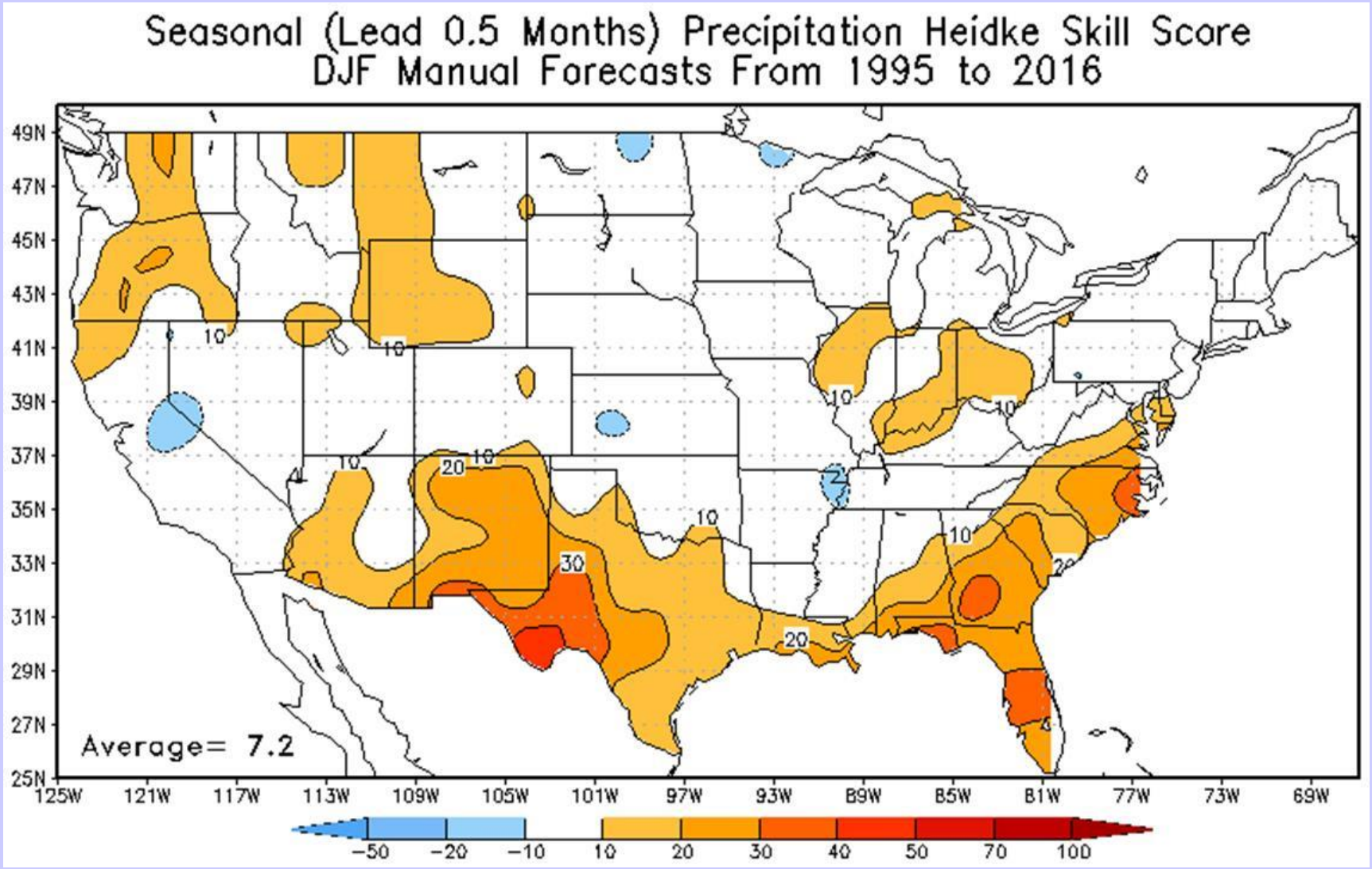
Improving Sub-seasonal to Seasonal Precipitation Forecasting for Water Management

Jeanine Jones, California Department of Water Resources

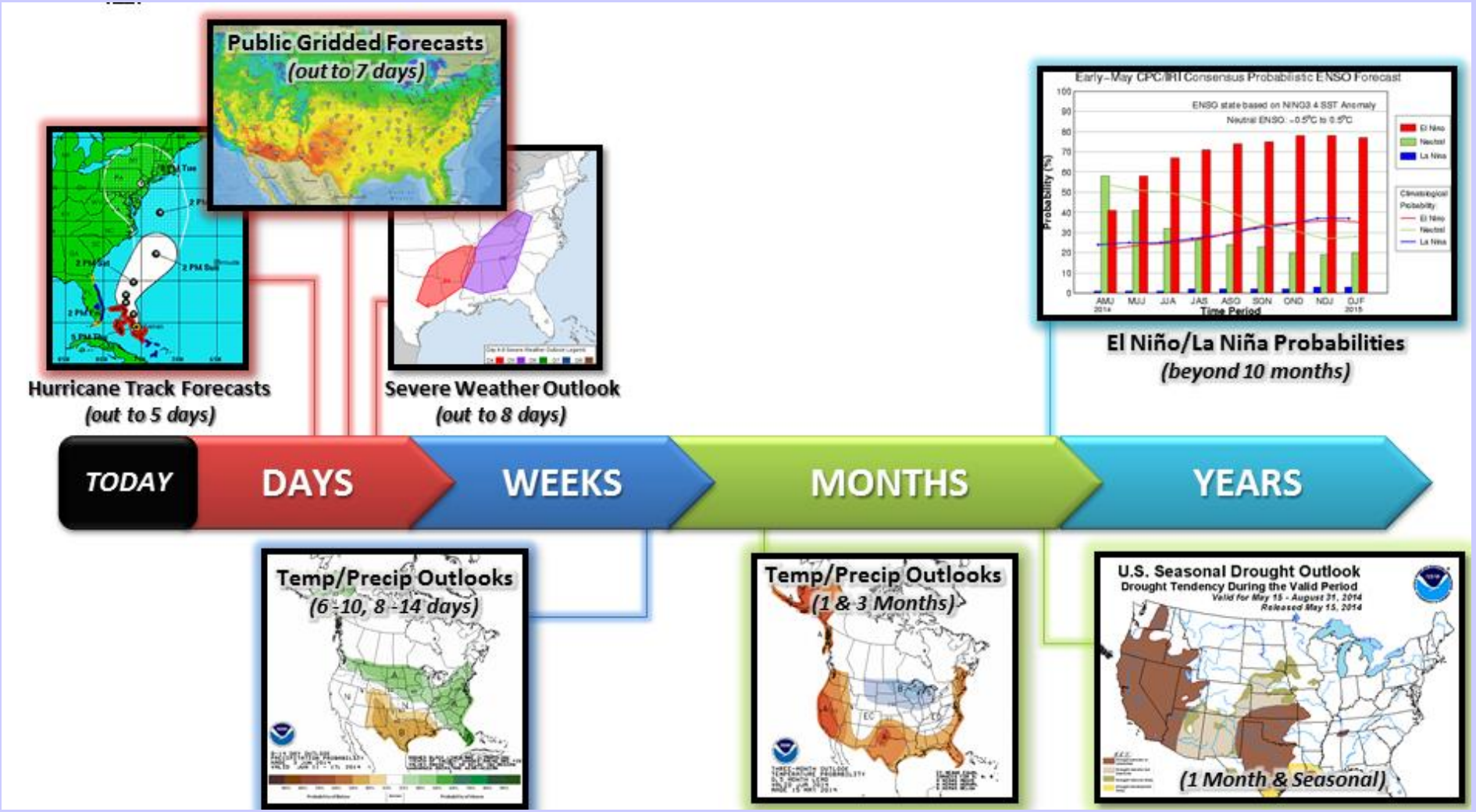
Sub-Seasonal to Seasonal (S2S) Precipitation Forecasting

