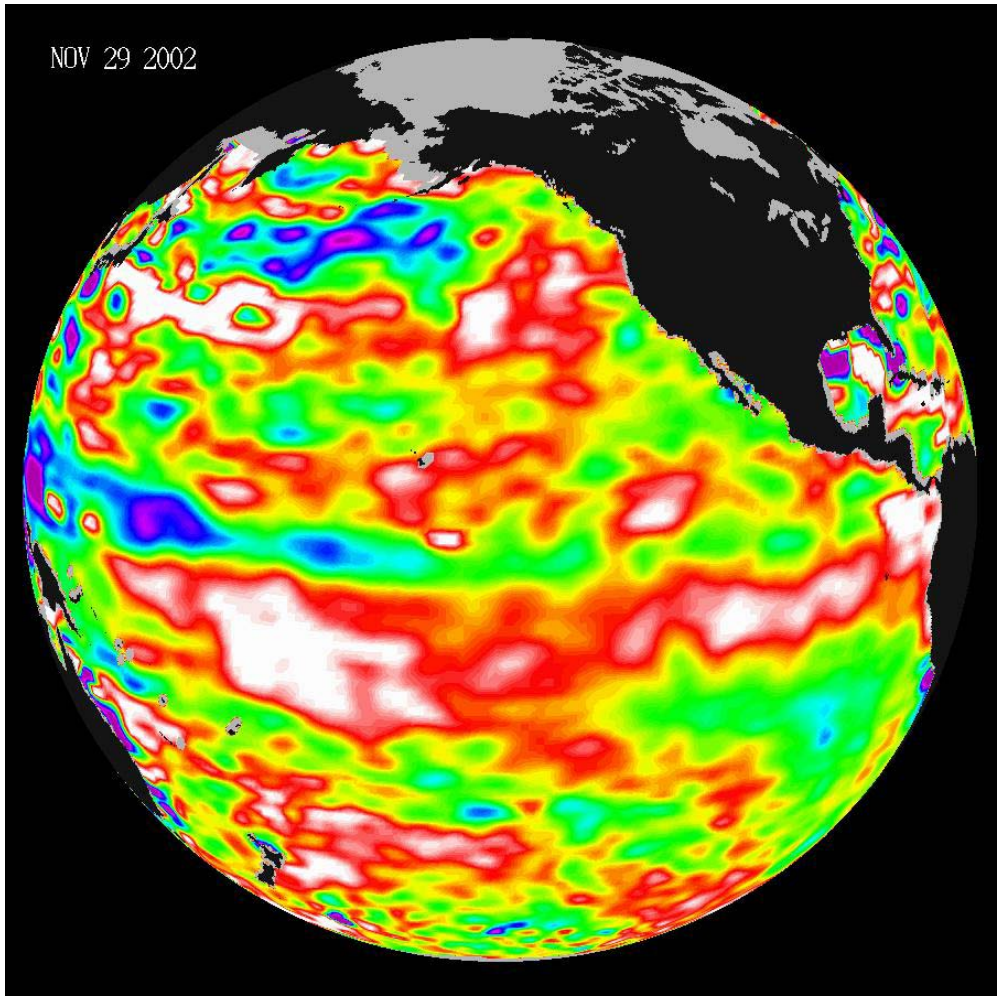


El Niño Signature

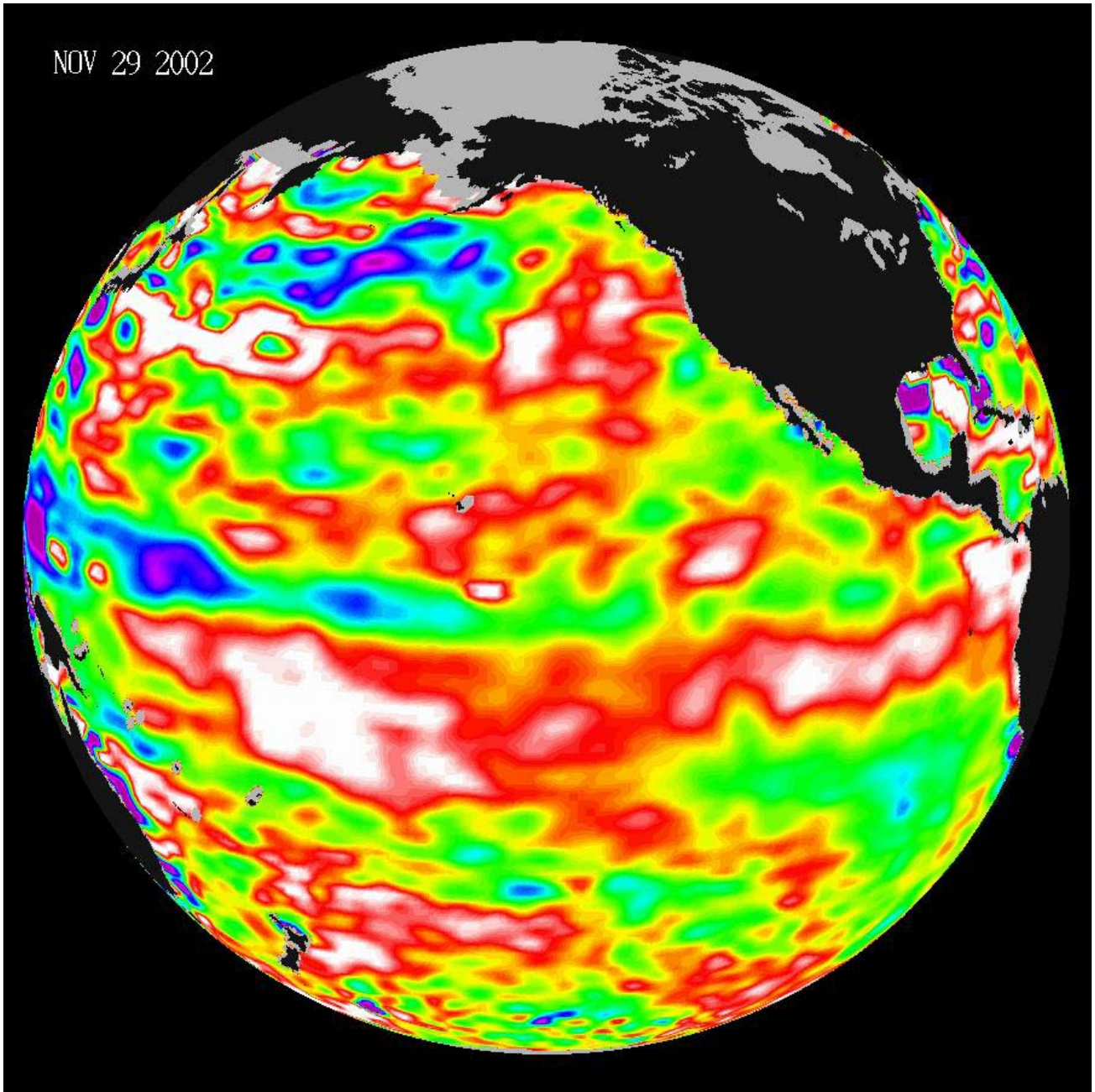
- El Niño is a temporary but cyclical phenomenon in the equatorial Pacific Ocean, characterized by a positive sea surface temperature departure from normal.

- El Niño is considered to be the second biggest climate-related influence on human activities, after the natural flow of the seasons.

- Although the phenomenon is at least thousands of years old, its impacts on global climate have only recently been recognized.

