

Water Year 2019 – Wet or Dry??



Improving Sub-seasonal to Seasonal Precipitation Forecasting
Jeanine Jones, Department of Water Resources

Sub-Seasonal to Seasonal (S2S) Precipitation Forecasting

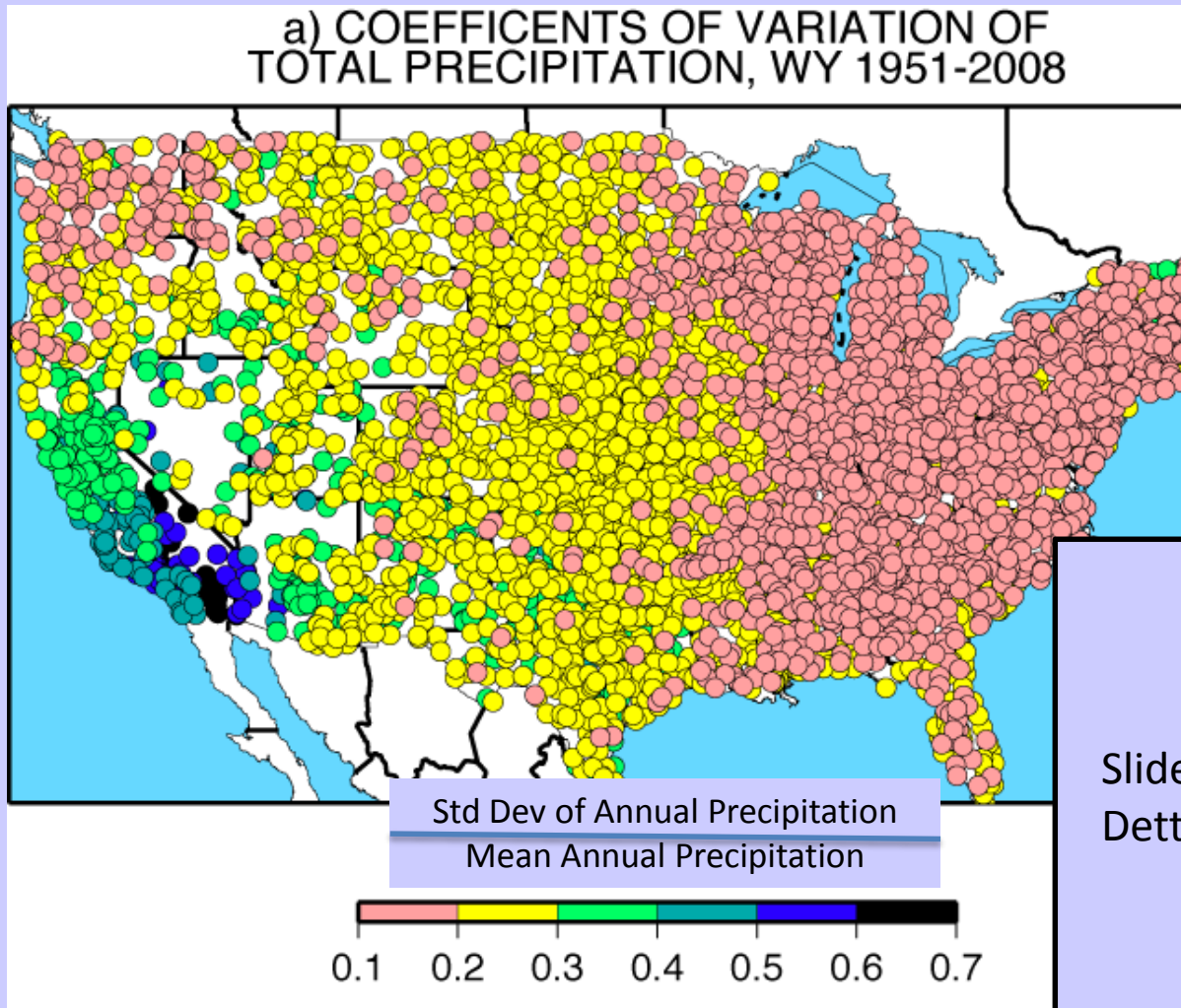
- Operational weather models – typically 2 weeks out (higher skill in first week)
- Sub-seasonal – 2 weeks to about 60 days
- Seasonal – up to 12 months



Water Managers Have Wanted Better S2S Forecasts for a Long Time!

