CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

Overall summary:

- A strong atmospheric river (AR) impacted much of California on 4-6 Feb 2024.
- It was an AR3 in the Santa Barbara base on the Ralph (2019) AR scale.

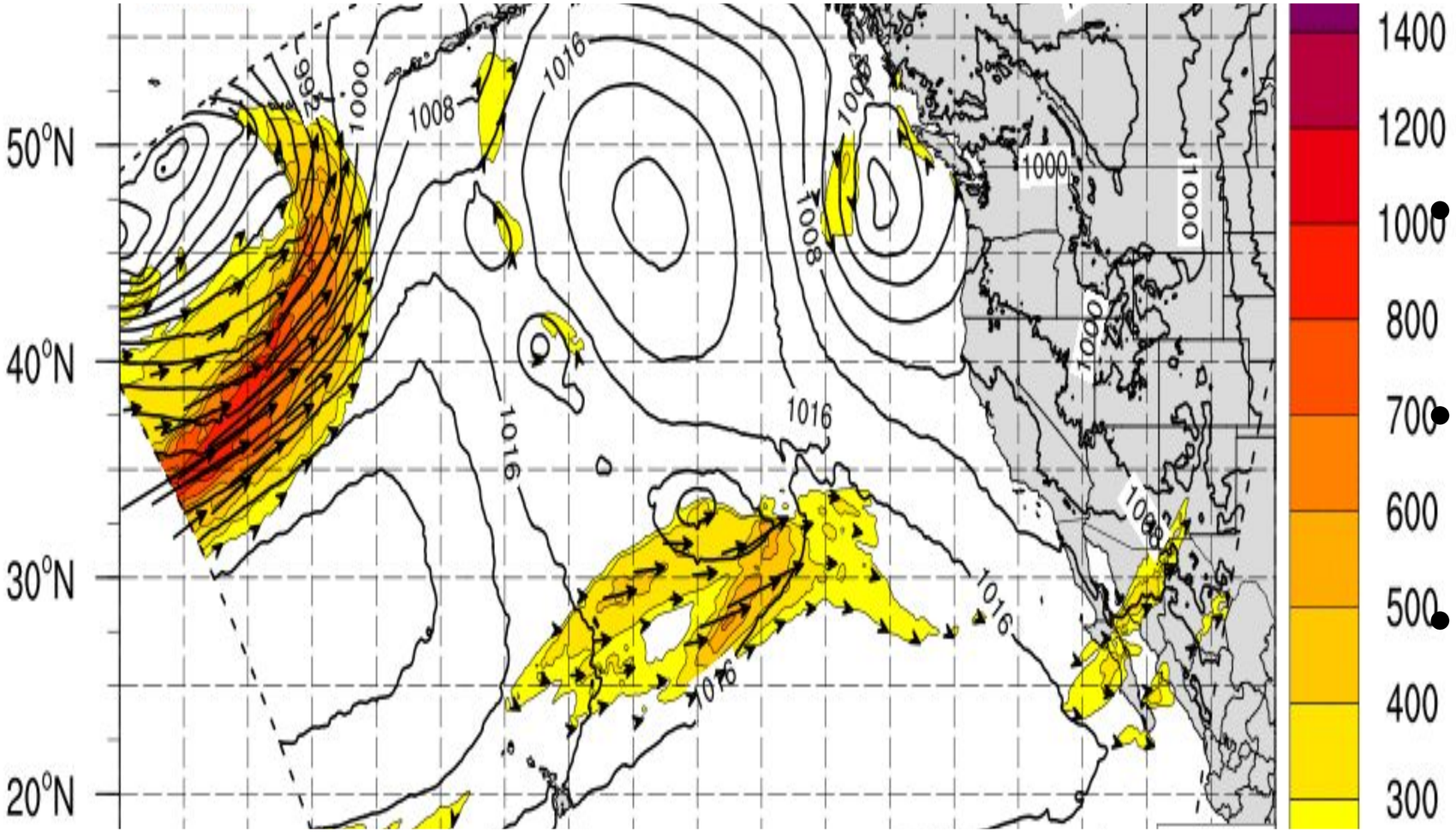
Precipitation impacts:

- Widespread precipitation of 1-5” fell across most of California with 5-10” in the coastal mountains and Los Angeles Basin. Some areas of the San Gabriel Mountains received 10-15” of precipitation.
- Los Angeles recorded one of its wettest multi-day stretches on record.
- Heavy rain resulted in hundreds of mudslides and high flows on area rivers.
- Year-to-date percent of normal snowfall increased by 10-20% across the Sierra Nevada mountains.

Wind and power outages:

- Storm produced widespread winds of 60+ mph across northern California with local peak wind gusts around the San Francisco Bay Area of 80-100 mph.
- Strong winds and wet soils felled hundreds of trees.
- A reported 1.4 million customers were without power at various points across the state.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)



- A low pressure system east of Hawaii drifted east towards California.
- A second low pressure system drifted south along the Washington & Oregon coasts.
- The interaction of these systems caused them both to strengthen.

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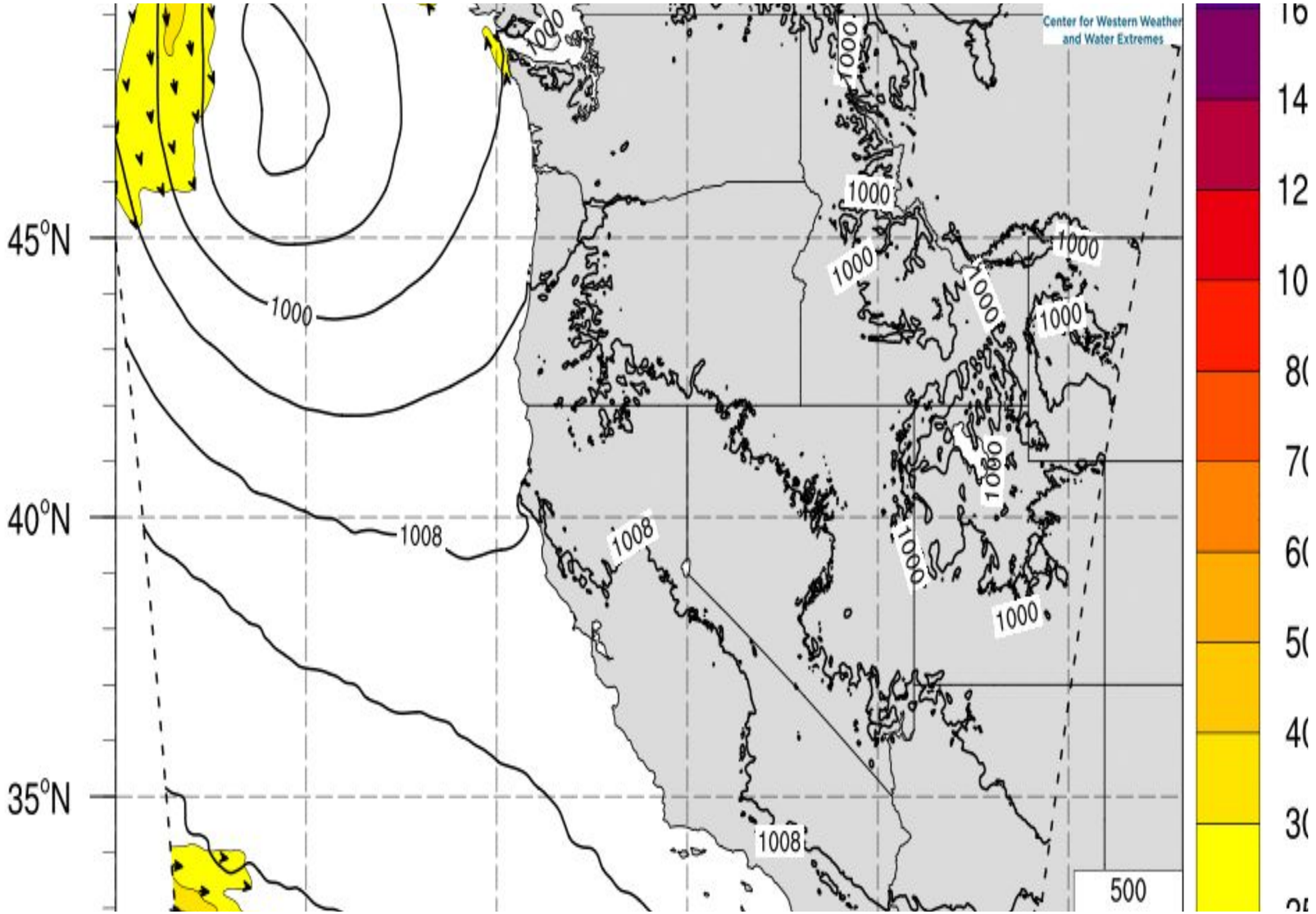

- A strong AR developed along the southern edge of the system(s) as the low pressure approached the coast.
- The AR stalled and retrograded slightly over southern California for several hours before pushing further inland.
- Further north, the associated low-pressure system rapidly intensified as it moved towards northern California.

