DWR Approach to Tracking Extremes and Adaptation Pathways (Extreme Event Attribution)

National Academy of Sciences
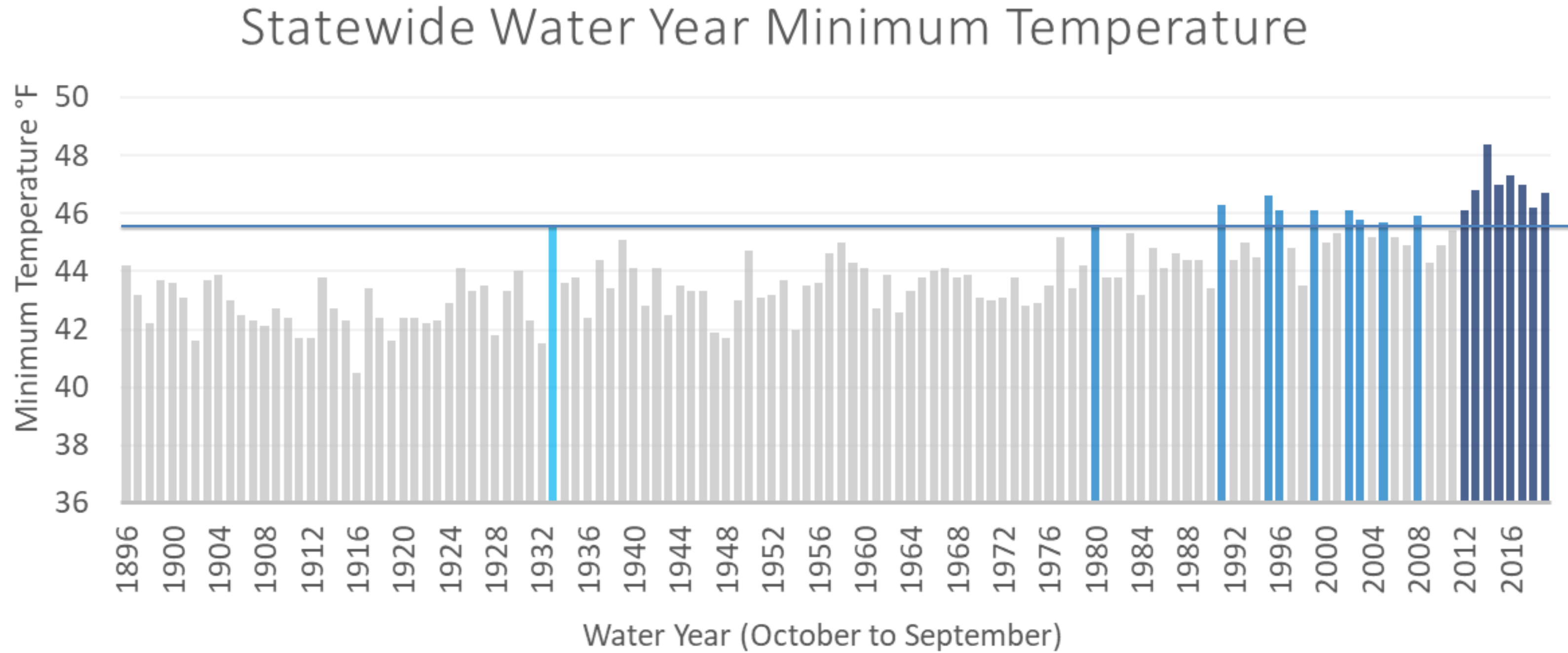
April1, 2025

Darren Bonfantine, Climate Resilience
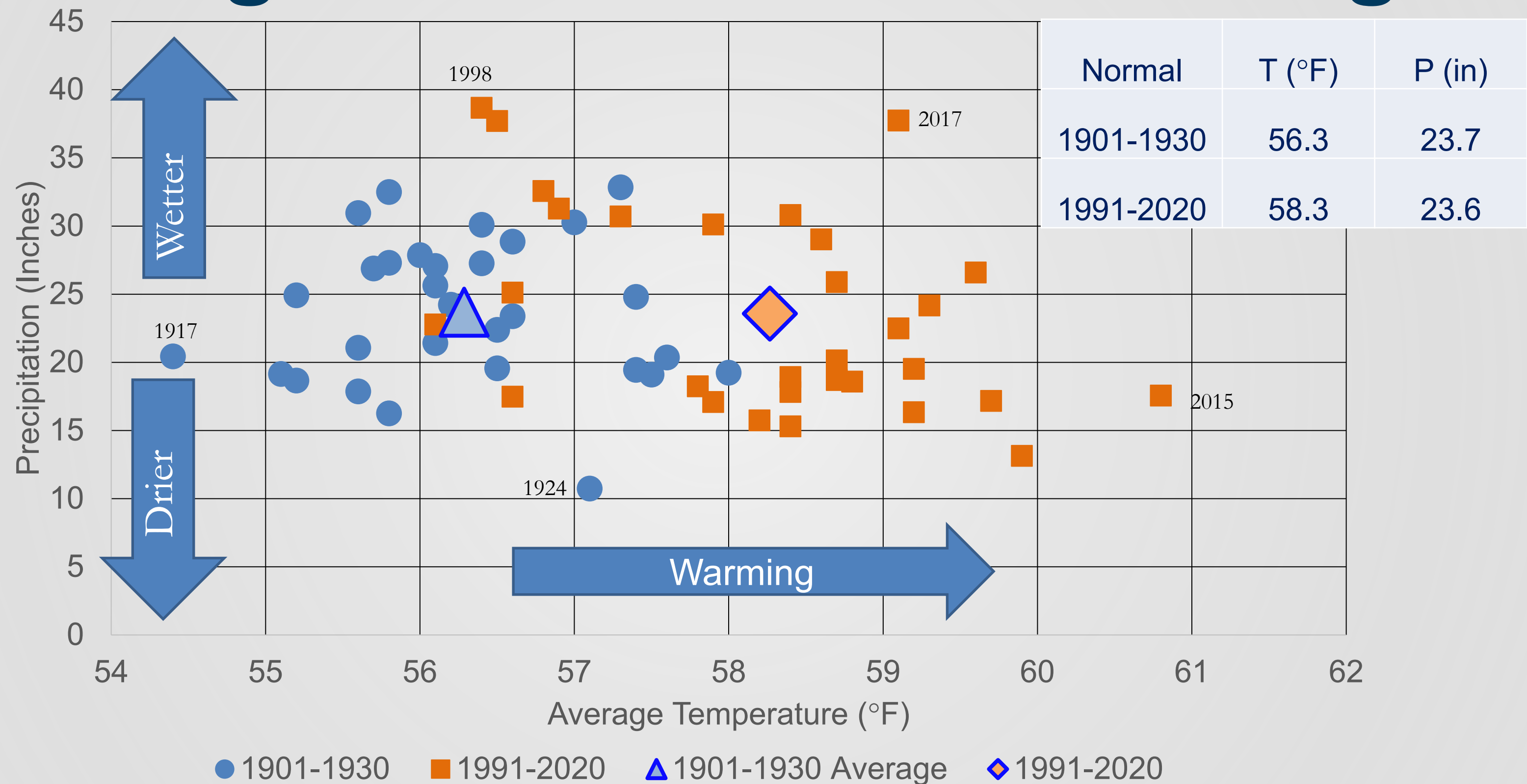Mike Anderson, State Climatologist
Romain Maendly, Climate Action Coordinator

From Extreme to Common

Statewide Water Year Minimum Temperature

Evolving Normal – 30 Year Averages

How Much Change for CA Mean Temperature?