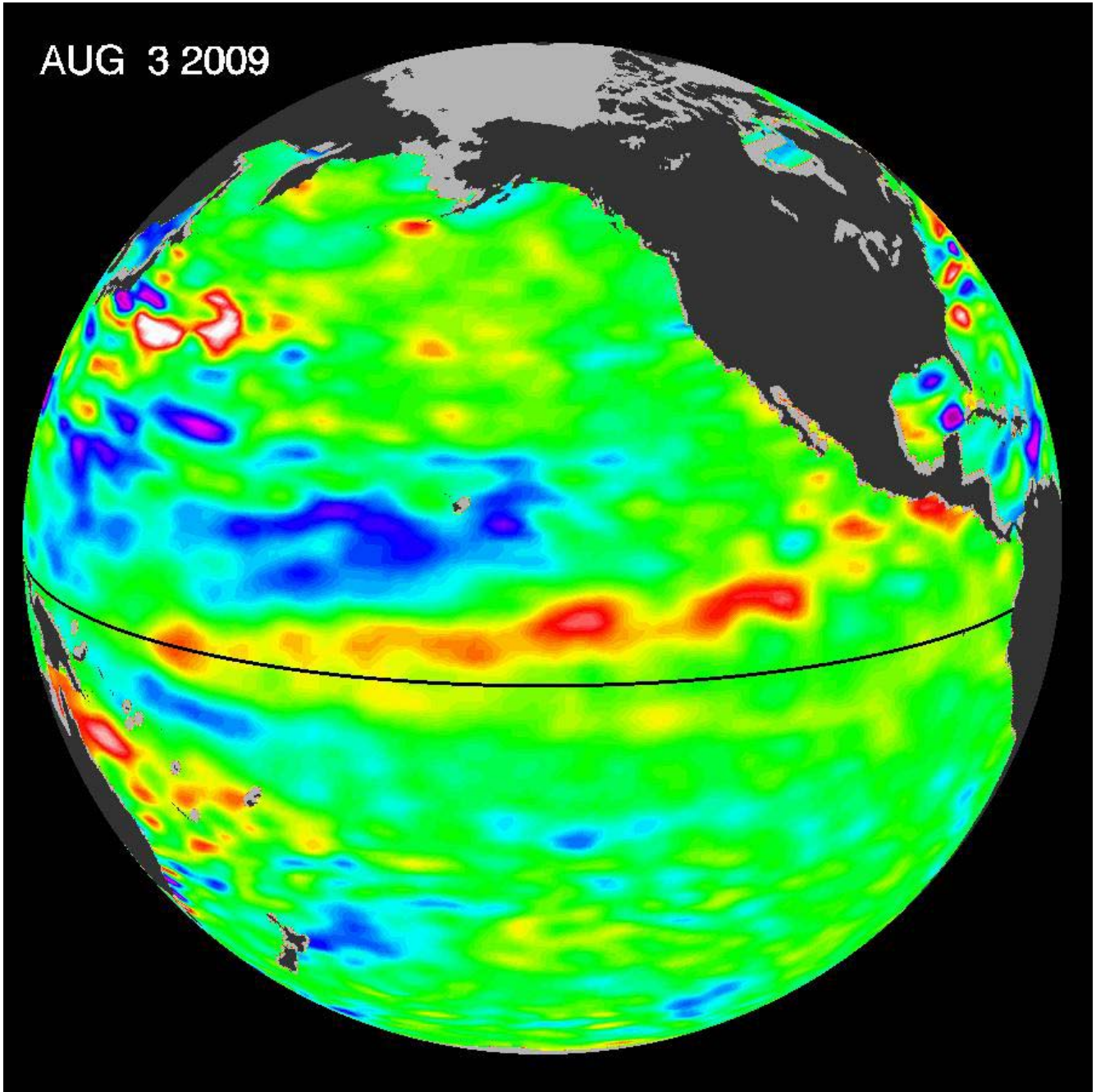


2002-2003 Moderate El Niño



ENSO Index 1.5

Current ENSO State



ENSO Index 0.6

Historical Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)], calculated with respect to the 1971-2000 base period. For historical purposes El Niño and La Niña episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1950	-1.7	-1.5	-1.3	-1.4	-1.3	-1.1	-0.8	-0.8	-0.8	-0.9	-0.9	-1.0
1951	-1.0	-0.9	-0.6	-0.3	-0.2	0.2	0.4	0.7	0.7	0.8	0.7	0.6
1952	0.3	0.1	0.1	0.2	0.1	-0.1	-0.3	-0.3	-0.2	-0.2	-0.1	0.0
1953	0.2	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
1954	0.5	0.3	-0.1	-0.5	-0.7	-0.7	-0.8	-1.0	-1.2	-1.1	-1.1	-1.1
1955	-1.0	-0.9	-0.9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.4	-1.8	-2.0	-1.9
1956	-1.3	-0.9	-0.7	-0.6	-0.6	-0.6	-0.7	-0.8	-0.8	-0.9	-0.9	-0.8
1957	-0.5	-0.1	0.3	0.6	0.7	0.9	0.9	0.9	0.9	1.0	1.2	1.5
1958	1.7	1.5	1.2	0.8	0.6	0.5	0.3	0.1	0.0	0.0	0.2	0.4
1959	0.4	0.5	0.4	0.2	0.0	-0.2	-0.4	-0.5	-0.4	-0.3	-0.2	-0.2
1960	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.1	0.0	-0.1	-0.2	-0.2	-0.2
1961	-0.2	-0.2	-0.2	-0.1	0.1	0.2	0.0	-0.3	-0.6	-0.6	-0.5	-0.4
1962	-0.4	-0.4	-0.4	-0.5	-0.4	-0.4	-0.3	-0.3	-0.5	-0.6	-0.7	-0.7
1963	-0.6	-0.3	0.0	0.1	0.1	0.3	0.6	0.8	0.9	0.9	1.0	1.0
1964	0.8	0.4	-0.1	-0.5	-0.8	-0.8	-0.9	-1.0	-1.1	-1.2	-1.2	-1.0
1965	-0.8	-0.4	-0.2	0.0	0.3	0.6	1.0	1.2	1.4	1.5	1.6	1.5
1966	1.2	1.0	0.8	0.5	0.2	0.2	0.2	0.0	-0.2	-0.2	-0.3	-0.3
1967	-0.4	-0.4	-0.6	-0.5	-0.3	0.0	0.0	-0.2	-0.4	-0.5	-0.4	-0.5
1968	-0.7	-0.9	-0.8	-0.7	-0.3	0.0	0.3	0.4	0.3	0.4	0.7	0.9
1969	1.0	1.0	0.9	0.7	0.6	0.5	0.4	0.4	0.6	0.7	0.8	0.7
1970	0.5	0.3	0.2	0.1	0.0	-0.3	-0.6	-0.8	-0.9	-0.8	-0.9	-1.1
1971	-1.3	-1.3	-1.1	-0.9	-0.8	-0.8	-0.8	-0.8	-0.8	-0.9	-1.0	-0.9
1972	-0.7	-0.4	0.0	0.2	0.5	0.8	1.0	1.3	1.5	1.8	2.0	2.1
1973	1.8	1.2	0.5	-0.1	-0.6	-0.9	-1.1	-1.3	-1.4	-1.7	-2.0	-2.1
1974	-1.9	-1.7	-1.3	-1.1	-0.9	-0.8	-0.6	-0.5	-0.5	-0.7	-0.9	-0.7
1975	-0.6	-0.6	-0.7	-0.8	-0.9	-1.1	-1.2	-1.3	-1.5	-1.6	-1.7	-1.7

Historical Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)], calculated with respect to the 1971-2000 base period. For historical purposes El Niño and La Niña episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1976	**-1.6**	**-1.2**	**-0.8**	**-0.6**	**-0.5**	-0.2	0.1	0.3	**0.5**	**0.7**	**0.8**	**0.7**
1977	**0.6**	**0.5**	0.2	0.2	0.2	0.4	0.4	0.4	**0.5**	**0.6**	**0.7**	**0.7**
1978	**0.7**	0.4	0.0	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.2	-0.1
1979	-0.1	0.0	0.1	0.1	0.1	-0.1	0.0	0.1	0.3	0.4	0.5	0.5
1980	0.5	0.3	0.2	0.2	0.3	0.3	0.2	0.0	-0.1	-0.1	0.0	-0.1
1981	-0.3	-0.5	-0.5	-0.4	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.1	-0.1
1982	0.0	0.1	0.1	0.3	**0.6**	**0.7**	**0.7**	**1.0**	**1.5**	**1.9**	**2.2**	**2.3**
1983	**2.3**	**2.0**	**1.5**	**1.2**	**1.0**	**0.6**	0.2	-0.2	-0.6	-0.8	-0.9	-0.7
1984	-0.4	-0.2	-0.2	-0.3	-0.5	-0.4	-0.3	-0.2	-0.3	**-0.6**	**-0.9**	**-1.1**
1985	**-0.9**	**-0.8**	**-0.7**	**-0.7**	**-0.7**	**-0.6**	**-0.5**	**-0.5**	**-0.5**	-0.4	-0.3	-0.4
1986	-0.5	-0.4	-0.2	-0.2	-0.1	0.0	0.3	**0.5**	**0.7**	**0.9**	**1.1**	**1.2**
1987	**1.2**	**1.3**	**1.2**	**1.1**	**1.0**	**1.2**	**1.4**	**1.6**	**1.6**	**1.5**	**1.3**	**1.1**
1988	**0.7**	**0.5**	0.1	-0.2	**-0.7**	**-1.2**	**-1.3**	**-1.2**	**-1.3**	**-1.6**	**-1.9**	**-1.9**
1989	**-1.7**	**-1.5**	**-1.1**	**-0.8**	**-0.6**	-0.4	-0.3	-0.3	-0.3	-0.3	-0.2	-0.1
1990	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4
1991	0.4	0.3	0.3	0.4	**0.6**	**0.8**	**1.0**	**0.9**	**0.9**	**1.0**	**1.4**	**1.6**
1992	**1.8**	**1.6**	**1.5**	**1.4**	**1.2**	**0.8**	**0.5**	0.2	0.0	-0.1	0.0	0.2
1993	0.3	0.4	0.6	0.7	0.8	0.7	0.4	0.4	0.4	0.4	0.3	0.2
1994	0.2	0.2	0.3	0.4	**0.5**	**0.5**	**0.6**	**0.6**	**0.7**	**0.9**	**1.2**	**1.3**
1995	**1.2**	**0.9**	**0.7**	0.4	0.3	0.2	0.0	-0.2	**-0.5**	**-0.6**	**-0.7**	**-0.7**
1996	**-0.7**	**-0.7**	**-0.5**	-0.3	-0.1	-0.1	0.0	-0.1	-0.1	-0.2	-0.3	-0.4
1997	-0.4	-0.3	0.0	0.4	**0.8**	**1.3**	**1.7**	**2.0**	**2.2**	**2.4**	**2.5**	**2.5**
1998	**2.3**	**1.9**	**1.5**	**1.0**	**0.5**	0.0	**-0.5**	**-0.8**	**-1.0**	**-1.1**	**-1.3**	**-1.4**
1999	**-1.4**	**-1.2**	**-0.9**	**-0.8**	**-0.8**	**-0.8**	**-0.9**	**-0.9**	**-1.0**	**-1.1**	**-1.3**	**-1.6**
2000	**-1.6**	**-1.4**	**-1.0**	**-0.8**	**-0.6**	**-0.5**	-0.4	-0.4	-0.4	**-0.5**	**-0.6**	**-0.7**
2001	**-0.6**	**-0.5**	-0.4	-0.2	-0.1	0.1	0.2	0.2	0.1	0.0	-0.1	-0.1

Historical Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)], calculated with respect to the 1971-2000 base period. For historical purposes El Niño and La Niña episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2002	-0.1	0.1	0.2	0.4	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.3**	**1.5**	**1.4**
2003	**1.2**	**0.9**	**0.5**	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	**0.5**	**0.7**	**0.8**	**0.9**	**0.8**	**0.8**	**0.8**
2005	**0.7**	**0.5**	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	**0.5**	**0.6**	**0.9**	**1.1**	**1.1**
2007	**0.8**	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	**-0.7**	**-1.0**	**-1.1**	**-1.3**
2008	**-1.4**	**-1.4**	**-1.1**	**-0.8**	**-0.6**	-0.4	-0.1	0.0	0.0	0.0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6						
2010												
2011												
2012												
2013												
2014												
2015												
2016												
2017												
2018												
2019												
2020												
2021												
2022												
2023												
2024												
2025												
2026												
2027												

Historical El Niño and La Niña Episodes

Based on the ONI computed using ERSST.v3b

NOTE:

After updating the ocean analysis to ERSST.v3b, a new La Niña episode was classified (ASO 1962-DJF 1962/63) and two previous La Niña episodes were combined into one single episode (AMJ 1973- MAM 1976).

El Niño	Highest ONI Value
JAS 1951 - NDJ 1951/52	0.8
MAM 1957 – MJJ 1958	1.7
JJA 1963 – DJF 1963/64	1.0
MJJ 1965 – MAM 1966	1.6
OND 1968 – MJJ 1969	1.0
ASO 1969 – DJF 1969/70	0.8
AMJ 1972 – FMA 1973	2.1
ASO 1976 – JFM 1977	0.8
ASO 1977 - DJF 1977/78	0.8
AMJ 1982 – MJJ 1983	2.3
JAS 1986 – JFM 1988	1.6
AMJ 1991 – JJA 1992	1.8
AMJ 1994 – FMA 1995	1.3
AMJ 1997 – AMJ 1998	2.5
AMJ 2002 – FMA 2003	1.5
MJJ 2004 – JFM 2005	0.9
JAS 2006 - DJF 2006/07	1.1

La Nina	Lowest ONI Value
ASO 1949 – FMA 1951	-1.7
MAM 1954 – DJF 1956/57	-2.1
ASO 1962 – DJF 1962/63	-0.8
MAM 1964 – DJF 1964/65	-1.1
NDJ 1967/68 – MAM 1968	-0.9
JJA 1970 – DJF 1971/72	-1.3
AMJ 1973 – MAM 1976	-2.0
SON 1984 – ASO 1985	-1.0
AMJ 1988 – AMJ 1989	-1.9
ASO 1995 – FMA 1996	-0.7
JJA 1998 – MJJ 2000	-1.6
SON 2000 – JFM 2001	-0.7
ASO 2007 – AMJ 2008	-1.4

El Niño Years Since 1950

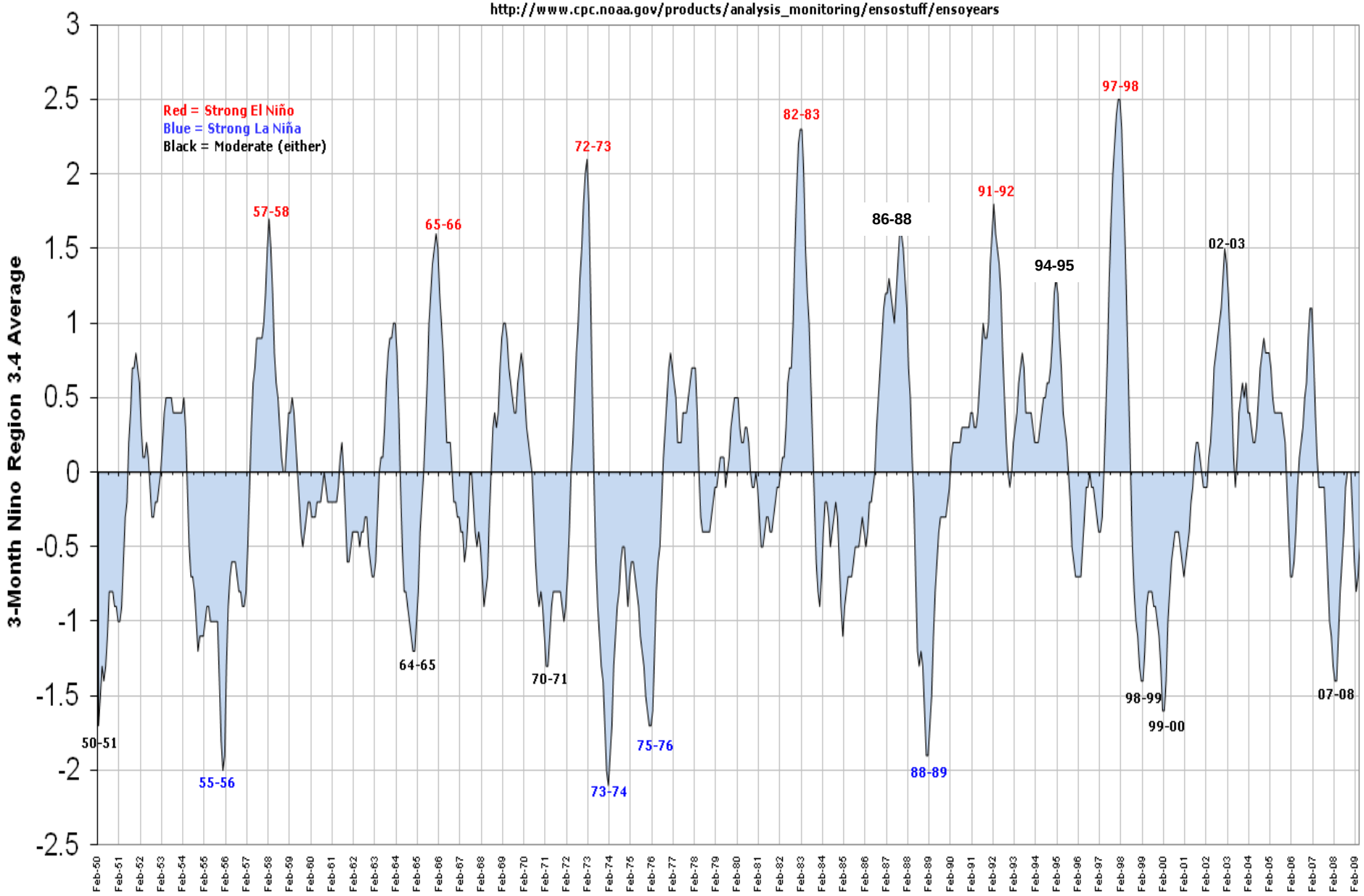
Weak*	Moderate*	Strong*
1951-52	1986-87	1957-58
1963-64	1987-88	1965-66
1968-69	1994-95	1972-73
1969-70	2002-03	1982-83
1976-77		1991-92
1977-78		1997-98
2004-05		
2006-07		

*Weak is Niño Oscillation Index between 0.5 and 0.9. Moderate between 1.0 and 1.4. Strong is greater than 1.4.

