Drought, Drought Vulnerability, & the Central Coast

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First a Word About Defining Drought When Does "Dry" Become "Drought"?

- Meteorological drought
- Hydrological drought
- Regulatory drought
- Drought indices, US Drought Monitor
- Sector-based definitions
- **Drought is a function of impacts (which are typically regional or local)**

When Does "Drought" Become "Drought Emergency"?

- Depends on impacts, and ability to mitigate impacts
- Drought differs from traditional "emergencies" (flood, fire, etc) in its very slow timescale
- California Emergency Services Act
  - Role of local government (counties)
  - Role of state

USGS Computed CA WY Runoff
Dozen Driest years -- (rank out of 115)

1.	1977	115th	7.	1990	109th
2.	1931	114th	8.	2015	108th
3.	1924	113th	9.	2001	107th
4.	2014	112th	10.	1934	106th
5.	1991	111th	11.	1992	105th
6.	1994	110th	12.	1976	104th

Driest 4 Consecutive Water Years Based on Statewide Precipitation

Year	4-Year Total, inches
2012-2015	62.2
1917-1920	63.1
1923-1926	63.3
1928-1931	64.5
1931-1934	65.1
1921-1924	65.7
1922-1925	65.9
1918-1921	66.8
1929-1932	67.3
1987-1990	67.3
1930-1933	68.0

WRCC data

California's 20th & 21st Century Statewide Droughts

- 1918-20
- 1922-24
- 1929-34
- 1947-50
- 1959-61
- 1976-77
- 1987-92
- 2007-09
- 2012-2016

1929-34

- State population 5.7 million
- WY 1931 is 2nd driest in historical record (statewide runoff)
- Major planning going on for future water infrastructure
- Drought impacts relative to Great Depression & agricultural programs
- The Lake Tahoe Dam war

1987-92

- Longest drought in near-modern times
- State population of 30 million in 1990
- Single driest year – 1991 – was 5th driest on record
- Delta conditions: D-1485, no ESA biological opinions until 1992
- CVP & SWP cutbacks in 1991 & 1992

2007-09

- Not as severe as big historical droughts in terms of hydrology
- Surplus water no longer available from Colorado River
- Delta: D-1641, new Biological Opinion in 2008
- CVPIA provisions in effect
- First-ever statewide proclamation of drought emergency
- Agricultural impacts in San Joaquin Valley: combined effects of drought + recession
- Small water system problems

2012-16

- Very dry hydrology, especially in Southern California
- Included warmest years on record, record low statewide snowpack
- State response actions not seen since 1976-77
- First-ever zero CVP ag contractor allocations
- First-ever state emergency response for areas of dry private residential wells

Points to Keep in Mind About Drought

- Droughts/dry years are a normal part of the hydrologic cycle
- Drought conditions develop slowly; drought by itself is not an emergency – drought impacts drive action
- Drought impacts are site-specific and sector-specific
- The greatest drought impacts are related to unmanaged water uses – e.g., rangeland grazing, wildfire
- The greatest economic impacts of drought in California have been associated with wildfire and forestry damages, not with urban & agricultural water uses

Expected Impacts of Multi-Year Drought

- **Unmanaged systems**
  - **Risk of catastrophic wildfire (health & safety, economic)**
  - **Non-irrigated agriculture (livestock grazing)**
  - **Fish & wildlife (e.g., salmonids)**
- **Managed systems**
  - **Small water systems (health & safety)**
  - **Irrigated agriculture**
  - **Green industry (urban water supplies)**
  - **Fish & wildlife (e.g., wildlife refuges, salmonids)**
  - **Other environmental (e.g., land subsidence)**

And Wildfire Damage to Water Infrastructure

Drought & Small Water Systems

- Dramatic increase in small water system problems during drought
- May use less reliable groundwater sources (fractured rock groundwater, small coastal terrace groundwater basins)
- Often located in rural areas – more difficult to do interconnections, potentially higher wildfire vulnerability
- Typically lack financial/technical resources
- Small ratepayer base means limited ability to do capital improvement projects
- (Private well owners can experience similar problems)