1981-2010 Climate Normal

1991-2020 Climate Normal

California (Statewide)
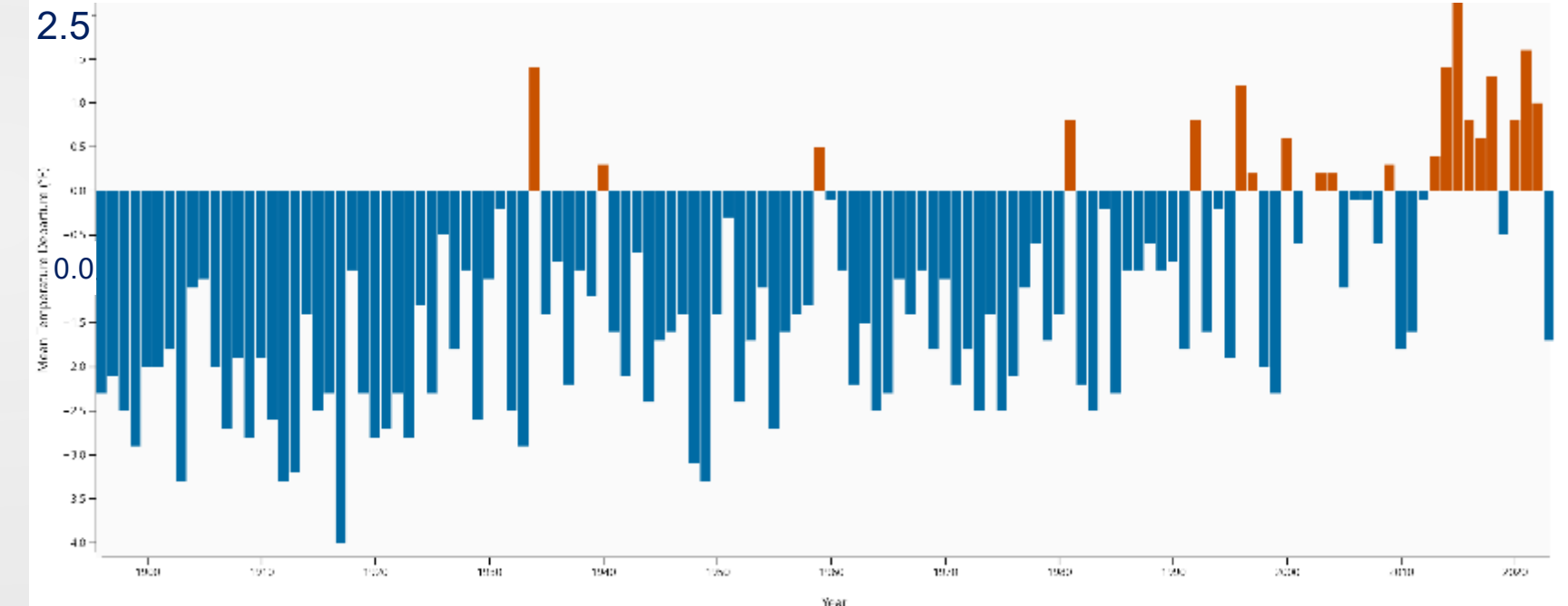Mean Temperature **Departures** from **1981-2010** Computed Averages for Water Year (October-September)

California (Statewide)
Mean Temperature **Departures** from **1991-2020** Computed Averages for Water Year (October-September)
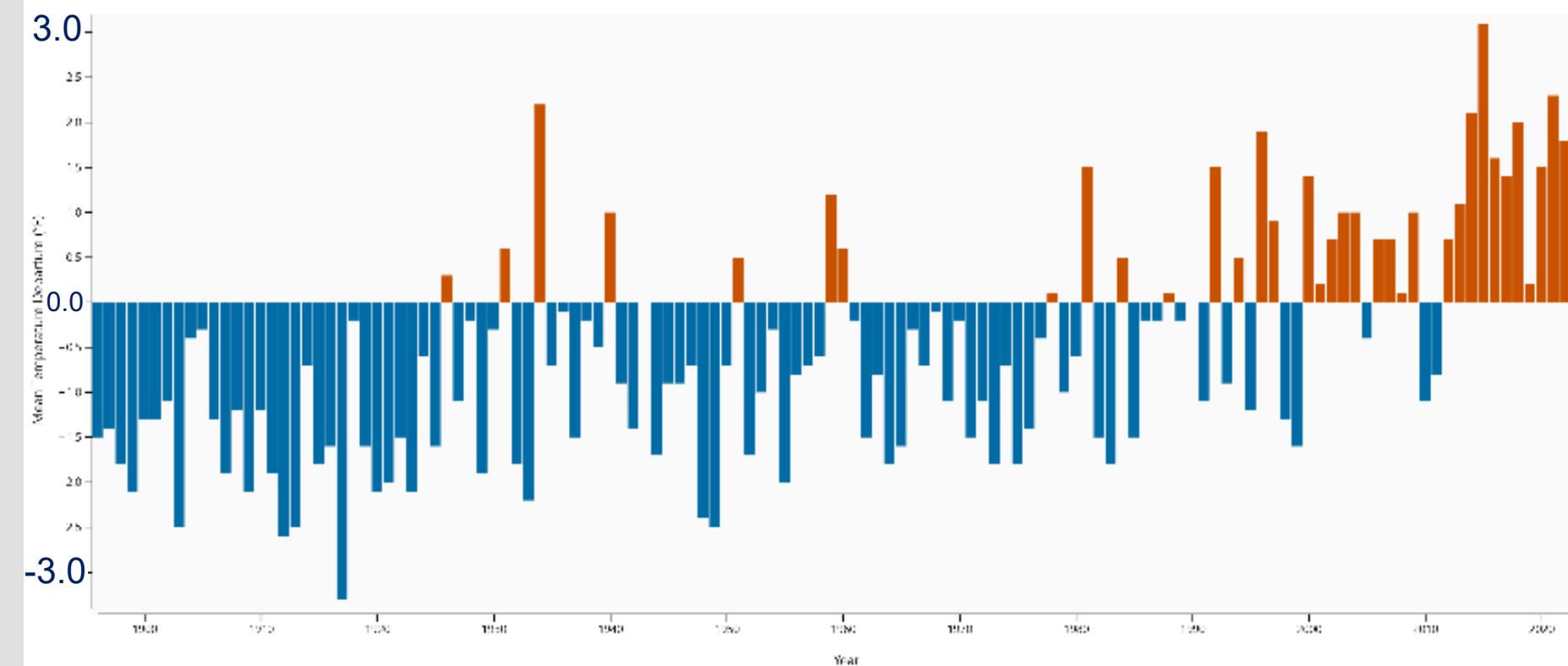
1981-2010 Mean and Median 57.7°F
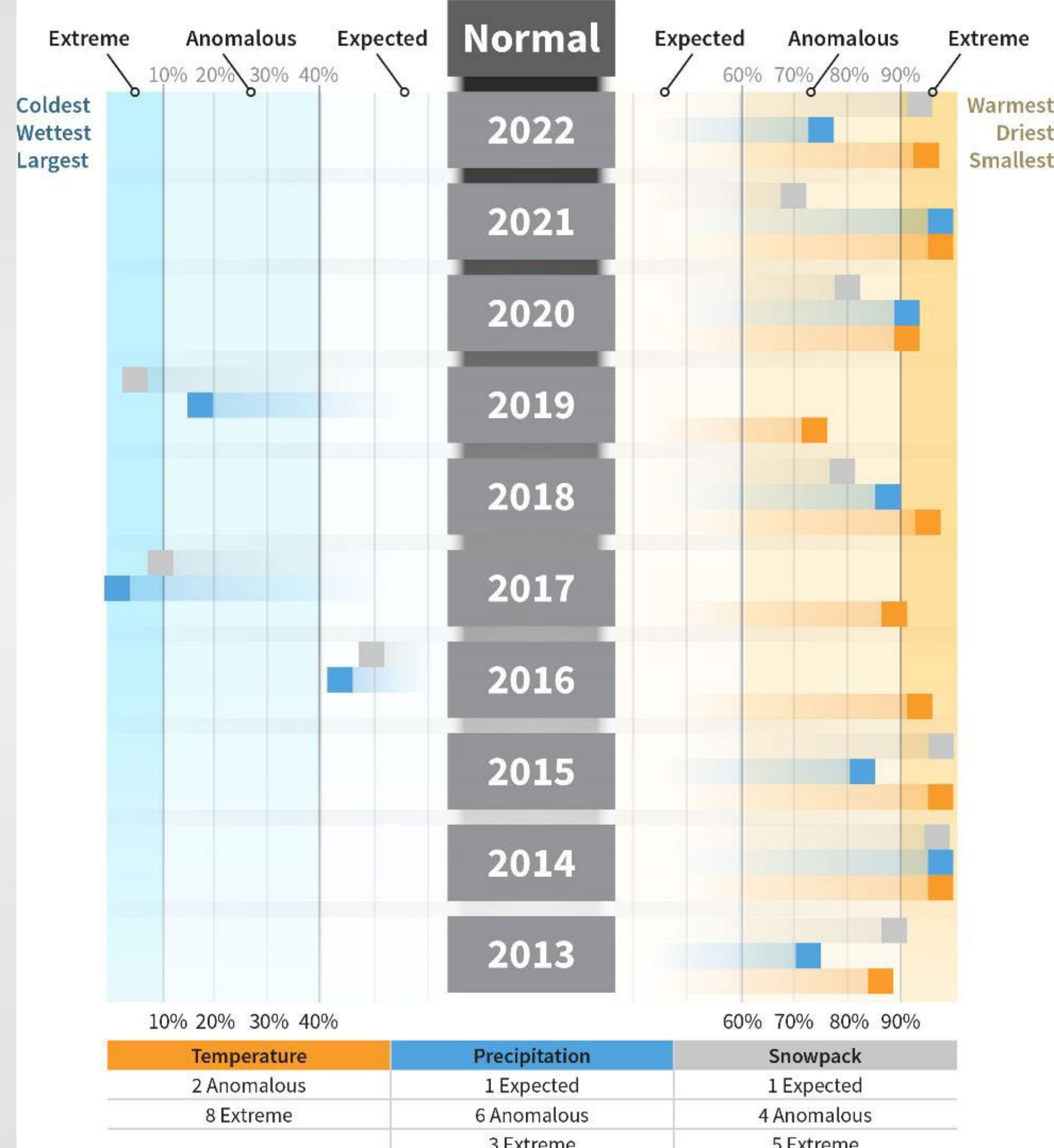
1991-2020 Mean 58.4°F and Median 58.5°F

