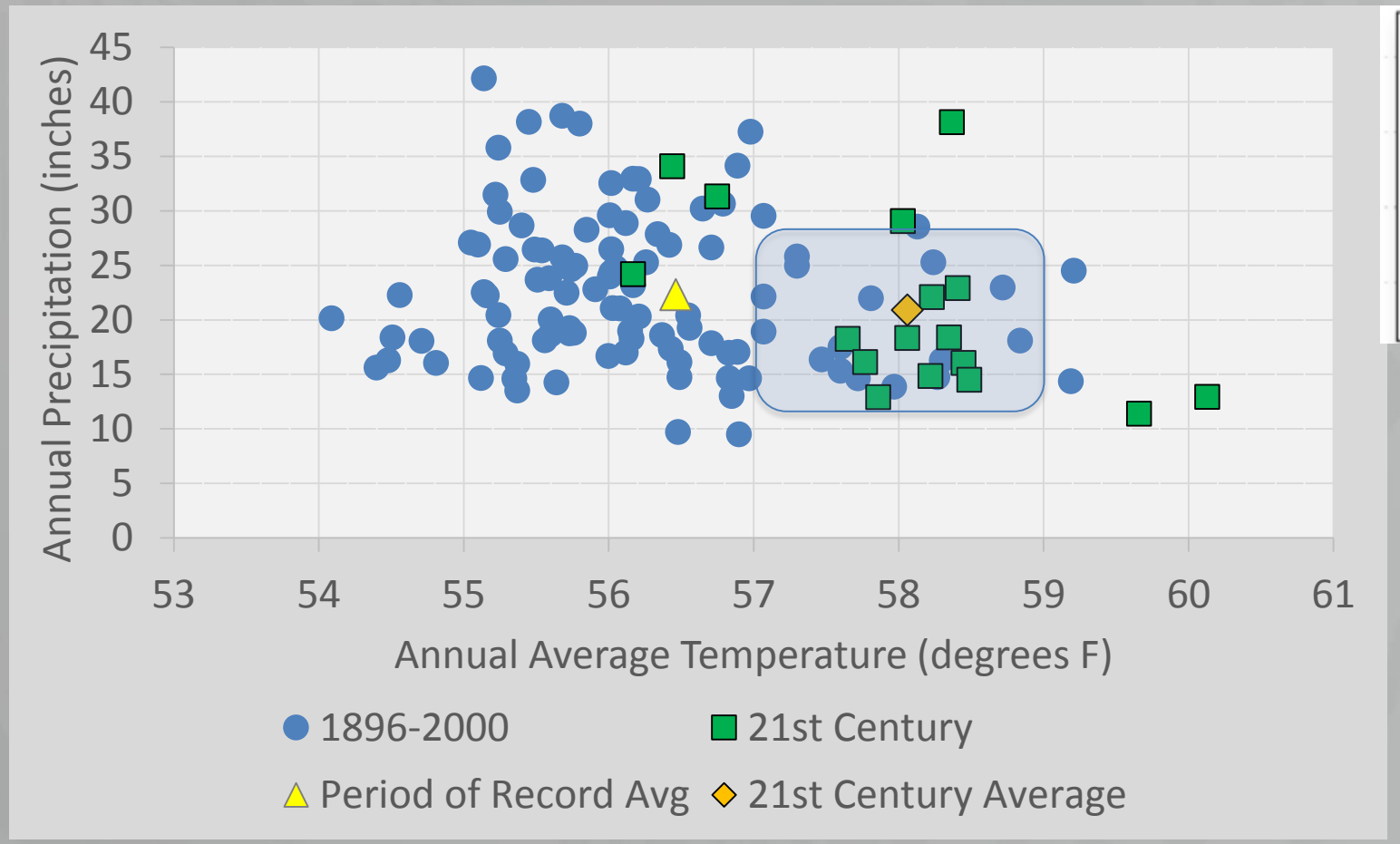
CA Investments in Observations and Forecasting for Integrated Water Management in a Warming World

