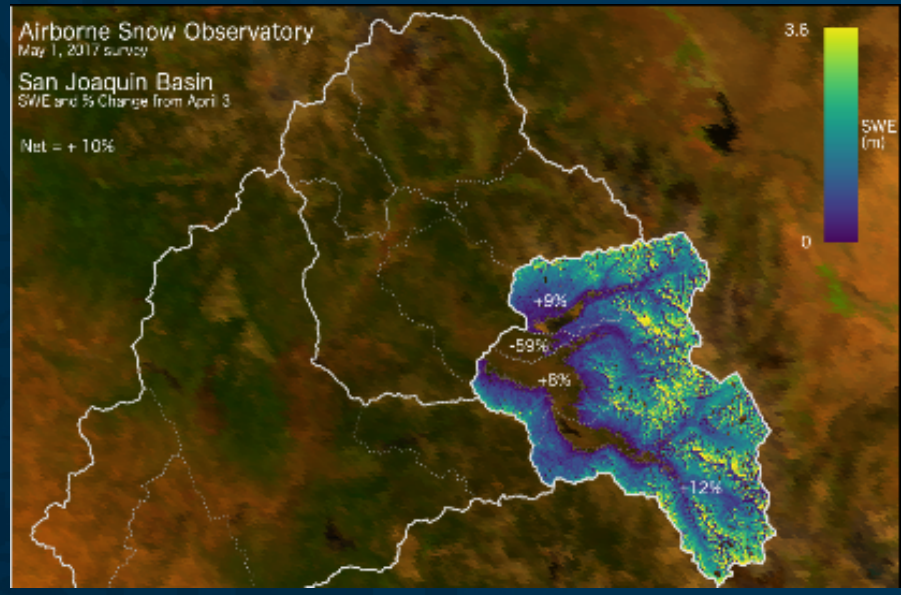


Advanced Observing Systems For Emergency Response and Integrated Water Management

Angelique Fabbiani-Leon

Climate Diagnostics and Prediction Workshop

October 23, 2018

Talk Overview

- Motivation
- History of the Past Decade
- Current and Future Investments

Motivation

- Atmospheric Rivers are a key component to California's water supply and flood risk. The character, size, number, and timing of atmospheric rivers play a key role in seasonal hydrologic outcomes for California including the size and distribution of the snowpack.

- Improved observations and forecasting are key elements for enabling more options for integrated water management in California.

- As the world warms, capabilities in observations and forecasts must adapt for water management to keep up with changing conditions.

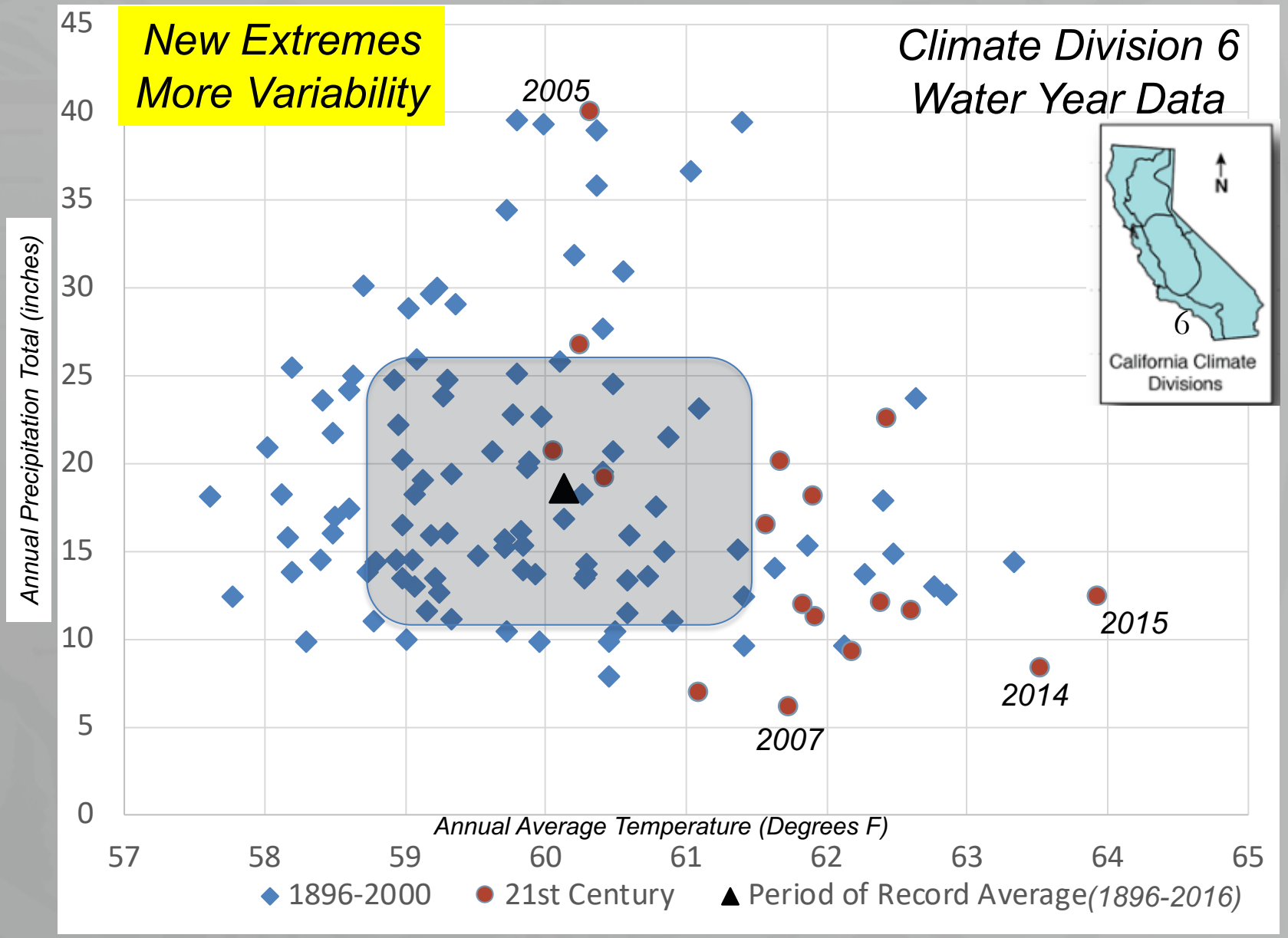
California's topography affects our weather and climate.

Observations play a critical role in resource management. Complex terrain can be challenging to observations on many fronts.

Time is a key element to water management – more time offers more alternatives to be employed. Forecasts can play a role.

A warming world challenges current forecasting practices

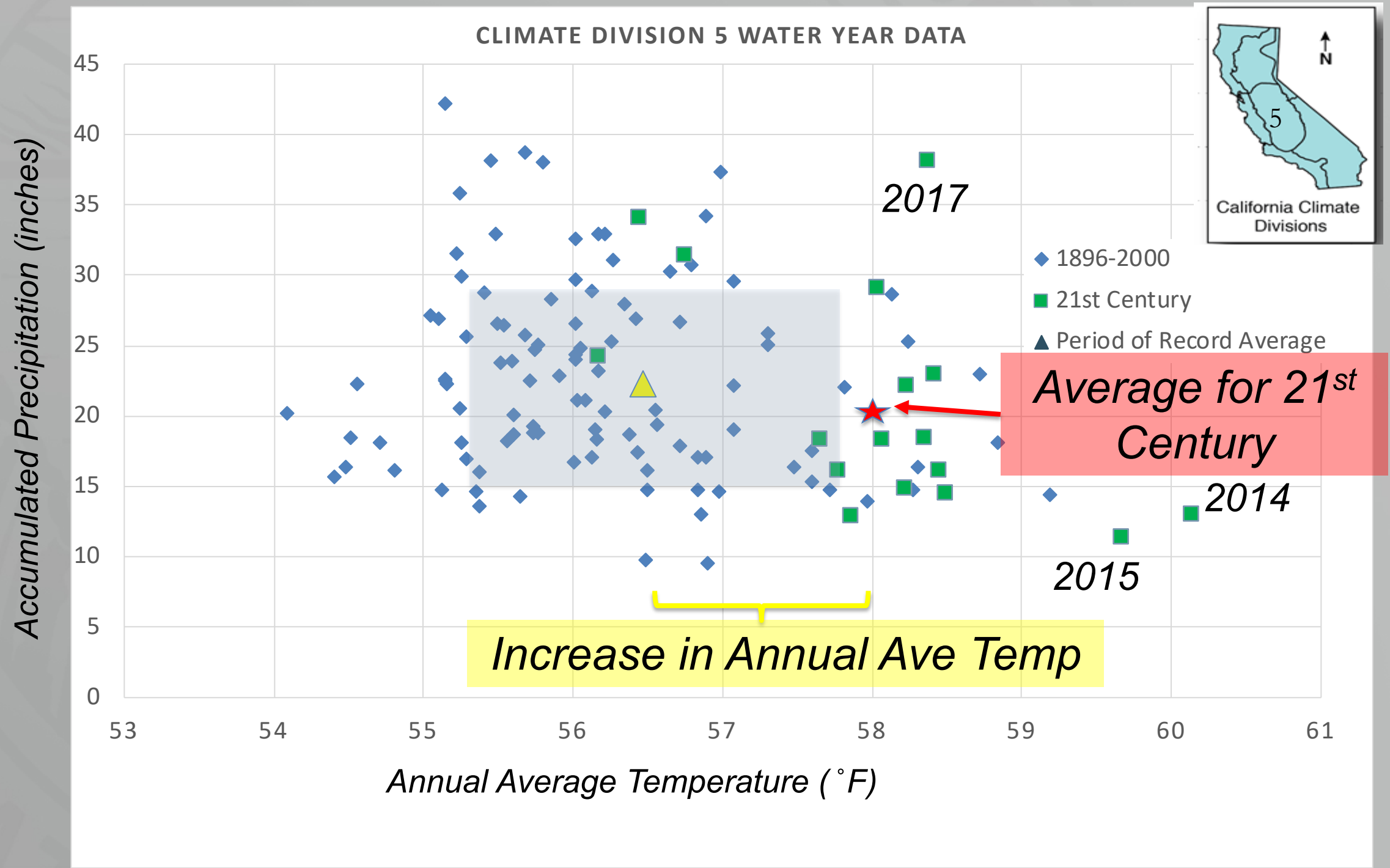
New extremes/ more variability → Essential to seek additional information

