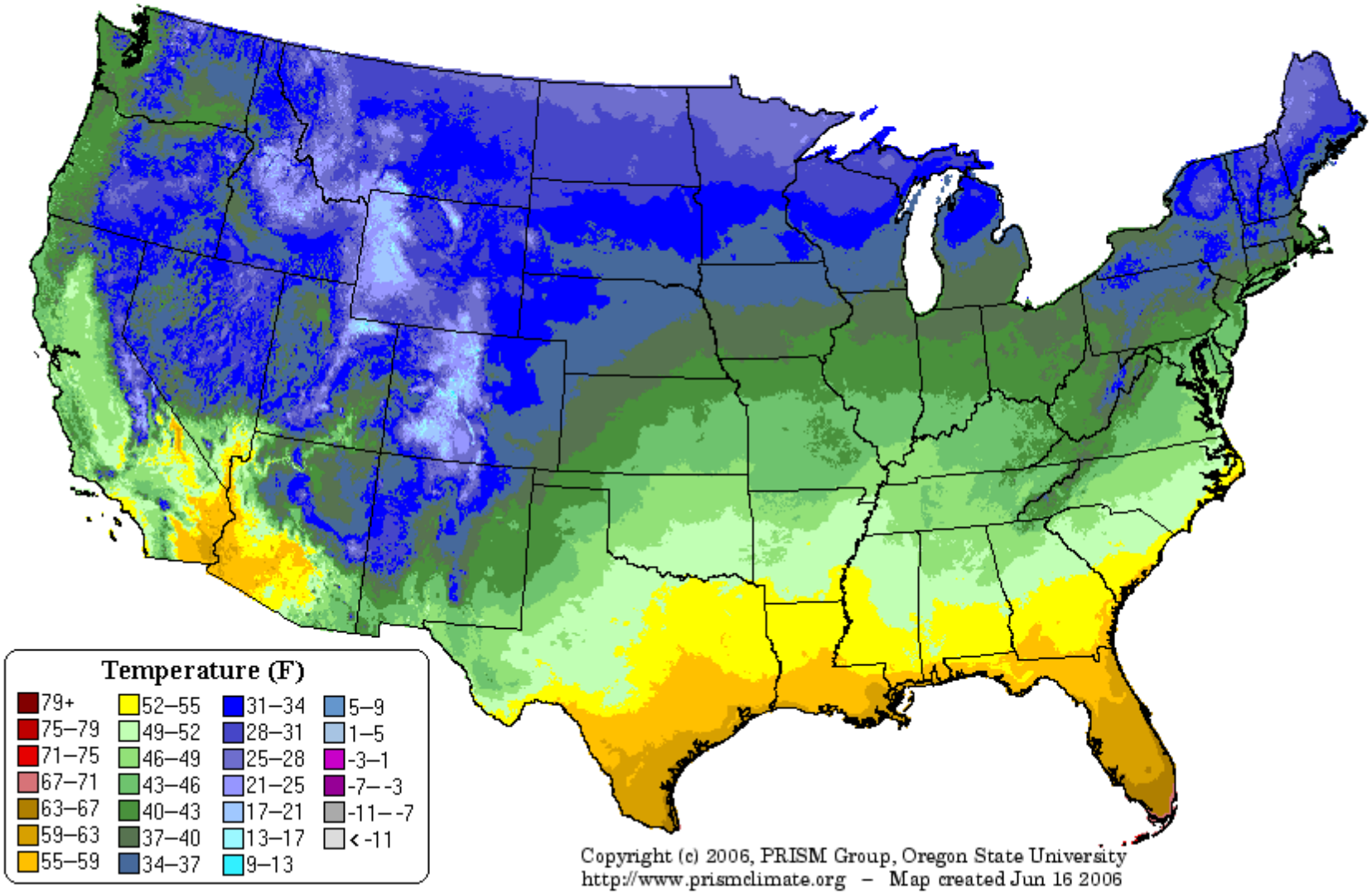
Seasonal Forecasting and the Western United States

Tales from the past 2 years

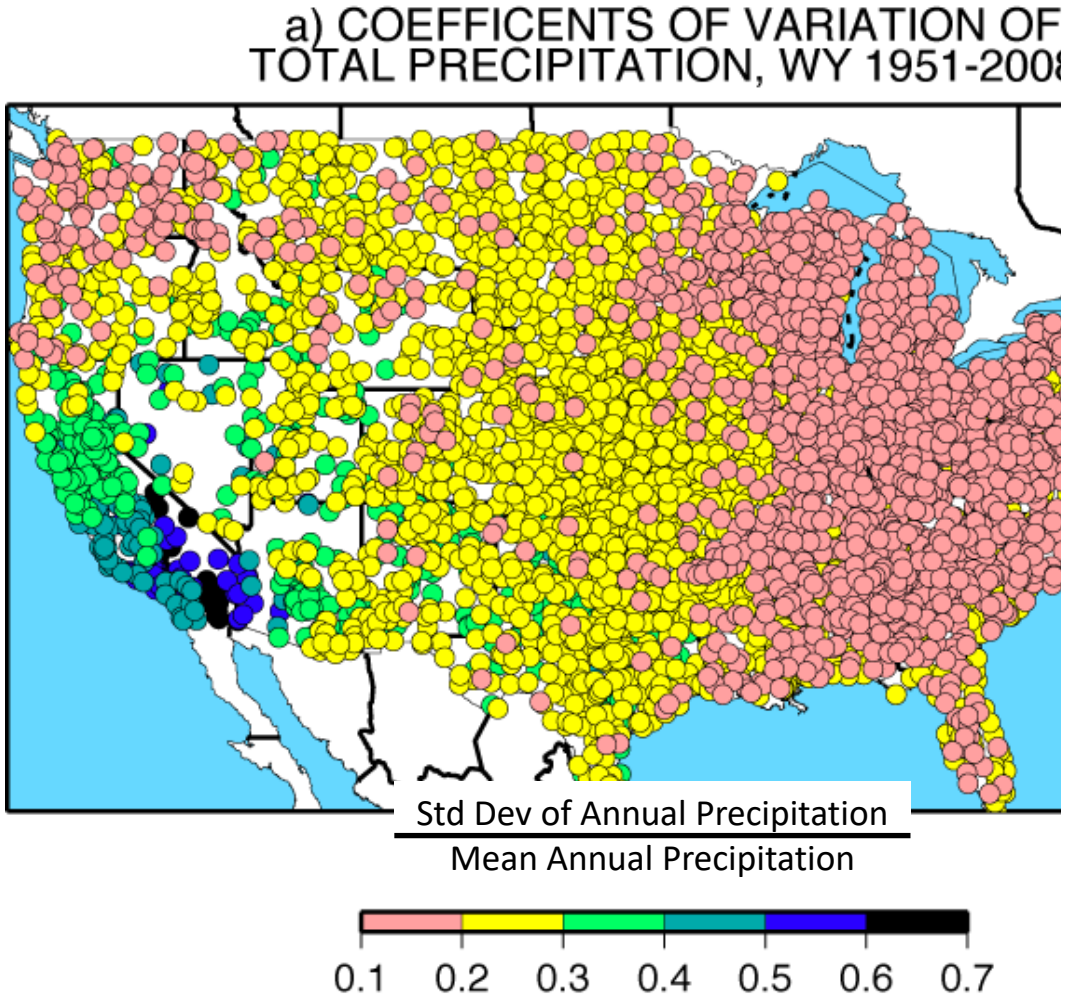
The west is a place of high variability

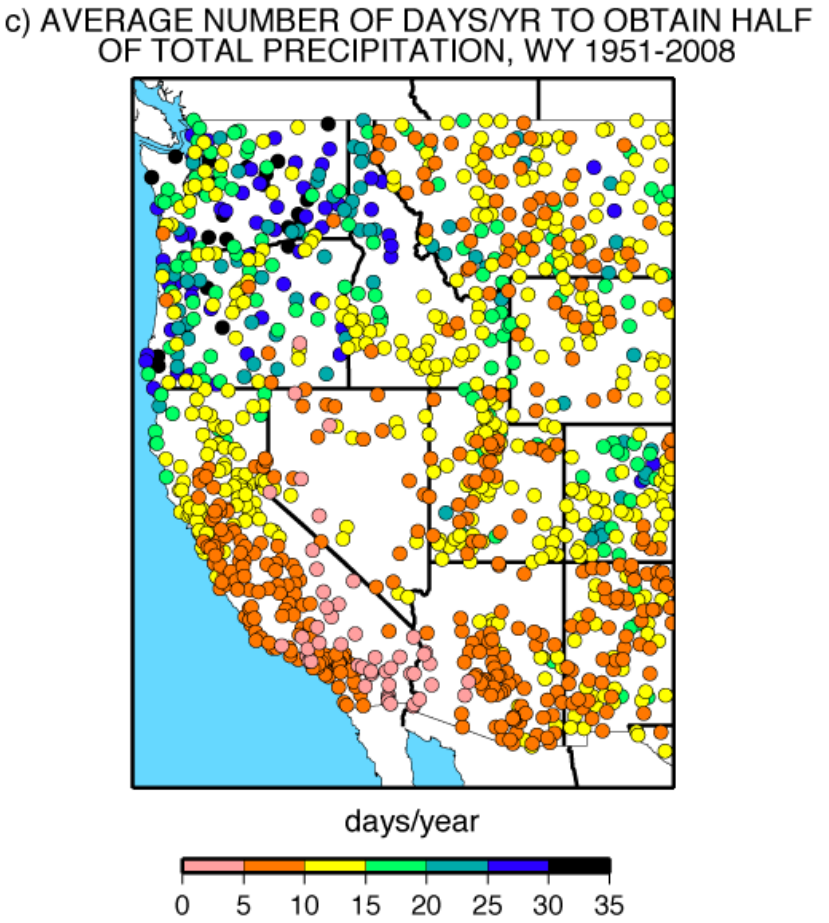
Minimum Temperature: Annual Climatology (1971–2000)