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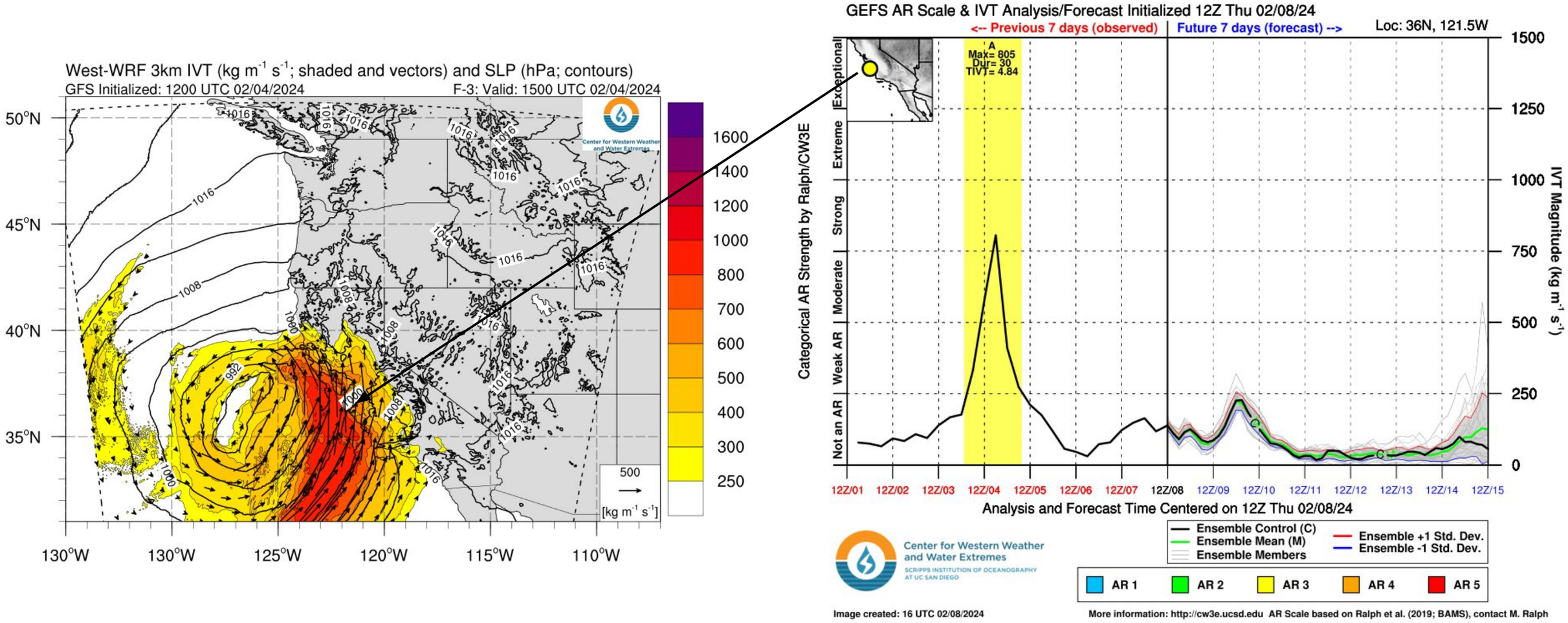

The peak IVT (integrated water vapor transport) value for this storm was ~800 kg/(m/s) which equates to a “strong” AR. At the location of peak intensity, AR conditions persisted for 30 hours. Based on the Ralph et al. (2019) AR Scale, this ranked as an AR3.

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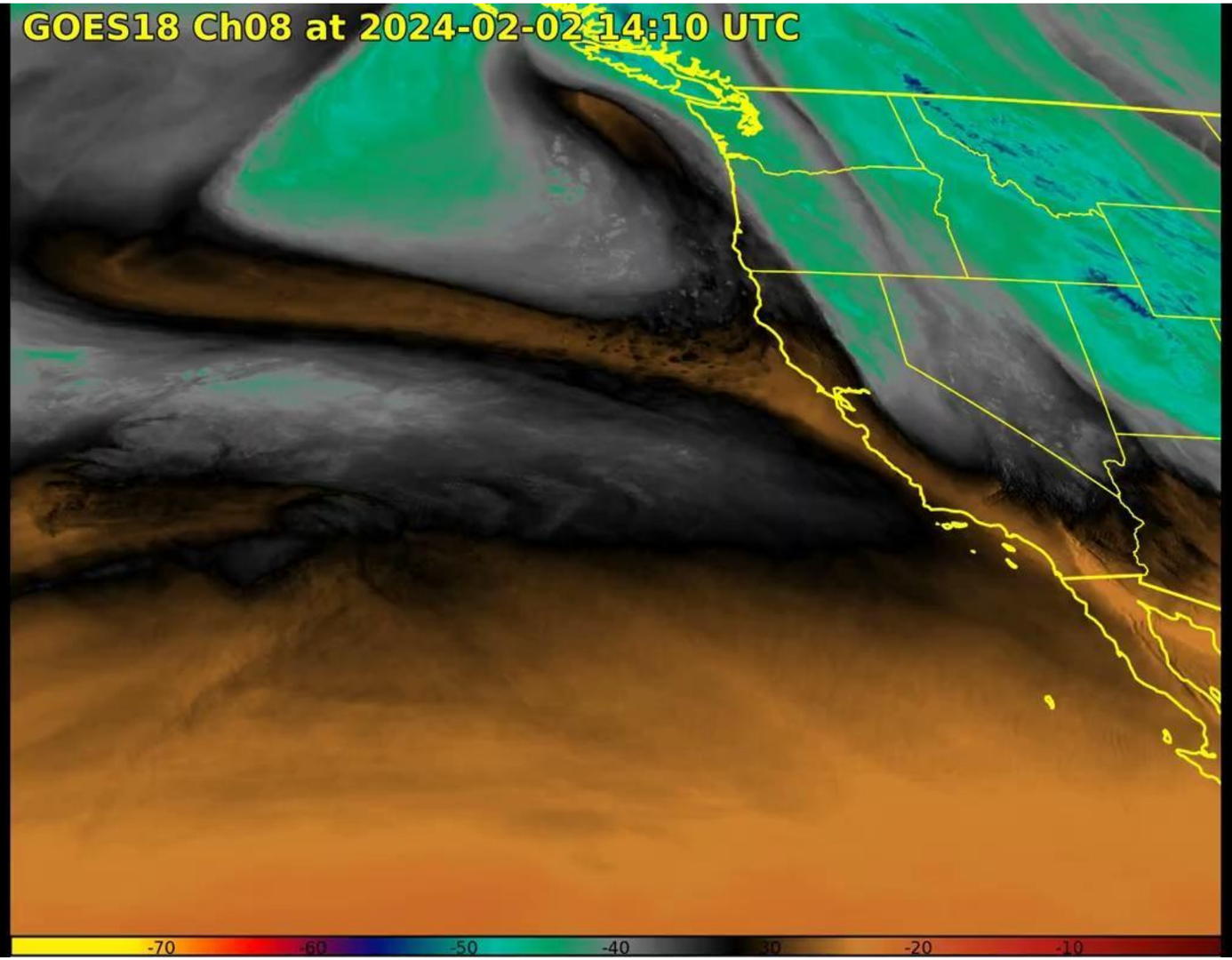
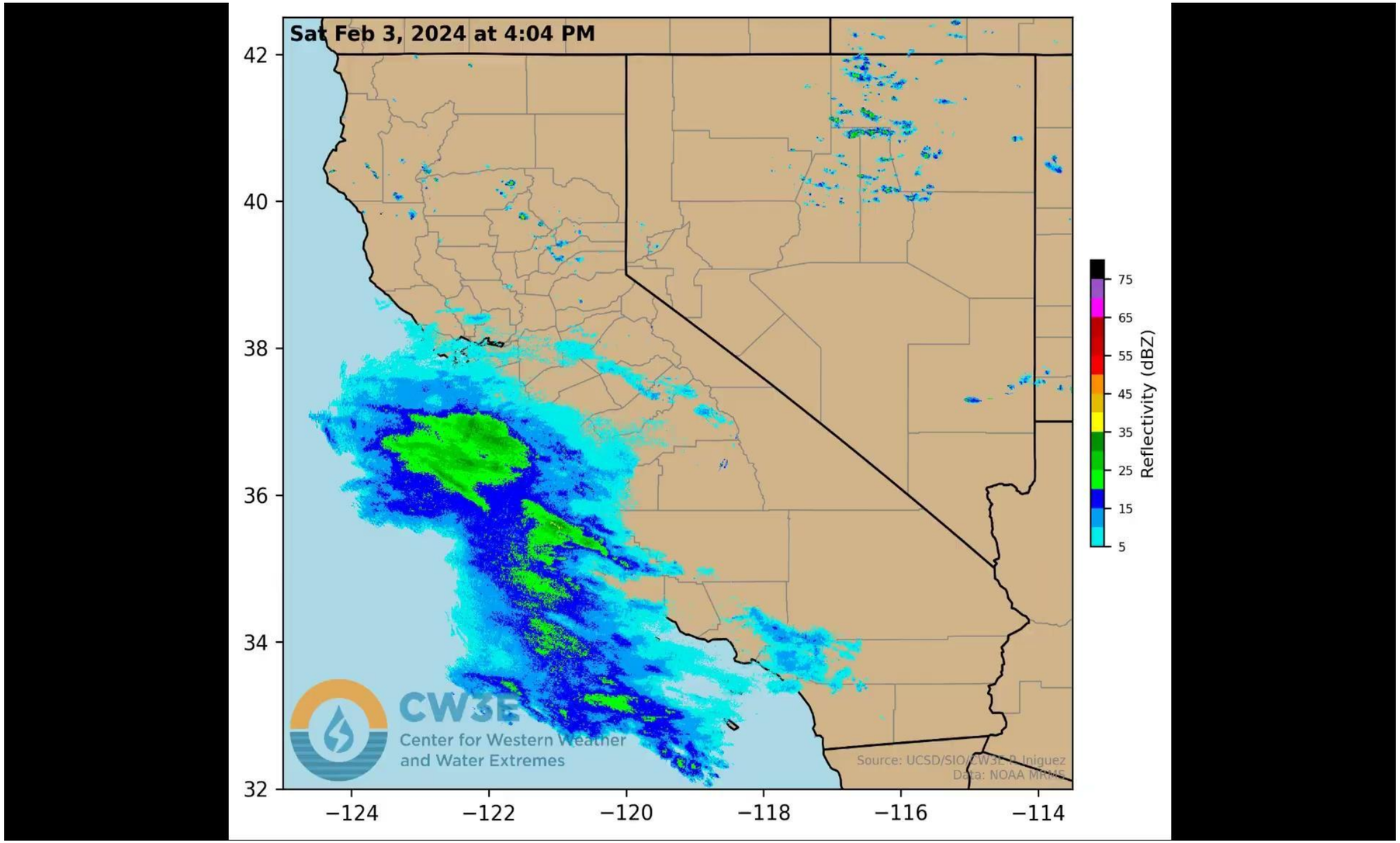


GOES-18 Upper Level Water Vapor (Ch08) depicting the development of the atmospheric river and associated upper level lows and subsequent passage across California.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)



Full event radar loop from 4 PM PST Sat Feb 3, 2024 to 6 AM PST Wed Feb 7, 2024.

