

# The California - Nevada Drought.

Update: 9 July 2015

**Kelly T. Redmond**

**Regional Climatologist**

**Western Regional Climate Center**

**Desert Research Institute**

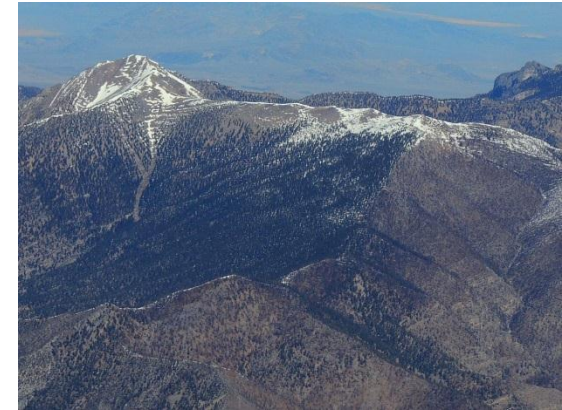
**Reno Nevada**

**White House Subcommittee on Disaster Reduction**

**National Science and Technology Council**

**National Integrated Drought Information System Briefing**

**9 July 2015**



Western Regional  
Climate Center



## **Outline**

**How did we get here?**

**Current status**

**Unusual aspects of the current drought**

**What can we say about the upcoming winter ?**

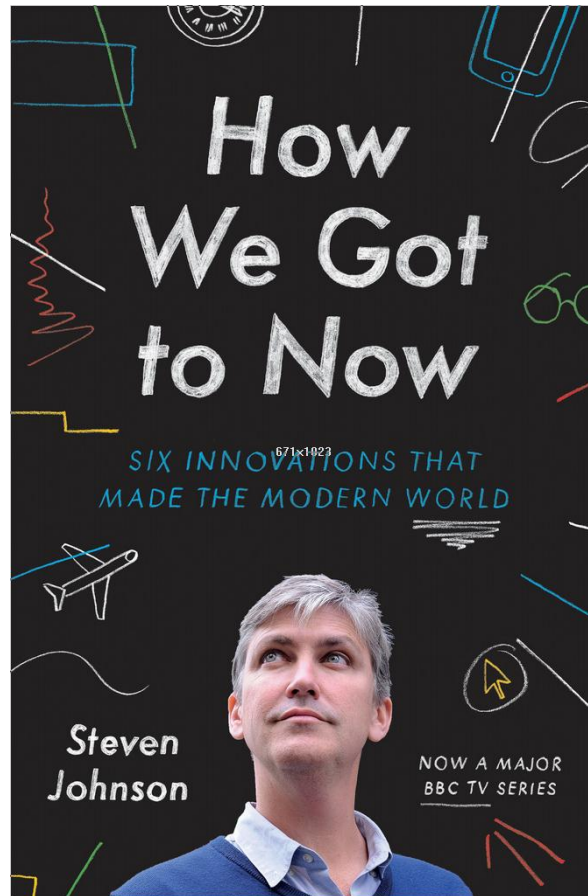
**The rise of El Nino ... Implications ???**

**Near term strategies (next several months into early winter)**

**Biological effects in rivers and ocean - relationship to drought**

**Discussion**

# Borrowing the phraseology of Steven Johnson,

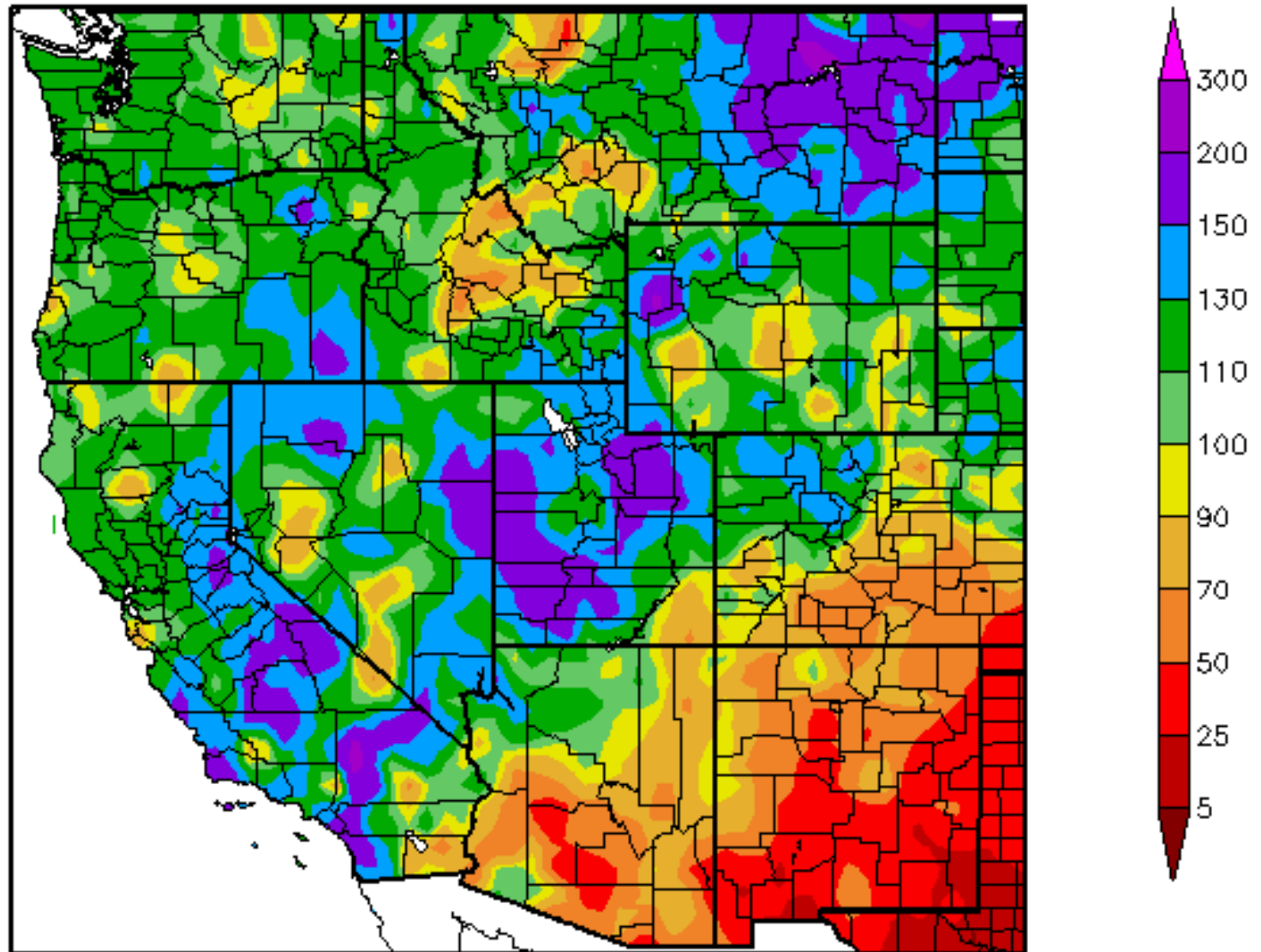


During the last year .....

Water Year  
2010-11  
01 Oct 2010  
Thru  
30 Sep 2011

# Percent of Normal Precipitation (%)

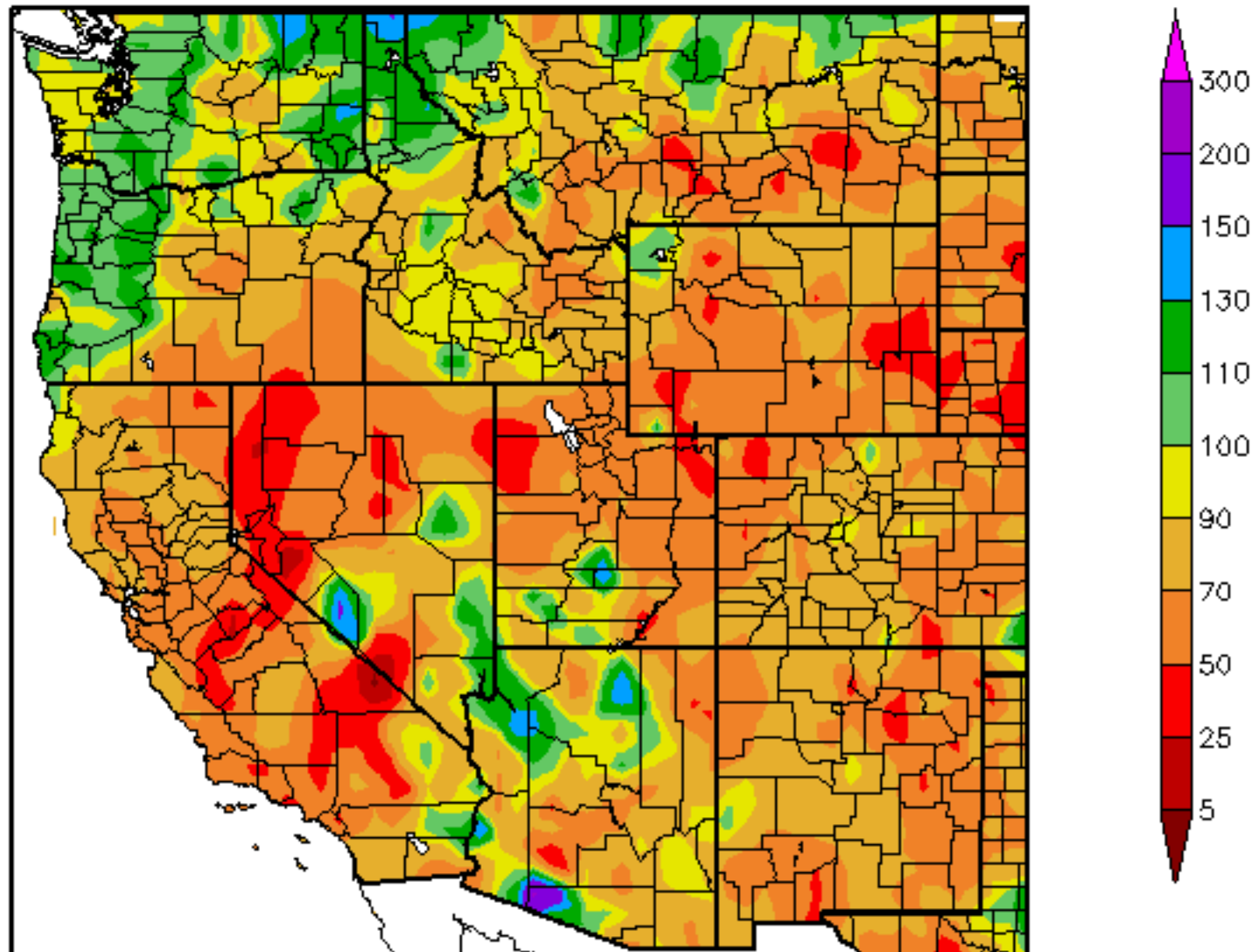
10/1/2010 - 9/30/2011



Water Year  
2011-12  
01 Oct 2011  
Thru  
30 Sep 2012

# Percent of Normal Precipitation (%)

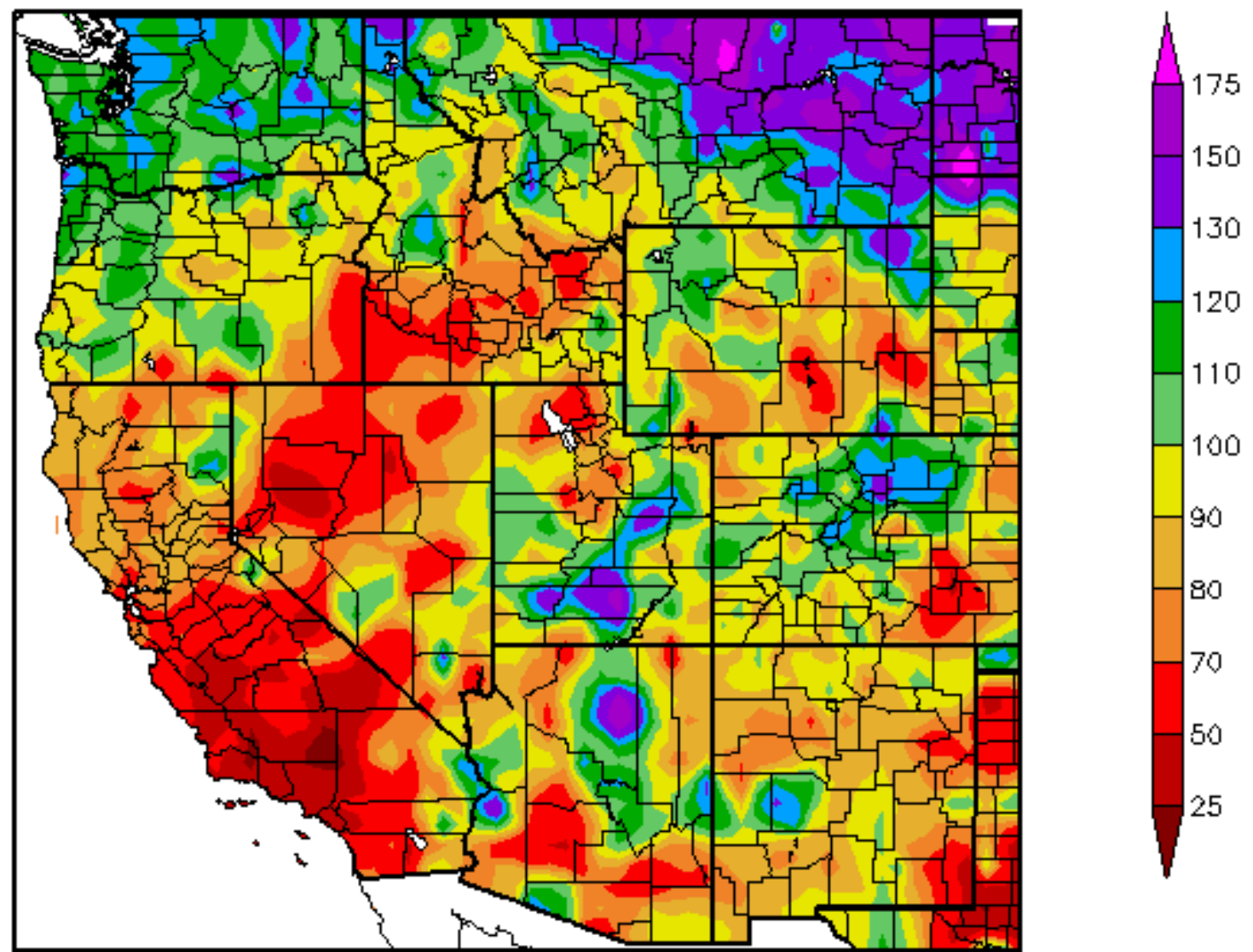
10/1/2011 - 9/30/2012



Water Year  
2012-13  
01 Oct 2012  
Thru  
30 Sep 2013

# Percent of Normal Precipitation (%)

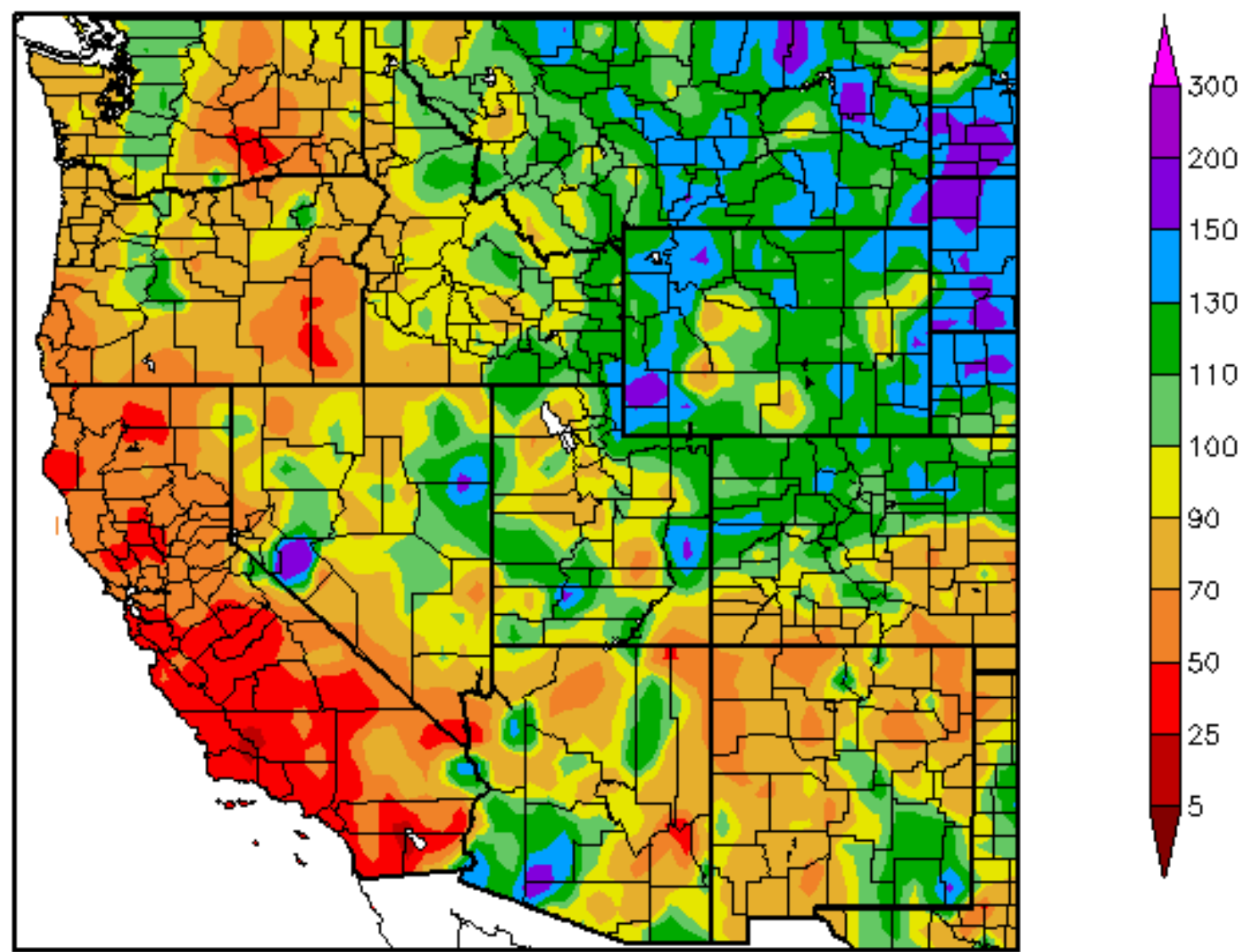
10/1/2012 - 9/30/2013



Water Year  
2013-14  
01 Oct 2013  
Thru  
30 Sep 2014

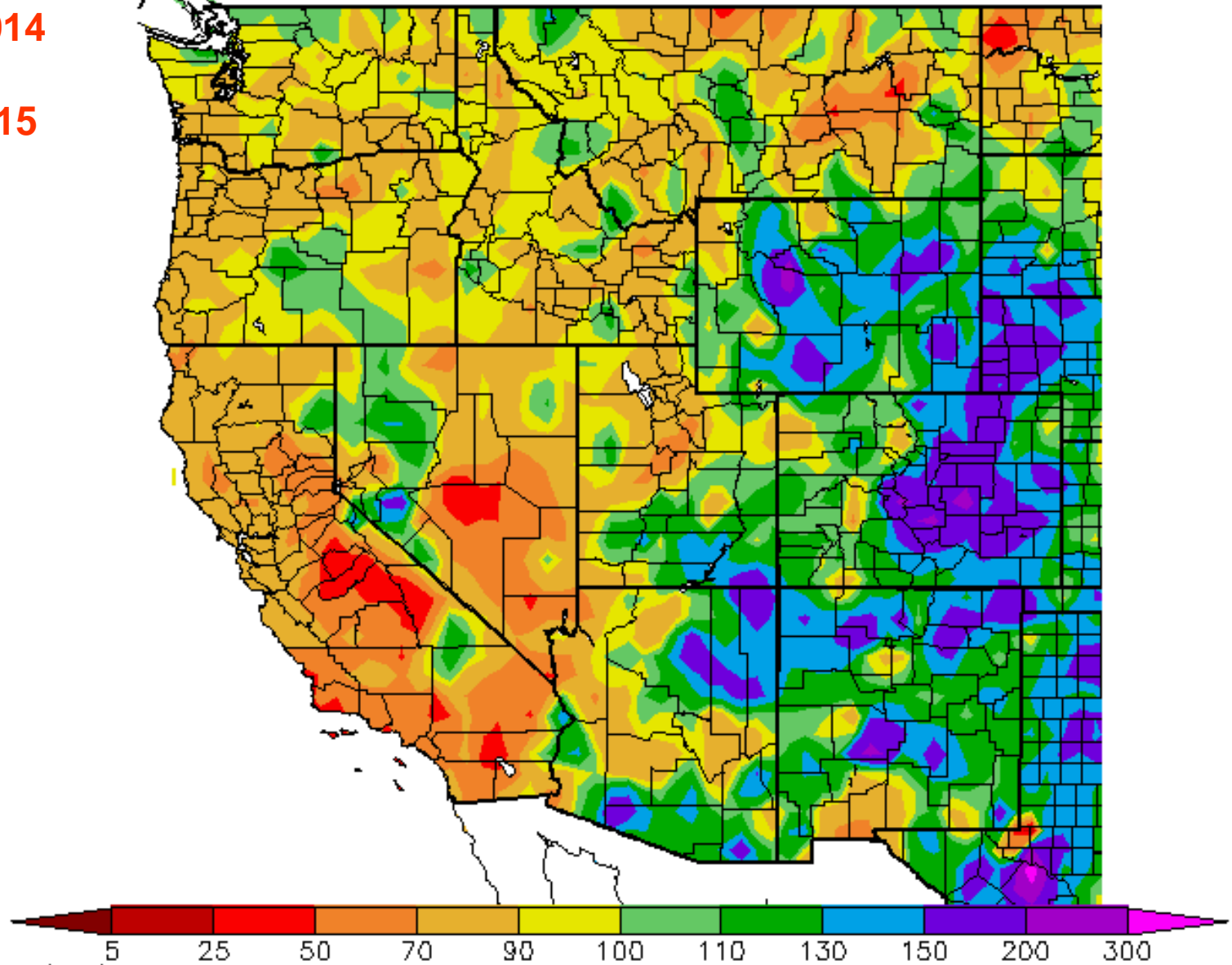
# Percent of Normal Precipitation (%)

10/1/2013 - 9/30/2014



**Water Year  
To Date  
2014-15  
01 Oct 2014  
Thru  
3 July 2015**

Percent of Average Precipitation (%)  
10/1/2014 – 7/3/2015



Generated 7/04/2015 at WRCC using provisional data.  
NOAA Regional Climate Centers

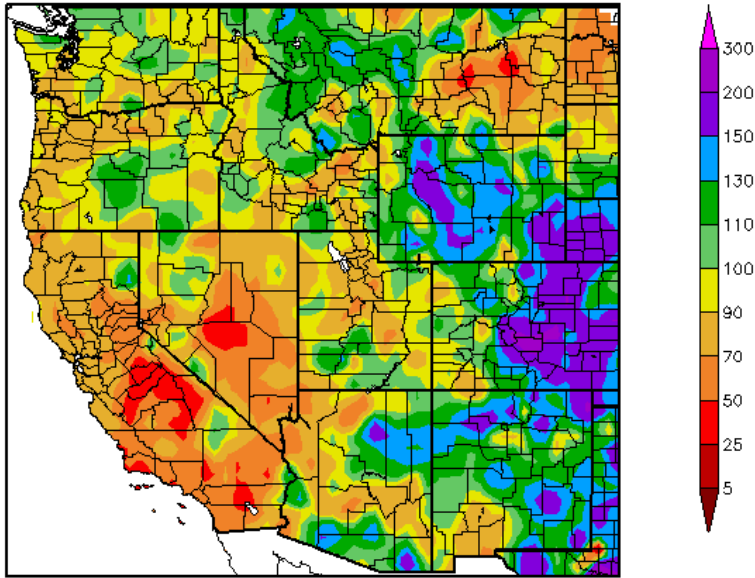


Oct 1 - May 31

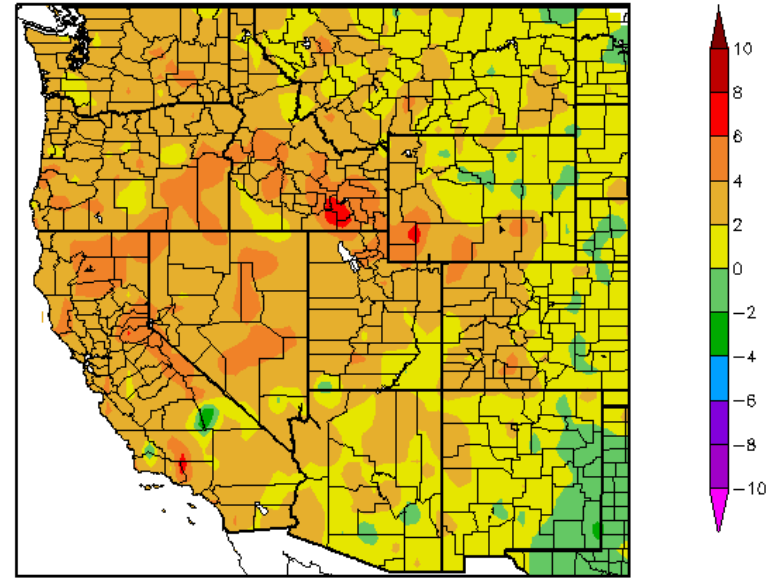
Water Year to Date 2014-2015

Oct 1 - May 31

Percent of Normal Precipitation (%)  
10/1/2014 - 5/31/2015



Departure from Normal Temperature (F)  
10/1/2014 - 5/31/2015



Generated 6/1/2015 at HPRCC using provisional data.

Regional Climate Center Generated 6/1/2015 at HPRCC using provisional data.