Dr. Michael Anderson, State Climatologist

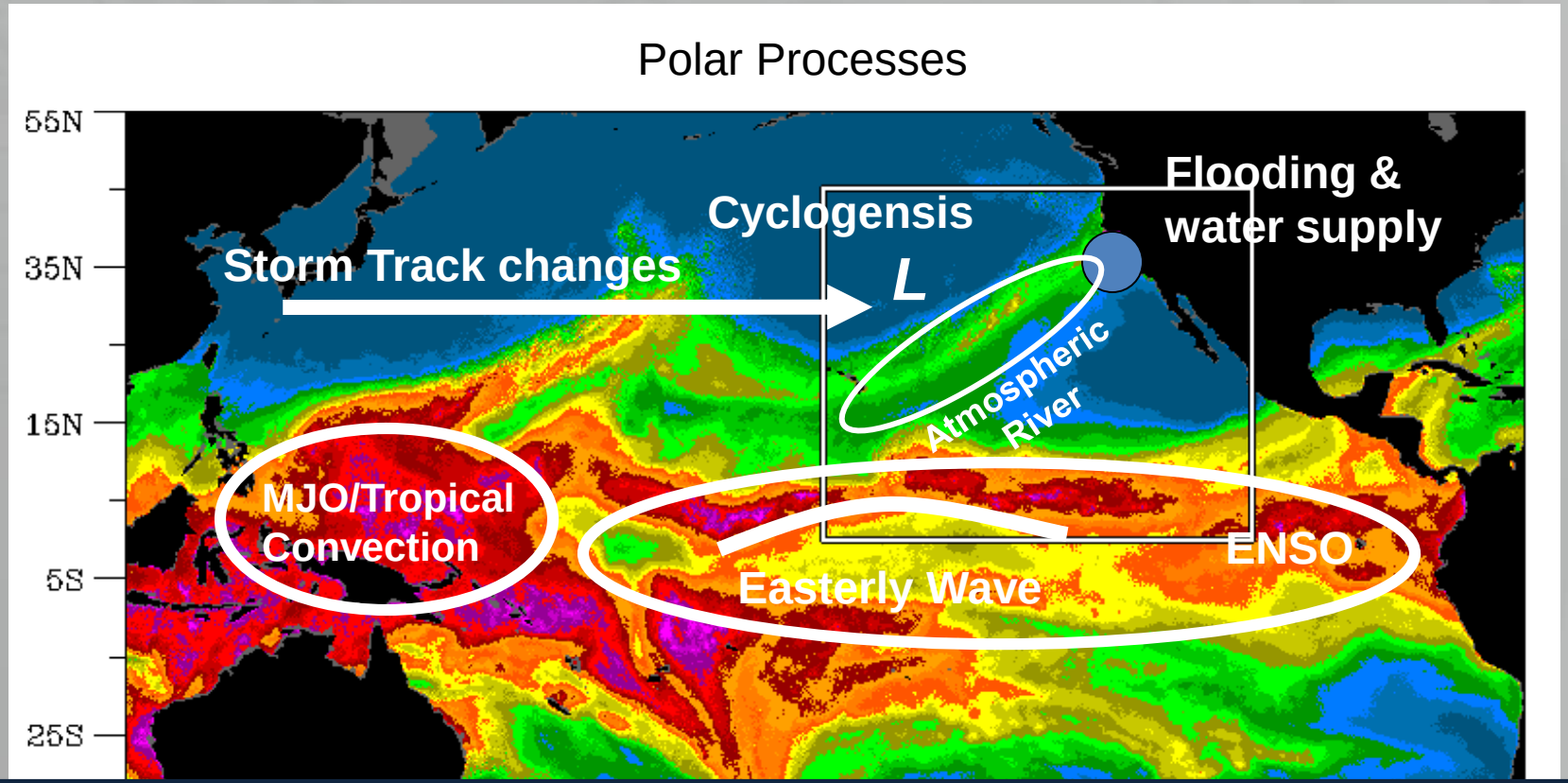
WOW Workshop

October 31, 2018

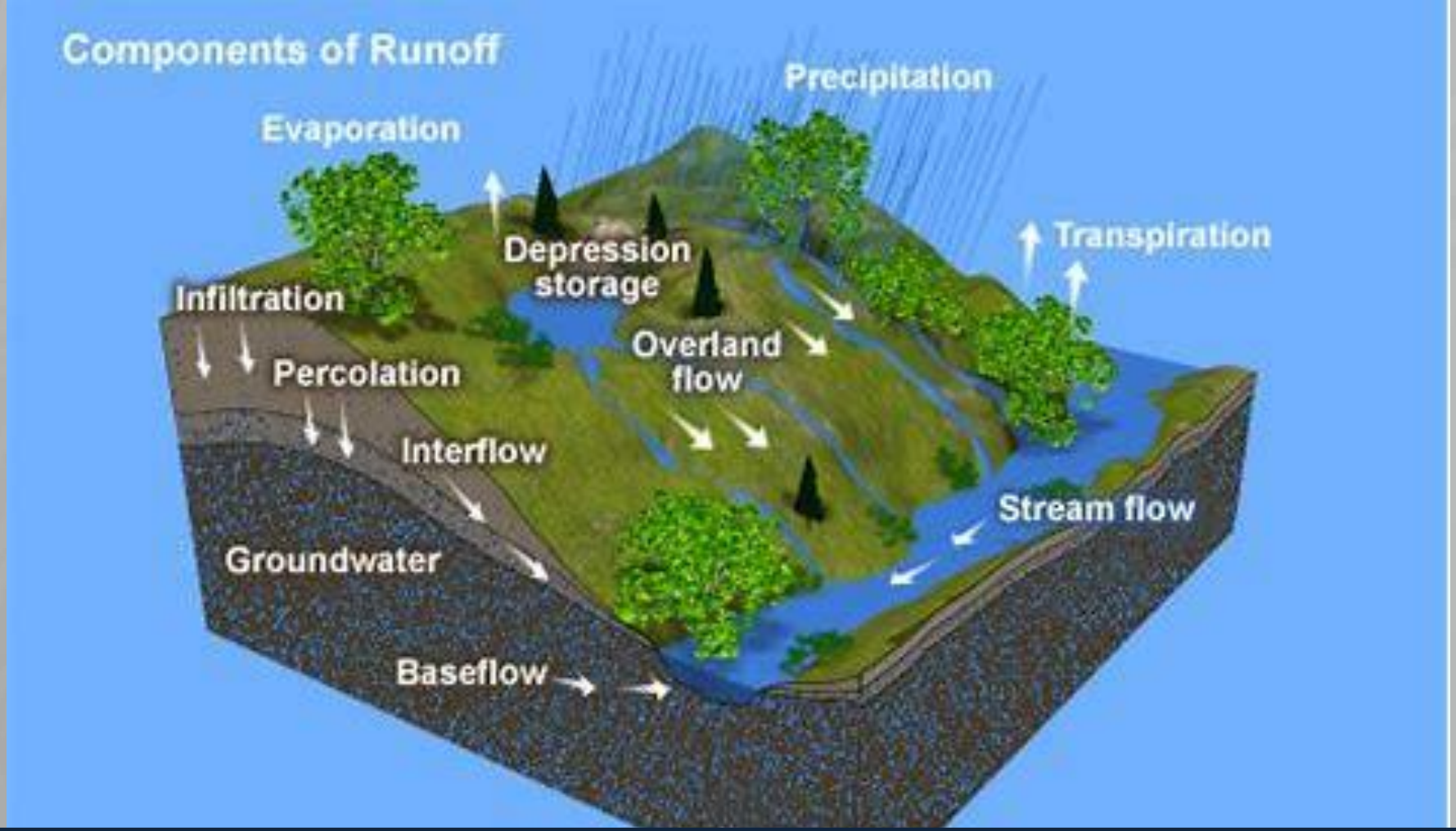
Climate Division 5 Water Year Data



Key Atmospheric Phenomena Affecting California Water Supply/Flooding:



The size, number, and strength of atmospheric river events (ARs) result from the alignment of key physical processes operating on different space and time scales that will change with climate change



The timing, magnitude, and duration of CA runoff results from the alignment of key physical processes operating on different space and time scales that will change with climate change