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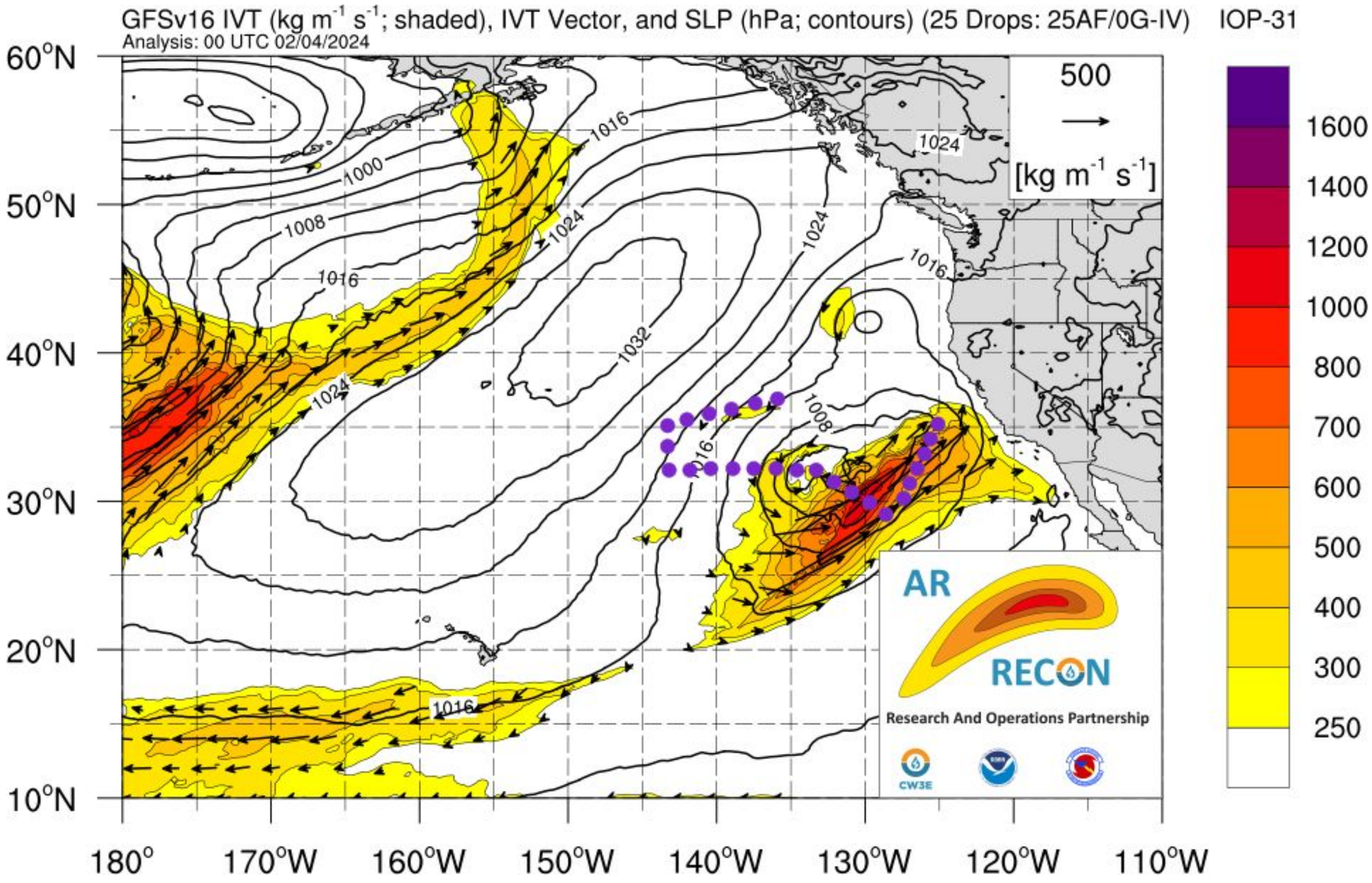
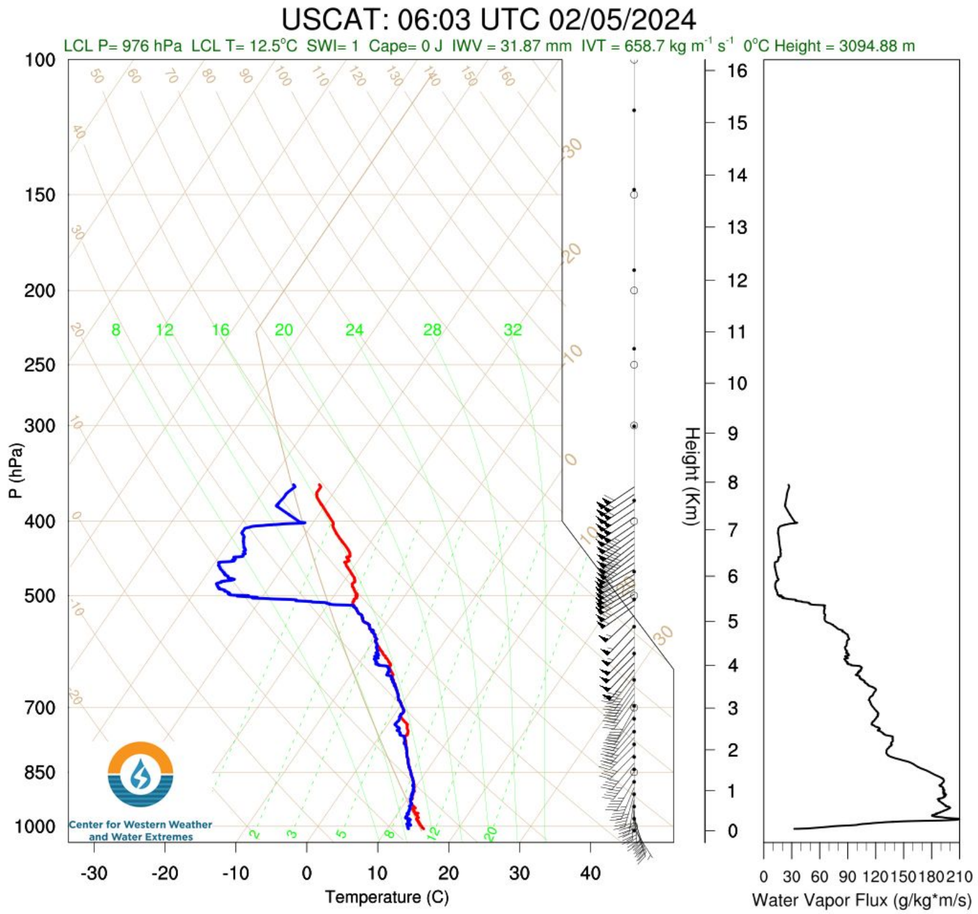
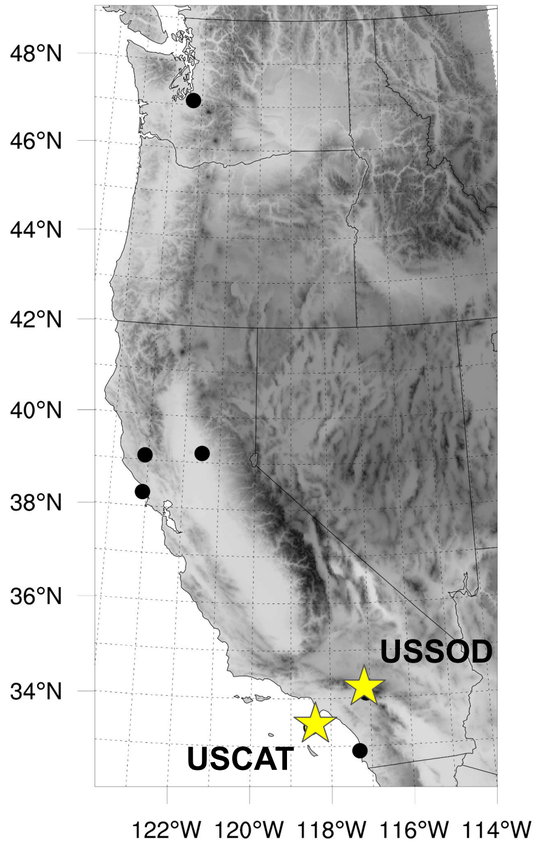


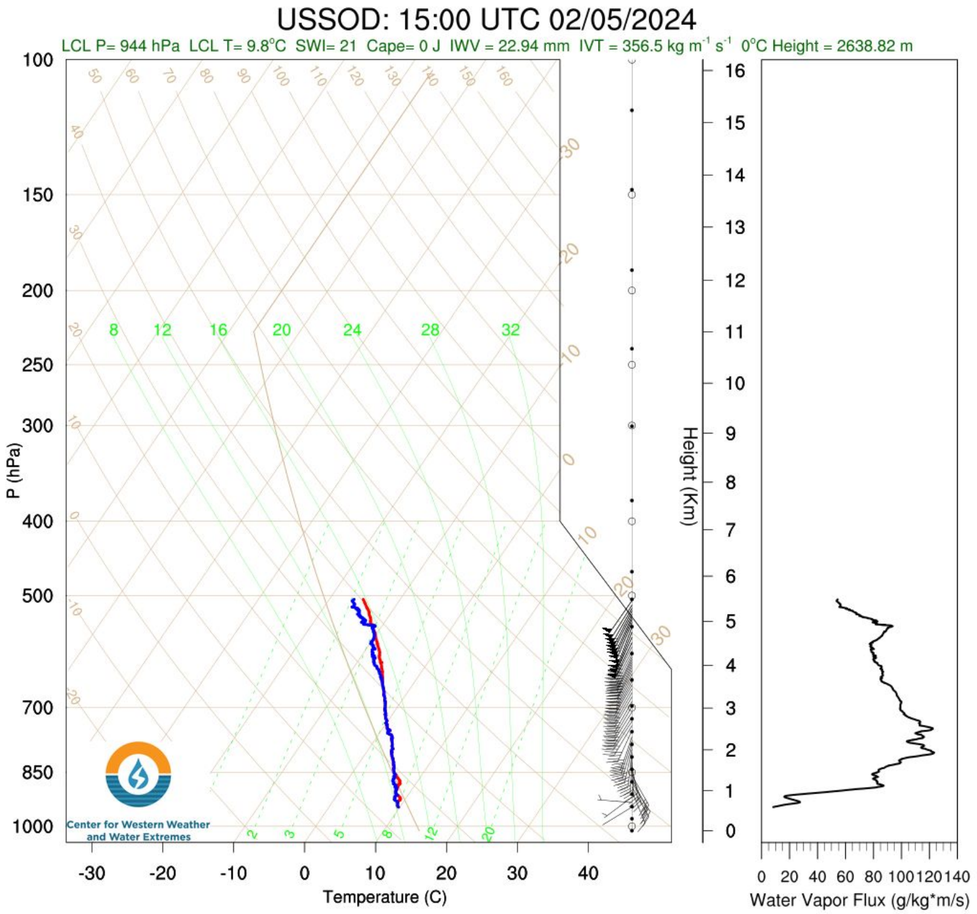
As part of CW3E's AR Recon field campaign, NOAA and the 53rd Weather Reconnaissance Squadron provided support over the Northeast Pacific Ocean.