A climate normal is a 30-year period used to calculate climate statistics
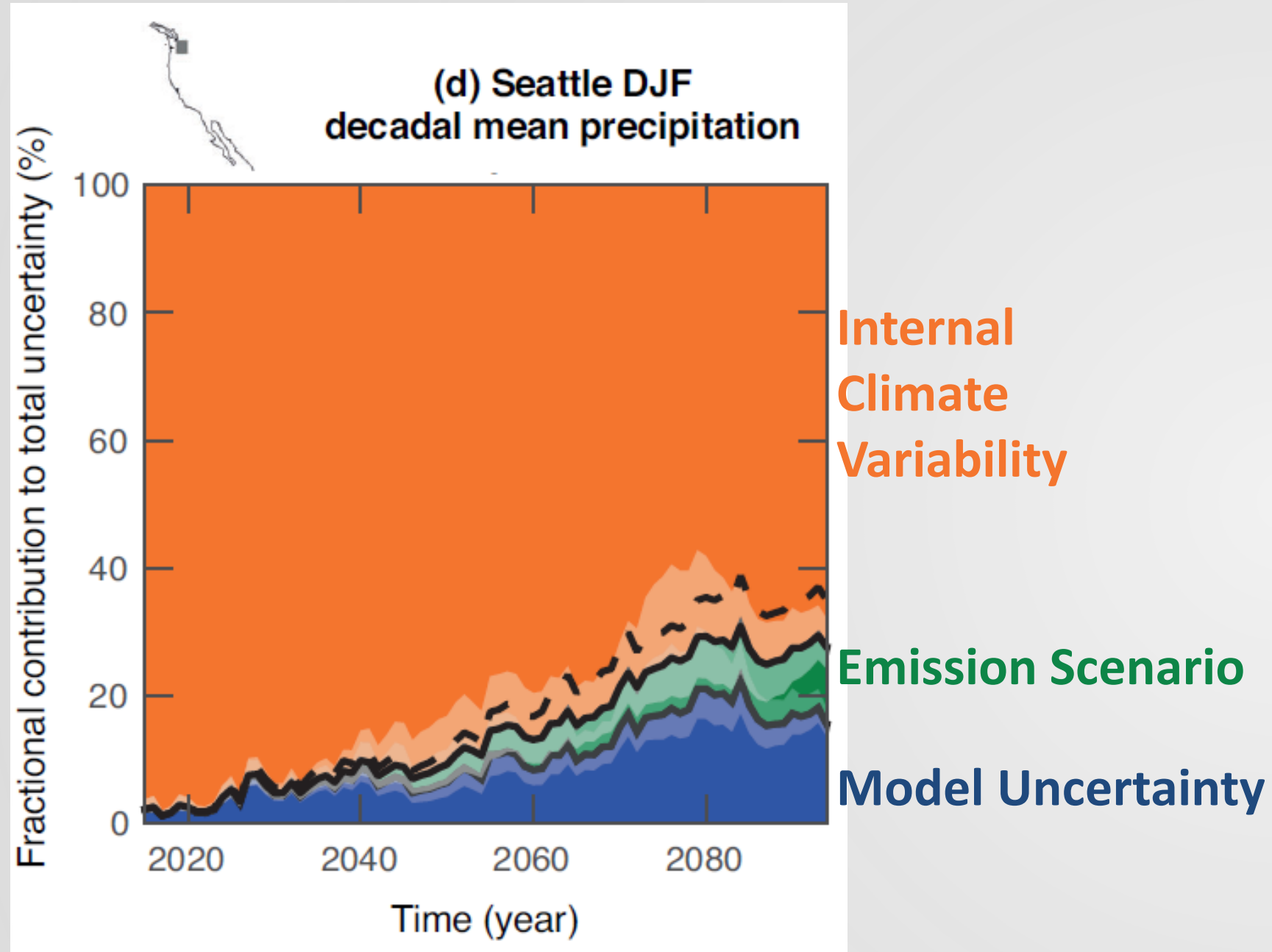
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A Decade of Extremes