Drought Preparedness Basics

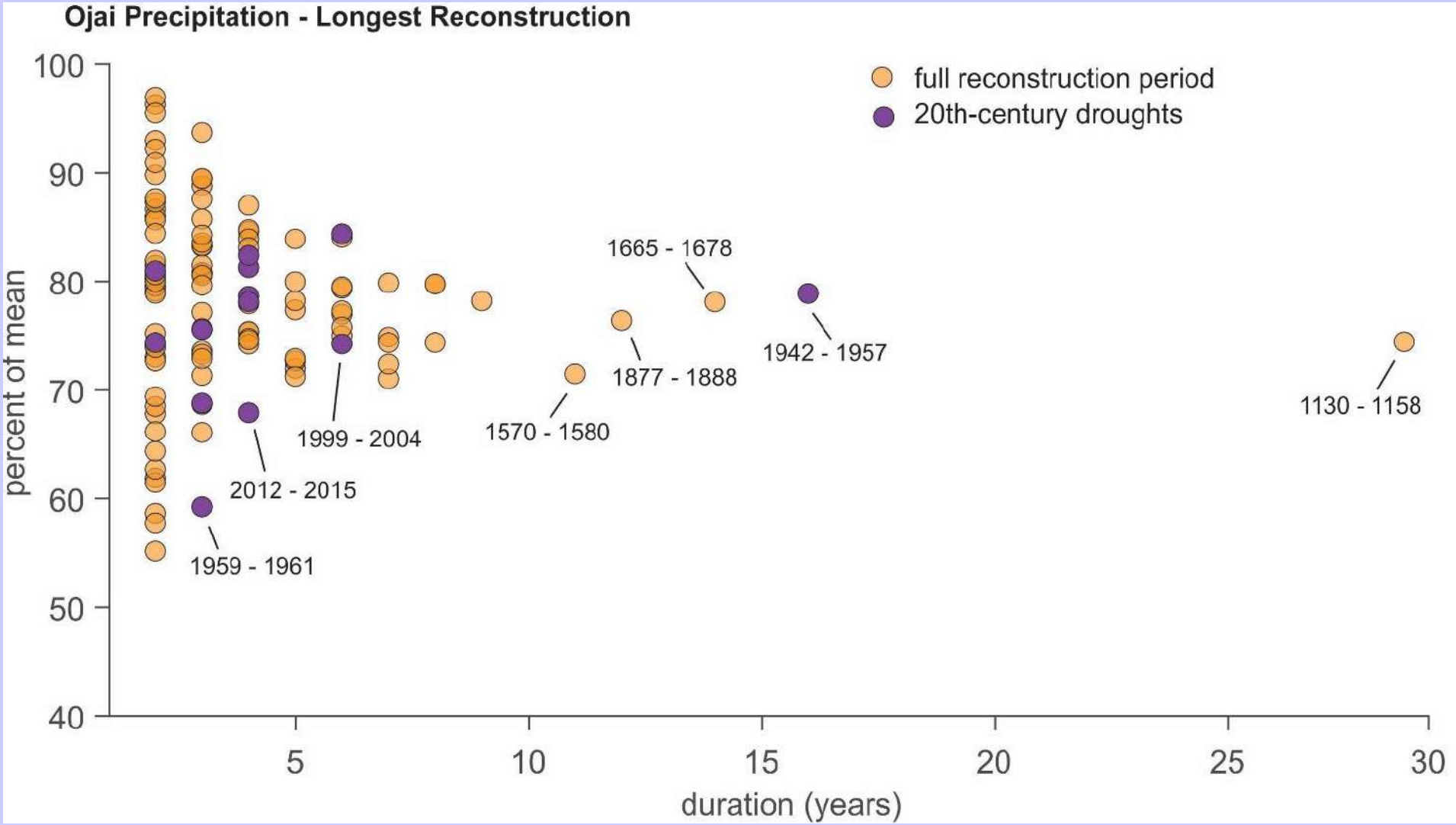
- Vulnerability assessment
- Monitoring
- Planning
  - Safe Drinking Water Act emergency plan (public water systems)
  - Urban Water Management Plans
  - Long-term planning (capital improvement plans)
- Response

How long a drought should we plan for?