During Intense Observation Period (IOP) 31, 25 dropsondes were deployed, providing valuable data for global forecast models and future research.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

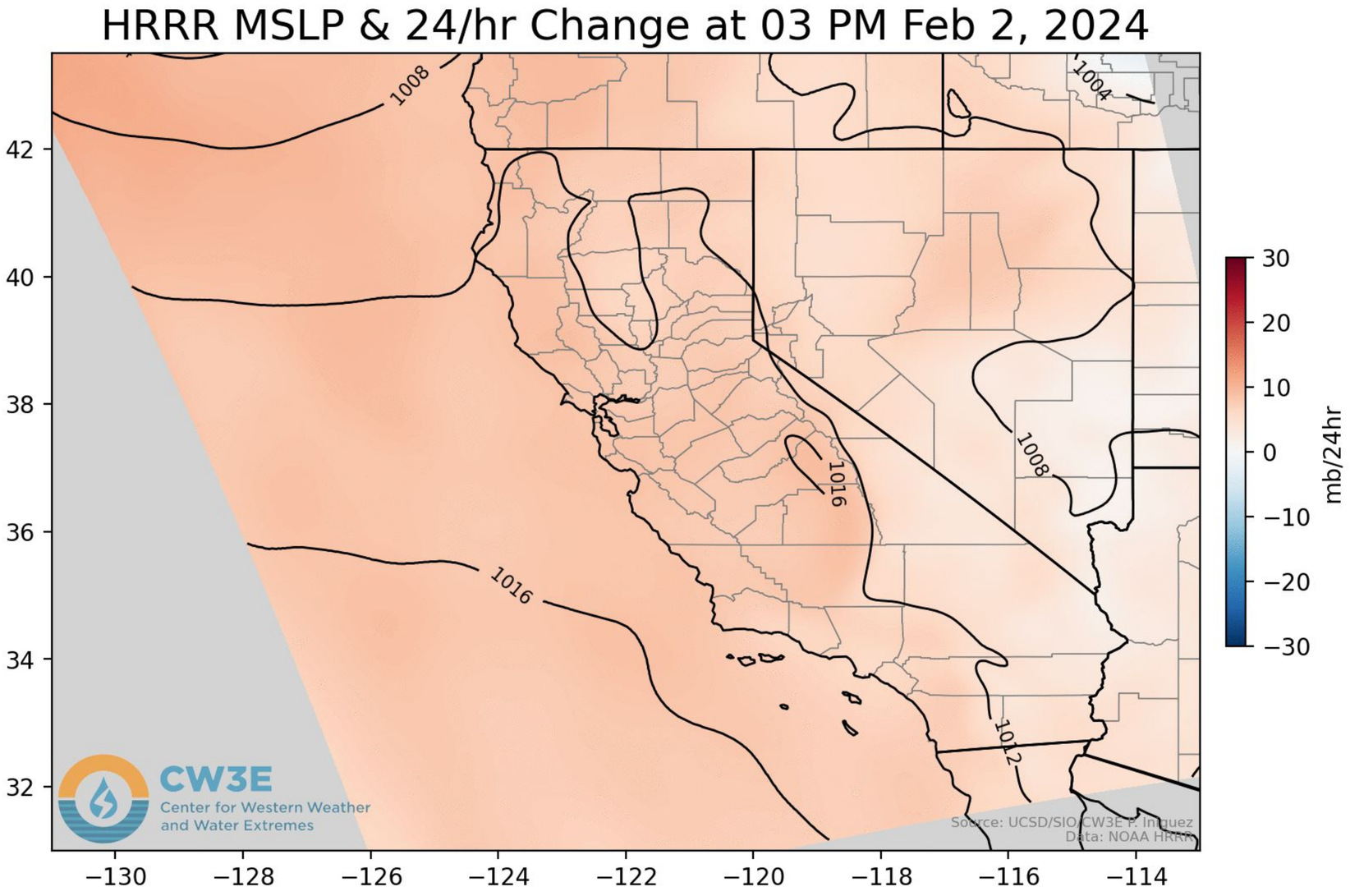






The CW3E Field Team launched 14 radiosondes over 42 hours at Catalina Island, CA (USCAT) and 17 over 51 hours at Seven Oaks Dam, CA (USSOD). IVT peaked at 659 kg m^{-1} s^{-1} at USCAT and 357 kg m^{-1} s^{-1} at USSOD during the event.

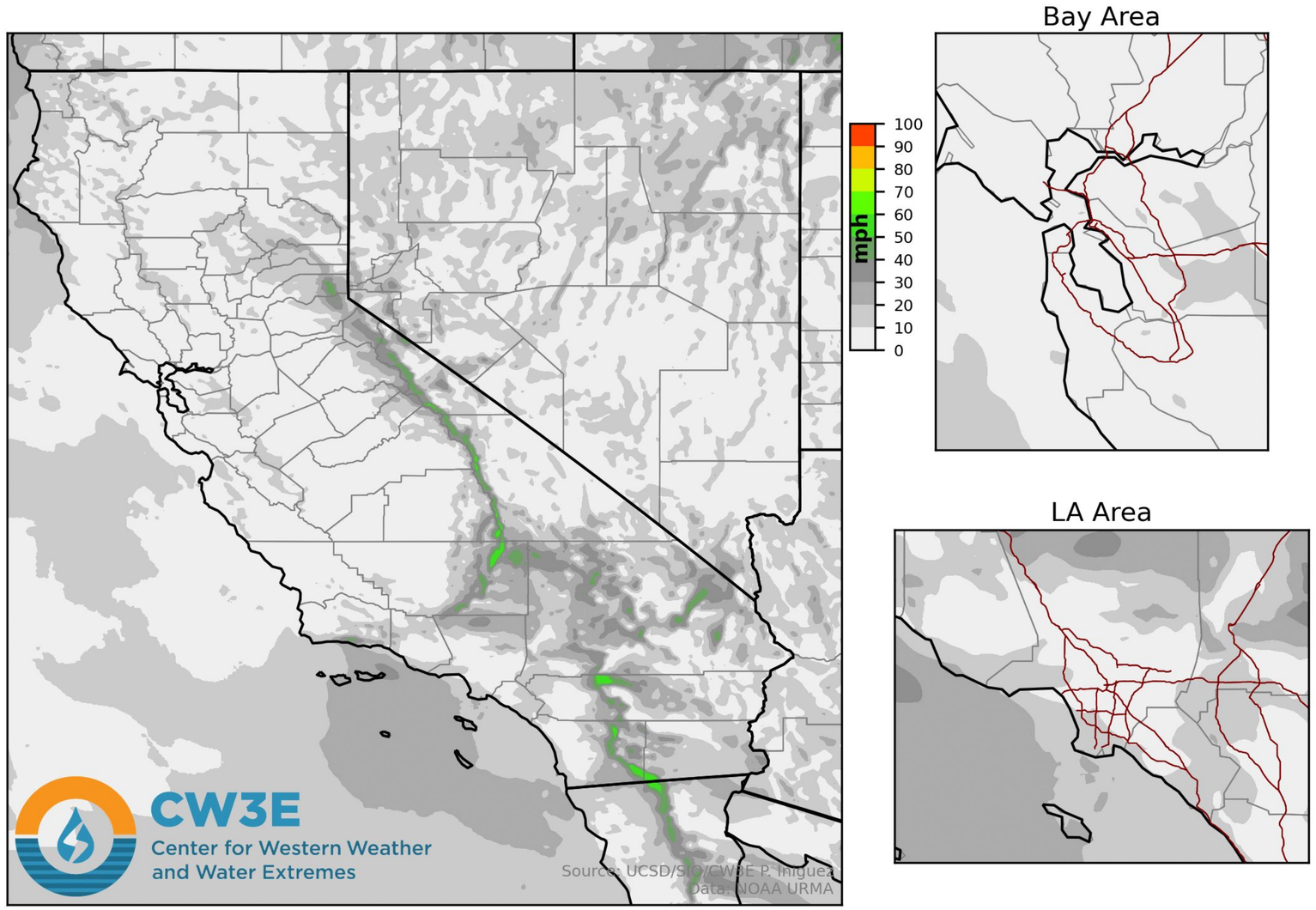
CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)



- A “bomb cyclone” is defined as a drop in pressure of 24 mb in 24 hours, corrected by latitude; results in criteria of 17 mb at 39 °N (Sanders and Gyakum 1980).
- The HRRR analyses (left) illustrate the storm met these criteria with a central pressure drop of 22.7 mb in 24 hours.
- Ukiah, CA recorded its fourth lowest MSLP reading on record (since 1949) with 986.0 mb.
- A bomb cyclone is associated with very strong winds due to the rapid pressure changes.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