Oceanic Niño Index (ONI)

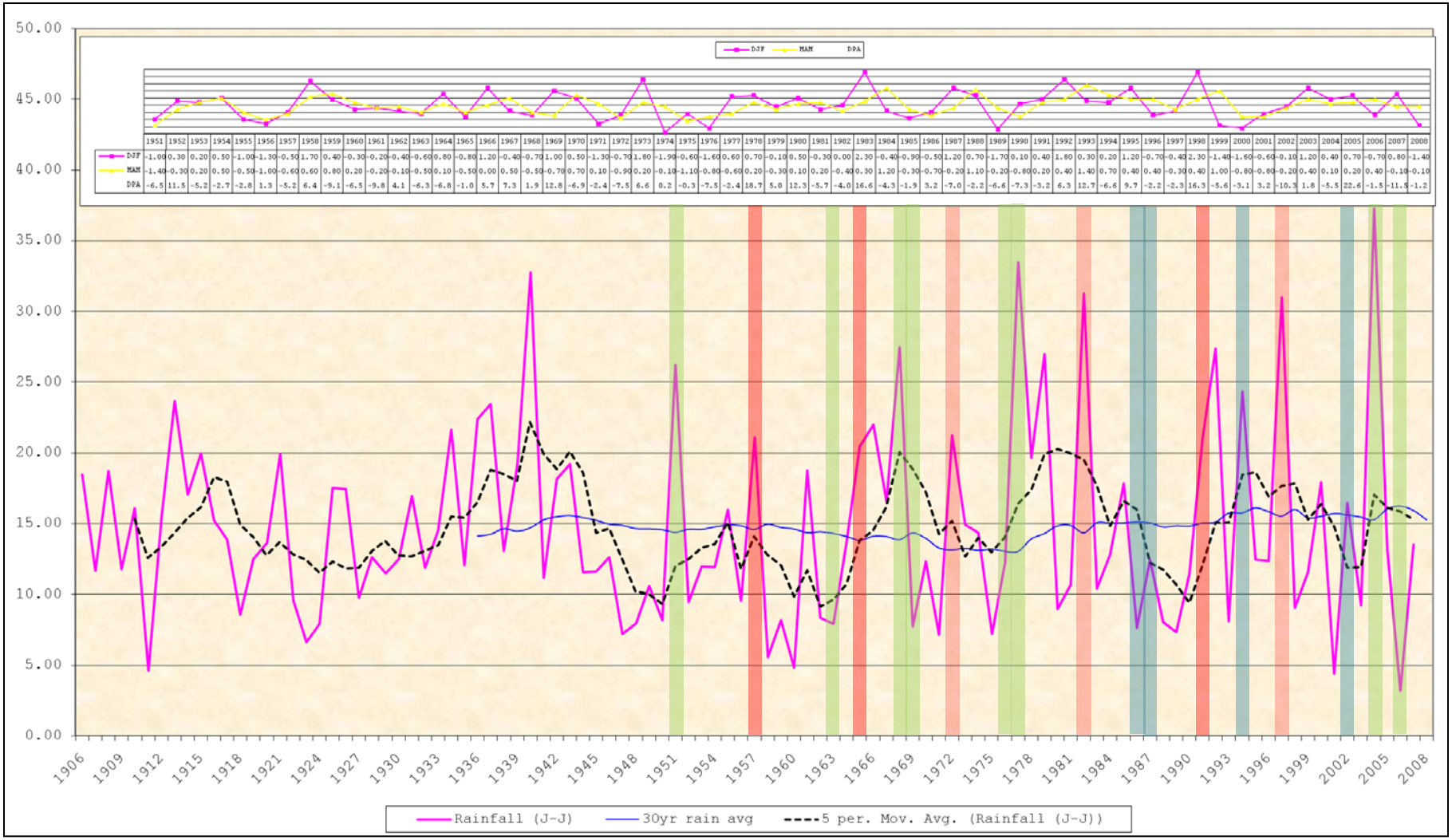
Graphic Courtesy of Jan Null/www.ggweather.com

http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears



Downtown Los Angeles Seasonal Precipitation

Ending on June 30 of year indicated



	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
DJF	-1.00	0.30	0.20	0.50	-1.00	-1.30	-0.50	1.70	0.40	-0.30	-0.20	-0.40	-0.60	0.80	-0.80	1.20	-0.40	-0.70	1.00	0.50	-1.30	-0.70	1.80	-1.90	-0.60	-1.60	0.60	0.70	-0.10	0.50	-0.30	0.00	2.30	-0.40	-0.90	-0.50	1.20	0.70	-1.70	0.10	0.40	1.80	0.30	0.20	1.20	-0.70	-0.40	2.30	-1.40	-1.60	-0.60	-0.10	1.20	0.40	0.70	-0.70	0.80	-1.40
MAM	-1.40	-0.30	0.20	0.50	-0.50	-1.00	-0.60	0.60	0.80	0.20	-0.20	-0.10	-0.50	0.10	-0.50	0.00	0.50	-0.50	-0.70	0.70	0.10	-0.90	0.20	-0.10	-1.10	-0.80	-0.60	0.20	-0.30	0.10	0.20	-0.40	0.30	1.20	-0.30	-0.70	-0.20	1.10	-0.20	-0.80	0.20	0.40	1.40	0.70	0.40	0.40	-0.30	0.40	1.00	-0.80	-0.80	-0.20	0.40	0.10	0.20	0.40	-0.10	-0.10
DPA	-6.5	11.5	-5.2	-2.7	-2.8	1.3	-5.2	6.4	-9.1	-6.5	-9.8	4.1	-6.3	-6.8	-1.0	5.7	7.3	1.9	12.8	-6.9	-2.4	-7.5	6.6	0.2	-0.3	-7.5	-2.4	18.7	5.0	12.3	-5.7	-4.0	16.6	-4.3	-1.9	3.2	-7.0	-2.2	-6.6	-7.3	-3.2	6.3	12.7	-6.6	9.7	-2.2	-2.3	16.3	-5.6	-3.1	3.2	-10.3	1.8	-5.5	22.6	-1.5	-11.5	-1.2