Regional Climate Centers

**Precipitation Percent**

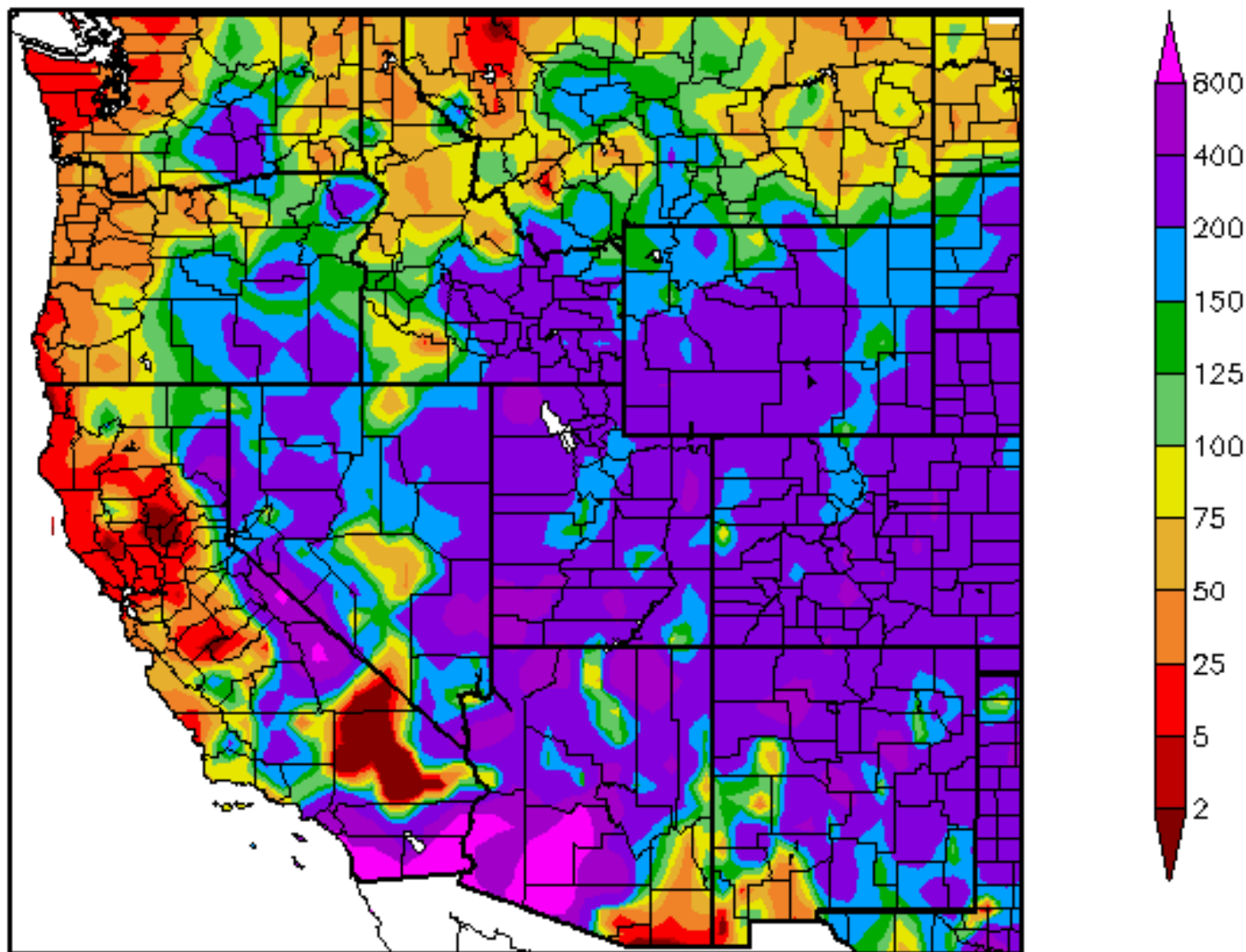
**Temperature Departure (F)**

# Percent of Normal Precipitation (%)

## 5/1/2015 – 5/31/2015

May 2015  
Precipitation  
Percent of  
Normal

01 May 2015  
Thru  
31 May 2015

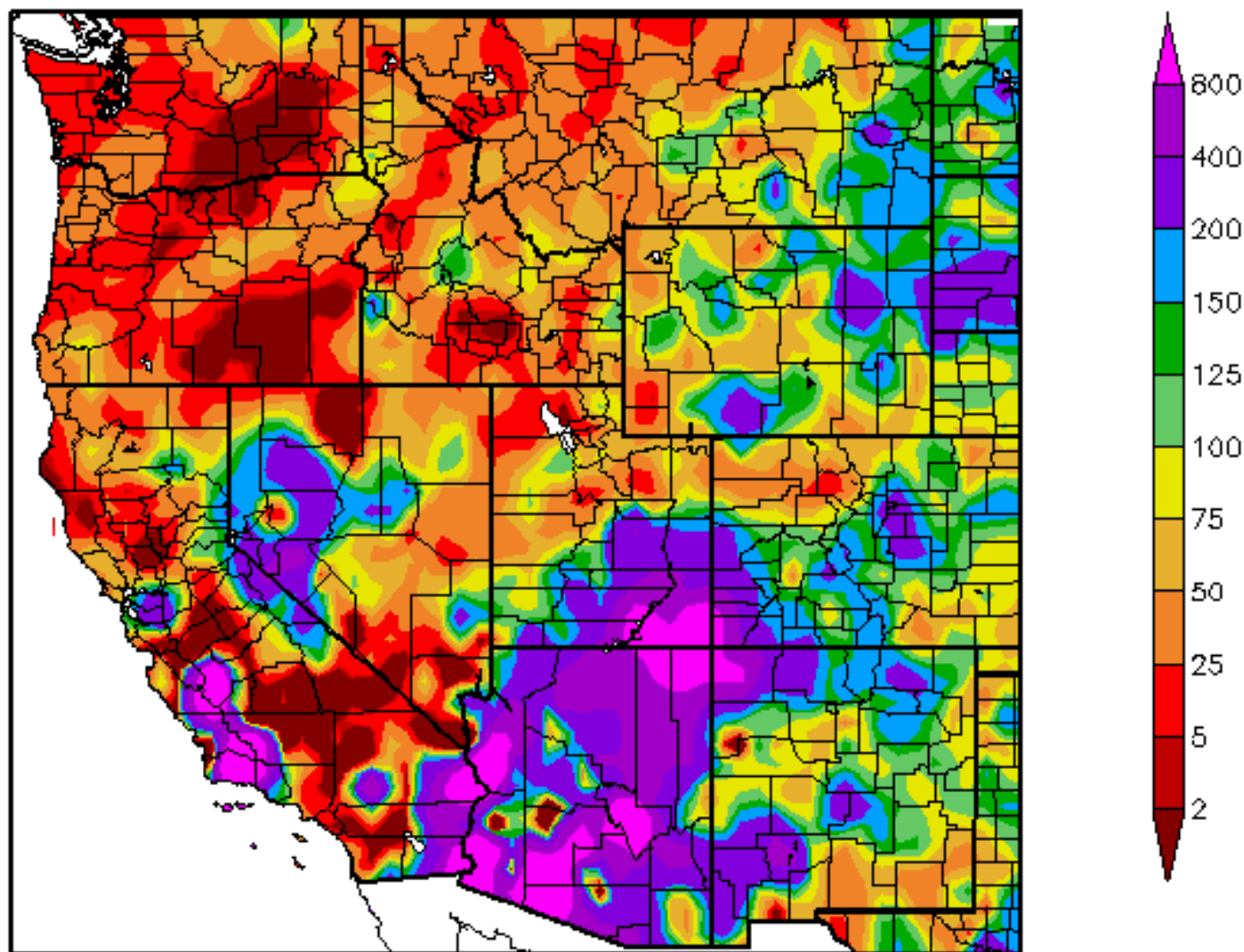


**June 2015  
Precipitation  
Percent of  
Normal**

# Percent of Normal Precipitation (%)

## 6/1/2015 – 6/30/2015

**01 June 2015  
Thru  
30 June 2015**

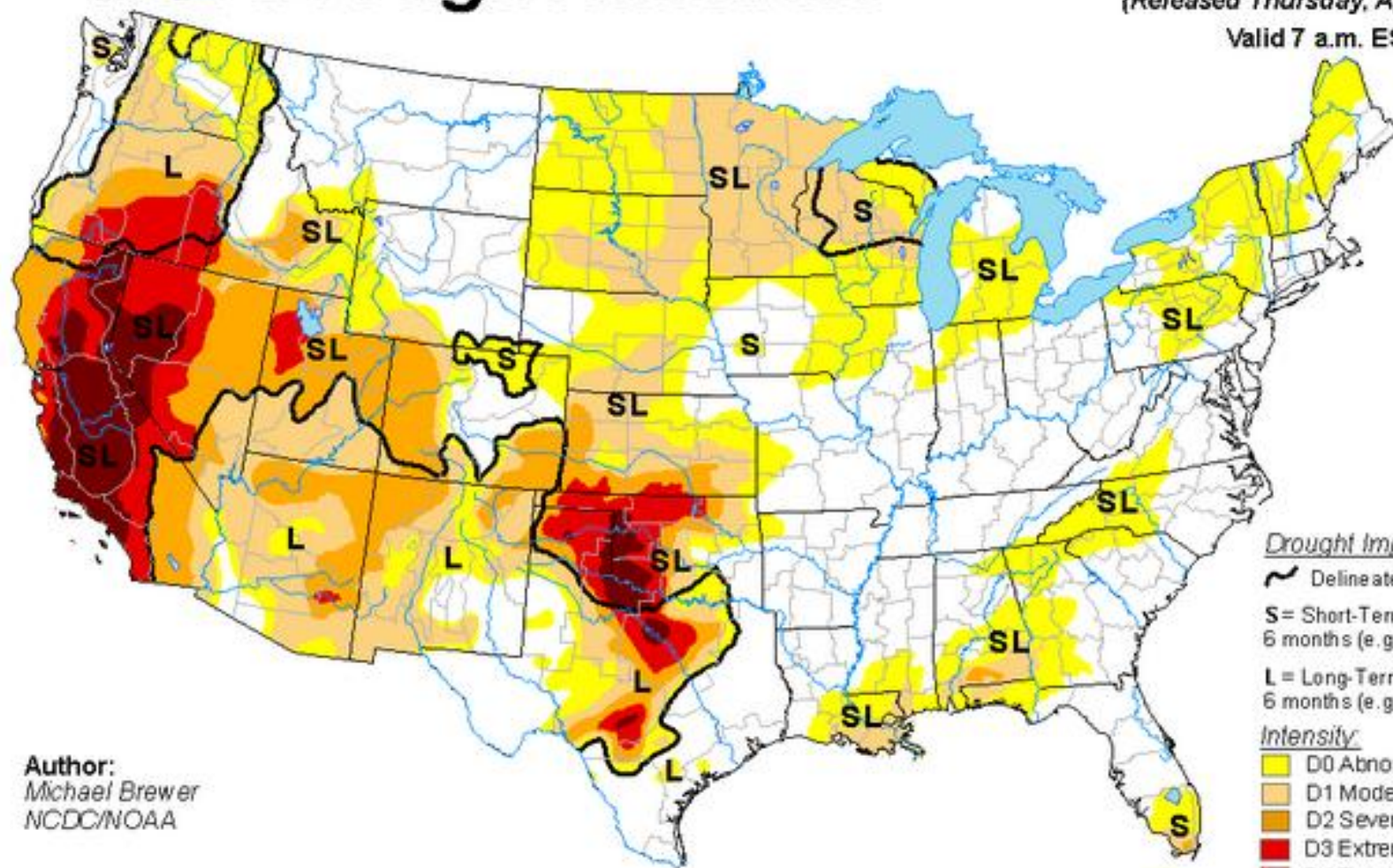


# U.S. Drought Monitor

April 7, 2015

(Released Thursday, Apr. 9, 2015)

Valid 7 a.m. EST



Author:  
Michael Brewer  
NCDC/NOAA

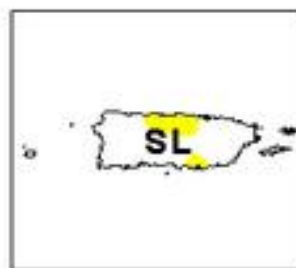
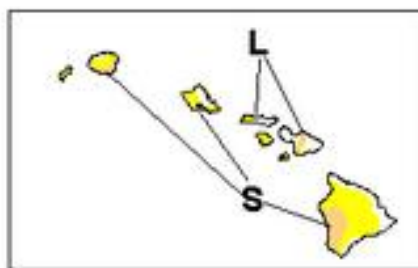
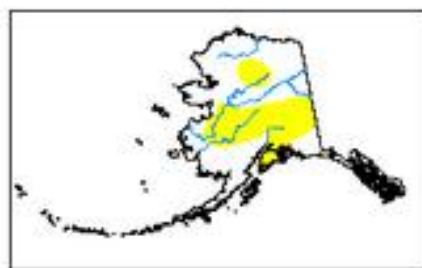
### Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

### Intensity:

- Yellow: D0 Abnormally Dry
- Light Orange: D1 Moderate Drought
- Orange: D2 Severe Drought
- Red: D3 Extreme Drought
- Dark Red: D4 Exceptional Drought

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



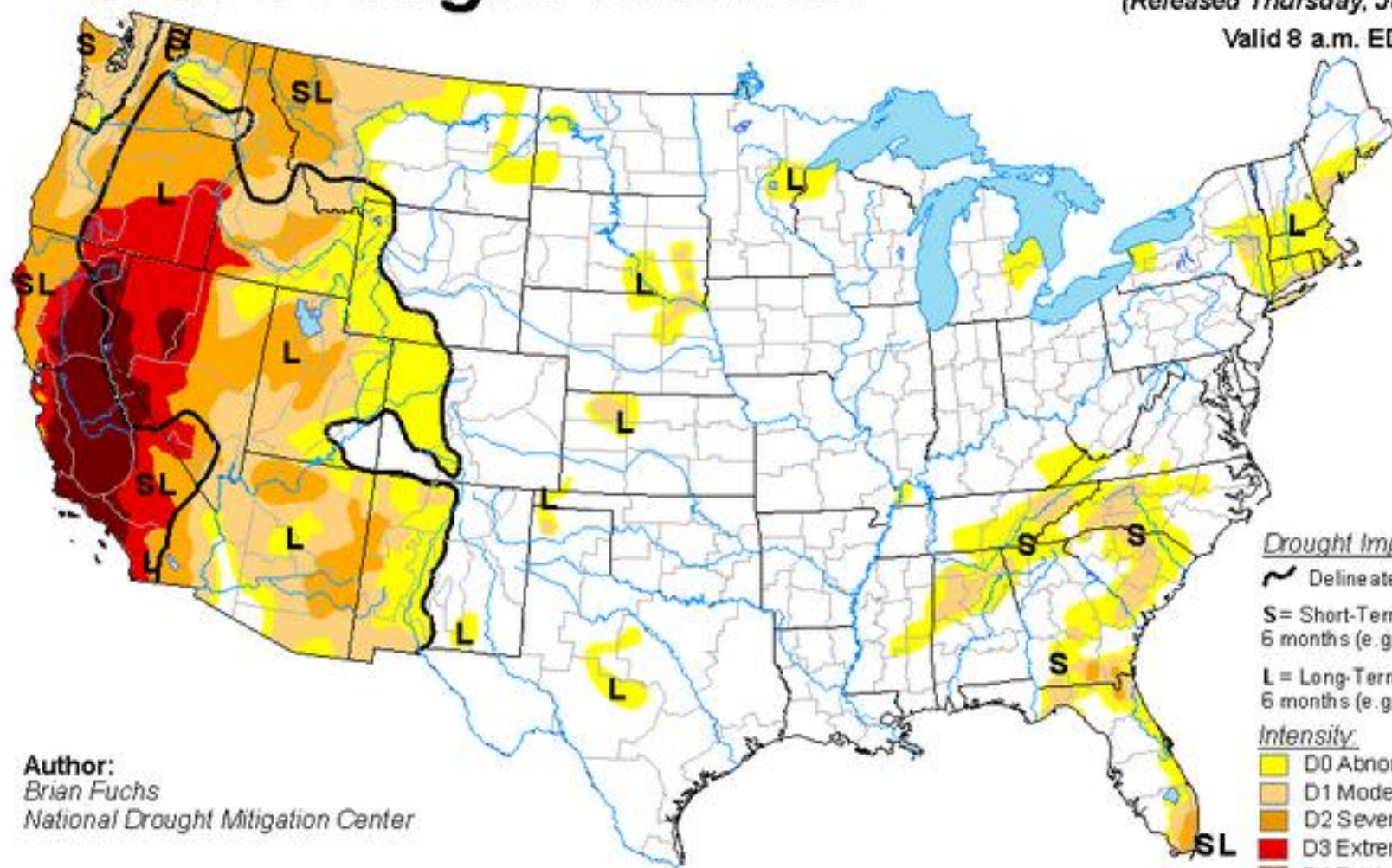
<http://droughtmonitor.unl.edu/>

# U.S. Drought Monitor

June 30, 2015

(Released Thursday, Jul. 2, 2015)

Valid 8 a.m. EDT



Author:  
Brian Fuchs  
National Drought Mitigation Center

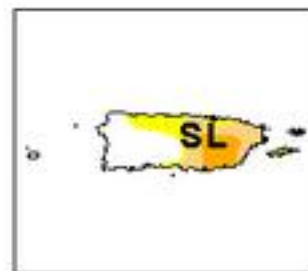
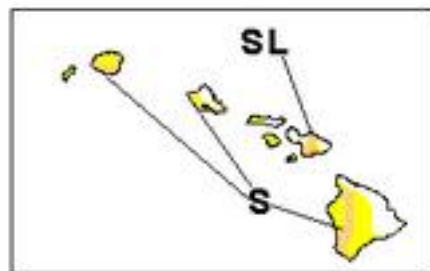
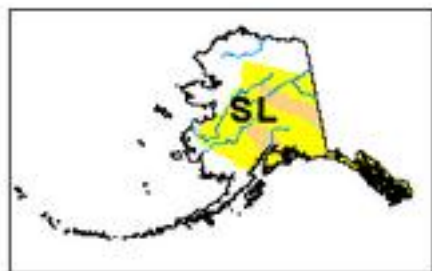
### Drought Impact Types

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### Intensity

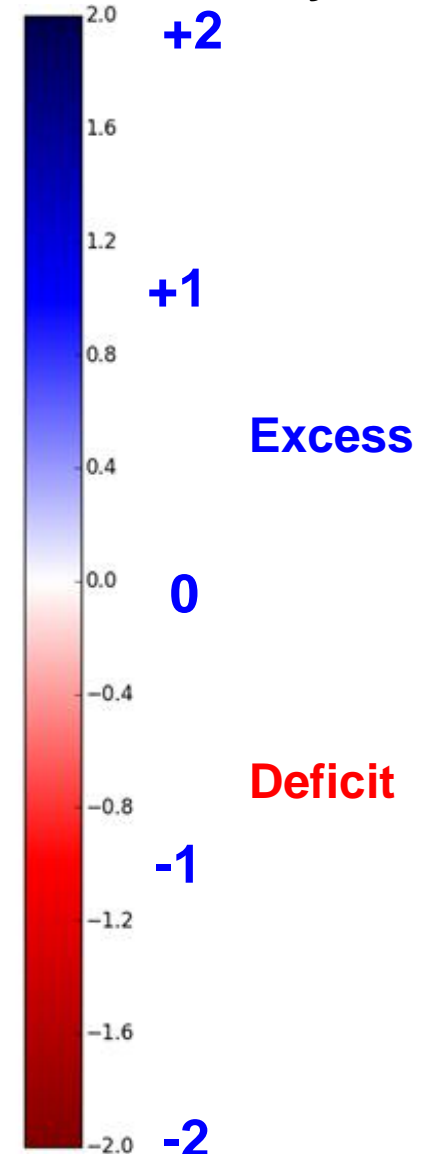
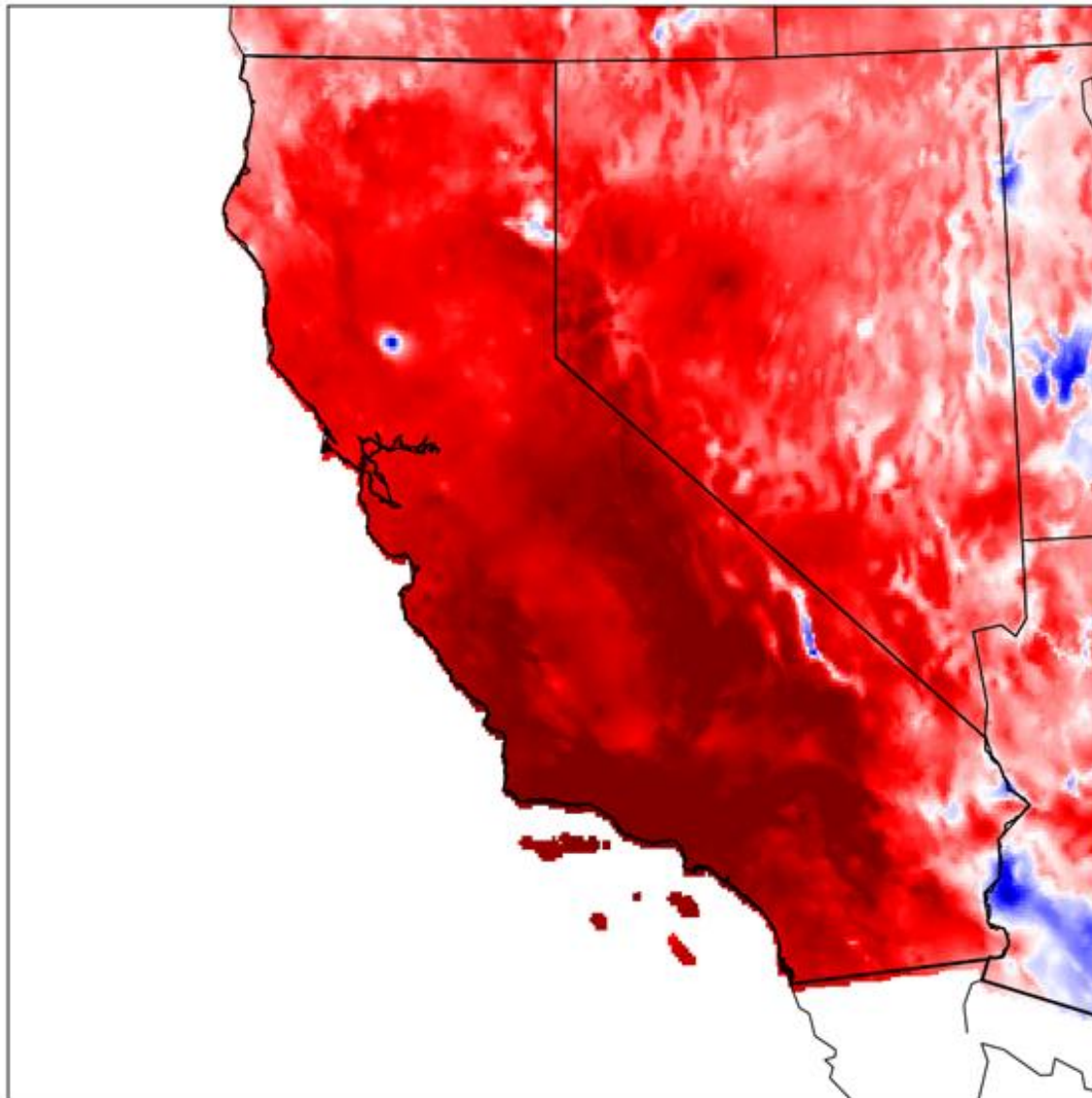
- Yellow: D0 Abnormally Dry
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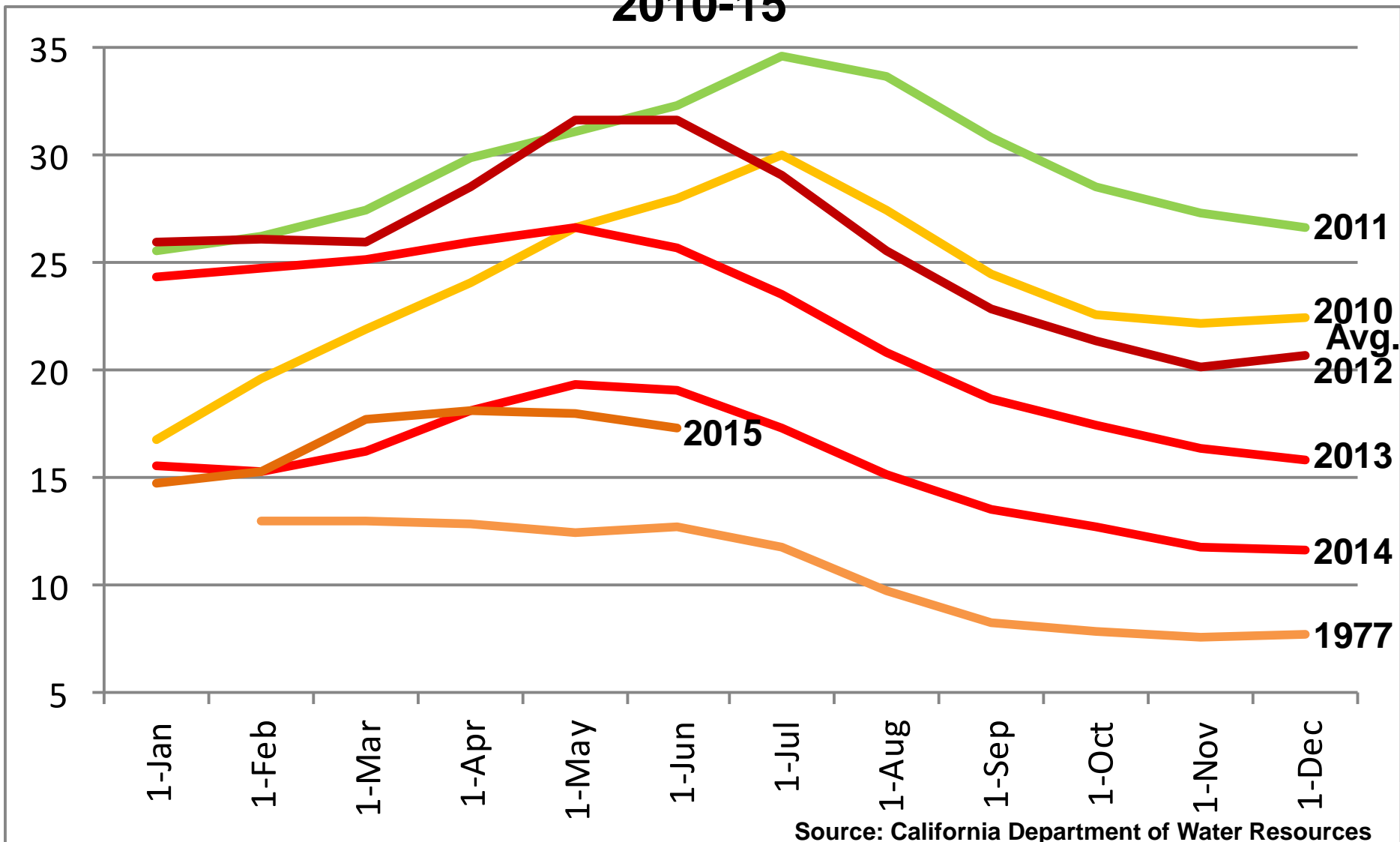


<http://droughtmonitor.unl.edu/>

**The Missing Years:  
Precipitation Deficits Over Four Winters 2011-12/14-15  
Expressed in Units of Average Annual Precipitation.  
Based on PRISM. Courtesy Paul Iniguez, NWS Phoenix.**



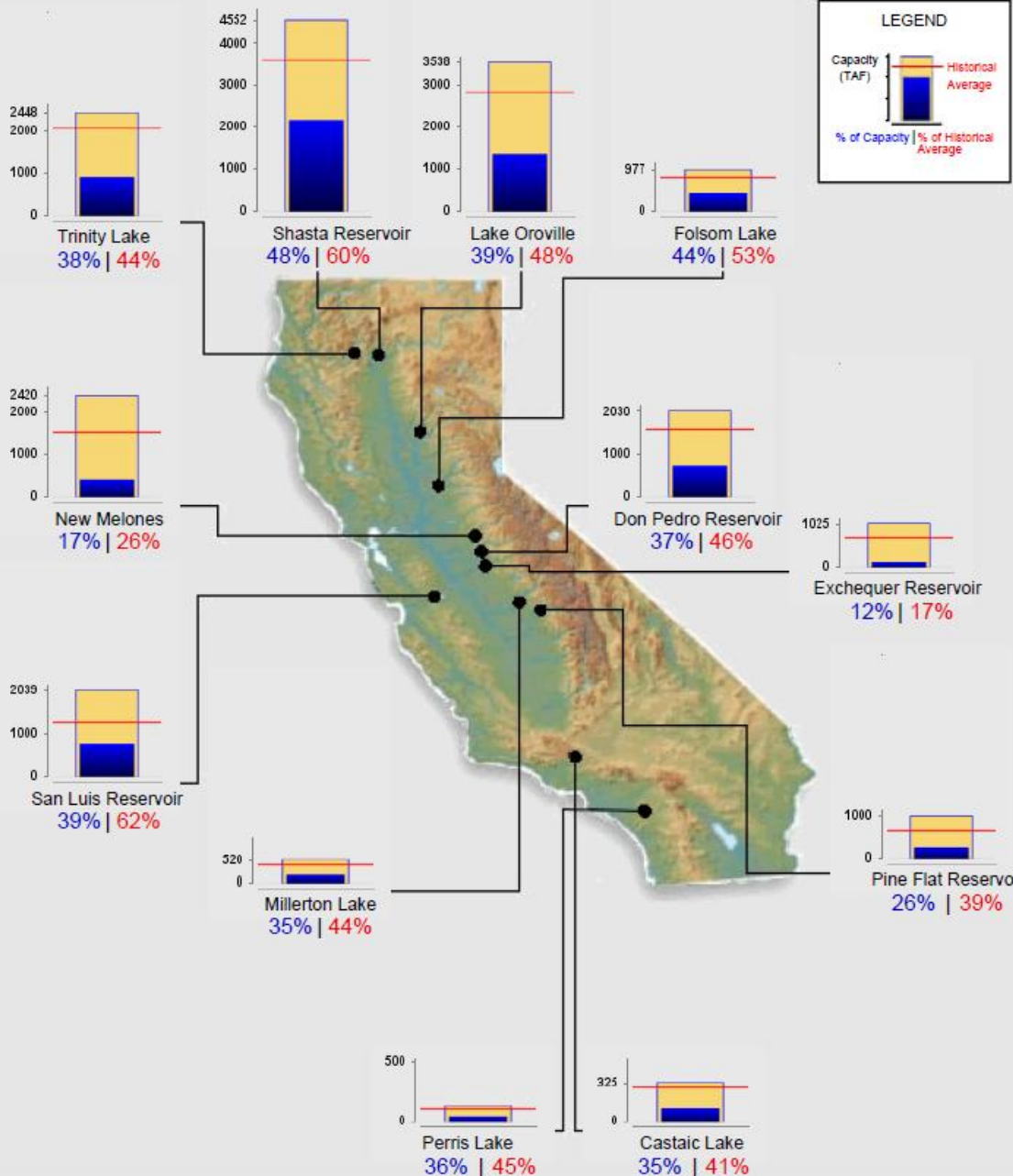
# California Reservoir Storage, Million Acre-Feet, 1977 and 2010-15



Source: California Department of Water Resources

Note: One acre-foot is equal to 325,851 gallons, or the amount of water it takes to cover one acre to a depth of one foot.

# CURRENT RESERVOIR CONDITIONS



**LEGEND**

Capacity (TAF) | Historical Average

% of Capacity | % of Historical Average





Winery in Napa Valley

# Welcome

The Department of Water Resources (DWR) is responsible for managing and protecting California's water. DWR works with other agencies to benefit the state's people, and to protect, restore and enhance the natural and human environments.

