El Nino and Water Resources Forecasts During California's Drought

Exploring Drought Recovery Climate Tools in the Western U.S.

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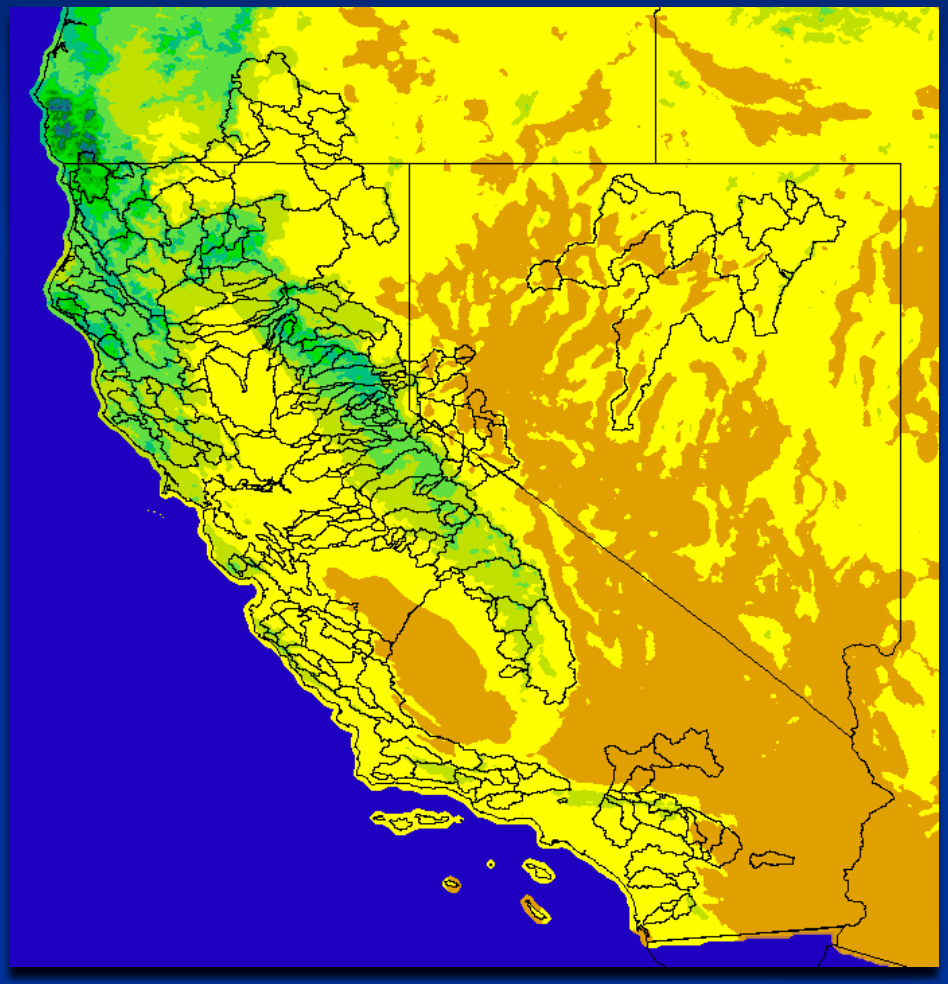
NOAA/NWS – California Nevada River Forecast Center