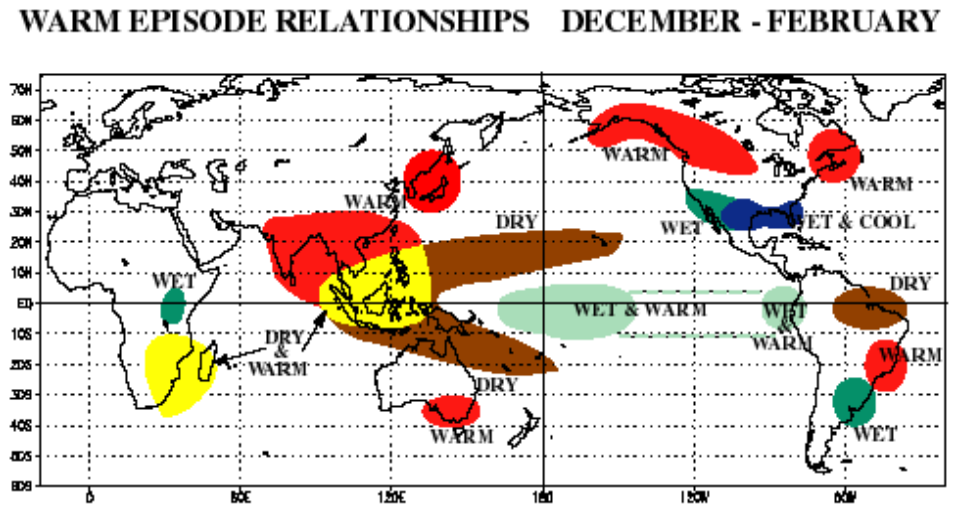
Weak El Nino

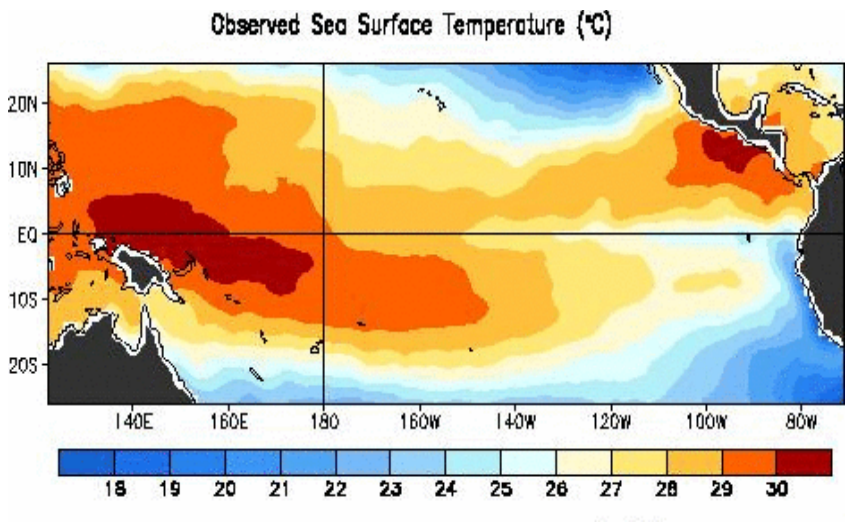
Mod. El Nino

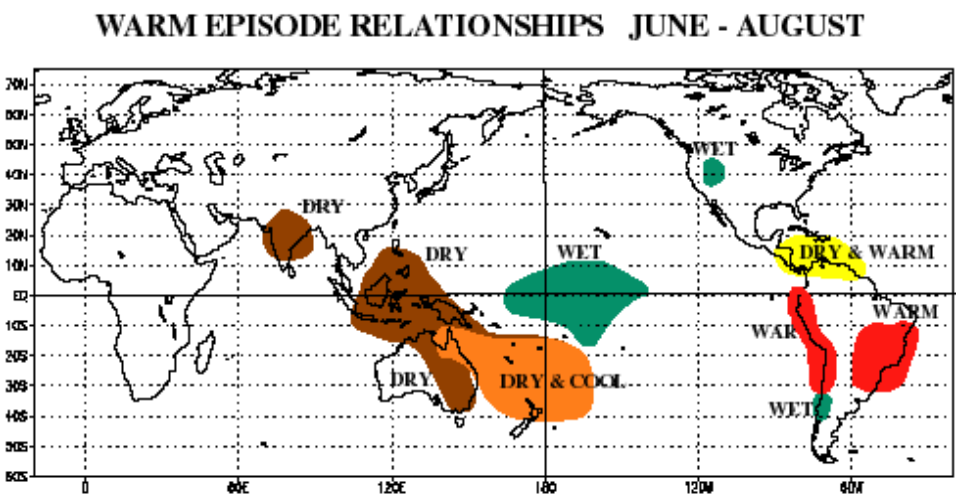
Strong El Nino

Global El Niño Relationships

- Warm episodes have weather relationships around the globe



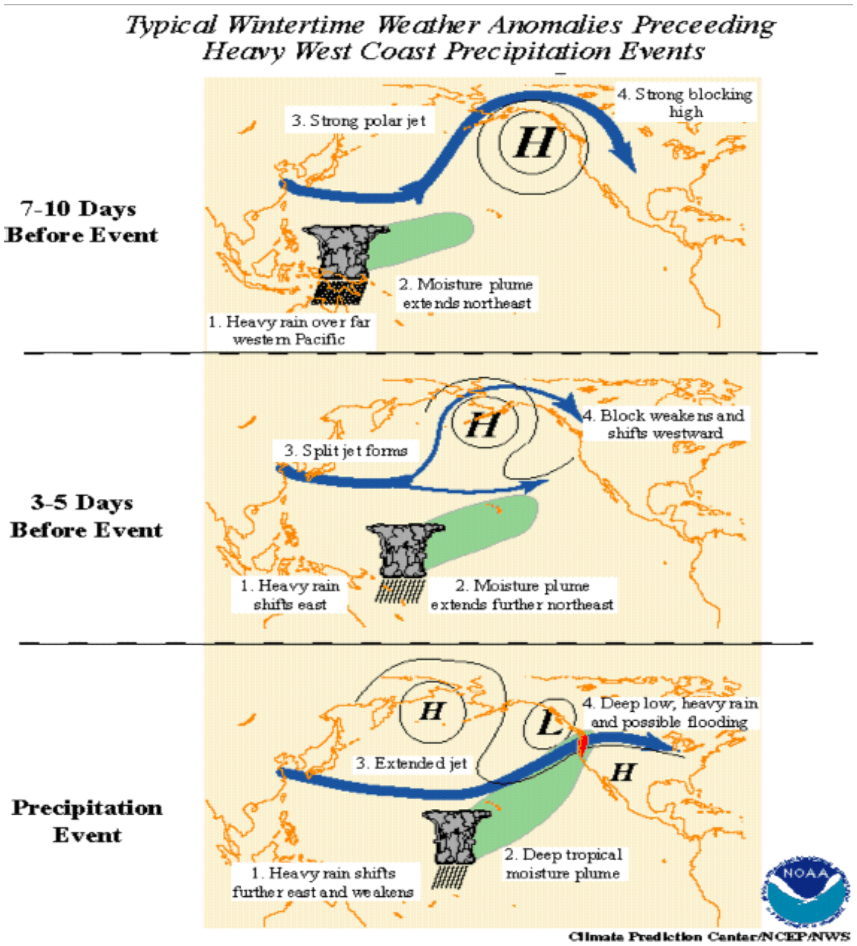




Climate Prediction Center
NCEP

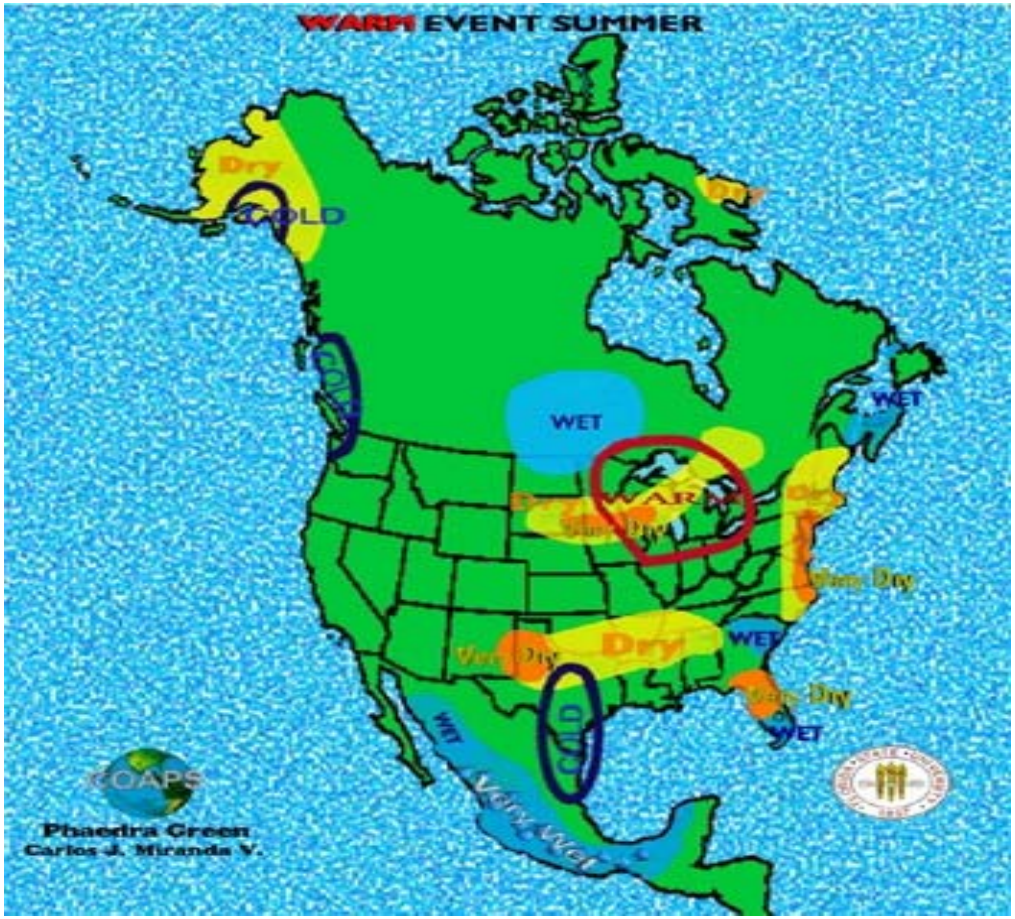
El Niño Jet Stream and Precipitation

- Upper level high pressure over Gulf of Alaska begins to weaken and retreat westward
- Polar jet begins to split and undercut the high pressure
- Undercutting polar jet also may phase with subtropical jet
- Undercutting polar jet becomes steering mechanism for trans-Pacific storms/deep moisture
- Sometimes referred to as the "Pineapple Express" since the moisture origins are often south and west of Hawaii



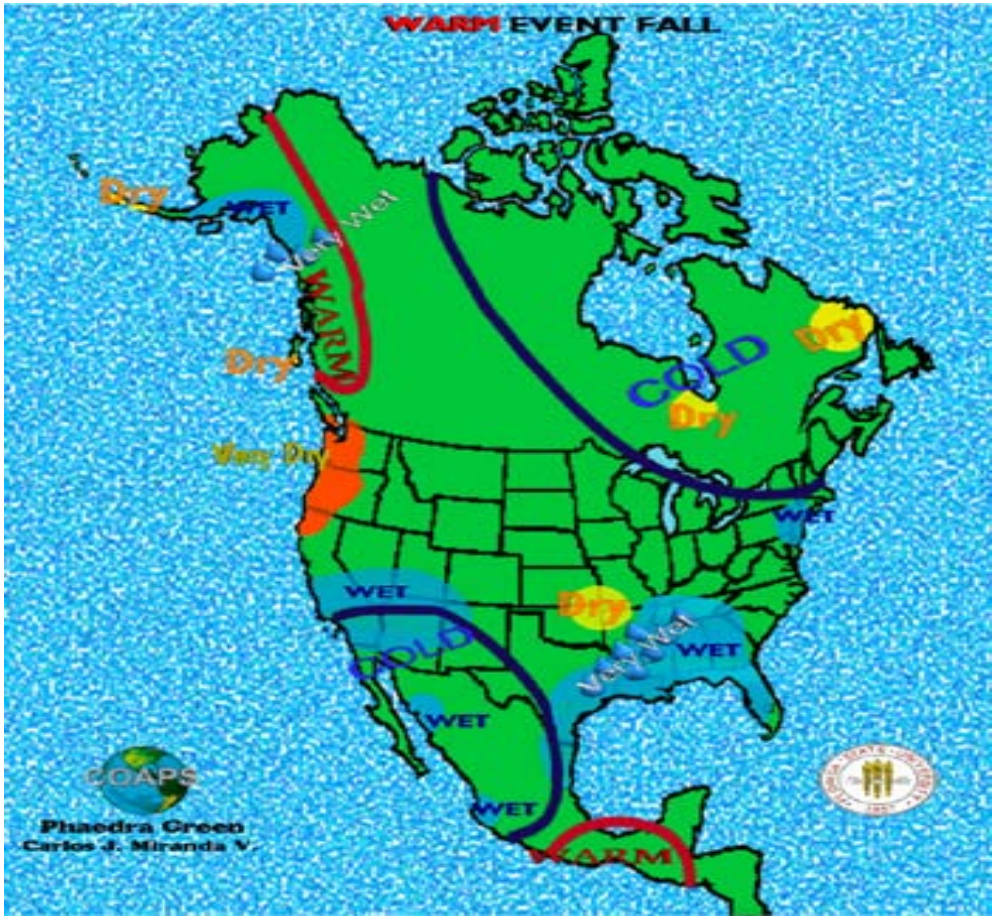
Summer El Niño Impacts

- Cold conditions in the Extreme Pacific NW
- Warm and dry in the Midwest, southern states, and NE
- Wet in the southeast and southern FL
- Higher Frequency of Eastern Pacific Hurricanes
- No California signal



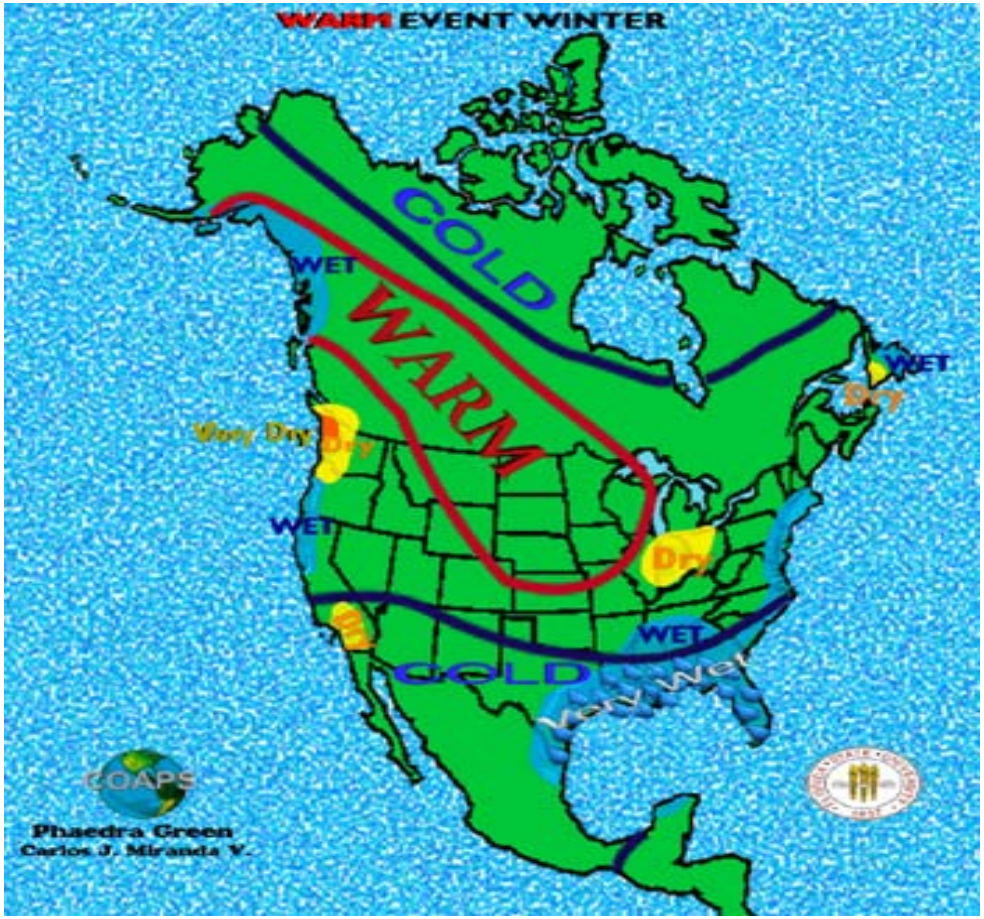
Fall El Niño Impacts

- Cold & wet conditions in the SW, including southern CA
- Cold and dry conditions in New England
- Wet in the southeast
- Very Dry in Pacific NW
- Higher Frequency of Eastern Pacific Hurricanes