- WY2023 adding to extremes narrative
  - Dry to Wet shift
  - Multiple Extremes
  - New Records

- New opportunities for adaptation

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Challenges with Downscaled Climate Projections: *Climate Variability is Important but Difficult to Explore*

Lehner et al., 2020: Partitioning climate projection uncertainty with multiple large ensembles and CMIP5/6, Earth System Dynamics
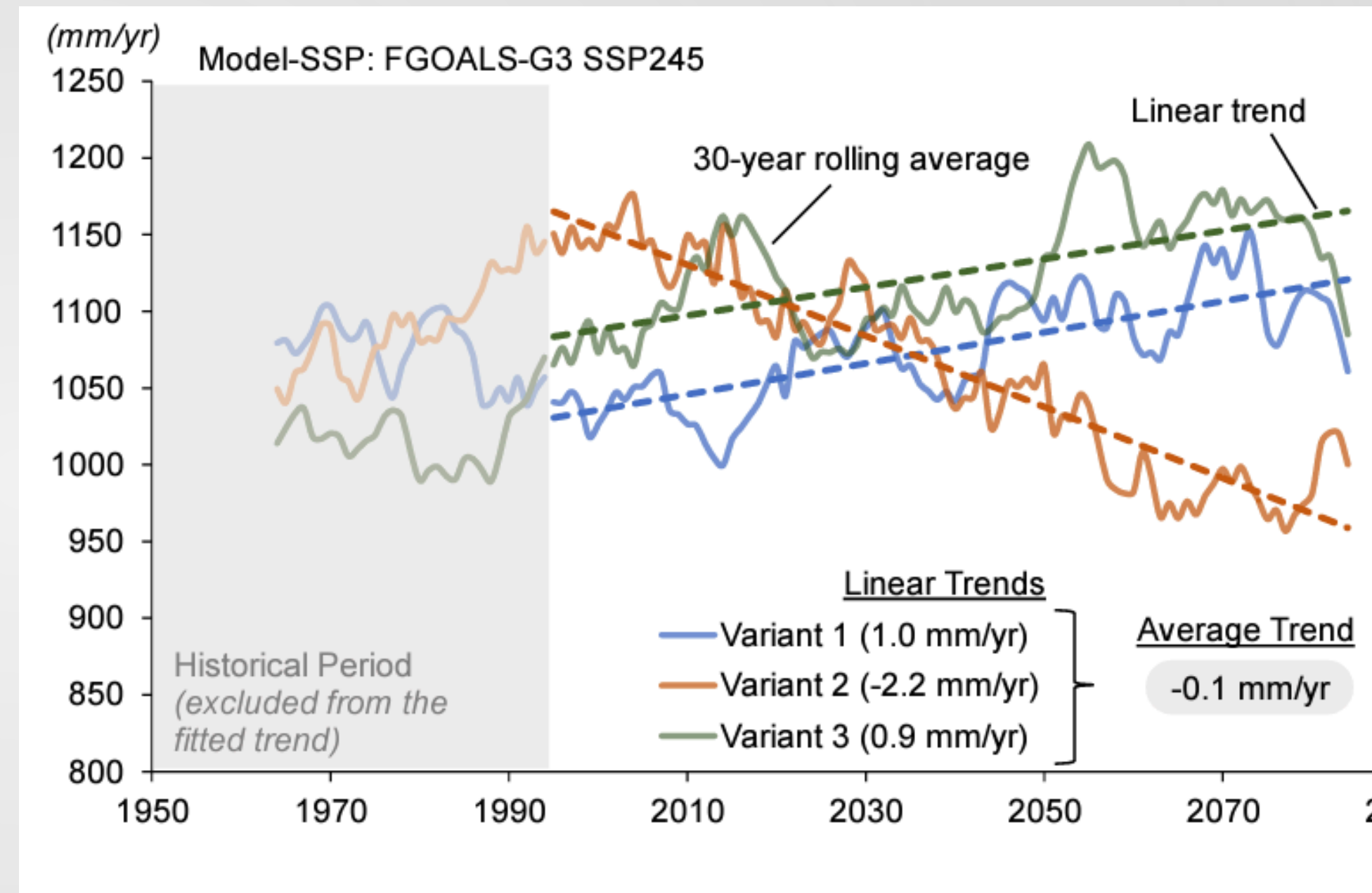
Figure taken from SWP Delivery Capability Report

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Weather Regime Based Stochastic Weather Generation

Weather Regime - Mid-latitude atmospheric intra-seasonal variability is characterized by large-scale flow patterns ("weather regimes")

- Organize mid-latitude storms
- Appear repeatedly at fixed geographical locations
- Persist beyond the lifetime of individual synoptic-scale storms (days-weeks)
- Exhibit rapid transitions associated with nonlinear atmospheric dynamics
- Respond to external forcings (e.g., ENSO or anthropogenic effects)