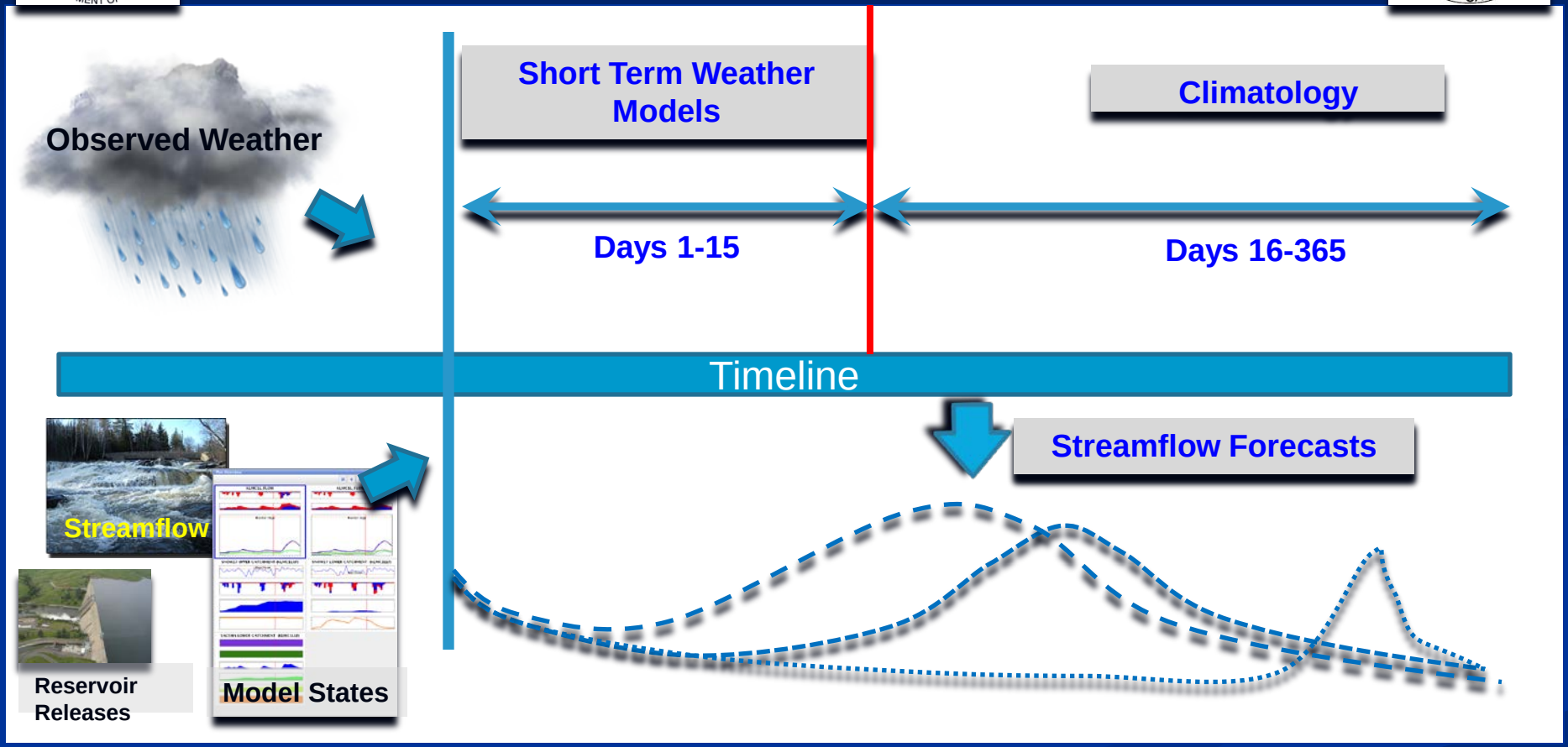
September 2015

CNRFC Operations



- 245,000 sq. miles
- ~270 Basins modeled
- 94 Forecast Points
- ~60 Reservoir Inflows

River Forecasts



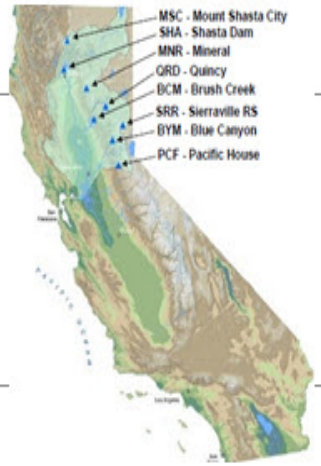
Creating Context

- How bad is the drought? Compared to what?
- First, quantify the extent of the drought
  - look at precipitation deficits
  - look at runoff deficits
  - compare to previous droughts

8-Station Index (Northern Sierra Precipitation)

Cumulative Actual Precipitation Vs. Cumulative Normal

October 2011 - July 2015



Normal Annual Precip: 50.0"

199.0 inches

45.09" Deficit

153.91 inches

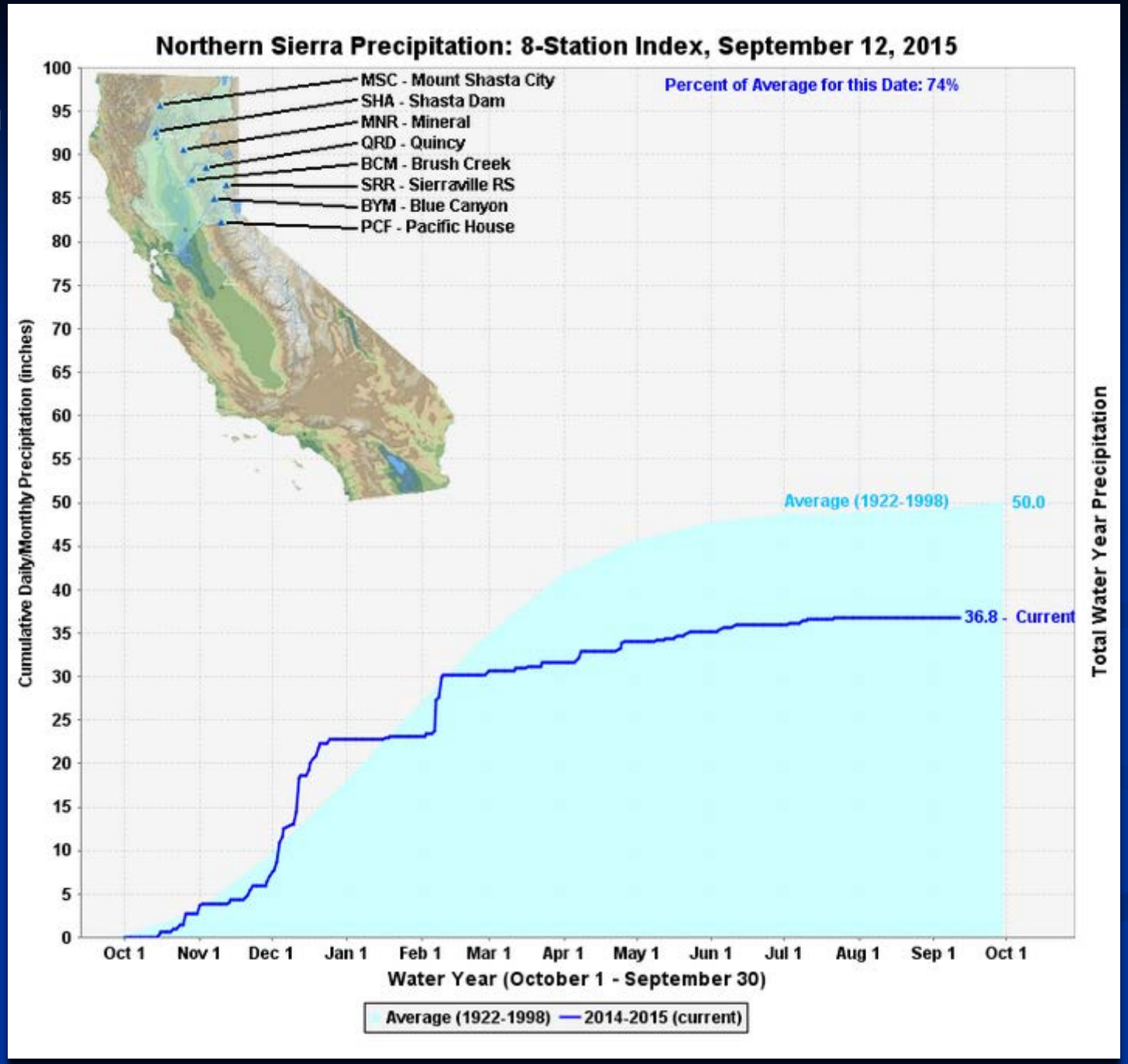
Precipitation (Inches)