- 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

NOAA NWS Climate Prediction Center Skill Scores



NOAA NWS Operational Products

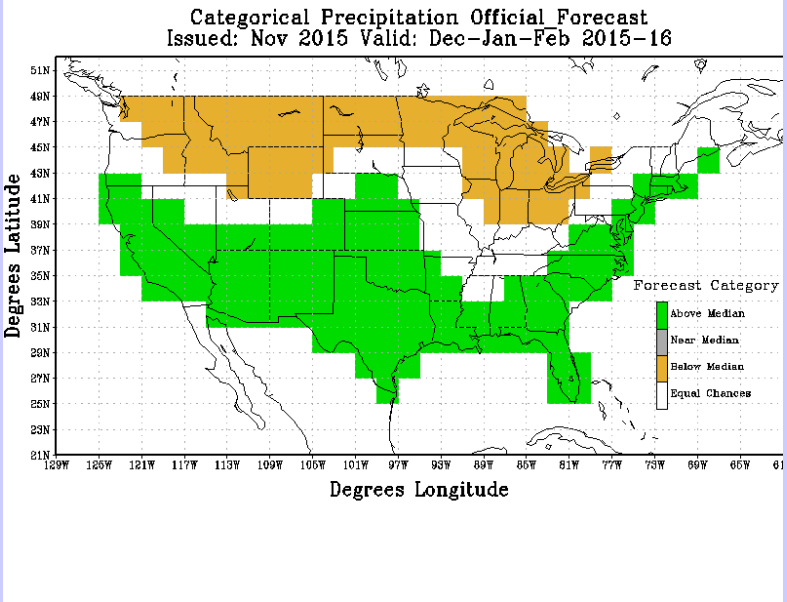


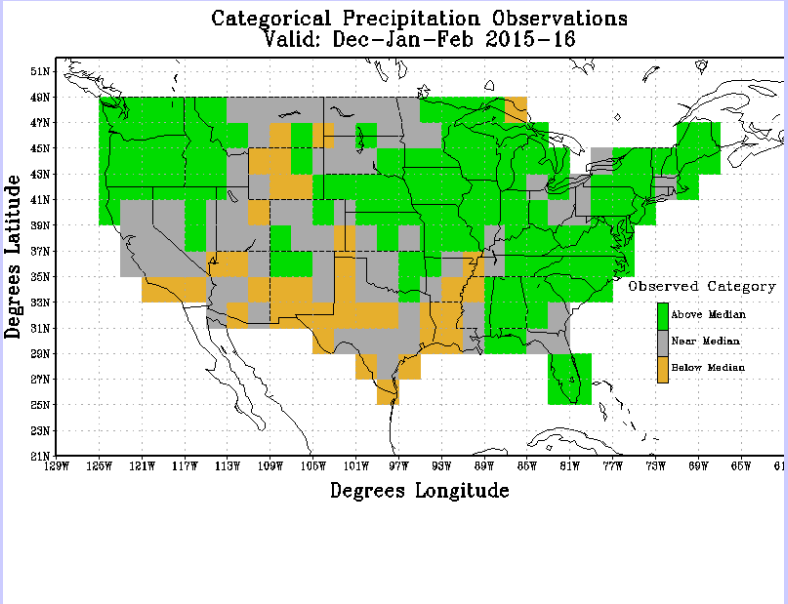
Sources of National Weather Service Seasonal Forecast Skill

- 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?