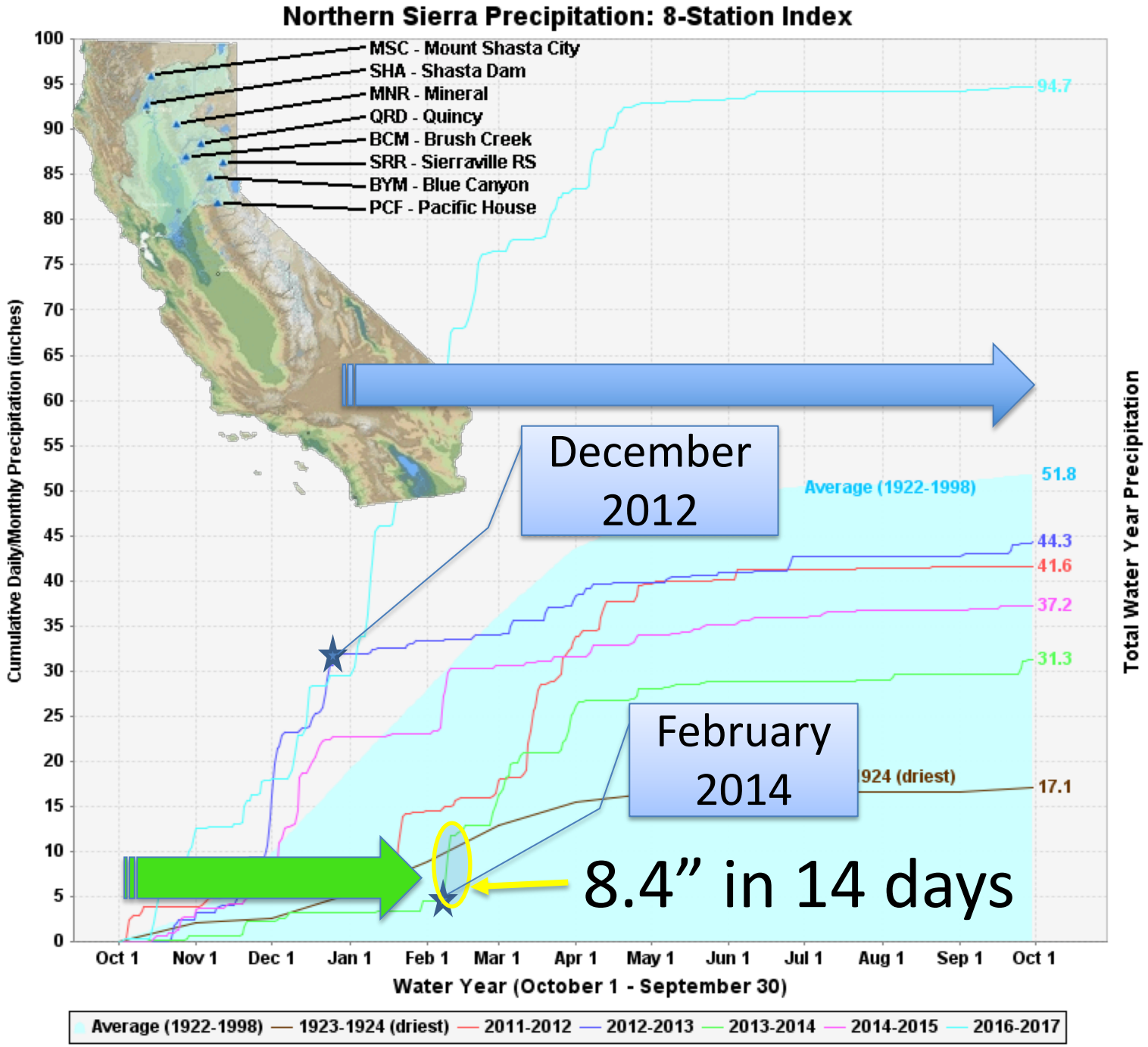


→ Statistical models may not be sufficient for future forecasting/ modeling

Shaded box=1 Stand. Dev.

Source: NOAA Climate Division 6 Water Year Data


CLIMATE DIVISION 5 WATER YEAR DATA
Accumulated Precipitation (inches)
Annual Average Temperature (˚F)
45
40
35
30
25
20
15
10
5
0
53
54
55
56
57
58
59
60
61
2017
2014
2015
1896-2000
21st Century
Period of Record Average
Average for 21st Century
Increase in Annual Ave Temp
N
5
California Climate Divisions



Variability at multiple scales

- *Not only variability between water years →*
- *Also variability within the water year → due to Atmospheric Rivers (AR)*

★16.8"

404 Days

(Less than driest year, 17.1")

Talk Overview

- Motivation
- **History of the Past Decade**
- Current and Future Investments

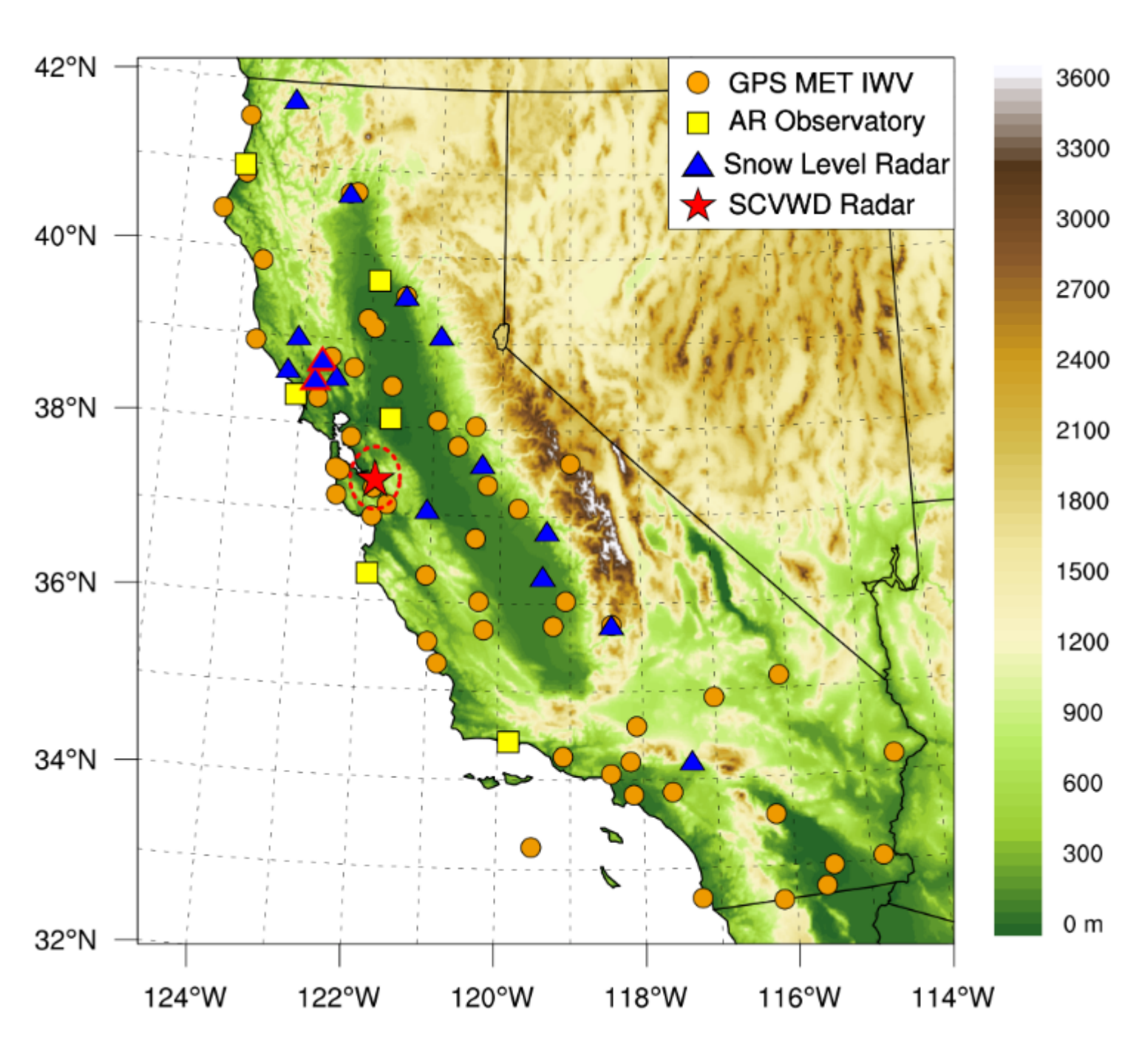
Funding Promoting Opportunity: 2005 to Present