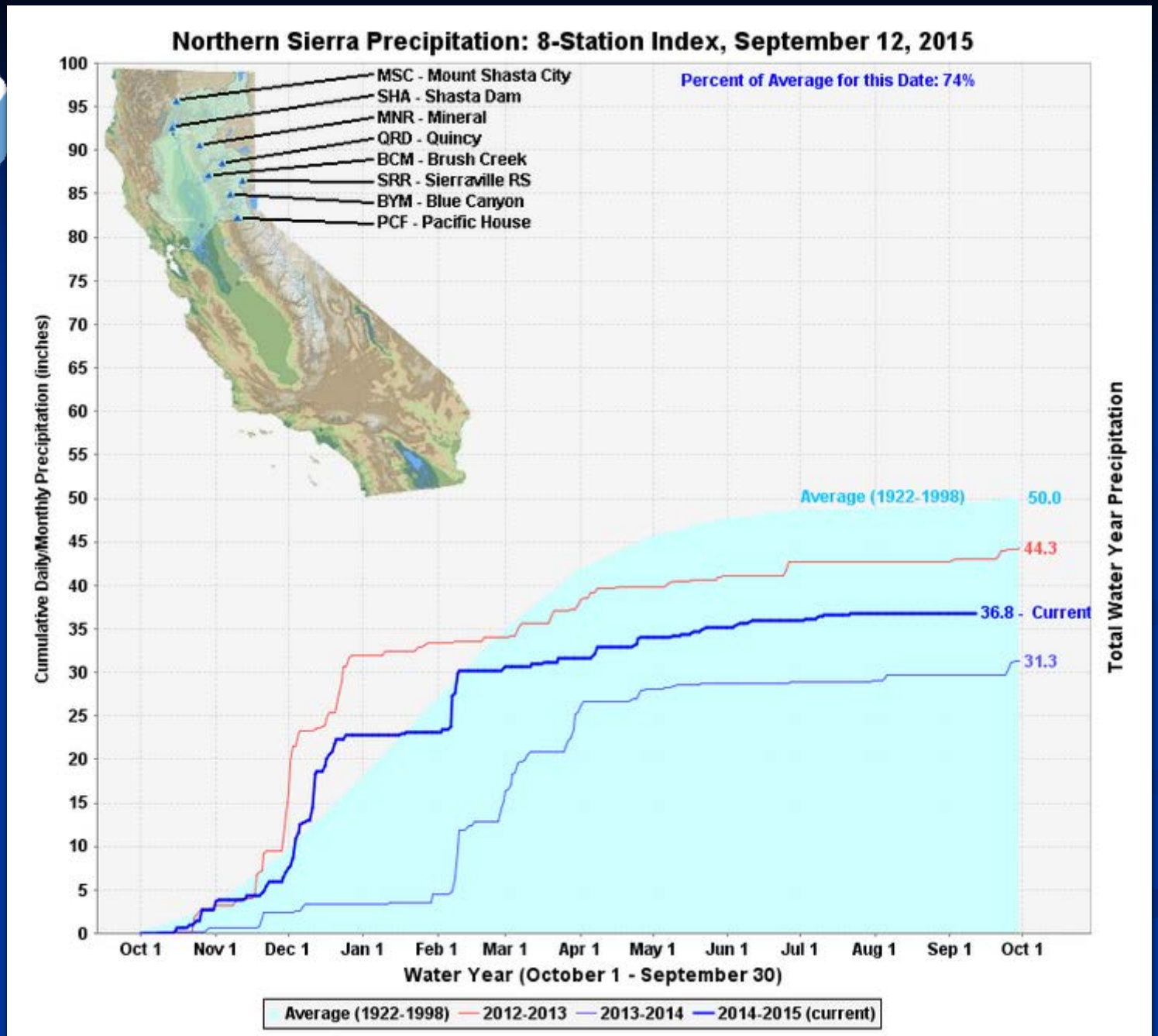
0
50
100
150
200

Oct-11 Dec-11 Feb-12 Apr-12 Jun-12 Aug-12 Oct-12 Dec-12 Feb-13 Apr-13 Jun-13 Aug-13 Oct-13 Dec-13 Feb-14 Apr-14 Jun-14 Aug-14 Oct-14 Dec-14 Feb-15 Apr-15 Jun-15