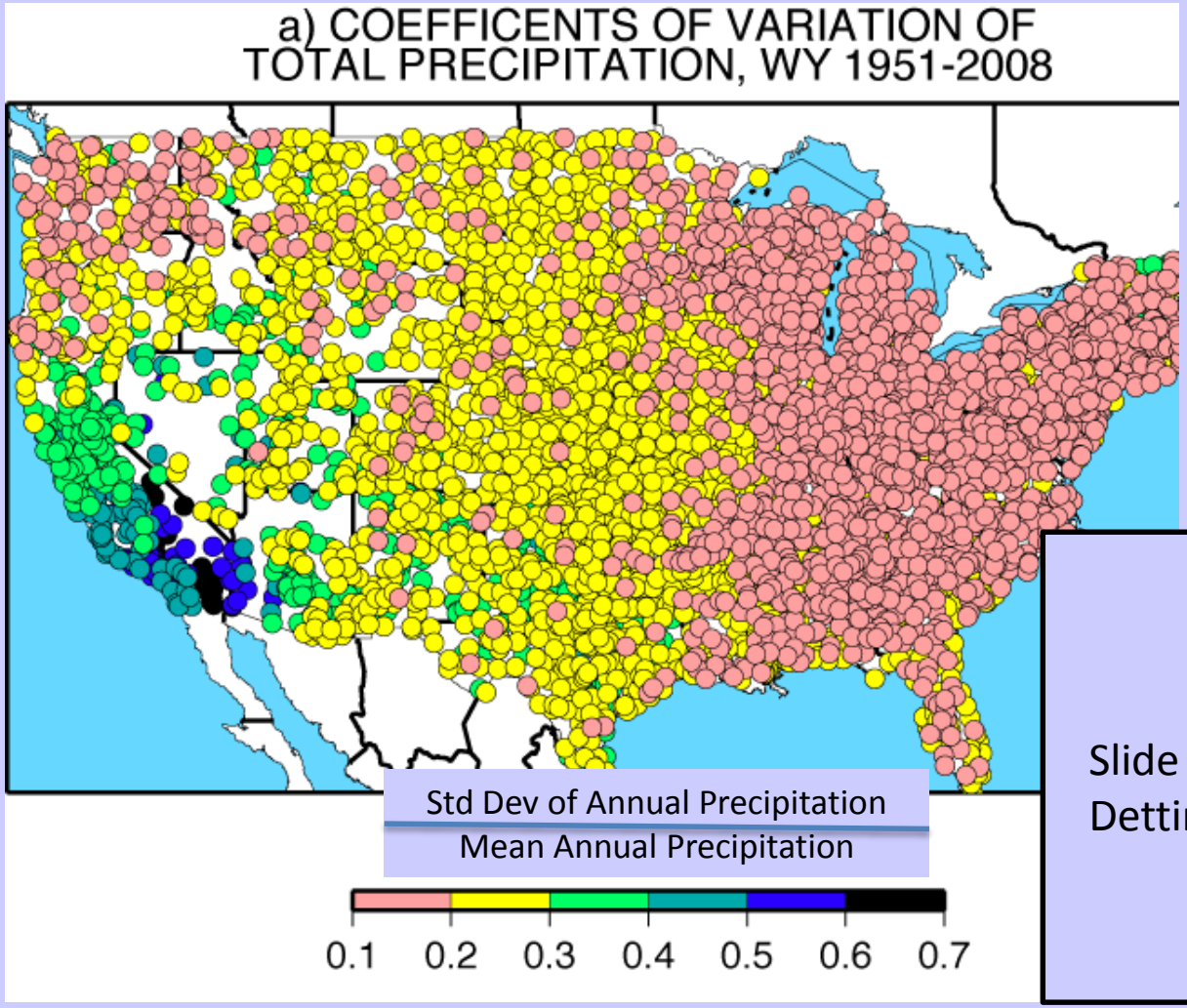
Present Forecasting Skill Not Usable for Water Management





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

Variability of Western Precipitation



Slide courtesy of Mike Dettinger, USGS

Lead Time Very Important for Water Management

- Public health & safety decisions
- Balancing risk/cost trade-offs
- Increasing water management efficiency
- Operating within legal & regulatory frameworks
- Reducing impacts of extreme events
- Responding to increased competition for resources
- Operating reservoirs and other infrastructure

Will the Rest of This Winter be Wet or Dry? Example Sub-Seasonal Decisions

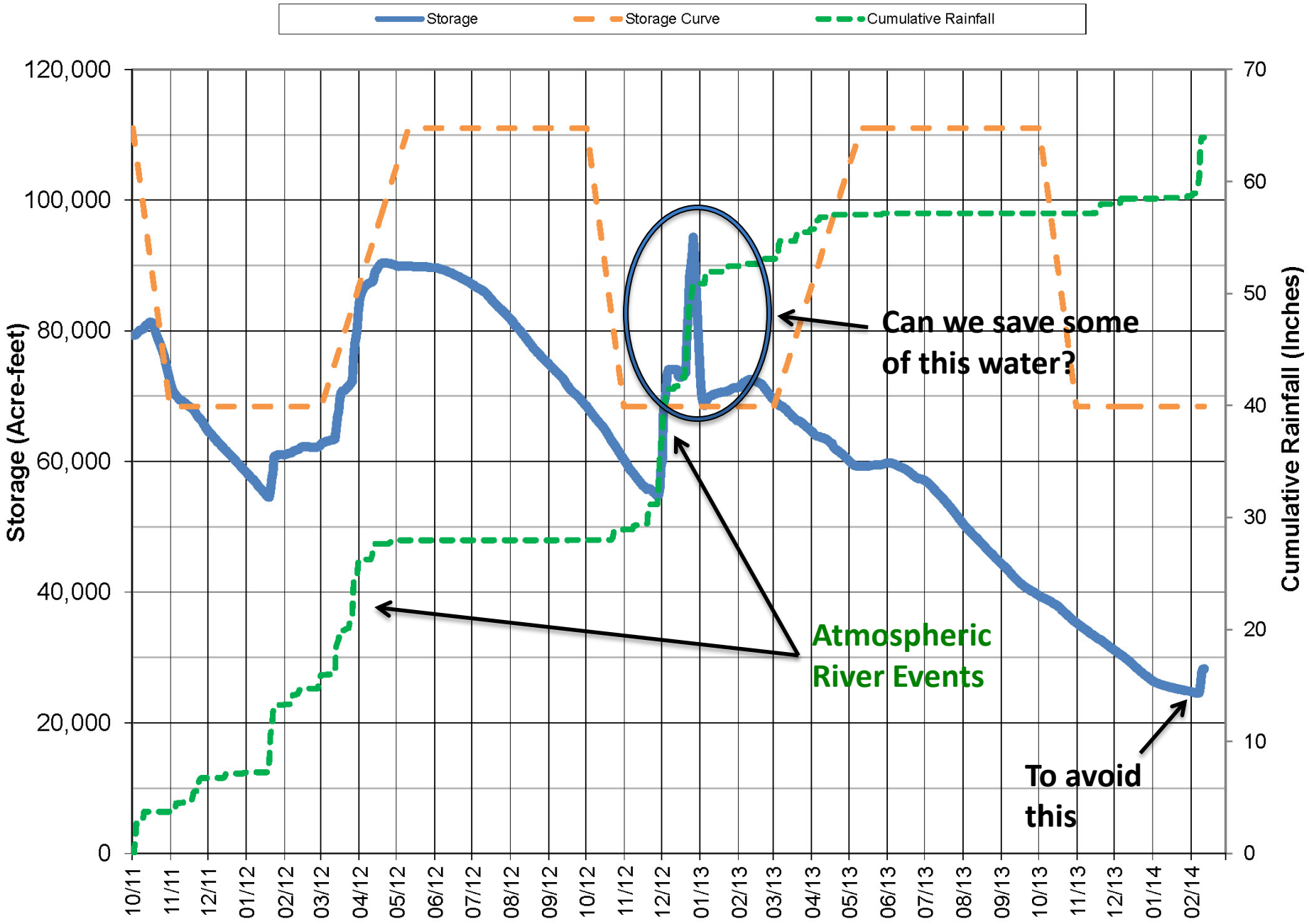
- How much water will we be able to provide to our water users? When can we make the announcement?
- Will we hit hydrologic shortage triggers that require extraordinary conservation measures, or the need to negotiate contracts or adopt regulations?
- Is an elevated flood risk likely this spring? Should we pre-position resources?
- If the rest of this winter looks dry, can we use reservoir flood control space to store water for allocation to users (e.g., forecast-informed reservoir operations)?
- Will we have to curtail diversions on intensively used rivers? How early in the season?