Wind Gust Analysis at 12 AM on Feb 3, 2024



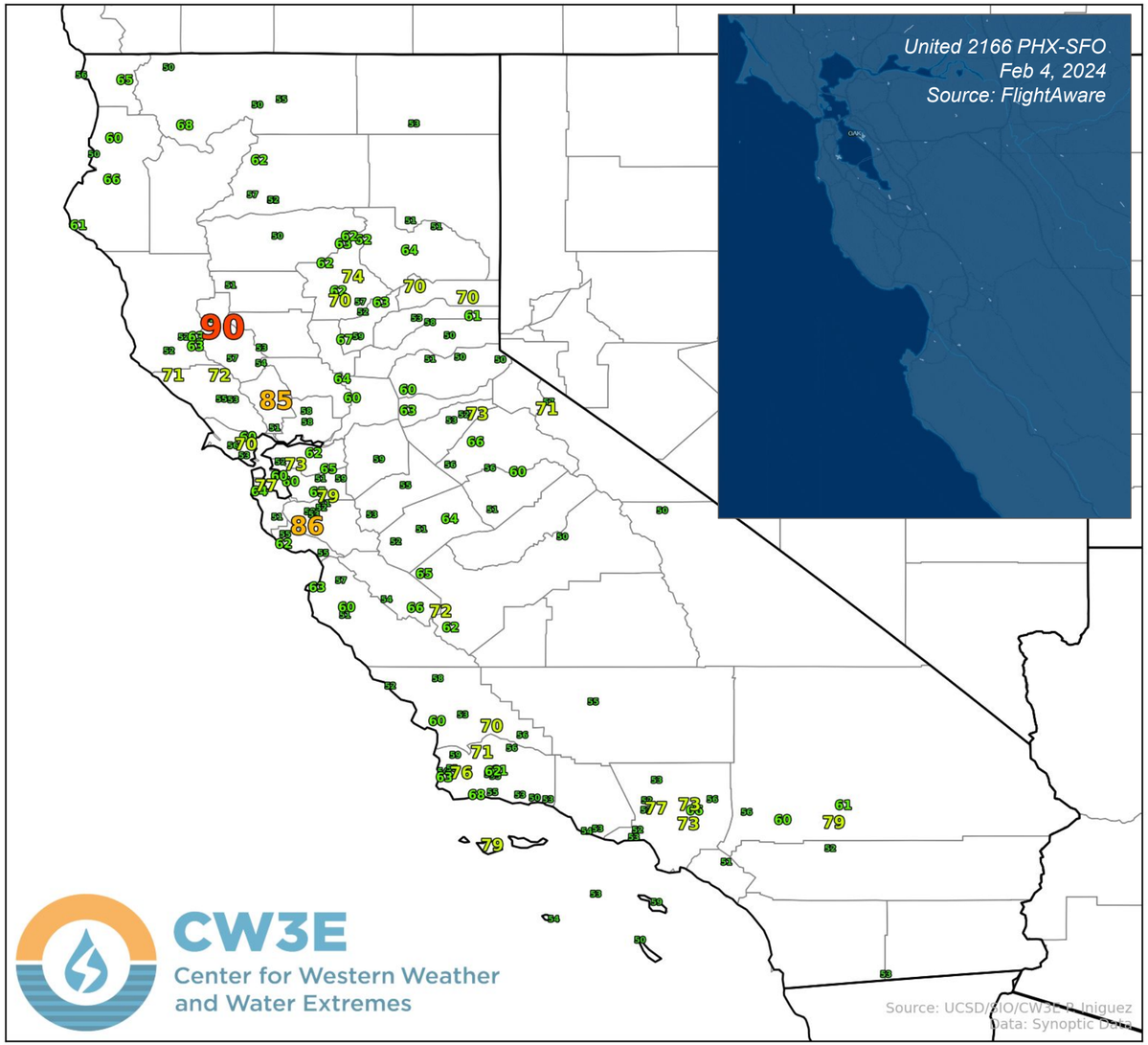
Bay Area

LA Area

- Winds strengthened in response, with many areas observing peak gusts of at least 40 mph.
- The strongest winds impacted the Central Coast and Bay Area, with localized wind gusts over 80 mph.
- Strong downslope winds were also observed on north-facing slopes (e.g. Grapevine).
- The passage of a narrow cold frontal rainband (NFCR) also contributed to high winds.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

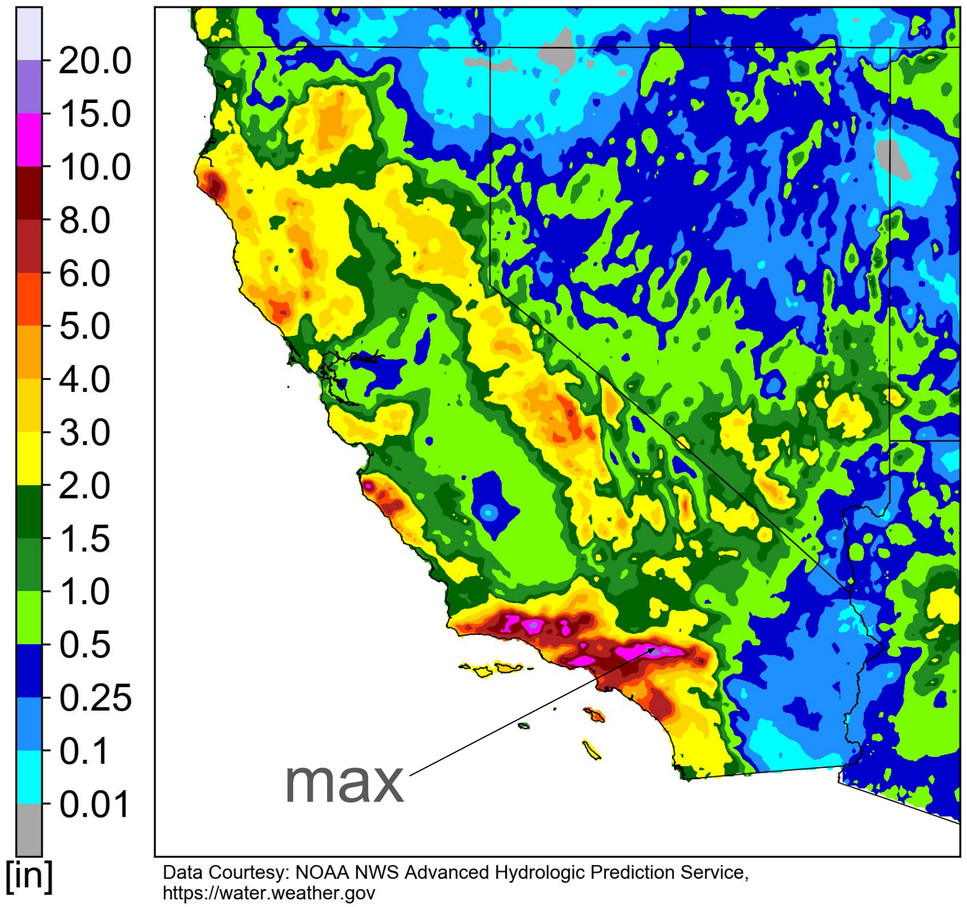
Peak Wind Gusts Feb 3-5 2024



- Numerous weather stations across California measured peak wind gusts in excess of 50 mph [left].
- The strongest winds were near and just north of the Bay Area with gusts of 80-90+ mph.
- Localized wind of 70+ mph were also observed in the San Gabriel Mountains.
- Aviation issues (go-arounds, diversions), including a ground stop at SFO and crosswinds at Mather AFB.

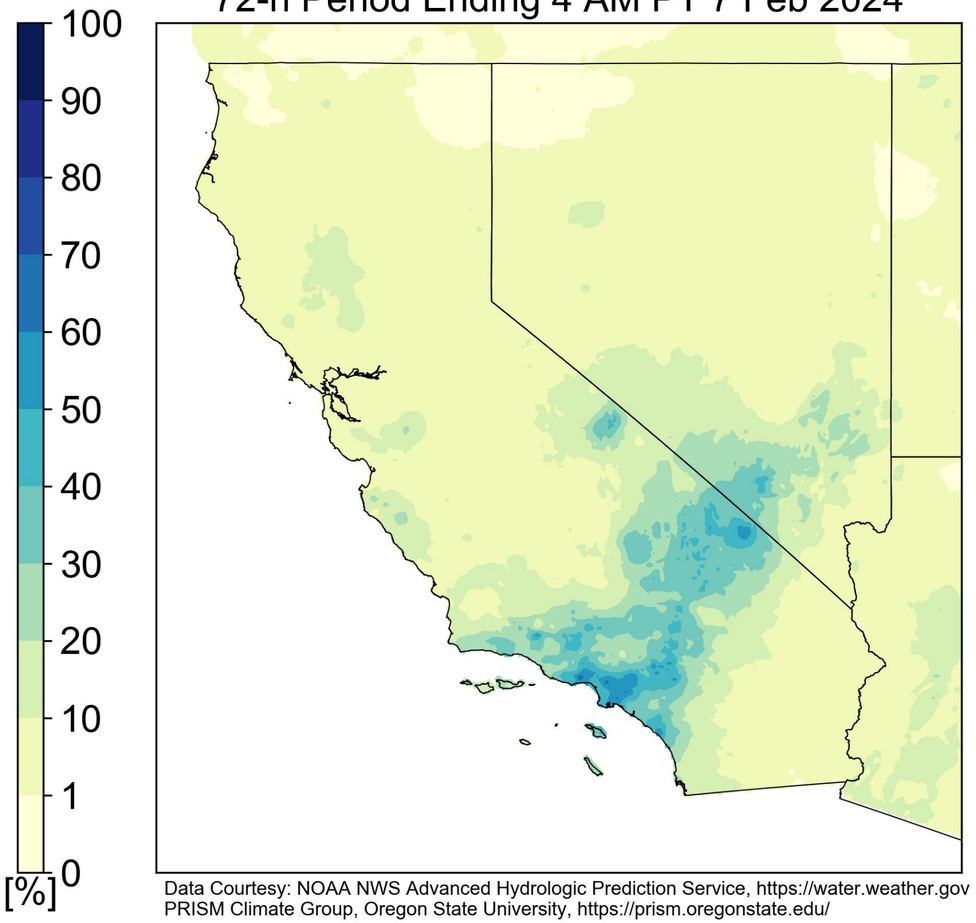
CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

NWS Stage IV 72-h QPE
Valid: 4 AM PT 7 Feb 2024



Data Courtesy: NOAA NWS Advanced Hydrologic Prediction Service, https://water.weather.gov