Actual Cumulative Precip

Normal Cumulative Precip


Northern Sierra Precipitation: 8-Station Index, September 12, 2015
MSC - Mount Shasta City
SHA - Shasta Dam
MNR - Mineral
QRD - Quincy
BCM - Brush Creek
SRR - Sierraville RS
BYM - Blue Canyon
PCF - Pacific House
Percent of Average for this Date: 74%
Average (1922-1998)
50.0
36.8 - Current
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Water Year (October 1 - September 30)
Average (1922-1998)
2014-2015 (current)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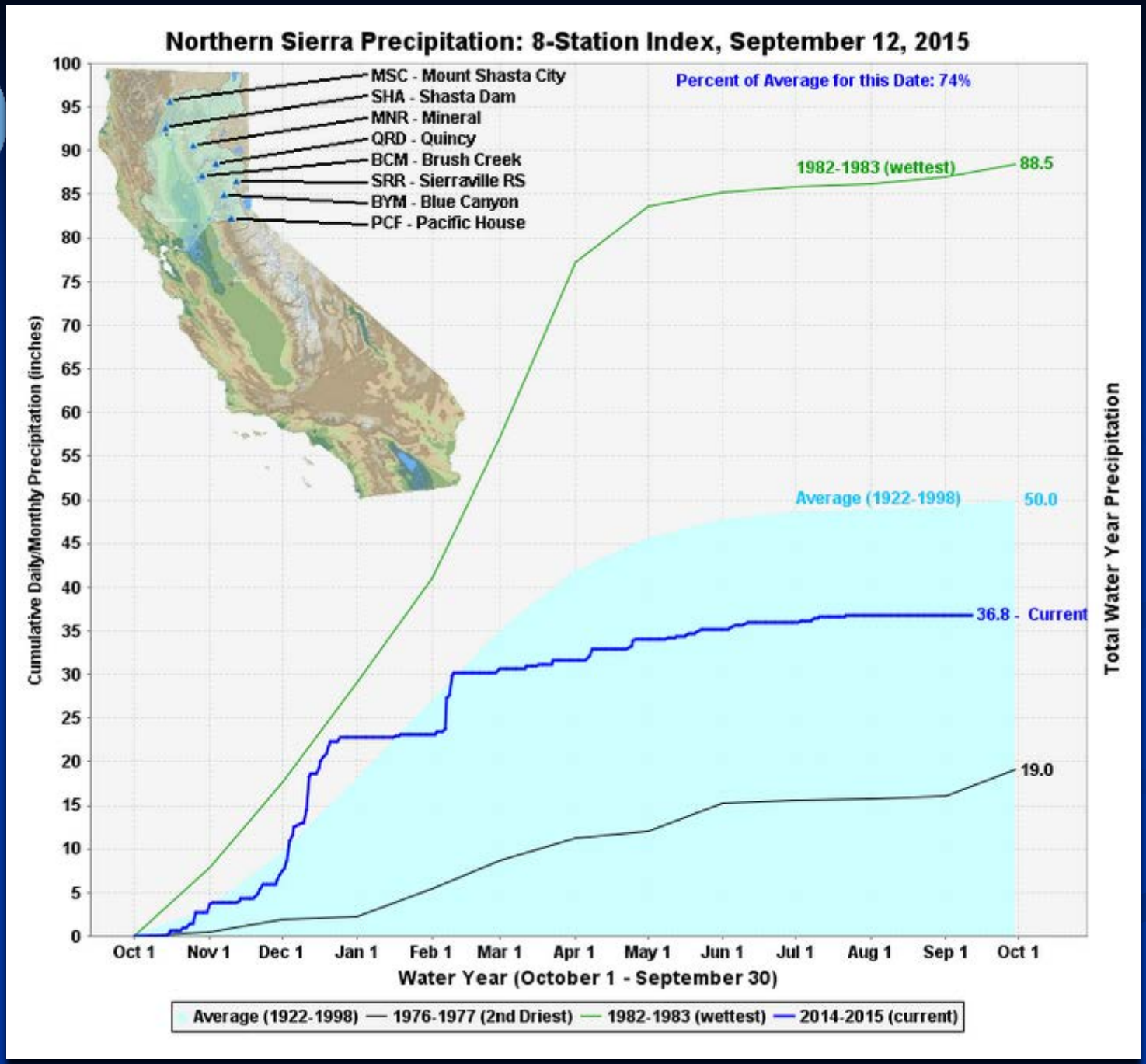
BYM - Blue Canyon
PCF - Pacific House
Percent of Average for this Date: 74%
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Average (1922-1998) 50.0
44.3
36.8 - Current
31.3
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Water Year (October 1 - September 30)
Average (1922-1998)
2012-2013
2013-2014
2014-2015 (current)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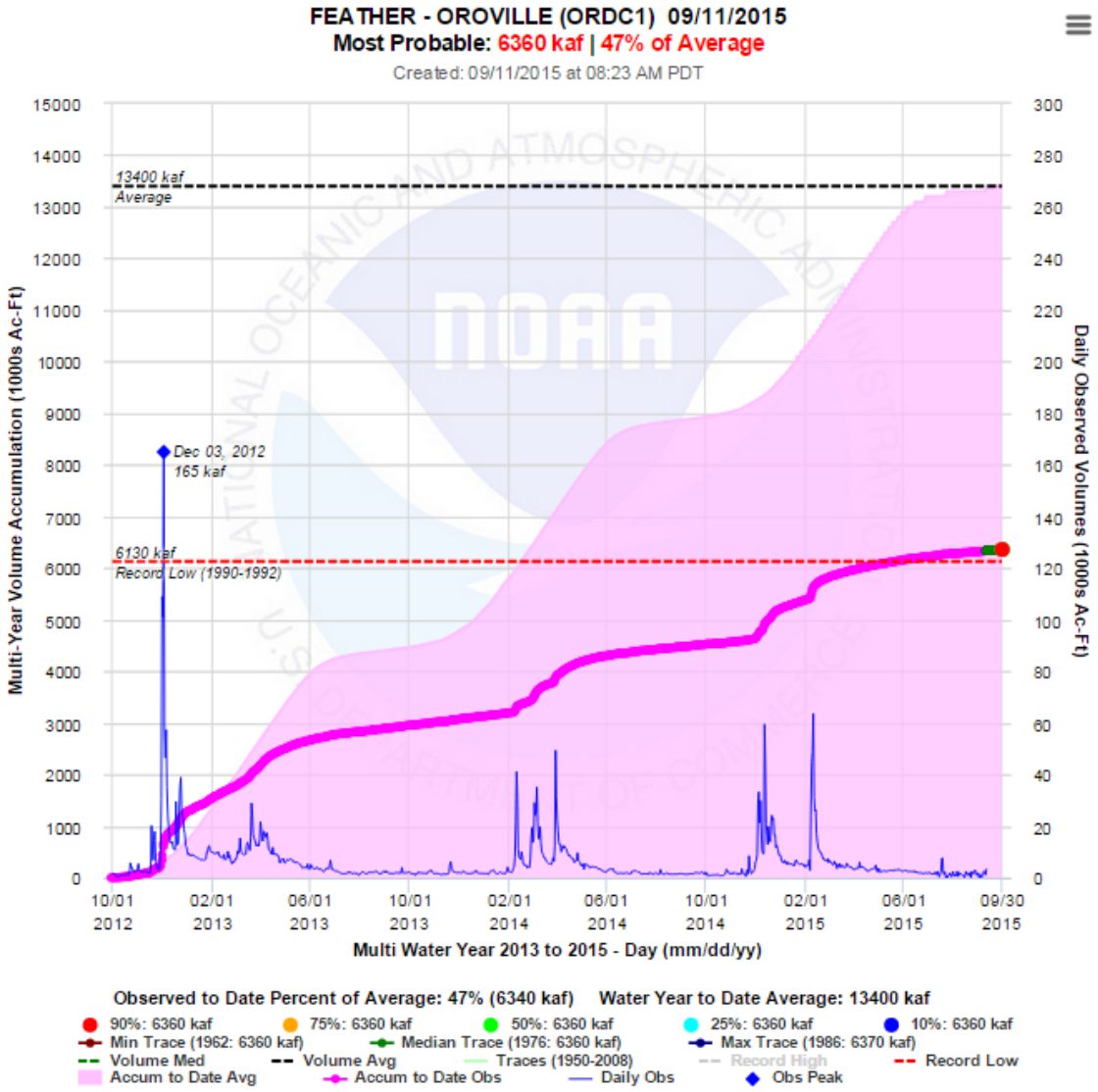
SHA - Shasta Dam
MNR - Mineral
QRD - Quincy
BCM - Brush Creek
SRR - Sierraville RS
BYM - Blue Canyon
PCF - Pacific House
Percent of Average for this Date: 74%
1982-1983 (wettest)
88.5
Average (1922-1998)
50.0
36.8 - Current
19.0
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Water Year (October 1 - September 30)
Average (1922-1998)
1976-1977 (2nd Driest)
1982-1983 (wettest)
2014-2015 (current)