- Hydrometeorological Testbed Study (HMT), Enhanced Flood Response and Emergency Preparedness (EFREP) and FloodSafe Investments → Funding for protection against flooding, increase obs. stations
- American Recovery and Reinvestment Act (ARRA , 2009) Funding, 2007-2009 Drought → NASA-JPL Collaboration
- Center for Western Weather and Water Extremes (CW3E) Formation, the 2012-2016 Drought, and Collaboration Expansion with ASO, WWAO, and FIRO → funding to research seasonal forecasting and AR
- Advance Quantitative Precip. Information (AQPI), The Events of WY 2017 & WY2018 → 10 Bay Area Counties single Integrated Water Management grant → Stormwater flooding, Forecast Informed Reservoir Operations (FIRO)

Monitoring Atmospheric Rivers

- Major impacts from heavy precip are associated with the landfall of AR
- Characteristics of AR were not operationally monitored offshore/onshore, until recently, with the help of the previous listed funding sources
- Key elements to monitoring AR and categorizing landfall events:
  1. Moisture
  2. Wind speed/direction
  3. Snowline/freezing elevation

California's Advanced Observing System for Atmospheric Rivers

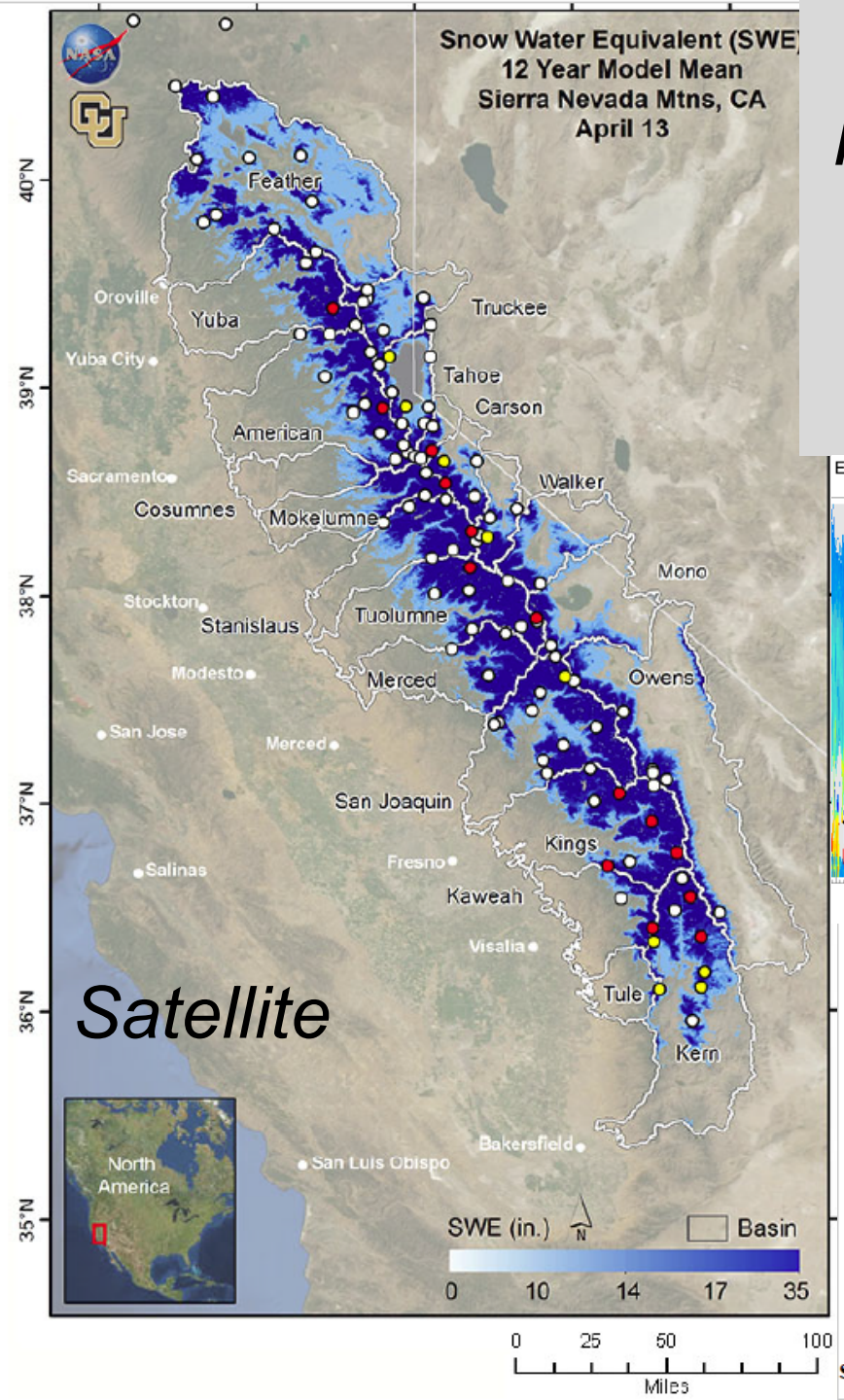


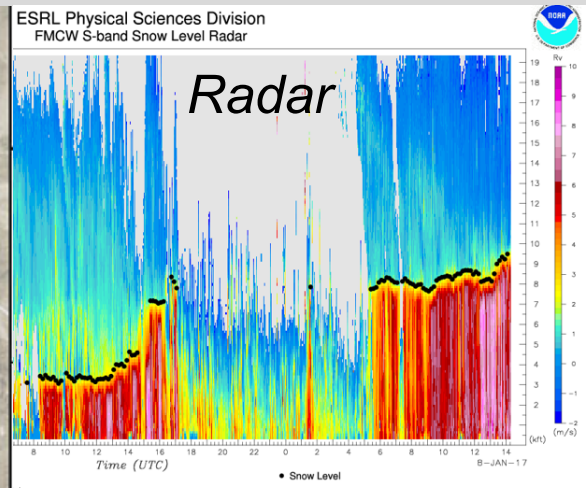
GPS-Met

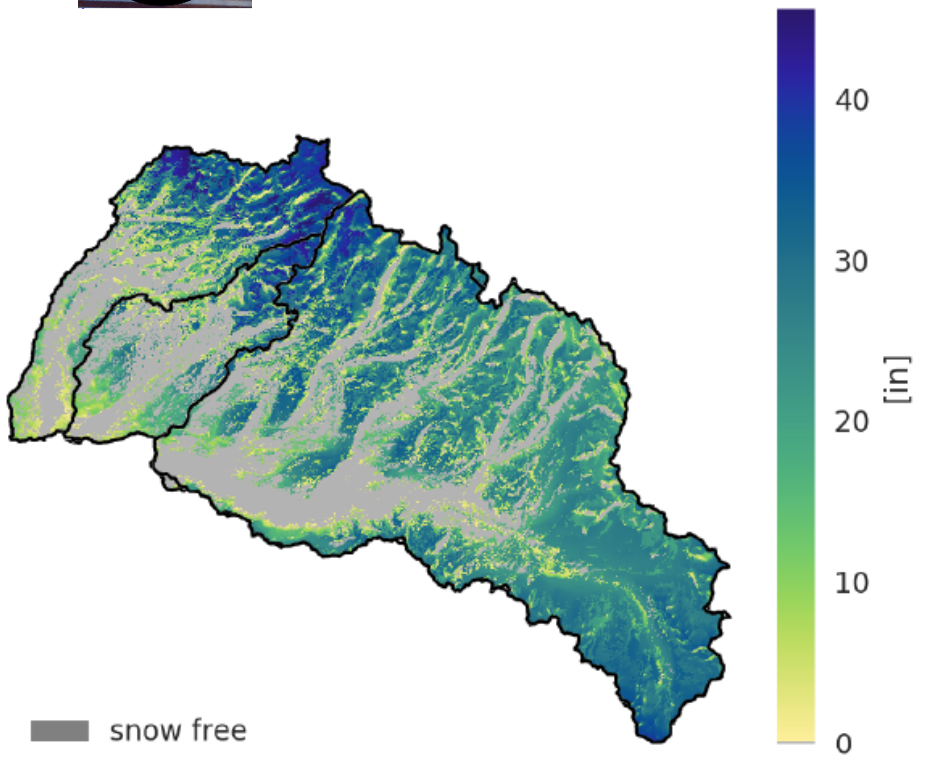
AR Observatories

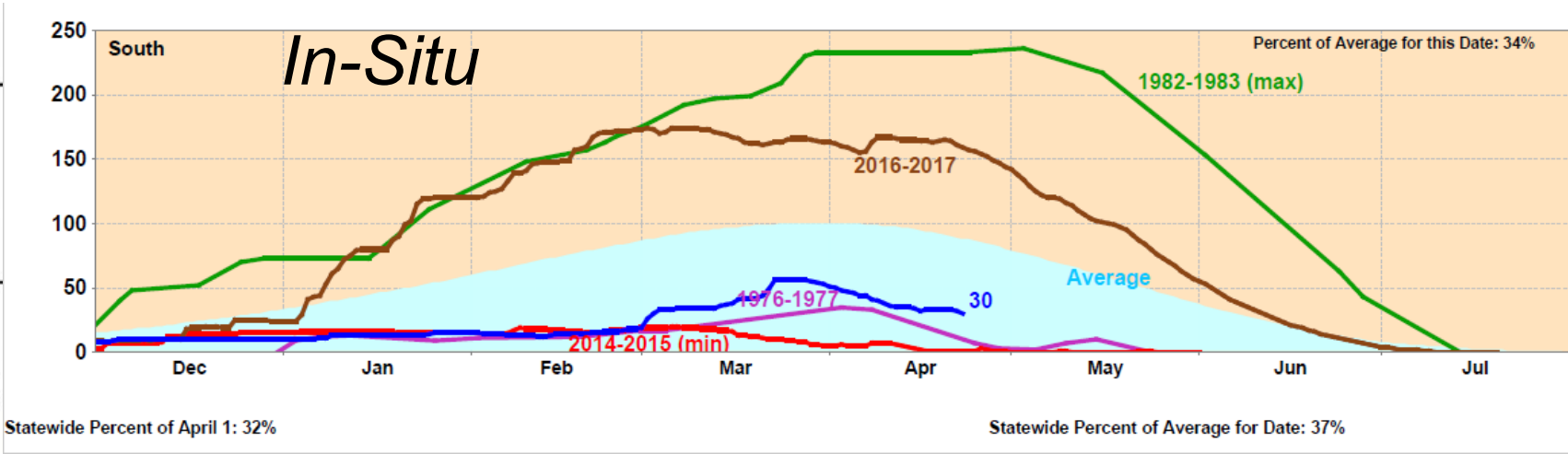
Snow Level Radar

Goal: Integrated Observing Systems for Integrated Water Management



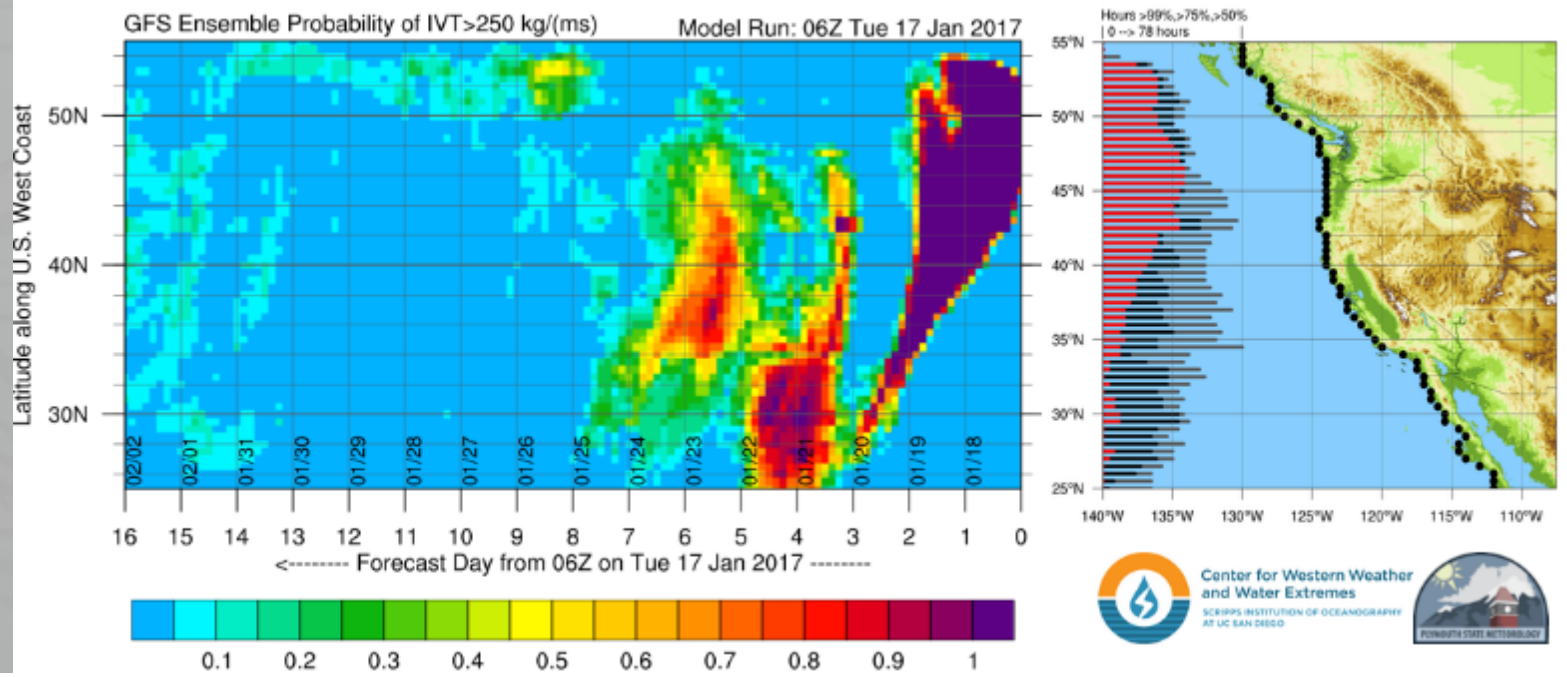


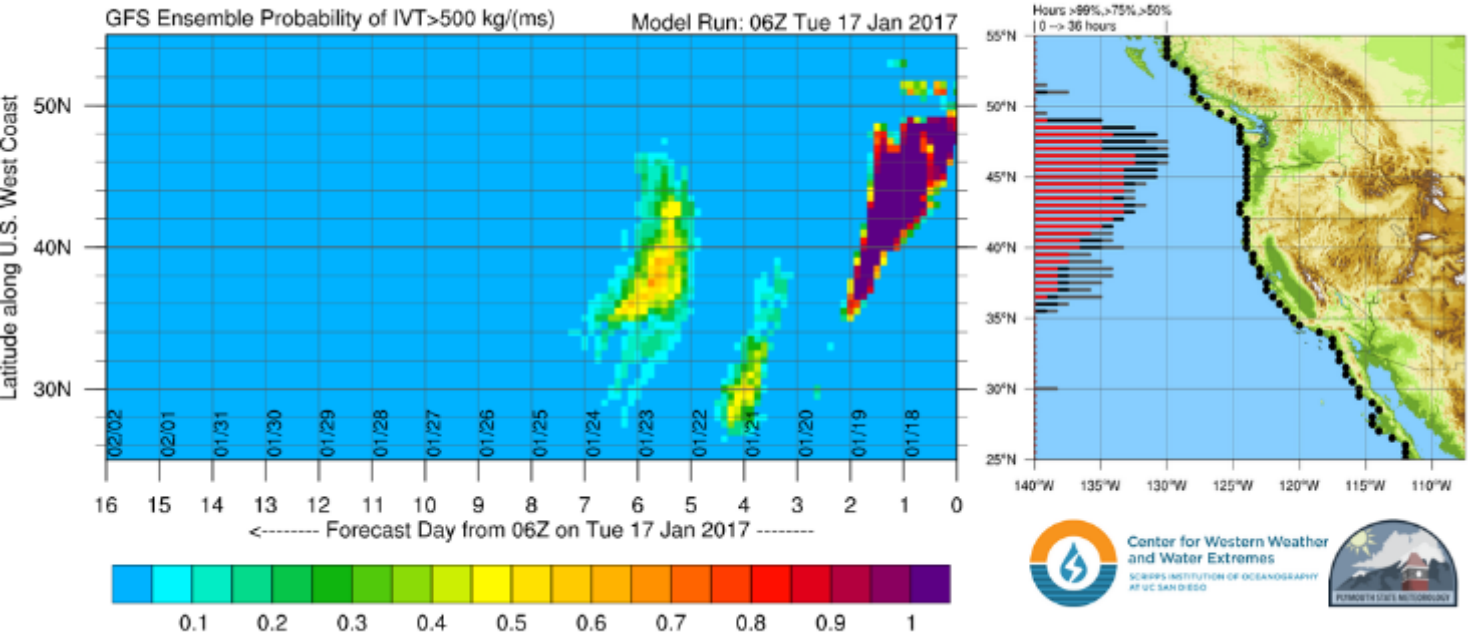




Forecast Tools from the Center for Western Weather and Water Extremes (CW3E)