## Spotlight

### Forum on Water Bond



Office of Governor  
**Edmund G. Brown Jr.**

Natural Resources Agency  
**John Laird**

Department of Water Resources  
**Mark Cowin**

[Top DWR Sites](#)

[Drought](#)

[California WaterFix](#)

[CA Water Plan](#)

[Public Notices](#)



**Green Bridge  
Lake Oroville  
Feather River**

**2011 July 20**



**Enterprise Bridge  
Lake Oroville  
Feather River**

**2014 August 20**



**Bidwell Marina  
Lake Oroville  
Feather River**

**2011 July 20**

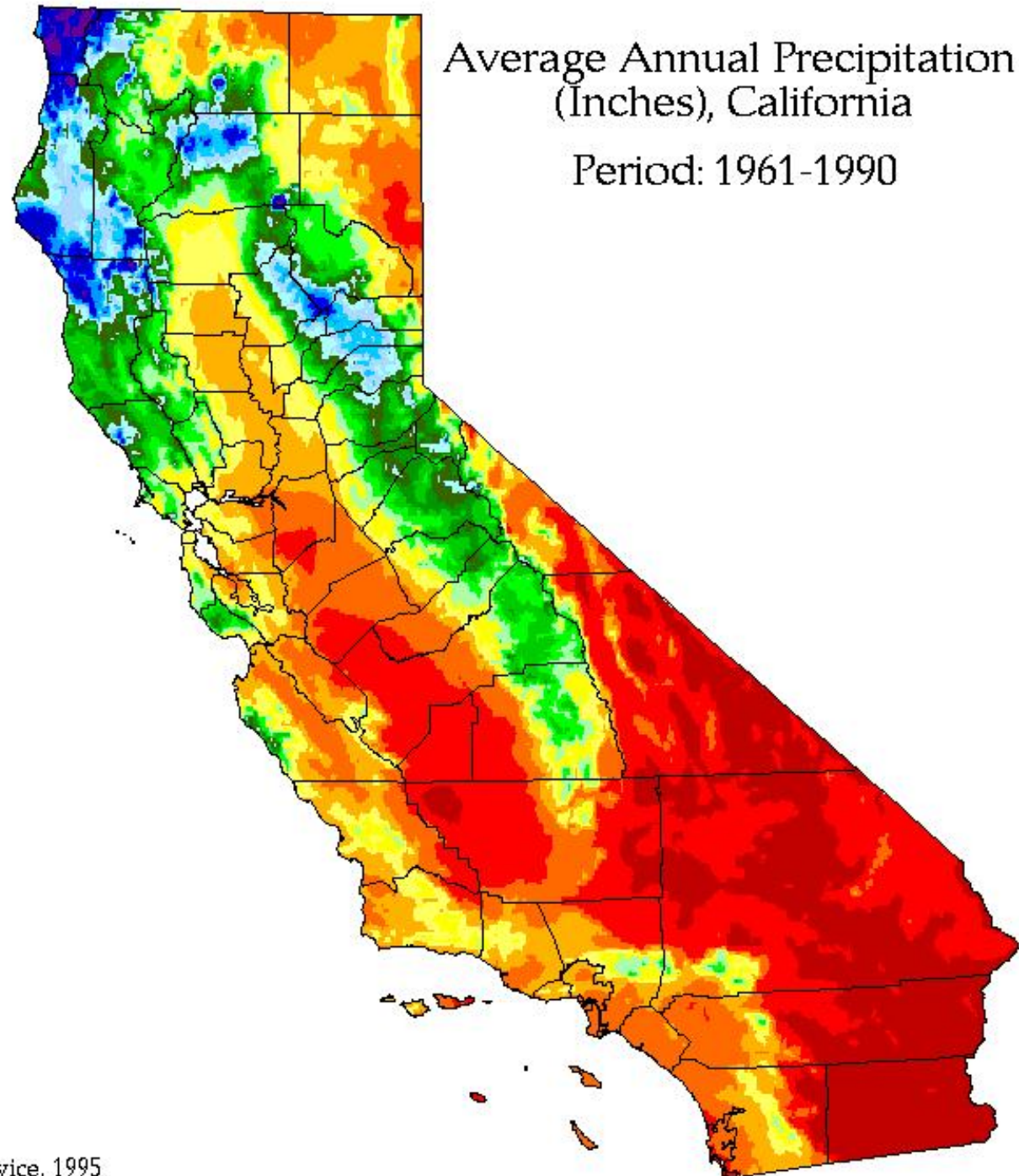
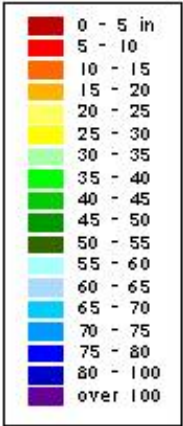


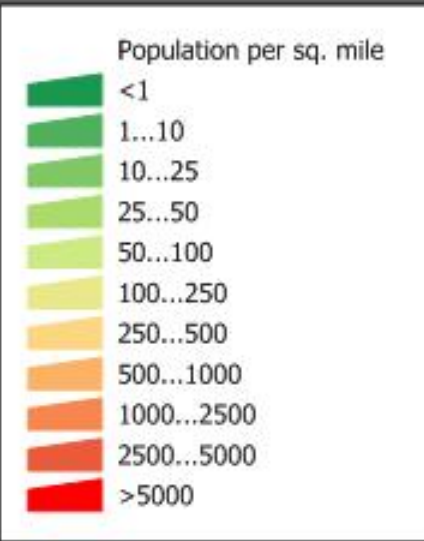
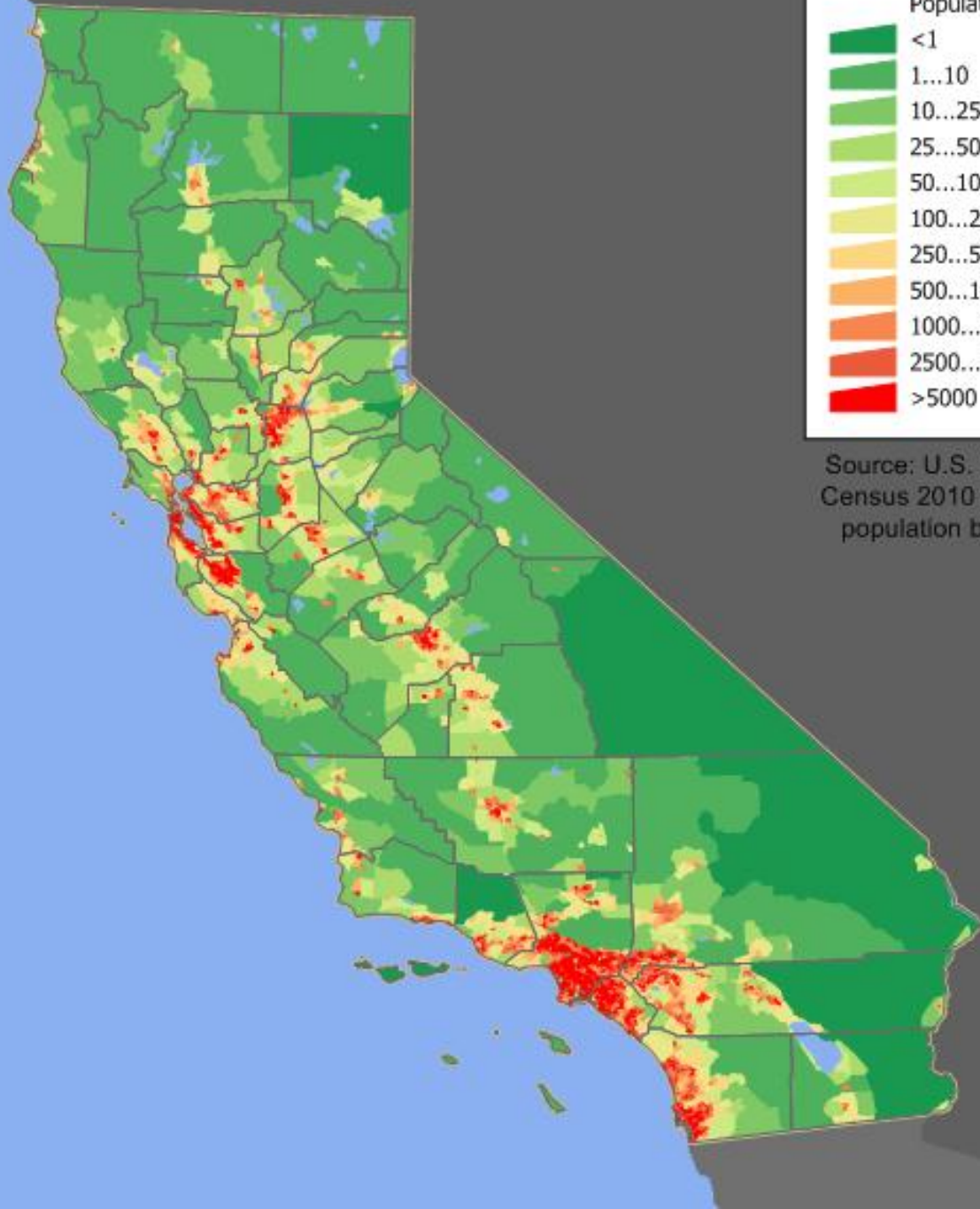
**Enterprise Bridge  
Lake Oroville  
Feather River**

**2014 August 19**

# Average Annual Precipitation (Inches), California

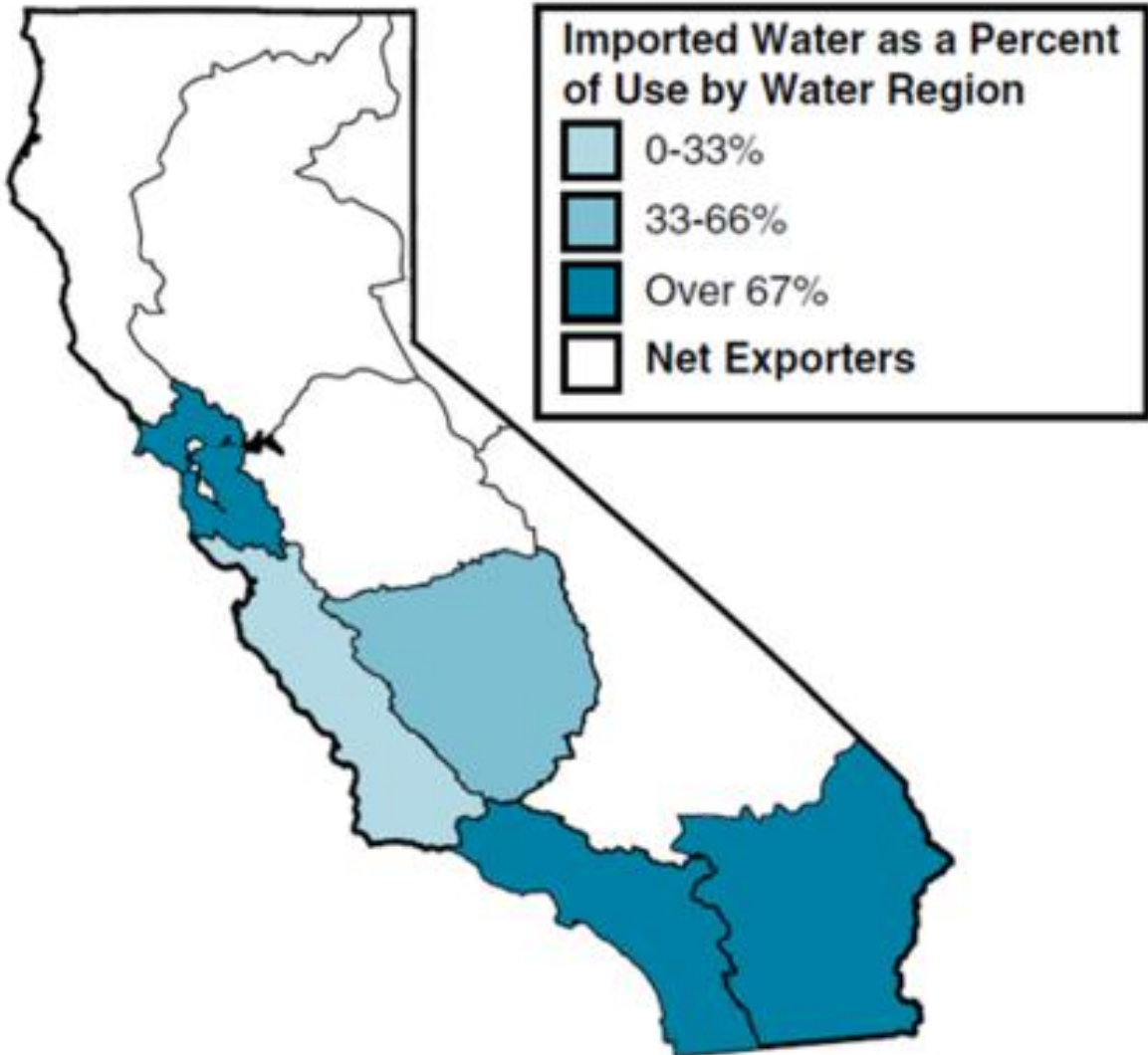
Period: 1961-1990





Source: U.S. Census Bureau  
Census 2010 Summary File 1  
population by census tract

# Population Centers Rely Heavily on Imported Water



# Water Storage & Distribution in California



What would a Drought Monitor map look like that incorporated this complexity ???

# California Water Action Plan

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**January 2014**

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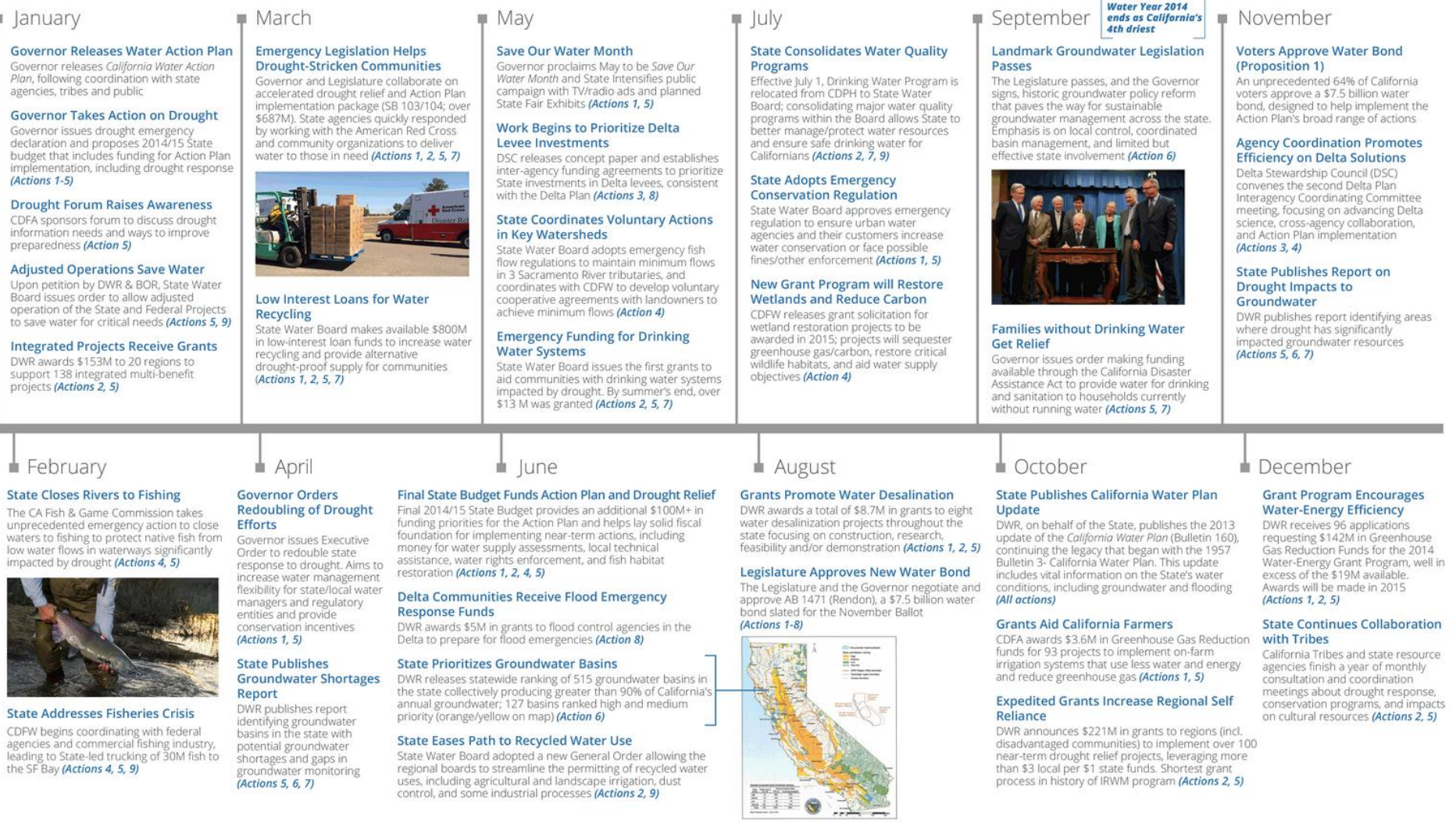




# California Water Action Plan. Charting Progress. 2014 Summary.

Implementing the California Water Action Plan

Figure 1: 2014 Highlights



# Sierra Region Precipitation Oct-Sep

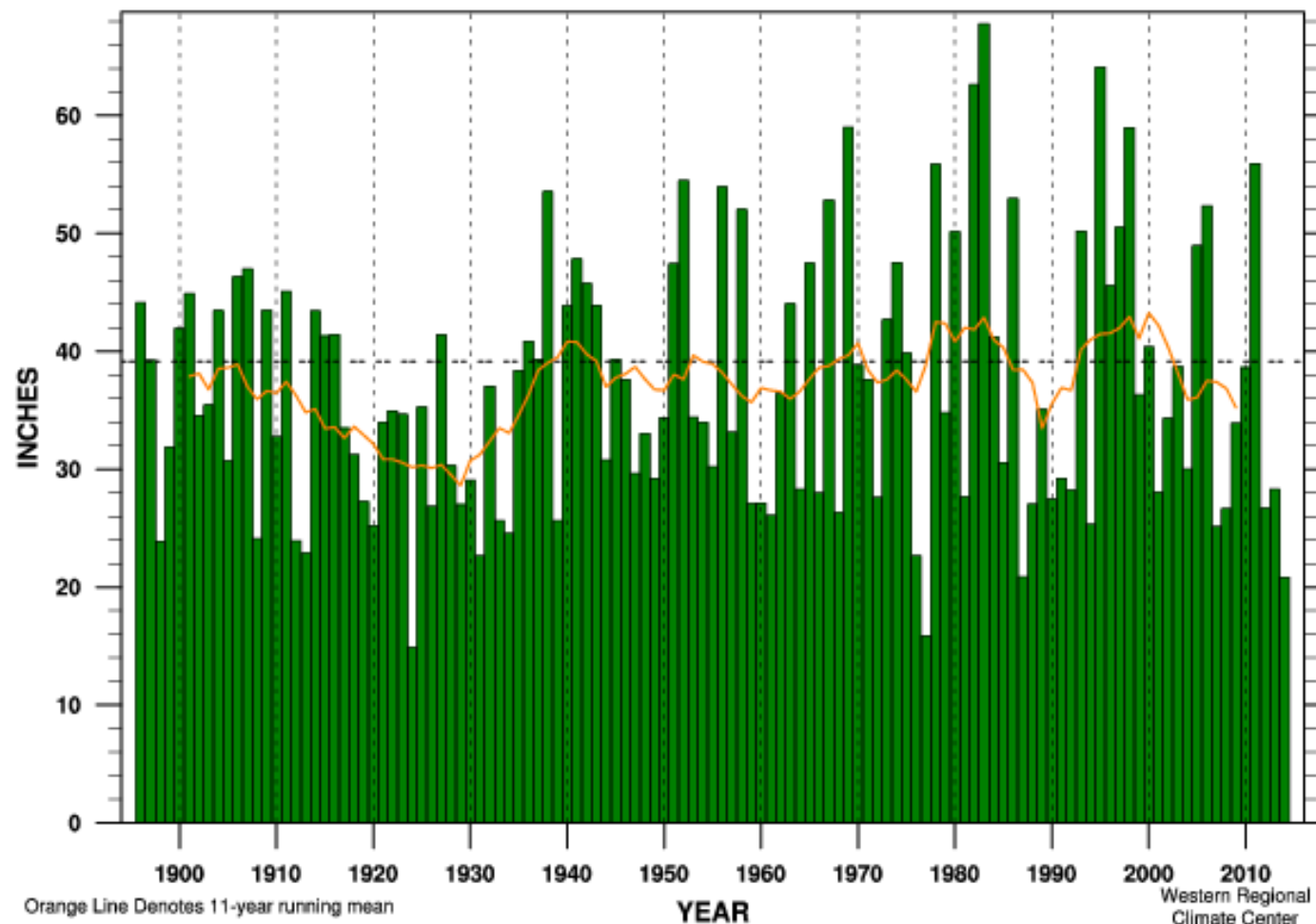
## Sierra Nevada Precipitation

Water Year

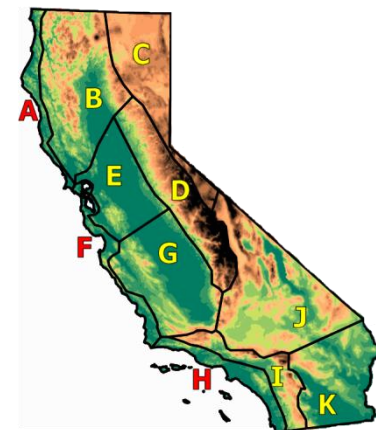
Oct-Sep

1895-96  
thru  
2013-14

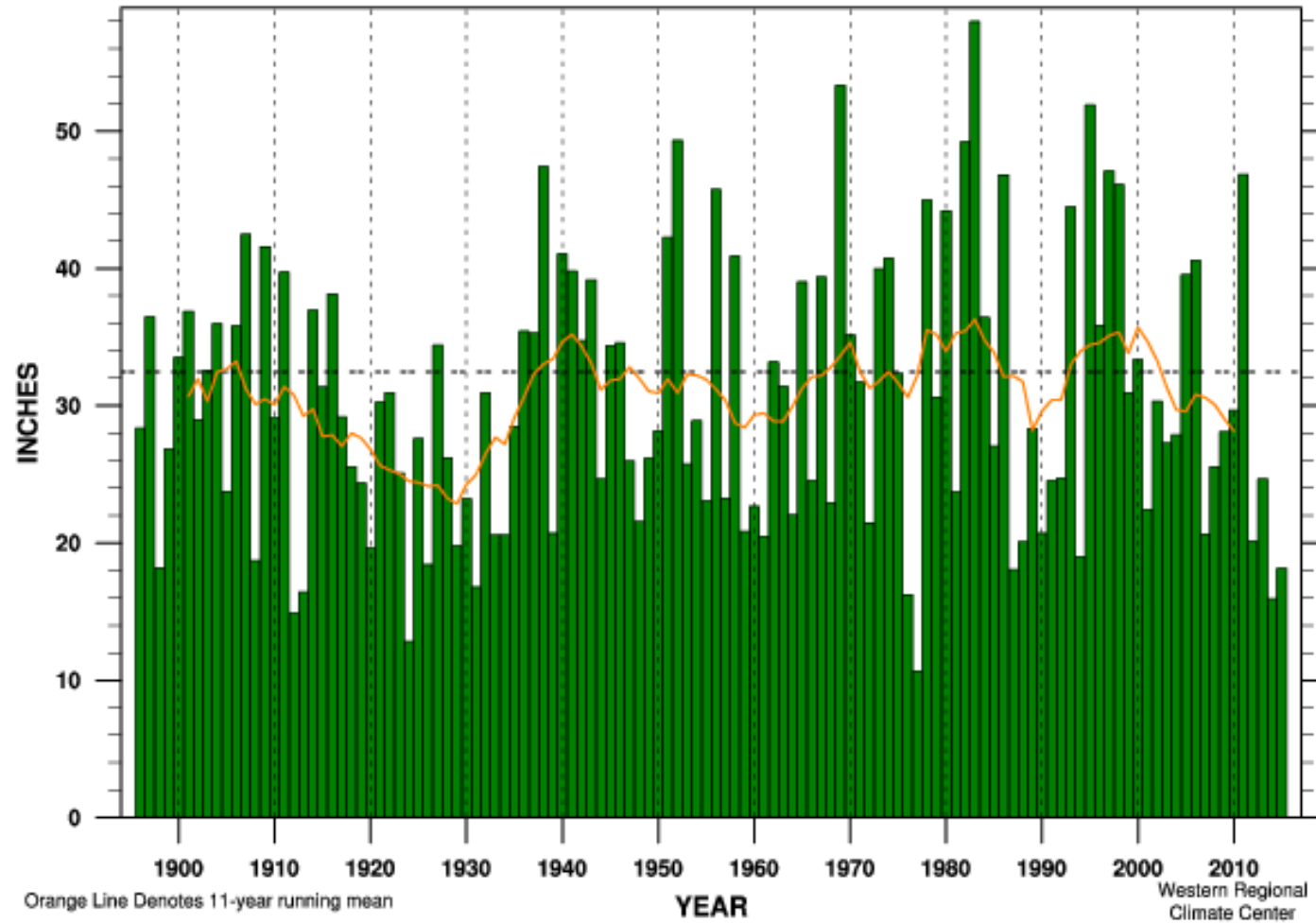
California  
Climate Tracker



Linear Trend 1895-present	+ 3.32 ± 5.69 in.	(+ 8 ± 14%) per 100 yr		
Linear Trend 1949-present	- 3.85 ± 16.39 in.	(- 9 ± 41%) per 100 yr		
Linear Trend 1975-present	-11.68 ± 39.68 in.	(- 29 ± 101%) per 100 yr		
Wettest Year	67.79 in. ( 173%)	in 1983	MEAN	39.15 in.
Driest Year	14.89 in. ( 38%)	in 1924	STDEV	12.33 in.
Oct-Sep	2014	20.81 in. ( 53%)	RANK	3 of 119



# Sierra Region Precipitation Oct-Mar



Sierra Nevada  
Precipitation

Snow Season

Oct-Mar

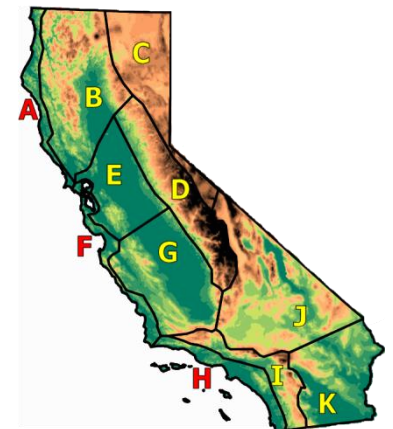
1895-96  
thru  
2014-15

California  
Climate Tracker

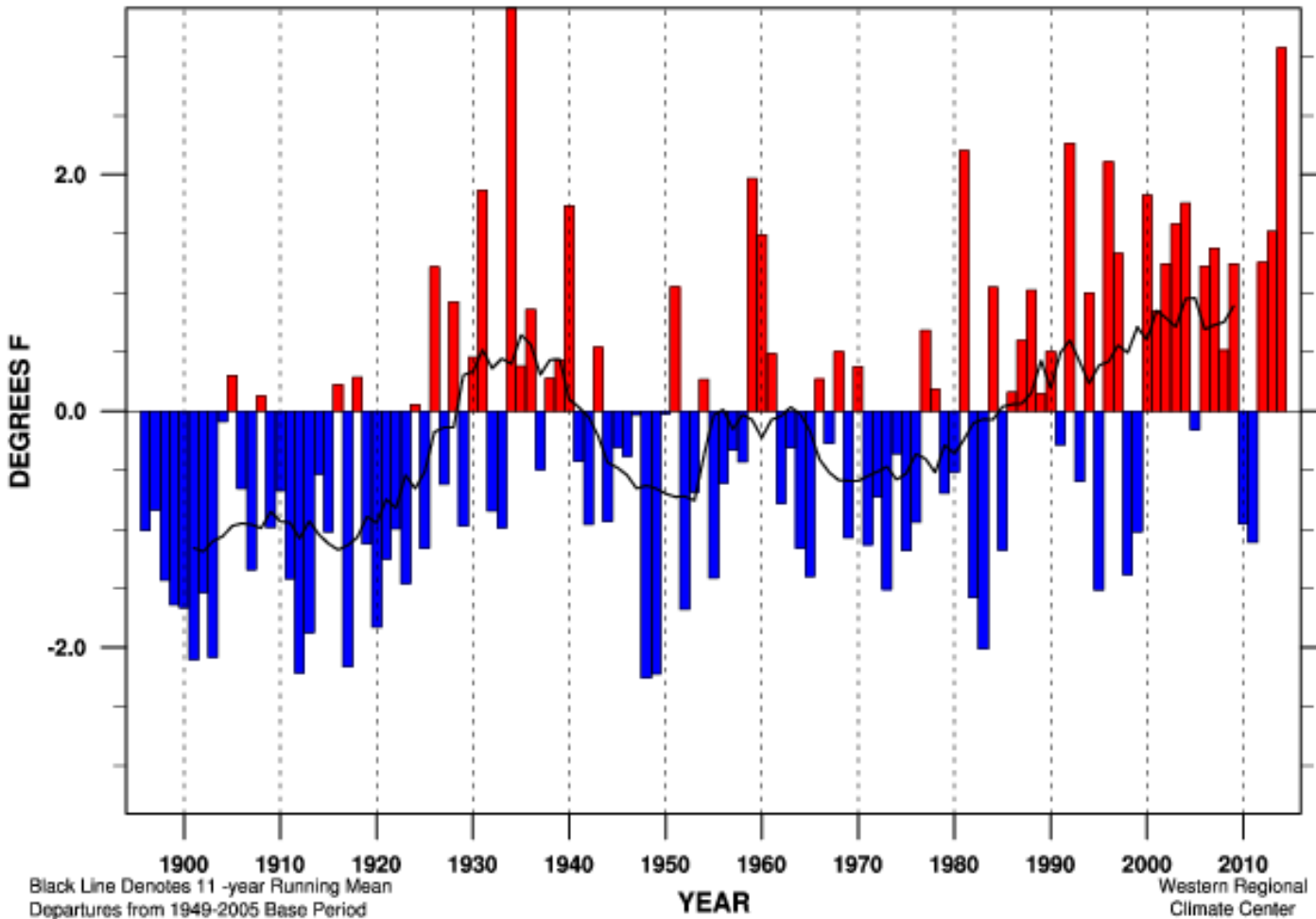
Orange Line Denotes 11-year running mean

Western Regional  
Climate Center

Linear Trend 1895-present	+ 2.23 ± 5.10 in.	(+ 6 ± 15%) per 100 yr		
Linear Trend 1949-present	- 5.05 ± 14.08 in.	(- 15 ± 43%) per 100 yr		
Linear Trend 1975-present	-15.13 ± 32.55 in.	(- 46 ± 100%) per 100 yr		
Wettest Year	57.99 in. ( 178%)	in 1983	MEAN	32.48 in.
Driest Year	10.69 in. ( 32%)	in 1977	STDEV	10.87 in.
Oct-Mar	2015	18.14 in. ( 55%)	RANK	9 of 120



# Sierra Region Mean Temperature Departure Oct-Sep



Black Line Denotes 11-year Running Mean  
Departures from 1949-2005 Base Period

Western Regional  
Climate Center

Linear Trend 1895-present	+ 1.50 ± 0.58 °F/100yr	
Linear Trend 1949-present	+ 2.33 ± 1.47 °F/100yr	
Linear Trend 1975-present	+ 3.82 ± 3.45 °F/100yr	
Warmest Year	52.4 °F (+ 3.4 °F) in 1934	MEAN 49.0 °F
Coldest Year	46.8 °F (- 2.3 °F) in 1948	STDEV 1.15 °F
Oct-Sep 2014	52.1 °F (+ 3.1 °F)	RANK 118 of 119