FEATHER RIVER - LAKE OROVILLE (ORDC1)

Latitude: 39.53° N Longitude: 121.52° W Elevation: 922 Feet
Location: Butte County in California River Group: Lower Sacramento

Issuance Time: Sep 11 2015 at 8:29 AM PDT

3-Water Year Accum. Volume Plot Ending 2015 **CSV Ensemble File Download:** Forecast Group | ORDC1



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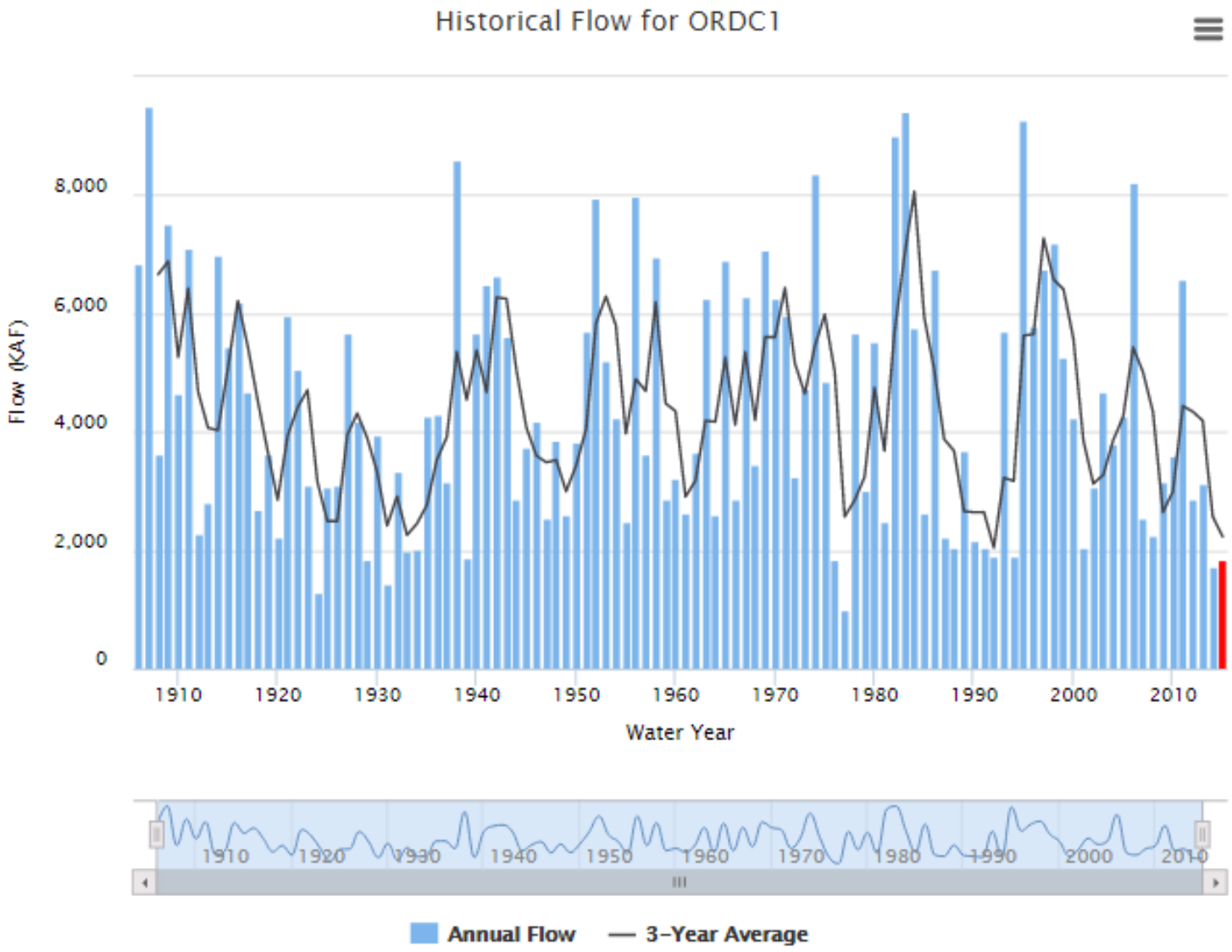