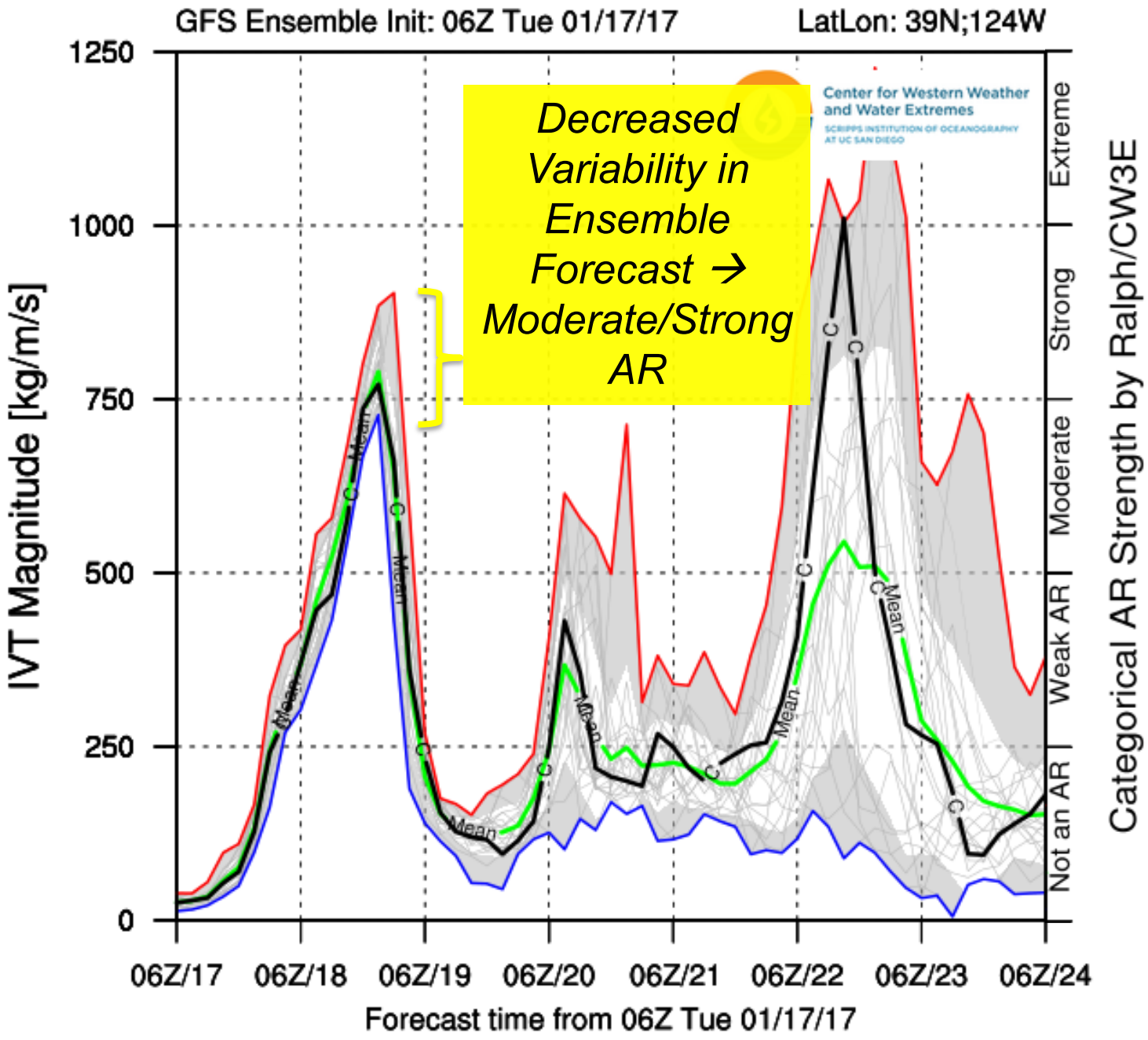
Probability of
IVT > 250 kg m^{-1} s^{-1}
~Indictor: Weak AR





AR Outlook Tool

Probability of
IVT > 500 kg m^{-1} s^{-1}
~Indictor: Strong AR



AR Strength Forecast and Uncertainty Tool

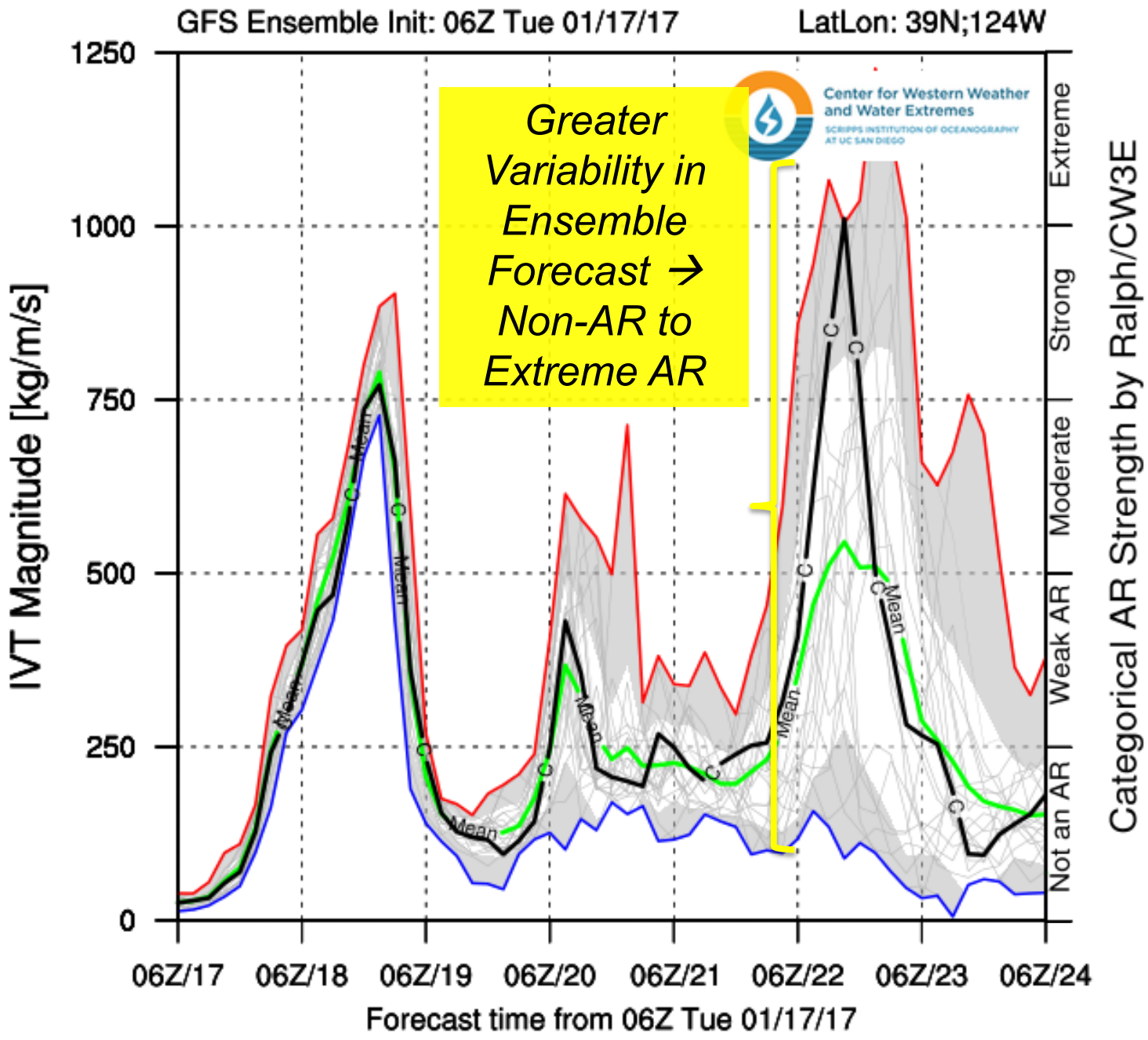
Grey Lines = *20 perturbed GFS ensemble members*

