

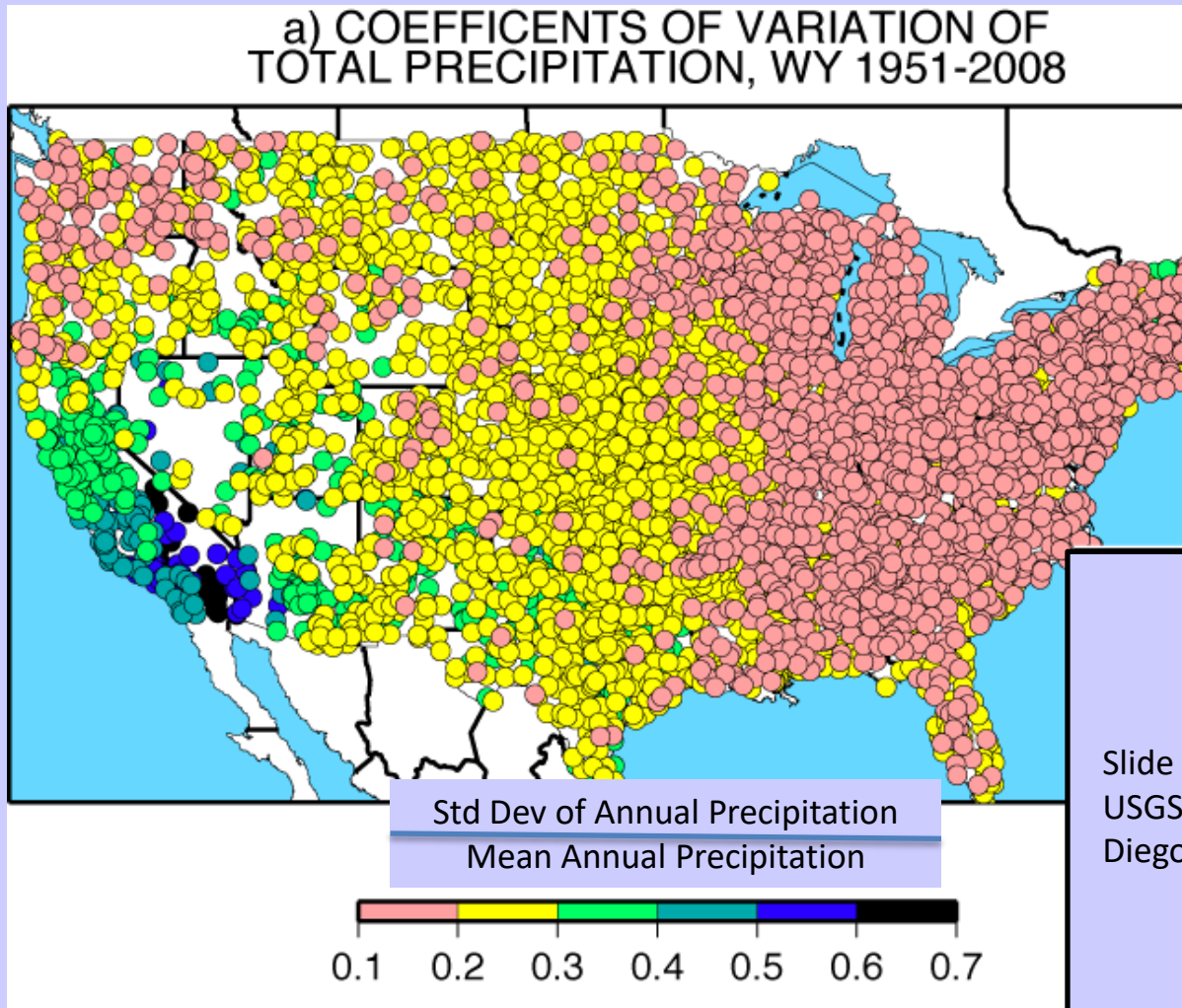
Water Year 2018 – Wet or Dry??