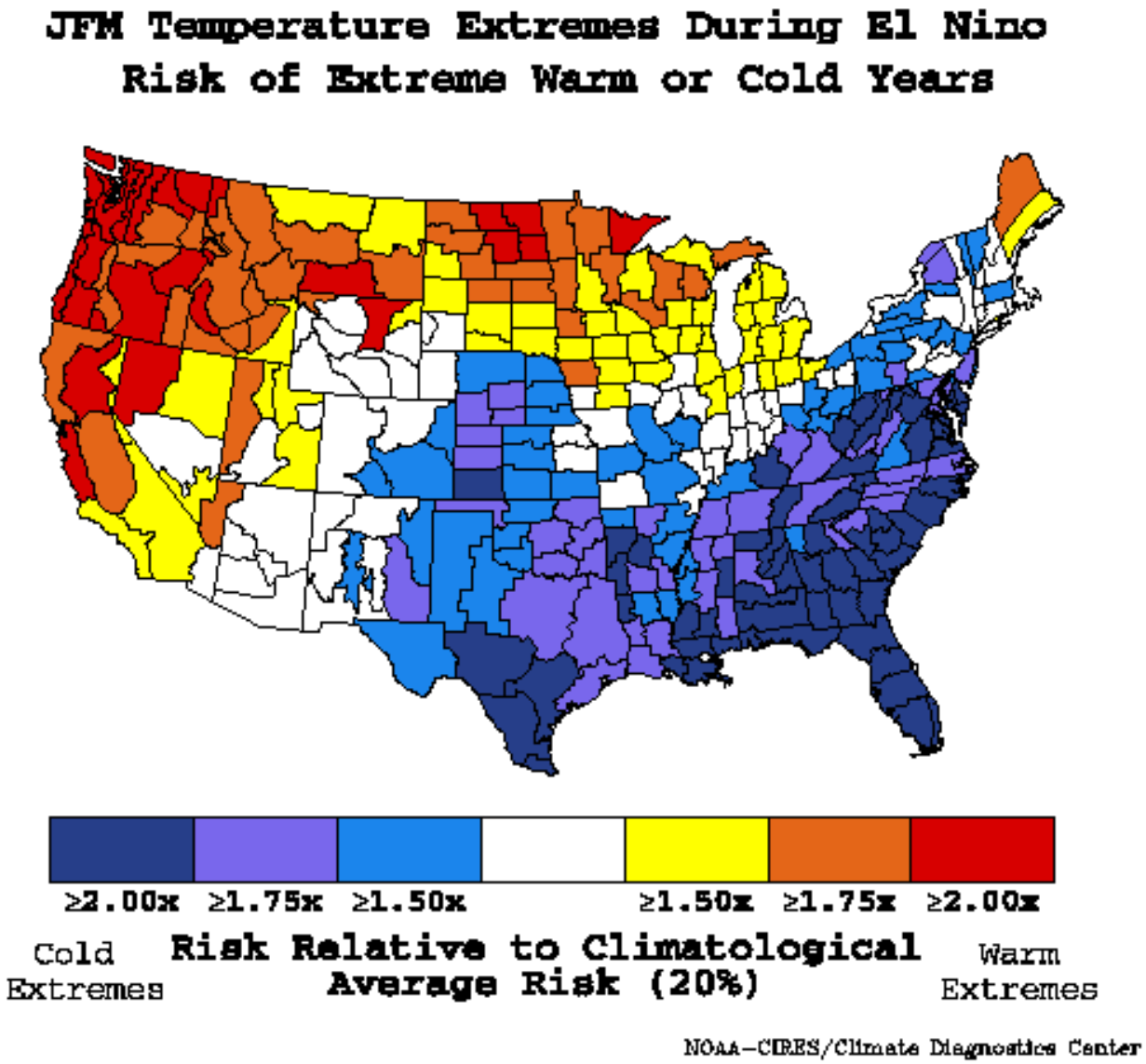


Winter El Niño Impacts

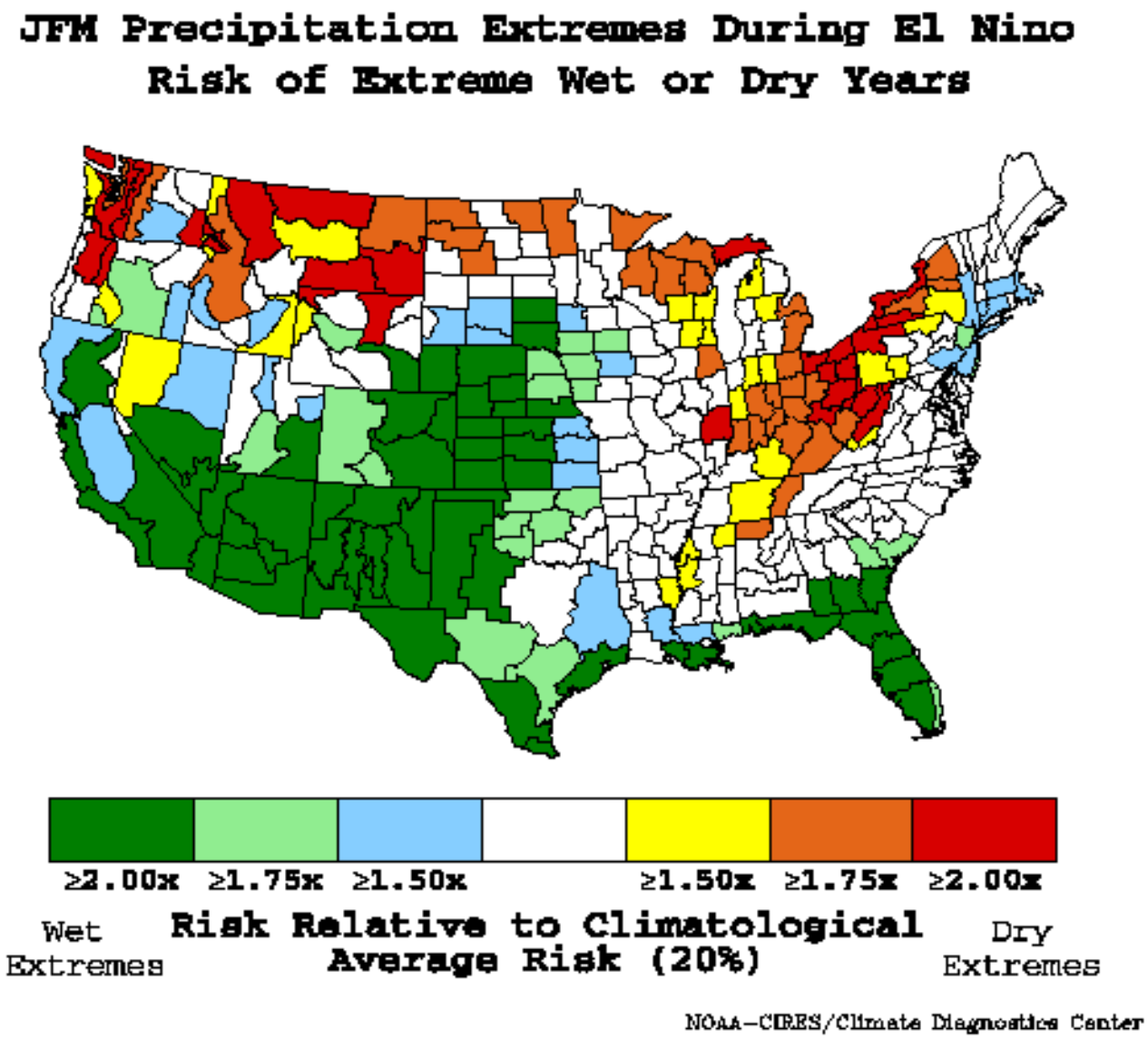
- Wet conditions in far Northern CA
- Cold and wet conditions throughout the southeast
- Warm across the northern Rockies and Great Plains
- Dry across extreme southern CA deserts