47% of average

Annual Flow Ranking

Rank	Year	Annual Flow	3-Year Average
1	1977	994.5	2566.0
2	1924	1295.3	3151.9
3	1931	1443.3	2413.2
4	2014	1721.9	2570.3
5	2015	1835.9	2229.2
6	1929	1844.3	3895.4
7	1976	1849.5	5022.2
8	1939	1857.0	4542.3
9	1994	1891.3	3167.5
10	1992	1897.5	2043.7

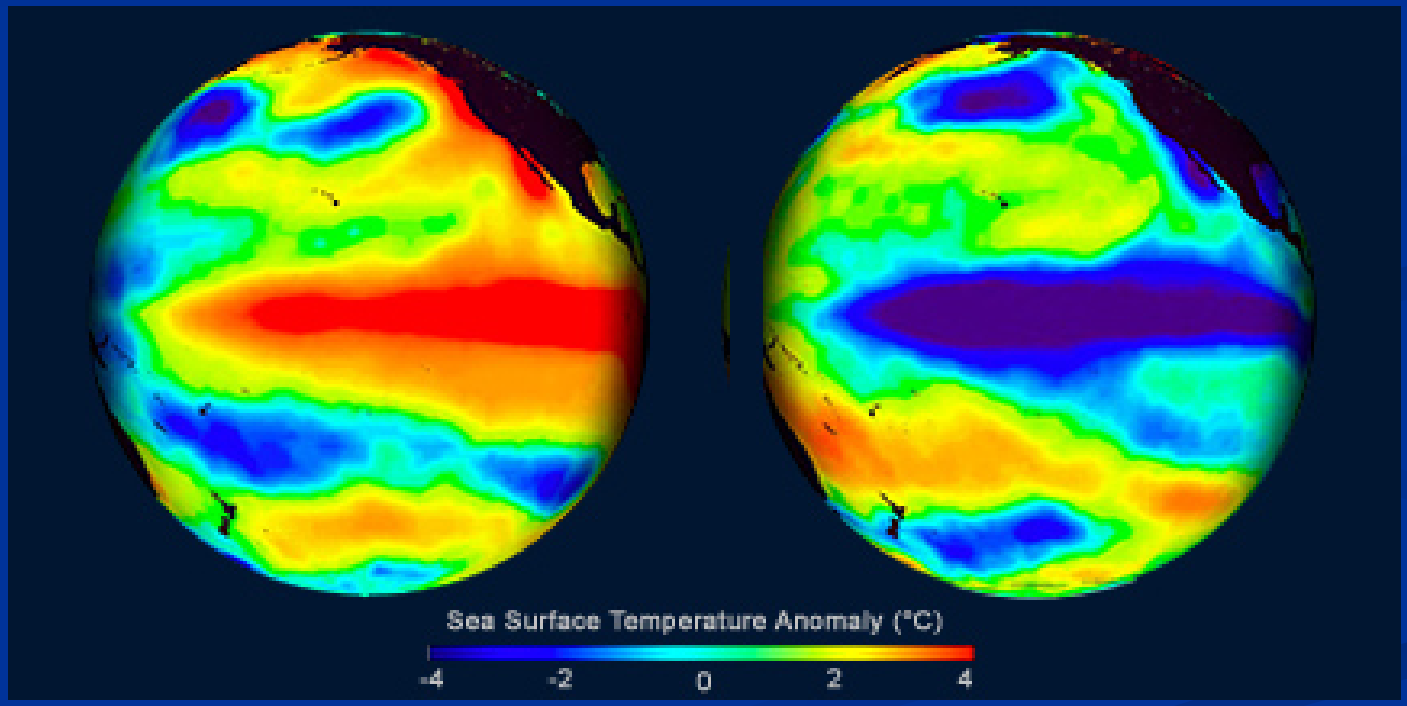
3 YR Flow Ranking

Rank	Year	Annual Flow	3-Year Average
1	1992	1897.5	2043.7
2	2015	1835.9	2229.2
3	1933	1999.5	2255.7
4	1931	1443.3	2413.2
5	1934	2016.8	2446.9
6	1925	3075.7	2489.0
7	1926	3097.8	2489.6
8	1977	994.5	2566.0
9	2014	1721.9	2570.3
10	1990	2176.9	2640.5

