# Improving Seasonal Forecasts to Help with Drought Planning in California
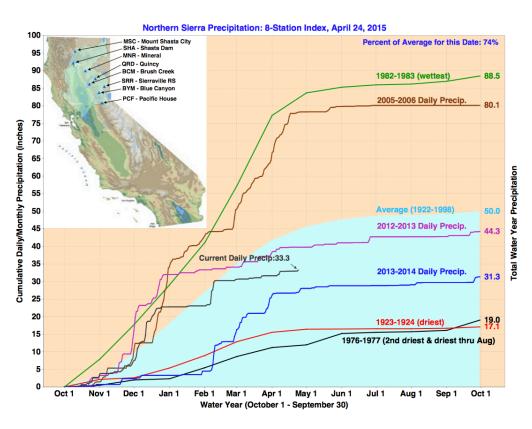
## Klaus Wolter

Science Review
12-14 May 2015
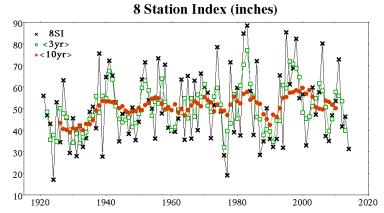Boulder, Colorado

# Background

- Involvement with **Colorado Water Availability Task Force** since 1999 through **WWA** – *recognized by Governor's Award for High impact Research (2013)*

- Monthly conference calls with **CPC** to help improve seasonal forecasts on a national scale

- Engagement with **NIDIS** regional drought webinars across the southern tier of states

- Annual fall briefings since 2008 about the upcoming Water Year to increase awareness about water supply situation (funded by **CA-DWR**)

# Northern CA '8 Station Index'



Sacramento Basin is represented by 8 Station Index (8SI), currently tracking a 4$^{th}$ drought year



8SI shows multi-year droughts since 1920, but **little long-term trend**

# ENSO footprint in California

- ENSO is monitored at PSD via the Multivariate ENSO Index (**MEI**) that combines the six main observed variables over the tropical Pacific

- Most of 'wet El Niño' signal is at lower elevations, while northern Sierra Nevada remains 'on the fence'

- *Dec-Feb contributes 50% of total moisture*
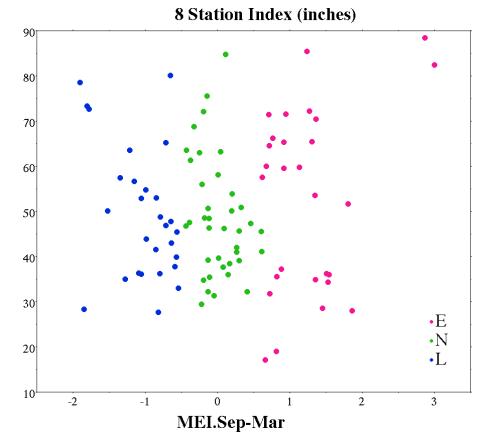


DJF PPT vs. MEI (1981–2010)

DRY El Niño     Correlation Coefficient     WET El Niño

−0.6 −0.5 −0.4 −0.3 −0.2 −0.1 0.1 0.2 0.3 0.4 0.5 0.6

# ENSO and '8 Station Index'

- Using an extended version of the MEI*, the last 95 years of the 8SI show **little sensitivity to ENSO**

- In fact, **El Niño** events encompass the two **driest** ('24, '77) and two of the **wettest** ('83, '98) Water Years
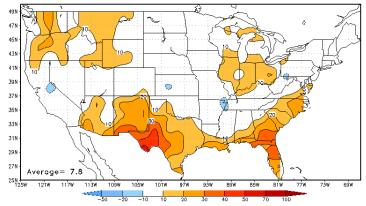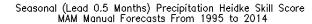
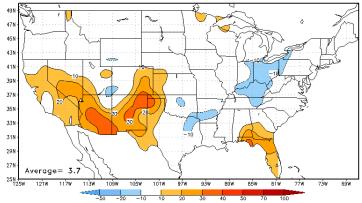**8 Station Index (inches)**