- *Although it would be desirable to develop additional skill in forecasting the weather a month hence, what is needed for operation & management of a complex water supply project is a long-term projection, at least a year in advance, with a high degree of reliability. (CDWR, 1978, review of 1976-77 Drought)*
- *The Panel recommends that DWR identify & seek funding for research in the areas of long-range weather forecasting...Improved long-range weather forecasting would be invaluable in operating federal, State, and local water projects...(Governor's Advisory Drought Planning Panel, 2000)*
- *Top findings include: Improve seasonal prediction. Numerous stakeholders commented on the need for a seasonal prediction capability focused on cool season mountain precipitation, both in California and in the Colorado River Basin. (NOAA, California Drought 2014 Service Assessment)*

Variability of Western Precipitation

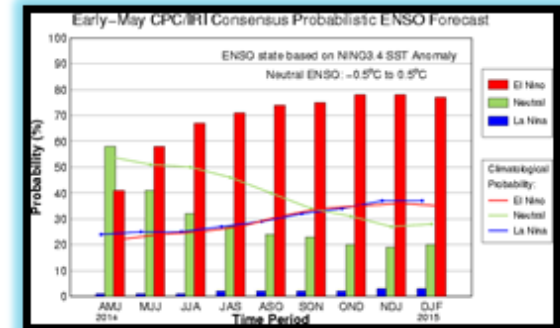
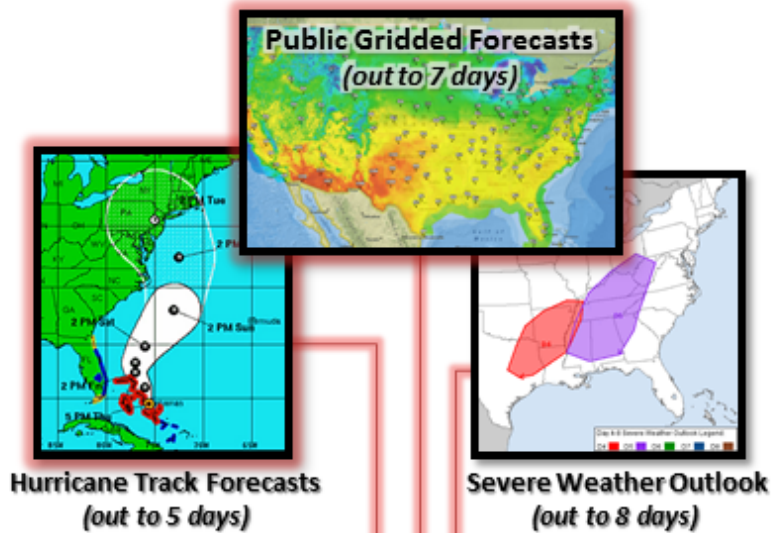


Slide courtesy of Mike
Dettinger, USGS

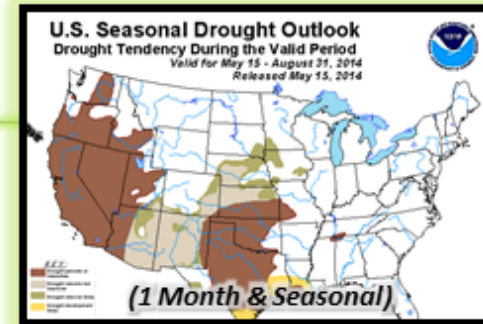
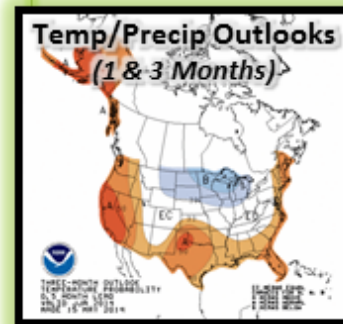
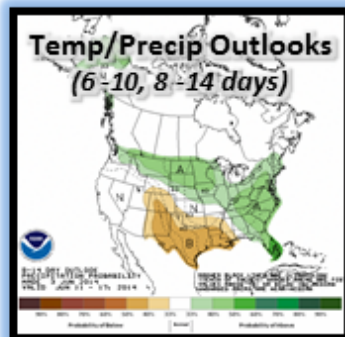
Can S2S Precipitation Forecasting be Improved?