CA UWMP Statutory Requirements

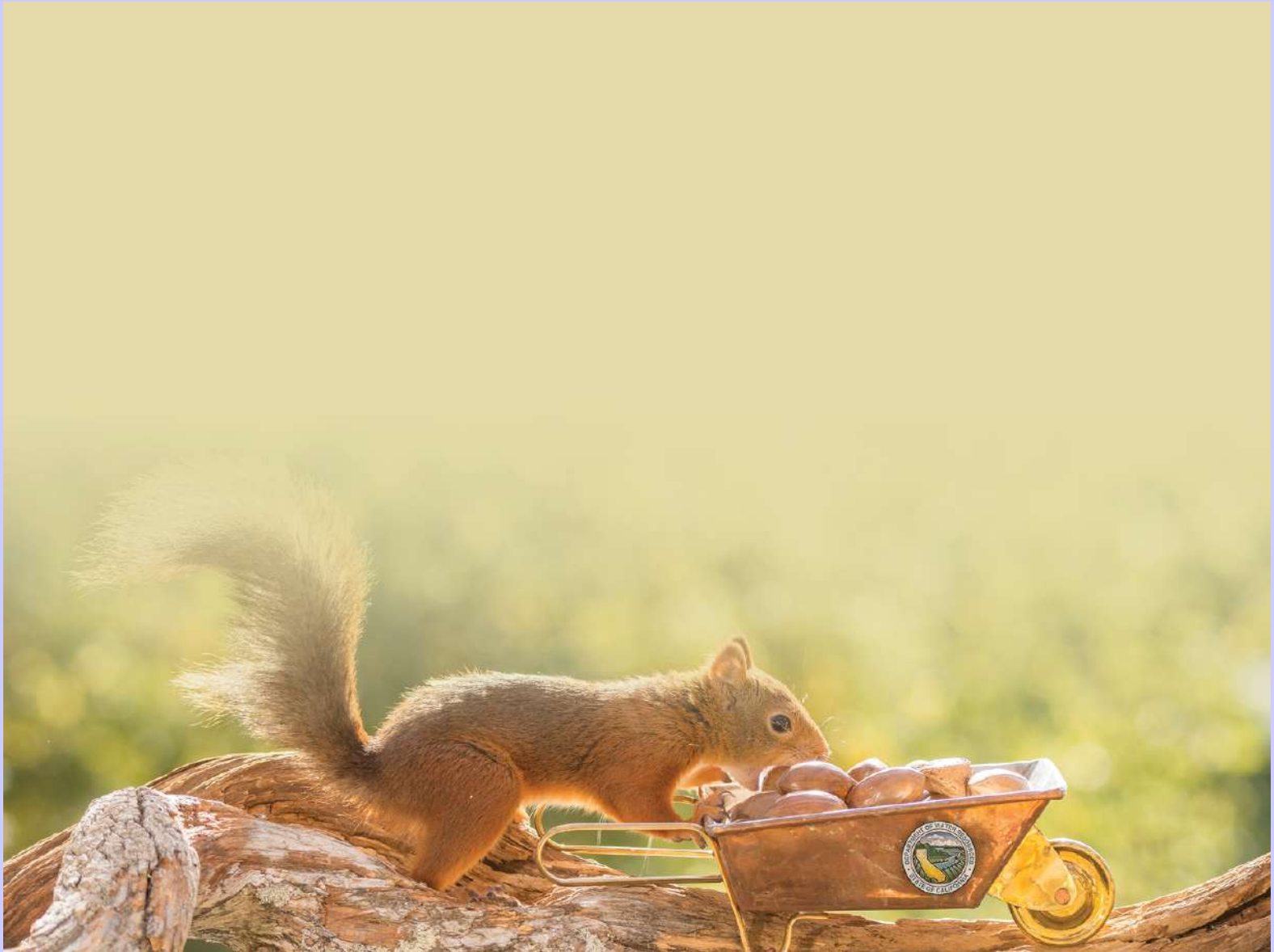
- Urban Water Management Plans (UWMPs), agencies serving > 3,000 AF annually, or 3,000 customers, prepare & update every 5 years
- Apply to 400+ systems
- Water shortage contingency analysis of:
  - Staged response actions to be taken by water supplier for shortages up to 50% reduction in supply
  - Specific water supply conditions associated with each stage
- Actions to prepare for/respond to a catastrophic interruption of water supplies
- Historically, 3-year drought planning requirement, changed in 2018 to 5-year drought