**MEI.Sep-Mar**

# CPC seasonal forecast skill

- During winter (when it counts the most), CPC forecasts have been 'harmless' at best

- Better forecast skill during spring (related to ENSO)

- *CPC uses 'Heidke Skill Score' which counts number of tercile hits (1 out of 3 hits is like flipping a coin, or a score of 0, 3 out of 3 = +100, none out of 3 = -50)*



Seasonal (Lead 0.5 Months) Precipitation Heidke Skill Score
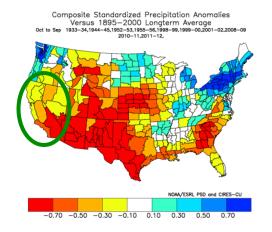DJF Manual Forecasts From 1995 to 2015
Average= 7.8



Seasonal (Lead 0.5 Months) Precipitation Heidke Skill Score
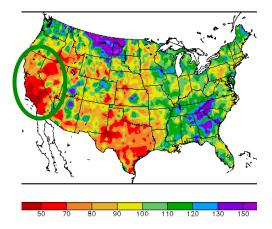MAM Manual Forecasts From 1995 to 2014
Average= 3.7

http://www.cpc.ncep.noaa.gov/products/verification/summary/index.php?page=map

# Forecasts of Opportunity – 'Analogues'

- Summer of 2012: most extreme combination of negative PDO and positive AMO on record*

- While this spelled drought conditions for CA, it anchored a successful forecast (skill score of +43 for 2012-13)

- Average skill score for CA from 2008-09 through 2013-14 was +15, with one negative score in 2010-11, when it was wetter than expected
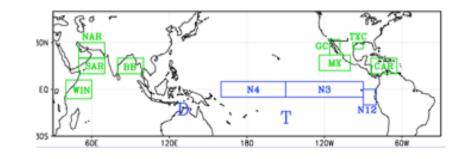


Composite Standardized Precipitation Anomalies Versus 1895–2000 Longterm Average
Oct to Sep 1933–34,1944–45,1952–53,1955–56,1998–99,1999–00,2001–02,2008–09 2010–11,2011–12,

NOAA/ESRL PSD and CIRES-CU

-0.70  -0.50  -0.30  -0.10  0.10  0.30  0.50  0.70

Percent of Normal Precipitation (%)
10/1/2012 – 9/30/2013

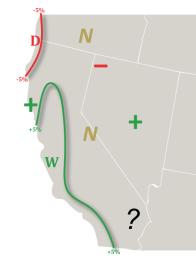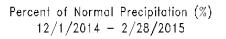50  70  80  90  100  110  120  130  150
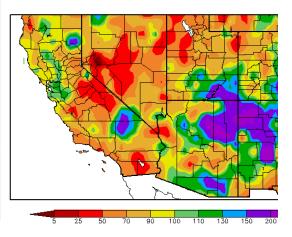
# Experimental Forecast Guidance

- Well-known teleconnection indices and regional SST anomalies are utilized for CA precipitation outlooks via cross-validated stepwise multiple linear regression models

- The last winter forecast correctly anticipated more abundant moisture near the coast ("W") than further inland and further north ("D" or "N")



**Experimental PSD Precipitation Forecast Guidance**
DEC 2014 – FEB 2015 (Issued November 19, 2014`

Percent of Normal Precipitation (%)
12/1/2014 – 2/28/2015

# Summary and Future Work

- CA is sensitive to ENSO, but least where it counts the most (unless you get a Super-El Niño) – *Predicting ENSO is not the (only) answer to figuring out CA's water supply*

- Analogue forecasts based on 'flavors of ENSO' and other influences have shown moderate skill (*such as the correct anomaly for the 8 Station Index in 5 out of 6 years*) - a more sophisticated forecast model is currently being tested

- CA gets much of its moisture from 'Atmospheric River' (AR) events – PSD scientists will explore their seasonal predictability

- Multi-year droughts are currently not addressed by any forecast system, denoting a clear gap in our capabilities not just for CA