- 2018 marks 10th anniversary of DWR Winter Outlook Workshops with research community – originally begun due to 2007-09 drought
- Two recent National Academies of Science reports
- Weather Research & Forecasting Innovation Act of 2017

NOAA NWS Operational Products



El Niño/La Niña Probabilities (beyond 10 months)



Sources of National Weather Service Seasonal Forecast Skill

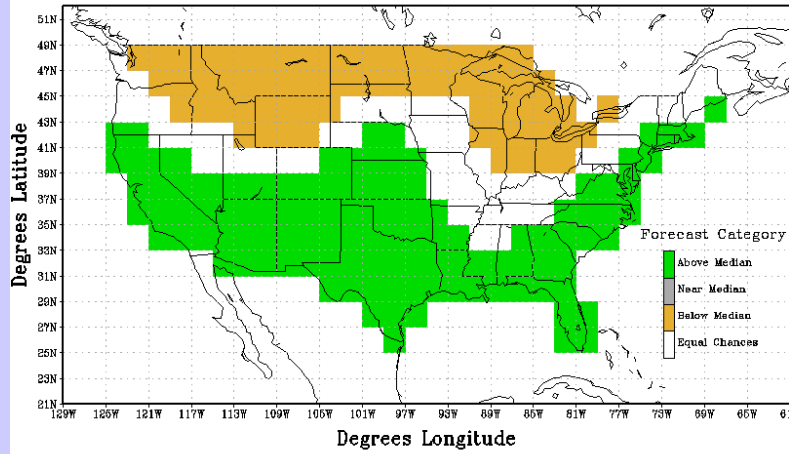
- 1. El Nino-Southern Oscillation
- 2. Trends (difference between 10yr temp mean or 15yr precip mean & 30yr climatology)
- 3. Madden-Julian Oscillation
- 4. North Atlantic Oscillation
- 5. Pacific Decadal Oscillation
- 6. Soil moisture/snow cover
- 7. Statistical forecast tools
- 8. Dynamical forecast models
- 9. Consolidation of trends & forecasts



Remember the Godzilla El Niño?

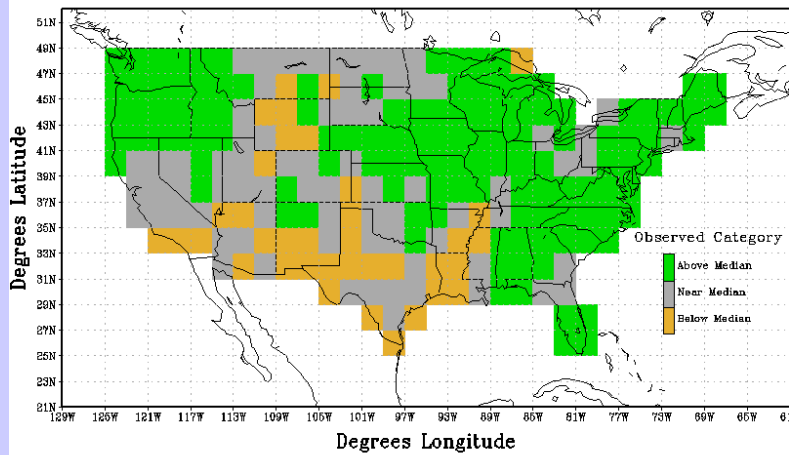
Present Forecasting Skill Not Usable for Water Management

Categorical Precipitation Official Forecast
Issued: Nov 2015 Valid: Dec-Jan-Feb 2015-16



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

Categorical Precipitation Observations
Valid: Dec-Jan-Feb 2015-16



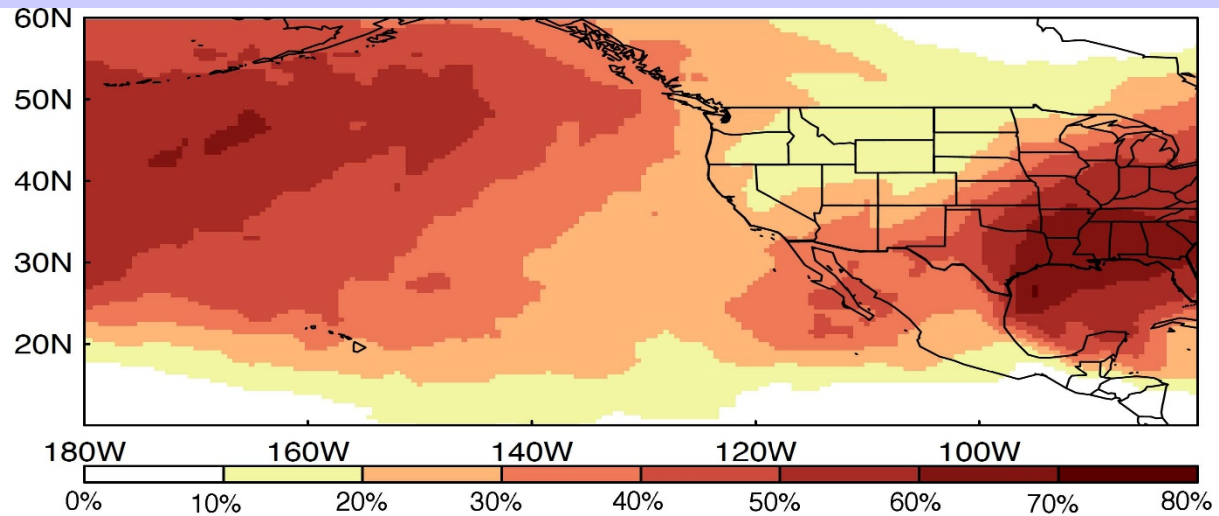
State of California Investments in Observing & Understanding/Forecasting Precipitation