The Limits of Water Resources Forecasting

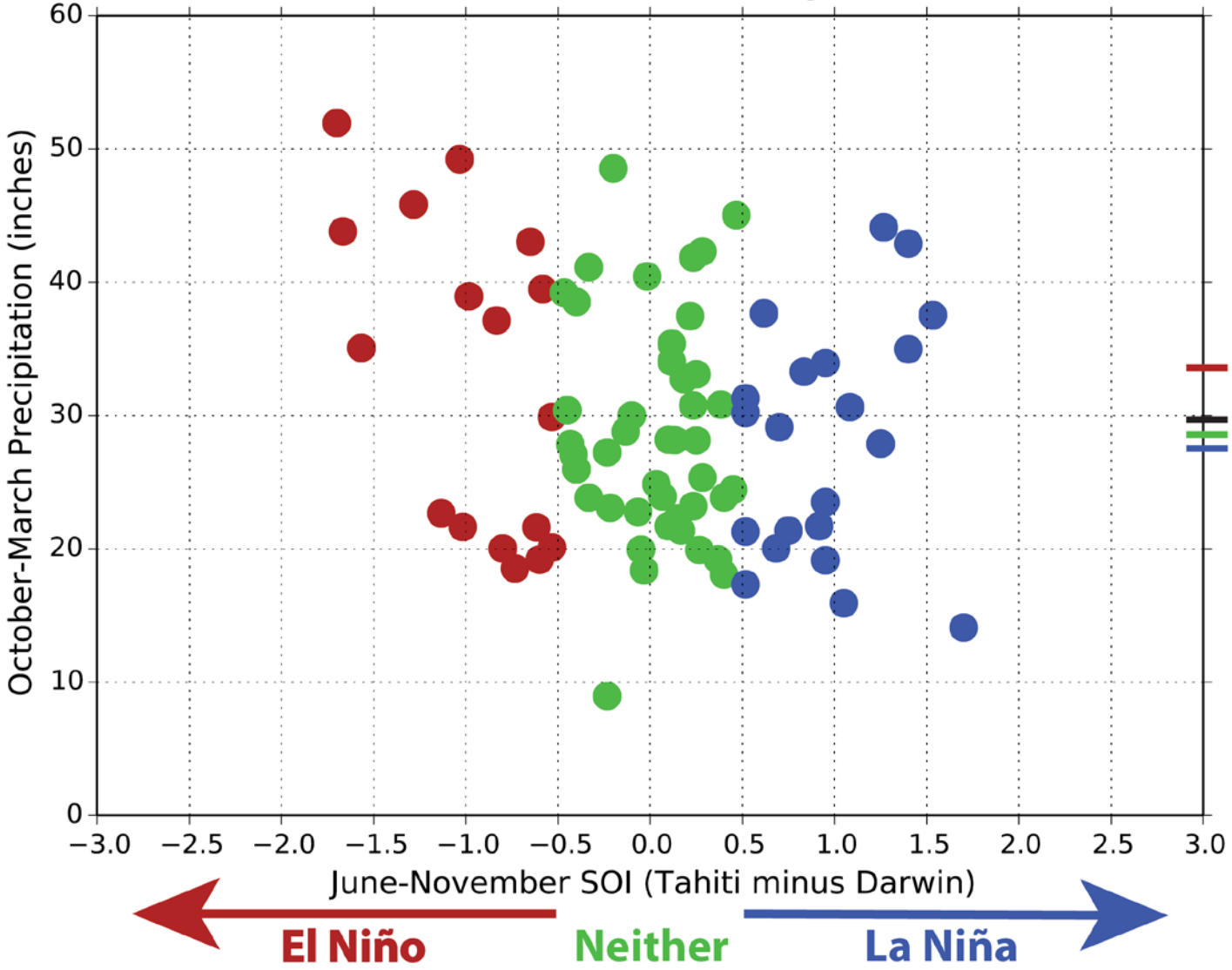
- Hydrologic forecasts are highly dependent on atmospheric forecasts
- Atmospheric forecast skill trails off after about 10-15 days
- ENSO offers some degree of seasonal predictability for select geographic regions
- The state of the mountain snowpack also offers some degree of seasonal runoff forecast skill

What About El Nino?