Will This Winter be Wet or Dry? Example Seasonal Decisions

- Should we begin negotiating contracts for one-time sale of surplus wet-weather water? Can we set up a temporary groundwater banking program to take advantage of wet conditions?
- Do we need to seek additional drought response funding or raise water rates? Do we need to budget for enhanced water conservation activities?
- Should we make plans and adopt regulations for adopting a drought water bank?
- Should we intensify flood preparedness activities in vulnerable areas?

Lake Mendocino Water Years 2012 - 2014

J. Jasperse, SCWA



Improving Water Conservation at Prado Dam on the Santa Ana River

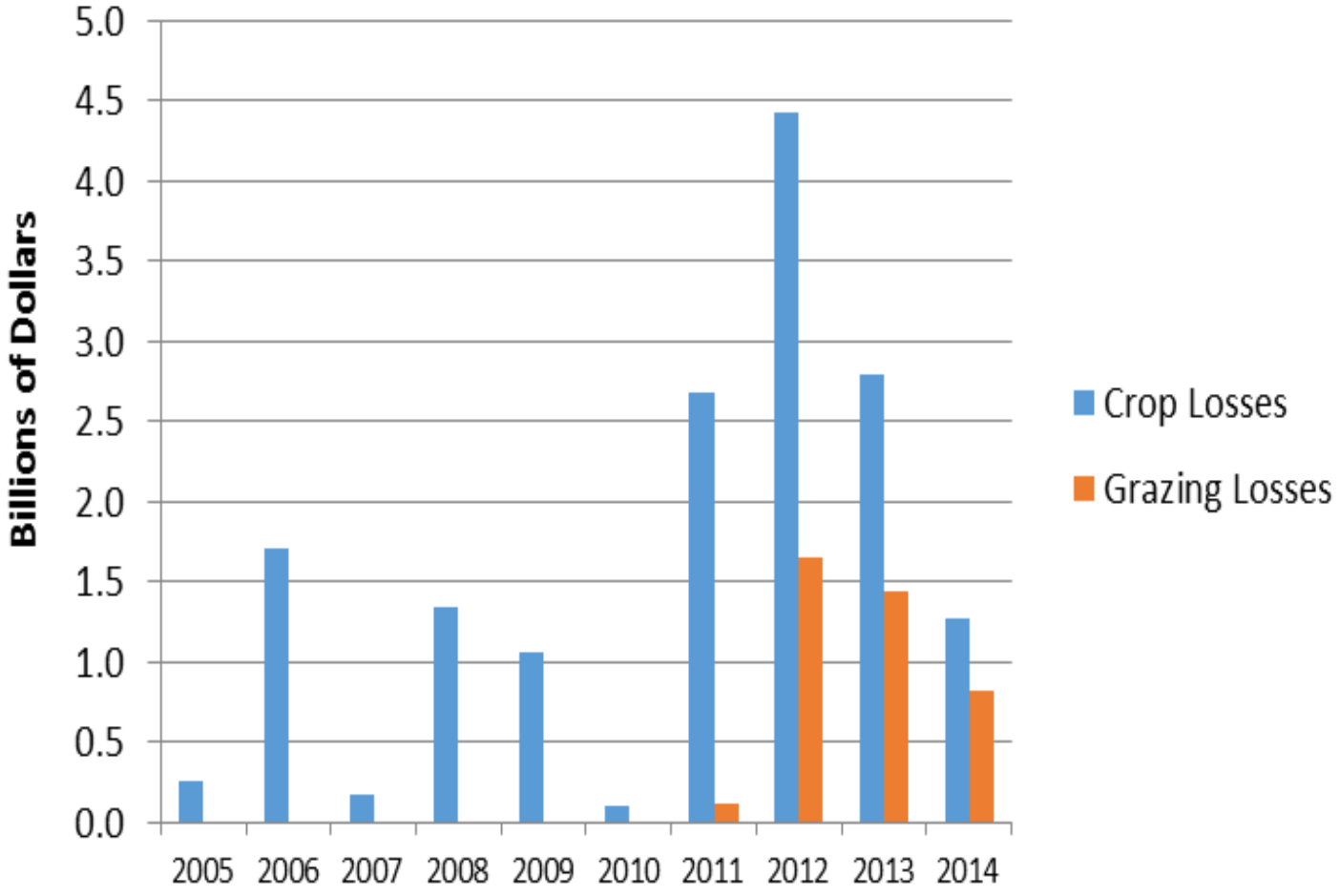
Adam Hutchinson, P.G., C.HG.