Drought Risk for Local Supplies

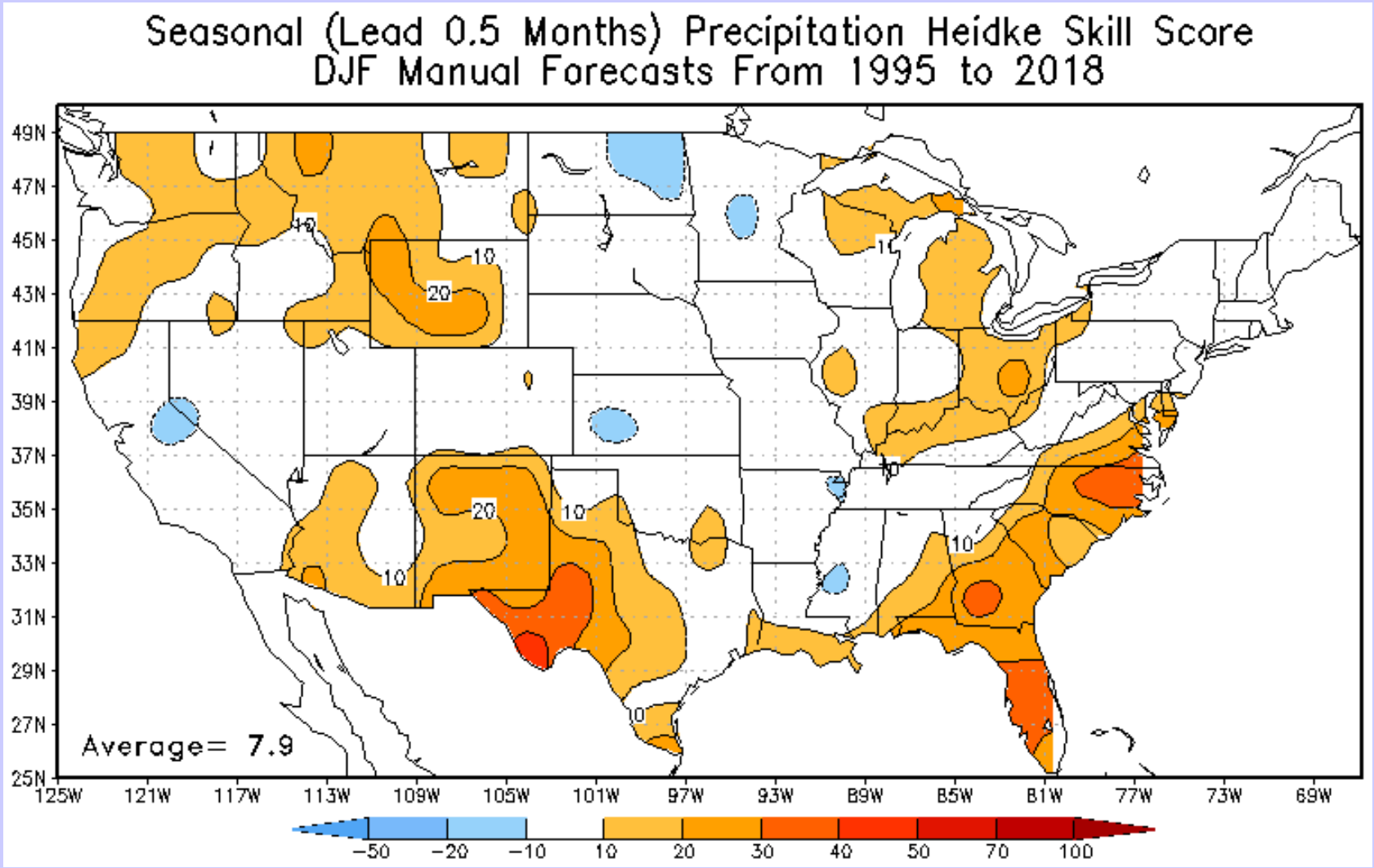


University of Arizona for DWR

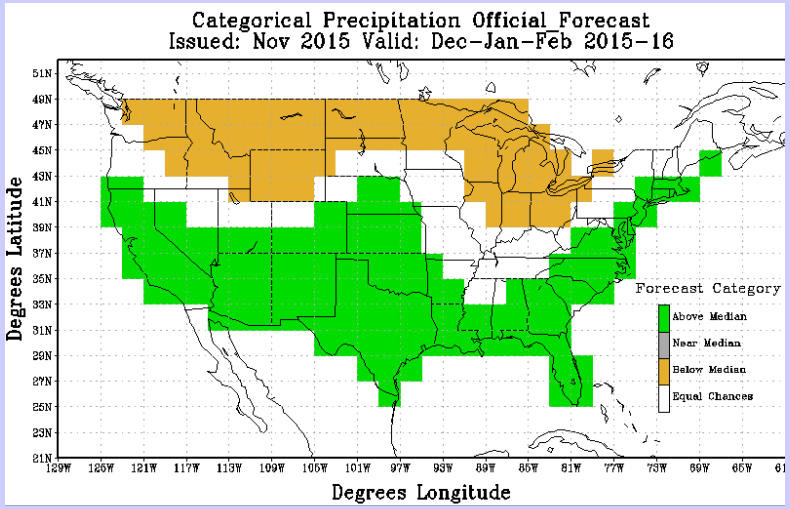
Next Winter – Wet or Dry??