Improving Sub-seasonal to Seasonal Precipitation Forecasting

Jeanine Jones, Department of Water Resources

Variability of Western Precipitation

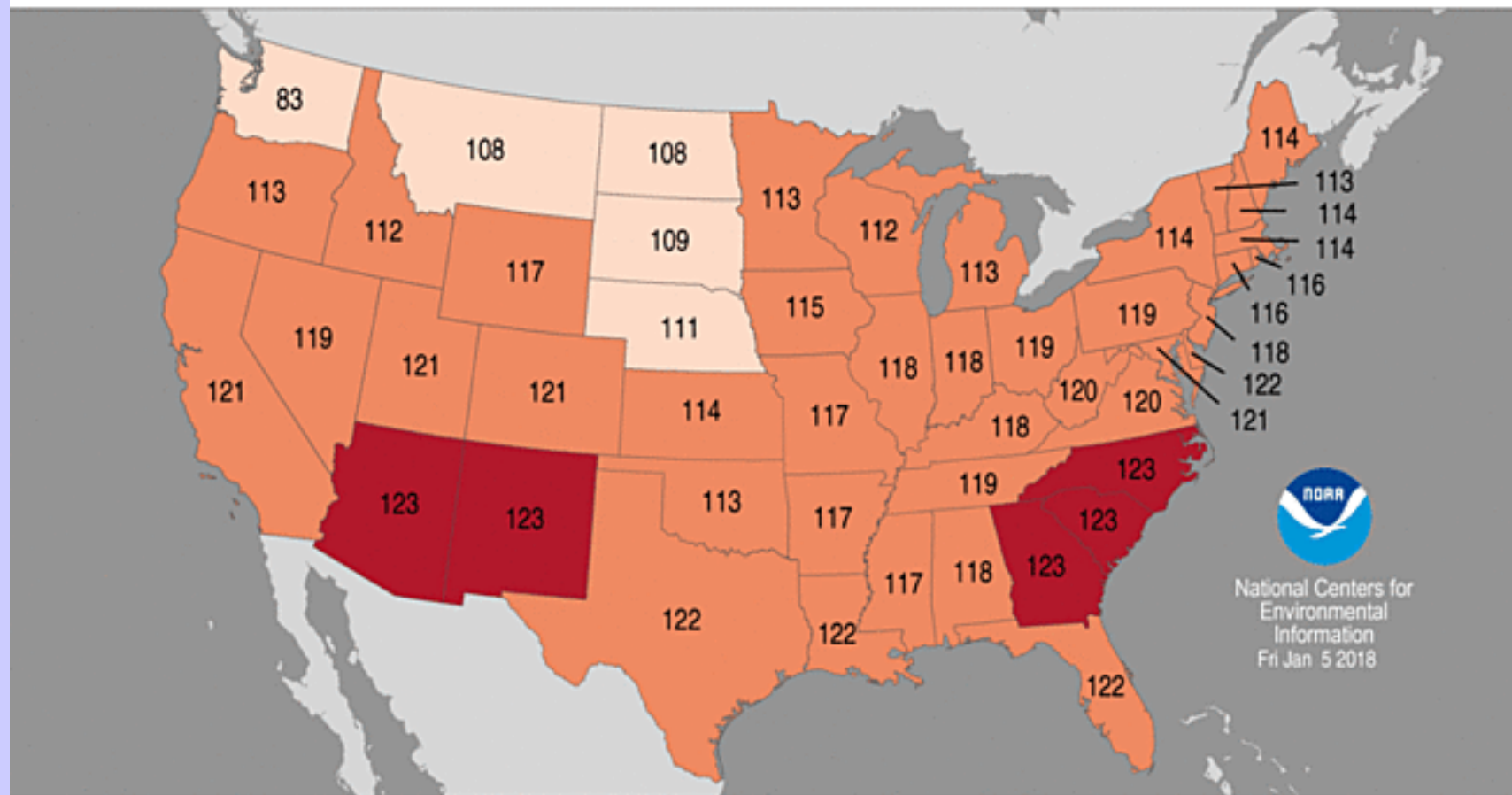


Slide courtesy of Mike Dettinger,
USGS/University of California San
Diego, Scripps

Statewide Average Temperature Ranks

January–December 2017

Period: 1895–2017



Recently in California.....

- 2007-09 drought
- 2010 normal year
- 2011 wet year
- 2012-16 drought
- 2017 2nd wettest year on record (but not 2nd snowiest!)