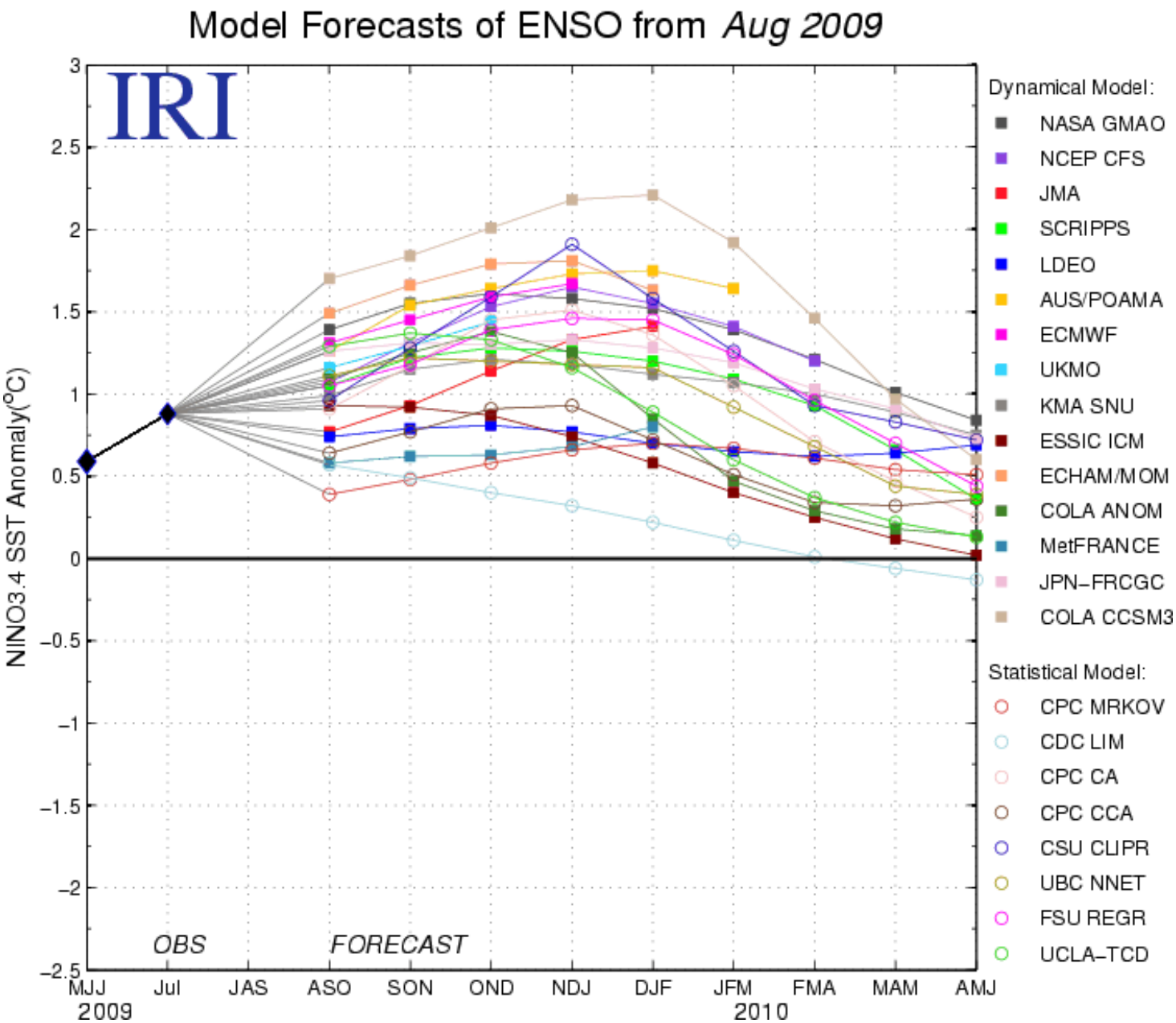


El Niño Temperature Extreme Risk

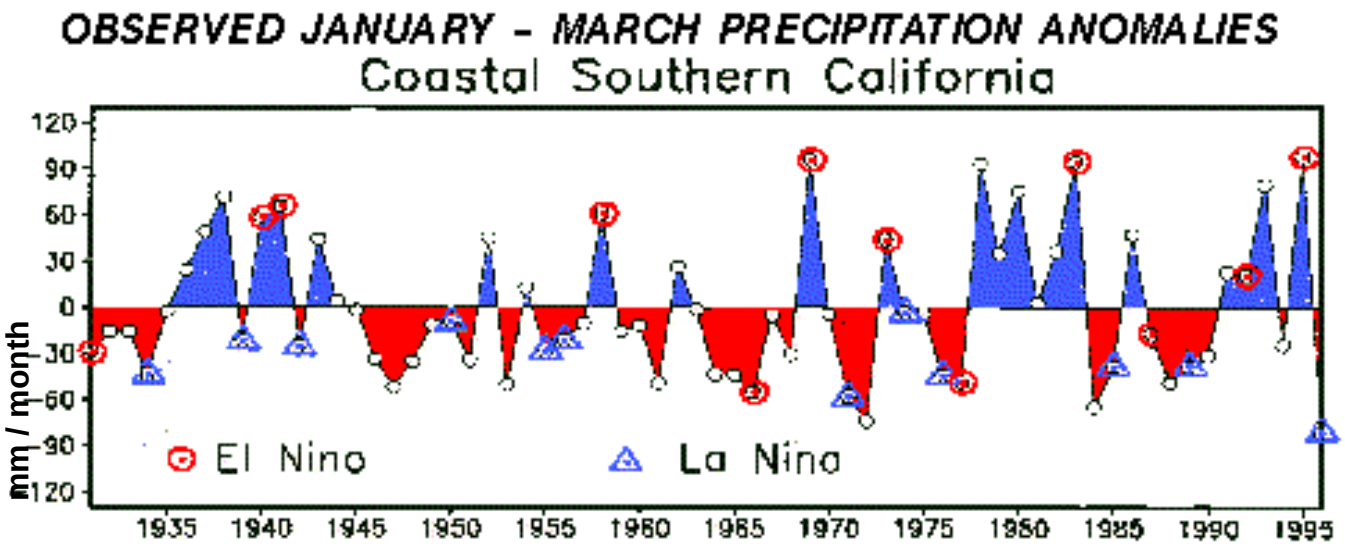


El Niño Precipitation Extreme Risk

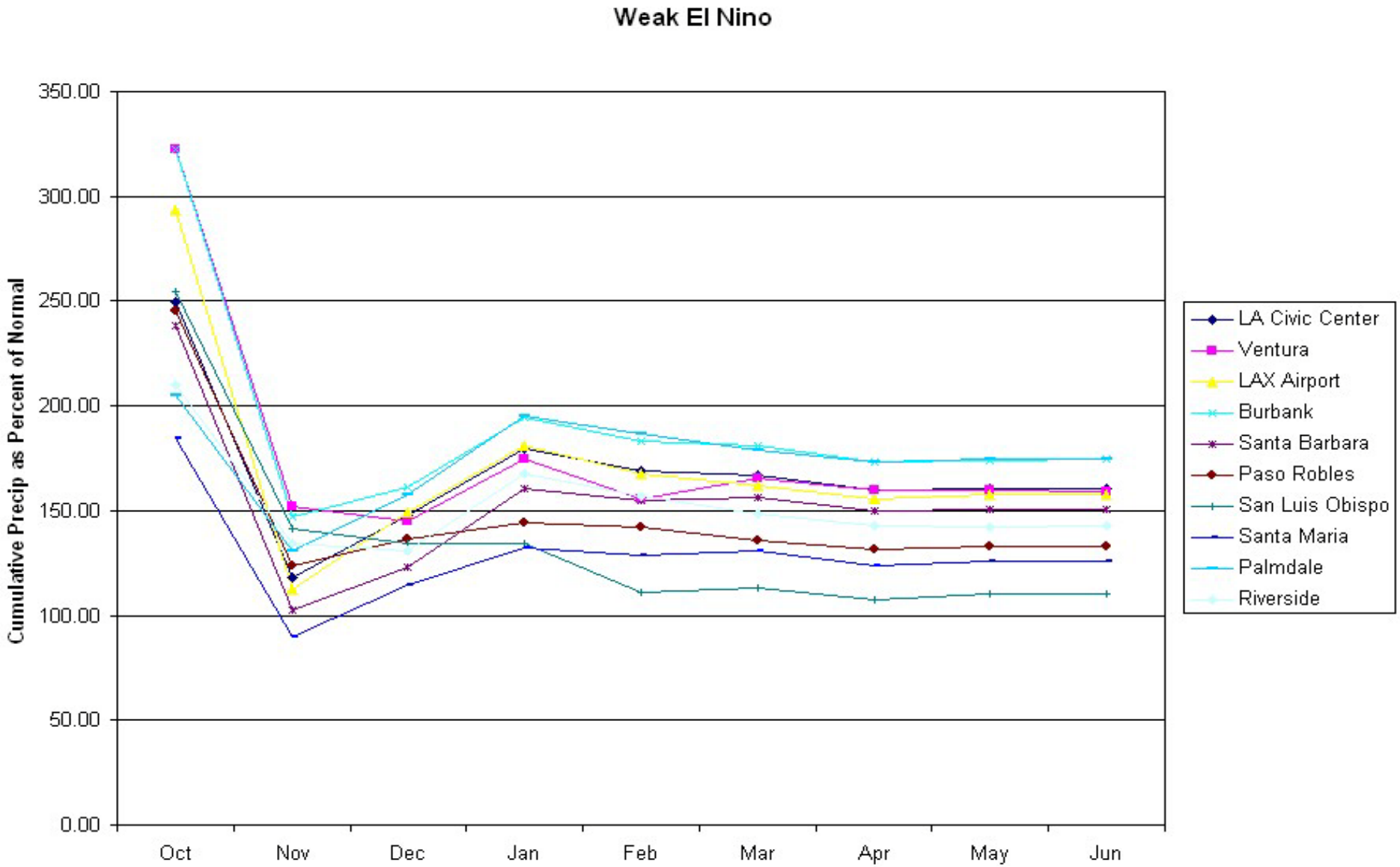



Model Forecasts of ENSO from *Aug 2009*
IRI
NINO3.4 SST Anomaly(°C)
3
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
OBS
FORECAST
MJJ
Jul
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
2009
2010
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN−FRCGC
COLA CCSM3
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA−TCD

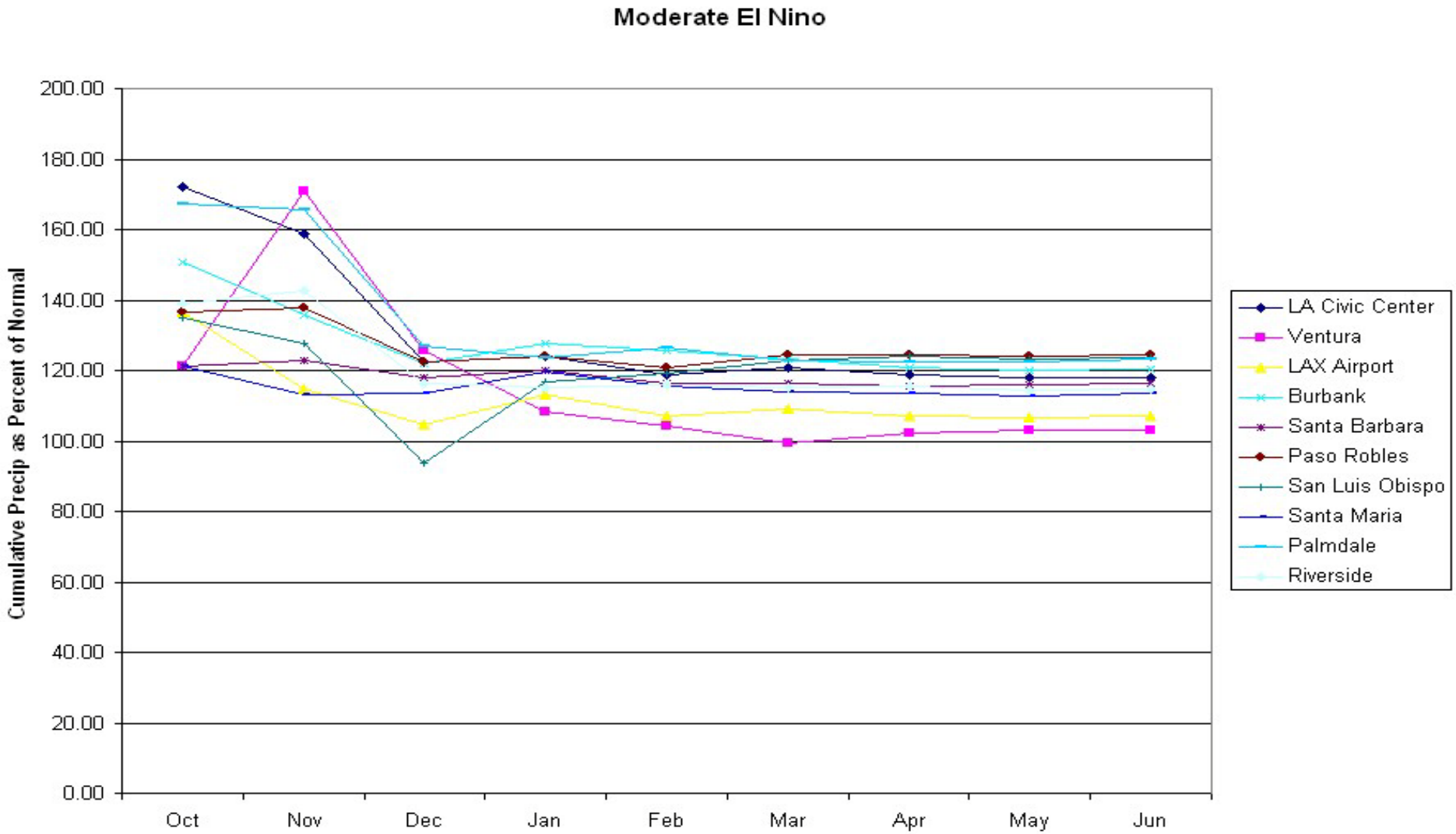
El Niño/La Niña and Southern California



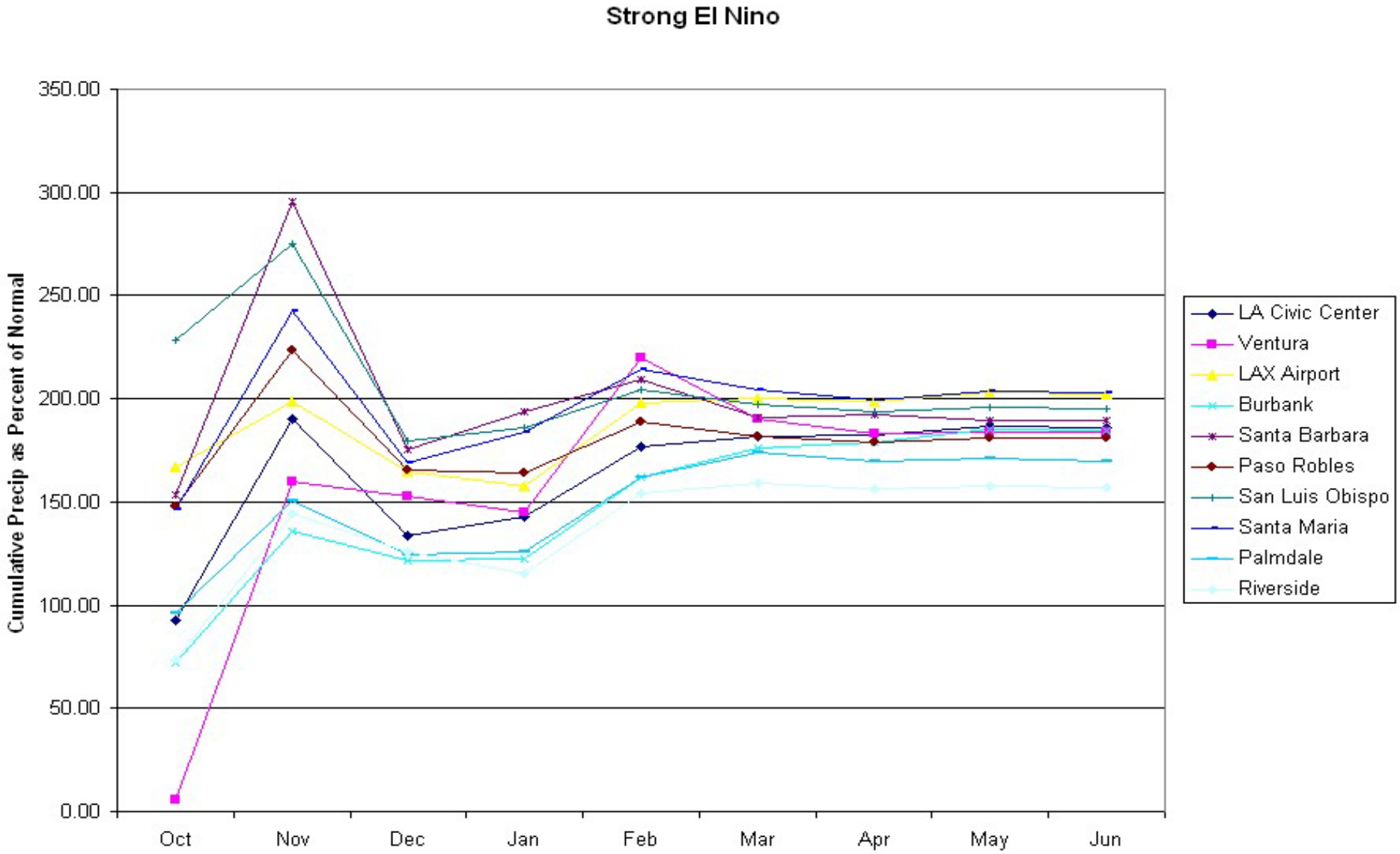
- Records clearly show that during almost all El Niño's, January - March precipitation anomalies are positive
- Records also clearly show that during almost all La Niña's J-M precipitation anomalies are negative