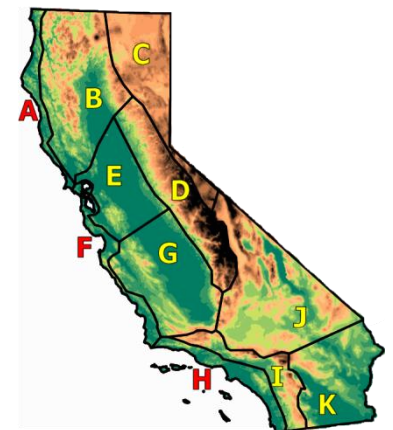
Sierra Nevada  
Temperature

Water Year

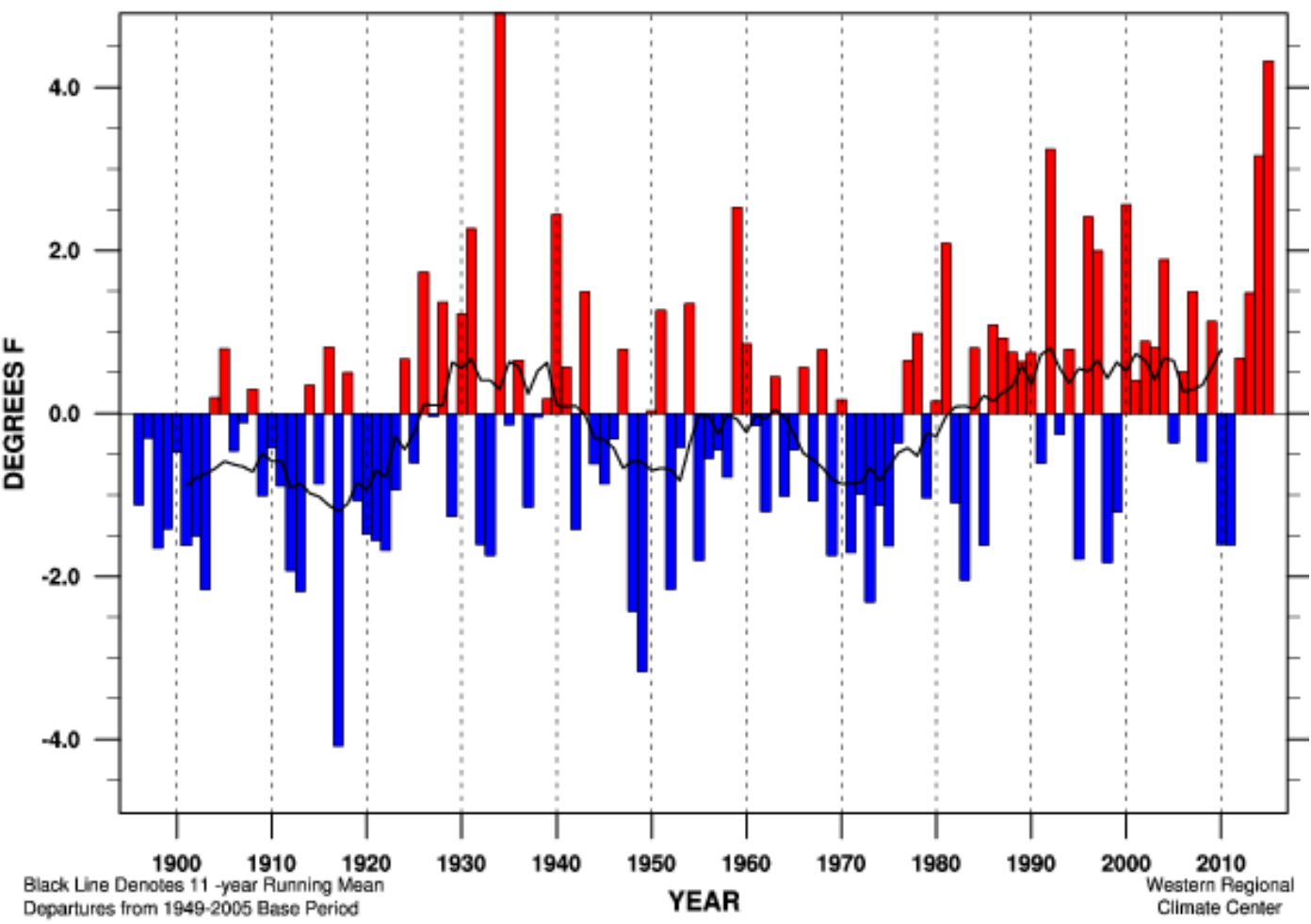
Oct-Sep

1895-96  
thru  
2013-14

California  
Climate Tracker



# Sierra Region Mean Temperature Departure Oct-May



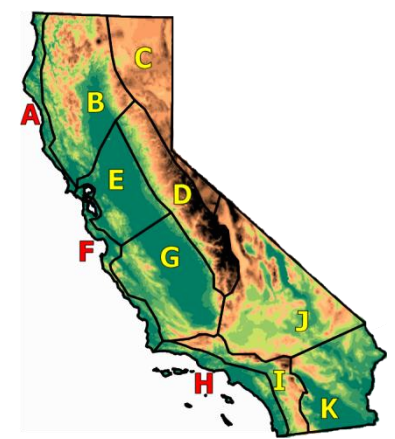
**Sierra Nevada  
Temperature**

**Oct-May**

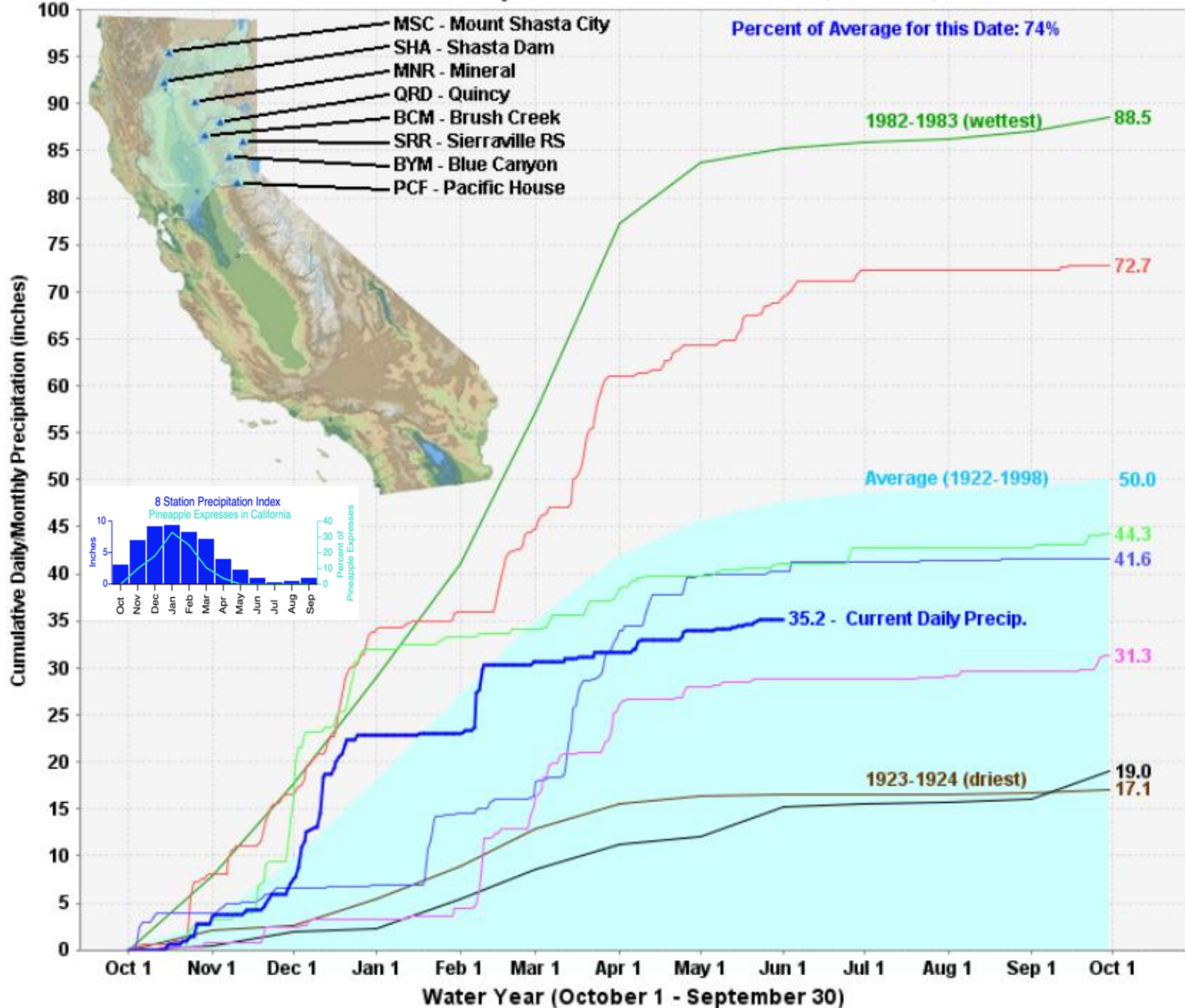
**1895-96  
thru  
2014-15**

**California  
Climate Tracker**

Linear Trend 1895-present	+ 1.27 ± 0.75 °F/100yr		
Linear Trend 1949-present	+ 2.43 ± 1.81 °F/100yr		
Linear Trend 1975-present	+ 3.10 ± 4.14 °F/100yr		
Warmest Year	47.0 °F (+ 4.9 °F) in 1934	MEAN	42.1 °F
Coldest Year	38.0 °F (- 4.1 °F) in 1917	STDEV	1.35 °F
Oct-May	2015	46.4 °F (+ 4.3 °F)	RANK 119 of 120



# Northern Sierra Precipitation: 8-Station Index, June 1, 2015



**8-Station Index Precipitation**

**Wettest (1982-83)**

**2010-11**

**2012-13**

**2011-12**

**2014-15**

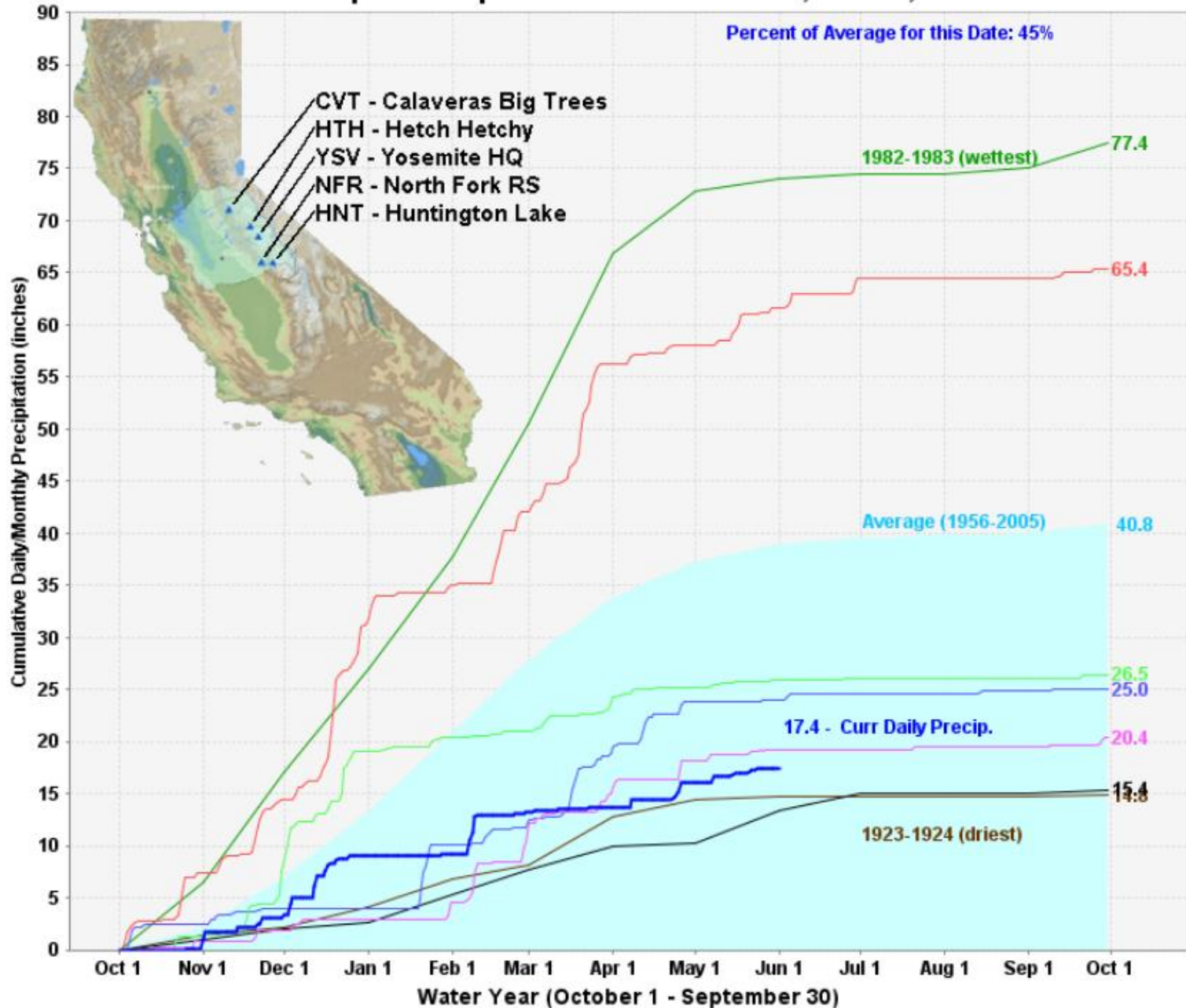
**2013-14**

**Two driest years, (1976-77, 1923-24)**

**CA - DWR**



# San Joaquin Precipitation: 5-Station Index, June 1, 2015



**5-Station Index  
Precipitation**

**Wettest (1982-83)**

**2010-11**

**2012-13**

**2011-12**

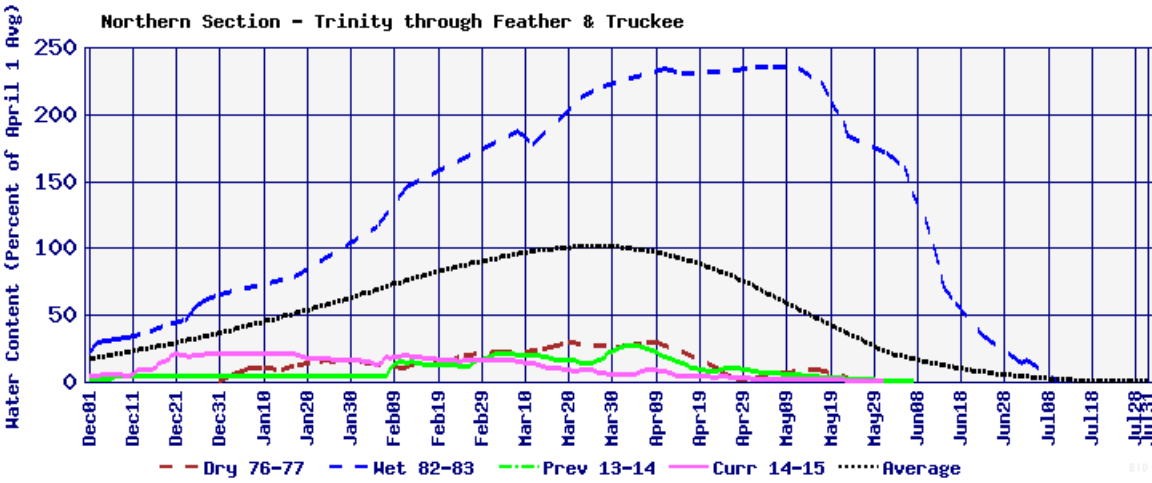
**2013-14**

**2014-15**

**Two driest years,  
(1976-77, 1923-24)**

**CA - DWR**

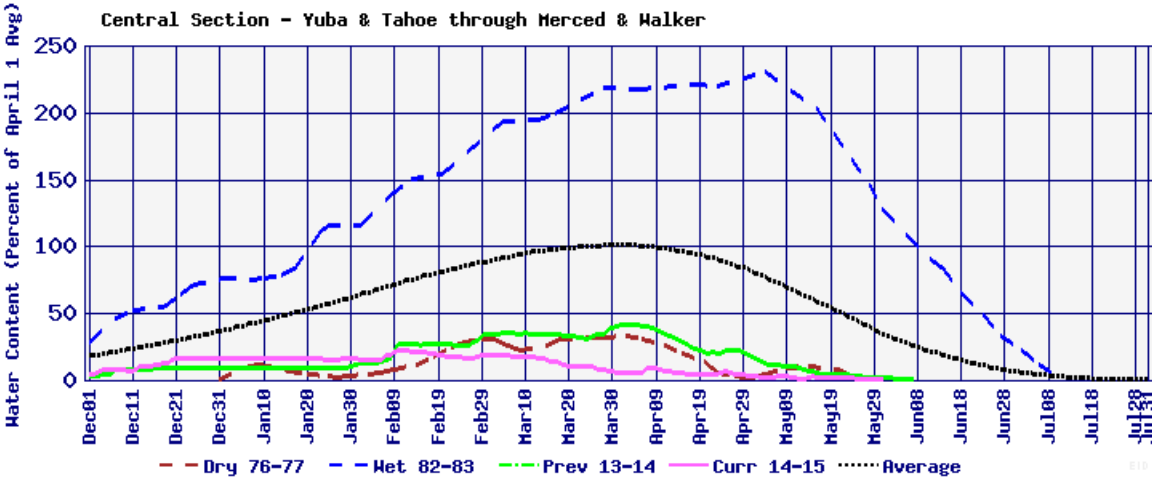
Average (1956-2005)	1923-1924 (driest)	1976-1977 (2nd Driest)	1982-1983 (wettest)	2010-2011	2011-2012
2012-2013	2013-2014	2014-2015 (current)			



**Winter Season  
Snow Water  
Content**

**Northern  
Sierra**

**1982-83 wettest**



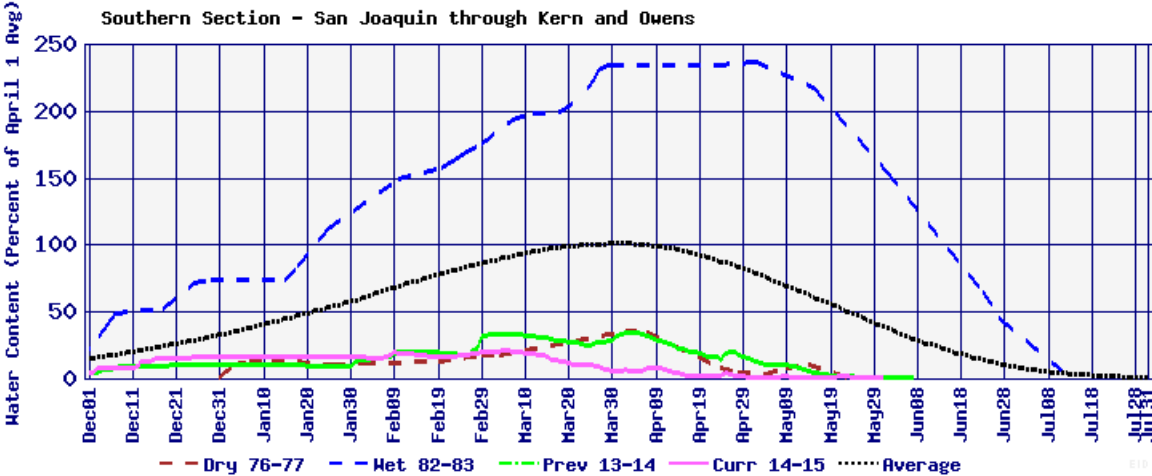
**Average**

**2013-14**

**2014-15**

**Central  
Sierra**

**1976-77 driest**

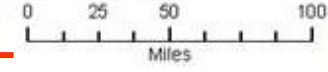
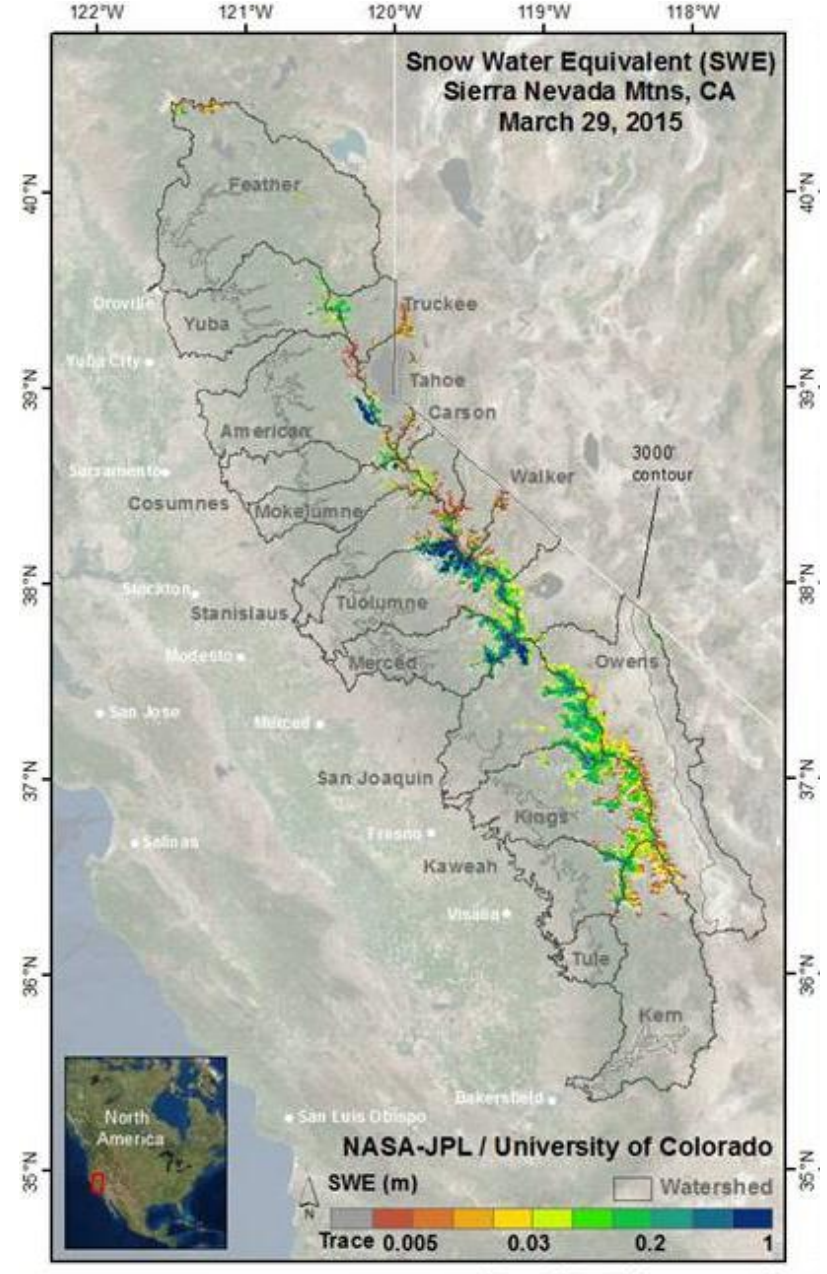
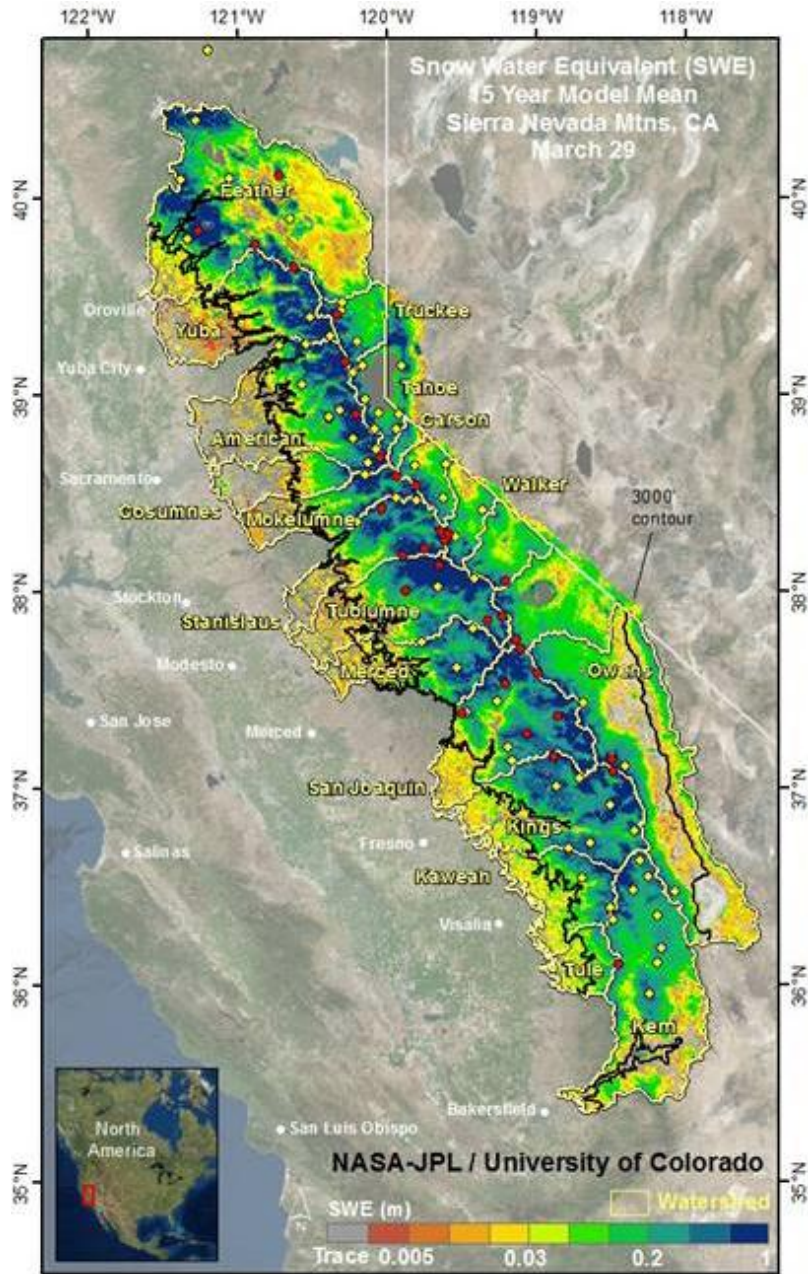


**Thru 01 Jun 2015  
Cal DWR**

**Southern  
Sierra**



# 15-Year Mean Sierra Snow Water Equivalent 2015 March 29



Noah Molotch - NASA/JPL

# The Great Snow Drought of 2014-15

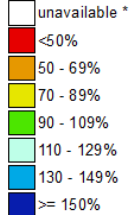
## Precipitation

## Snowpack

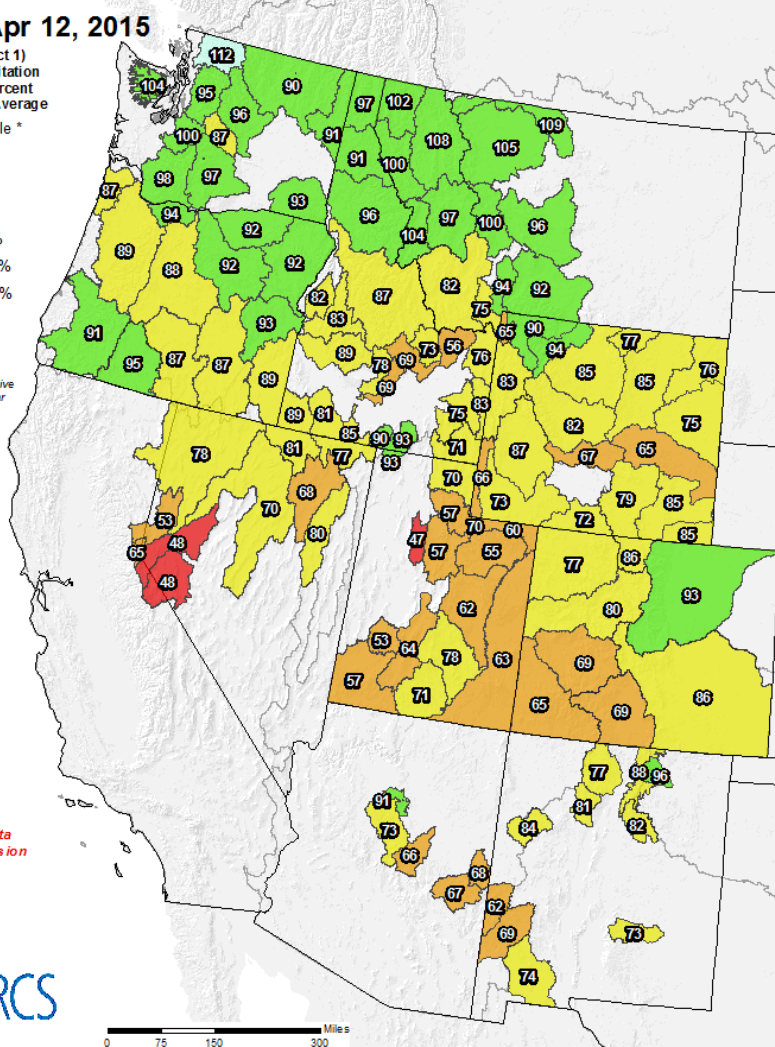
Westwide SNOTEL Water Year (Oct 1) to Date Precipitation % of Normal

Apr 12, 2015

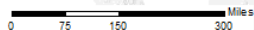
Water Year (Oct 1) to Date Precipitation Basin-wide Percent of 1981-2010 Average



\* Data unavailable at time of posting or measurement is not representative at this time of year



Provisional data subject to revision



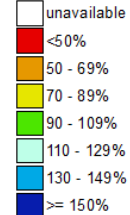
The water year to date precipitation percent of normal represents the accumulated precipitation found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

Prepared by:  
USDA/NRCS National Water and Climate Center  
Portland, Oregon  
<http://www.wcc.nrcs.usda.gov>

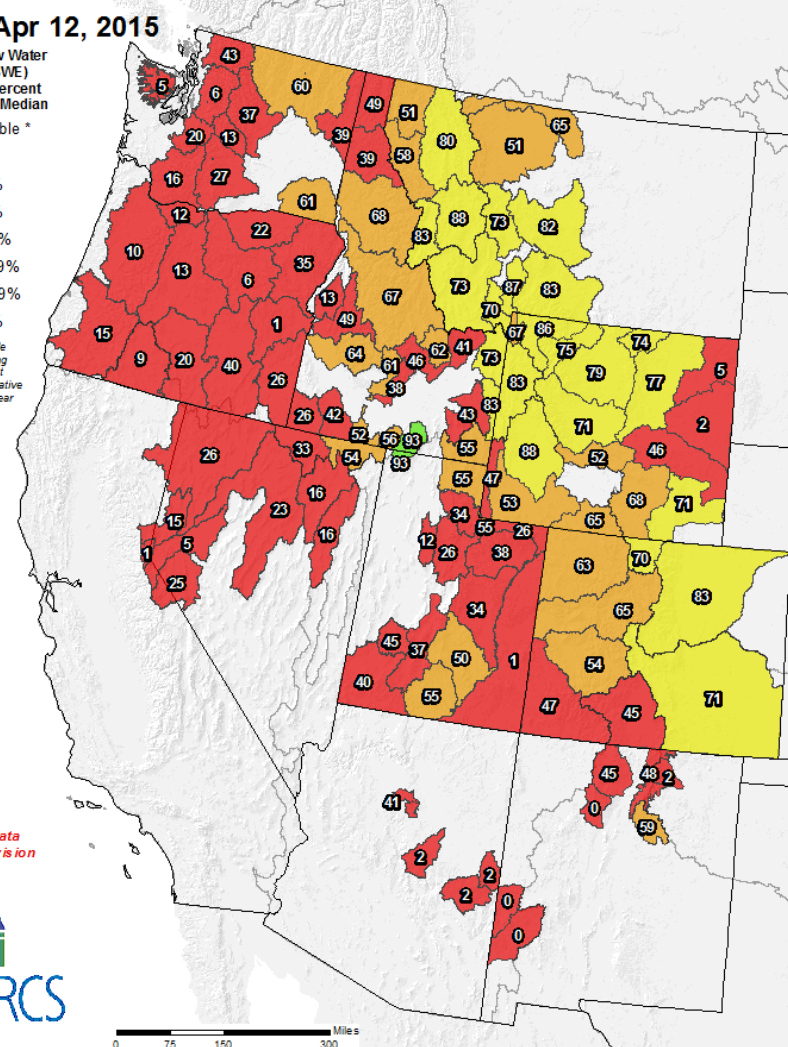
Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Apr 12, 2015