- NOAA Hydrometeorology Testbed (state share) -- \$15M
- Advanced precipitation monitoring & forecasting grant to Bay Area water agencies -- \$19M
- Calwater I & II field observing campaigns -- \$5M
- Other research with NOAA & University of California system -- \$7+M

Initial Preliminary Experimental Research AR S2S Probability Forecasts

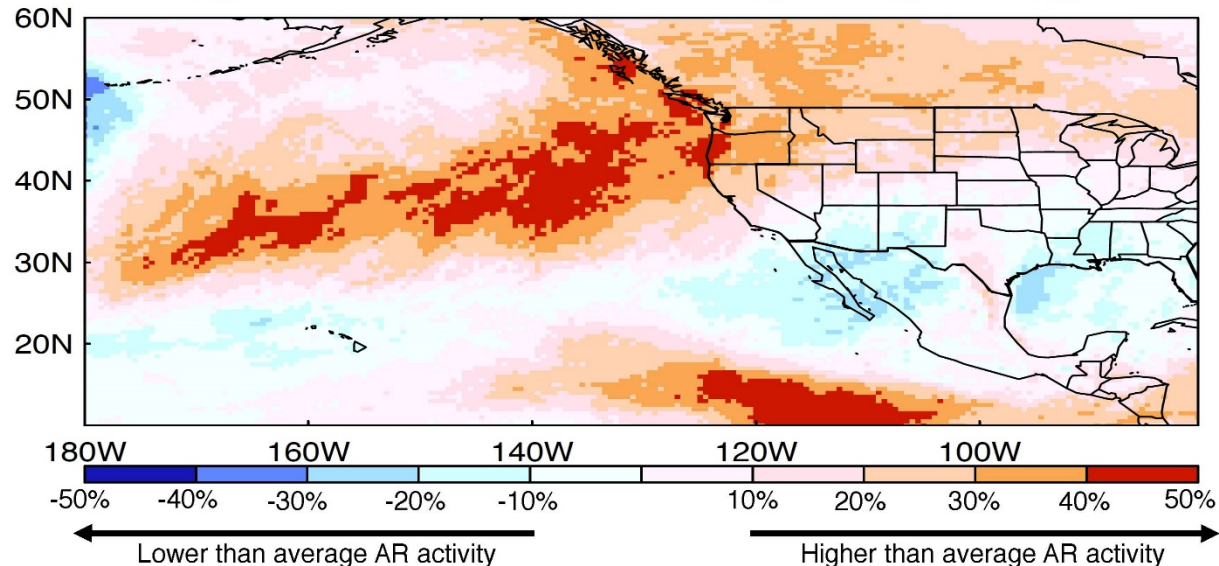
AR Occurrence Climatology

- Chance of an AR occurring sometime during a week-long period in mid-January
- Climatology based on all week-3 ECMWF forecasts from 1996-2015 for mid-January



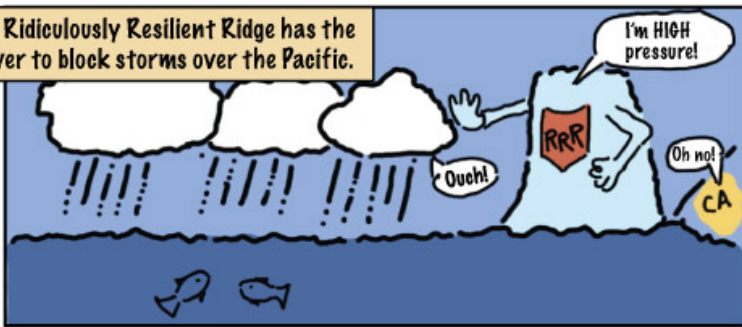
AR Occurrence Forecast Relative to Climatology

- Week 3 ECMWF forecast valid for Jan 16-22, 2018
- Values shown are forecast minus climatology (top)
- ECMWF ensemble forecast includes 51 members



Courtesy of D. Waliser et al.