http://www.prismclimate.org – Map created Jun 16 2006

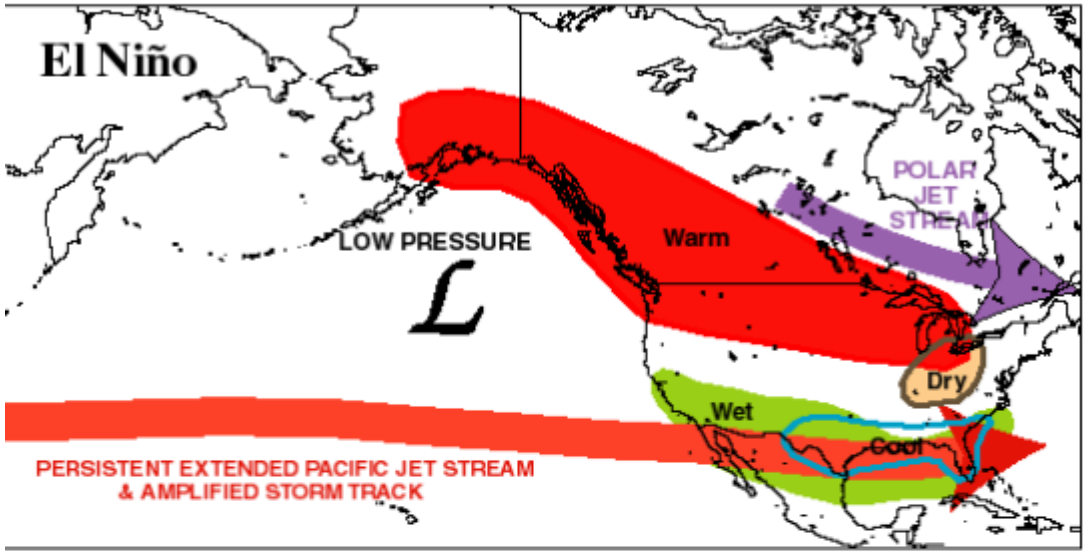
The west is a place of high variability

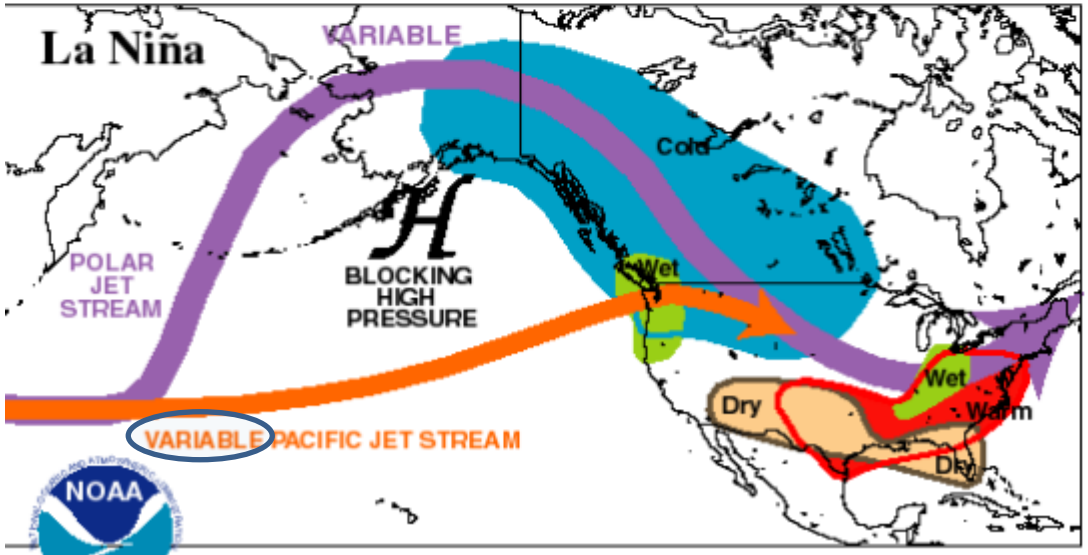




Source: Dettinger et al (2011)

TYPICAL JANUARY-MARCH WEATHER ANOMALIES AND ATMOSPHERIC CIRCULATION DURING MODERATE TO STRONG EL NIÑO & LA NIÑA





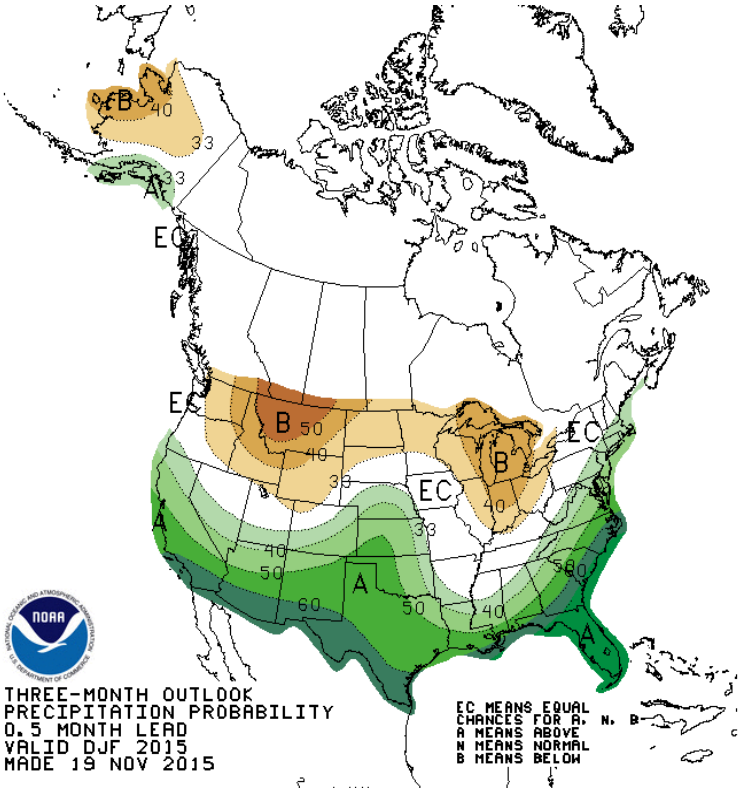
Climate Prediction Center/NCEP/NWS

U. S. Seasonal Outlooks

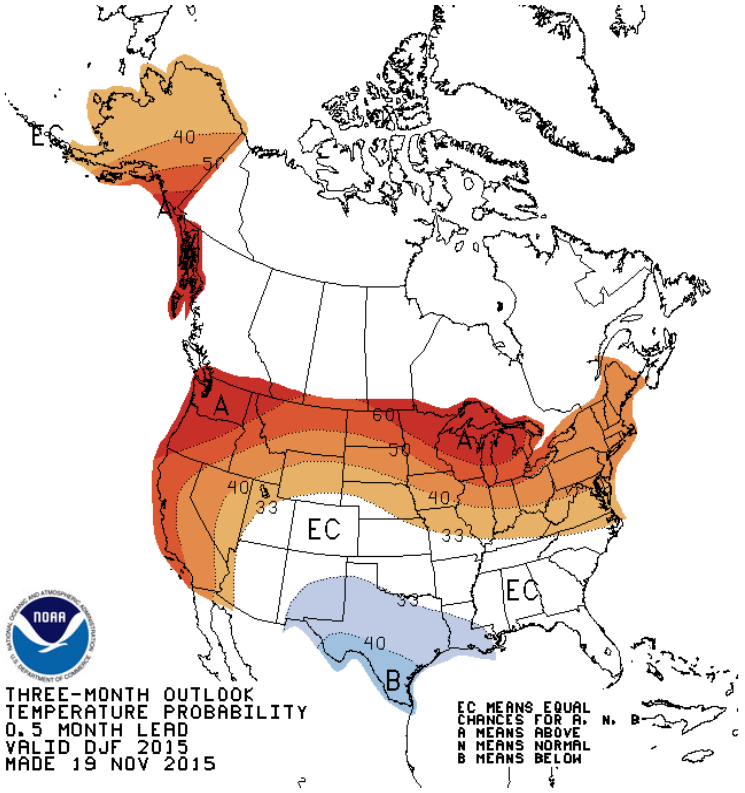
December 2015 - February 2016

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

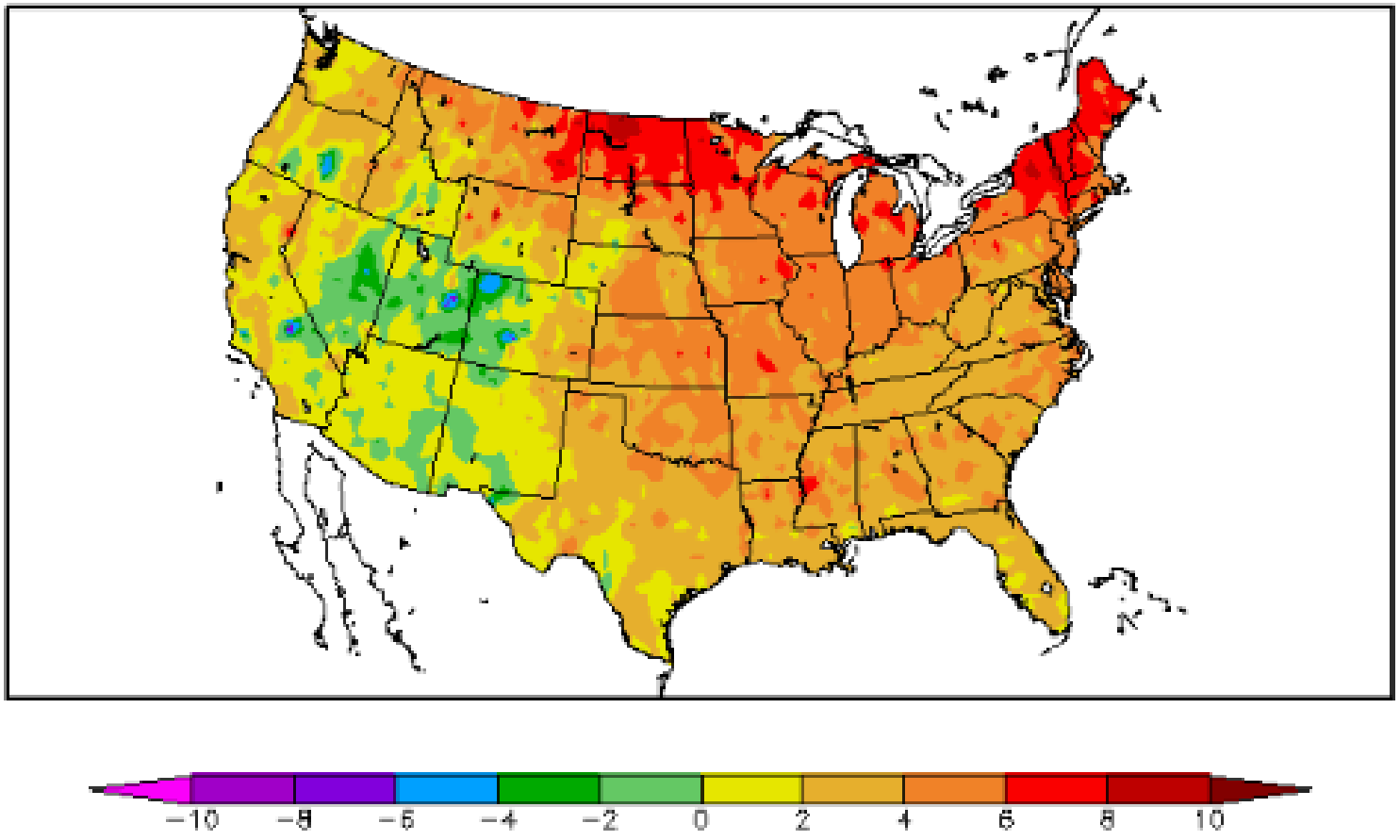
Precipitation



Temperature



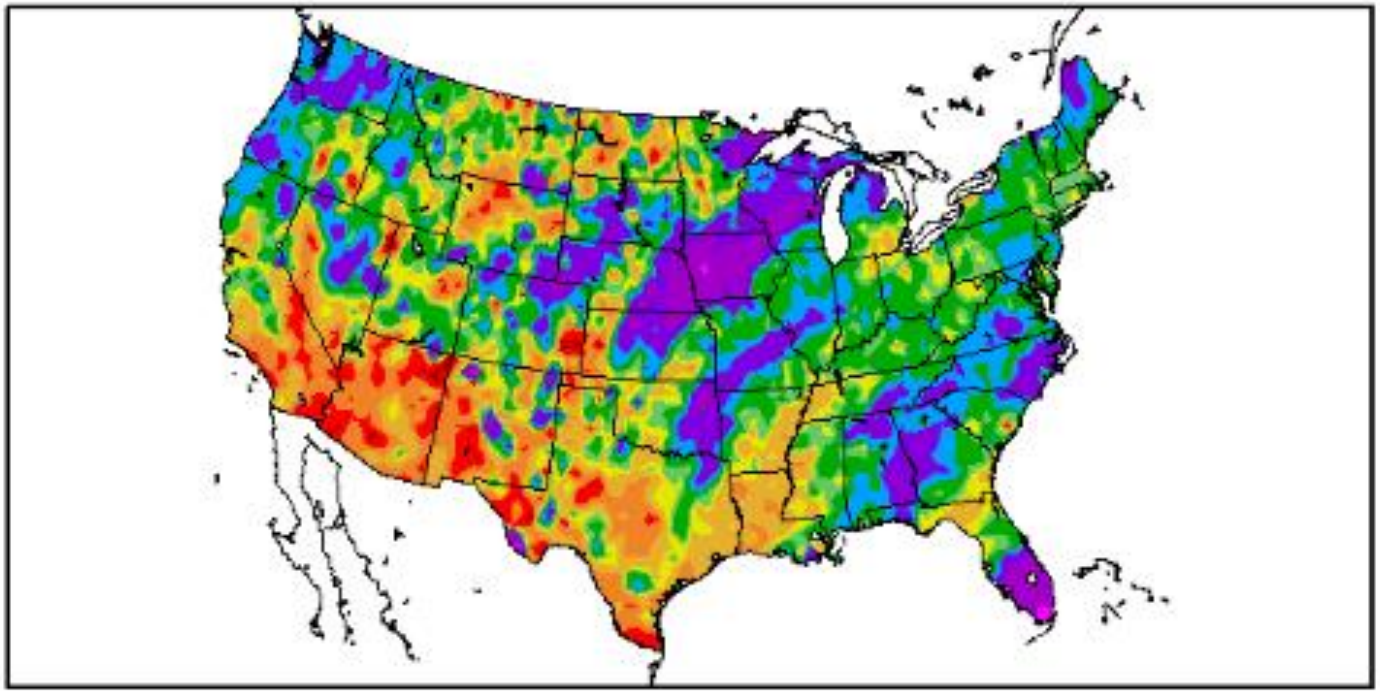
Departure from Normal Temperature (F)
12/1/2015 - 2/29/2016