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

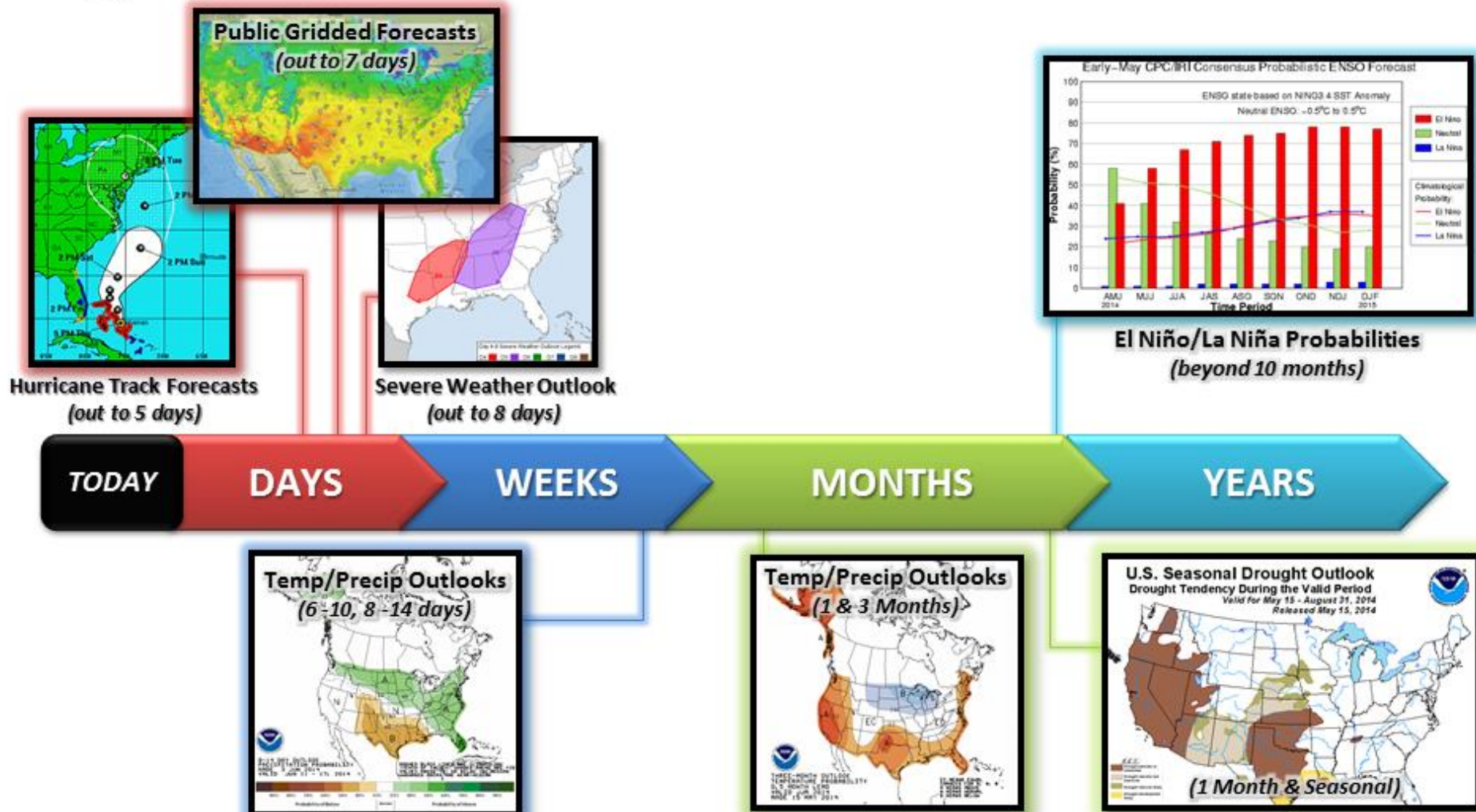
WRCC data

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



NOAA National Weather Service Products



Sources of National Weather Service Seasonal Forecast Skill

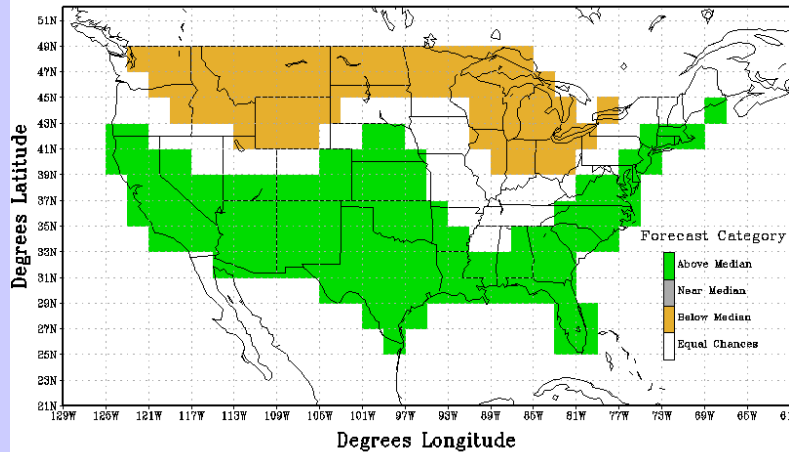
- 1. El Nino-Southern Oscillation
- 2. Trends (difference between 10yr temp mean or 15yr precip mean & 30yr climatology)
- 3. Madden-Julian Oscillation
- 4. North Atlantic Oscillation
- 5. Pacific Decadal Oscillation
- 6. Soil moisture/snow cover
- 7. Statistical forecast tools
- 8. Dynamical forecast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



Remember the Godzilla El Niño?

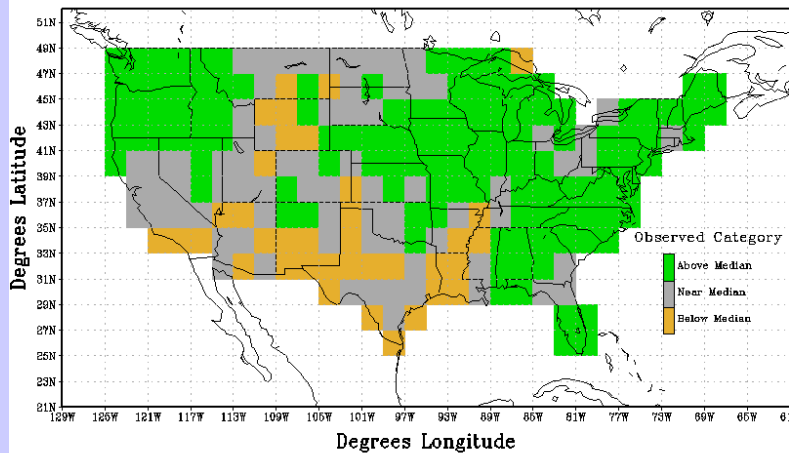
Present Forecasting Skill Not Usable for Water Management