The Ridiculously Resilient Ridge has the power to block storms over the Pacific.



It stopped rain and snow from getting to California.

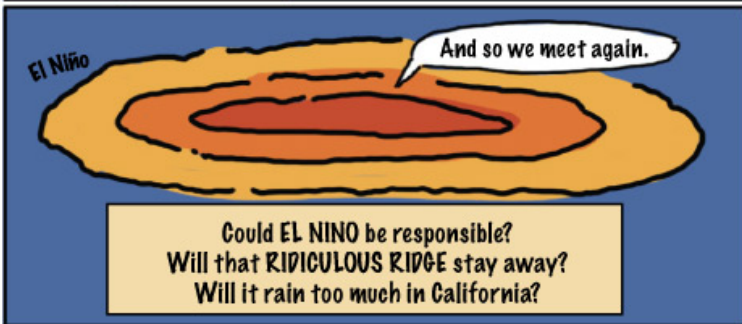


YAHOO! IT'S THE PINEAPPLE EXPRESS!



But then one day the Ridiculously Resilient Ridge disappeared and storms started blowing through.

And so we meet again.



Could EL NINO be responsible?
Will that RIDICULOUS RIDGE stay away?
Will it rain too much in California?

New experimental effort to forecast ridging, CDWR contract with NASA JPL

One Hundred Fifteenth Congress of the United States of America

AT THE FIRST SESSION

*Began and held at the City of Washington on Tuesday,
the third day of January, two thousand and seventeen*

An Act

To improve the National Oceanic and Atmospheric Administration's weather research through a focused program of investment on affordable and attainable advances in observational, computing, and modeling capabilities to support substantial improvement in weather forecasting and prediction of high impact weather events, to expand commercial opportunities for the provision of weather data, and for other purposes.

*Be it enacted by the Senate and House of Representatives of
the United States of America in Congress assembled,*

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the “Weather Research and Forecasting Innovation Act of 2017”.

(b) TABLE OF CONTENTS.—The table of contents for this Act is as follows:

Sec. 1. Short title; table of contents.
Sec. 2. Definitions.

TITLE I—UNITED STATES WEATHER RESEARCH AND FORECASTING IMPROVEMENT

Sec. 101. Public safety priority.
Sec. 102. Weather research and forecasting innovation.
Sec. 103. Tornado warning improvement and extension program.
Sec. 104. Hurricane forecast improvement program.
Sec. 105. Weather research and development planning.
Sec. 106. Observing system planning.
Sec. 107. Observing system simulation experiments.
Sec. 108. Annual report on computing resources prioritization.
Sec. 109. United States Weather Research program.
Sec. 110. Authorization of appropriations.

TITLE II—SUBSEASONAL AND SEASONAL FORECASTING INNOVATION

Sec. 201. Improving subseasonal and seasonal forecasts.

TITLE III—WEATHER SATELLITE AND DATA INNOVATION

Sec. 301. National Oceanic and Atmospheric Administration satellite and data management.
Sec. 302. Commercial weather data.
Sec. 303. Unnecessary duplication.