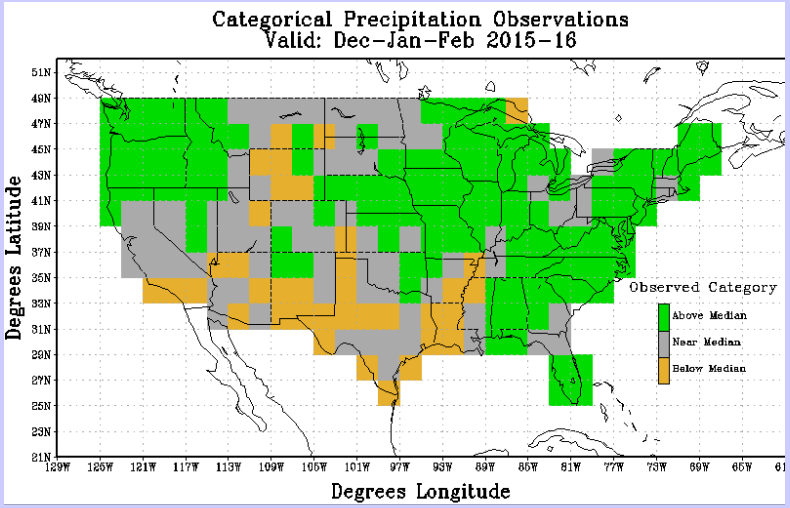


NOAA NWS Climate Prediction Center Skill Scores



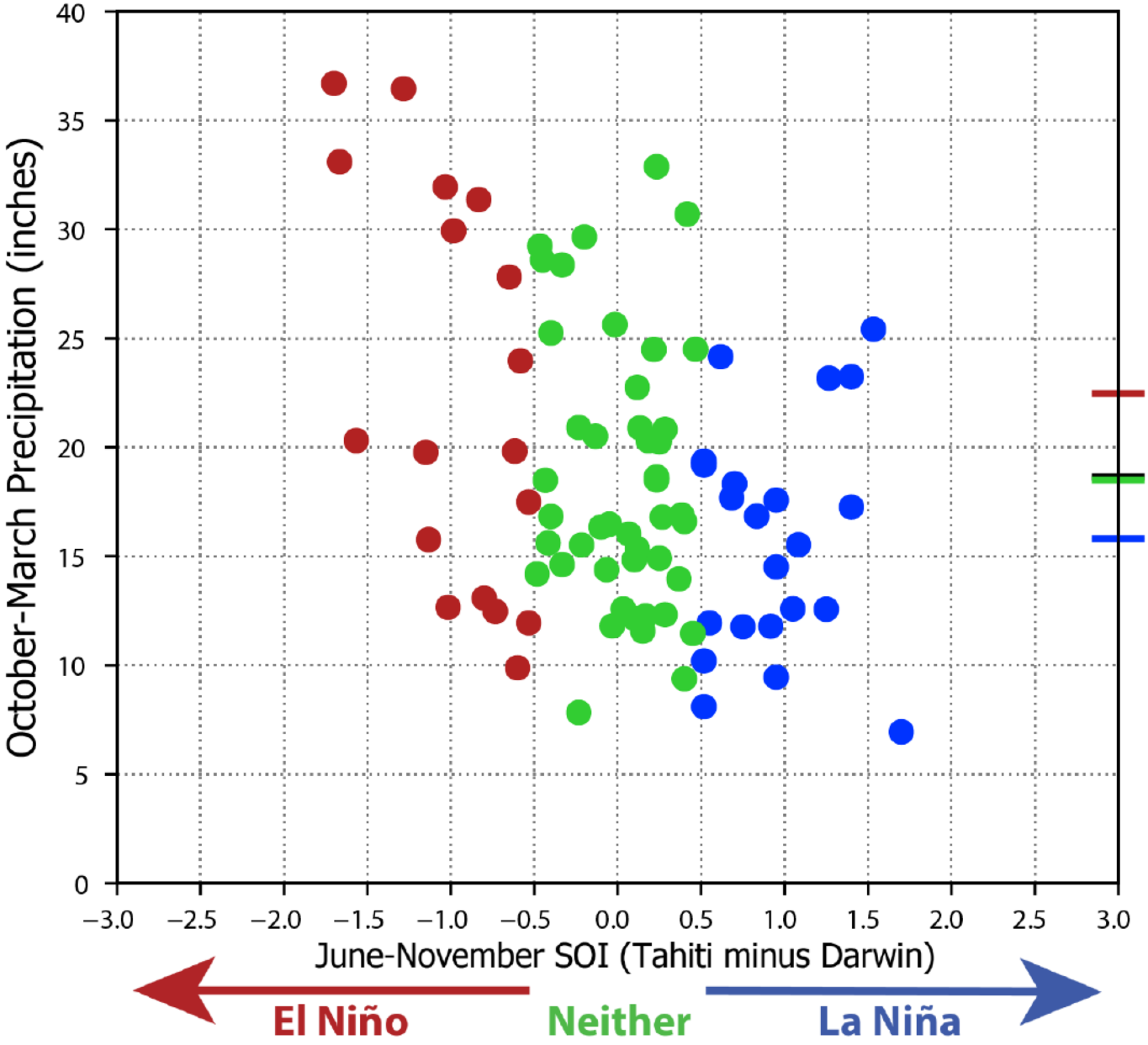
Present Forecasting Skill Not Usable for Water Management





The Godzilla El Niño – forecasted vs. observed precipitation, NWS CPC verification

CA Division 4 October-March Precipitation
(versus Southern Oscillation Index for prior year June-November)