Red Line = *Max ensemble value*

Black Line = Unperturbed GFS control forecast

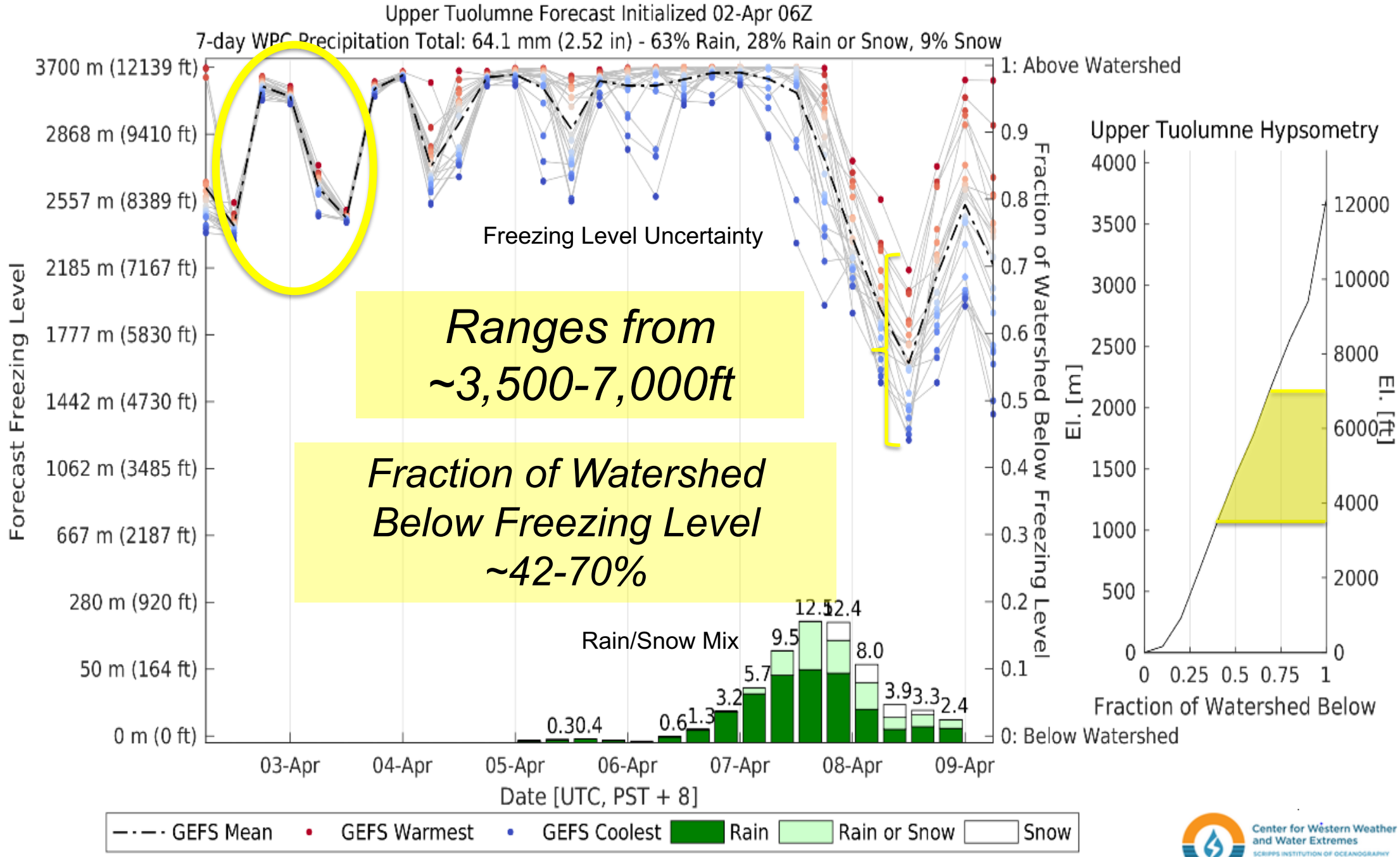
Green Line = *20-member ensemble mean*

Blue Line = *Min ensemble value*



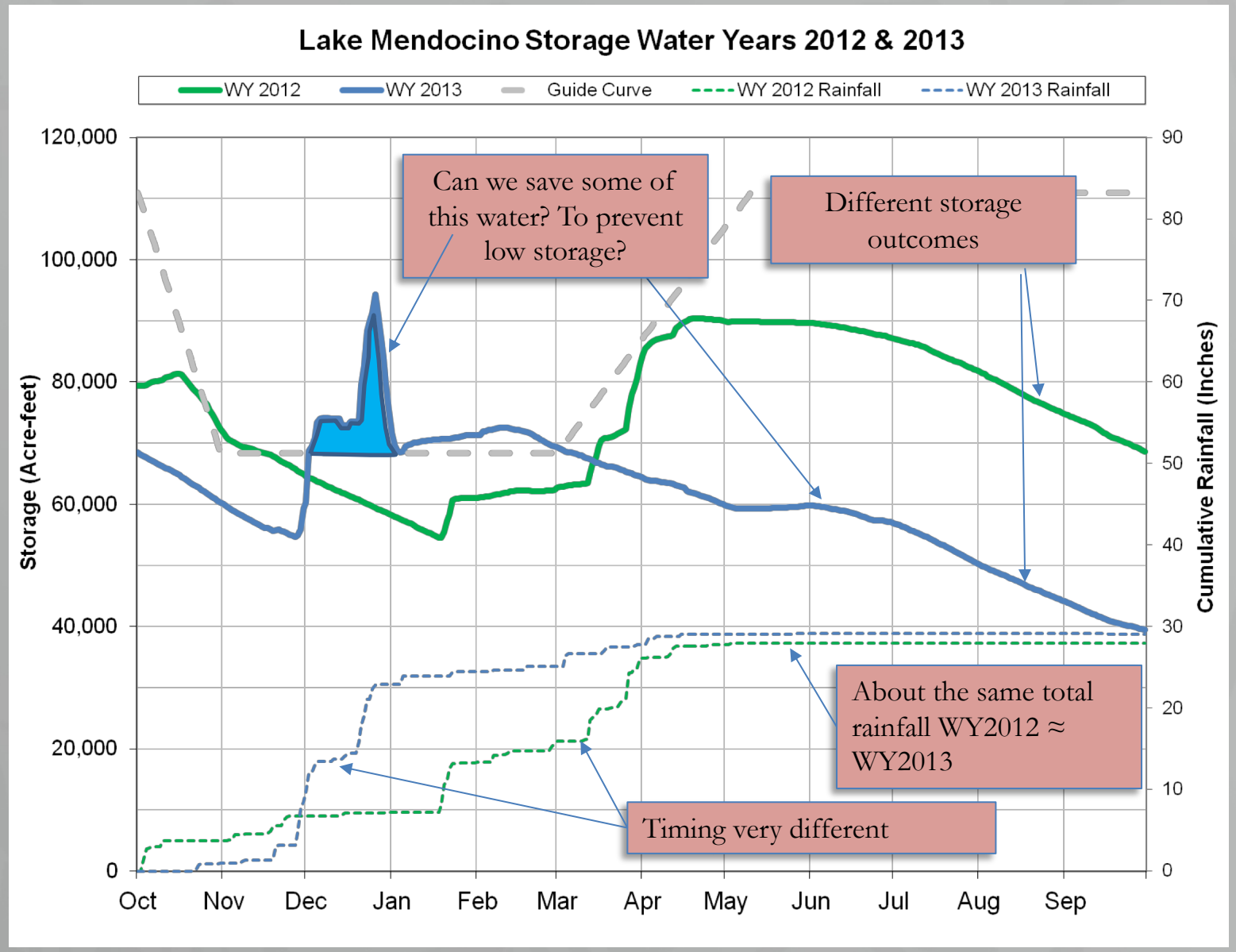
AR Strength Forecast and Uncertainty Tool

Goal: Decrease uncertainty in order to increase lead-time for decision making

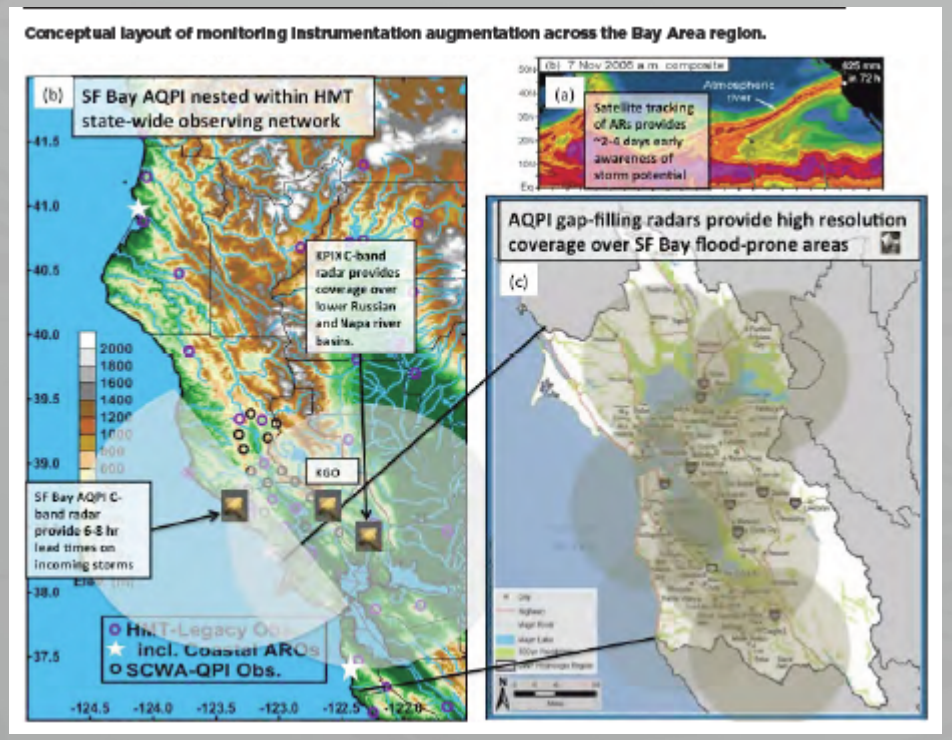


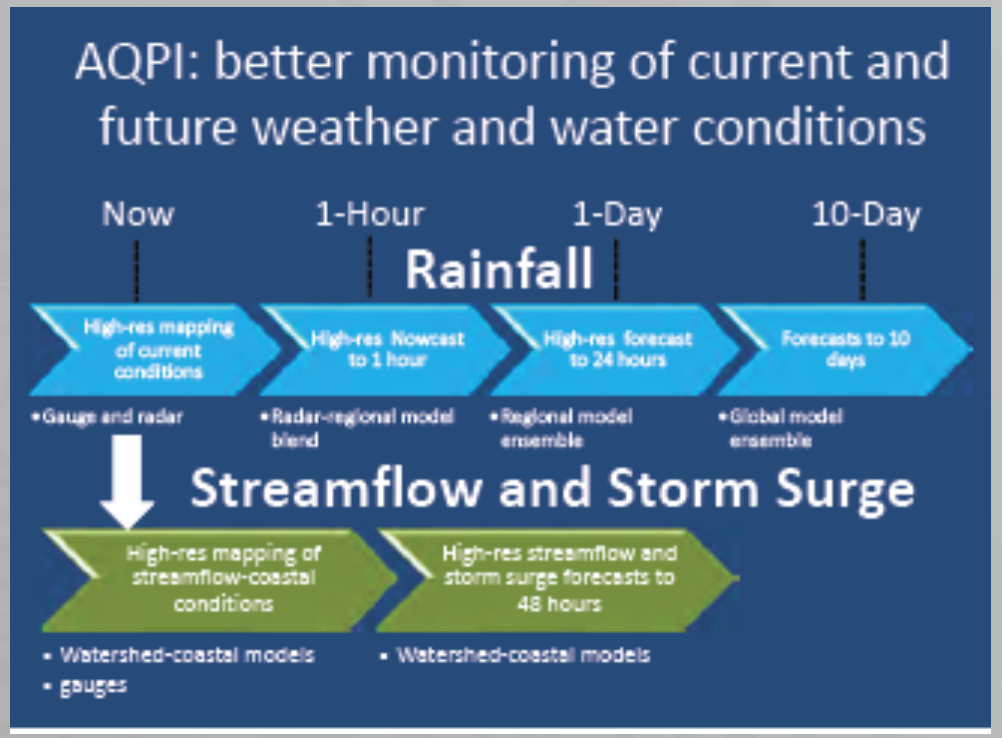
Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