Recharge Planning Manager

November 9, 2017

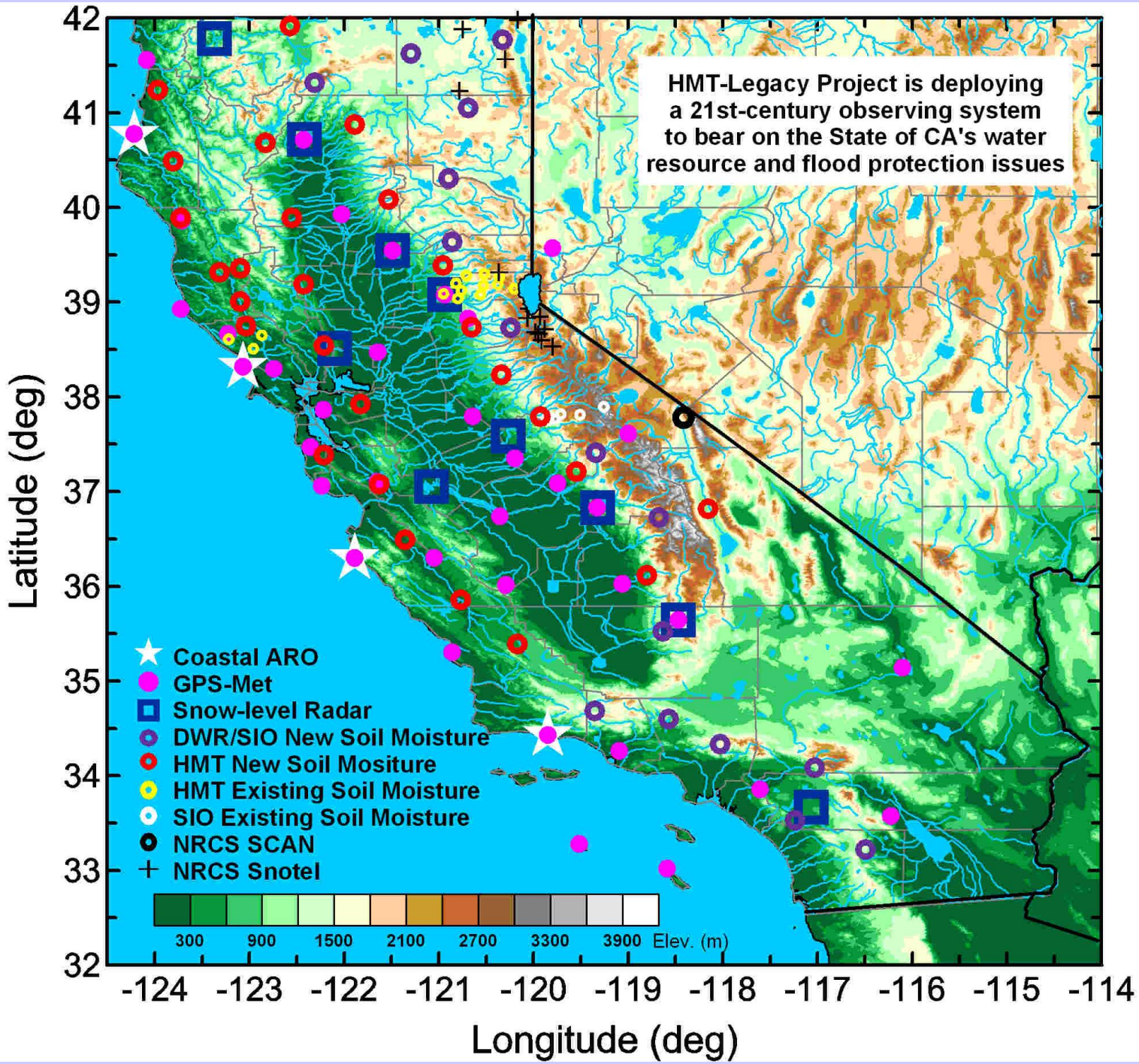


Claimed crop losses (USDA- FCIC, 2005-2014) and grazing losses (USDA-LFP, 2011-2014) due to drought in WSWC member states



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


HMT-Legacy Project is deploying a 21st-century observing system to bear on the State of CA's water resource and flood protection issues
Coastal ARO
GPS-Met
Snow-level Radar
DWR/SIO New Soil Moisture
HMT New Soil Mositure
HMT Existing Soil Moisture
SIO Existing Soil Moisture
NRCS SCAN
NRCS Snotel
300 900 1500 2100 2700 3300 3900 Elev. (m)
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42 41 40 39 38 37 36 35 34 33 32
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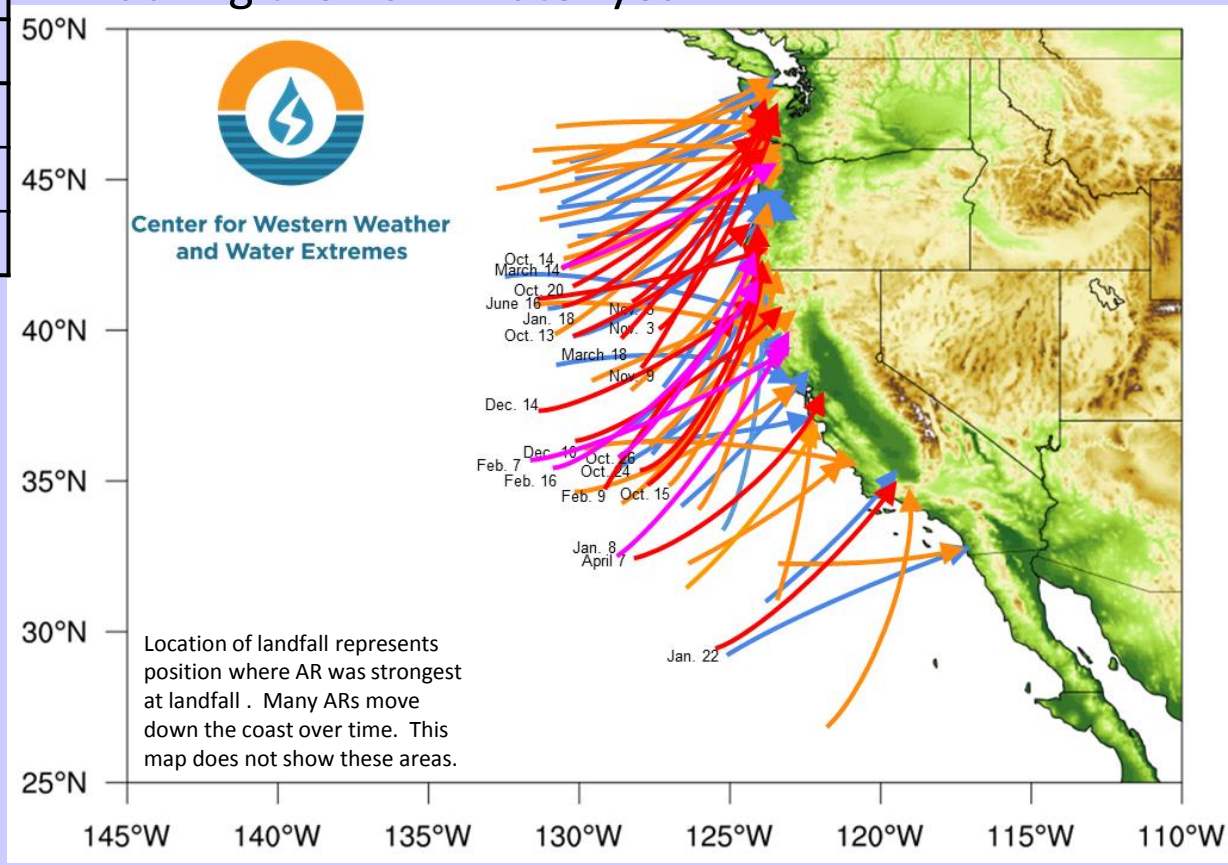
17L
17K
17J