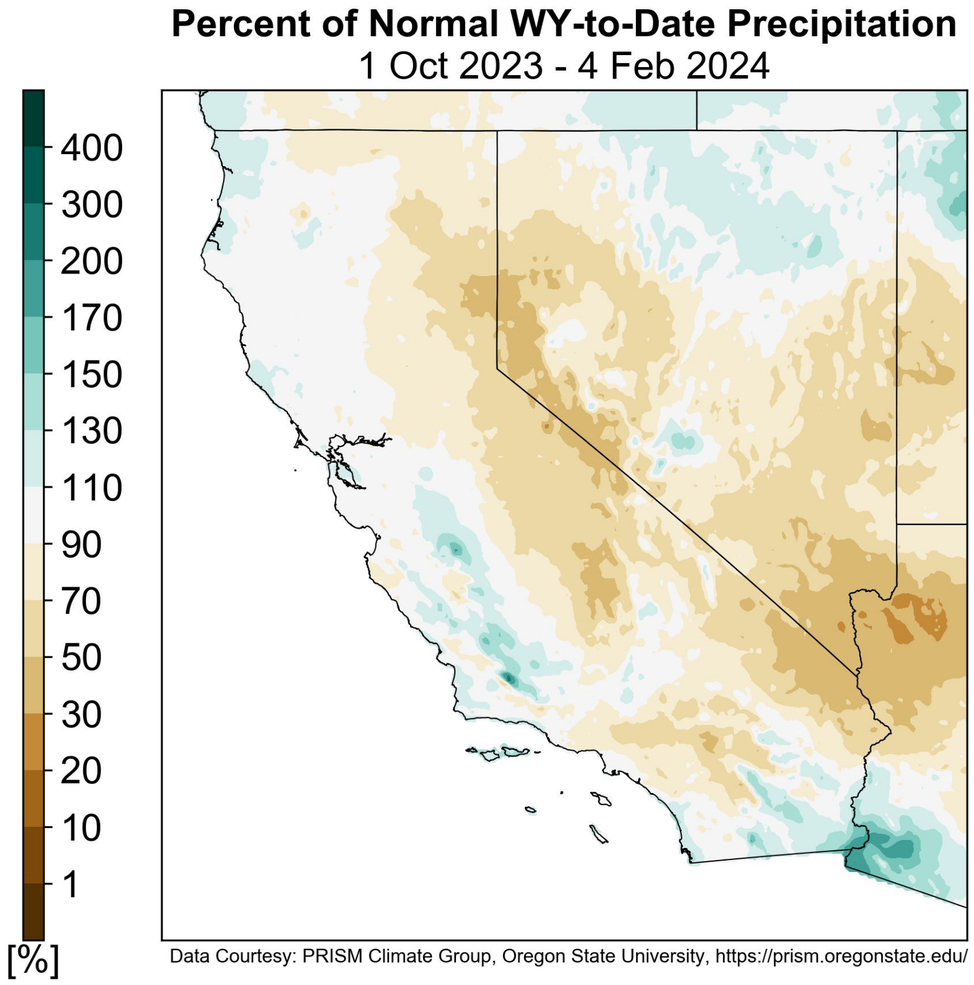
Percent of Normal WY Precipitation
72-h Period Ending 4 AM PT 7 Feb 2024

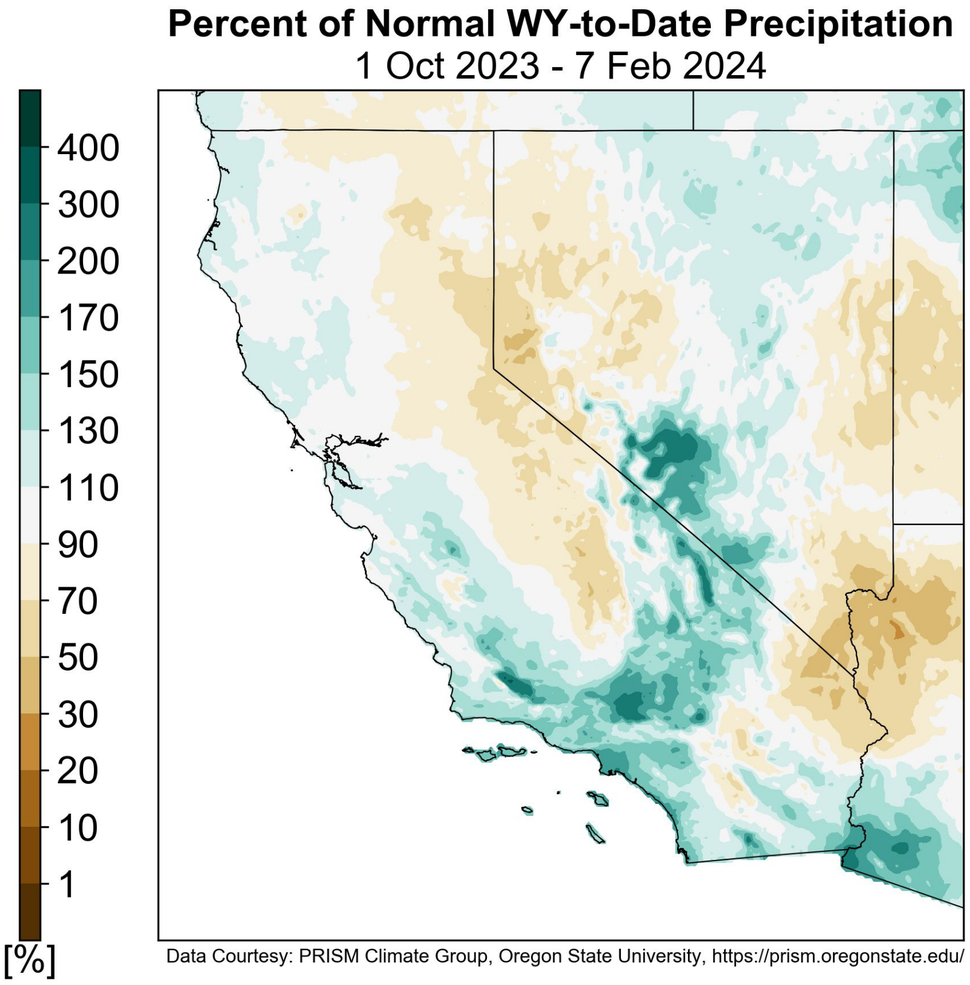


Data Courtesy: NOAA NWS Advanced Hydrologic Prediction Service, https://water.weather.gov
PRISM Climate Group, Oregon State University, https://prism.oregonstate.edu/

Precipitation totals for this event exceeded 0.5” for most of California. Nearly all coastal and mountain areas received 2”+. The heaviest precipitation was in the Transverse Ranges of southern California, where 5-10” was common, with some areas receiving near 12”. Parts of the LA metro area received 40-60% of their annual rainfall.

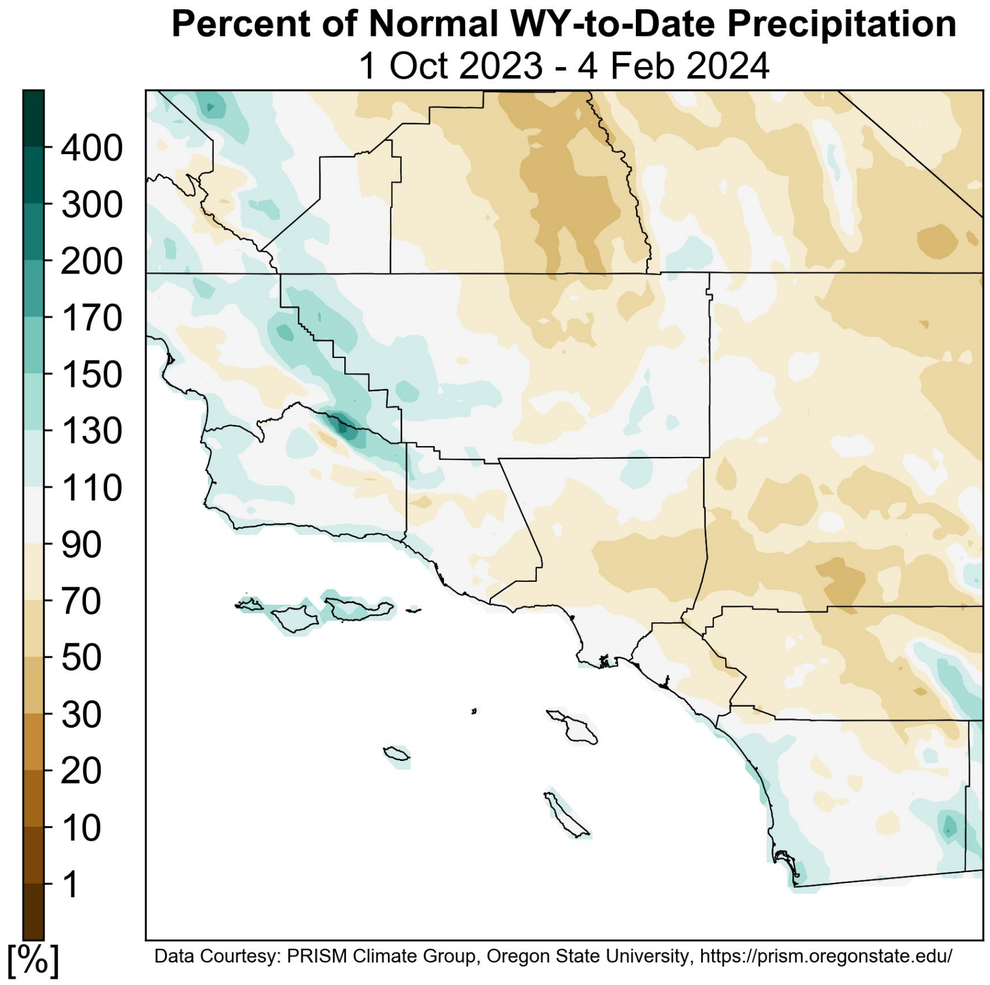
CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