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

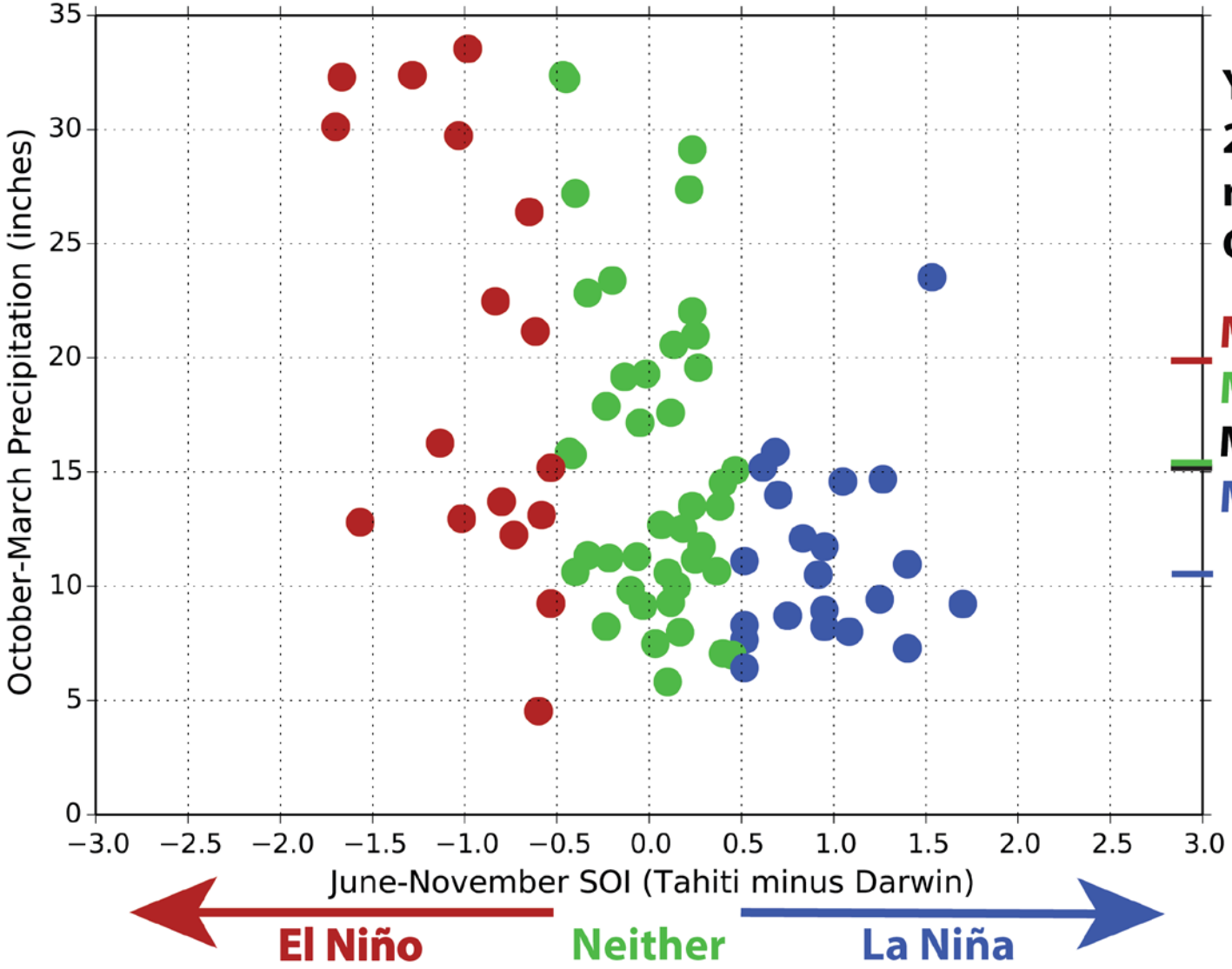
Mean = 28.8 in

Mean = 28.0 in

Western Regional Climate Center

CA Division 6 October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



Years 1933/1934-2013/2014

$r^2 = 0.22$

Correlation = -0.47

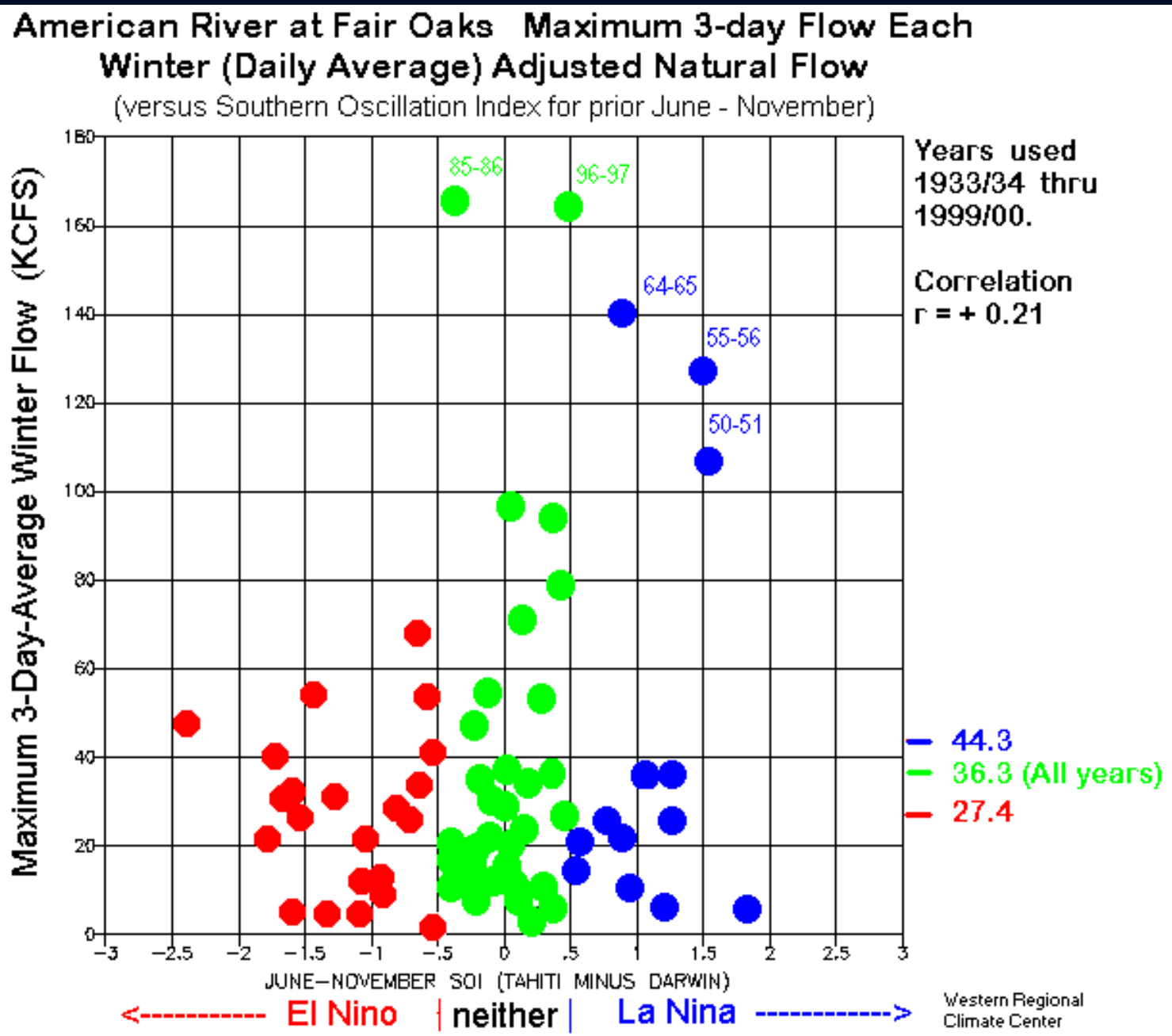
Mean = 19.89 in

Mean = 15.45 in

Mean all = 15.30 in

Mean = 11.27 in

Western Regional Climate Center


American River at Fair Oaks Maximum 3-day Flow Each Winter (Daily Average) Adjusted Natural Flow
(versus Southern Oscillation Index for prior June - November)
Maximum 3-Day-Average Winter Flow (KCFS)
0
20
40
60
80
100
120
140
160
180
85-86
96-97
64-65
55-56
50-51
−3
−2.5
−2
−1.5
−1
−.5
0
.5
1
1.5
2
2.5
3
JUNE−NOVEMBER SOI (TAHITI MINUS DARWIN)
<---------- El Nino | neither | La Nina ---------->
Years used
1933/34 thru
1999/00.
Correlation
r = + 0.21
44.3
36.3 (All years)
27.4
Western Regional
Climate Center

Summray

- The CNRFC provides water resources forecasts out to one year and context
- Most areas have a 3-4 year precipitation deficit of 1-2 years of the annual average
- Erasure of the precipitation deficit this year would require 2-3 times the annual average
- The impact of El Nino is to improve the chances for above normal precipitation in Southern CA, with more uncertainty in Northern CA
- Drought “recovery” is likely to be uneven and take a few years

California Nevada River Forecast Center

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