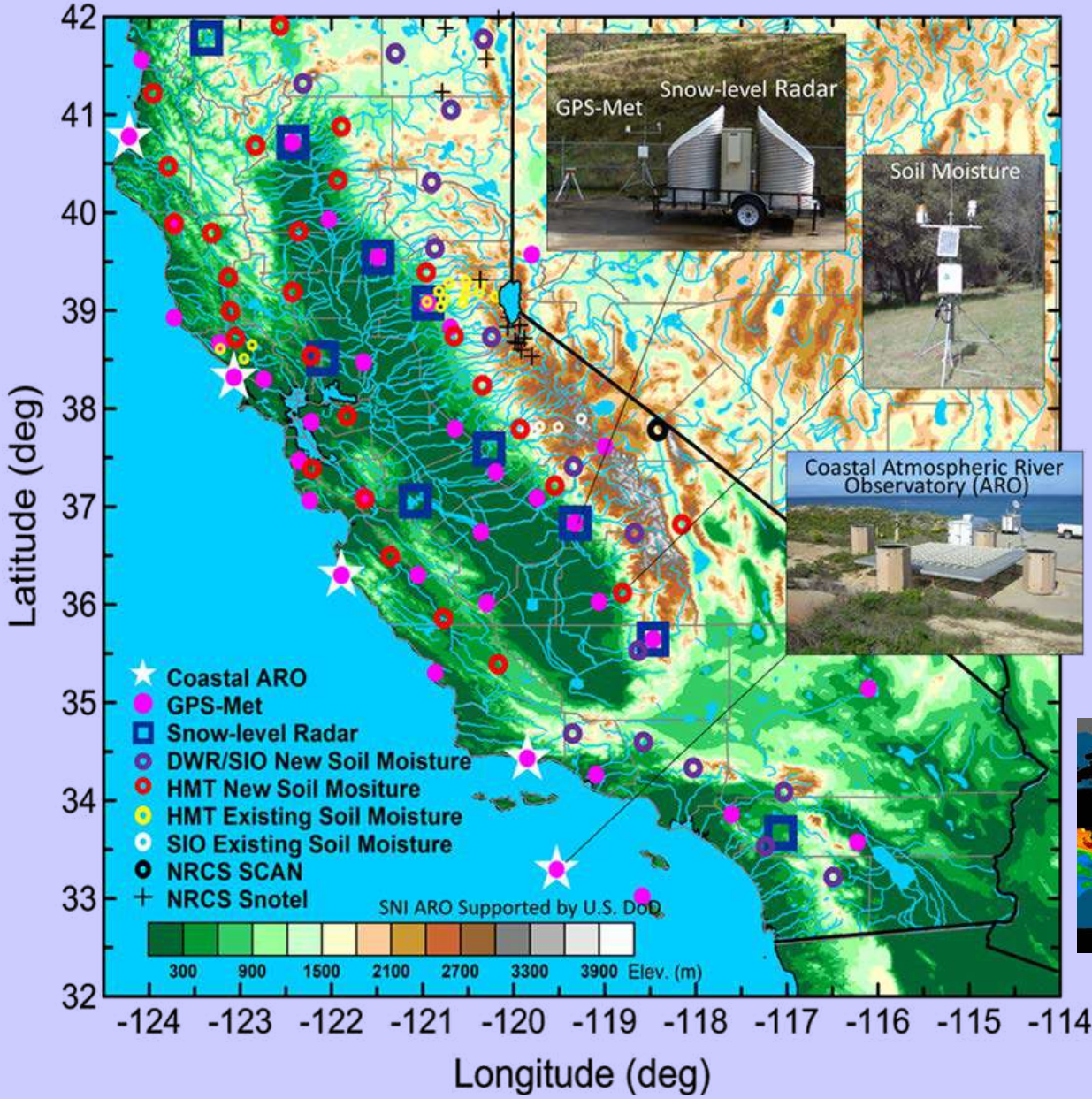


Years 1933/1934 - 2017/2018
r^2 = 0.15
Correlation = -0.38

Mean = 22.47 in
Mean all = 18.64 in
Mean = 18.49 in
Mean = 15.80 in

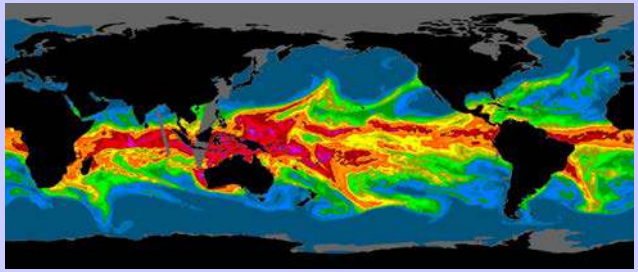
Western Regional Climate Center

California Observing System for Extreme Precipitation



►Jointly funded by NOAA HMT & DWR (from Prop. 1E bond funds), investment of about $25M