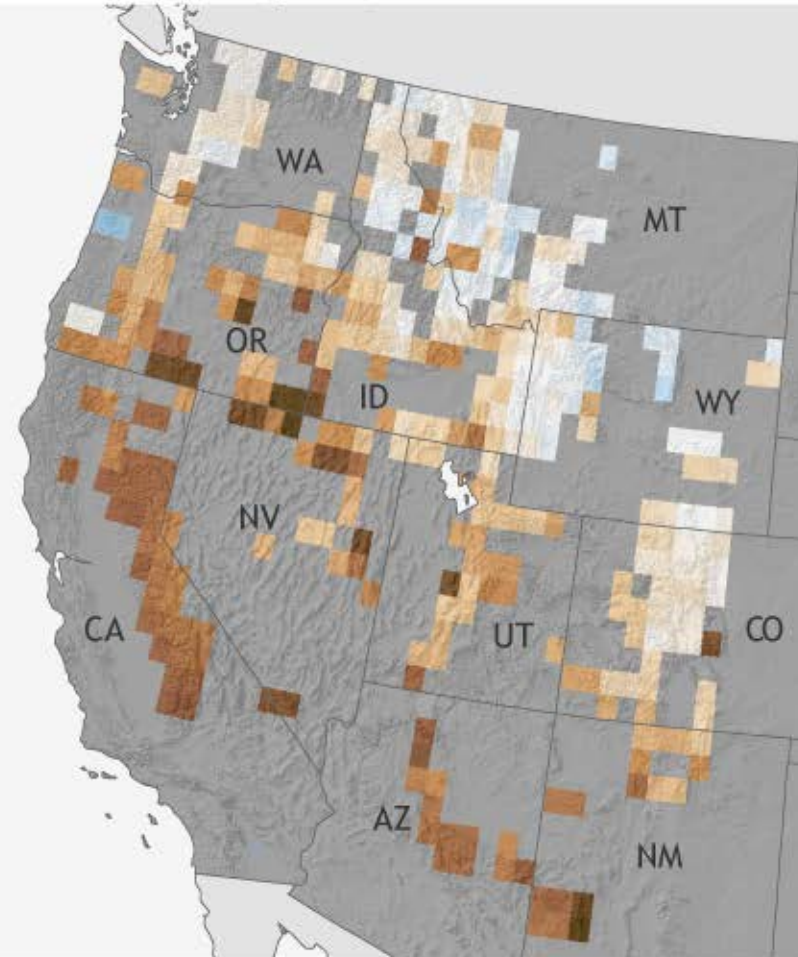
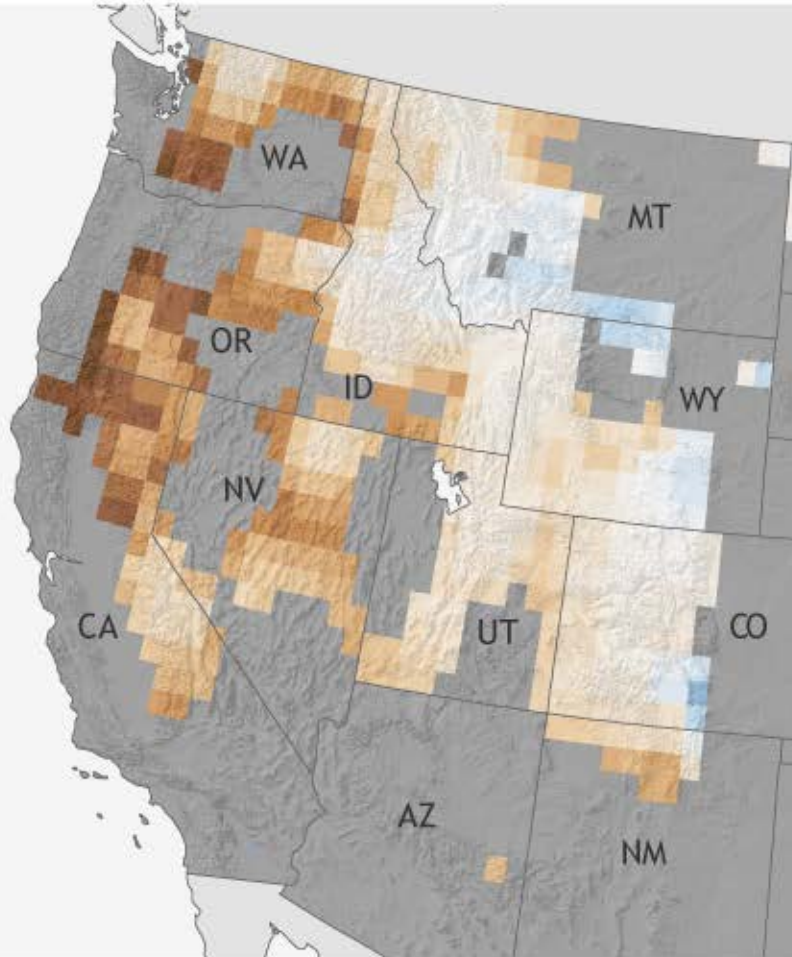
TITLE IV—FEDERAL WEATHER COORDINATION

Sec. 401. Environmental Information Services Working Group.
Sec. 402. Interagency weather research and forecast innovation coordination.
Sec. 403. Office of Oceanic and Atmospheric Research and National Weather Service exchange program.
Sec. 404. Visiting fellows at National Weather Service.
Sec. 405. Warning coordination meteorologists at weather forecast offices of National Weather Service.
Sec. 406. Improving National Oceanic and Atmospheric Administration communication of hazardous weather and water events.
Sec. 407. National Oceanic and Atmospheric Administration Weather Ready All Hazards Award Program.