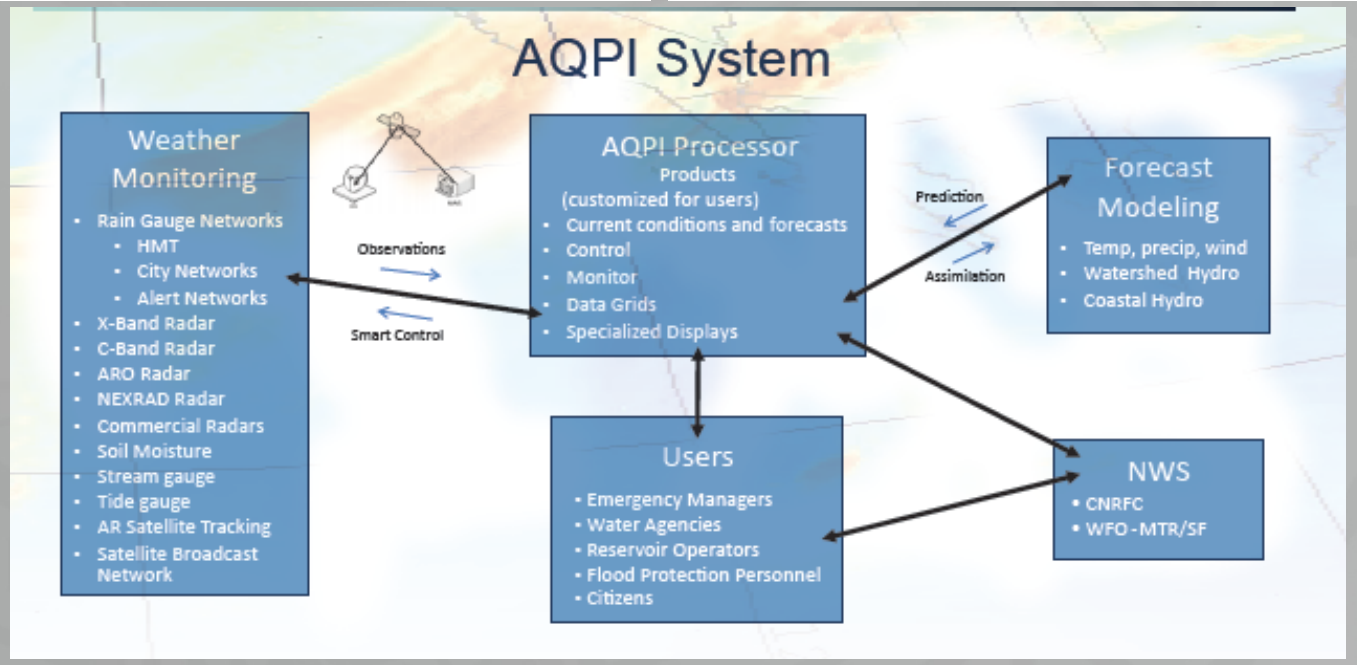
Lake Mendocino Guide Curve – A Tale of 2 Water Years



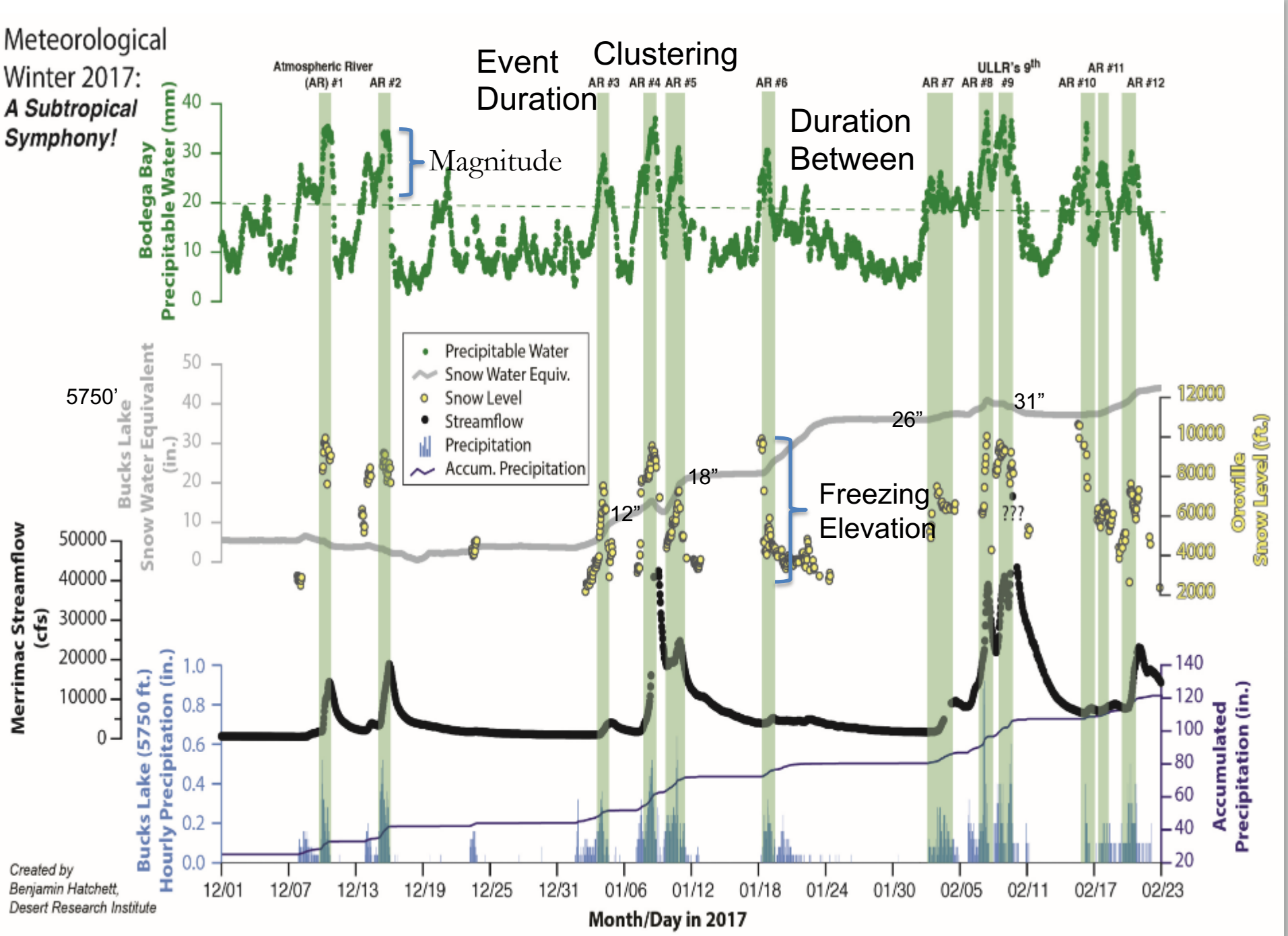
Advanced Quantitative Precipitation Information (AQPI)