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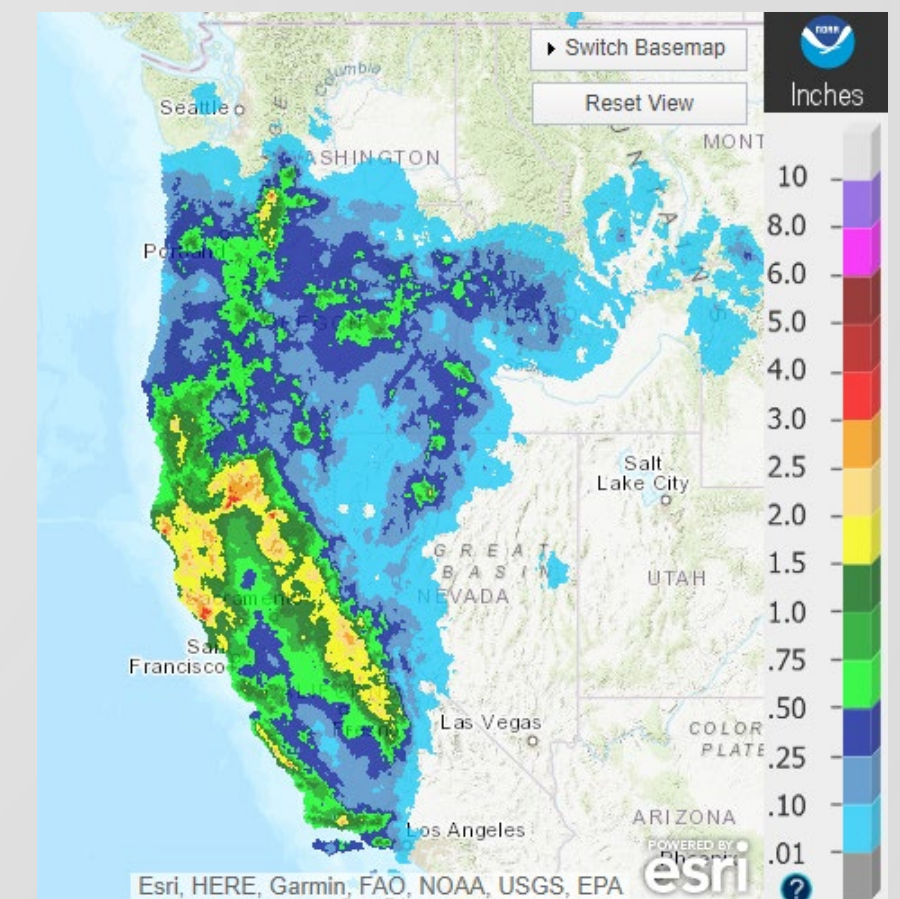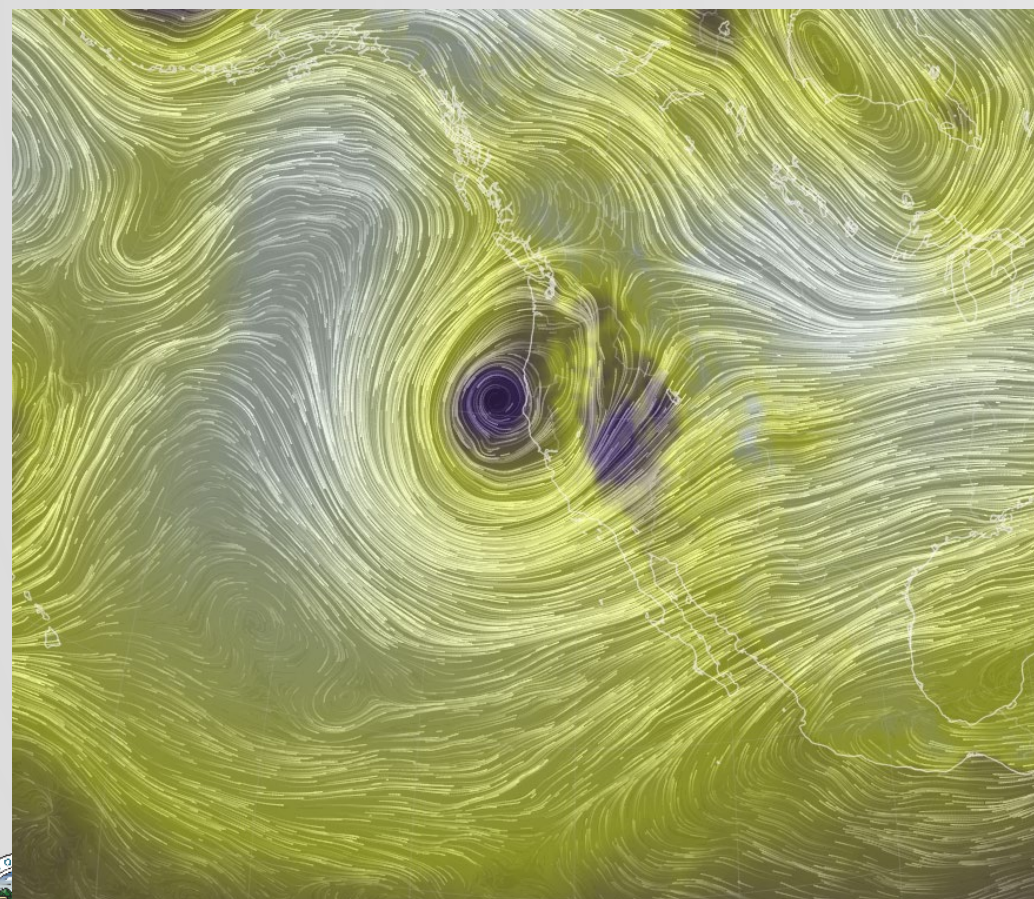
The simulation indicated that human-induced warming caused an 11-percent increase in precipitation during the first pulse and a 15-percent increase in the second pulse.
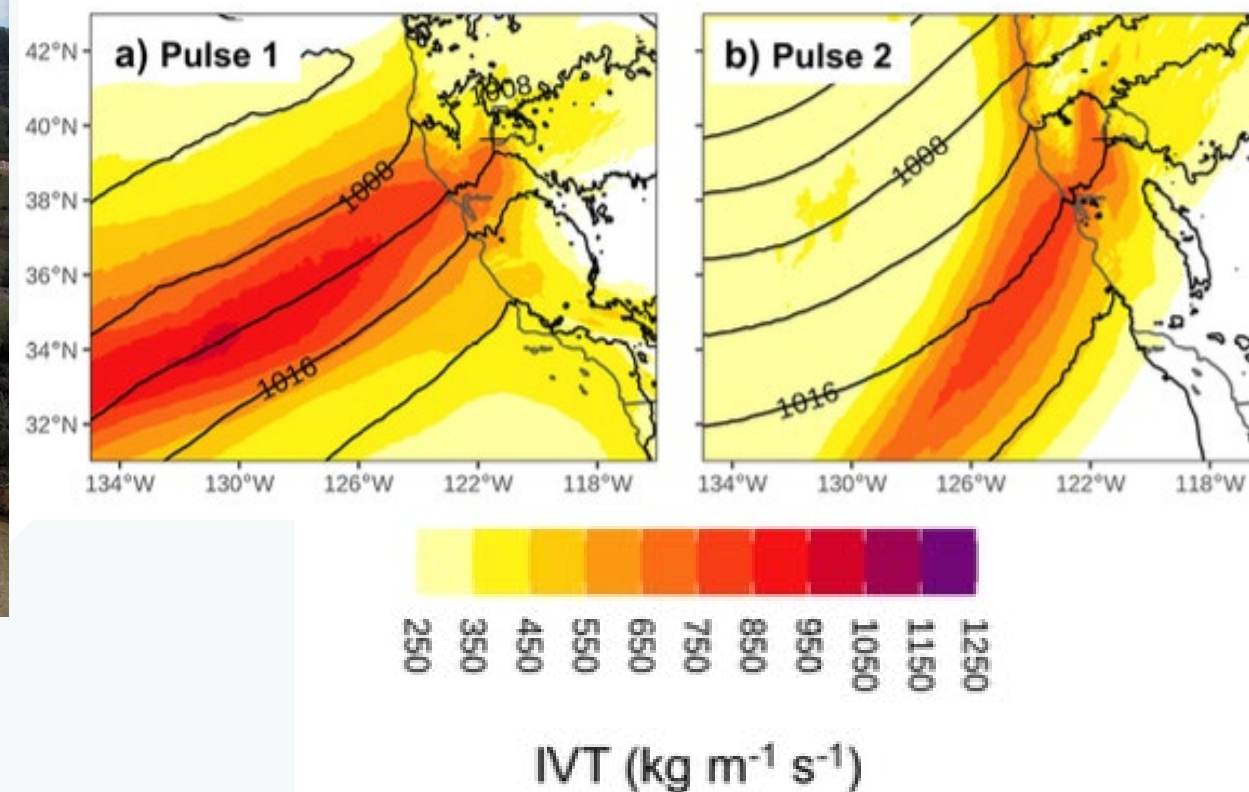
- Extreme event that caused flood leading to billion dollar damages and many social impacts in California