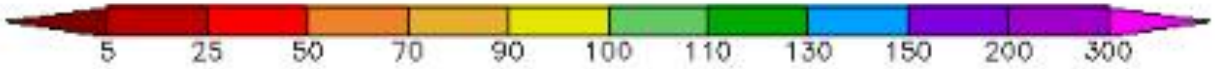


Generated 3/11/2016 at HPRCC using provisional data.

Regional Climate Centers

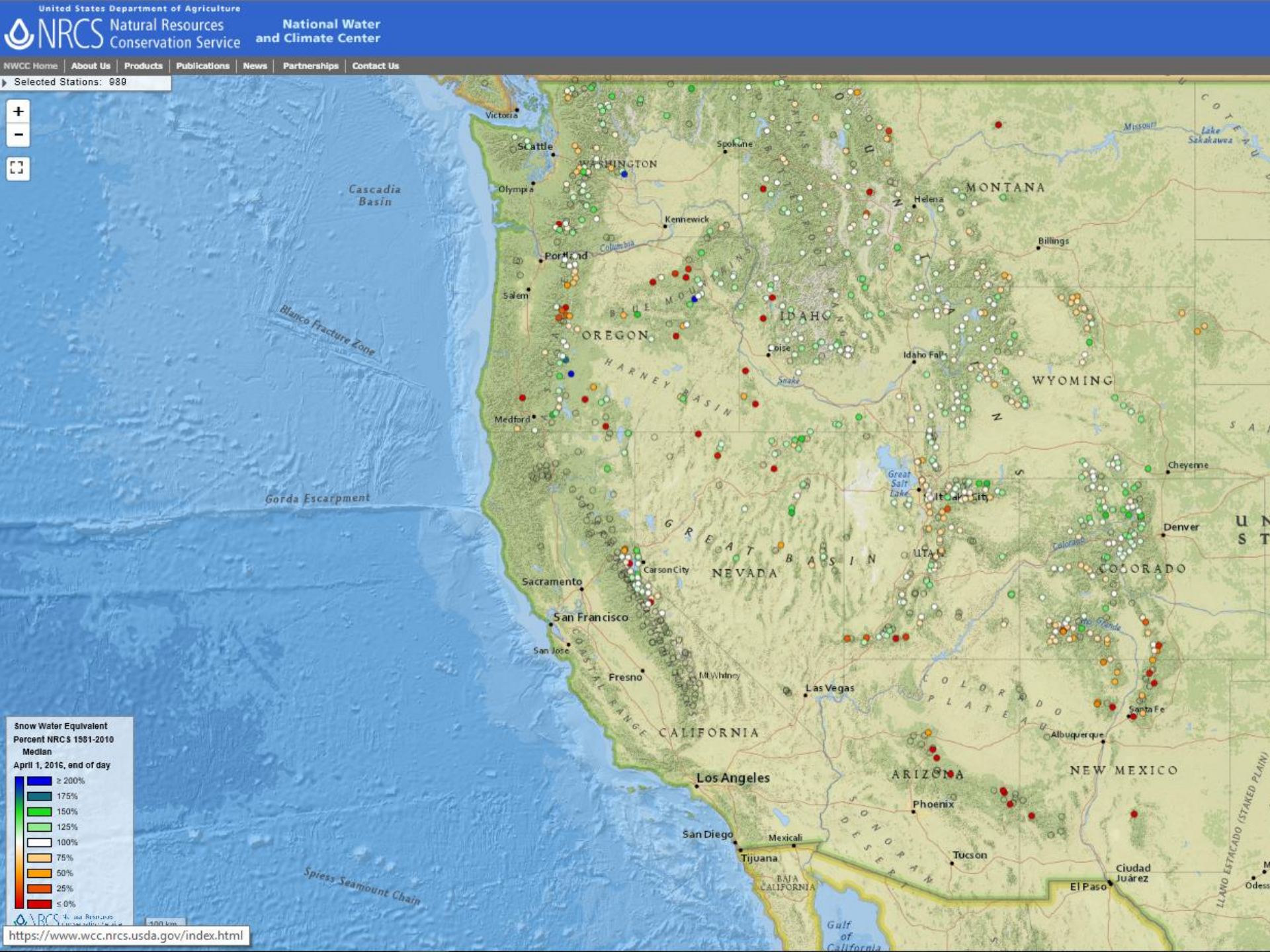
Percent of Normal Precipitation (%)
12/1/2015 – 2/29/2016





Generated 3/11/2016 at HPRCC using provisional data.

Regional Climate Centers

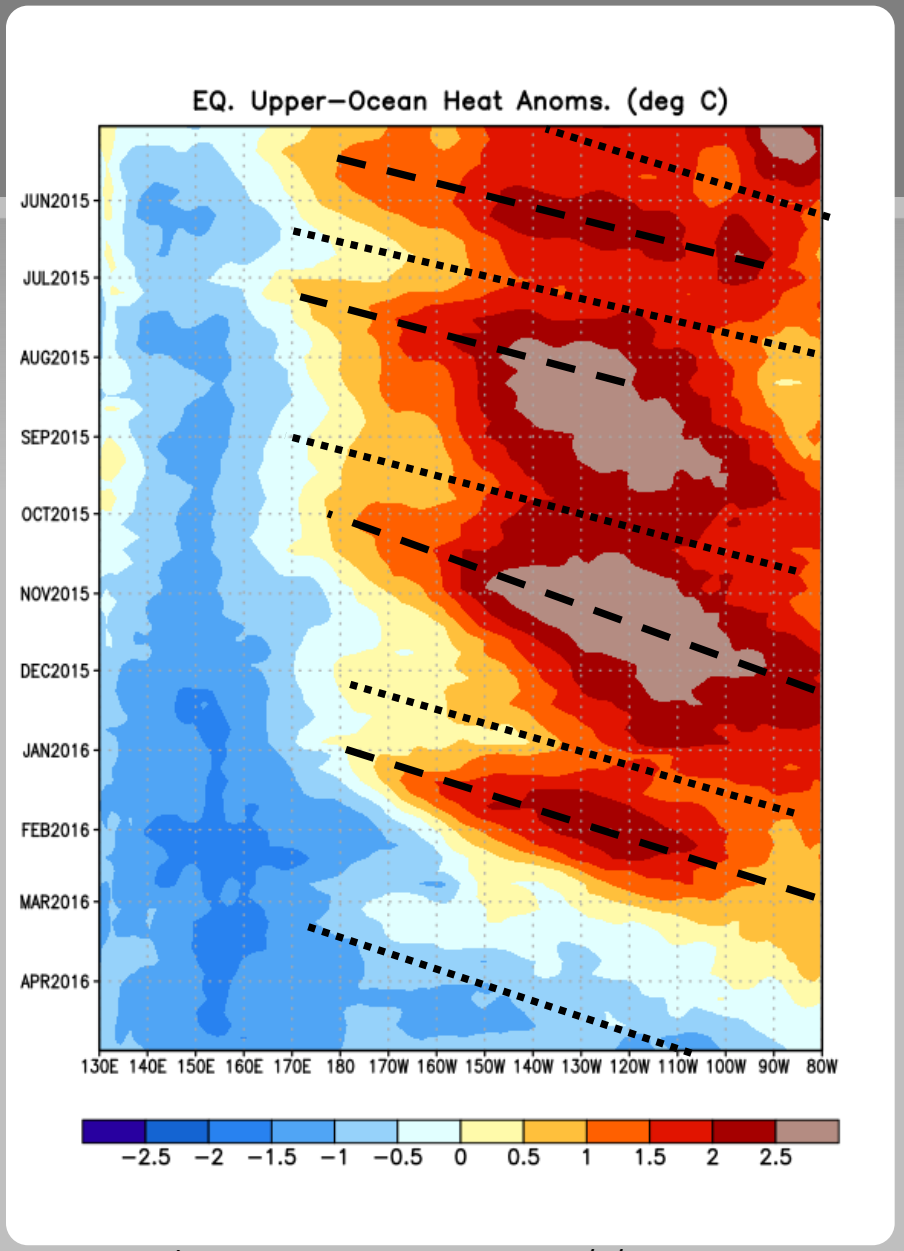

United States Department of Agriculture
NRCS Natural Resources Conservation Service
National Water and Climate Center
NWCC Home | About Us | Products | Publications | News | Partnerships | Contact Us
Selected Stations: 989
Snow Water Equivalent
Percent NRCS 1981-2010 Median
April 1, 2016, end of day
≥ 200%
175%
150%
125%
100%
75%
50%
25%
≤ 0%
https://www.wcc.nrcs.usda.gov/index.html

Weekly Heat Content Evolution in the Equatorial Pacific

Downwelling phases of a Kelvin wave were observed in mid-May to late June, July-August, and October to November, and January-February 2016.