Distribution of Landfalling Atmospheric Rivers Over the U.S. West Coast During Water Year 2017

AR Strength	AR Count
Weak	21
Moderate	26
Strong	16
Extreme	5
Exceptional	0

- **68** Atmospheric Rivers made landfall on the USWC during the 2017 water year



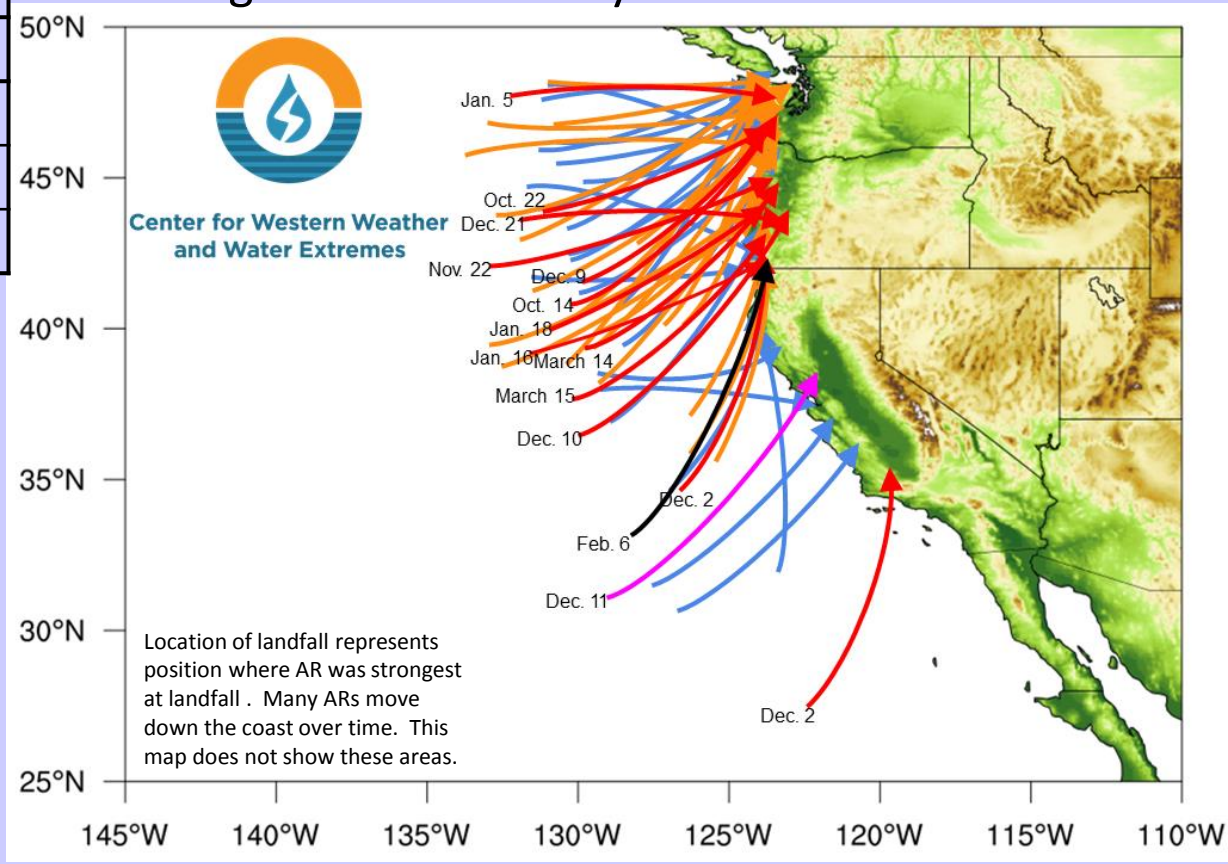
Ralph/CW3E AR Strength Scale

- 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=1000–1250 kg m^{-1} s^{-1}
- Exceptional: IVT>1250 kg m^{-1} s^{-1}

Distribution of Landfalling Atmospheric Rivers on the U.S. West Coast During Water Year 2015

AR Strength	AR Count
Weak	22
Moderate	20
Strong	13
Extreme	1
Exceptional	1

- **57** Atmospheric Rivers made landfall on the USWC during the 2015 water year



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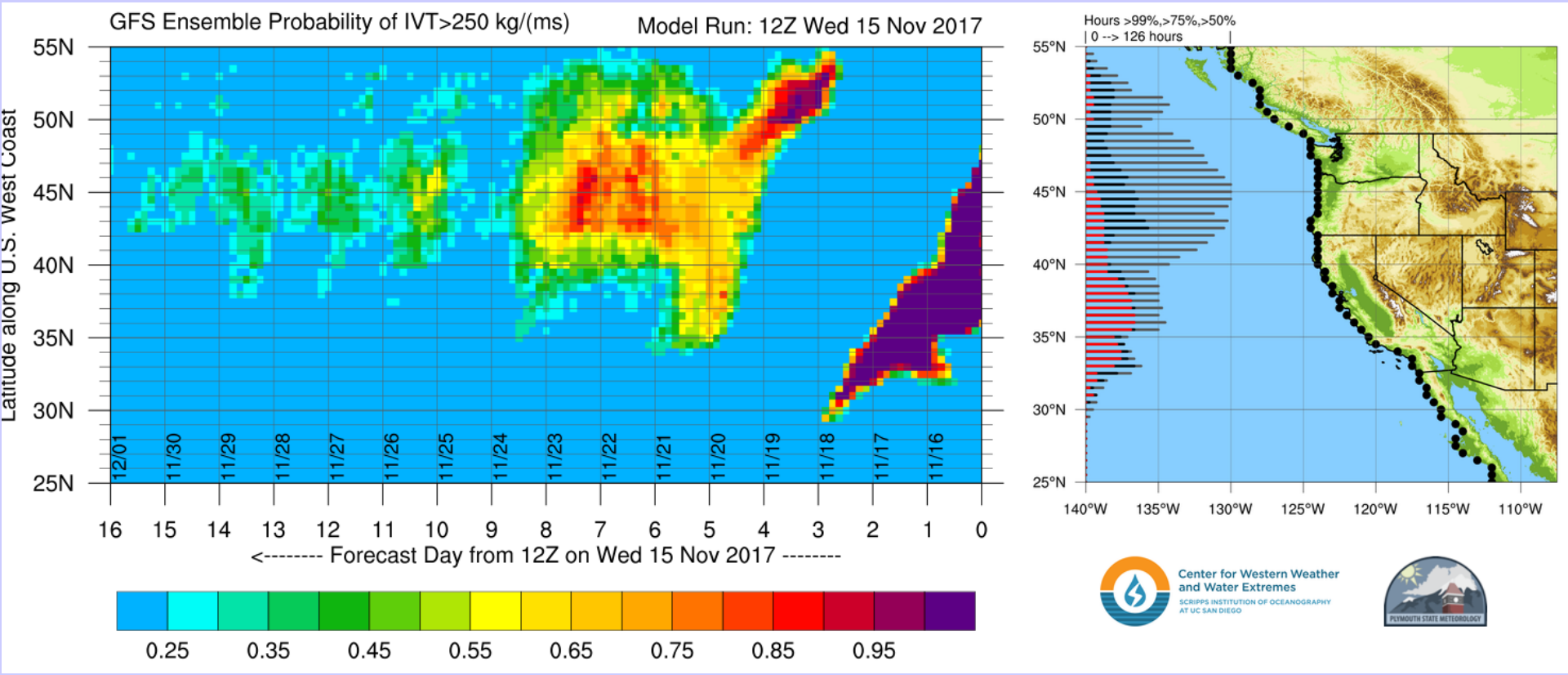
From Observing to Experimental Research Weather Forecasts…..