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

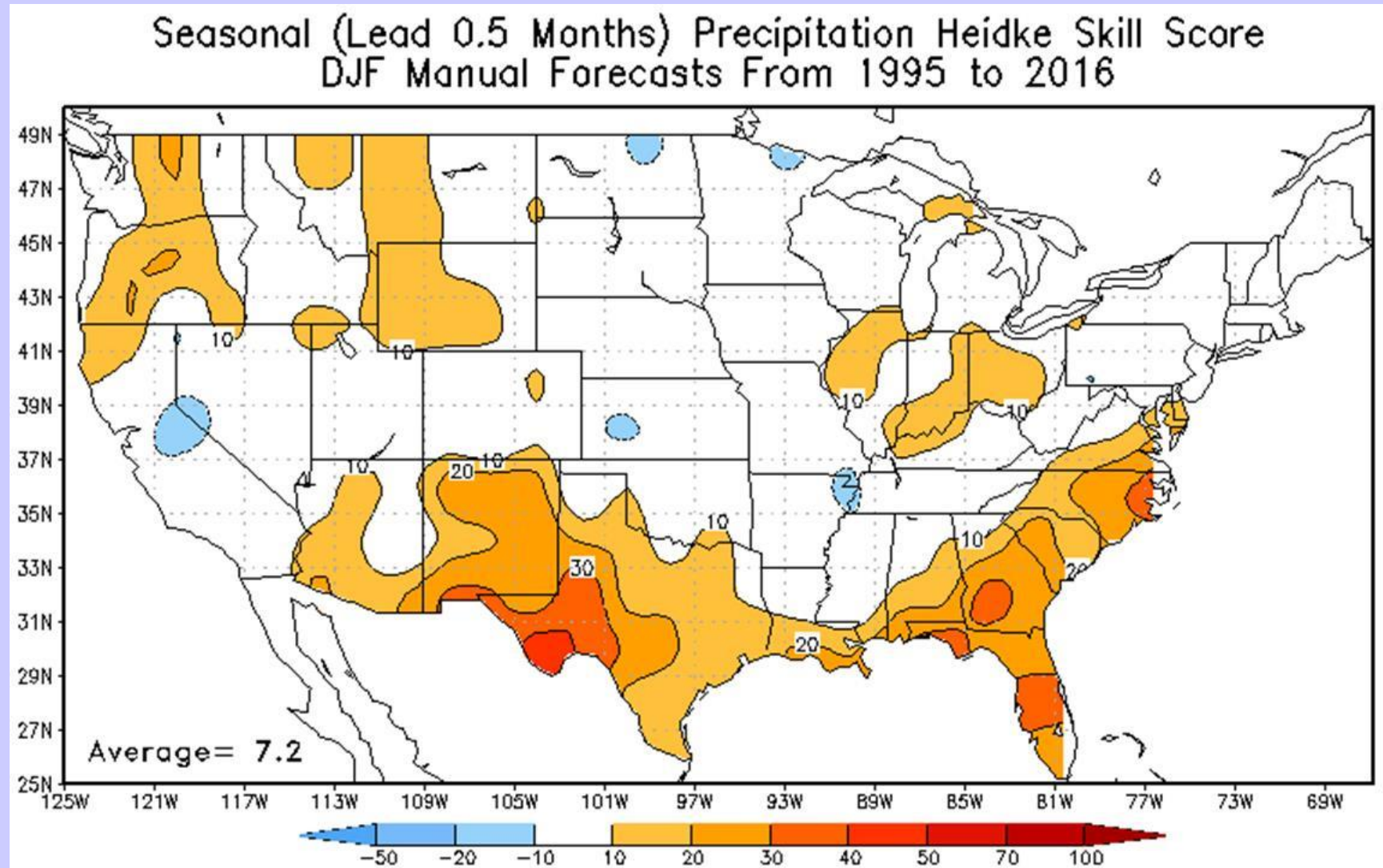


**The Godzilla El Niño –
forecasted vs. observed
precipitation**

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



Historical Skill -- NWS Outlook Example



NWS CPC figure

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.