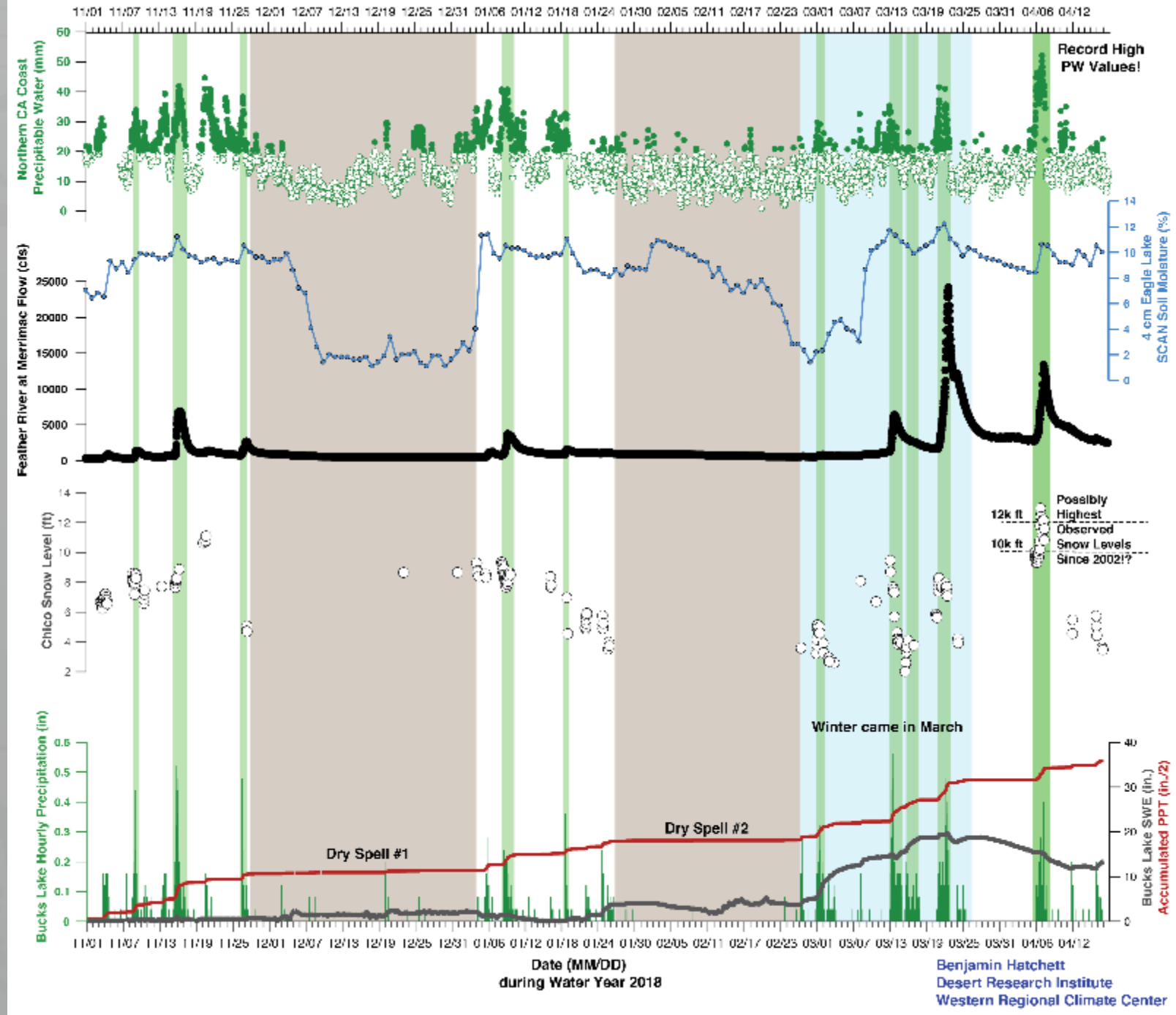




Water Year 2017



Water Year 2018



Talk Overview

- Motivation
- History of the Past Decade
- **Current and Future Investments**

Federal State and Local Alignment

- DWR plays a key role in facilitating the transition of new science in observations and forecasting from research to operations for water management.
- Relationships with federal partners have been built over the past decade with the availability of resources on a project-by-project basis.
- Continued engagement with the science community is key to adapting to a warming world.

Next Steps

- Embarking on new partnership with Climate Prediction Center and furthering partnership with Earth Systems Research Lab

- FIRO comes to Southern California with Orange County Water District and Prado Dam and planned expansion into Feather/Yuba watersheds

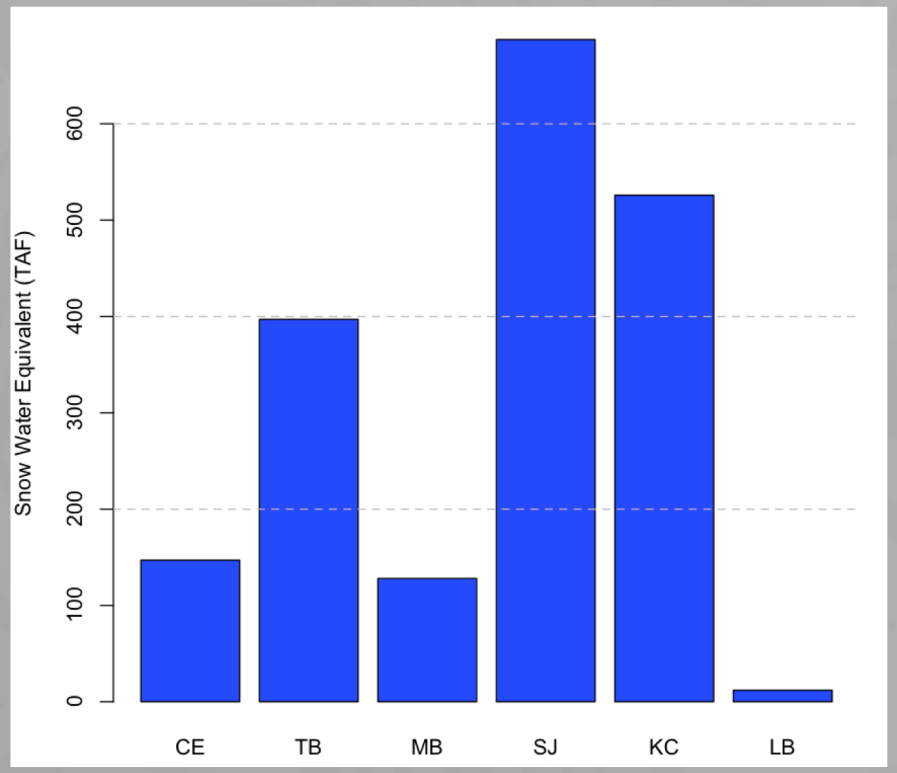
- Gathering data, management, and implementation are key goals in the future

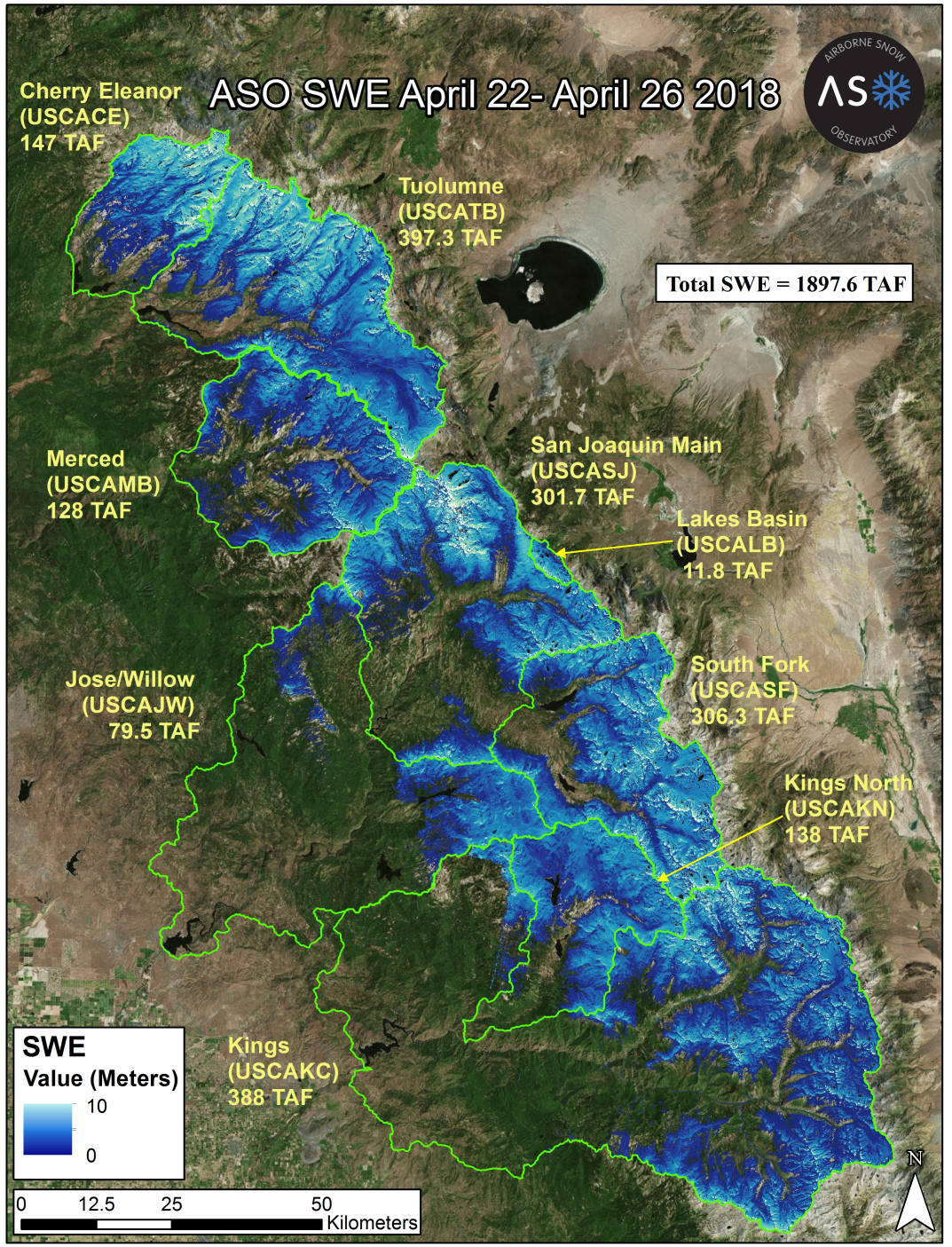
- The Next Great Collaboration and Finding Funding

Questions?

Michael.L.Anderson@water.ca.gov

ASO April 2018 Surveys





Slide from Dr.Thomas Painter, JPL