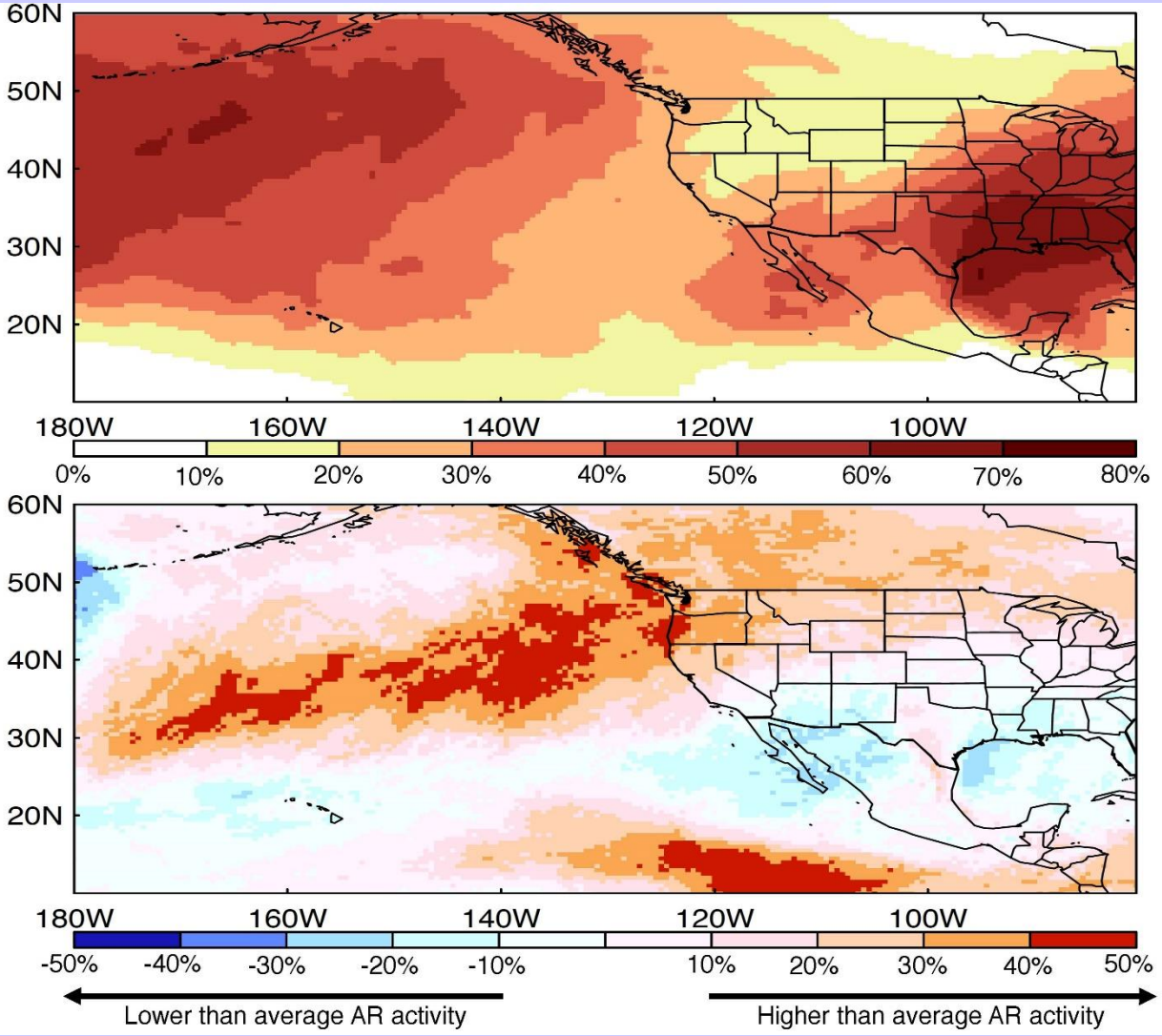
Initial Preliminary Experimental Research AR S2S Probability Forecasts