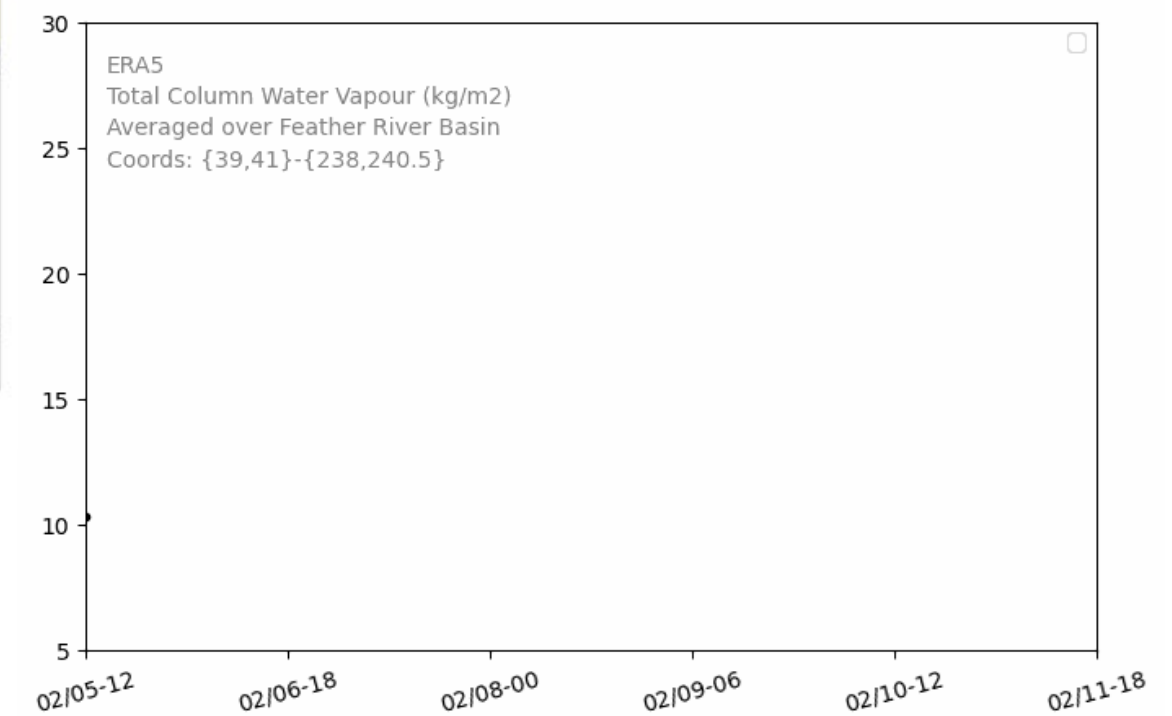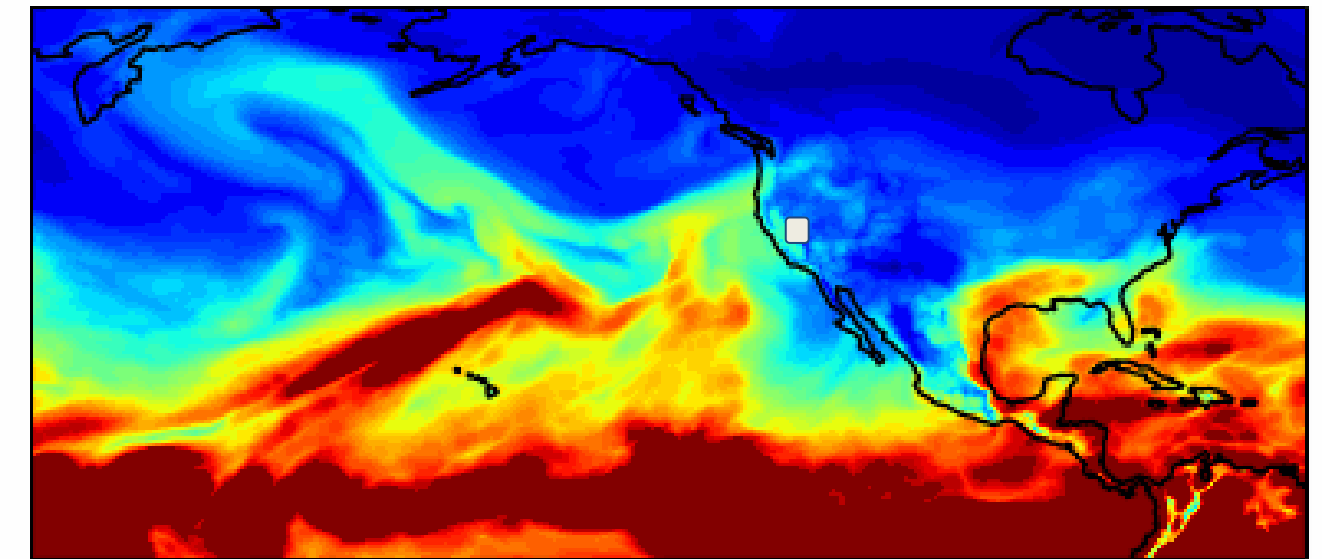*How did climate change contribute to the event?*

Total column water vapour (kg/m2)
2017-02-05T12:00:00

Oroville dam during the AR of February 2017

AR was a two pulse event

a) Pulse 1   b) Pulse 2

IVT (kg m⁻¹ s⁻¹)

250 350 450 550 650 750 850 950 1050 1150 1250

ERA5
Total Column Water Vapour (kg/m2)
Averaged over Feather River Basin
Coords: {39,41}-{238,240.5}