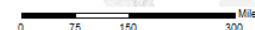
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1981-2010 Median



\* Data unavailable at time of posting or measurement is not representative at this time of year



Provisional data subject to revision

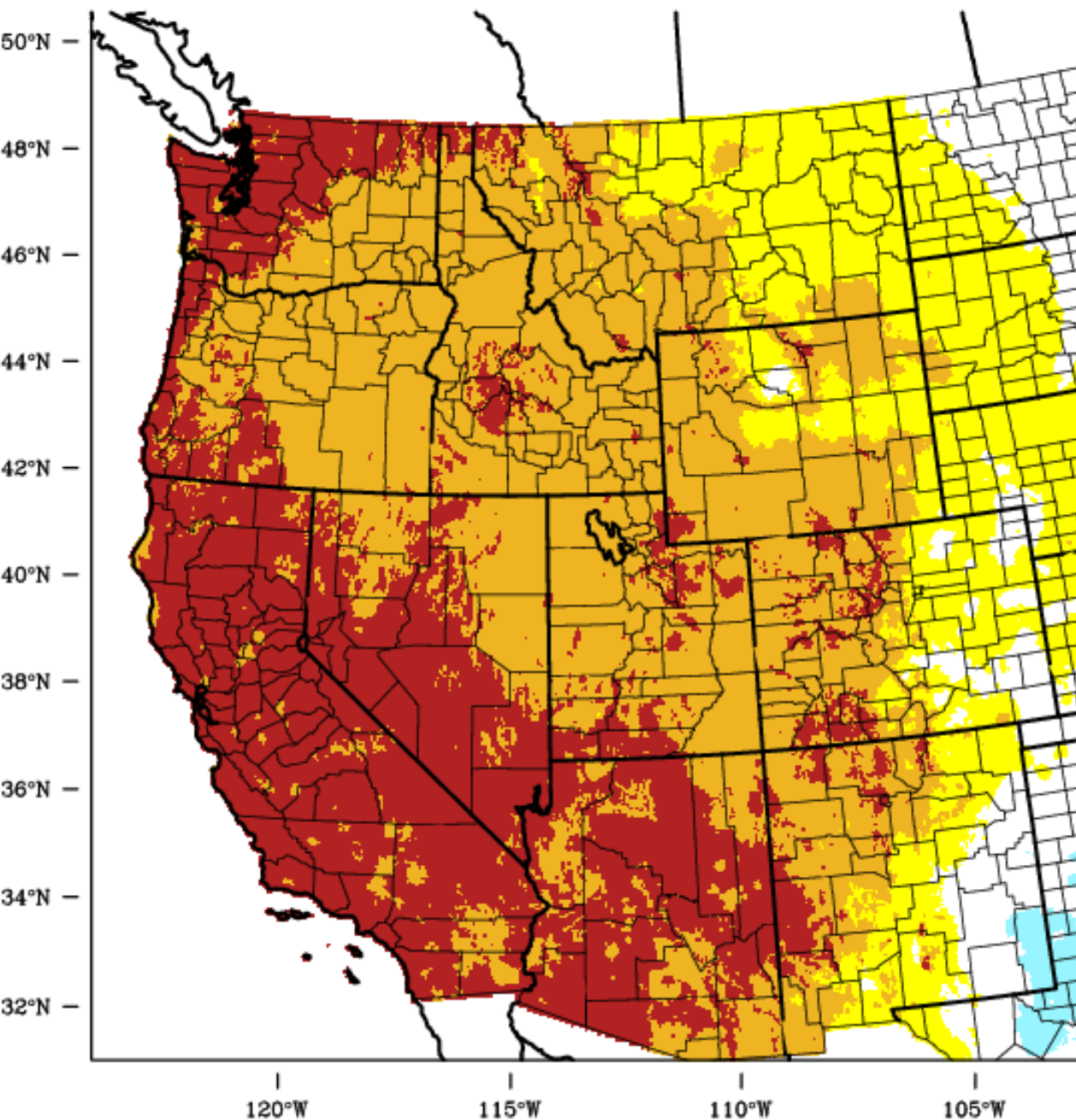


The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

Prepared by:  
USDA/NRCS National Water and Climate Center  
Portland, Oregon  
<http://www.wcc.nrcs.usda.gov>

# Western United States - Mean Temperature

## October-March 2015 Percentile



**Western US  
Temperature  
Percentiles**

**Water Year  
To Date**

**Oct 2014  
thru  
Mar 2015**

**Reference  
Period  
120 Years  
1895-2015**

**WestWide  
Drought  
Tracker**

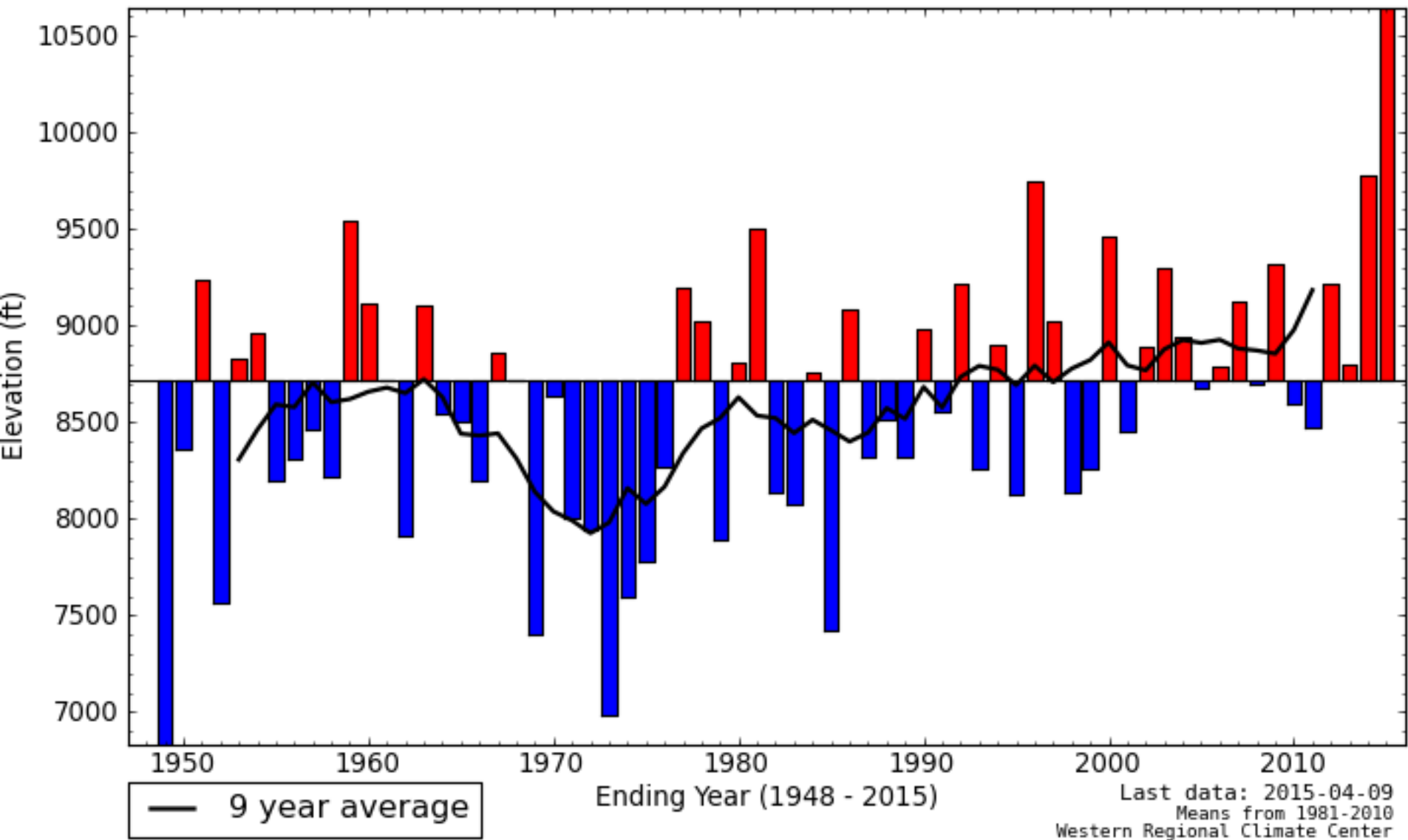
**Updated  
Monthly**

**WRCC**

**Rankings (1895-2010)**

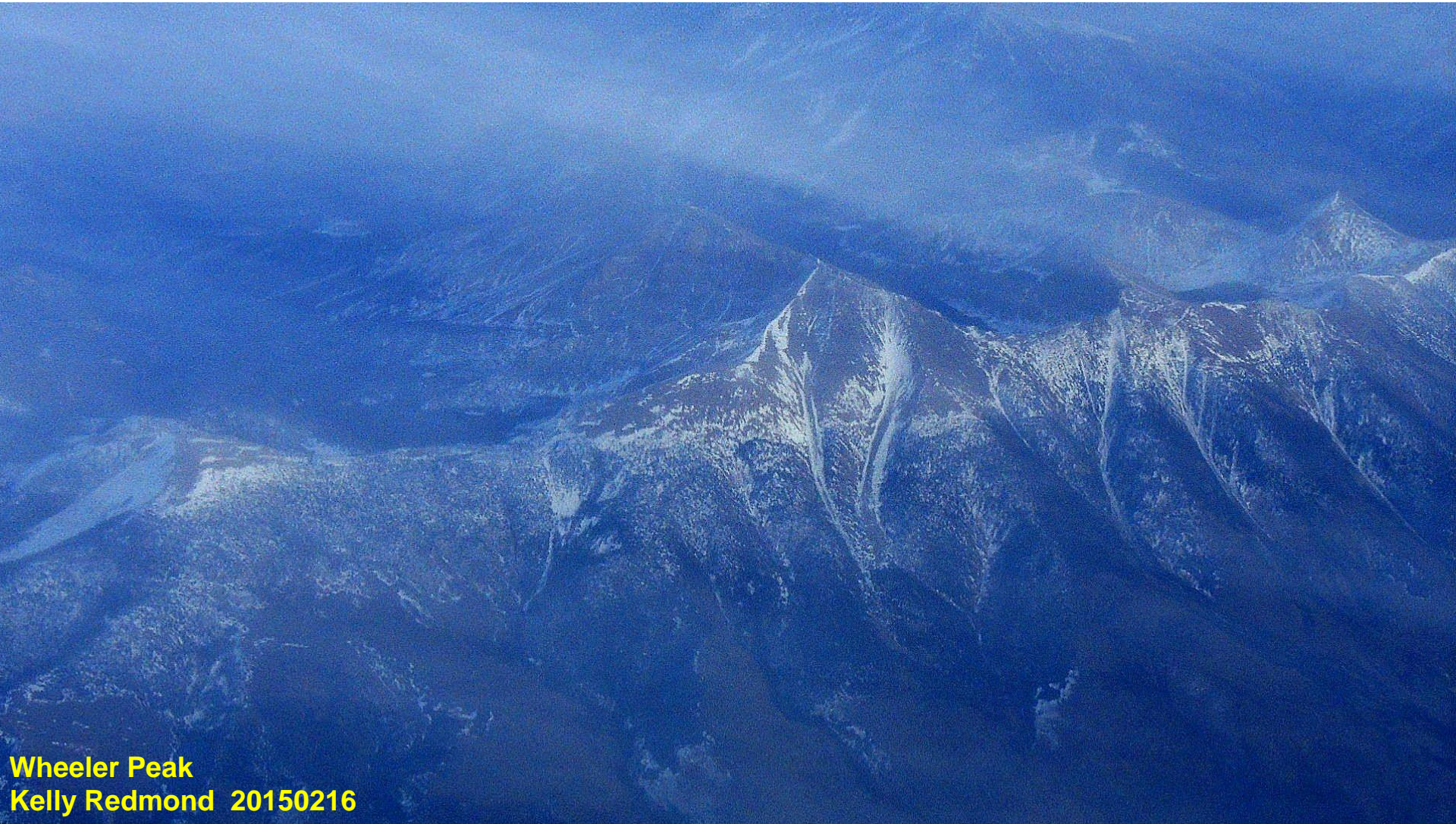
# Oct-Mar Freezing Level Over Lake Tahoe. 1948-49 thru 2014-15

0°C Level at 39.06°N, 120.02°W - 6 Months Ending in March





**Mt Charleston. Kelly Redmond 20150315**



**Wheeler Peak**  
**Kelly Redmond 20150216**

# Elevation of Lake Tahoe at Tahoe City 2011 Oct 01 - 1 Jun 2015



## USGS 10337000 LAKE TAHOE A TAHOE CITY CA



— Gage height

— Period of provisional data

— Period of approved data

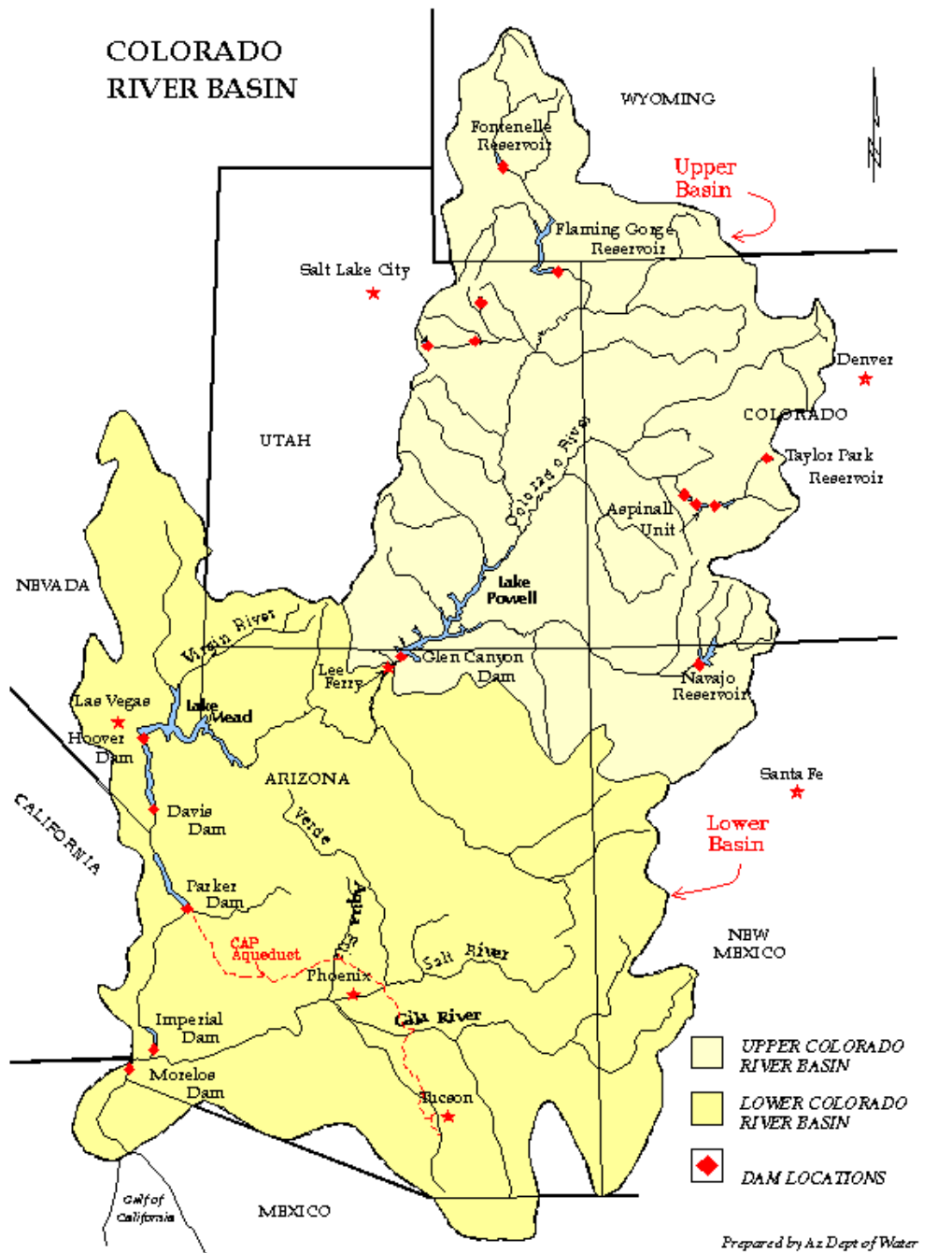
# Water Storage & Distribution in California



What would a Drought Monitor map look like that incorporated this complexity ???



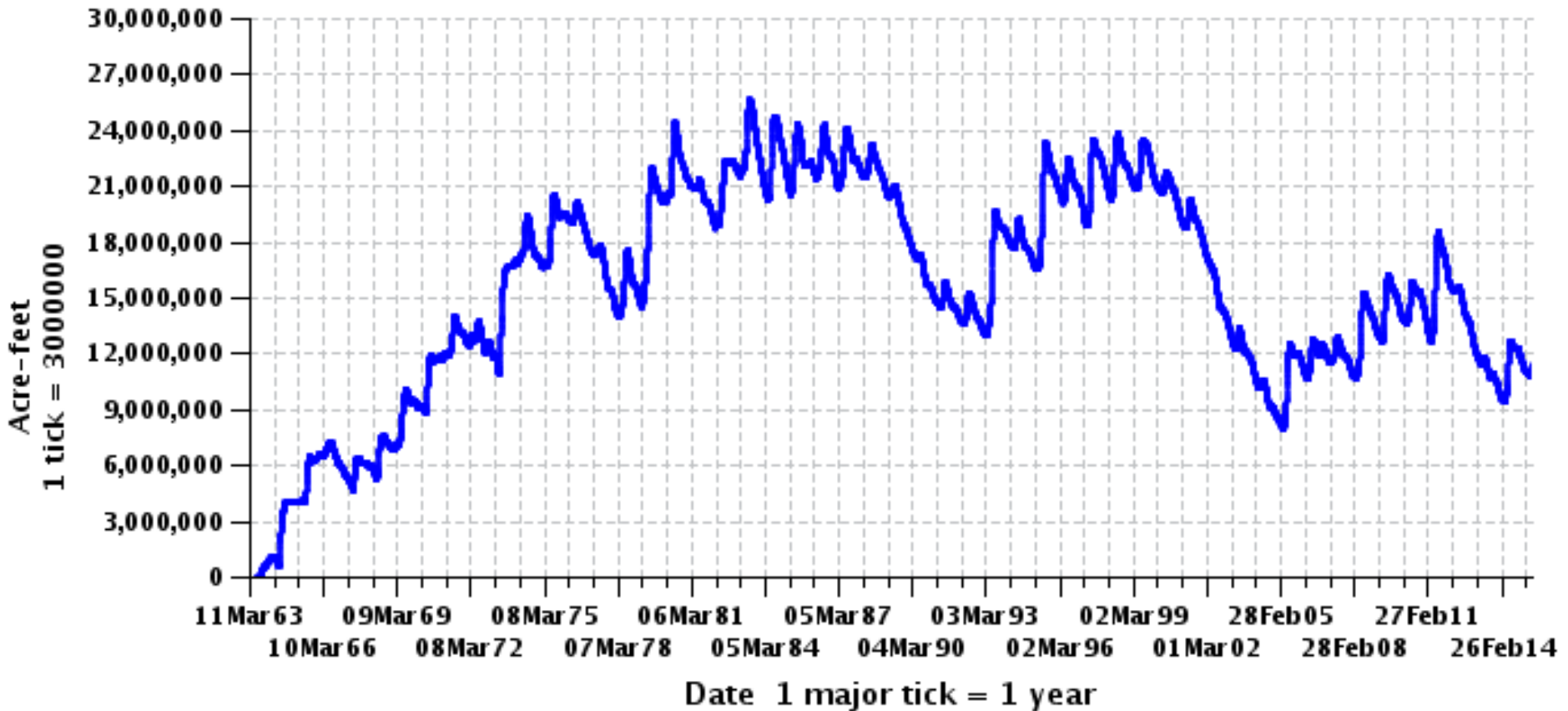
# COLORADO RIVER BASIN



- UPPER COLORADO RIVER BASIN
- LOWER COLORADO RIVER BASIN
- DAM LOCATIONS

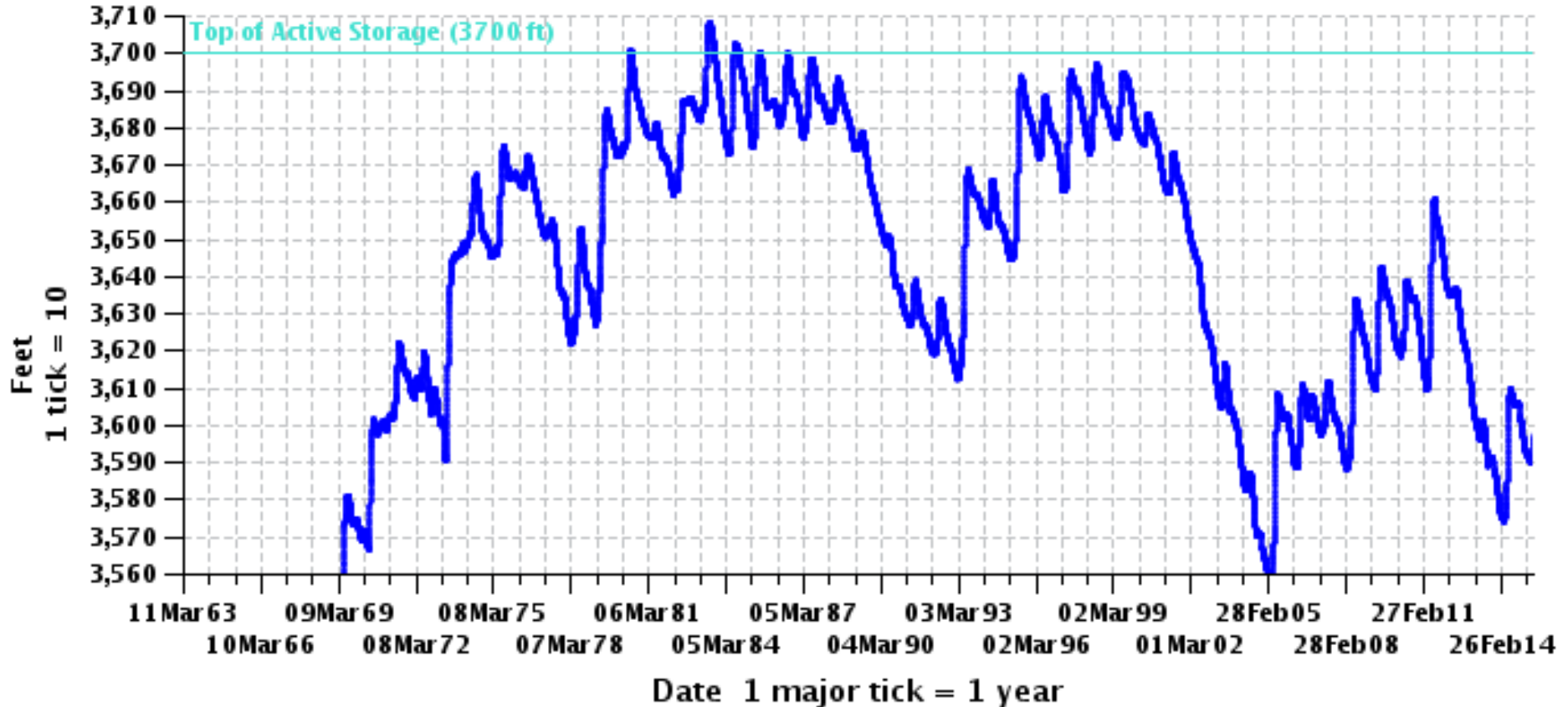
Prepared by Az Dept of Water Resources, Colorado River Mgmt Phyllis Andrews June 12, 1997

## Lake Powell Storage Through May 31, 2015



**Currently 48 % full (capacity 24.17 MAF)**  
**Minimum: 33 % full on April 8, 2005**

## Lake Powell Elevation Through May 31, 2015



**Water level on April 10, 2015 was 3597.27 ft, -103 ft below full.**

**Minimum level on April 8, 2005 was 3555 ft, -145 ft below full.**

**Source: [www.usbr.gov/uc/water/index.html](http://www.usbr.gov/uc/water/index.html)**



Marina, Overton, Lake Mead.  
Kelly Redmond 20150220



Lake Mead. Kelly Redmond 20150220



Lake Mead. Kelly Redmond 20150220



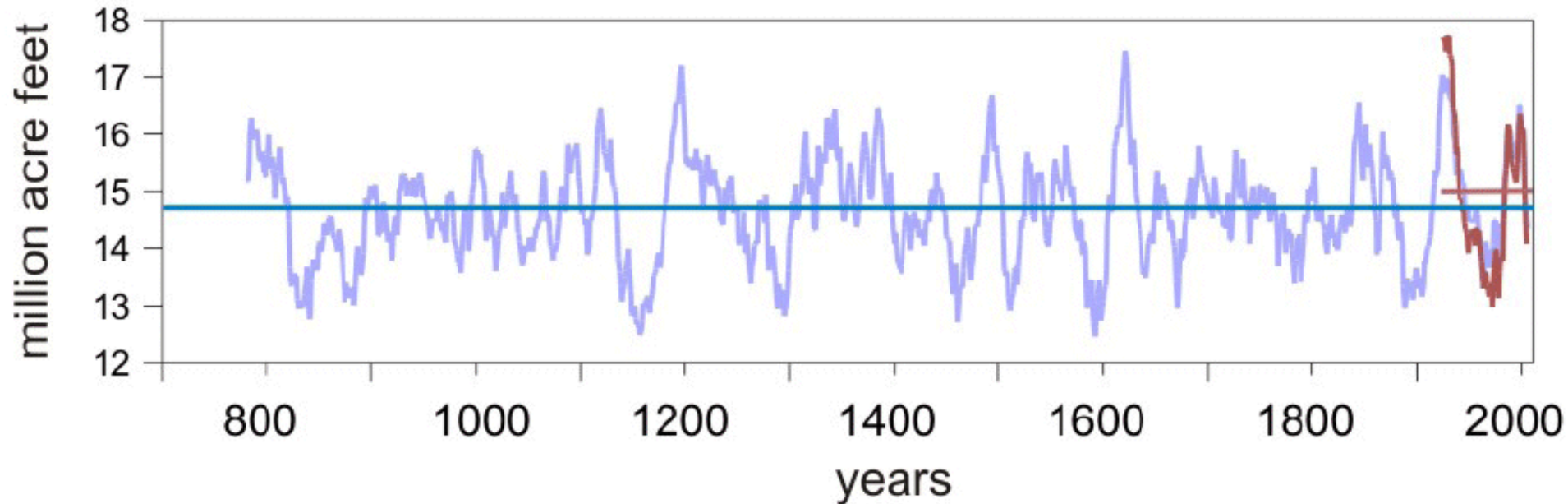
Lake Mead. Kelly Redmond 20150220





## Lessons from History.

### Colorado River Flow. Lees Ferry. Reconstructed 762 thru 2005 A.D.



**Red: Gauged record.**

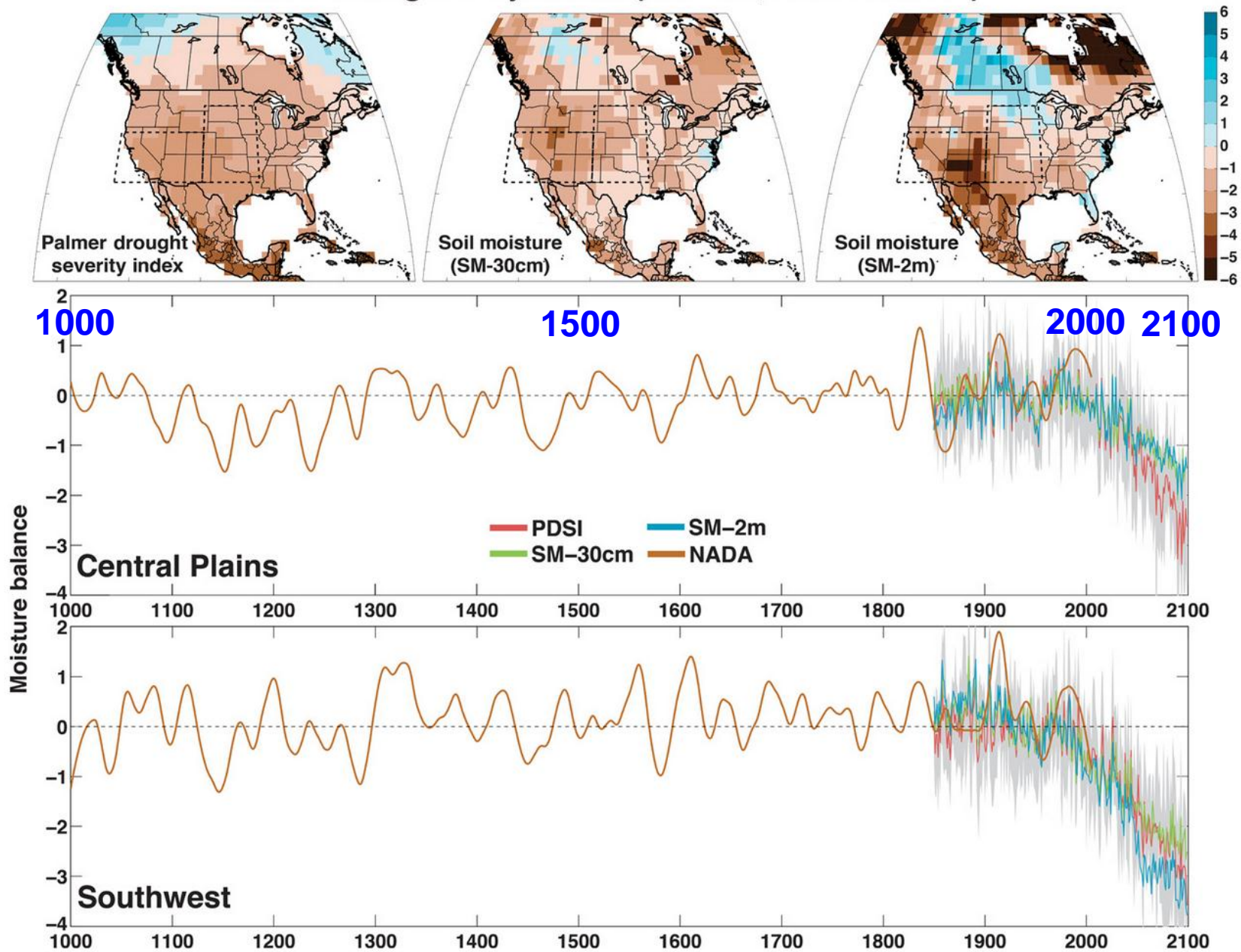
**Blue: Reconstructed record.**

**20-Year moving averages.**

Meko, D.M., C.A. Woodhouse, C.H. Baisan, T. Knight, J.J. Lukas, M.K. Hughes, and M.W. Salzer, 2007.  
Medieval drought in the upper Colorado River basin.