Integrated Water Resources Management

Public Safety – Forecast/Warning

Extremes Response and Coordination

Supply Reliability

Resource Stewardship

Observations

In Situ

Radar

HMT/AQPI
HYDAS
USGS Stream Gages
ASO
MODIS (satellite)
AR Airborne Recon

Airborne

Satellite

Decision Support Tool Kit

RFC Forecast Points
HEC-HMS/HED 71/PRMS
B120
INFORM
FCO/FIRO
AQPI DSS

Forecasts

QPF

Week 1/ Week2

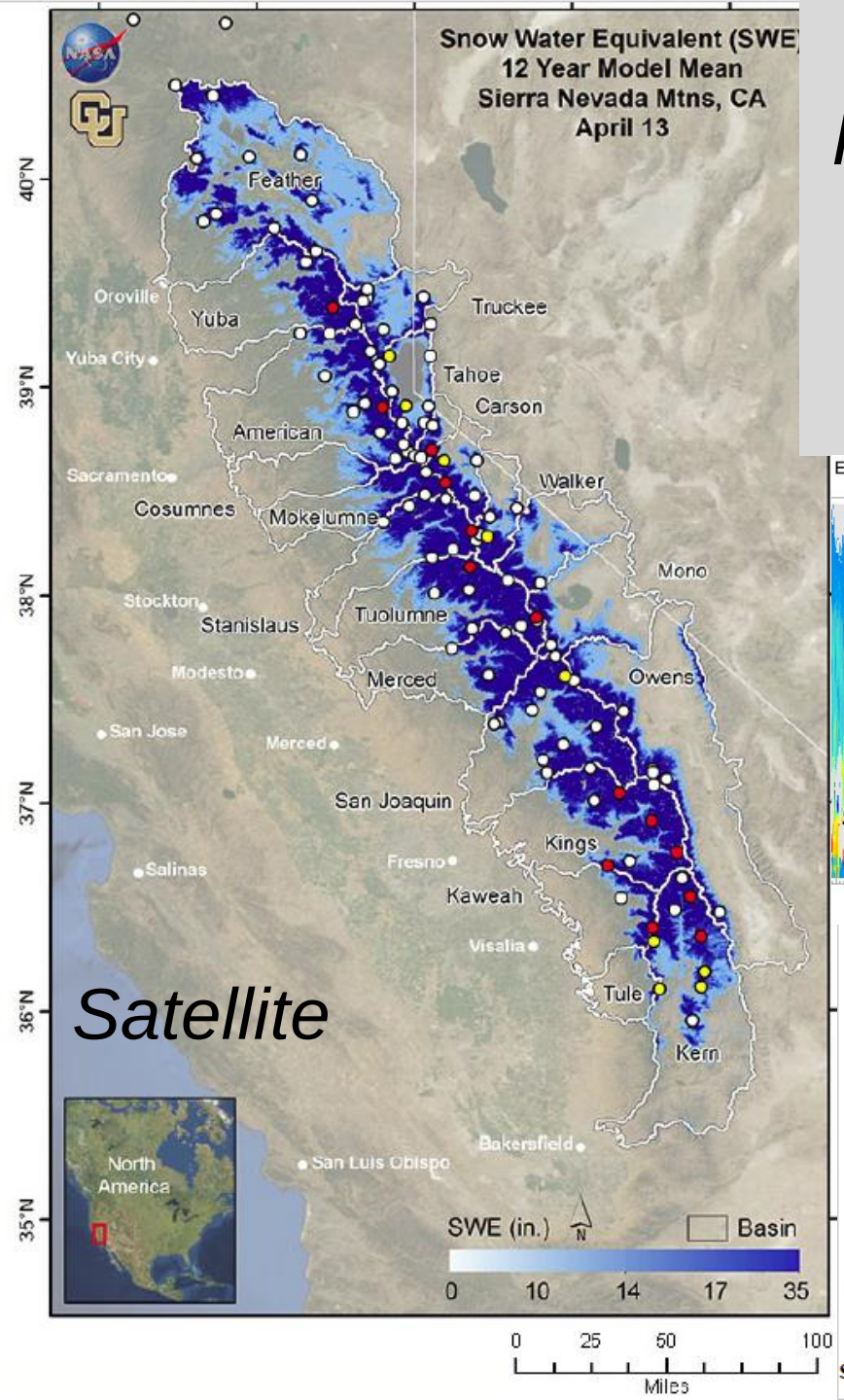
NWS CNRFC
NWS CPC
NASA JPL
NOAA ESRL
IRI
CW3E