- **Weak El Niño's feature an earlier start to the rainy season.**
- **The pattern becomes more consistent and parallels normal patterns later in winter, with totals settling around 150% of normal, on average.**

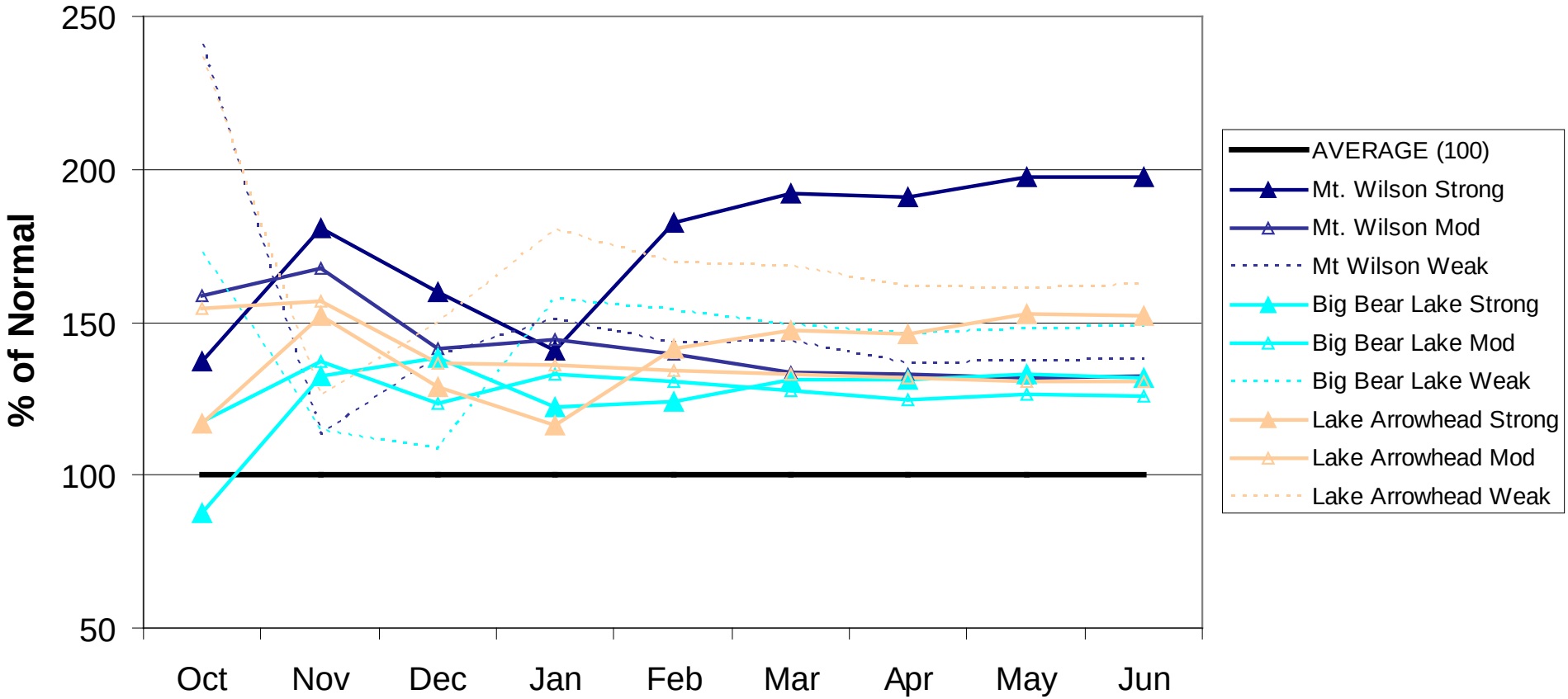


- **Moderate El Niños tend to feature a more modest increase in rainfall than weak or strong El Niños. Seasonal totals average around 100-120%.**
- **The reason weaker El Niños tend to have a greater effect is poorly understood at this point.**

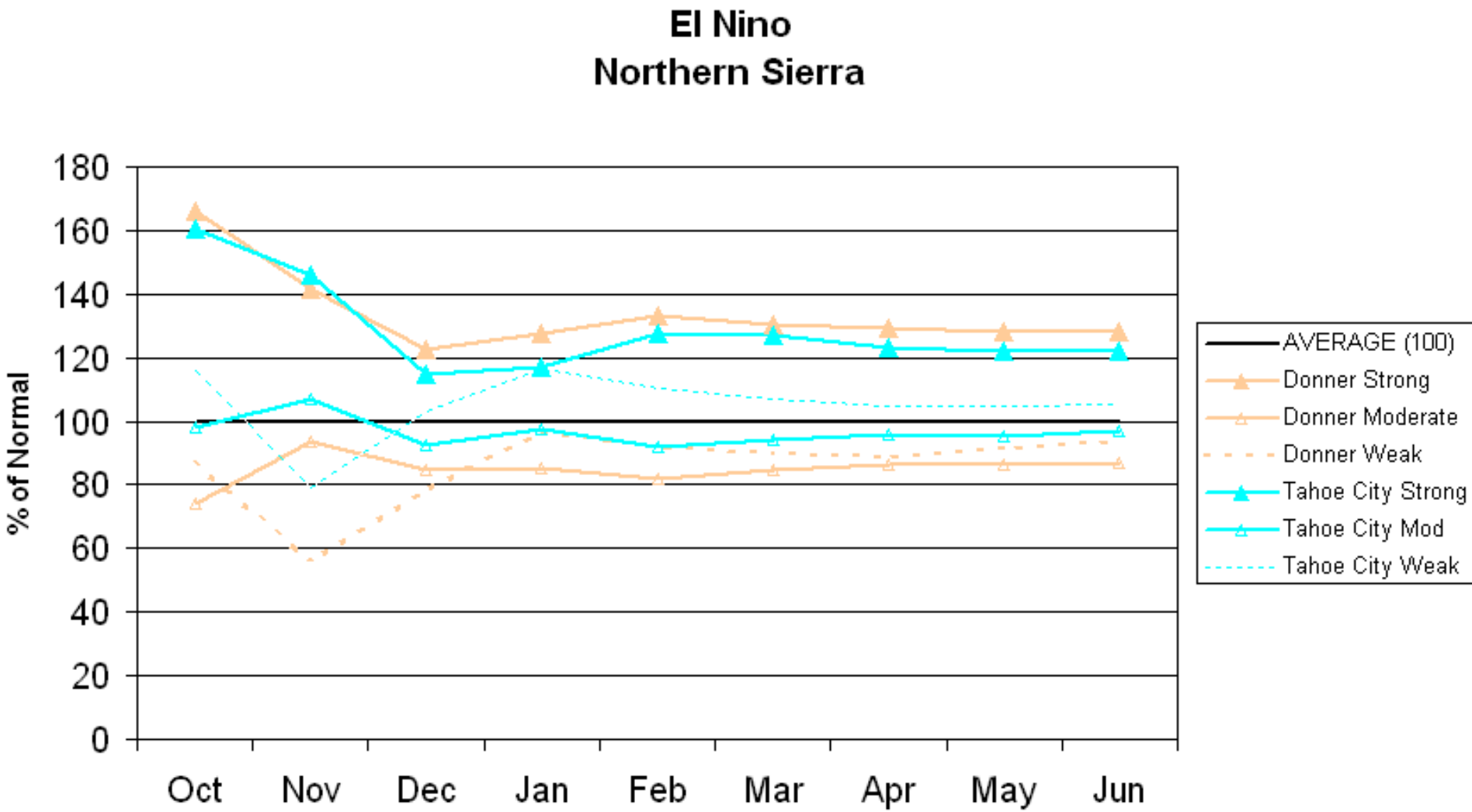


- **Strong El Niños have the most dramatic effect on local rainfall with seasonal totals averaging 150-200% of normal.**
- **Immediate coastal areas tend to see a greater increase in rainfall with lesser effects inland.**

Strong El Nino
Southern CA Mountains

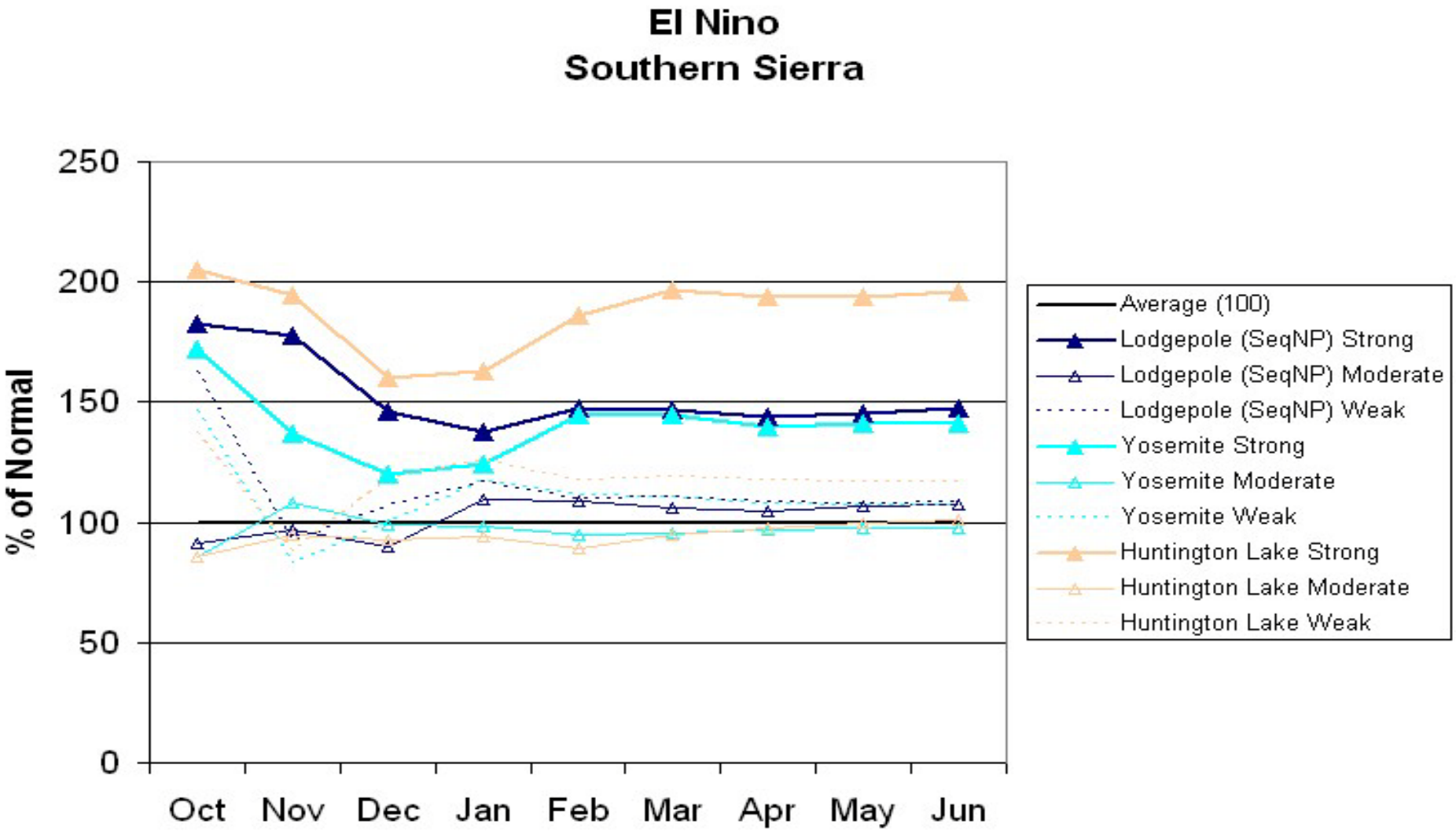


- **Weak El Niños tend to feature higher precip than moderate El Niños.**
- **There is more variability with respect to normal in precip before January. Thereafter precipitation tends to level out to a more consistent and steadier pattern, but rates are higher compared to normal. This extends into the Spring.**
- **Strong El Niños have a less predictable effect in the mountains than at lower elevations for reasons that are not clear.**