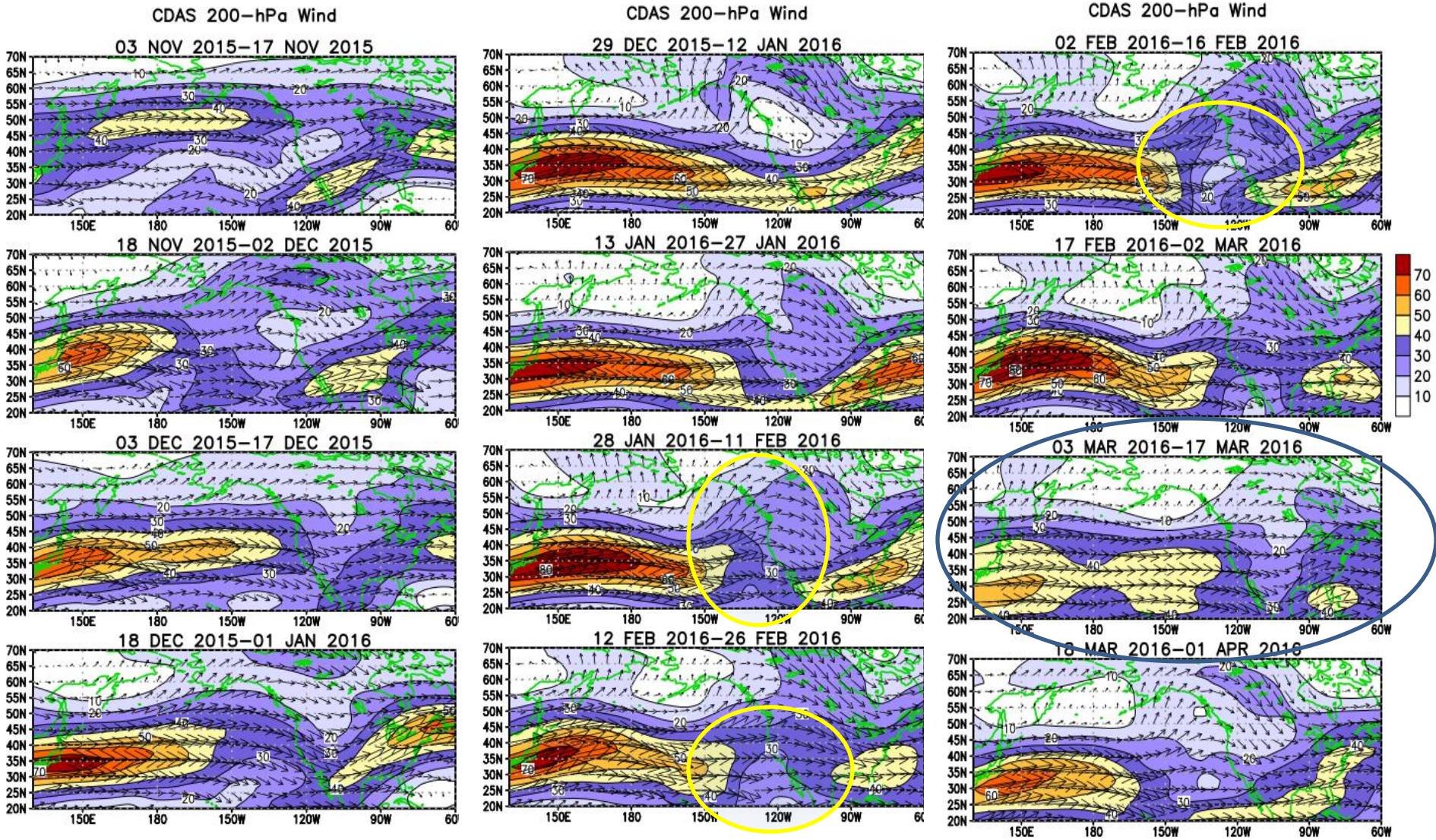
Since February 2016, an upwelling phase of a Kelvin wave has influenced the equatorial Pacific.

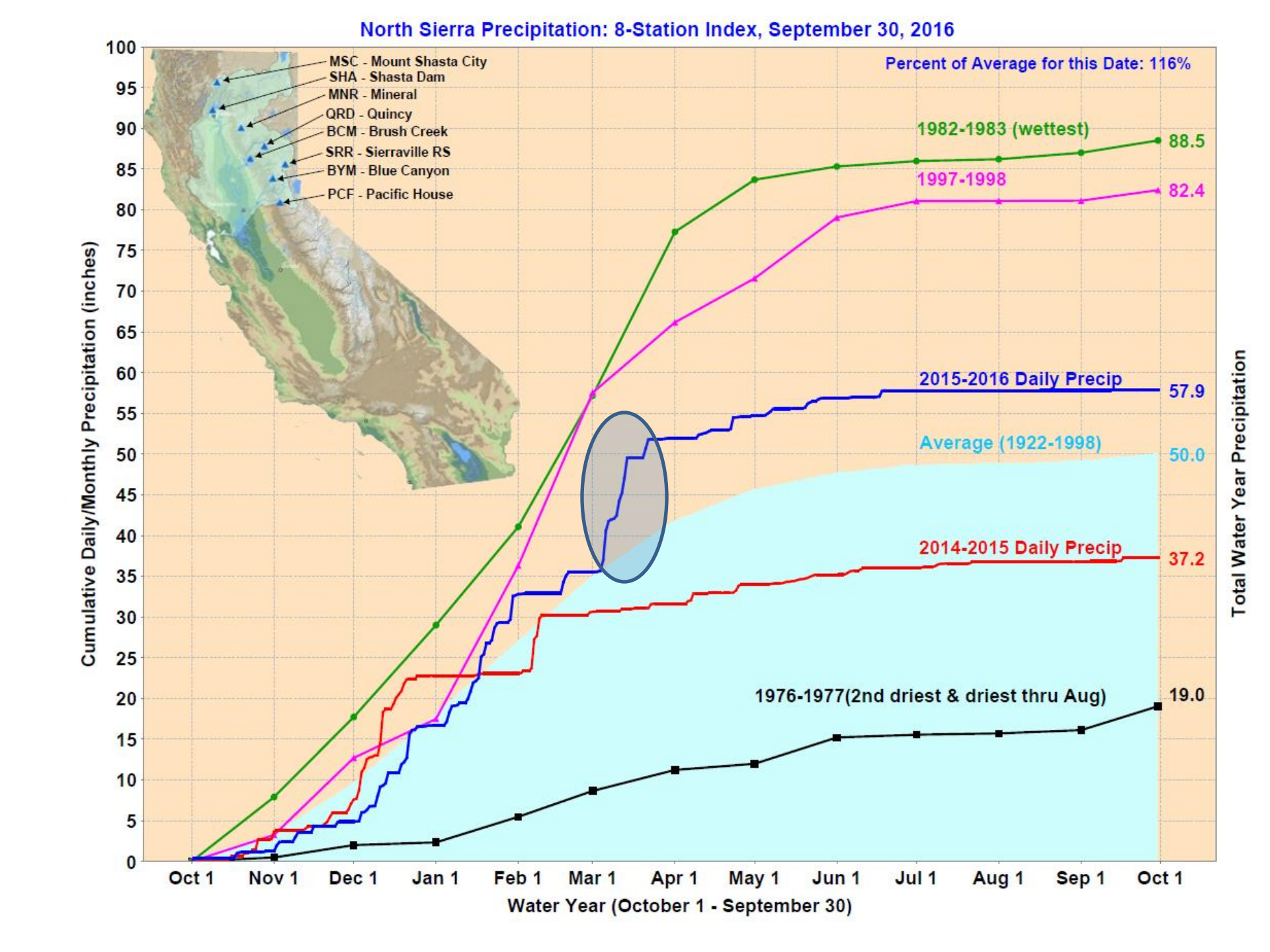
Oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.