AR Occurrence Climatology

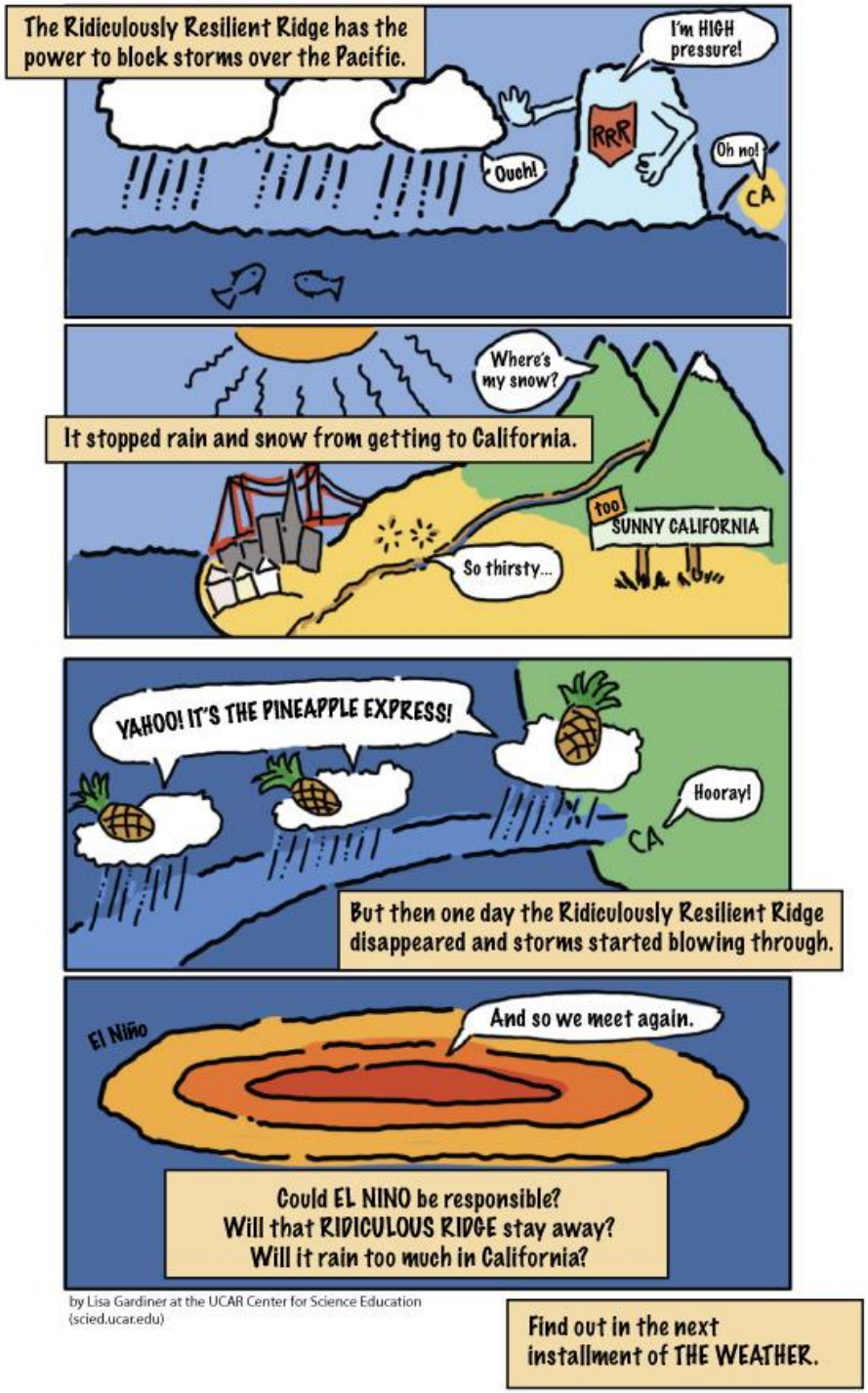
- Chance of an AR occurring sometime during a week-long period in mid-January
- Climatology based on all week-3 ECMWF forecasts from 1996-2015 for mid-January

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.



New experimental effort to forecast ridging, CDWR contracts with NASA JPL, Scripps

UCAR/NCAR, 2014

H. R. 353

One Hundred Fifteenth Congress of the United States of America

AT THE FIRST SESSION

Begun 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:

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.

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

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.

FOUNDING MEMBERS

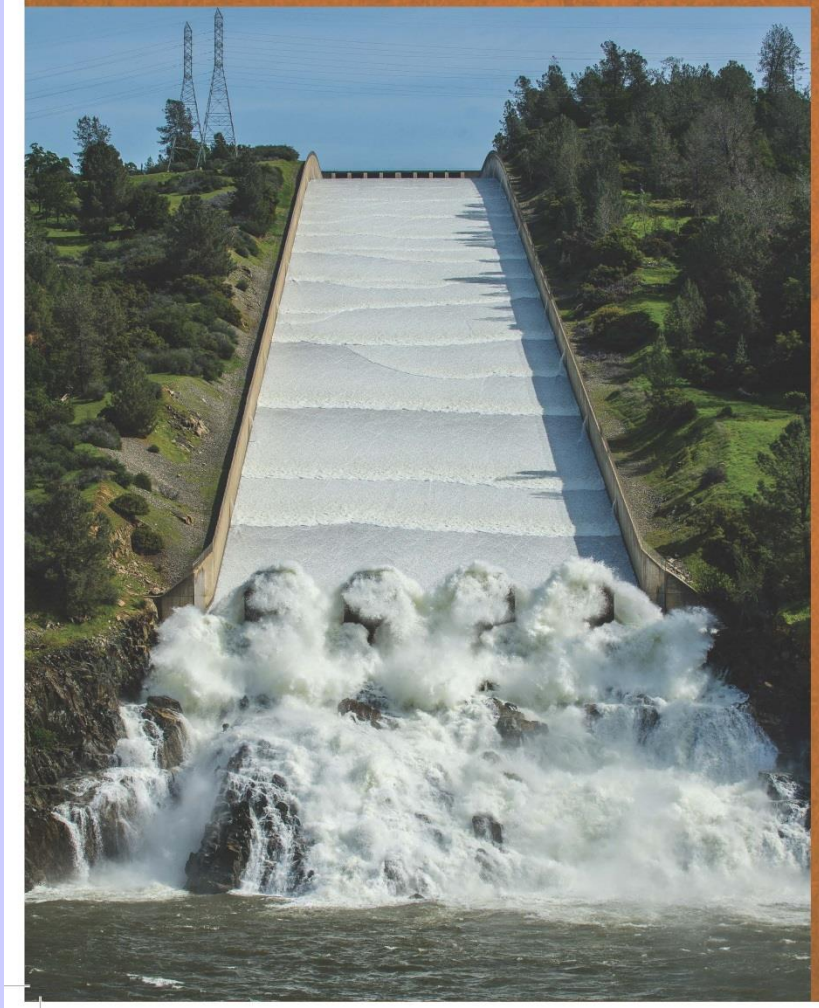
Association of Metropolitan Water Agencies	www.amwa.net
Association of California Water Agencies	www.acwa.com
California Department of Water Resources	http://www.water.ca.gov
Colorado River District	www.coloradoriverdistrict.org
Orange County Water District	www.ocwd.com
Salt River Project	www.srpnet.com
Sonoma County Water Agency	www.scwa.ca.gov
Scripps Institution of Oceanography, UC San Diego	cw3e-web.ucsd.edu
Western States Water Council	www.westernstateswater.org

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

September 2017

Next Winter – Wet or Dry??

Improving Sub-Seasonal to Seasonal Precipitation Forecasting for Water Management



WESTERN STATES WATER COUNCIL