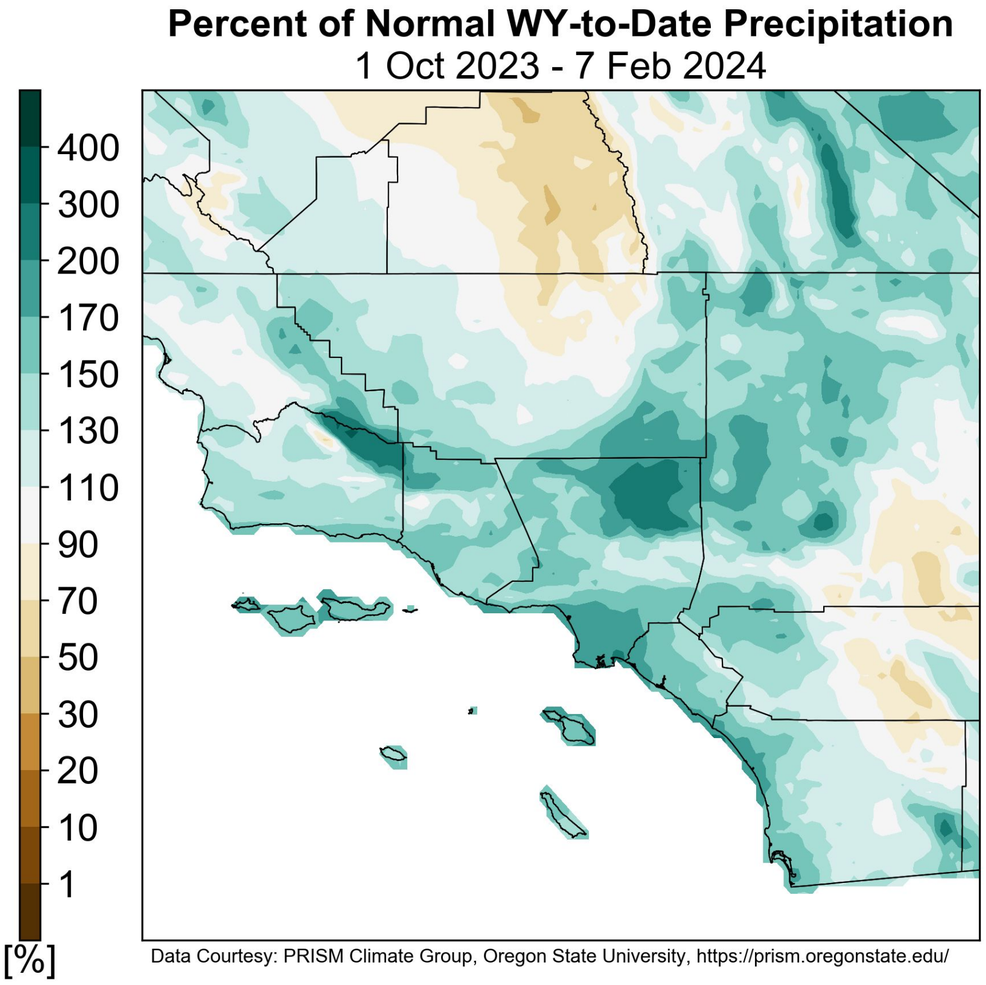




Precipitation for the 2024 water year expressed as a percent of the normal water year-to-date valid Feb. 4 (left) and Feb 7 (right). This storm drastically increased this year's precipitation, especially along coastal southern California and the western half of the Mojave Desert.

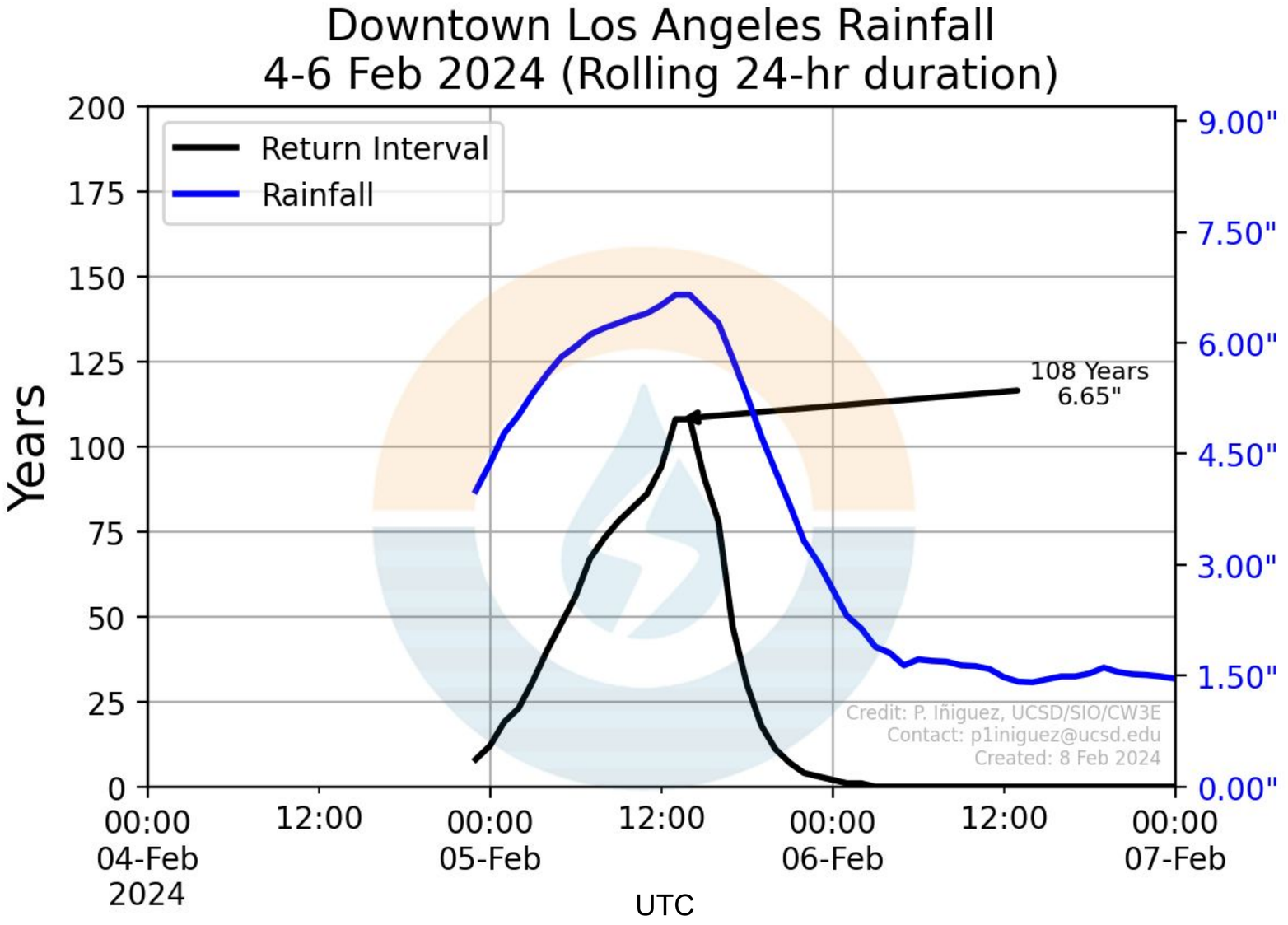
CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)





Precipitation for the 2024 water year expressed as a percent of the normal water year-to-date valid Feb. 4 (left) and Feb 7 (right). This storm drastically increased this year's precipitation, especially along coastal southern California and the western half of the Mojave Desert where values are now well above normal.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)



7.03”

Rainfall in Downtown LA (KCQT) Feb 4-5, 2024.
Second wettest 2-day stretch on record.

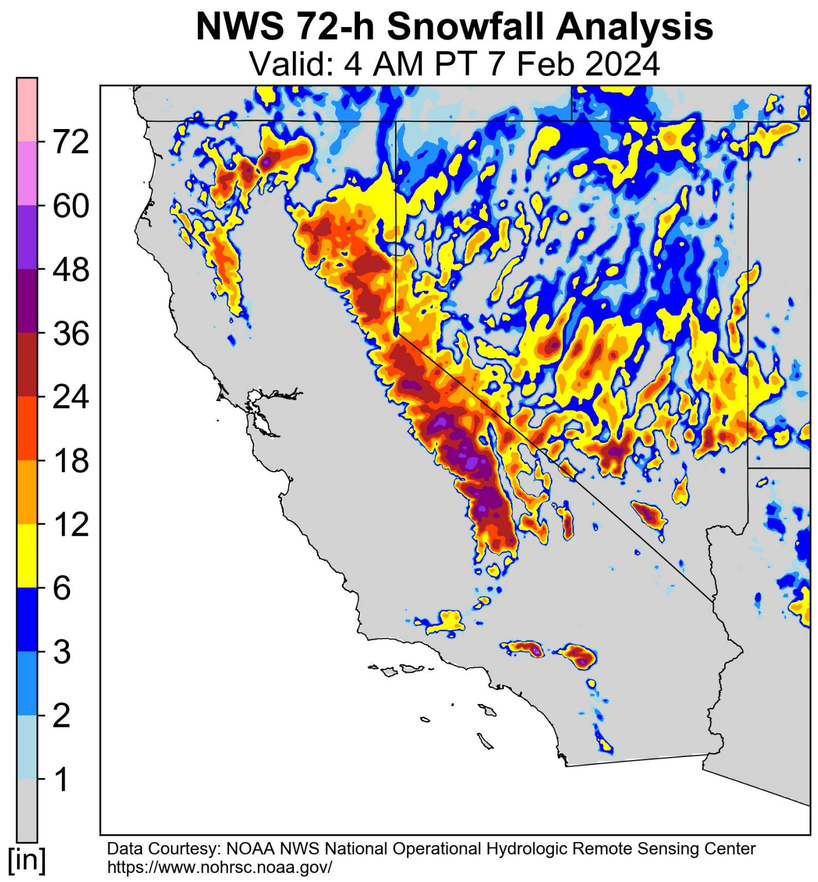
8.51”

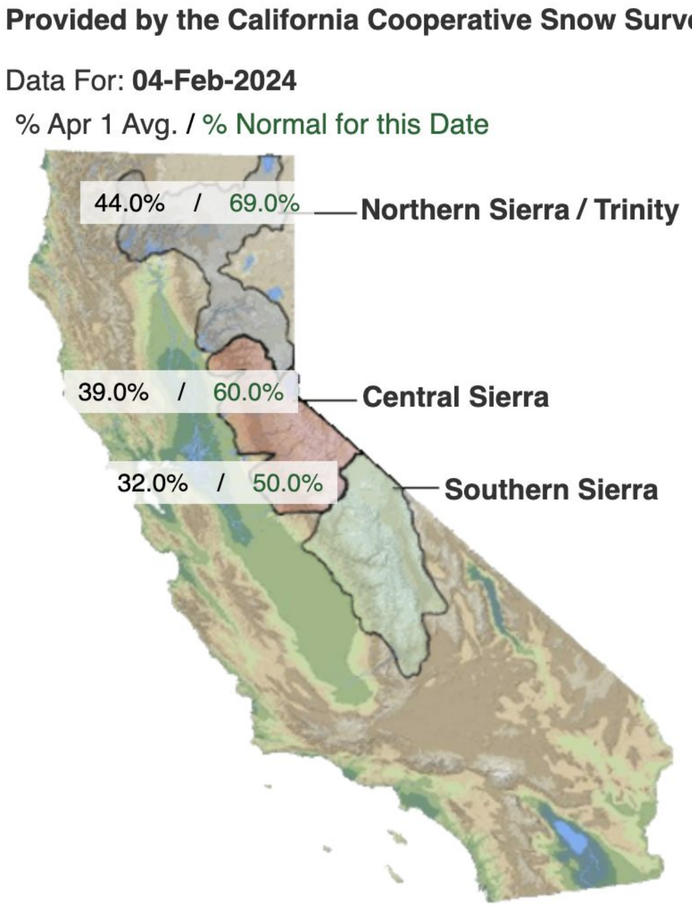
Rainfall in Downtown LA (KCQT) Feb 4-6, 2024.
Second wettest 3-day stretch on record.