The National Academies of
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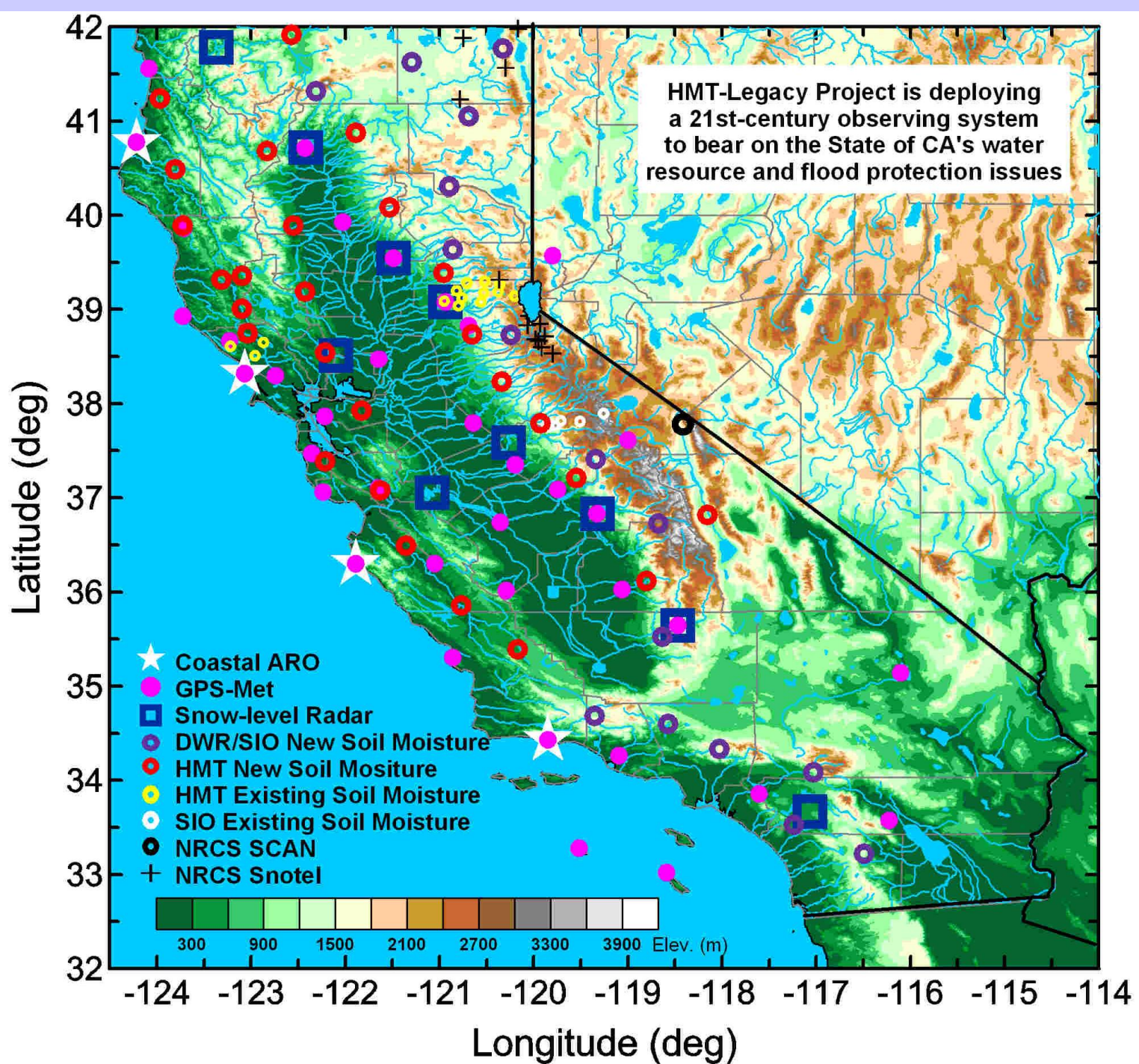
Washington, DC

www.nap.edu

State of California Investments in Observing & Understanding Atmospheric River Storms

- 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 University of California system -- \$3.5M

New understanding of role of extreme precipitation (e.g., atmospheric river storms) in West, implications for improving predictability at regional scale





Distribution of Landfalling Atmospheric Rivers on the U.S. West Coast

(From 1 Oct 2016 to 31 March 2017)

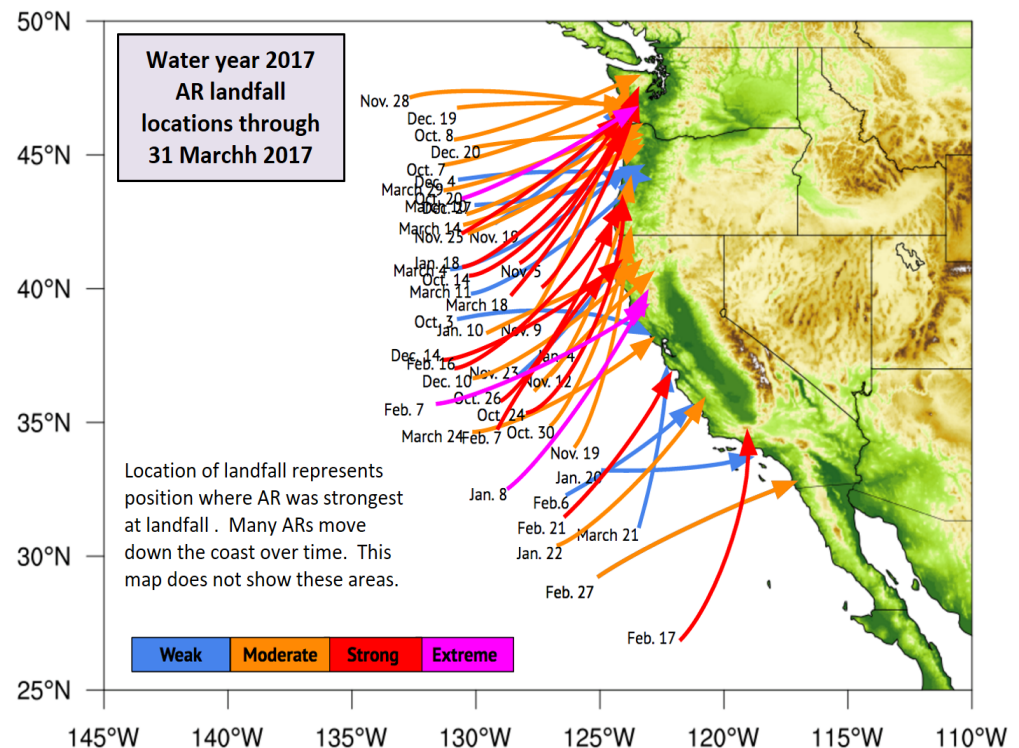
AR Strength	AR Count*
Weak	11
Moderate	19
Strong	13
Extreme	3