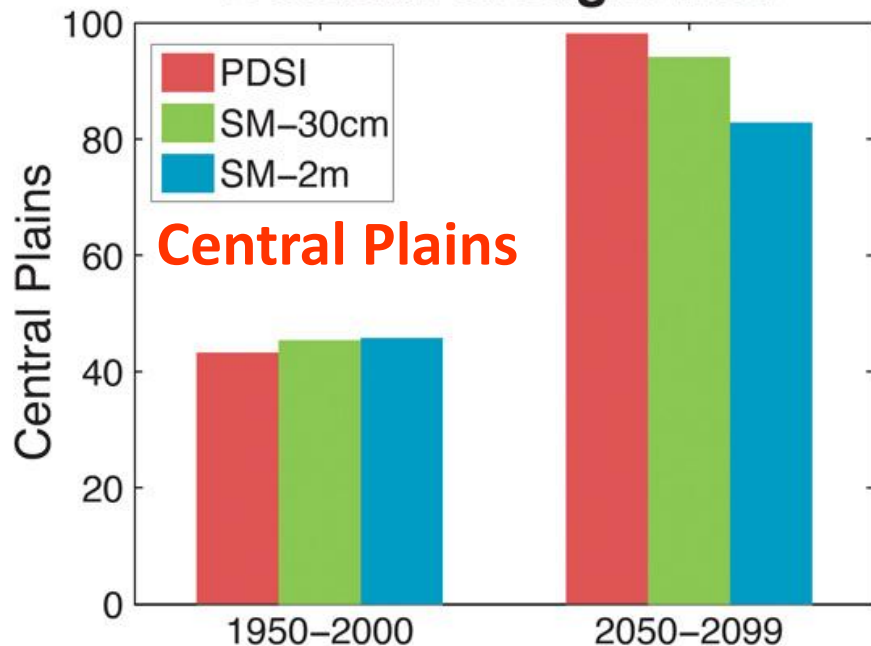
Geophysical Research Letters 34m L10705, doi: 10.1029/2007GL029988

# CMIP5 Drought Projections (RCP 8.5, 2050-2099 CE)

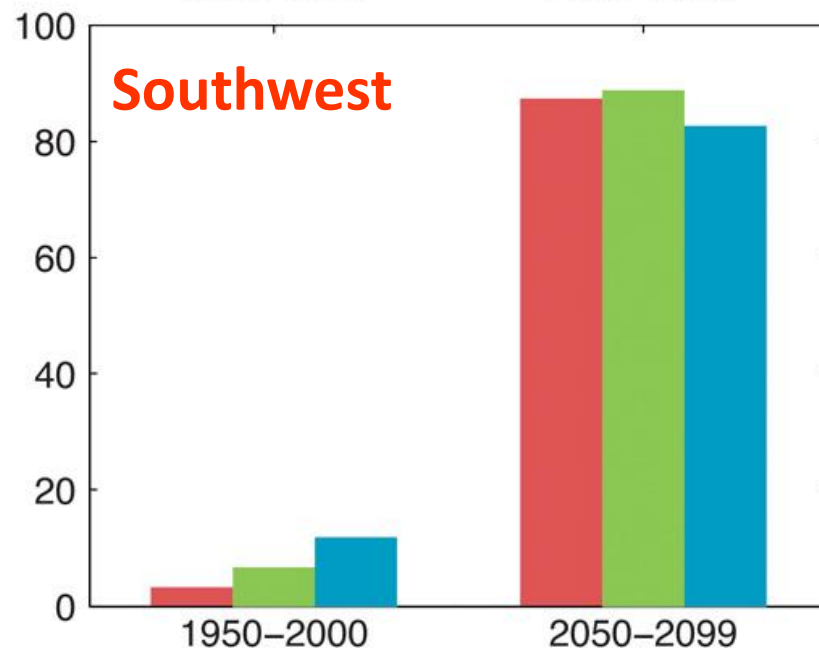
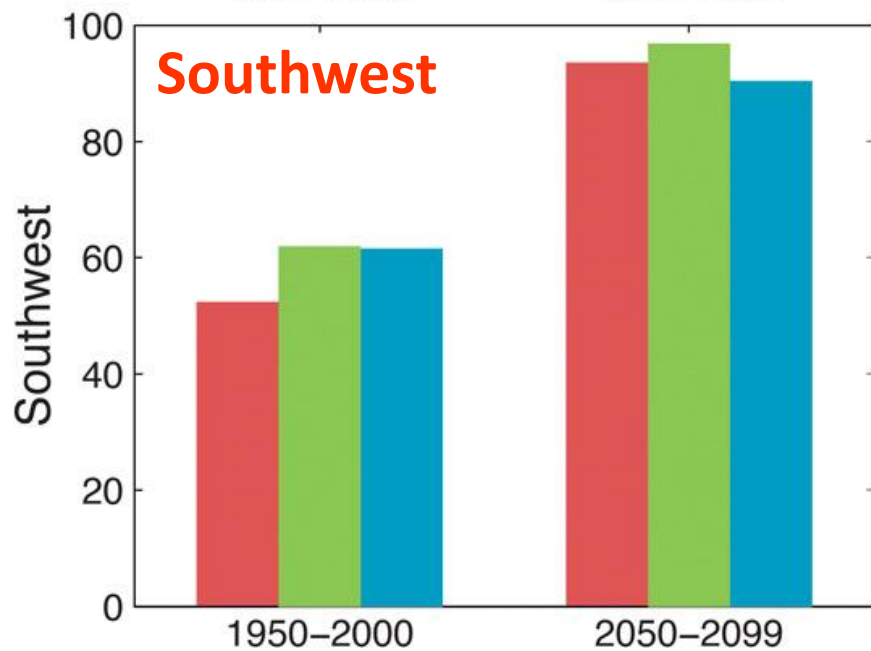
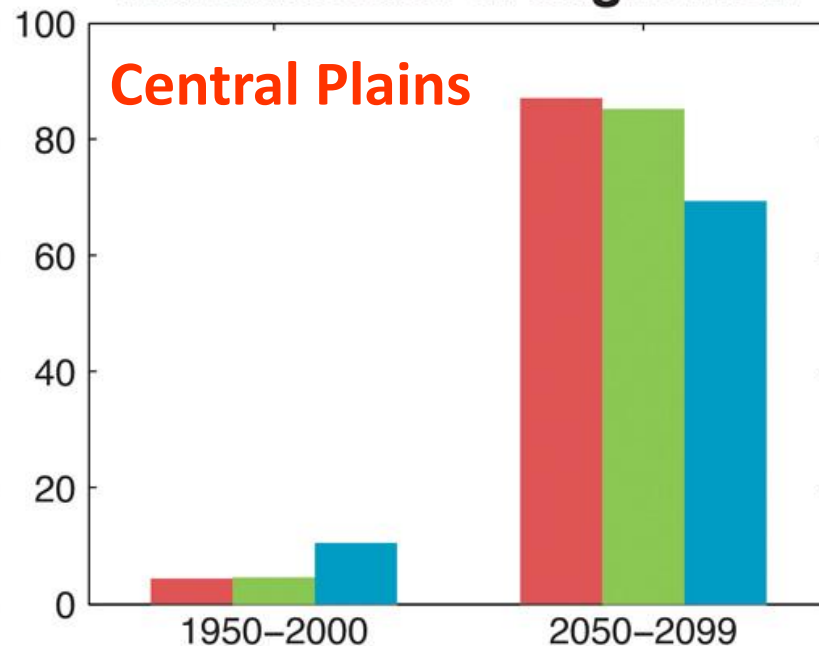


Benjamin Cook, Toby Ault, Jason Smerdon, 2015. Unprecedented 21<sup>st</sup> century drought risk in the American Southwest and Central Plains. *Science Advances*, 12 Feb 2015. [10.1126/sciadv.1400082](https://doi.org/10.1126/sciadv.1400082)

## Decadal drought risk



## Multidecadal drought risk



Benjamin Cook, Toby Ault, Jason Smerdon, 2015. Unprecedented 21<sup>st</sup> century drought risk in the American Southwest and Central Plains. *Science Advances*, 12 Feb 2015. [10.1126/sciadv.1400082](https://doi.org/10.1126/sciadv.1400082)



**Is the current Southwest drought a once-or-twice-a-century drought like those of the past 500 years ...**



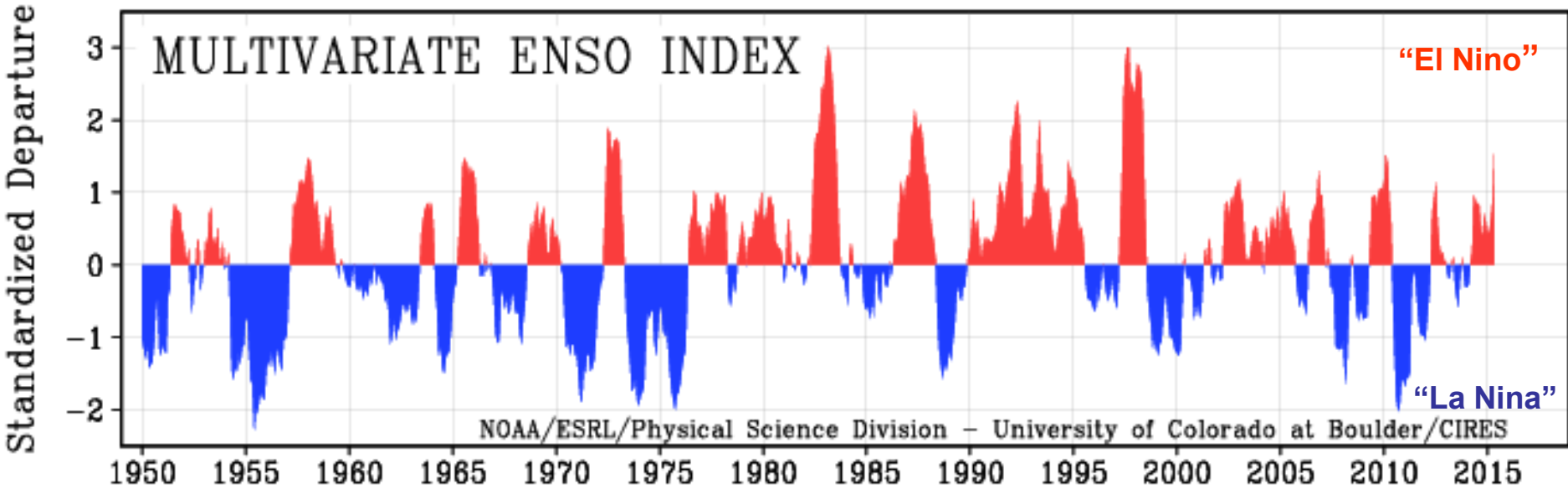
**... or ...**



**a harbinger of things to come, a different type of drought that we have not observed before ?**

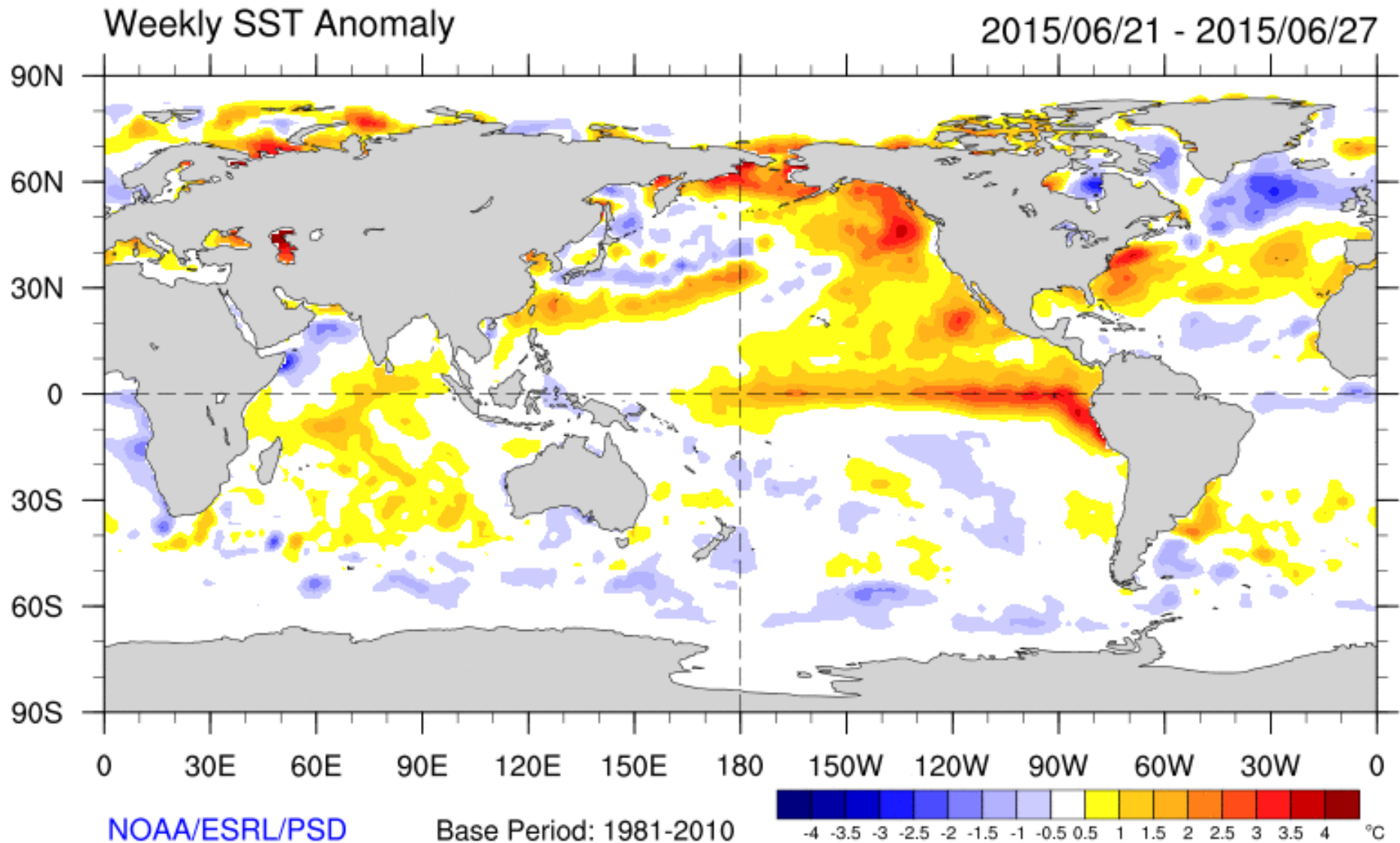


Through May 2015



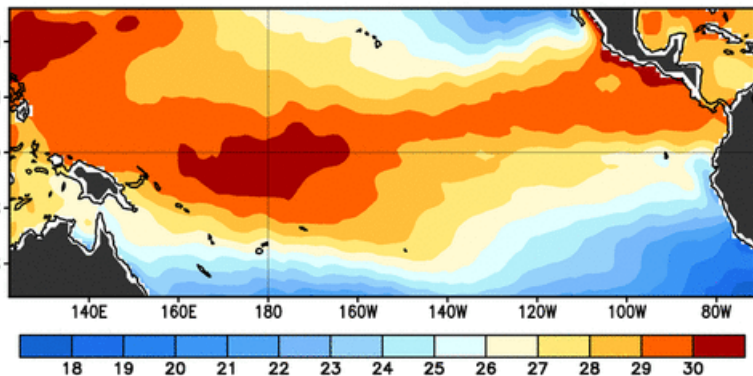
NOAA ESRL ("CDC"), Wolter and Timlin

# Ocean Departures from Average Temperature ( C ) 21 - 27 Jun 2015

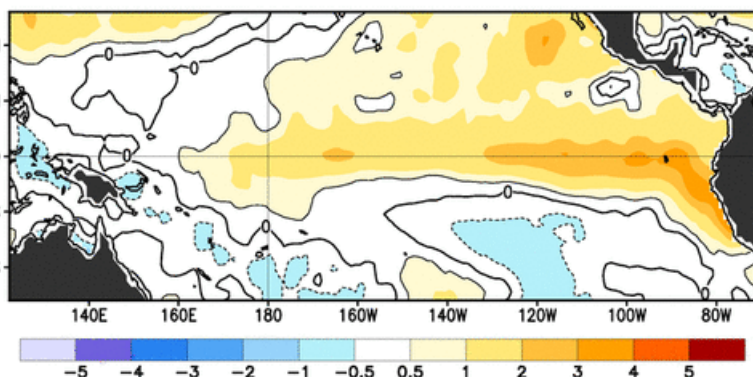


# Recent Evolution of Equatorial Pacific SST Departures

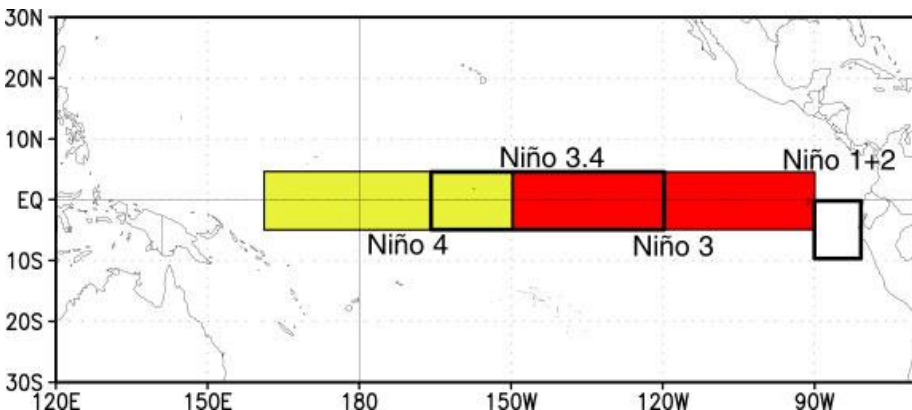
Observed Sea Surface Temperature (°C)



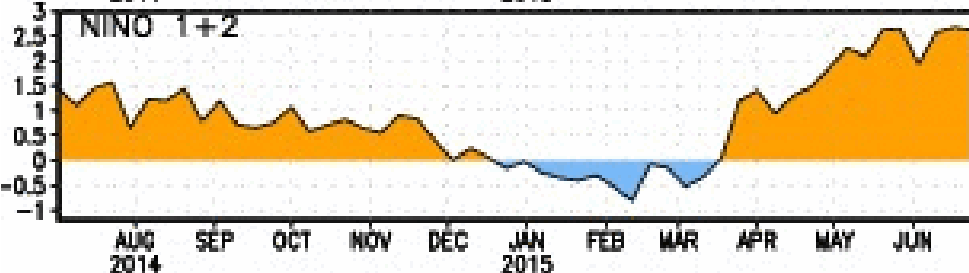
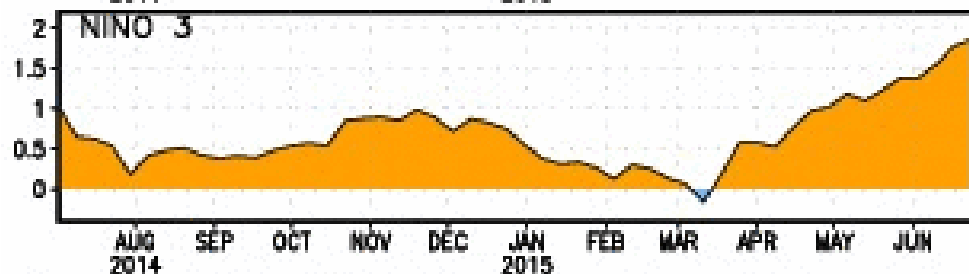
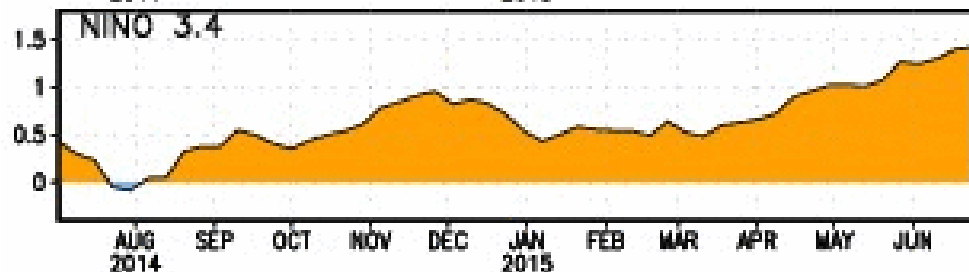
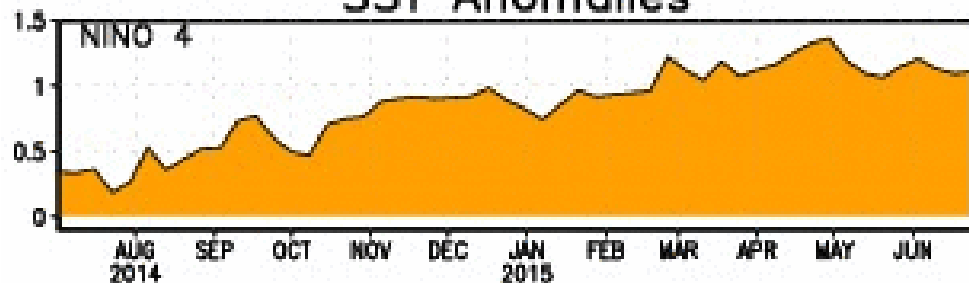
Observed Sea Surface Temperature Anomalies (°C)



7-day Average Centered on 24 June 2015



SST Anomalies

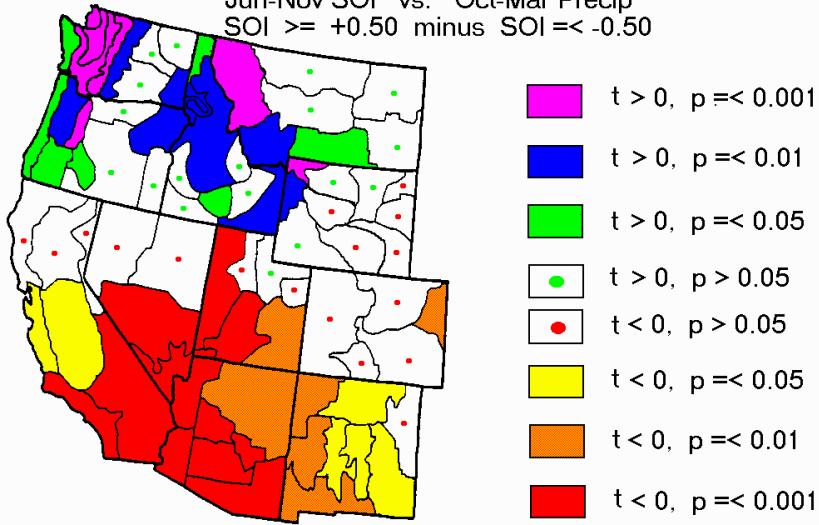


Updated through 2015 21-27 Jun

Climate Prediction Center

**Split Samples:**

Jun-Nov SOI vs. Oct-Mar Precip  
 SOI  $\geq +0.50$  minus SOI  $\leq -0.50$



Updated from Redmond and Koch (1991). Winters of 1933/34 - 1994/95.  
 Reddish: Composite El Nino winters are wet, La Nina winters are dry.  
 Bluish/greenish: Composite El Nino winters are dry, La Nina winters are wet.

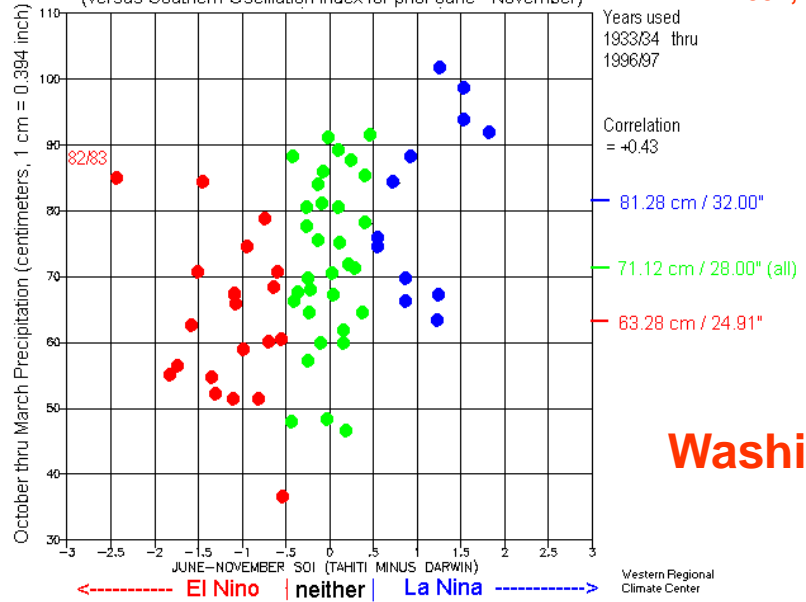
Redmond, K.T., and R.W. Koch, 1991. Surface climate and streamflow variability in the western United States and their relationship to large-scale circulation indices. *Water Resources Research*, 27(9), 2381-2399.