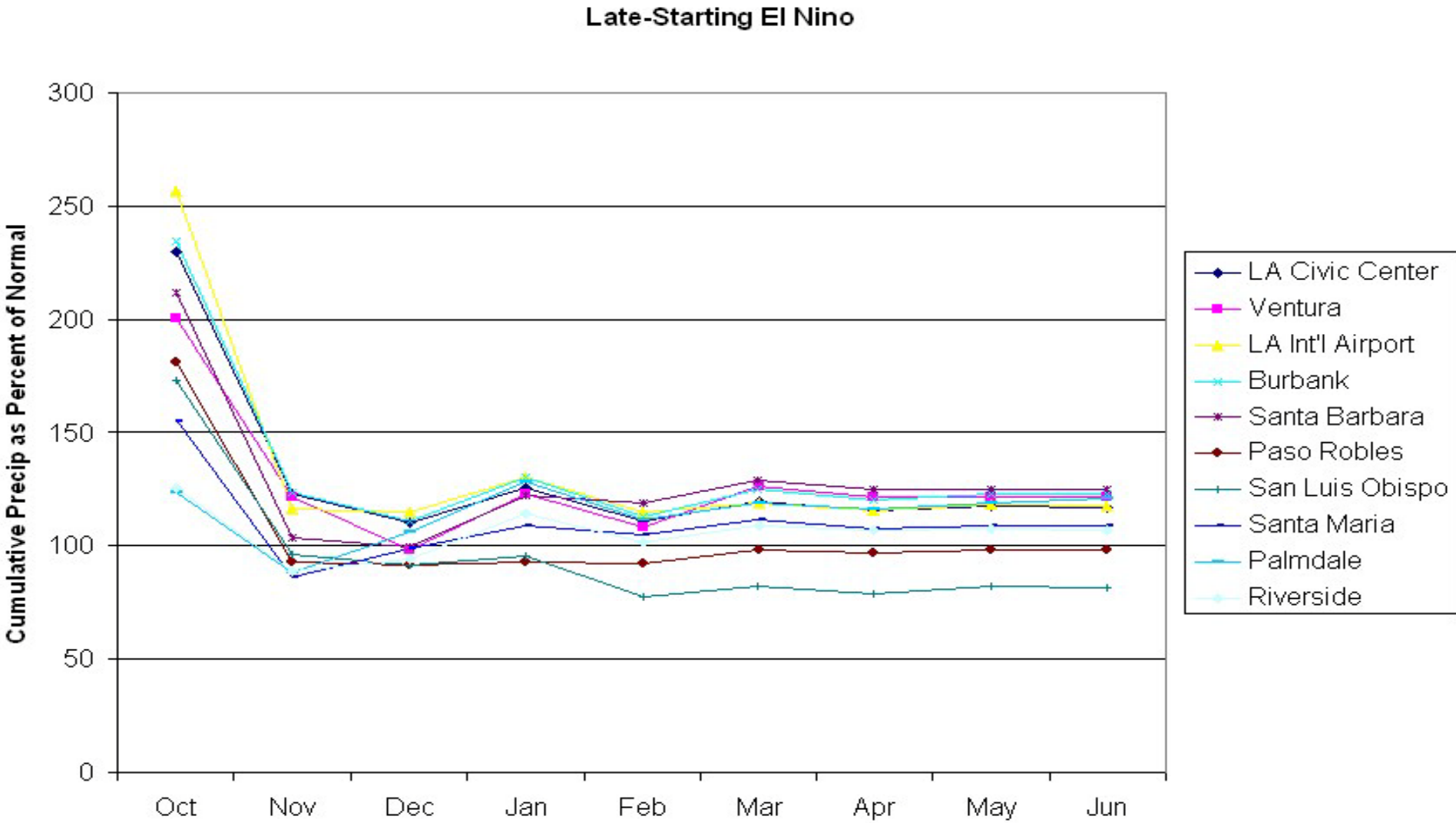


- **The El Niño signal is not quite as consistent in the northern Sierra.**

- **Strong El Niño's still produce the most precip (125%) but weak and moderate events are similar – near to slightly below normal.**



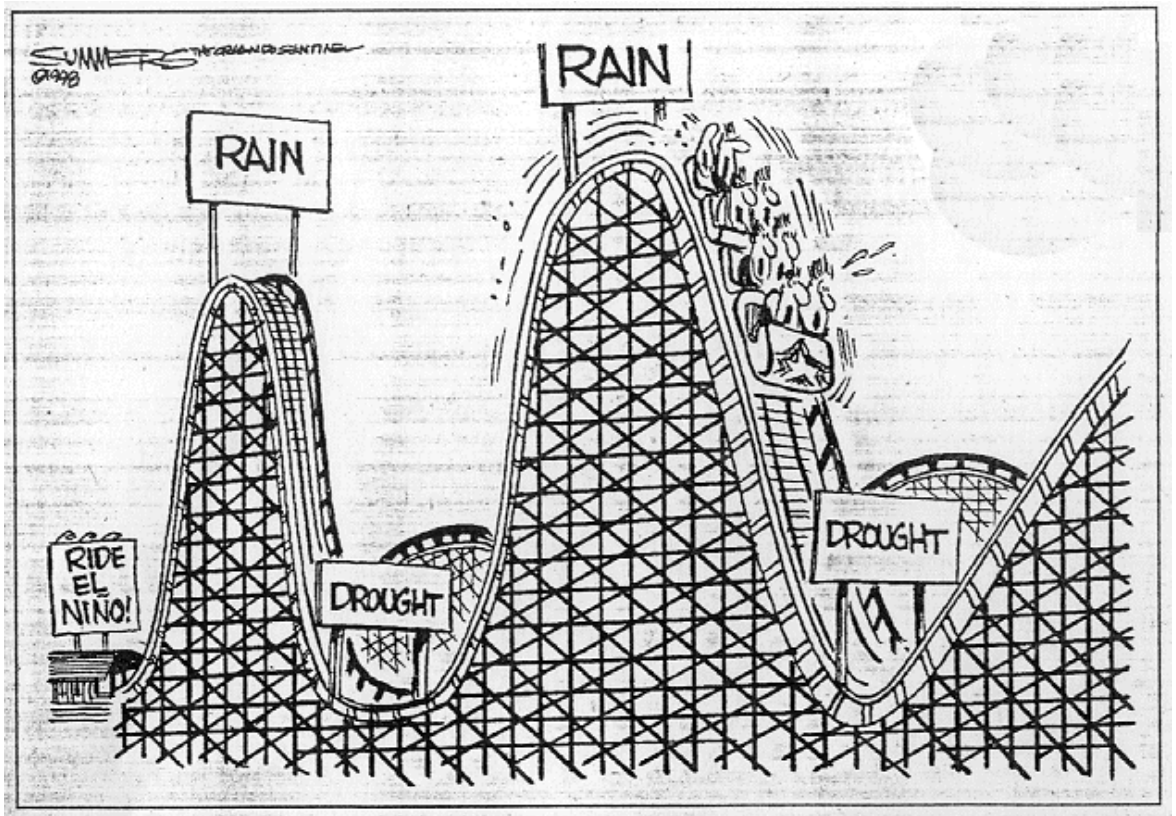
- **Winter Storms are consistently wetter-than-normal in winter and spring in both weak and strong El Niño's.**
- **Strong and Weak El Niño's produce more precipitation than Moderate El Niño's.**



- **4 out of 5 El Niño years used in this composite were weak events. The fifth was moderate.**

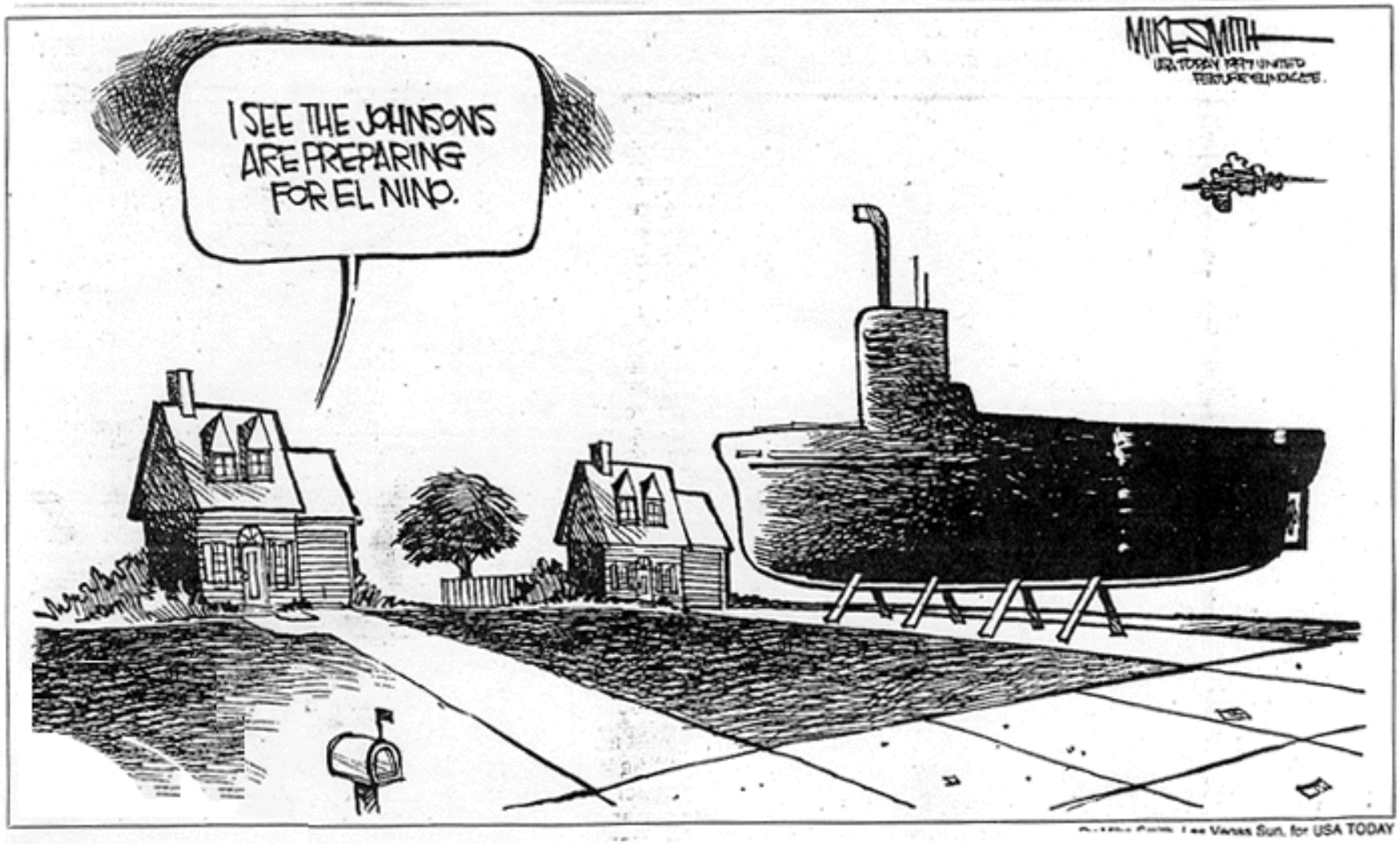
- **This composite shows much closer to normal seasonal rainfall totals than typical weak El Niño's.**

El Niño has a repeat cycle of 2-7 years with an average repeat cycle of approximately 4 yrs.



By Dana Summers, The Orlando (Fla.) Sentinel, Tribune Media Services

www.coaps.fsu.edu/lib/climatoons



Las Vegas Sun, for USA TODAY

www.coaps.fsu.edu/lib/climatoons

COAPS