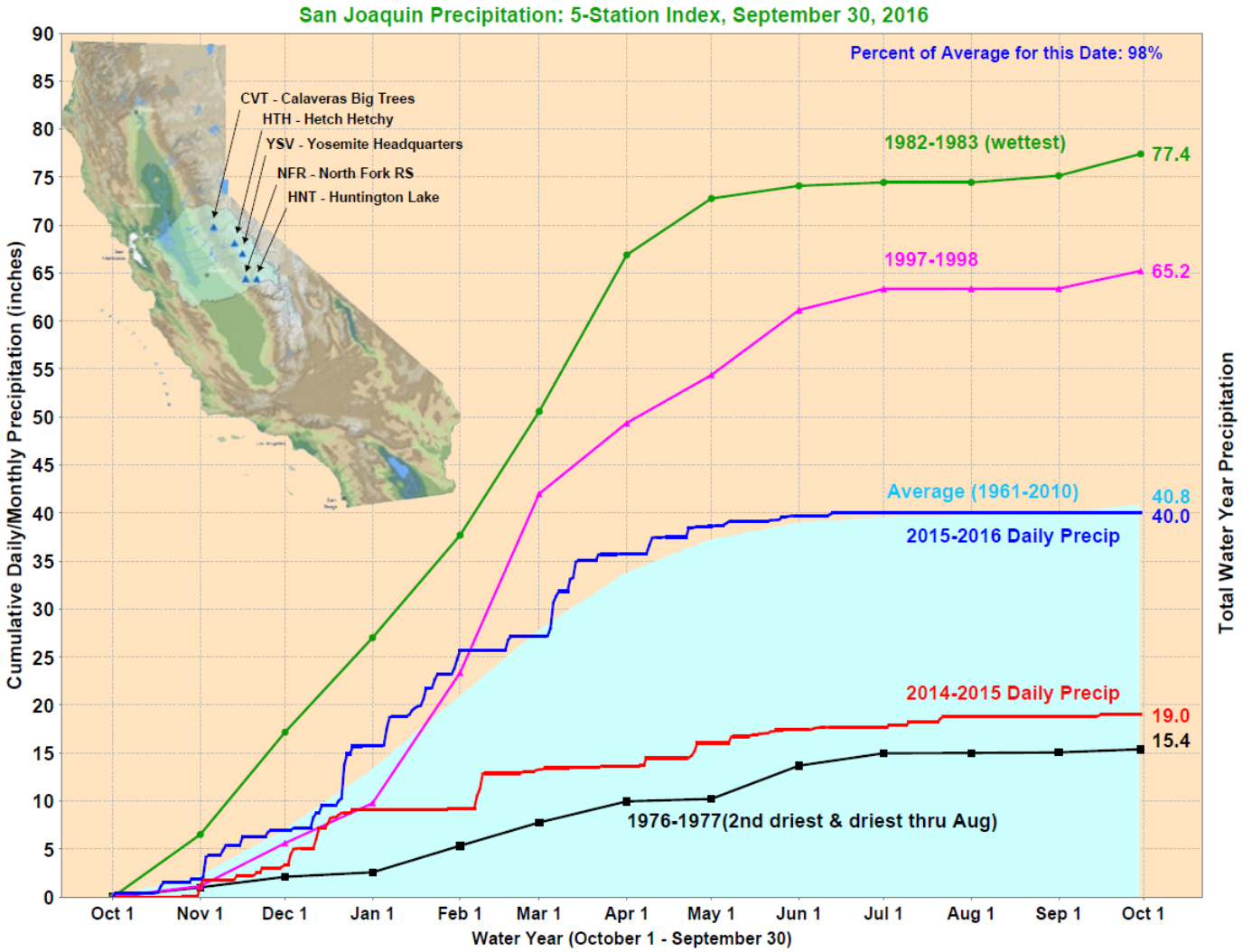


From CPC's ENSO Diagnostic Discussion 5/9/16

El Niño and the Jet Stream



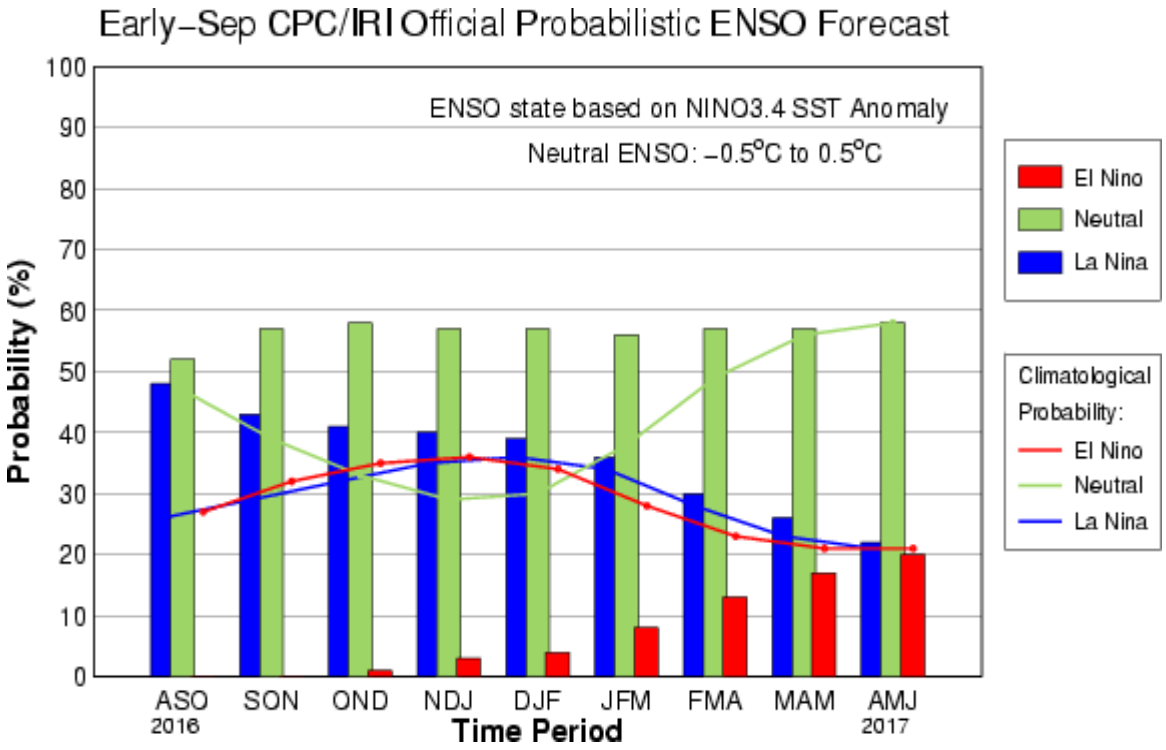

North Sierra Precipitation: 8-Station Index, September 30, 2016
Percent of Average for this Date: 116%
MSC - Mount Shasta City
SHA - Shasta Dam
MNR - Mineral
QRD - Quincy
BCM - Brush Creek
SRR - Sierraville RS
BYM - Blue Canyon
PCF - Pacific House
1982-1983 (wettest)
88.5
1997-1998
82.4
2015-2016 Daily Precip
57.9
Average (1922-1998)
50.0
2014-2015 Daily Precip
37.2
1976-1977(2nd driest & driest thru Aug)
19.0
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Water Year (October 1 - September 30)
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
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100


San Joaquin Precipitation: 5-Station Index, September 30, 2016
Percent of Average for this Date: 98%
CVT - Calaveras Big Trees
HTH - Hetch Hetchy
YSV - Yosemite Headquarters
NFR - North Fork RS
HNT - Huntington Lake
1982-1983 (wettest)
77.4
1997-1998
65.2
Average (1961-2010)
40.8
40.0
2015-2016 Daily Precip
2014-2015 Daily Precip
19.0
15.4
1976-1977(2nd driest & driest thru Aug)
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Water Year (October 1 - September 30)
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
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90

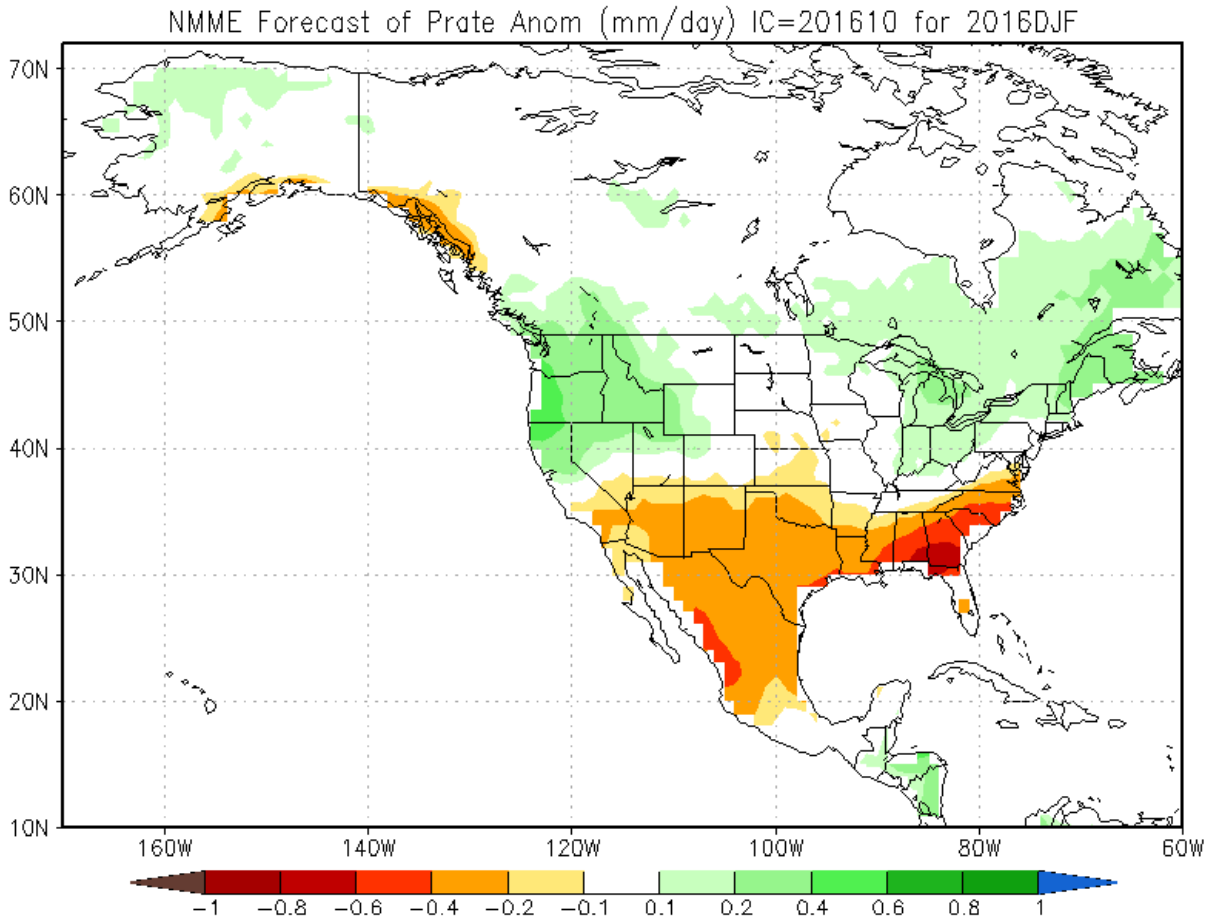
CPC/IRI Probabilistic ENSO Outlook

Updated: 8 September 2016

ENSO-neutral is slightly favored (55-60% chance) through the Northern Hemisphere fall and winter 2016-17.