**Redmond & Koch, 1991, updated.**



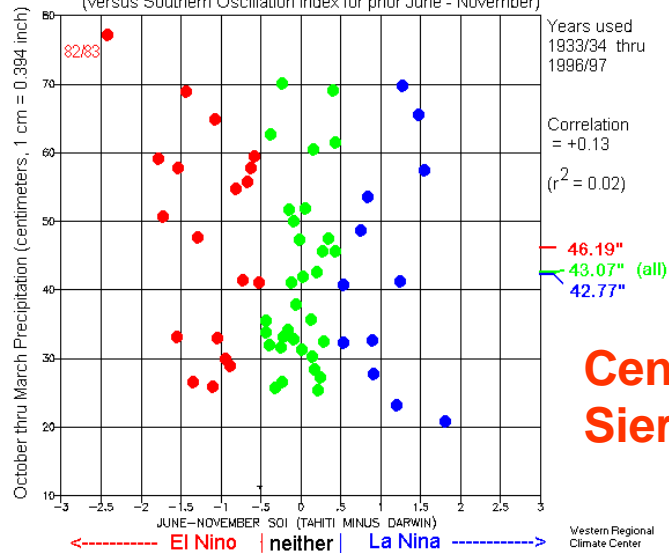
**Redmond & Koch, 1991, updated.**

**Washington statewide October thru March Precipitation**  
 (versus Southern Oscillation Index for prior June - November)



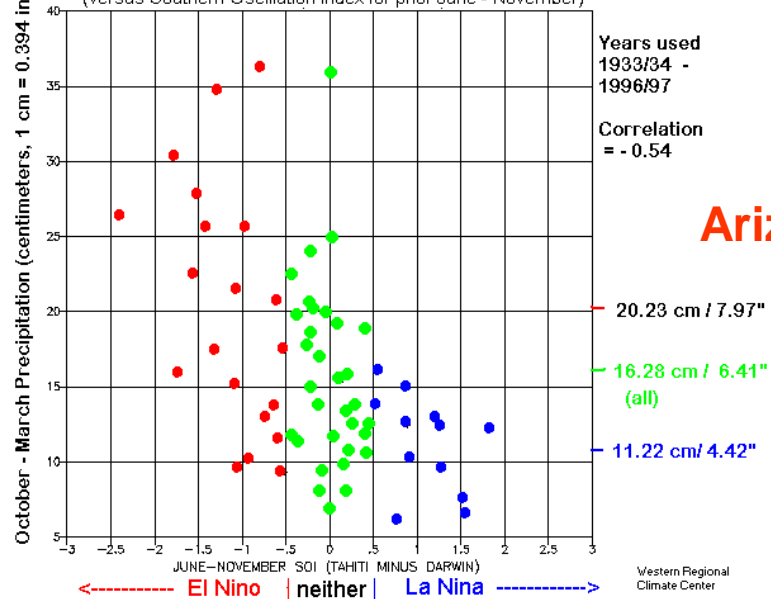
**Washington**

**California 8-Station Index October thru March Precipitation**  
 (versus Southern Oscillation Index for prior June - November)



**Central Sierra**

**Arizona statewide October thru March Precipitation**  
 (versus Southern Oscillation Index for prior June - November)

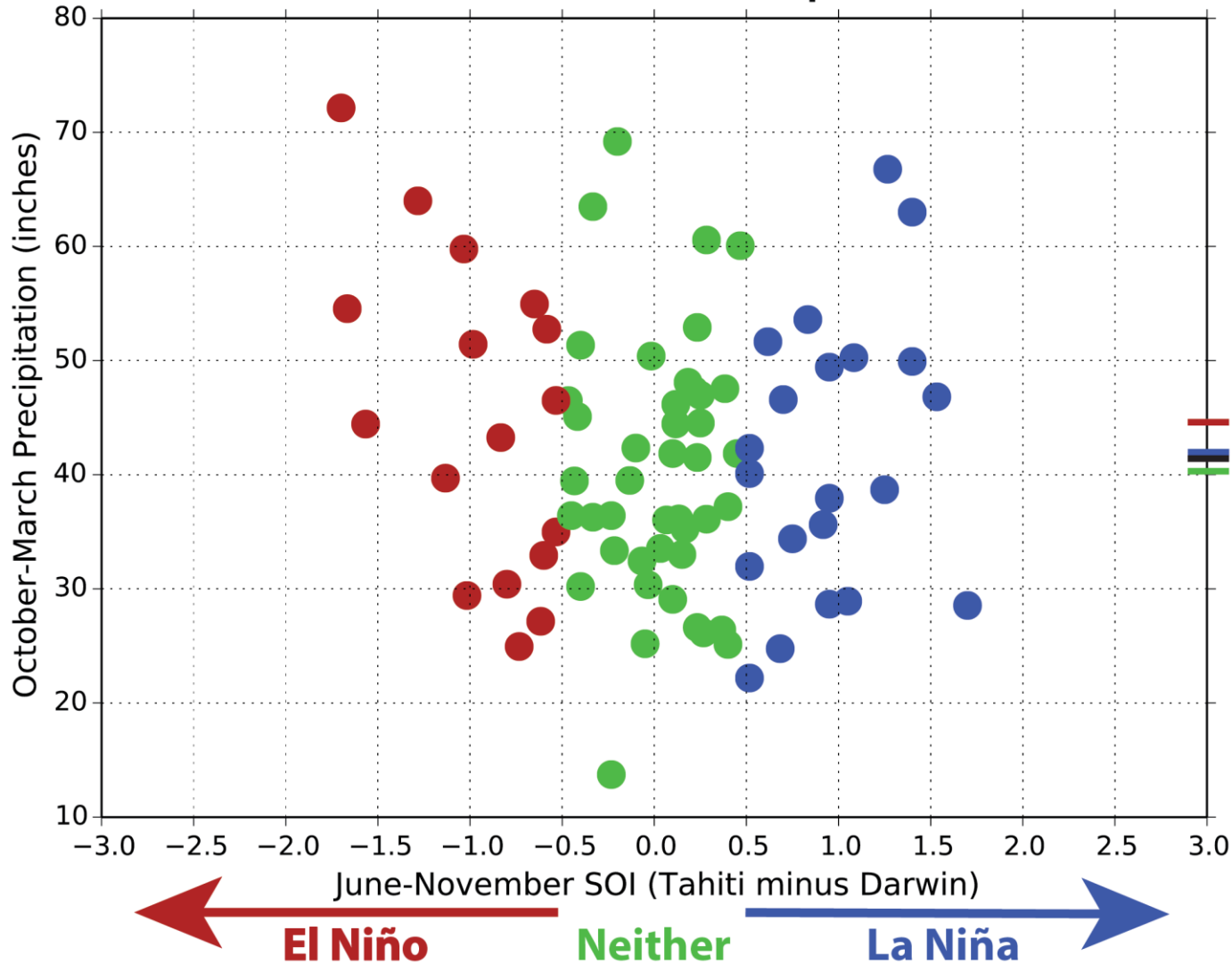


**Arizona**



# CA Division 1 October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



Years 1933/1934-  
2013/2014

$r^2 = 0.01$

Correlation = -0.11

Mean = 44.9 in

Mean = 41.53 in

Mean all = 41.51 in

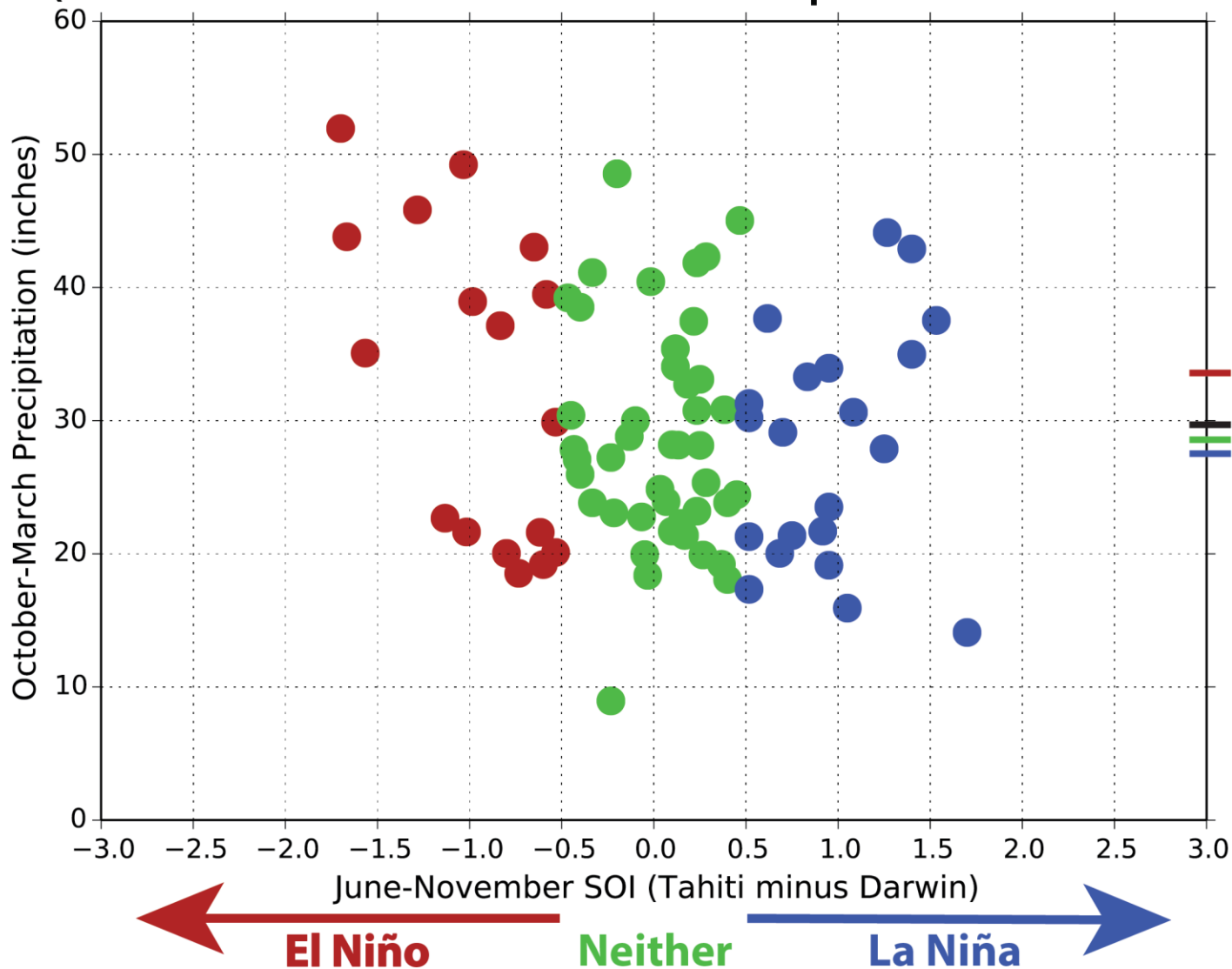
Mean = 40.15 in



Western Regional  
Climate Center

# CA Division 2 October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



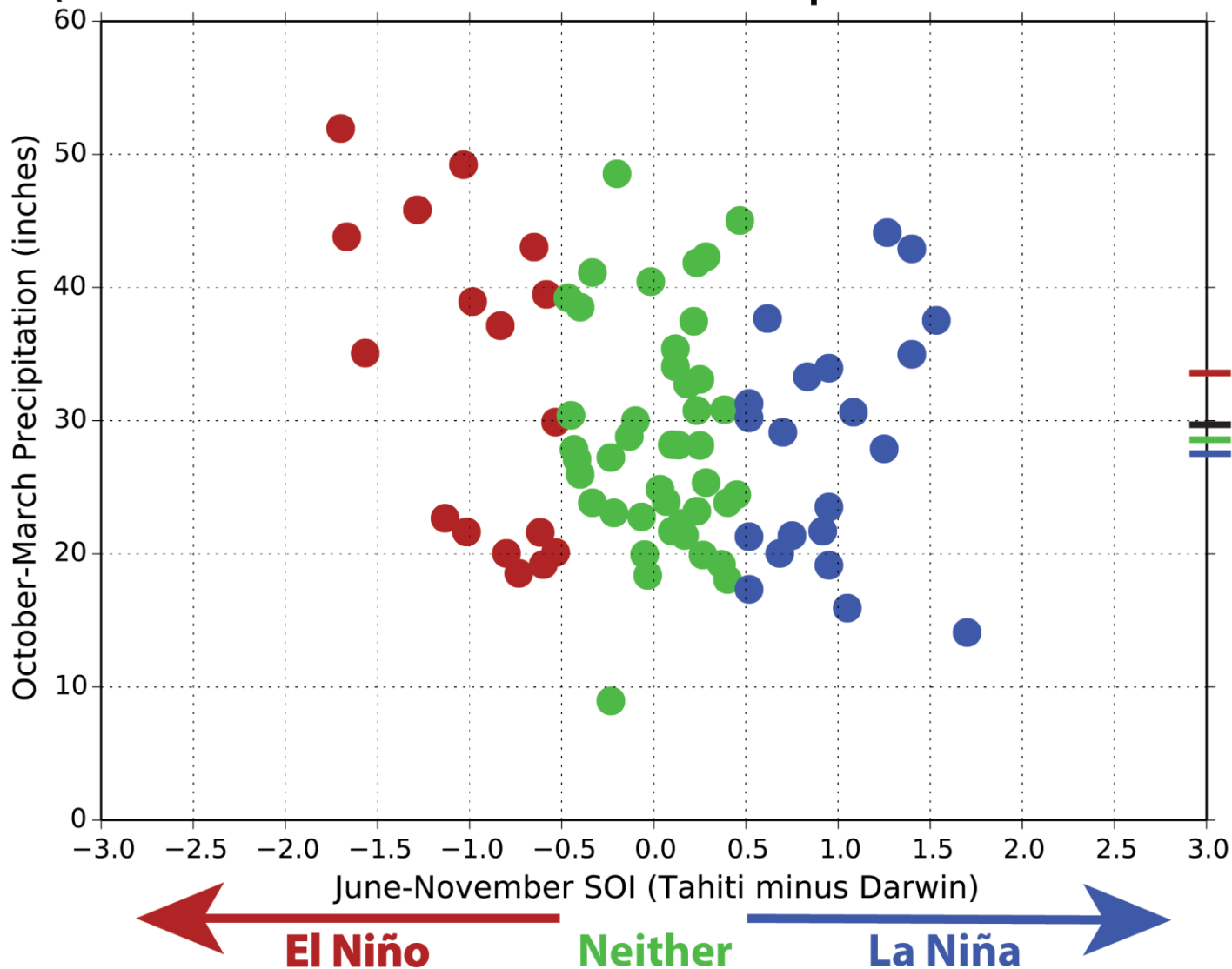
**Years 1933/1934-2013/2014**  
 **$r^2 = 0.05$**   
**Correlation = -0.22**  
**Mean = 32.83 in**  
**Mean all = 29.44 in**  
**Mean = 28.8 in**  
**Mean = 28.0 in**



Western Regional  
Climate Center

# CA Division 2 October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



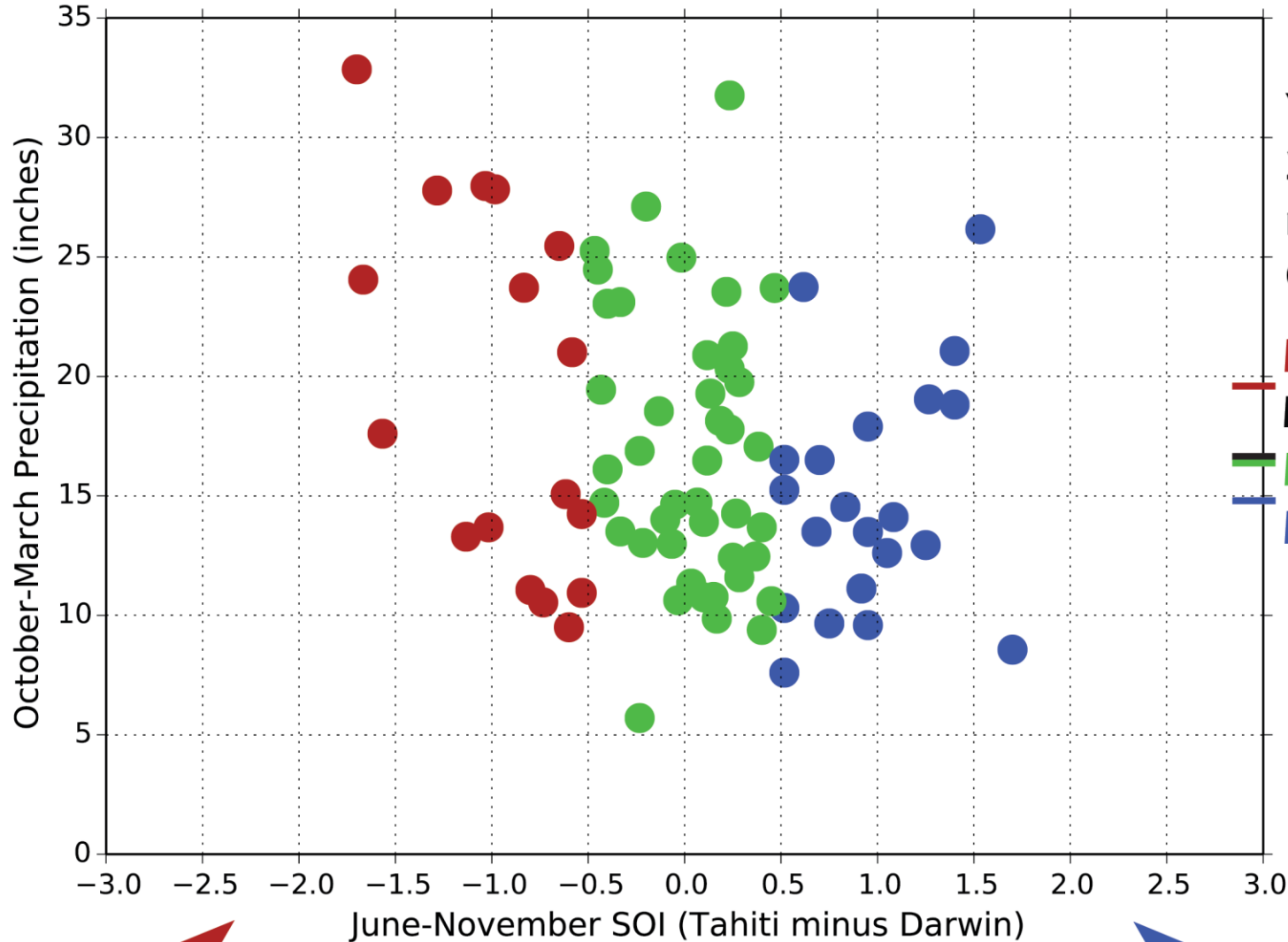
**Years 1933/1934-2013/2014**  
 **$r^2 = 0.05$**   
**Correlation = -0.22**  
**Mean = 32.83 in**  
**Mean all = 29.44 in**  
**Mean = 28.8 in**  
**Mean = 28.0 in**



Western Regional  
Climate Center

# CA Division 5 October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



Years 1933/1934-2013/2014

$r^2 = 0.09$

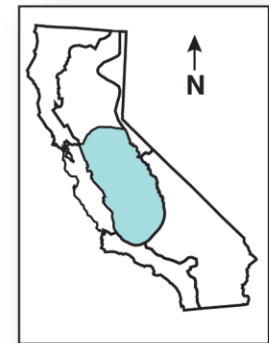
Correlation = -0.3

Mean = 19.21 in

Mean all = 16.83 in

Mean = 16.83 in

Mean = 14.91 in



Western Regional  
Climate Center

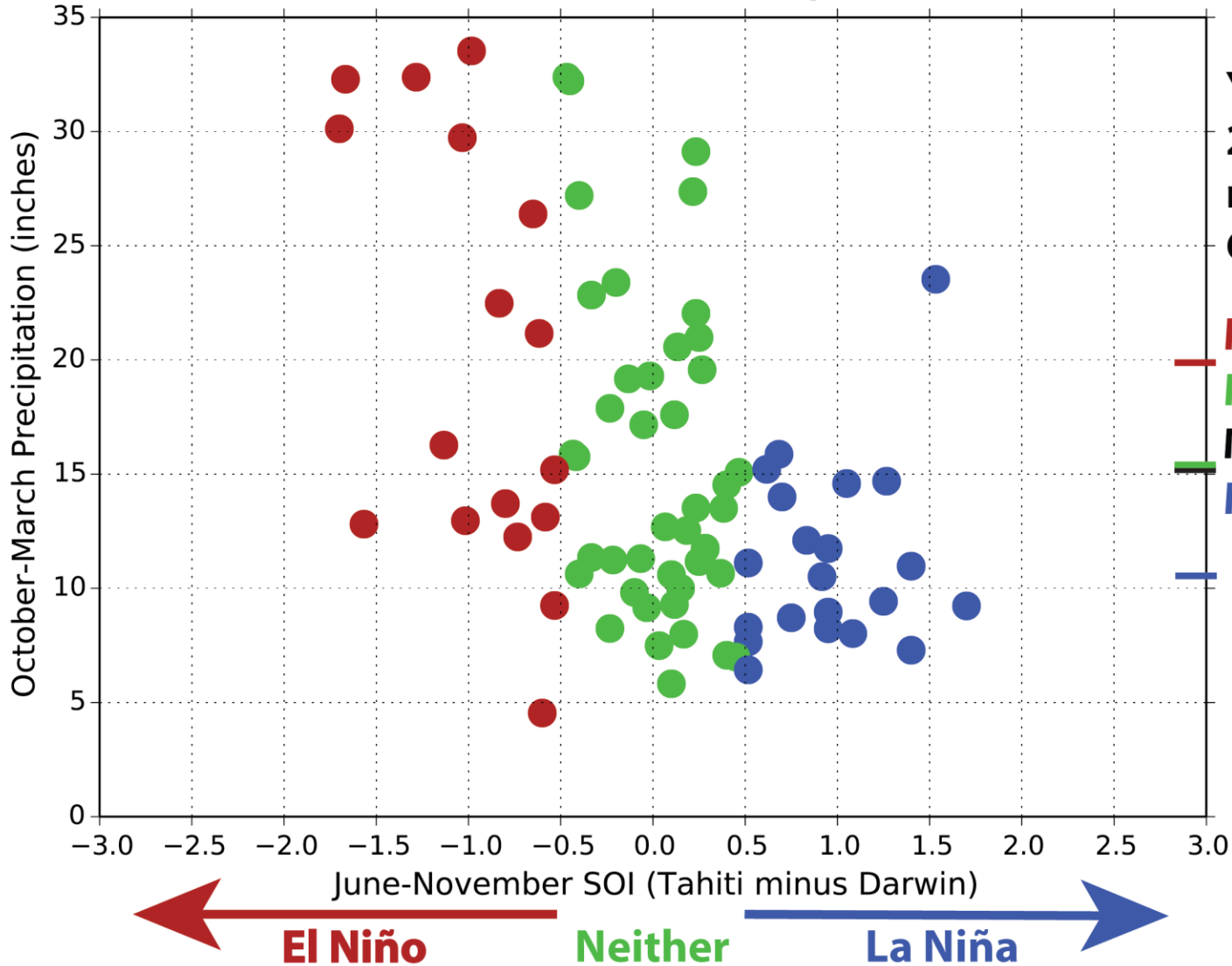
El Niño

Neither

La Niña

# CA Division 6 October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



**Years 1933/1934-2013/2014**  
 **$r^2 = 0.22$**   
**Correlation = -0.47**

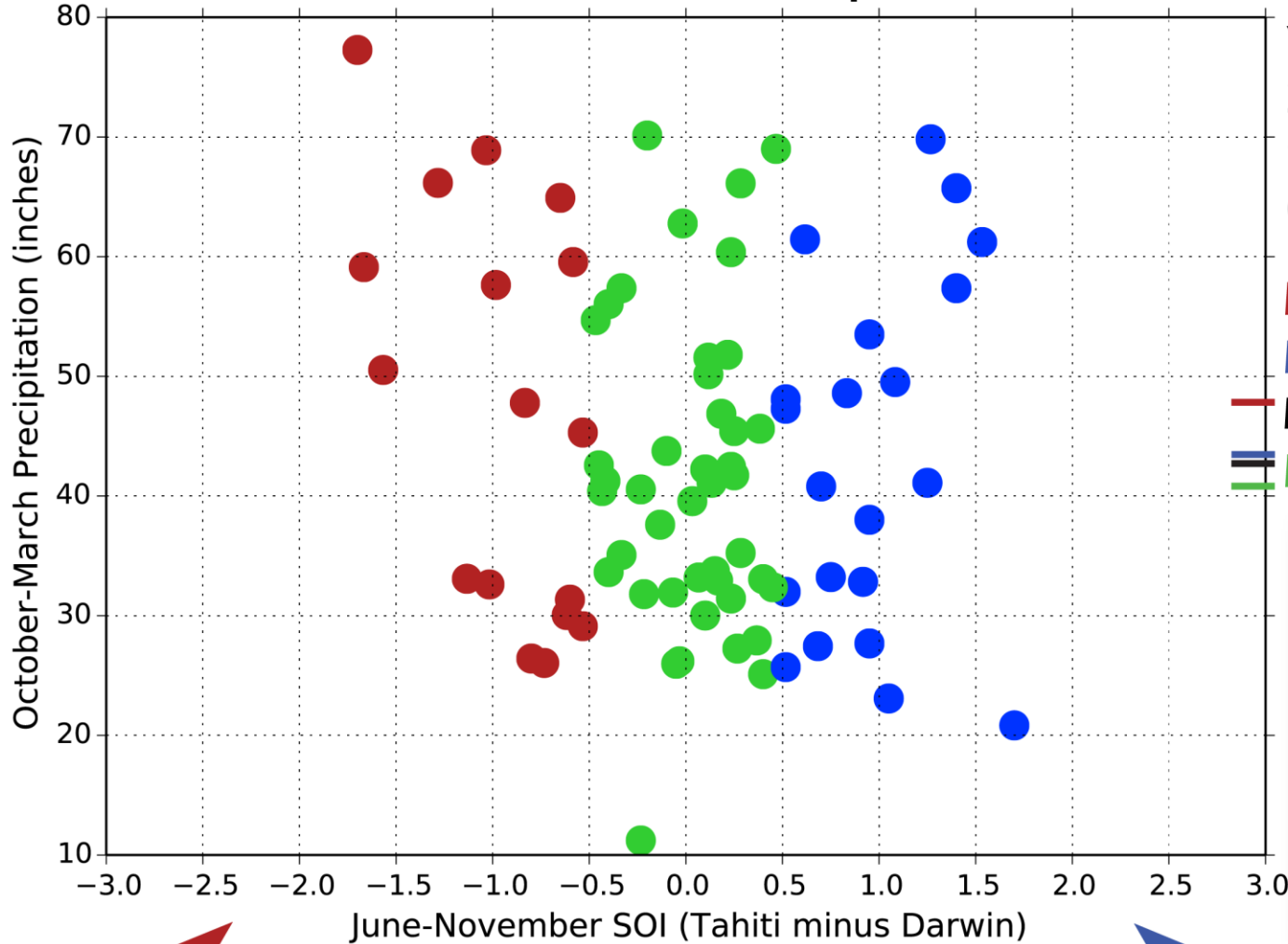
**Mean = 19.89 in**  
**Mean = 15.45 in**  
**Mean all = 15.30 in**  
**Mean = 11.27 in**



Western Regional  
Climate Center

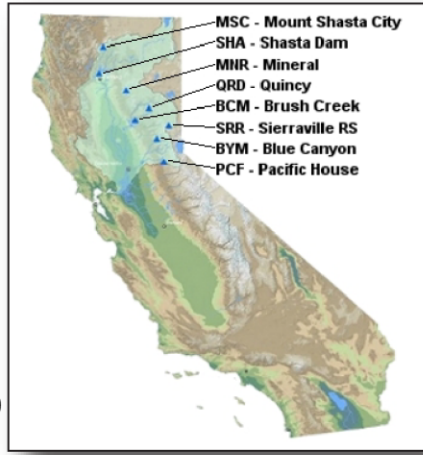
# CA 8-Station Index October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



Years 1933/1934-2013/2014  
 $r^2 = 0.02$   
Correlation = -0.13

Mean = 47.4 in  
Mean = 43.11 in  
Mean all = 43.09 in  
Mean = 41.38 in

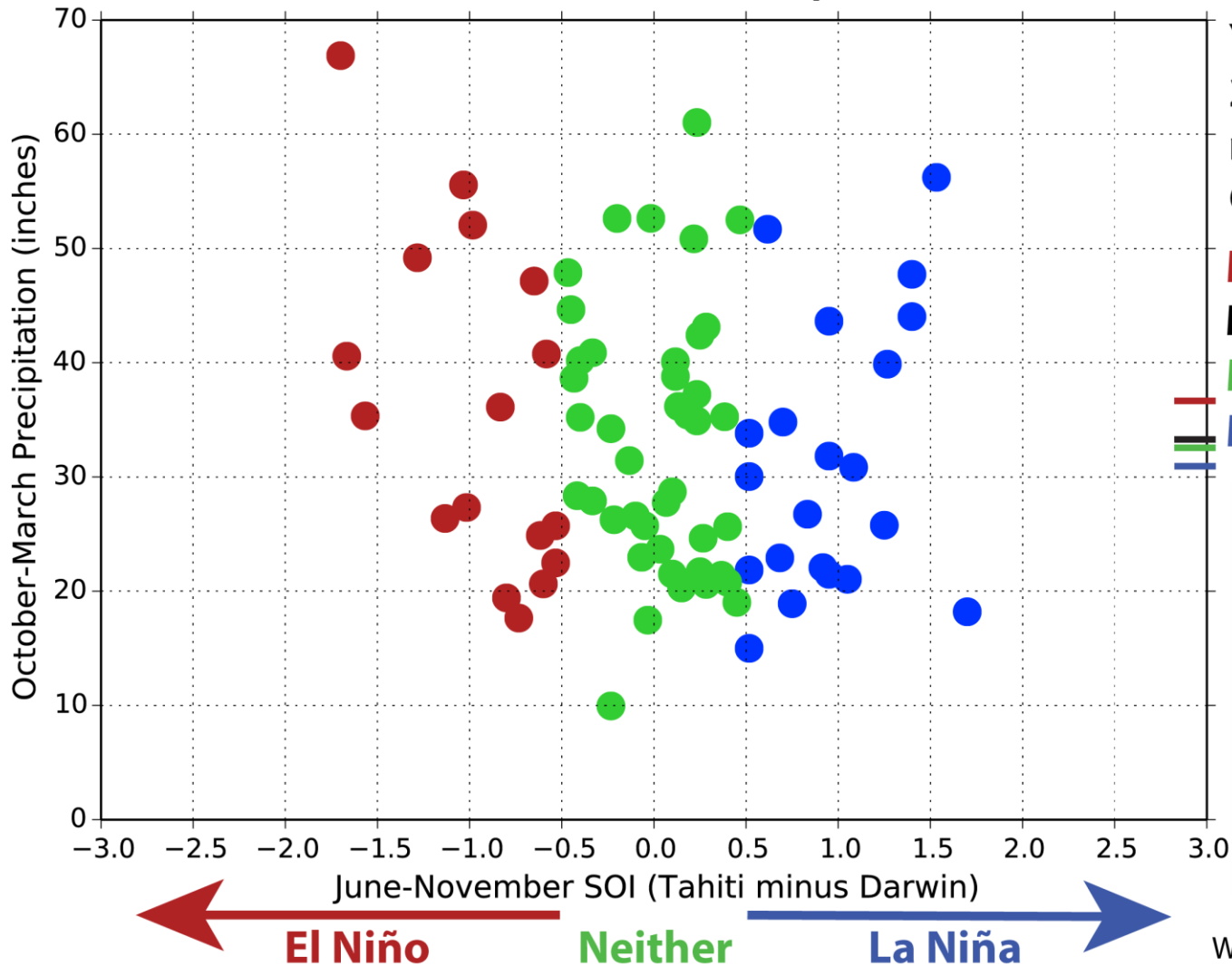


El Niño      Neither      La Niña

Data Source: CA DWR  
Western Regional Climate Center

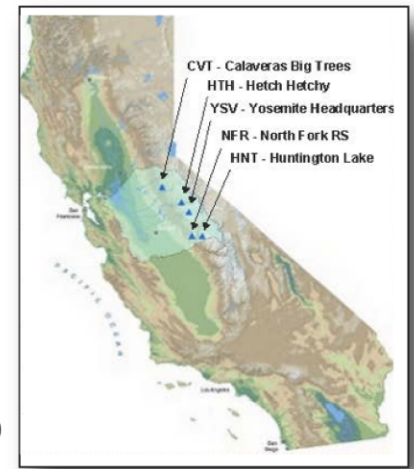
# CA 5-Station Index October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