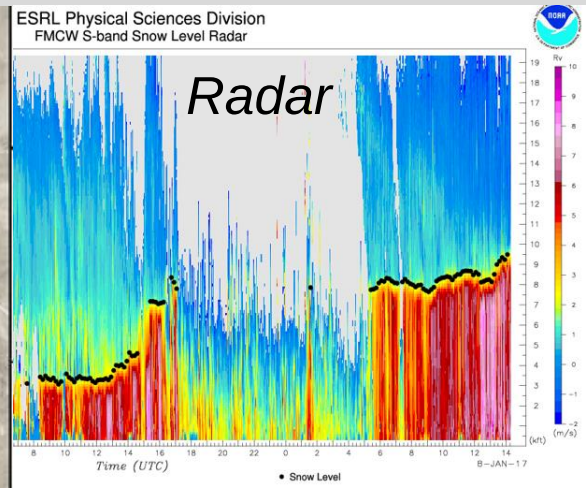
30-Day

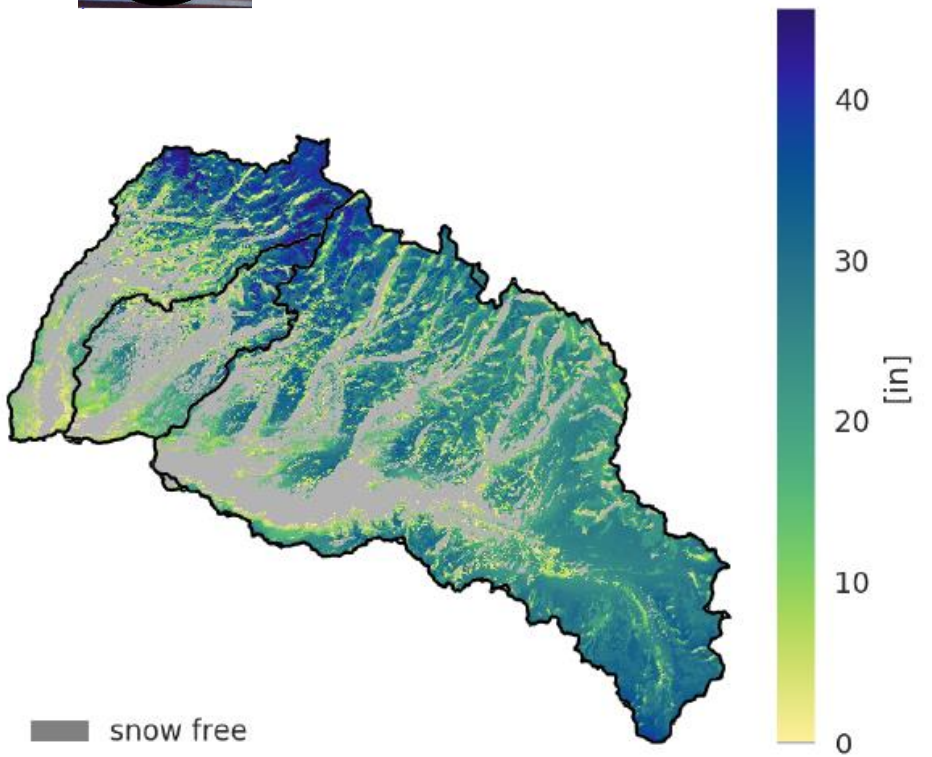
90-Day

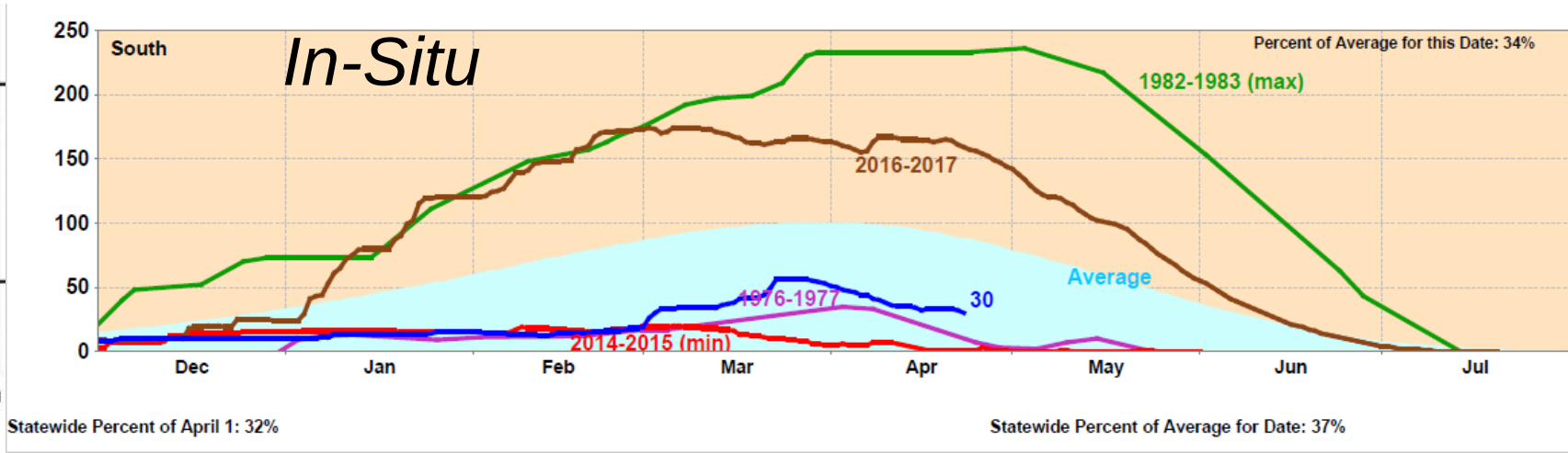
Water Year Outlook

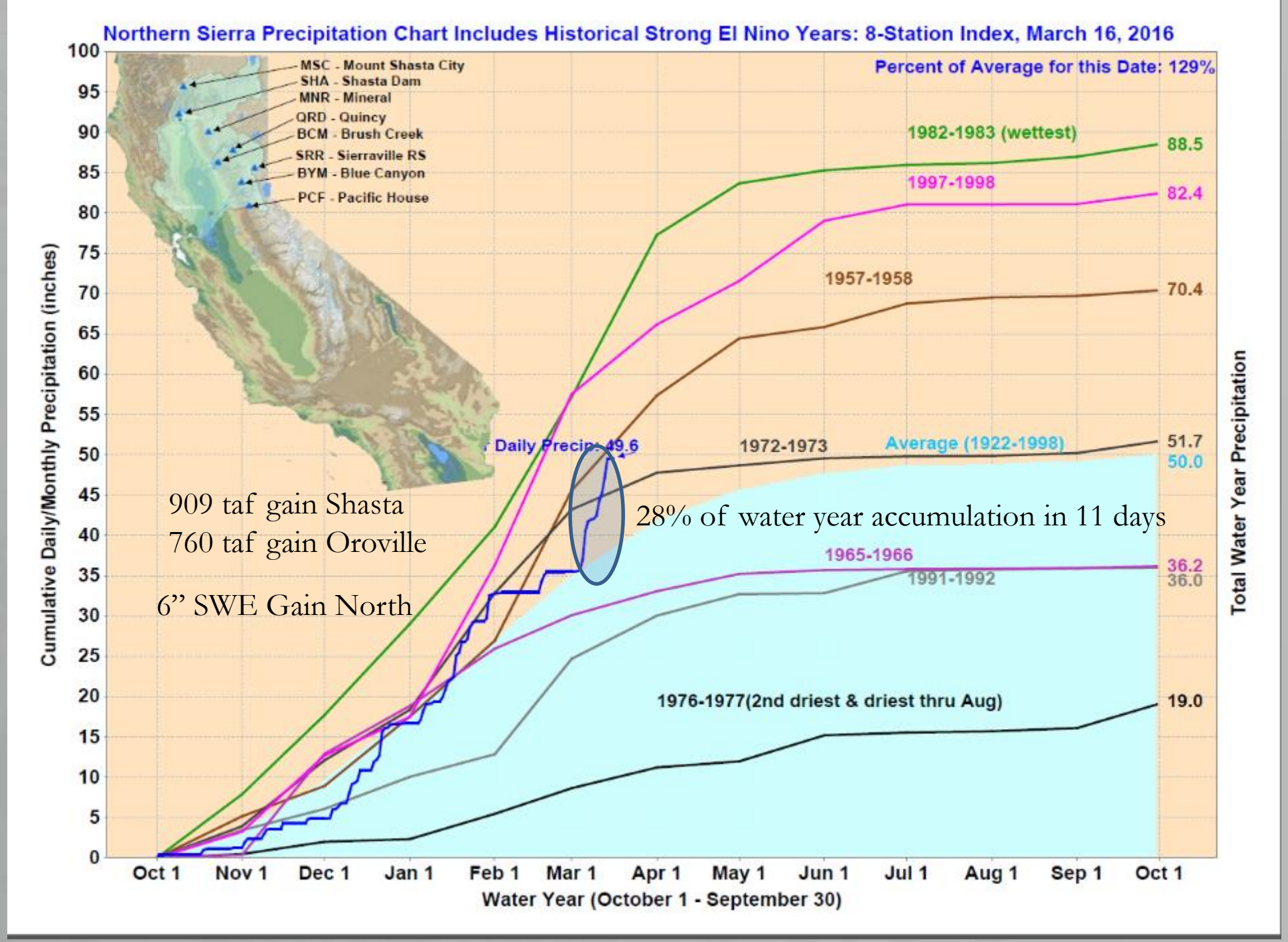
Goal: Integrated Observing Systems for Integrated Water Management