North American Multimodel Ensemble

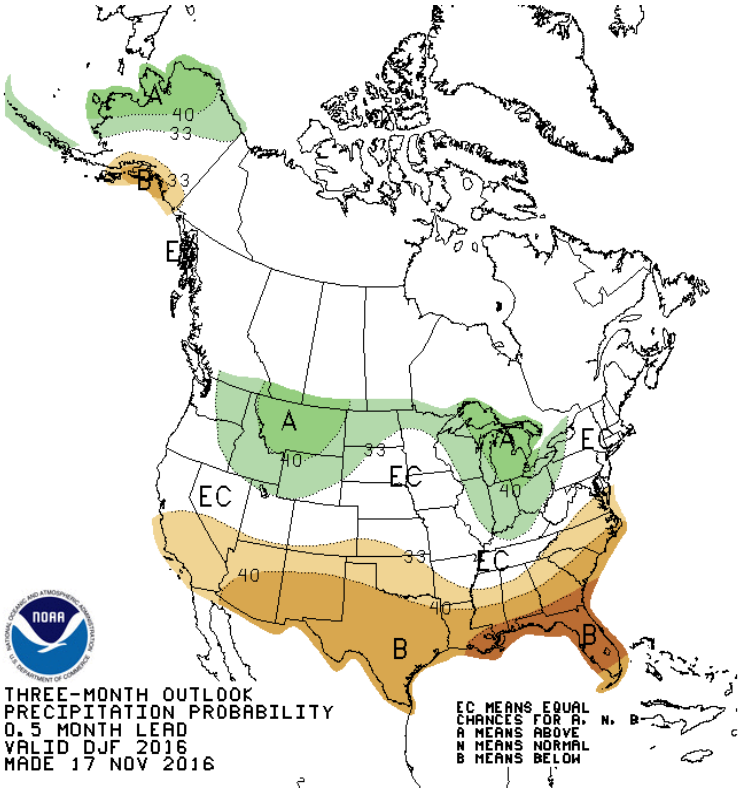


U. S. Seasonal Outlooks

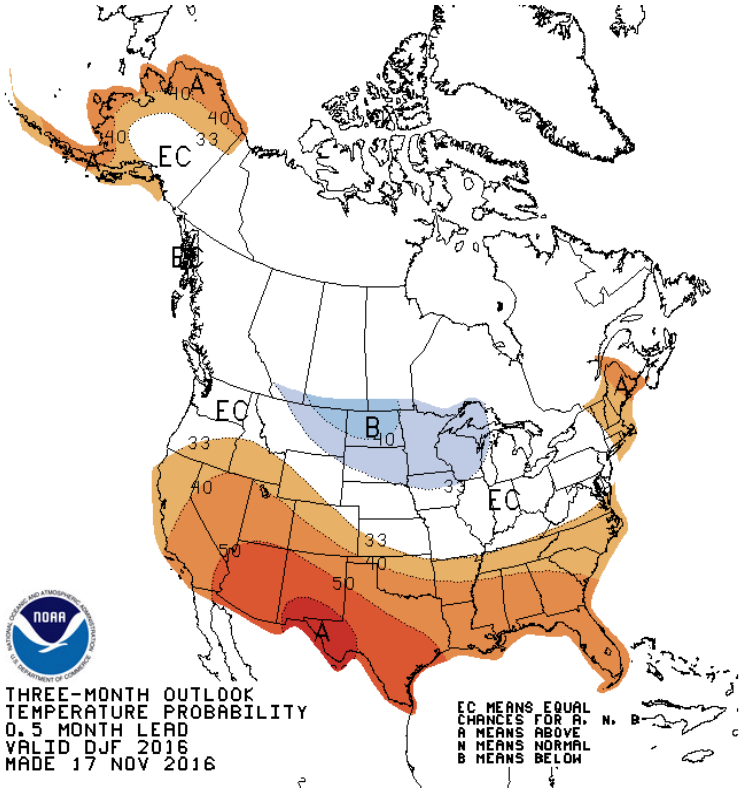
December 2016 - February 2017

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

Precipitation



Temperature

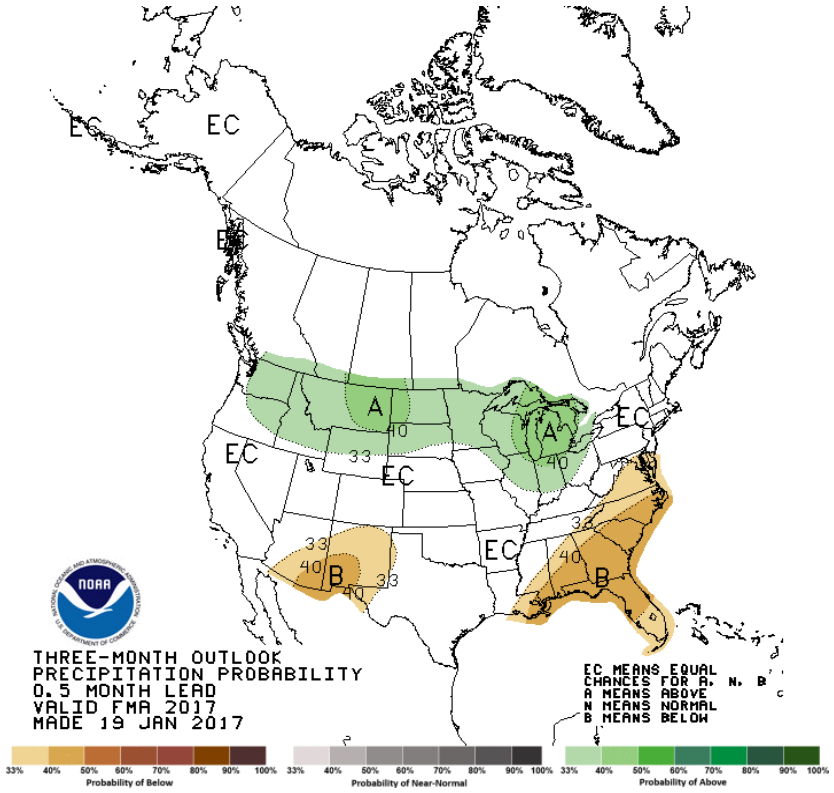


U. S. Seasonal Outlooks

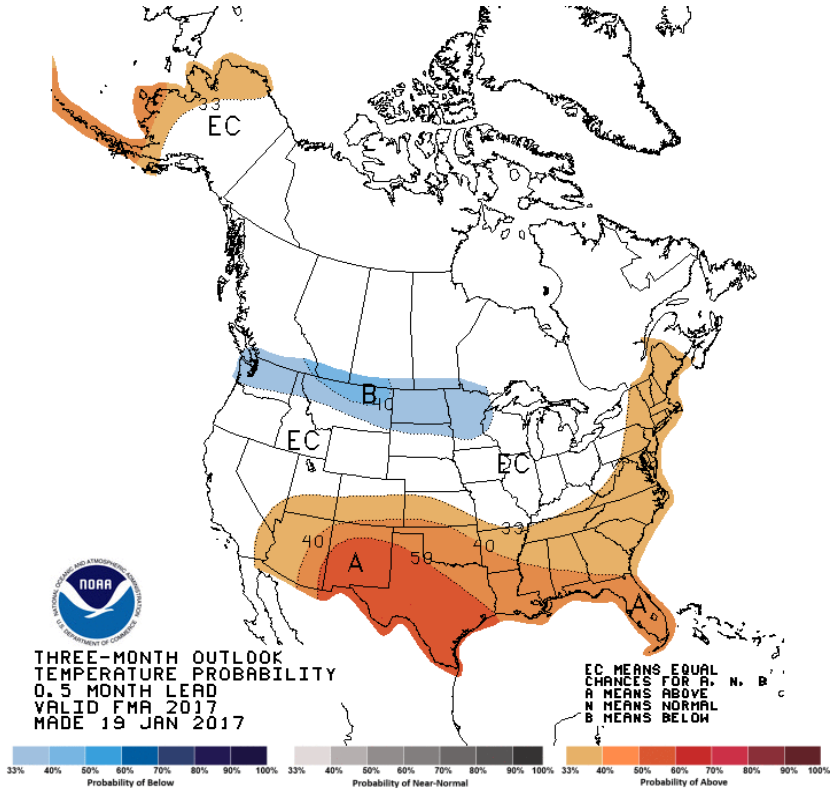
February - April 2017

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

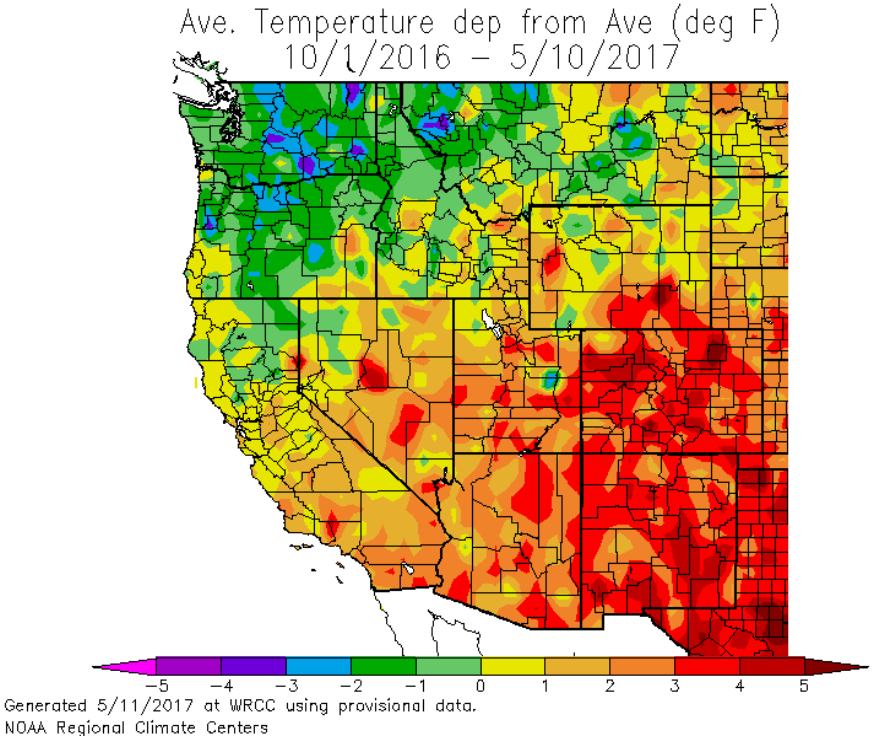
Precipitation

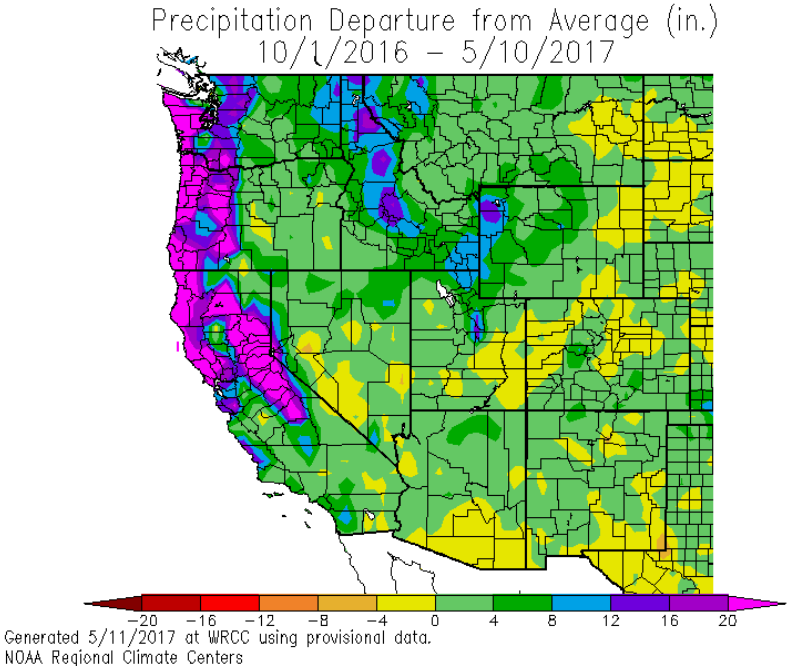


Temperature



WY 207 Outcomes





United States Department of Agriculture

NRCS Natural Resources Conservation Service

National Water and Climate Center

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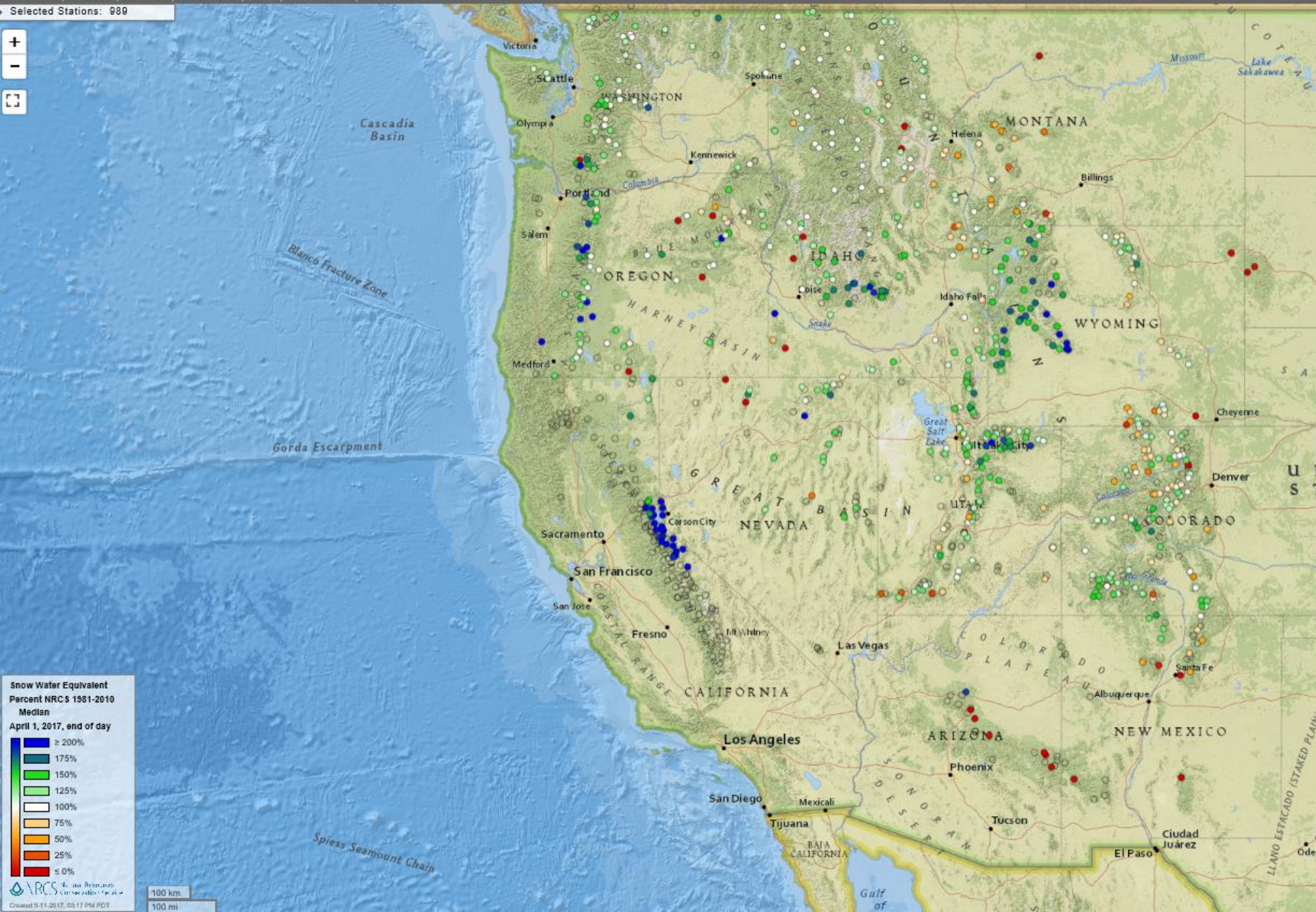
Selected Stations: 989



Distribution of Landfalling Atmospheric Rivers on the U.S. West Coast
(From 1 Oct 2016 to 12 April 2017)