NOAA Research Example – Seasonal Prediction of Western Snowpack

Predicted March 2012–2015 snowpack

Observed March snowpack, 2012–2015



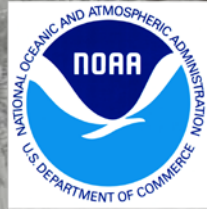
Snow water content



below average

above average

NOAA Climate.gov
Data: Sarah Kapnick



Predicting western US snowfall and runoff before the winter begins: a prospectus

Tom Hamill¹, Sarah Kapnick², Dave DeWitt³, Brian Gross⁴, John Lhotak⁵

¹ NOAA/OAR Earth System Research Lab, Physical Sciences Division, Boulder Colorado

² NOAA/OAR Geophysical Fluid Dynamics Laboratory, Princeton, New Jersey

³ NOAA/NWS Climate Prediction Center, College Park, Maryland

⁴ NOAA/NWS Environmental Modeling Center, College Park, Maryland

⁵ Colorado Basin River Forecast Center, Salt Lake City, Utah

a presentation to Western States Water Council, Coeur d'Alene ID, October 2018

Can S2S Precipitation Forecasting Be Improved?

- Research
- Funding, increased federal priority
- Reauthorize Weather Research Act of 2017
- Focused pilot projects, e.g., winter precipitation in Western U.S.

NEXT GENERATION EARTH SYSTEM PREDICTION

STRATEGIES FOR SUBSEASONAL TO SEASONAL FORECASTS

Committee on Developing a U.S. Research Agenda to Advance Subseasonal to
Seasonal Forecasting

Board on Atmospheric Sciences and Climate
Ocean Studies Board

Division on Earth and Life Studies

This prepublication version of Next Generation Earth System Prediction: Strategies for Subseasonal to Seasonal Forecasts has been provided to the public to facilitate timely access to the report. Although the substance of the report is final, editorial changes may be made throughout the text and citations will be checked prior to publication. The final report will be available through the National Academies Press in spring 2016.

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THE NATIONAL ACADEMIES PRESS
Washington, DC
www.nap.edu



Subseasonal-to-Seasonal (S2S) Precipitation Coalition

The Subseasonal-to-Seasonal (S2S) Precipitation Coalition is a broad-based, multi-state coalition of entities committed to advancing federal support for enhanced precipitation prediction in the Western United States.

After enduring several years of drought, Western states have experienced historic precipitation in recent months. In both extremes, improved forecasting will allow communities throughout the West to better prepare for wet and dry seasons alike.

Effective water management in the West is enhanced by sound, scientifically-based decisions made weeks to months ahead of time. While some of these key decisions hinge on expectations or predictions of precipitation, snow pack and general watershed conditions, precipitation forecasting beyond 5-7 days is highly uncertain.

The science community has identified a strategy for pursuing improvements to national precipitation forecasts from two weeks to several months in advance. The S2S Precipitation Coalition is informing policymakers of the importance of these water decisions and the need for forecast research and related science.

Subseasonal-to-Seasonal "S2S" timescales span from lead times of two weeks to several months for precipitation forecasting.

FOUNDING MEMBERS

- Association of Metropolitan Water Agencies
- Association of California Water Agencies
- California Department of Water Resources
- Colorado River District
- Orange County Water District
- Salt River Project
- Sonoma County Water Agency
- Scripps Institution of Oceanography, UC San Diego
- Western States Water Council

- www.amwa.net
- www.acwa.com
- <http://www.water.ca.gov>
- www.coloradoriverdistrict.org
- www.ocwd.com
- www.srpnet.com
- www.scwa.ca.gov
- cw3e-web.ucsd.edu
- www.westernstateswater.org

For additional information, please contact Jordan Smith at 202-298-1914 or jas@vnf.com.