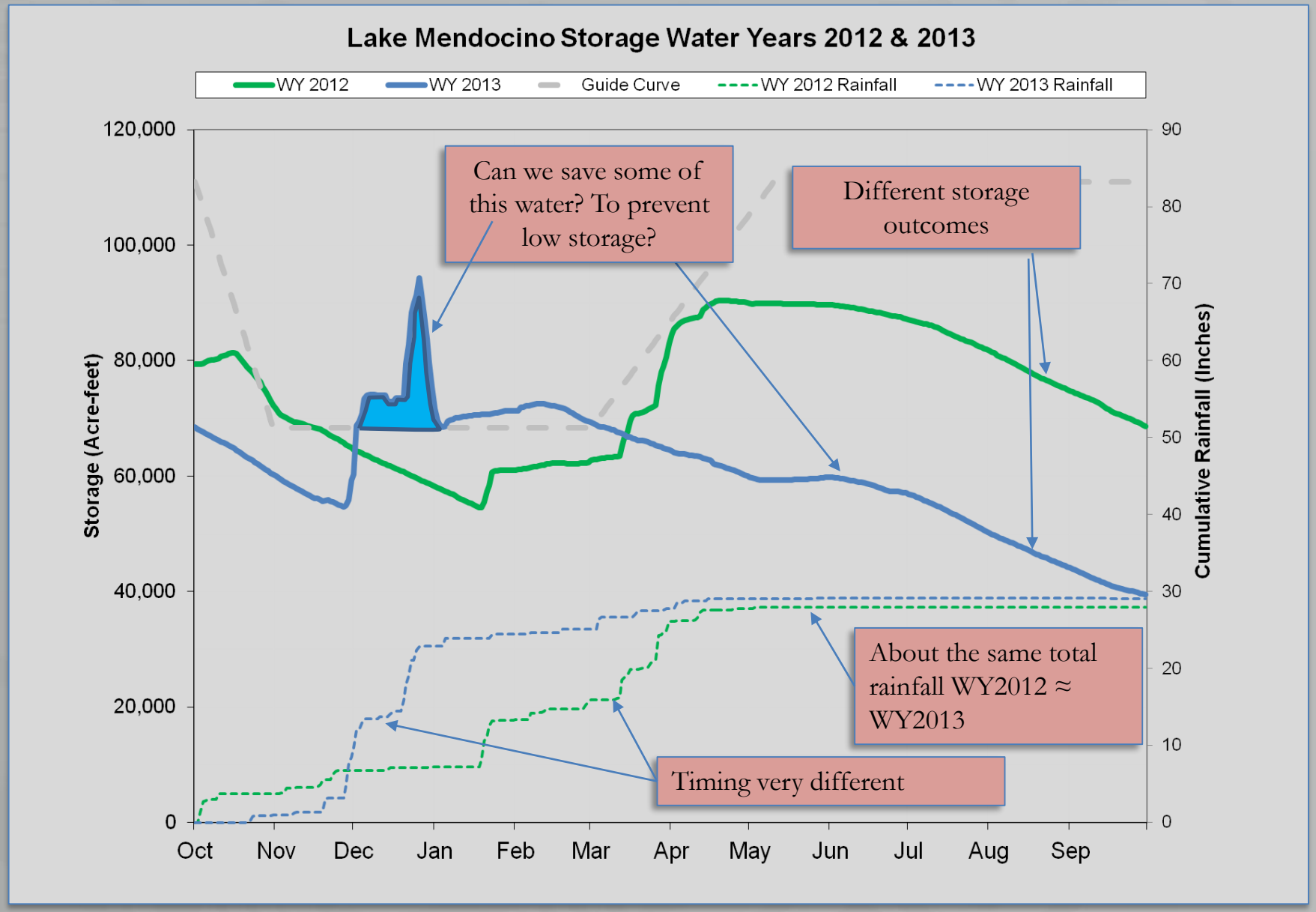







Northern Sierra Precipitation Chart Includes Historical Strong El Nino Years: 8-Station Index, March 16, 2016
MSC - Mount Shasta City
SHA - Shasta Dam
MNR - Mineral
QRD - Quincy
BCM - Brush Creek
SRR - Sierraville RS
BYM - Blue Canyon
PCF - Pacific House
Percent of Average for this Date: 129%
1982-1983 (wettest)
88.5
1997-1998
82.4
1957-1958
70.4
1972-1973
51.7
Average (1922-1998)
50.0
1965-1966
36.2
1991-1992
36.0
1976-1977(2nd driest & driest thru Aug)
19.0
Daily Precip: 49.6
909 taf gain Shasta
760 taf gain Oroville
6" SWE Gain North
28% of water year accumulation in 11 days
Cumulative Daily/Monthly Precipitation (inches)
Total Water Year Precipitation
Oct 1
Nov 1
Dec 1
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Water Year (October 1 - September 30)