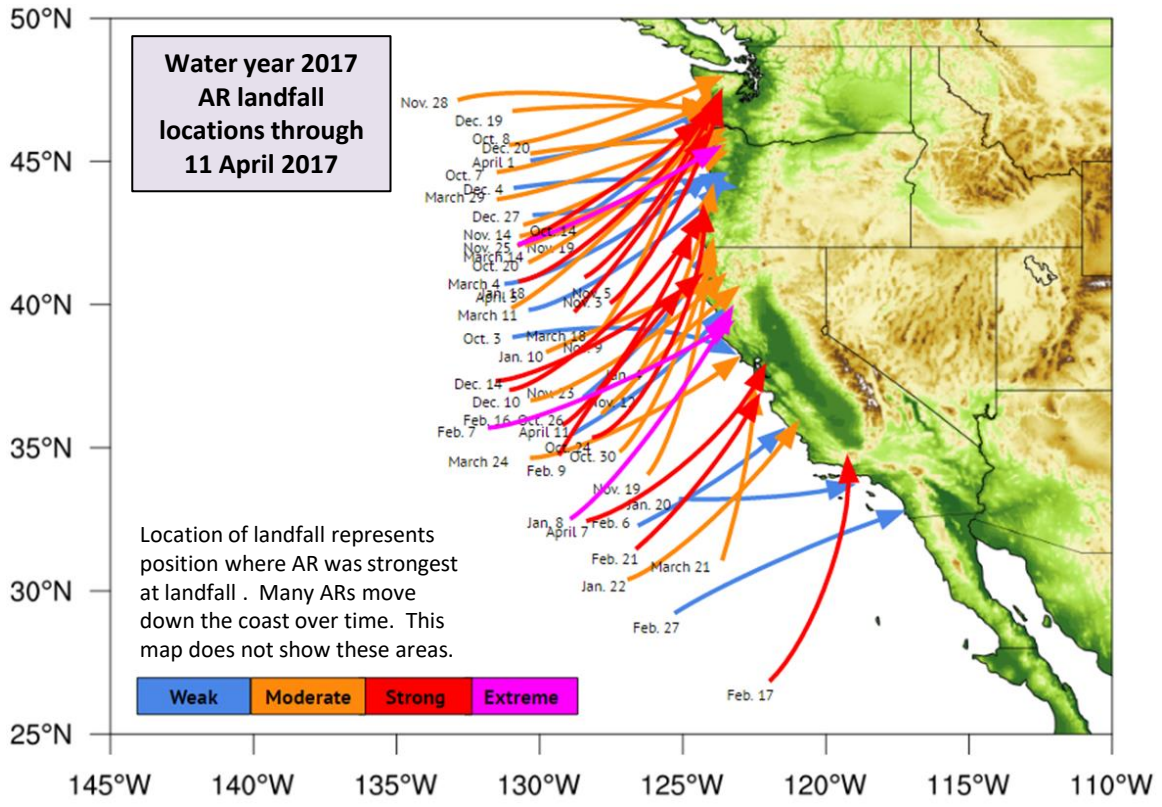
AR Strength	AR Count*
Weak	12
Moderate	21
Strong	13
Extreme	3

Ralph/CW3E AR Strength Scale

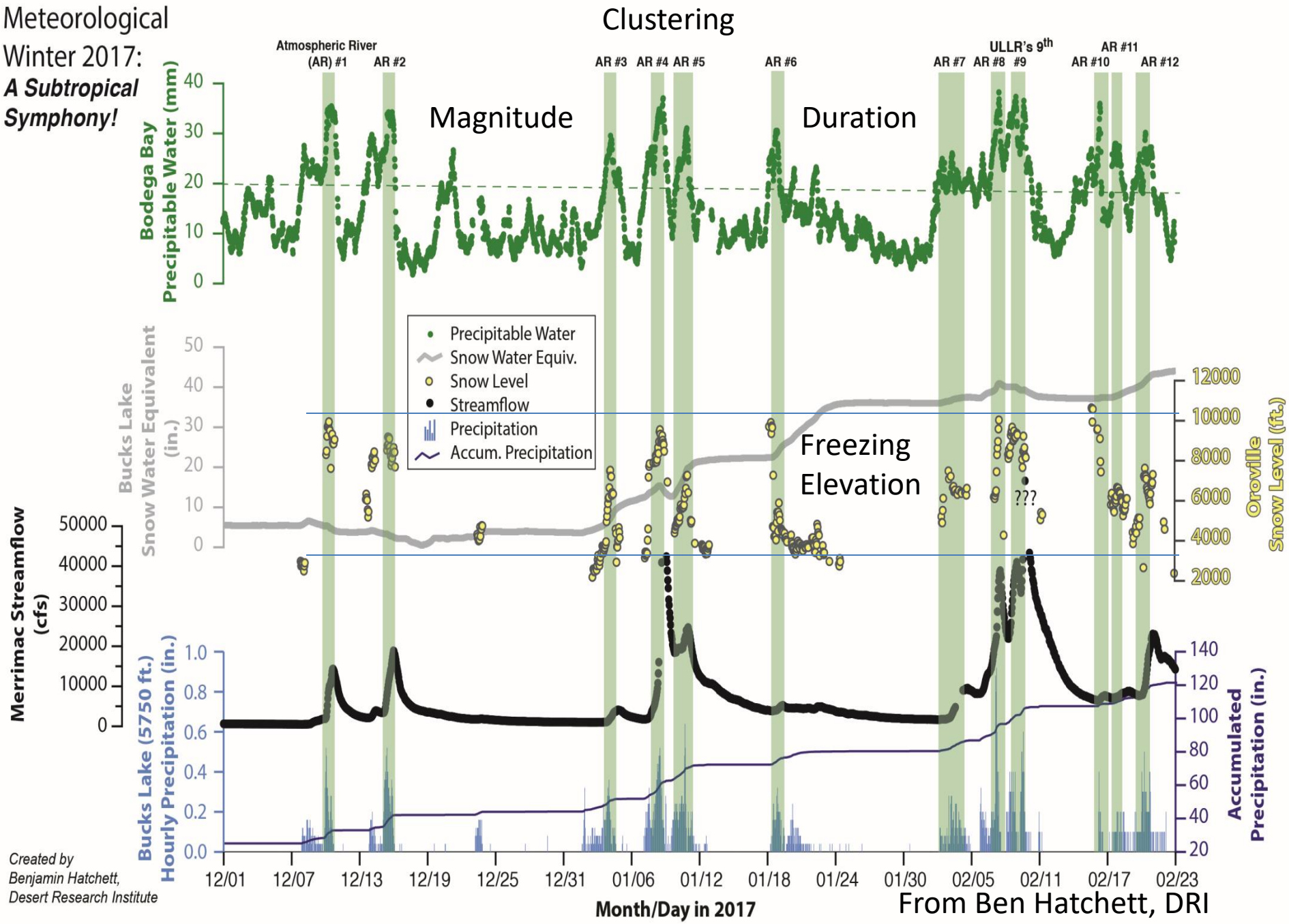
- Weak: IVT=250–500 kg m^{-1} s^{-1}
- Moderate: IVT=500–750 kg m^{-1} s^{-1}
- Strong: IVT=750–1000 kg m^{-1} s^{-1}
- Extreme: IVT>1000 kg m^{-1} s^{-1}

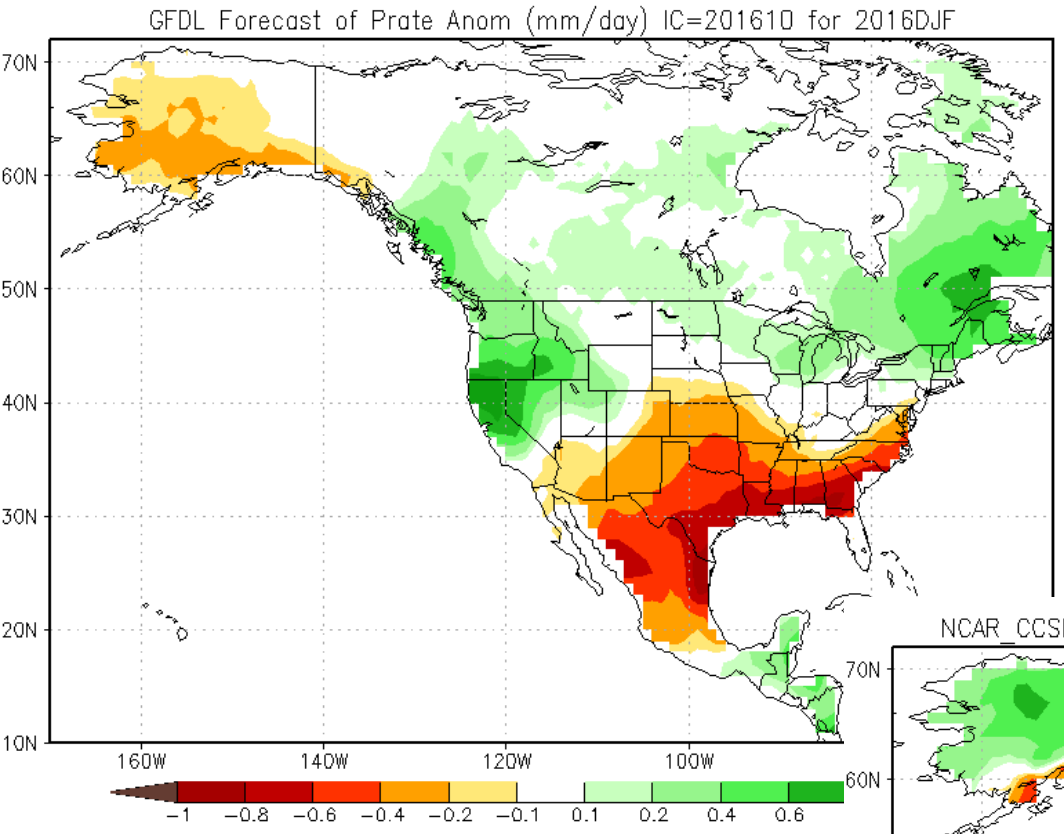
*Radiosondes at Bodega Bay, CA indicated the 10–11 Jan AR was strong (noted as moderate based on GFS analysis data) and 7–8 Feb AR was extreme (noted as strong)

- 49 Atmospheric Rivers have made landfall on the West Coast thus far during the 2017 water year (1 Oct. – 12 April 2017)
- This is much greater than normal
- 1/3 of the landfalling ARs have been “strong” or “extreme”