► Focus on observing & understanding atmospheric river storms



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

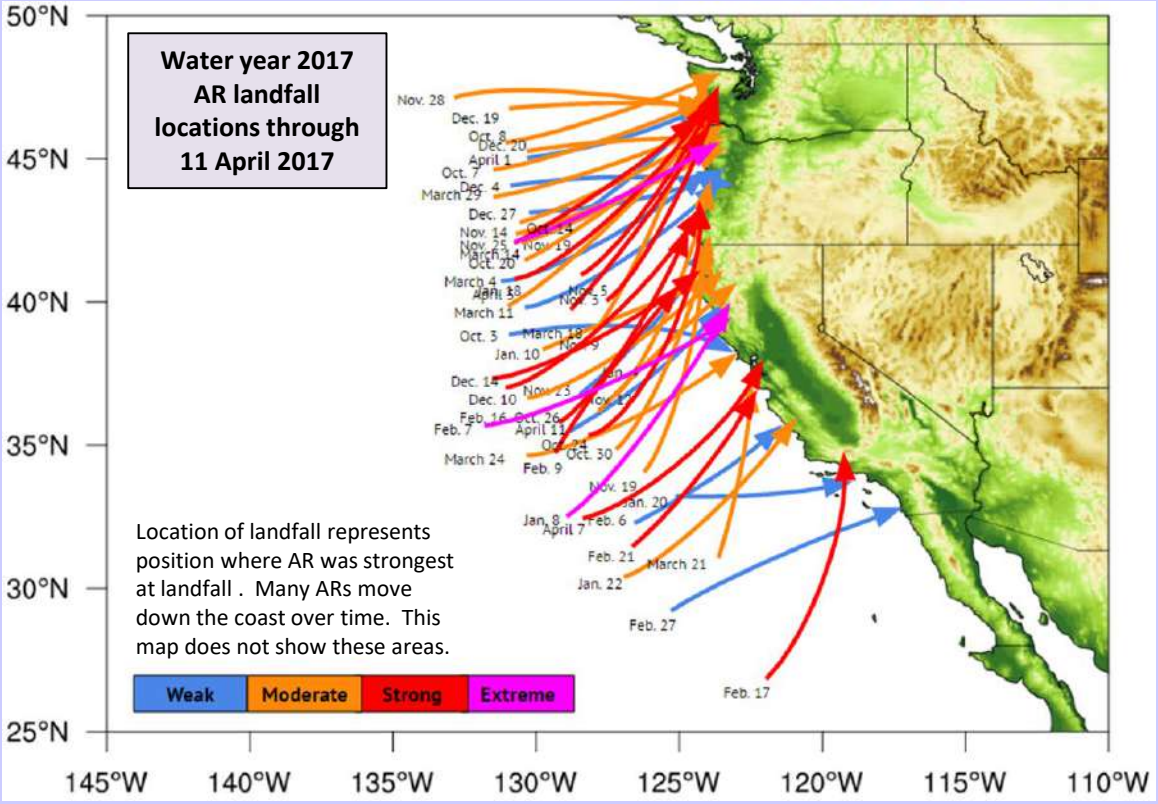
AR Strength	AR Count*
Weak	12
Moderate	21
Strong	13
Extreme	3

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”



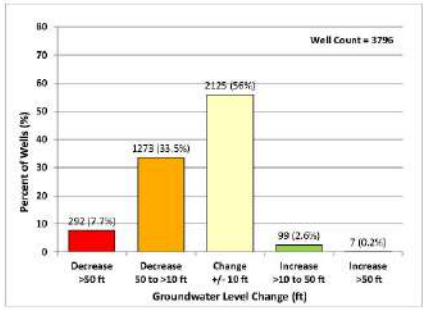
By F.M. Ralph, B. Kawzenuk, C. Hecht, J. Kalansky

Edge of Drought Tour · August 27-29, 2019

Water Supplies of the Cachuma Project Member Agencies
Testimony of Steve Mack, Water Supply Manager, City of Santa Barbara
(from SWRCB Water Rights Hearing)

My testimony and the State Board Environmental Impact Report show summaries of Member Unit water supplies combined as in Tables 1 and 2 of my testimony. These summaries show a general picture of the water supplies, but imply an integration of supplies that does not exist. The Member Units are distinct, separate entities with separate elected boards or councils. Legal, political, and practical reasons limit the ability to combine and/or exchange supplies. In particular, because of the physical geographic separation, there is little that Improvement District #1 (ID#1) can do to help the Member Units on the South Coast during a drought and because of water treatment issues, little the South Coast Member Units can do to help ID#1. On the South Coast there is a central pipeline that does allow exchanges to a certain degree, but the infrastructure does not exist to allow exchanges or sales of local supplies to the degree implied by the summaries, even if that were legally and politically possible.

Groundwater Level Change* - Fall 2011 to Fall 2016



Groundwater Level Change
- Increase > 50 feet
- Increase > 10 to 50 feet
- Change +/- 10 feet
- Decrease > 10 to 50 feet
- Decrease > 50 feet

Groundwater Basin
County Boundary
Major Highway
Major Canal

0 10 20 40 60 80 100 120 140 Miles

*Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Water Data Library as of 2/16/2017. Document Name: DROUGHT_DOTMAP_F1611_50ft.mxd. Updated: 3/2/2017. Data subject to change without notice.