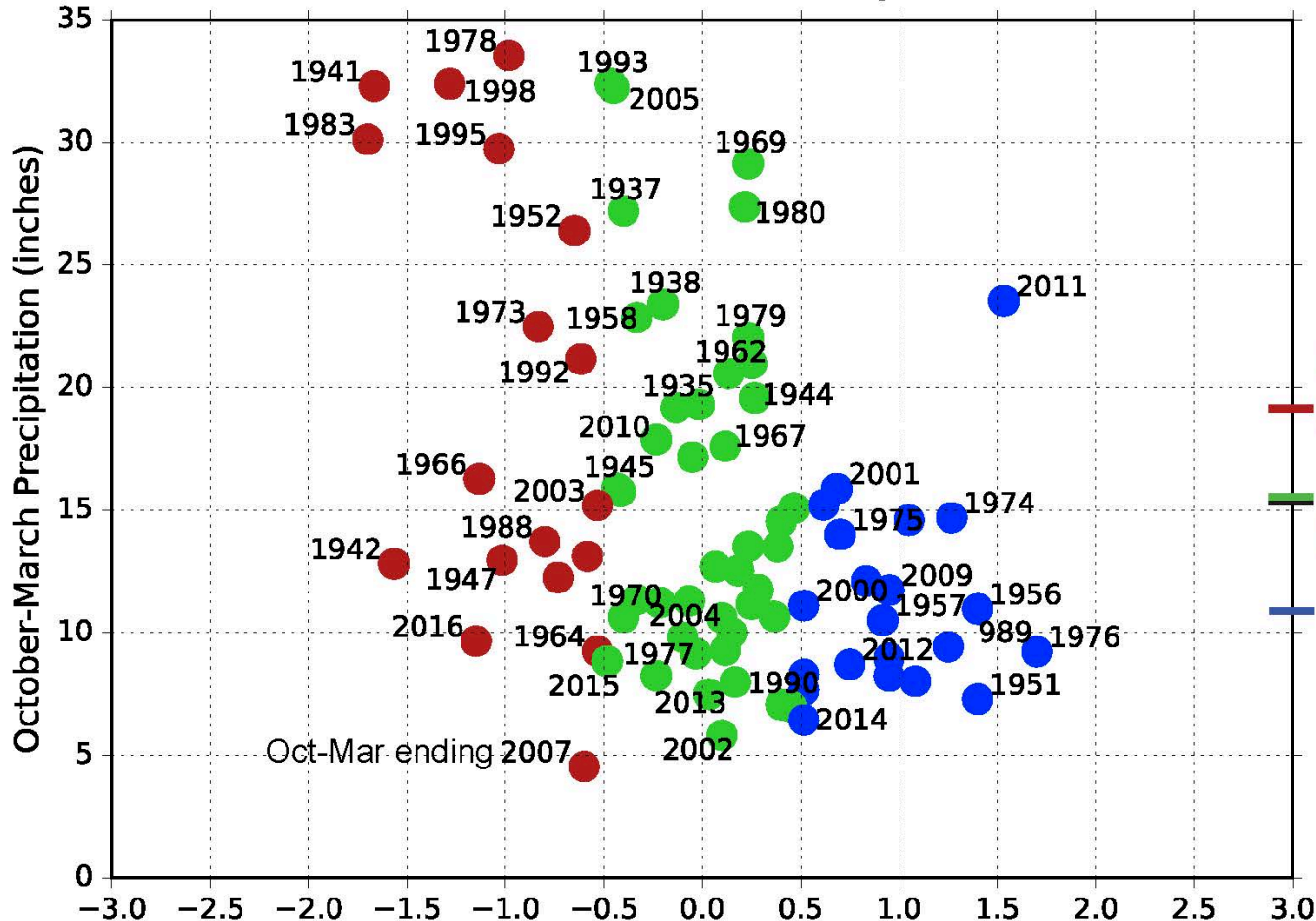
So What About WY 2019 -- Are We Back to Extended Dry Conditions?

- 2007-09 drought
- 2010 normal year
- 2011 wet year
- 2012-16 drought
- 2017 very wet
- 2018 dry



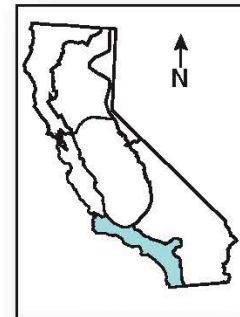
CA Division 6 October-March Precipitation

(versus Southern Oscillation Index for prior June-November)



Years 1933/1934-
2015/2016
 $r^2 = 0.19$
Correlation = -0.44

Mean = 19.32 in
Mean = 15.30 in
Mean all = 15.15 in
Mean = 11.27 in



Western Regional
Climate Center

What Can We Say About WY 2019?

- Historically, no guidance from ENSO
- If atmospheric ridging sets up, persistence may offer short-term guidance
- Need to understand wet season climate system regime shifts (transitions), potentially predictive guidance there

DWR Strategy for Improving S2S Prediction

- Extend weather forecasts out (week 3-4 experimental forecasts of atmospheric river storms)
- Experimental forecasts of persistent ridging (weeks to couple of months)
- Explore ability to predict wet season regime shifts
- Encourage research on Western seasonal snowpack prediction

Improving
Sub-Seasonal to Seasonal
Precipitation Forecasting for
Water Management



WESTERN
STATES
WATER
COUNCIL