Ralph/CW3E AR Strength Scale

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

*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)

- 46 Atmospheric Rivers have made landfall on the West Coast thus far during the 2017 water year (1 Oct. – 31 March 2017)
- This is much greater than normal
- 1/3 of the landfalling ARs have been “strong” or “extreme”



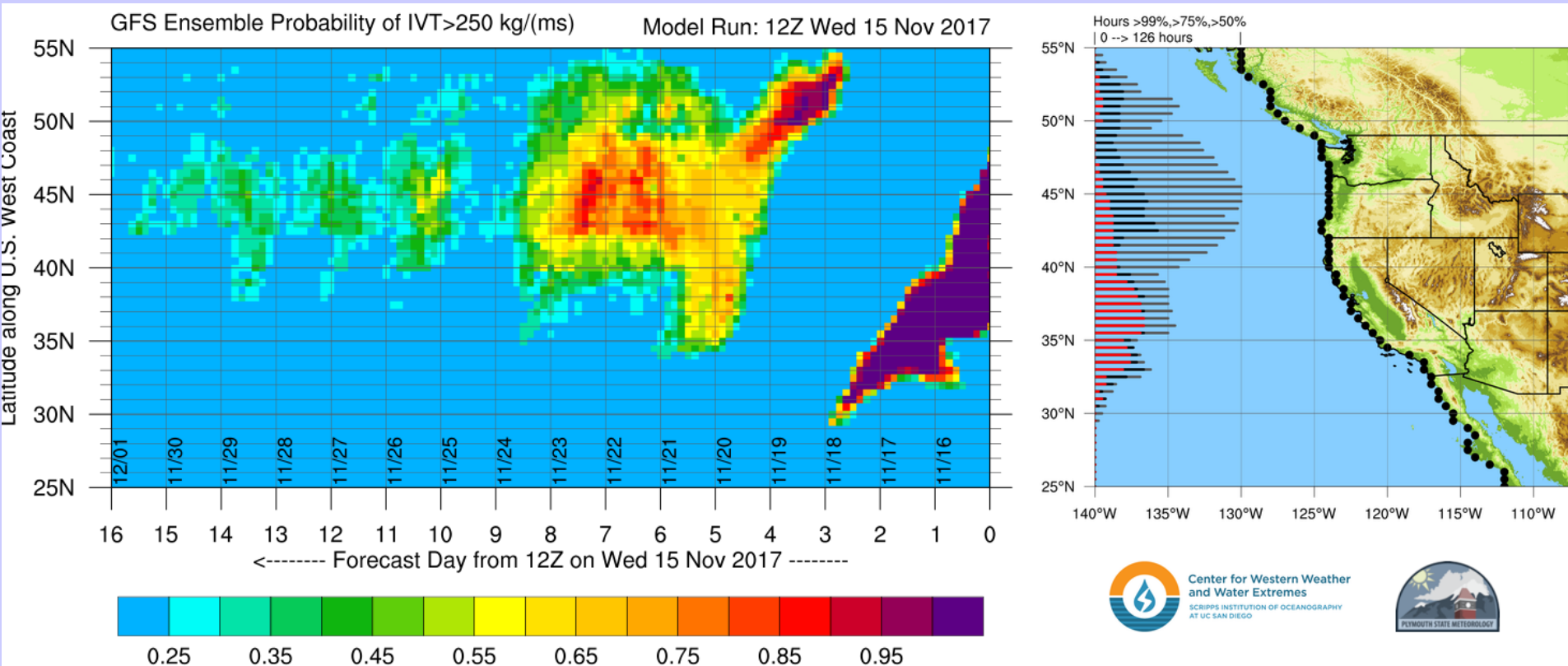
Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

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

Experimental

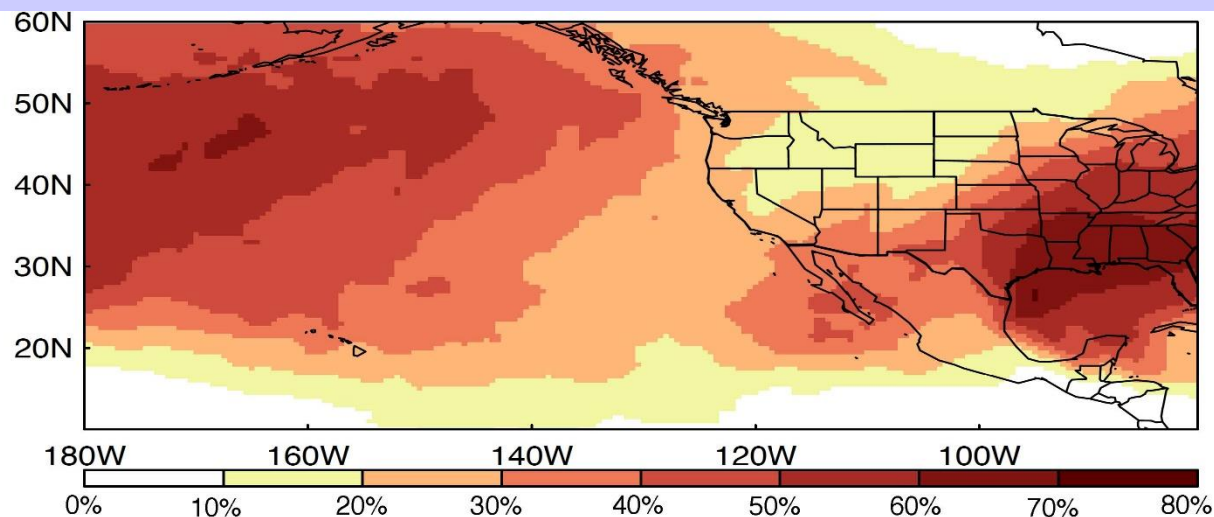
From Observing to Experimental Research Weather Forecasts.....