Center for Western Weather and Water Extremes
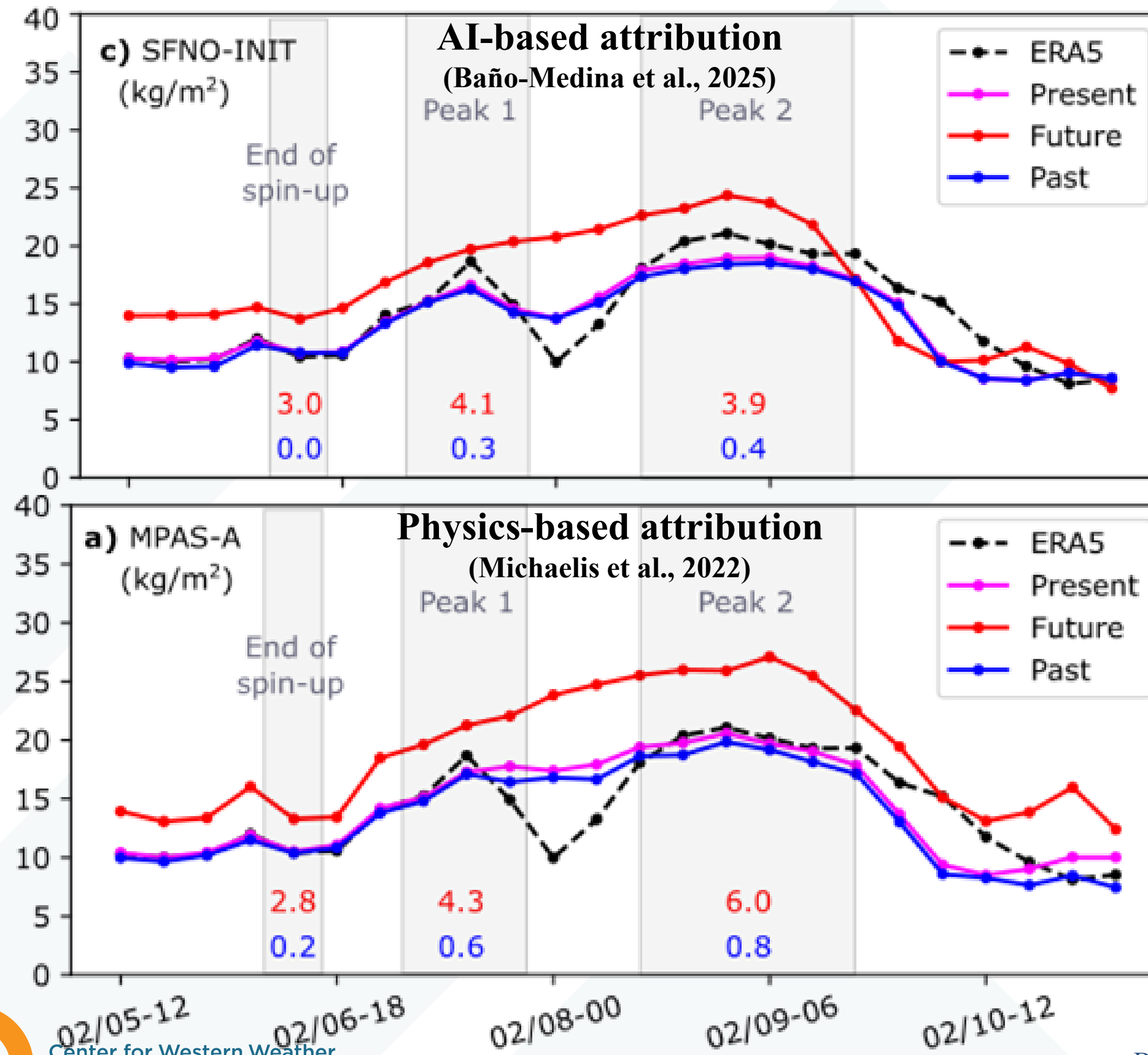
Total column water vapor simulations for different climate conditions over the Feather River Basin

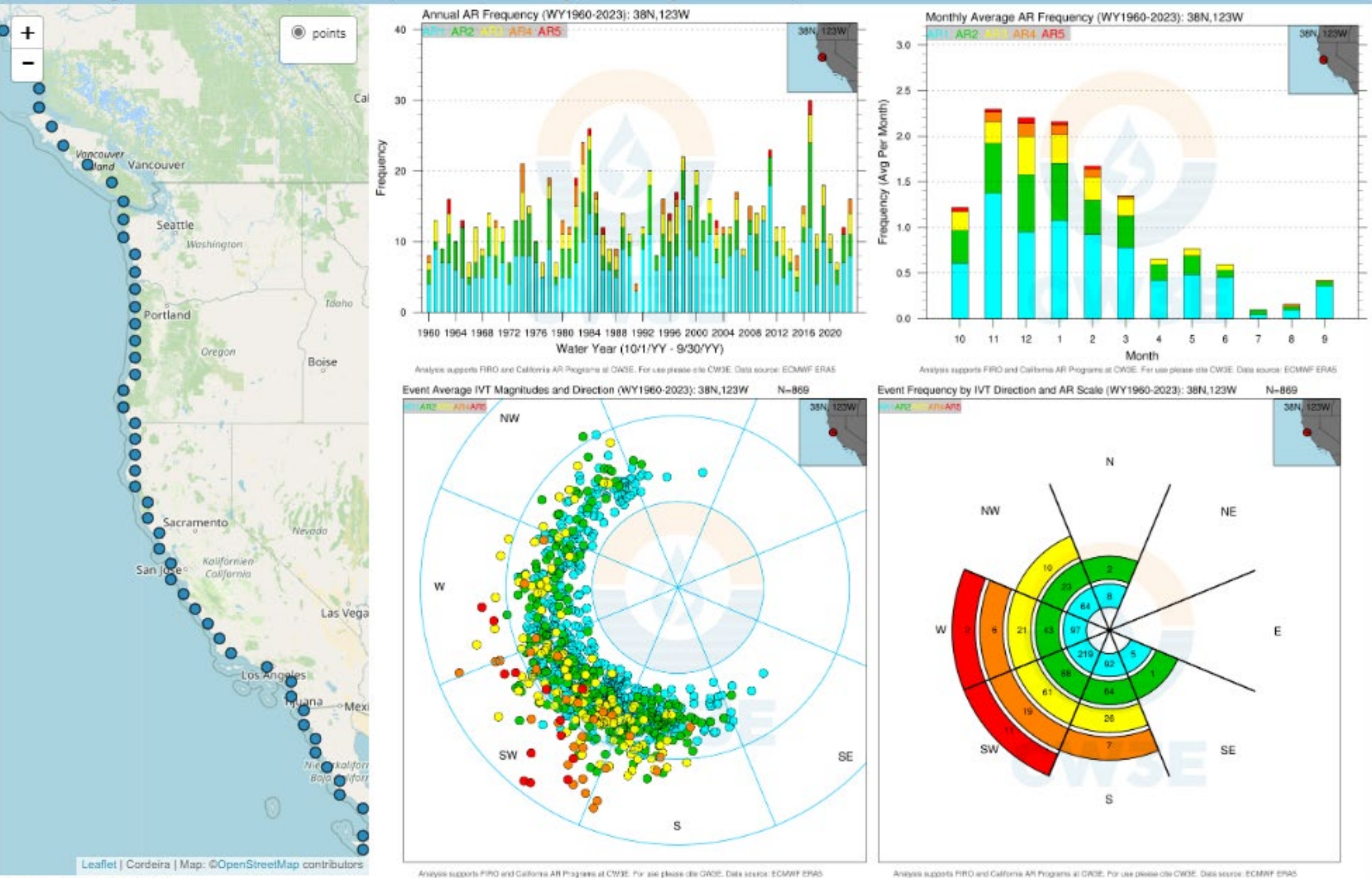**Key points:**

1. **Physical realism:** AI models show consistent response to "climate change" perturbations (i.e., similar to physics-based attribution response)
2. **Near-real time:** given the small computational requirements… attribution in near-real time?