Lake Mendocino Guide Curve



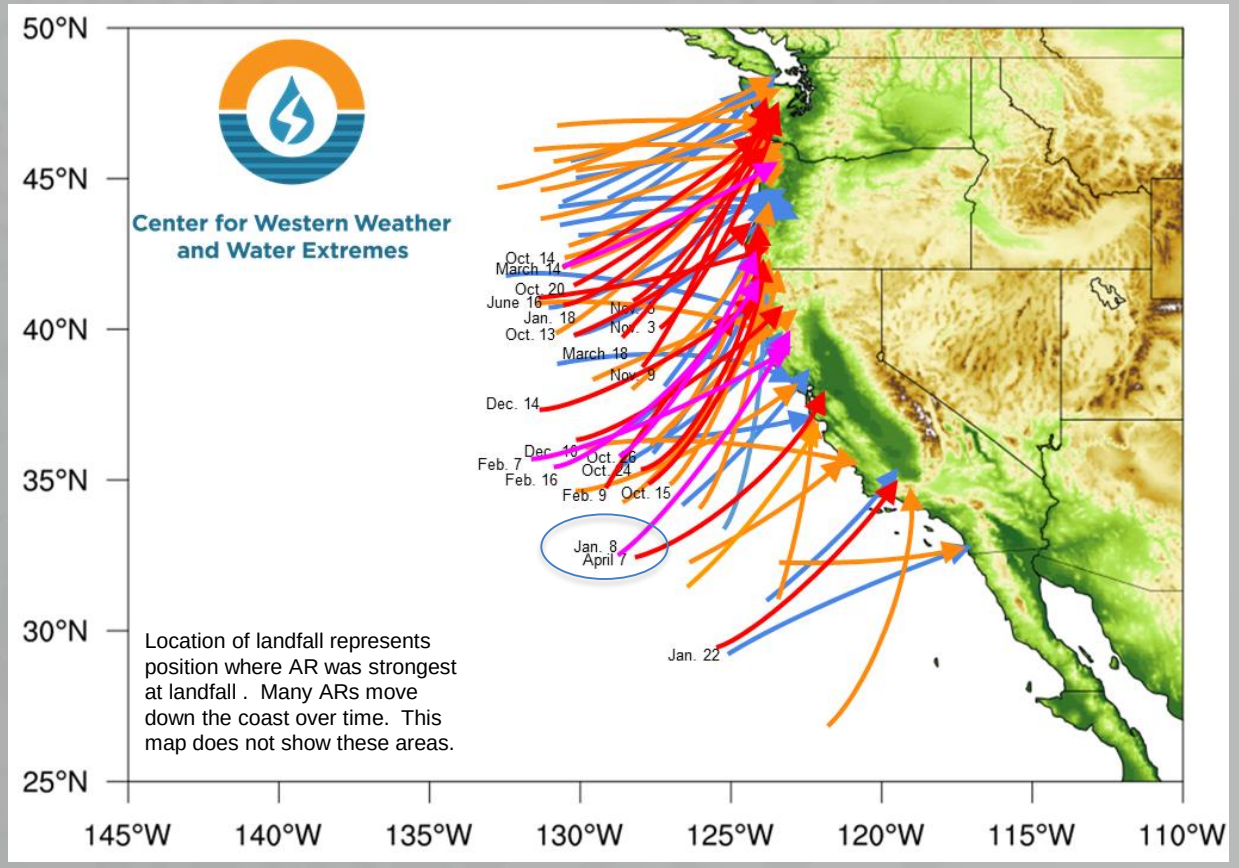
Distribution of Landfalling Atmospheric Rivers Over the U.S. West Coast During Water Year 2017

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

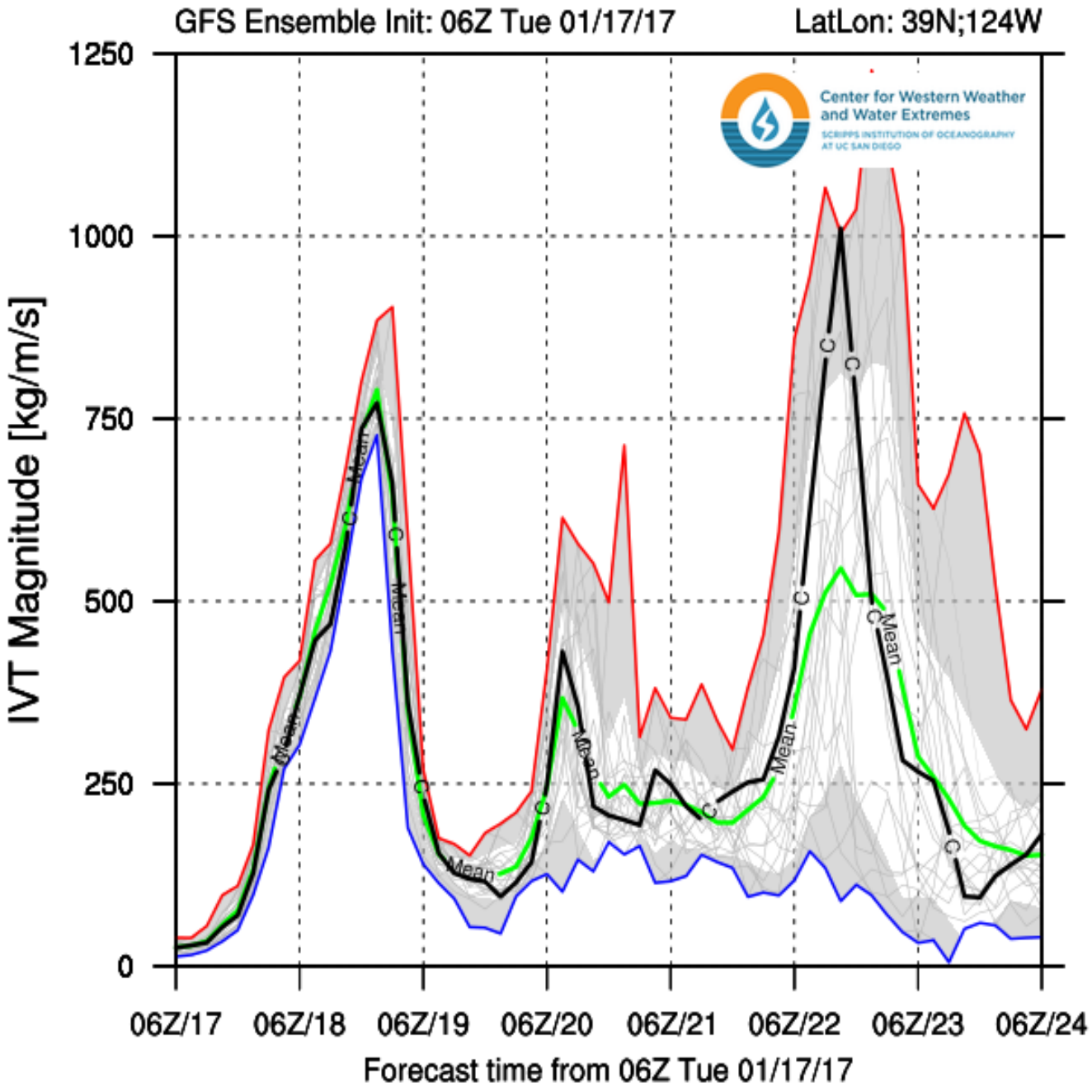
AR Strength	AR Count
Weak	21
Moderate	26
Strong	16
Extreme	5
Exceptional	0