Years 1933/1934-2013/2014  
 $r^2 = 0.03$   
Correlation = -0.17

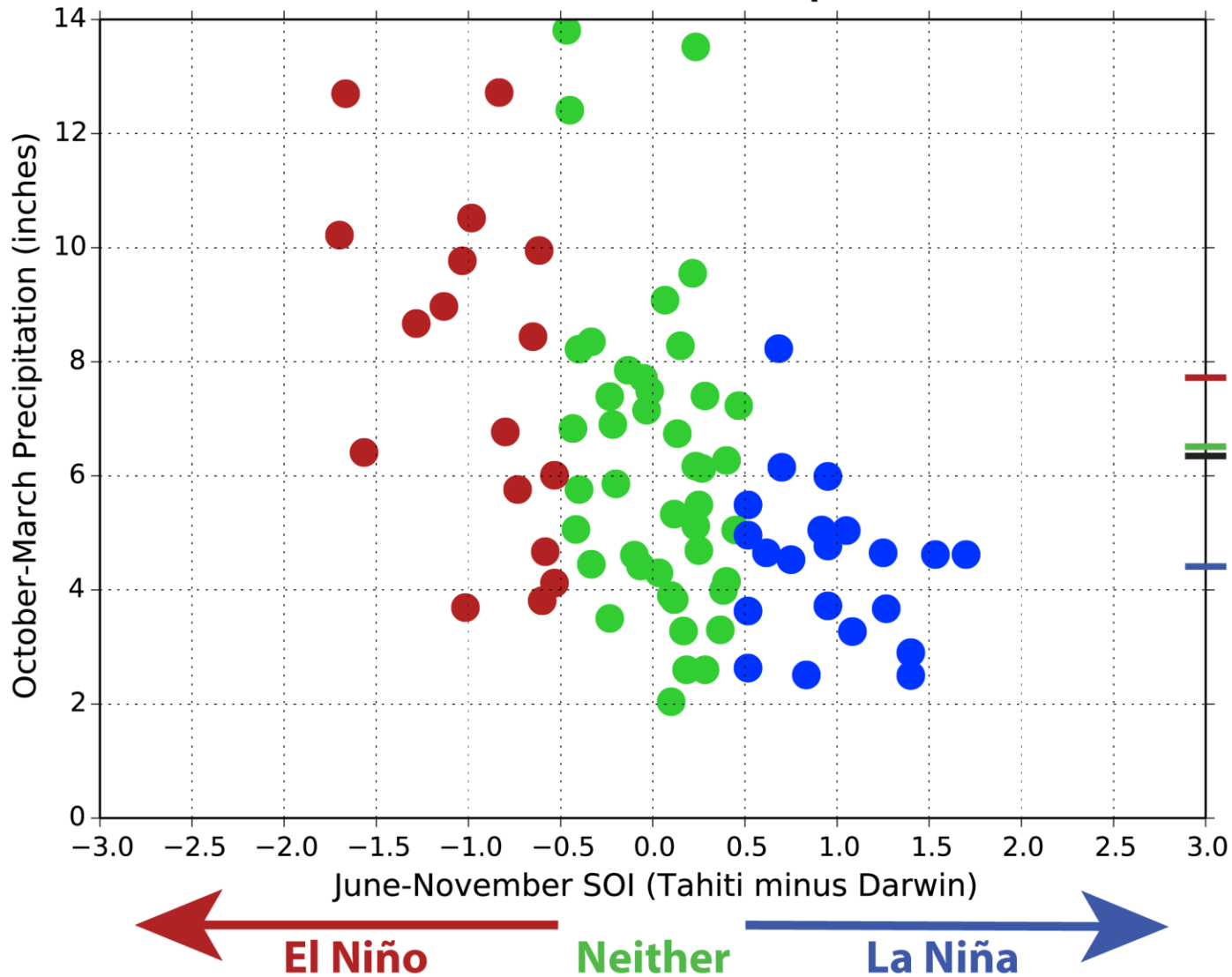
Mean = 35.77 in  
Mean all = 33.02 in  
Mean = 32.74 in  
Mean = 31.36 in



Data Source: CA DWR  
Western Regional Climate Center

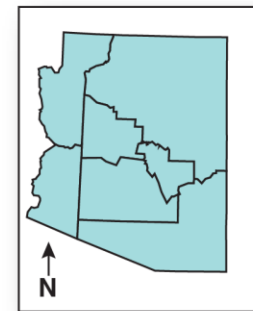
# Arizona Statewide October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



Years 1933/1934-  
2013/2014  
 $r^2 = 0.27$   
Correlation = -0.52

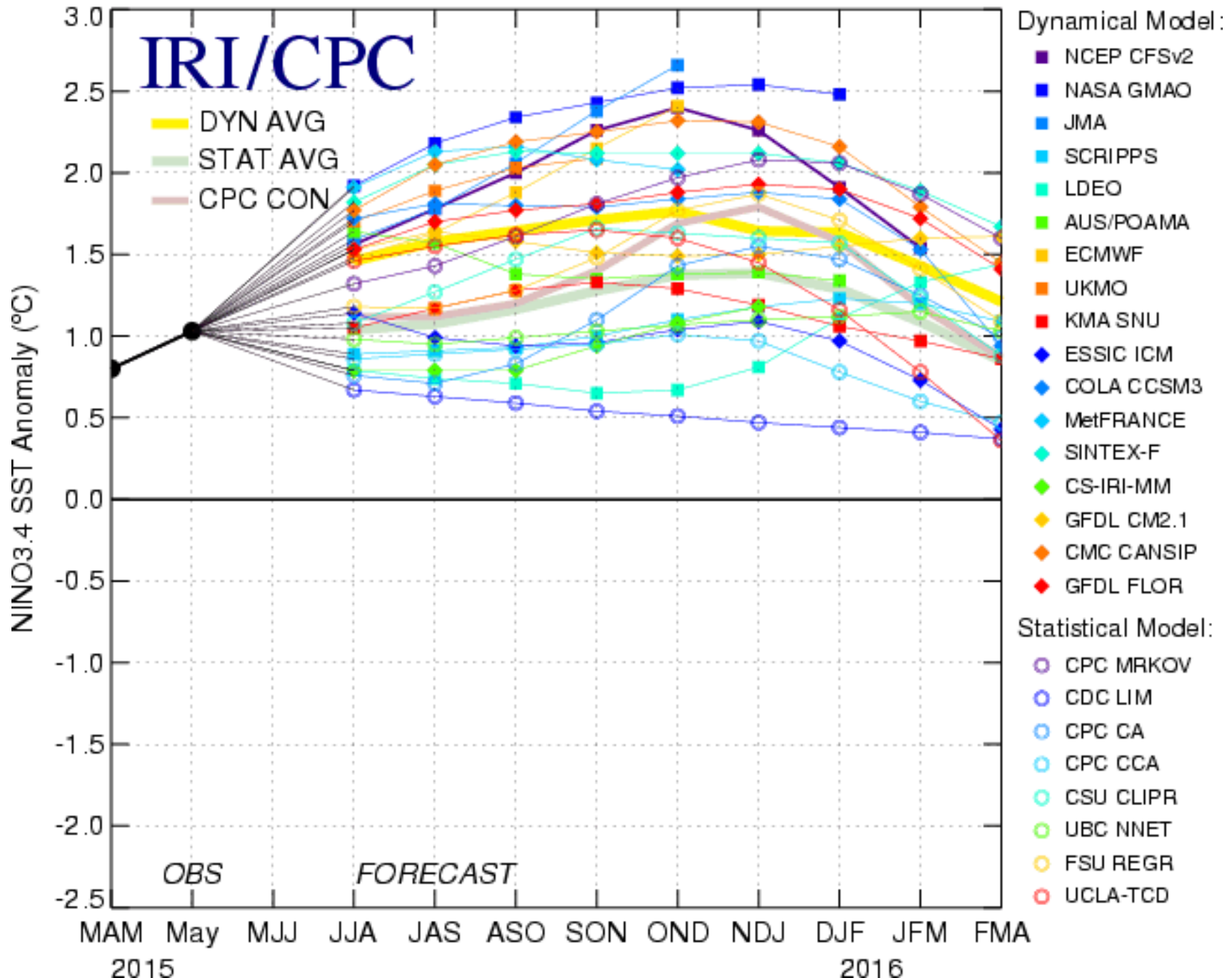
— **Mean = 7.84 in**  
— **Mean = 6.23 in**  
— **Mean all = 6.11 in**  
— **Mean = 4.46 in**



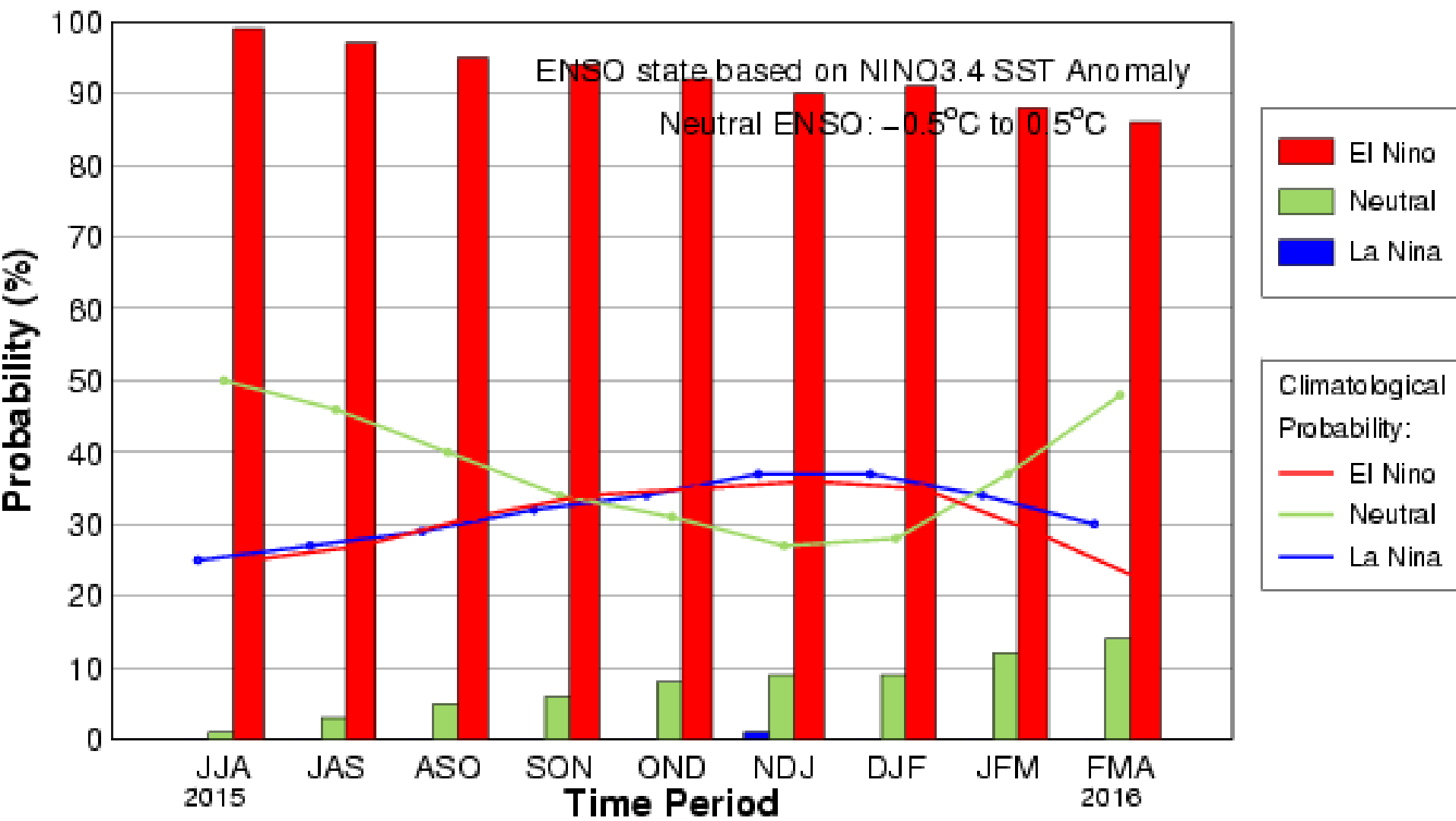
Western Regional  
Climate Center



# Mid-Jun 2015 Plume of Model ENSO Predictions



# Mid-Jun IR/CPC Plume-Based Probabilistic ENSO Forecast



# Temperature & Precipitation Official Outlooks

## Three Month Summer

## 2015

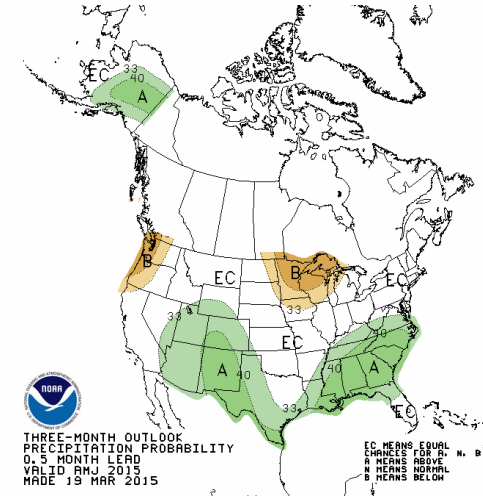
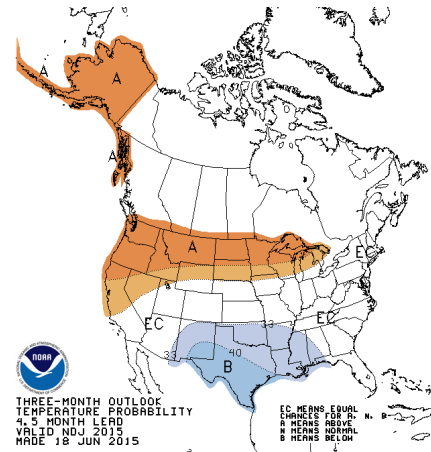
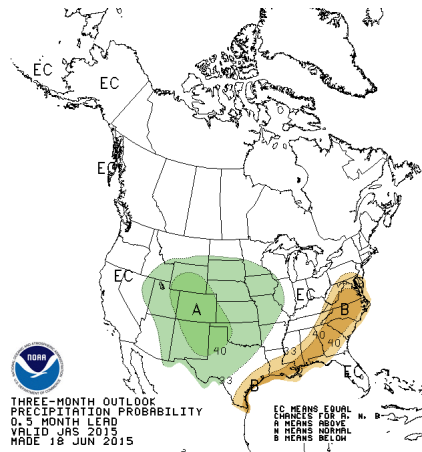
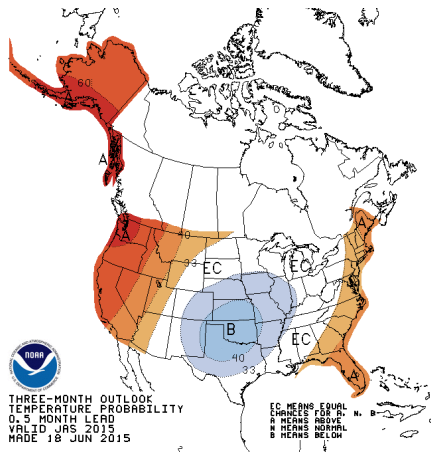
## Three Month Winter

### Jul-Aug-Sep T

### Jul-Aug-Sep P

### Nov-Dec-Jan T

### Nov-Dec-Jan P



Orange / Red  
Green

- Higher likelihood of drier than usual  
- Higher likelihood of wetter than usual

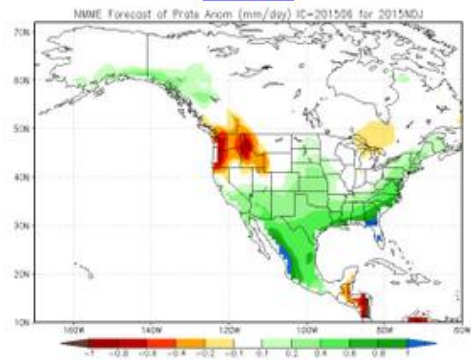
# Seven experiments in near-term climate forecasting Nov-Jan 2015-6. Precipitation.

**NMME (National Multi-Model Ensemble).**  
**IMME (International Multi-Model Ensemble).**

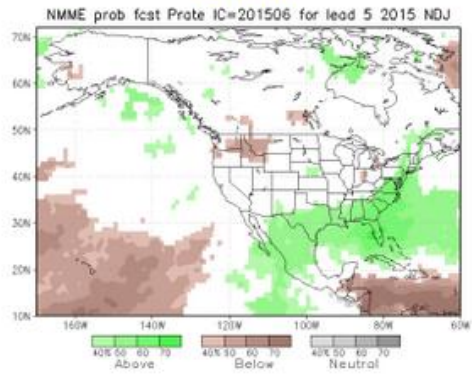
## Dynamical Models

- CFSv2:** US Climate Forecasting System version 2
- CMC1:** Canadian Meteorological Center version 1
- CMC2:** Canadian Meteorological Center version 2
- GFDL:** US Geophysical Fluid Dynamics Laboratory
- NCAR:** US National Center for Atmospheric Research
- NASA:** US National Aeronautics and Space Administration
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- IMME:** International Multi-Model Ensemble

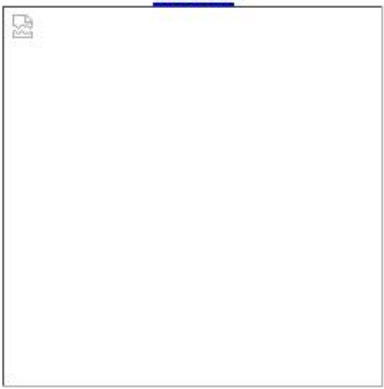
**NMME**



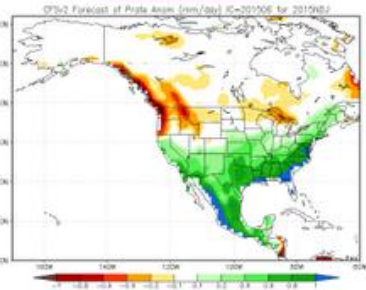
**Prob fcst**



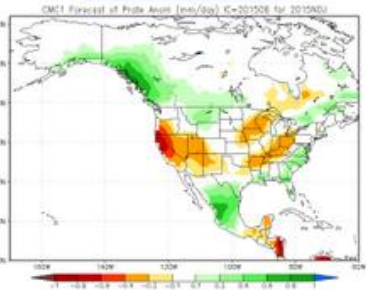
**IMME**



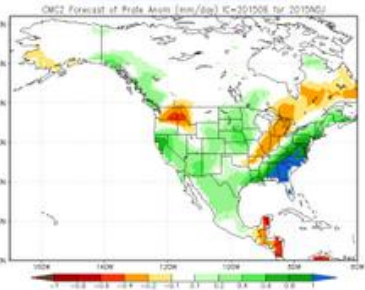
**NCEP CFSv2**



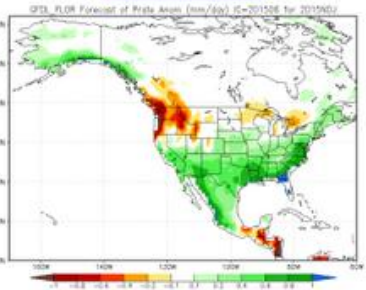
**CMC1 CanCM3**



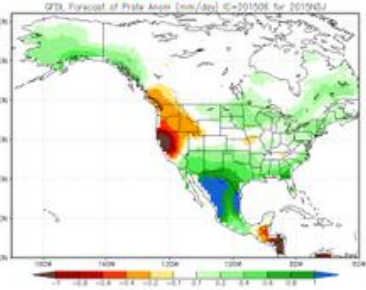
**CMC2 CanCM4**



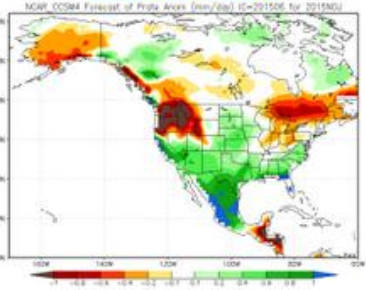
**GFDL FLOR**



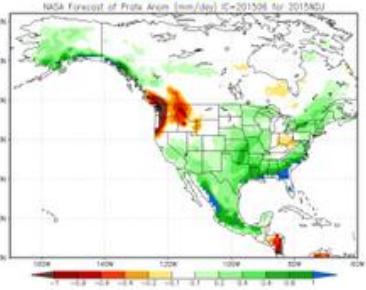
**GFDL CM2.1**



**NCAR CCSM4**



**NASA GEOS5**

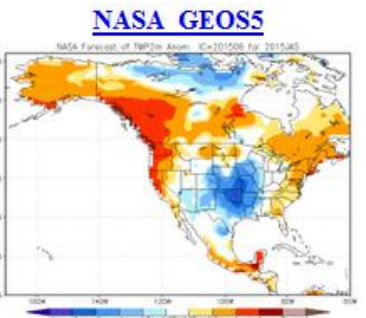
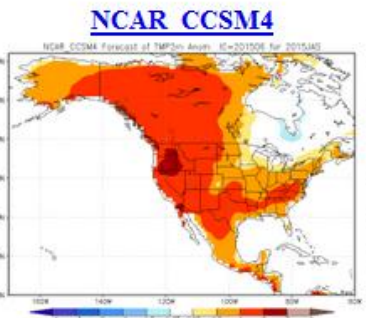
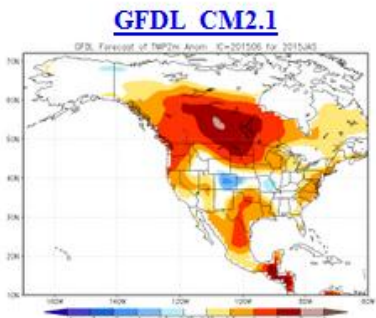
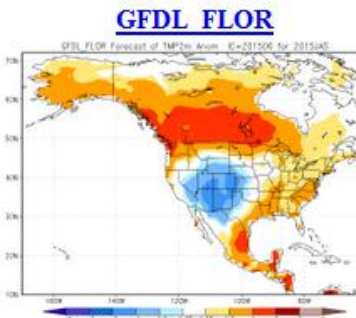
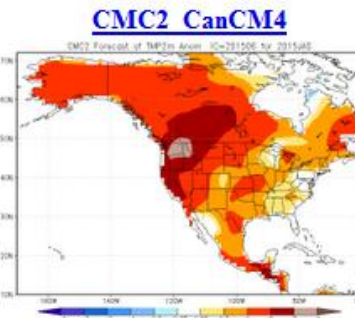
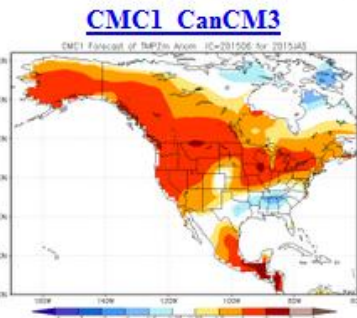
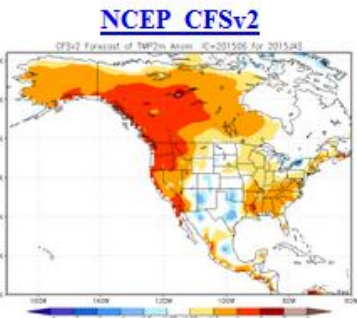
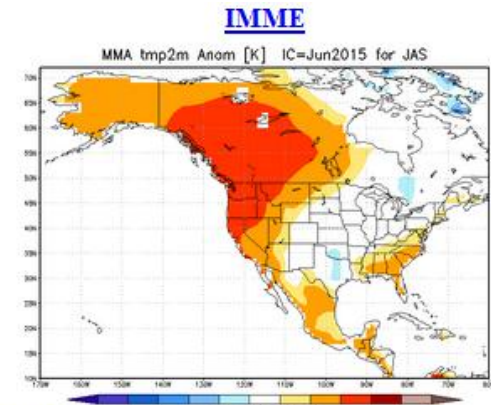
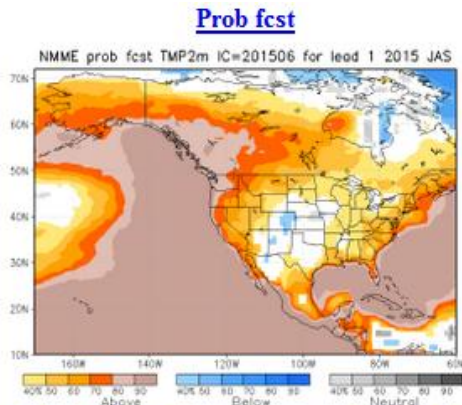
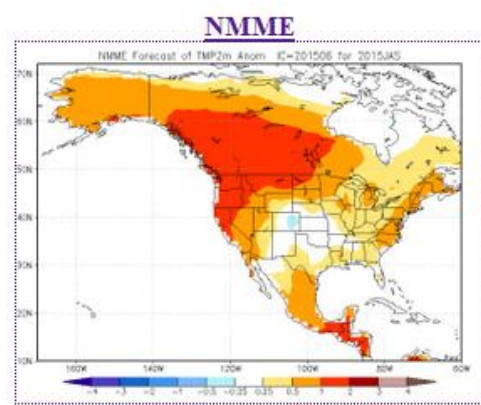


Seven experiments in near-term climate forecasting Jul-Sep 2015. Temperature.

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 IMME (International Multi-Model Ensemble).

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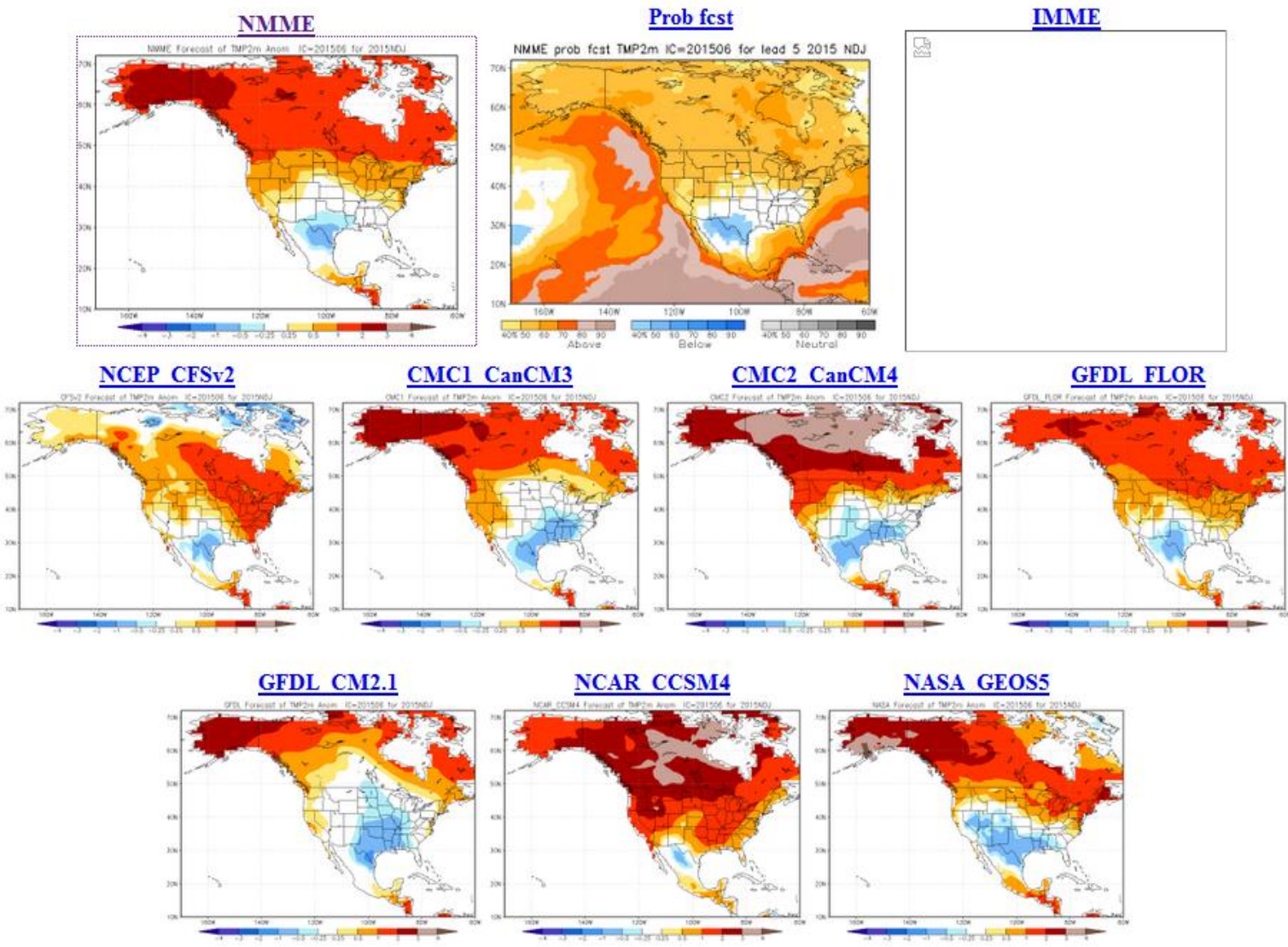


# Seven experiments in near-term climate forecasting Nov-Jan 2015-6. Temperature.

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ASSESSMENT REPORT  
**Causes and Predictability  
of the 2011-14  
California Drought**

**RICHARD SEAGER**  
Lamont Doherty Earth Observatory of Columbia University

**MARTIN HOERLING**  
NOAA Earth System Research Laboratory

**SIEGFRIED SCHUBERT**  
**HAILAN WANG**  
NASA Goddard Space Flight Center

**BRADFIELD LYON,**  
International Research Institute for Climate and Society

**ARUN KUMAR**  
NOAA Climate Prediction Center

**JENNIFER NAKAMURA**  
**NAOMI HENDERSON**  
Lamont Doherty Earth Observatory of Columbia University

**The First Three Winters of Drought**

**2014-2015 Update in the Works**

**Each winter played out differently**

**Background and thus causes  
somewhat different each winter**

**2014-15 cause also likely not  
identical to previous three winters**

**Explanations reach to western  
Pacific and eastern Indian Oceans**

**Not much sign of climate change  
as a contributor**

**But, possible harbinger of  
future droughts:**

**Not just dry, but extremely warm**

# The California - Sierra - Nevada Drought - Where from here?

## NIDIS as a Drought Early Warning System

Managers and decision-makers worst fear: Being taken by surprise

How to portray current status more optimally and completely - drought in managed systems

Concerted push on prediction communities

What were we saying last year at this time?

Huge interest in the coming winter

What has stayed the same (in the climate system) over the past 4 years ??

Not great prospects for rapid seasonal / interannual forecast improvement

Thus, also need a focus on coping mechanisms

Is this drought “natural” or “climate change enhanced” or what combination?

Enlarging the climate knowledge sand pile: what is the angle of repose?

The Colorado River drought (12 of last 15 years) ... is this a megadrought??

Snow drought (snow deficiencies worse than precipitation deficiencies)

A harbinger for the future?

Why has the recent past, and particularly this winter, been so warm?

Exploring and understanding the effects of temperature, other demand variables

EL Nino : Unreliably wet winters in southern California. May / can help, but not guaranteed.

Near-term focus: Why some El Nino winters wet, others dry, in Southern California?

Connection between climate and weather seems crucial

Extreme events (large storms) often make or break a winter

Other biological phenomena: fish, marine mammals, harmful algal bloom, “the Blob”

Never waste a crisis



**Thank You !**



**Mather RAWS Station  
Great Basin Nat Park**