Initial Preliminary Experimental Research AR S2S Probability Forecasts

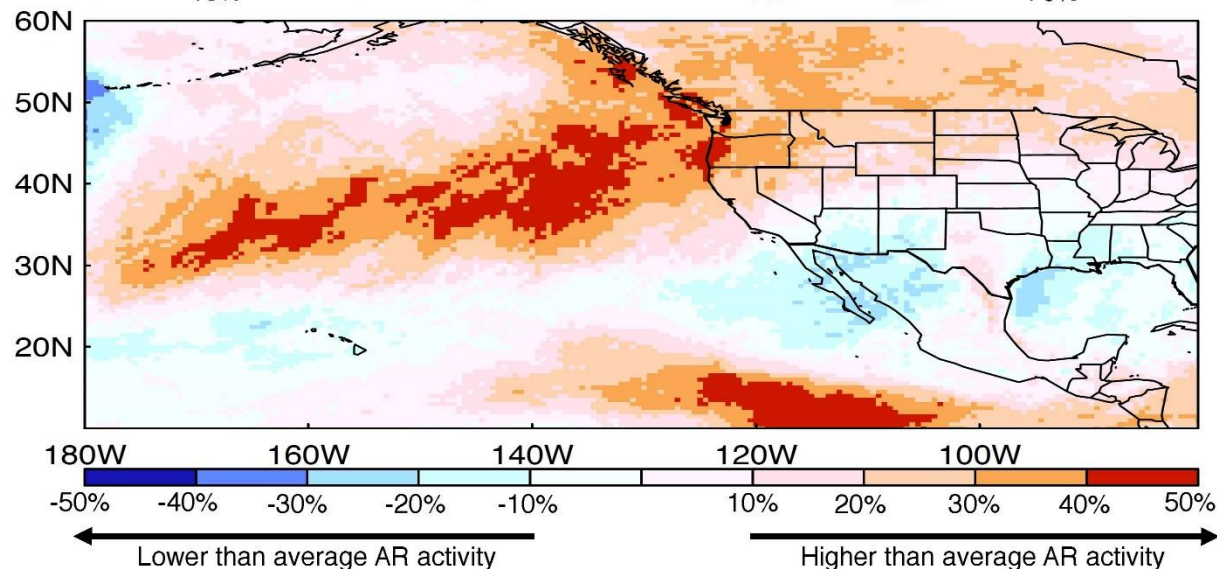
AR Occurrence Climatology

- 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.

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

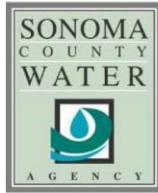
- Sec. 101. Public safety priority.
- Sec. 102. Weather research and forecasting innovation.
- Sec. 103. Tornado warning improvement and extension program.
- Sec. 104. Hurricane forecast improvement program.
- Sec. 105. Weather research and development planning.
- Sec. 106. Observing system planning.
- 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.



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.