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}

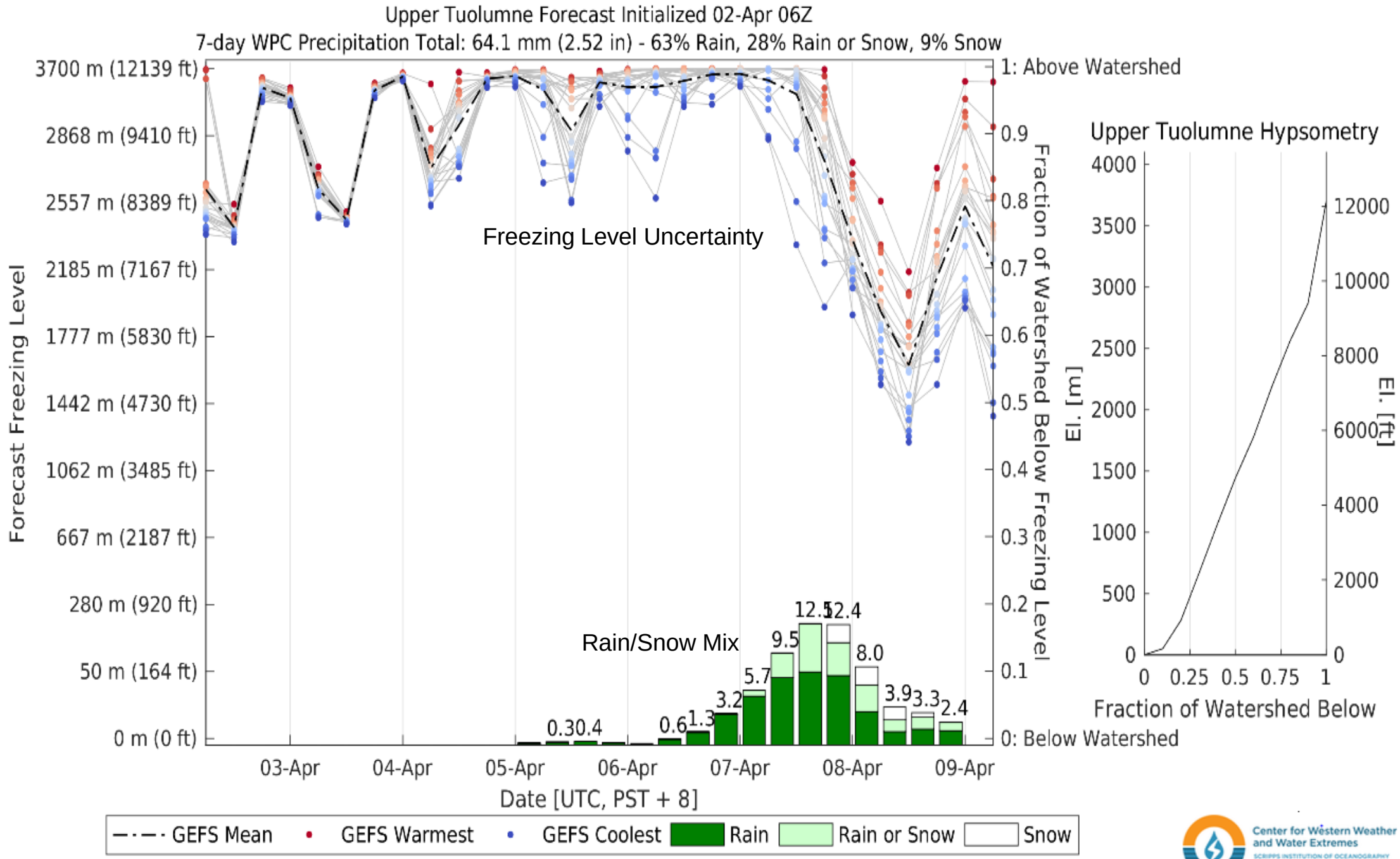


By F.M. Ralph, C. Hecht, J. Kalansky

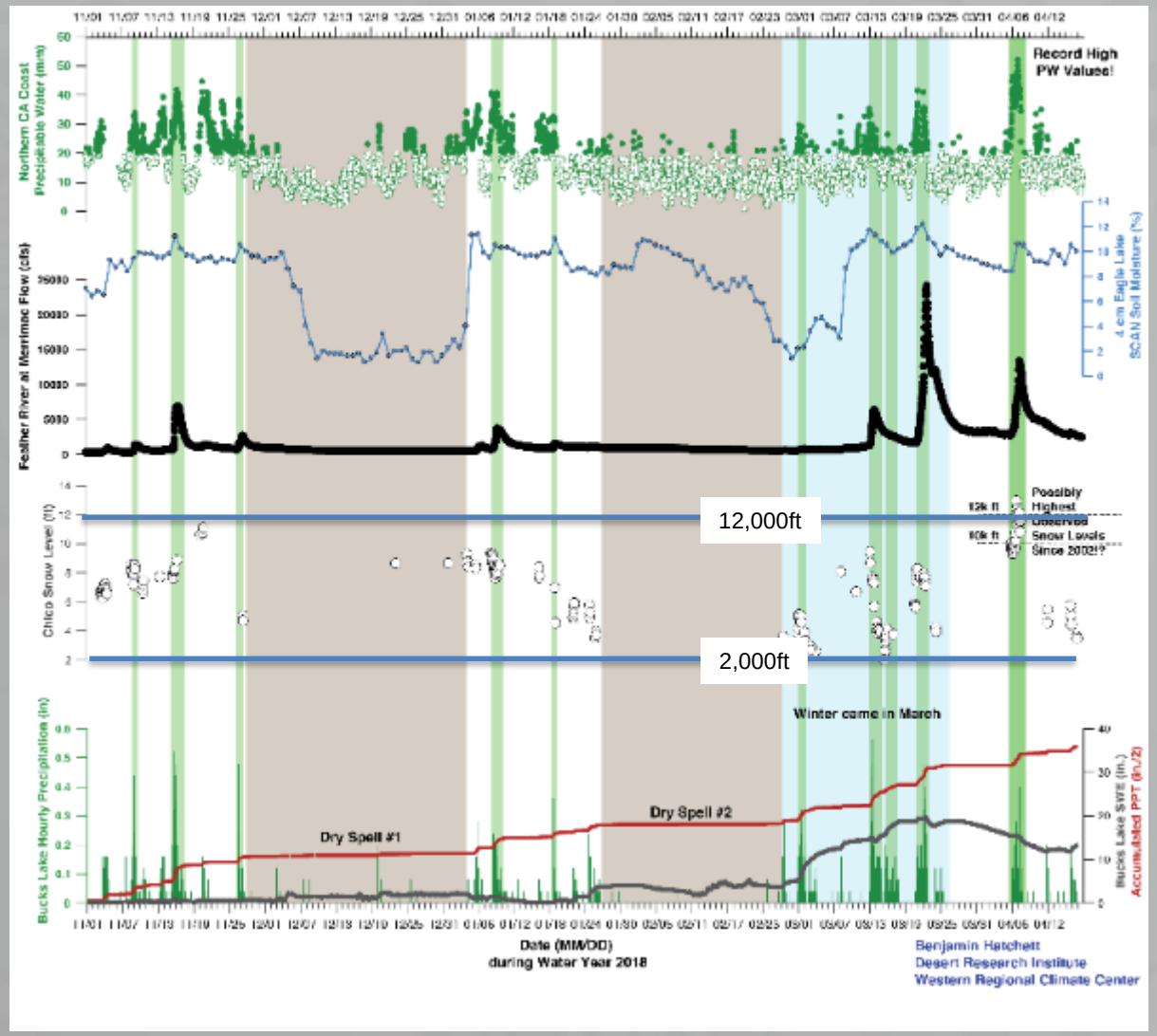


AR Strength Forecast and Uncertainty Tool

Think about reportable metrics relative to a given watershed for insight into runoff response



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


Record High PW Values!
Northern CA Coast Precipitable Water (mm)
Feather River at Merrimac Flow (cfs)
4 cm Eagle Lake SCAN Soil Moisture (%)
12,000ft
2,000ft
Possibly Highest Observed Snow Levels Since 2002!?
Chico Snow Level (ft)
Winter came in March
Dry Spell #1
Dry Spell #2
Bucks Lake Hourly Precipitation (in)
Bucks Lake SWE (in.)
Accumulated PPT (in./2)
Date (MM/DD)
during Water Year 2018
Benjamin Hatchett
Desert Research Institute
Western Regional Climate Center

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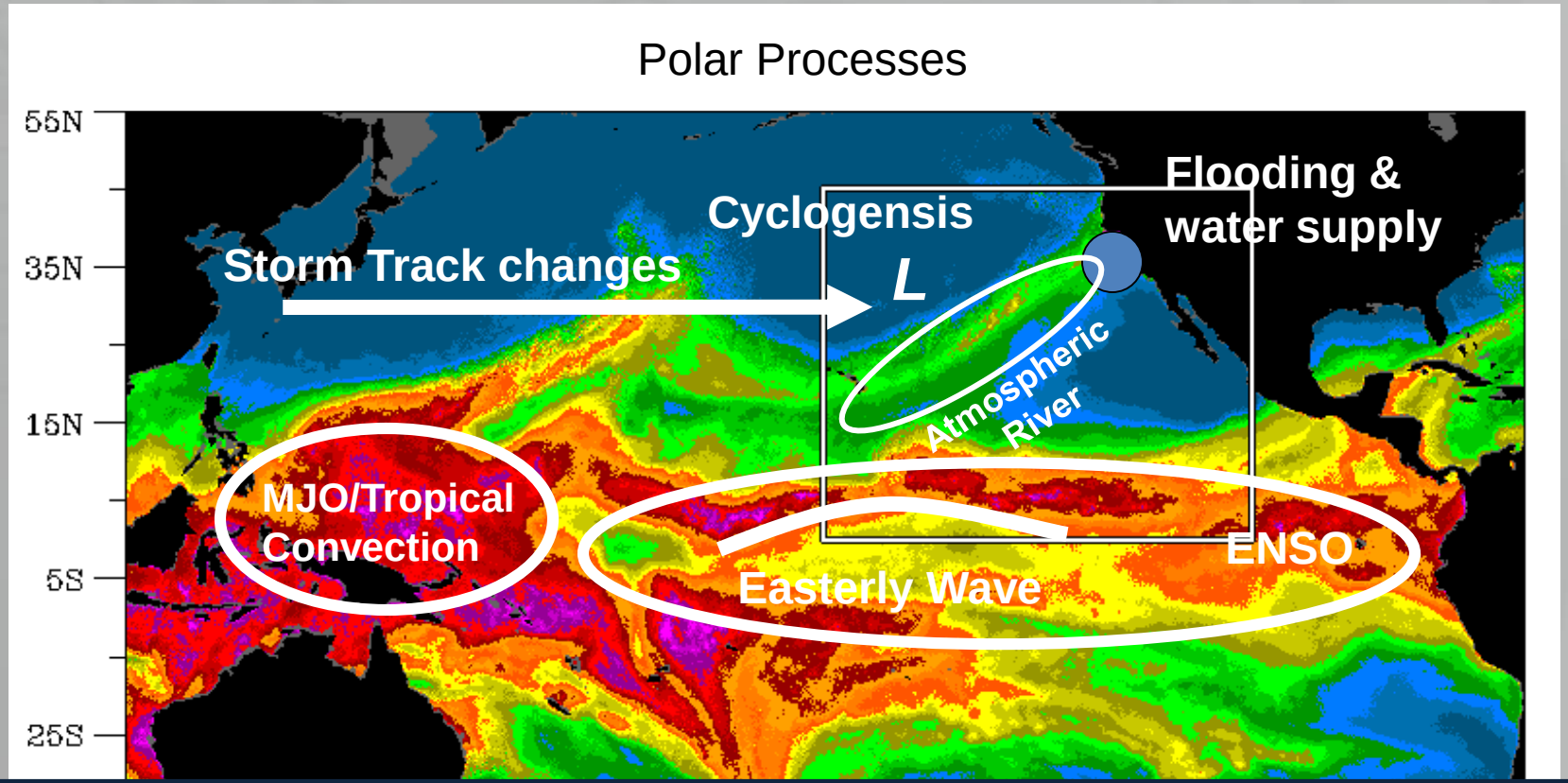

How do climate system components set the structure of the wintertime weather circulation patterns that result in a wet or dry seasonal outcome and potential for extremes?

Summary Thoughts

- Investments to date have focused on developing observational capability that enables collaboration with research while providing operational support to the State
- CW3E Investments in AR research have helped characterize a key building block to water year outcomes in CA and provided insights into how a warming world can impact precipitation modulation in CA
- We are at a point to expand on this effort with more partners to tackle the forecasting problem from the climate side towards weather as a complementary piece of the portfolio.

Summary Thoughts

- CA investments in improved observations forecasts and associated “tools of the trade” exceed $50 million over the past decade
- Partnerships play a key role in successfully advancing the science and putting it into practice
- Opportunity exists now to push the envelope on what information can be gleaned at the seasonal time scale which can inform decisions valued in the $100 million per year range.

Questions?

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