Baño-Medina et al., 2025. Harnessing AI data-driven global weather models for climate attribution: An analysis of the 2017 Oroville dam extreme atmospheric river. Artificial Intelligence for Earth Systems

CW3E – Atmospheric River Landfall Catalog

California Climate Tracker

- Product of Western Region Climate Center

- Tracks Precipitation and Temperature

- Monthly with Period of Record back to October 1895

[WRCC - State Climate Tracker Home (dri.edu)](dri.edu)

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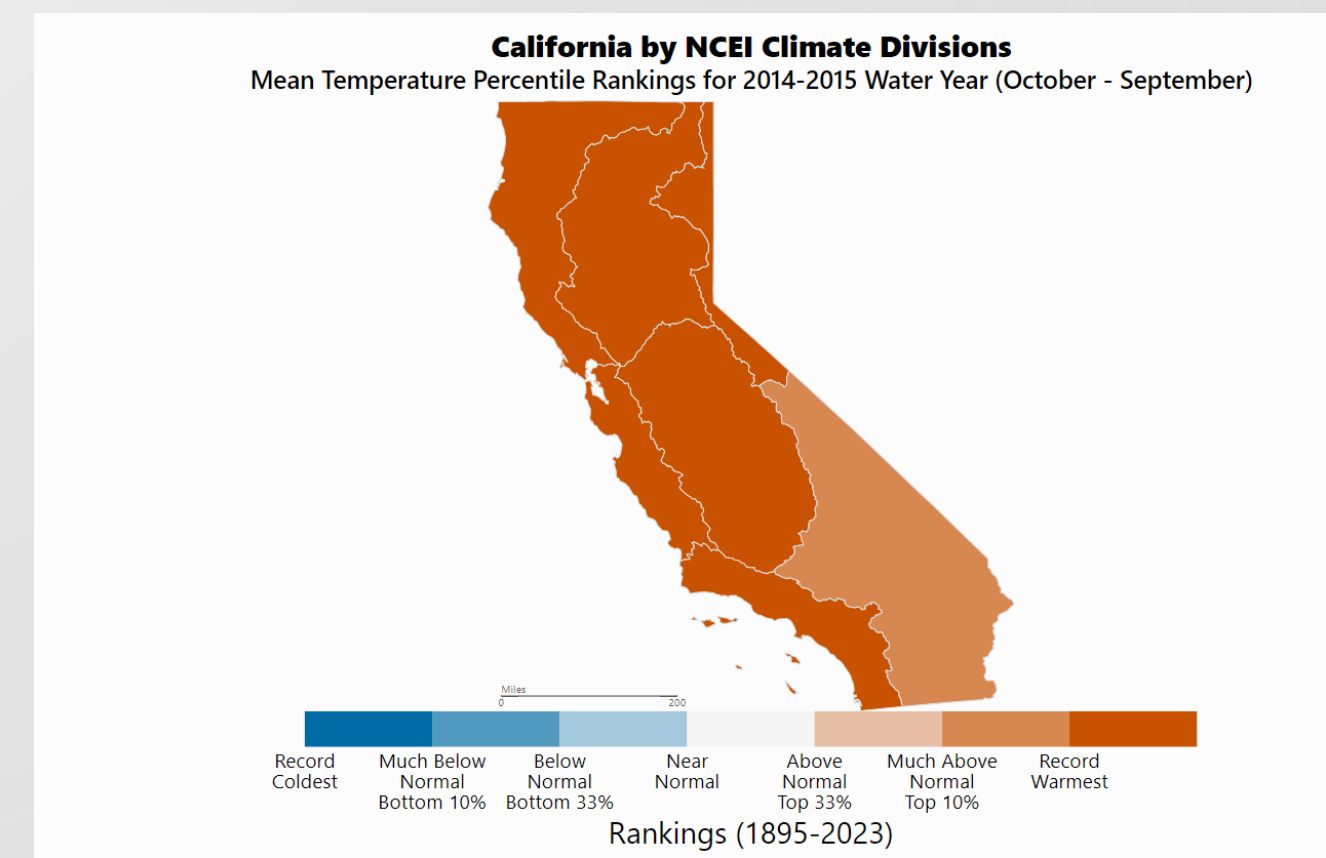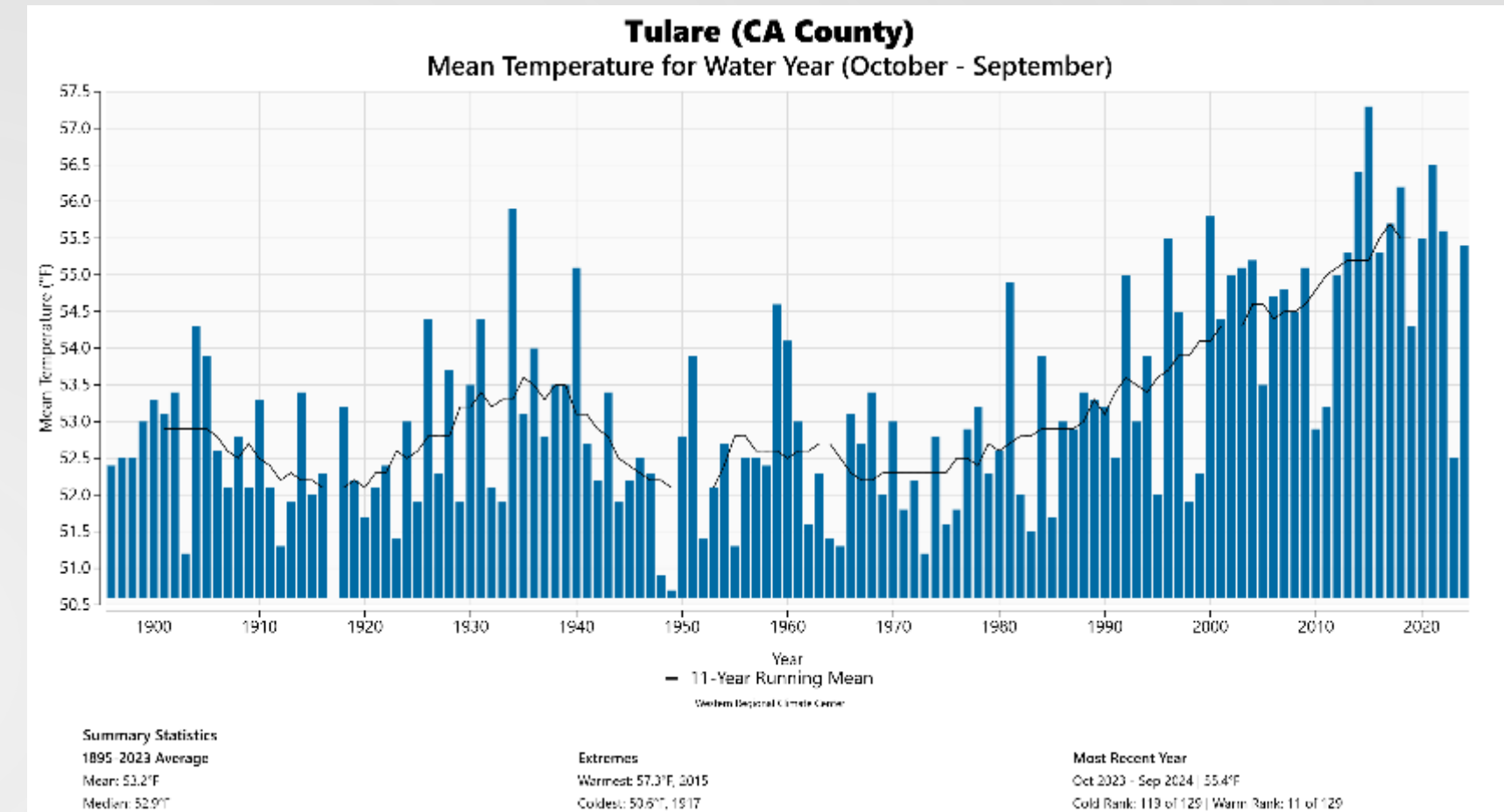
Questions?

- Darren.Bonfantine@water.ca.gov
- Michael.L.Anderson@water.ca.gov
- Romain.Maendly@water.ca.gov

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24 Oct 2021 16:56Z NOAA/NESDIS/STAR GOES-West GEOCOLOR