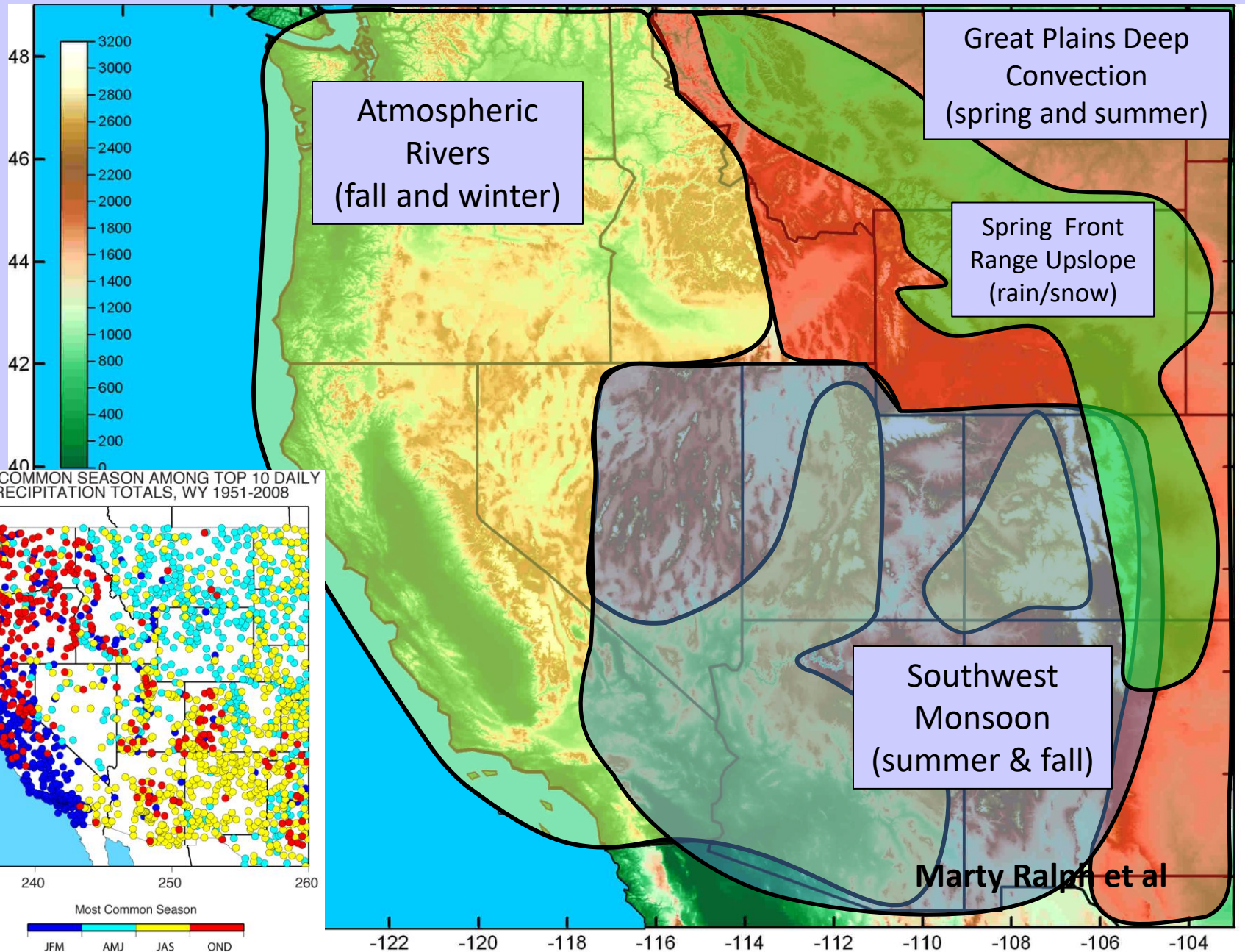
FOUNDING MEMBERS

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

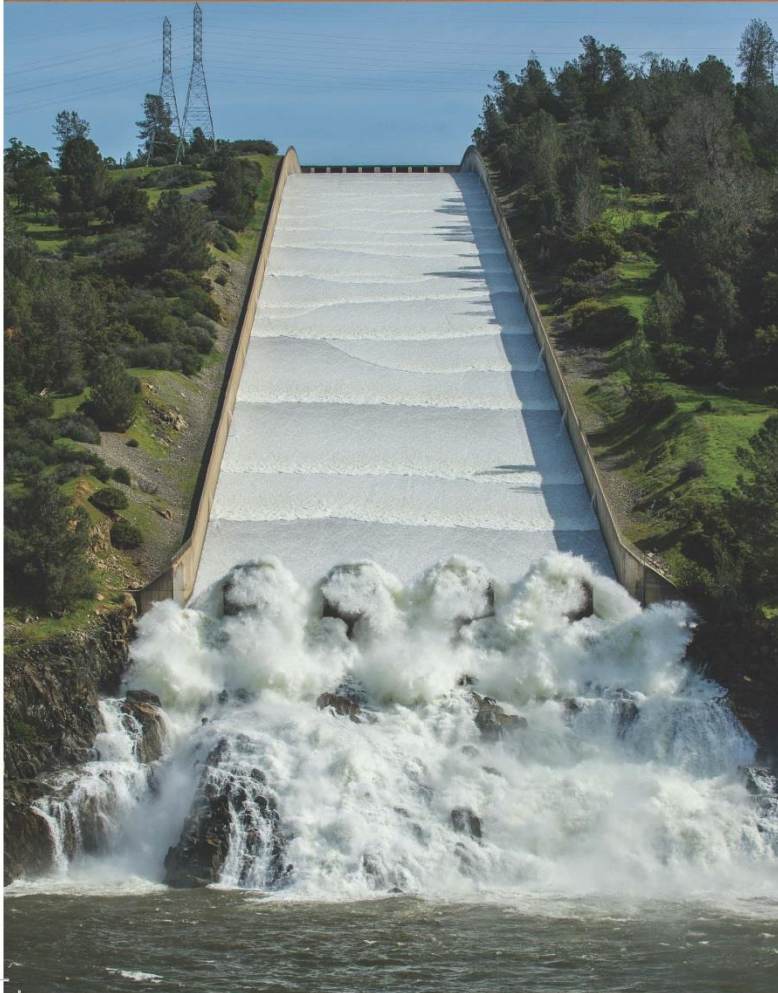
www.amwa.net
www.acwa.com
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www.scwa.ca.gov
cw3e-web.ucsd.edu
www.westernstateswater.org

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

Schematic illustration of regional variations in the primary weather phenomena that lead to extreme precipitation, flooding and contribute to water supply in the Western U.S.



Improving
Sub-Seasonal to Seasonal
Precipitation Forecasting for
Water Management



WESTERN
STATES
WATER
COUNCIL