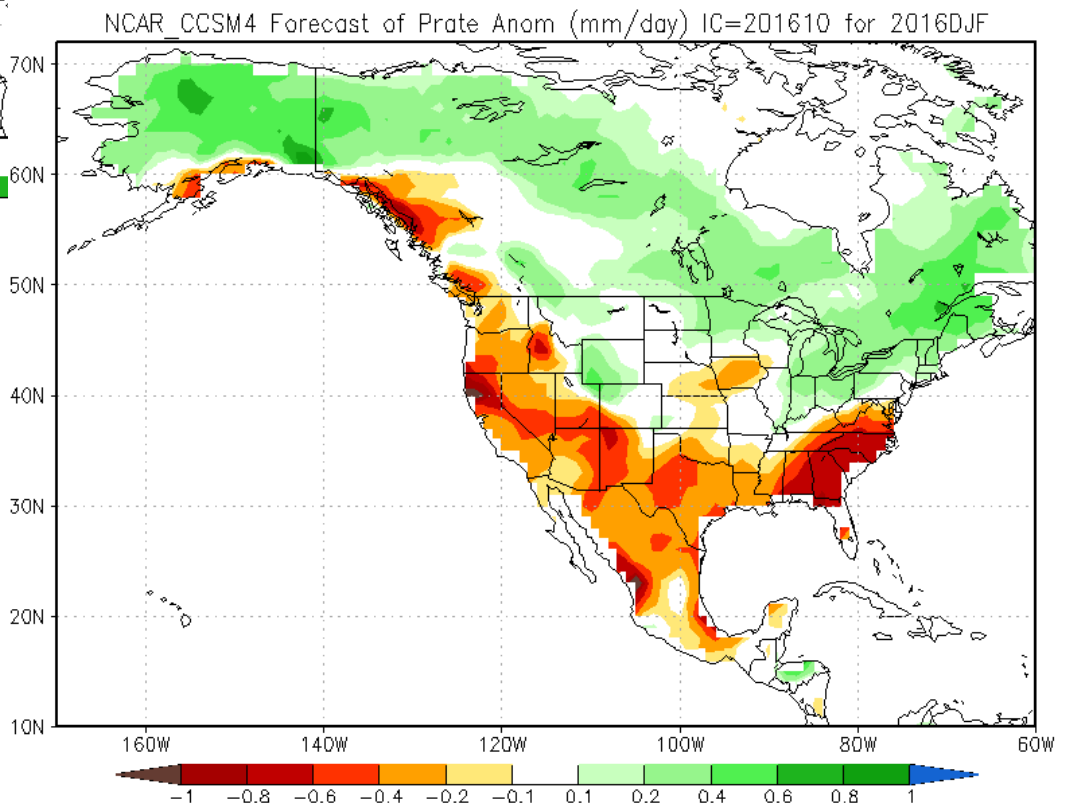


By F.M. Ralph, B. Kawzenuk, C. Hecht, J. Kalansky


Meteorological Winter 2017:
A Subtropical Symphony!
Clustering
Magnitude
Duration
Freezing Elevation
???
Atmospheric River (AR) #1
AR #2
AR #3
AR #4
AR #5
AR #6
AR #7
ULLR's 9th AR #8 #9
AR #10
AR #11
AR #12
Bodega Bay Precipitable Water (mm)
Bucks Lake Snow Water Equivalent (in.)
Precipitable Water
Snow Water Equiv.
Snow Level
Streamflow
Precipitation
Accum. Precipitation
Oroville Snow Level (ft.)
Merrimac Streamflow (cfs)
Bucks Lake (5750 ft.) Hourly Precipitation (in.)
Accumulated Precipitation (in.)
12/01
12/07
12/13
12/19
12/25
12/31
01/06
01/12
01/18
01/24
01/30
02/05
02/11
02/17
02/23
Month/Day in 2017
Created by Benjamin Hatchett, Desert Research Institute
From Ben Hatchett, DRI



GFDL Model Positive



NCAR Model Negative

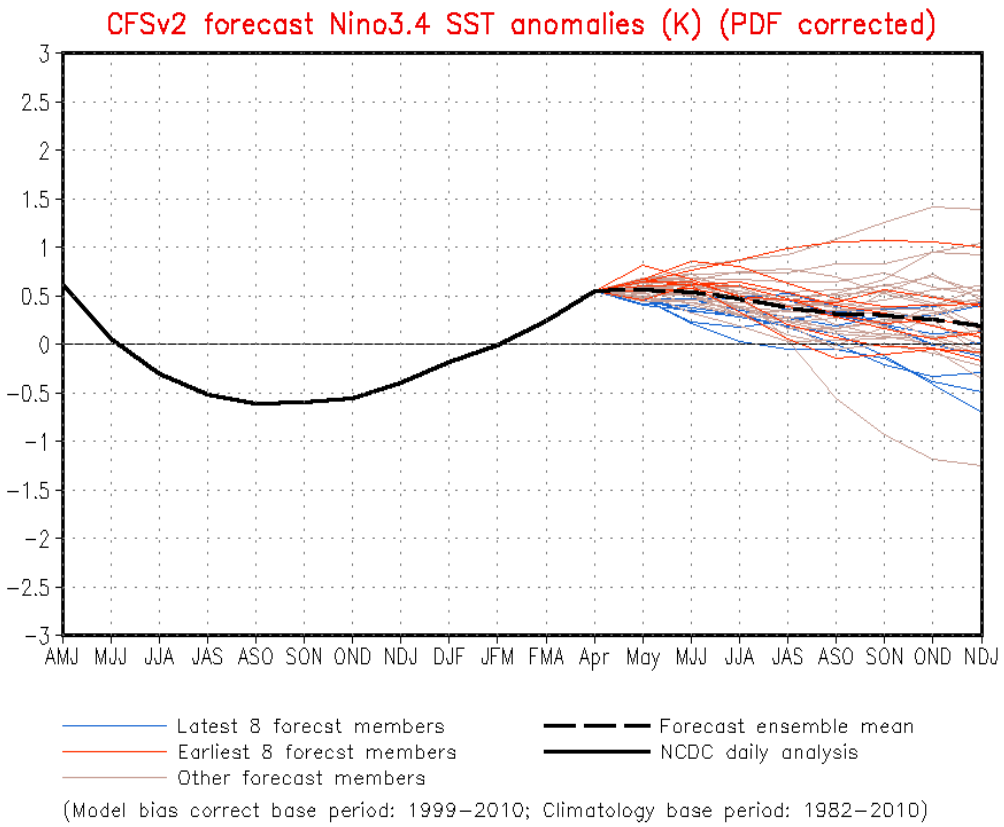
Going Beyond P,T Outcomes

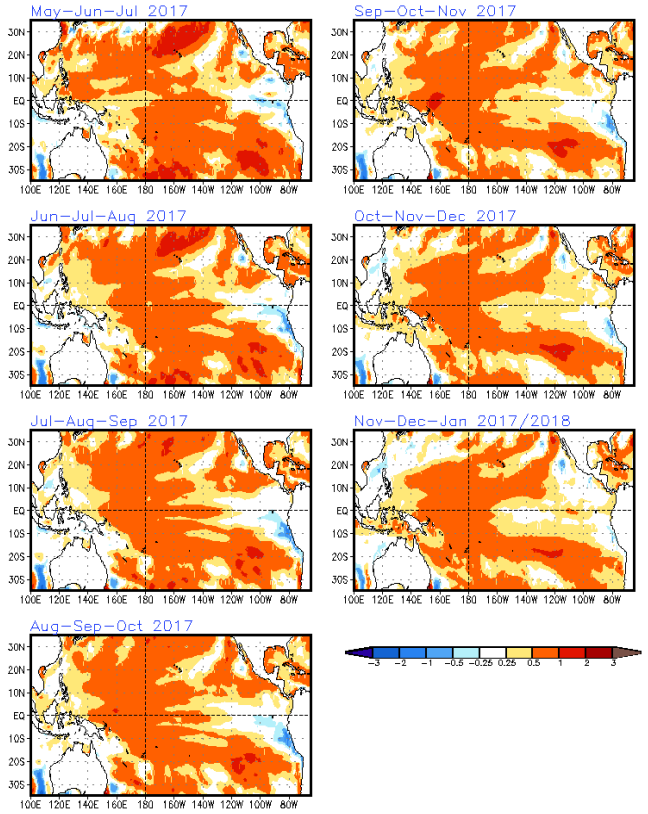
- Revisiting dynamic model predictions – what did the models end up doing well, what not so well and why?
- What lessons learned from diagnosis can be applied to future forecast efforts?
- How do we get more out of statistical forecasting efforts?

SST Outlook: NCEP CFS.v2 Forecast (PDF corrected)

Issued: 8 May 2017

The CFS.v2 ensemble mean (black dashed line) favors borderline El Niño to develop in the near term and weaken through 2017.

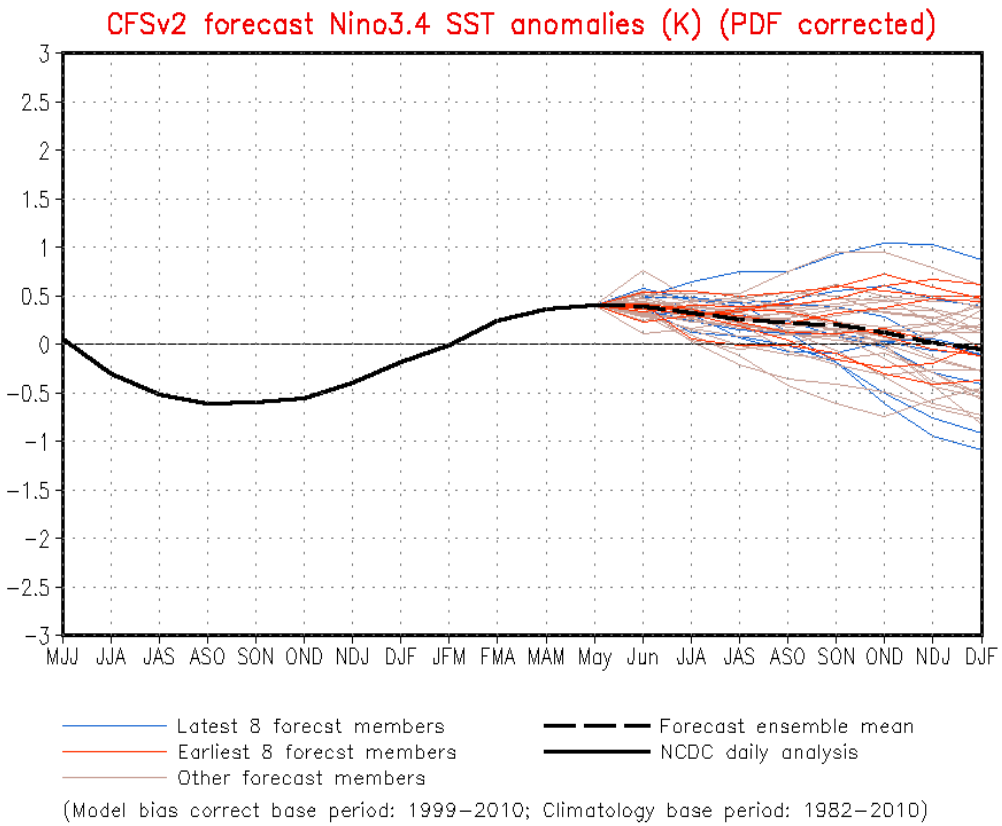


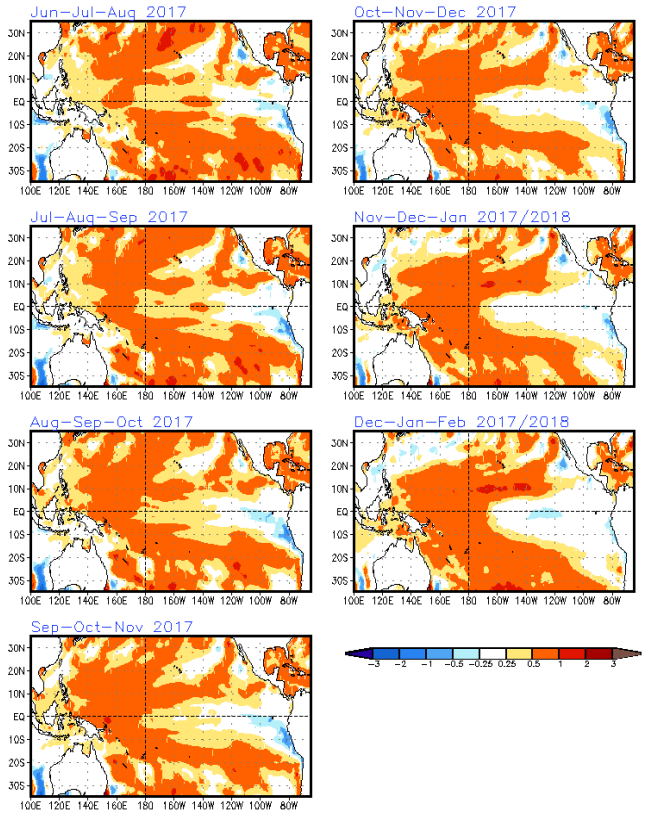


SST Outlook: NCEP CFS.v2 Forecast (PDF corrected)

Issued: 15 May 2017

The CFS.v2 ensemble mean (black dashed line) favors ENSO-neutral to continue through 2017.





Project INFORM

- Reservoir Management Decision Support Tool that uses forecasts across different time scales to evaluate water management options out to a full year in advance
- Developed by HRC and Georgia Tech
- Sacramento Basin project coming online this summer for DWR

Questions?

Michael.L.Anderson@water.ca.gov