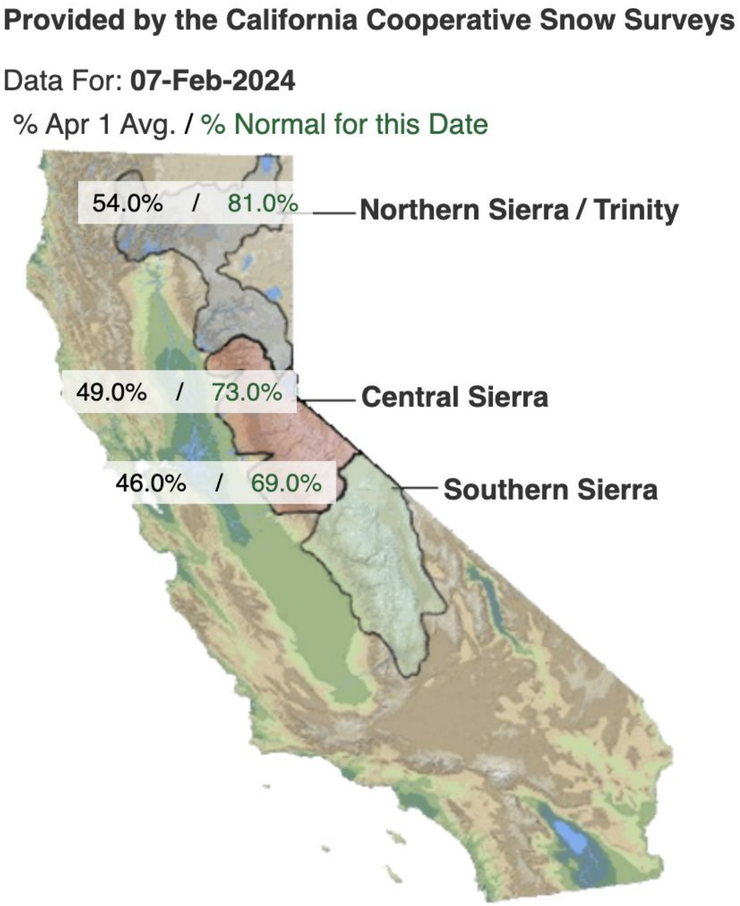
12.42”

Peak 24-hr rainfall at Bel Air, equating to a return interval (annual chance) of 380 years (0.3%).

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)







Significant snow (≥ 24 inches) fell in the Sierra Nevada Mountains, with percent normal snowpack to date increasing 10-20% from this single event.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

Impacts:

- The heavy precipitation and high winds from the storm resulted in impacts across California.
- High winds resulted in trees falling and branches being brought down across the state. There were many instances of power lines being brought down by falling trees and branches, causing power outages.
- Heavy precipitation over a period of days caused already moist soils and higher river stages to be overwhelmed, which brought on debris flows and flooding to many areas.
- Disruptions to air and ground travel were felt state-wide.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

Trees Knocked Over Cause Closure of Highway 1 in Monterey County

Source: Caltrans District 5 on X https://twitter.com/CaltransD5/status/1754229340014068073?s=20

Tree Knocked Over During AR In San Jose

Source: Noah Berger, AP Photo, https://weather.com/photos/news/2024-02-04-california-flood-images-slideshow

Hundreds of trees were felled across the state due to the high winds and saturated soils. There were many instances of trees landing on buildings and cars, the latter unfortunately resulting in four deaths.

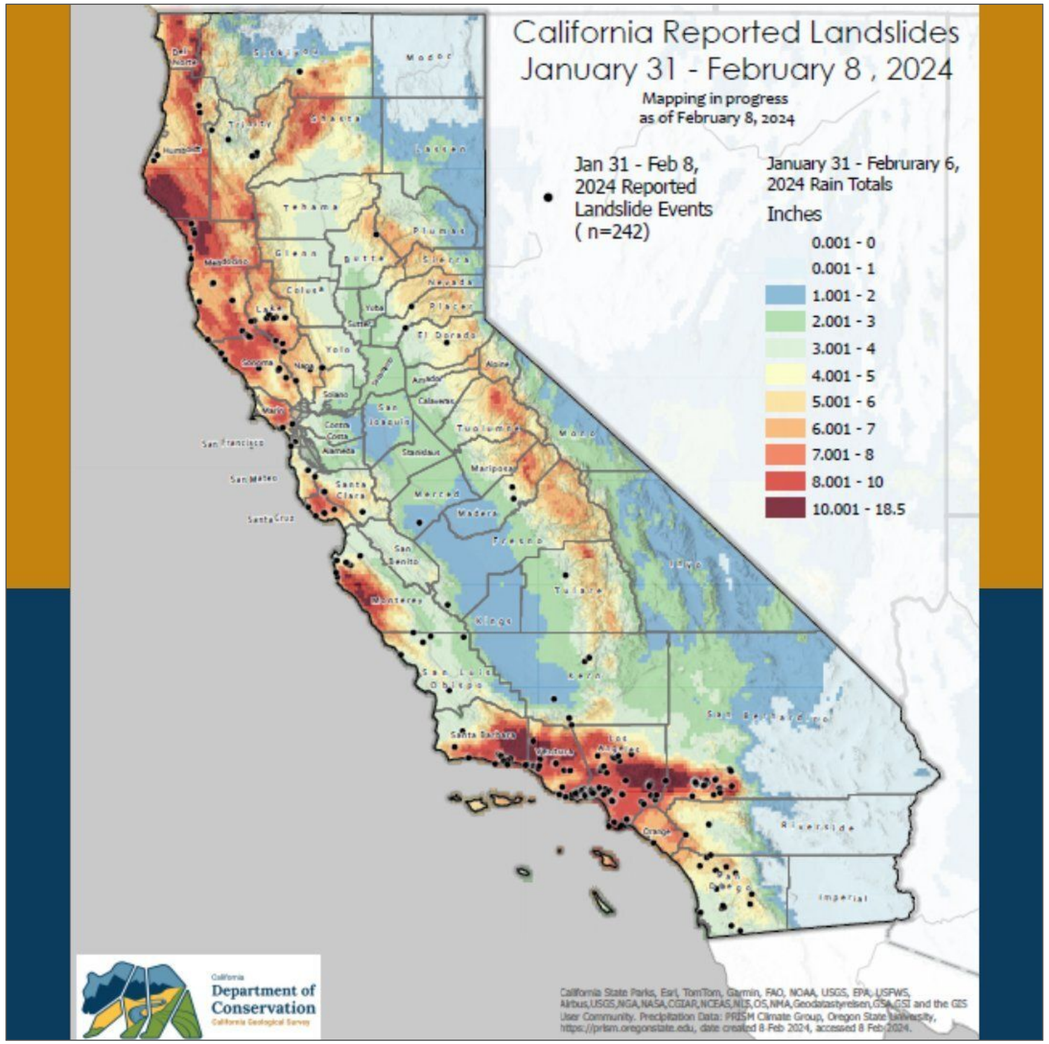
CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

Landslide Destroys Home in Los Angeles

Source: AFP via Getty Images
https://www.msn.com/en-gb/news/other/california-flooding-in-pictures-as-1-in-1000-year-storm-wreaks-havoc/ar-BB1hSgV7

Landslide and Fallen Trees Lead to Road Closure and Fallen Power Lines

Source: CHP Santa Cruz on X,
https://twitter.com/CHPscrz/status/1754537815734706532?s=20

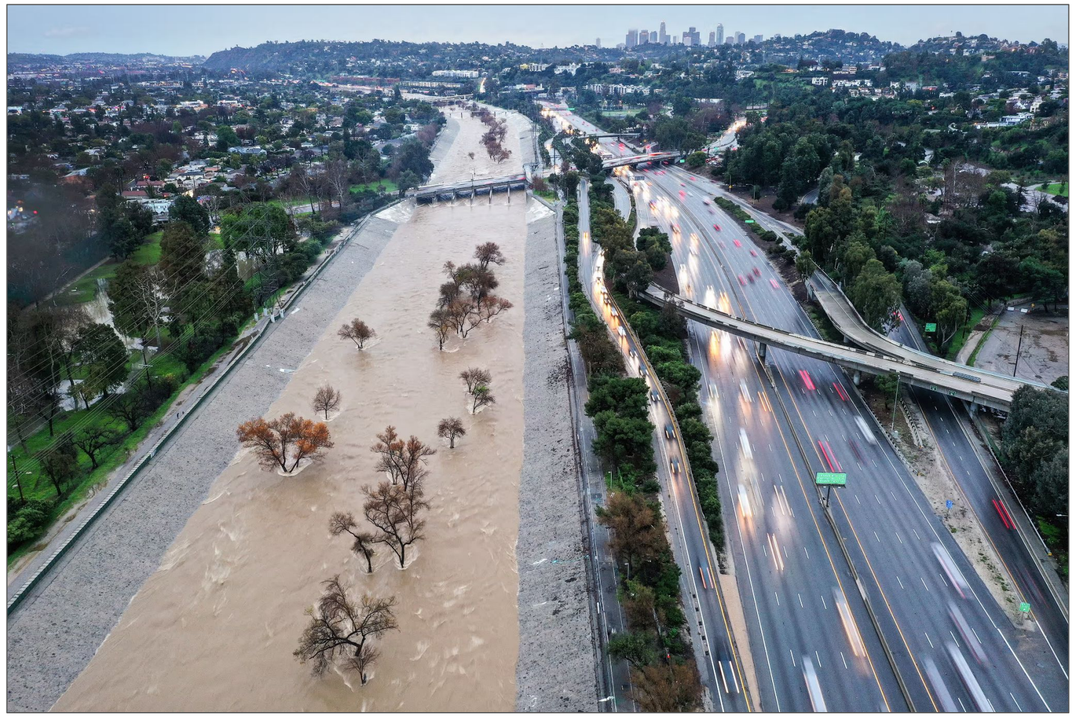


During recent storms (Jan 31 - Feb 8), 242 landslides (black dots) were reported to the CA Department of Conservation.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

Street Flooding in Santa Barbara

Source: Ethan Swope, AP Photos: https://weather.com/photos/news/2024-02-04-california-flood-images-slideshow



High Flow through the Los Angeles River

Source: The Guardian
https://www.theguardian.com/us-news/2024/feb/06/los-angeles-river-pictures-rain-storms-flooding

Widespread flooding occurred across southern California as rain overwhelmed drainage systems. Area rivers swelled with runoff, resulting in historically high flows.

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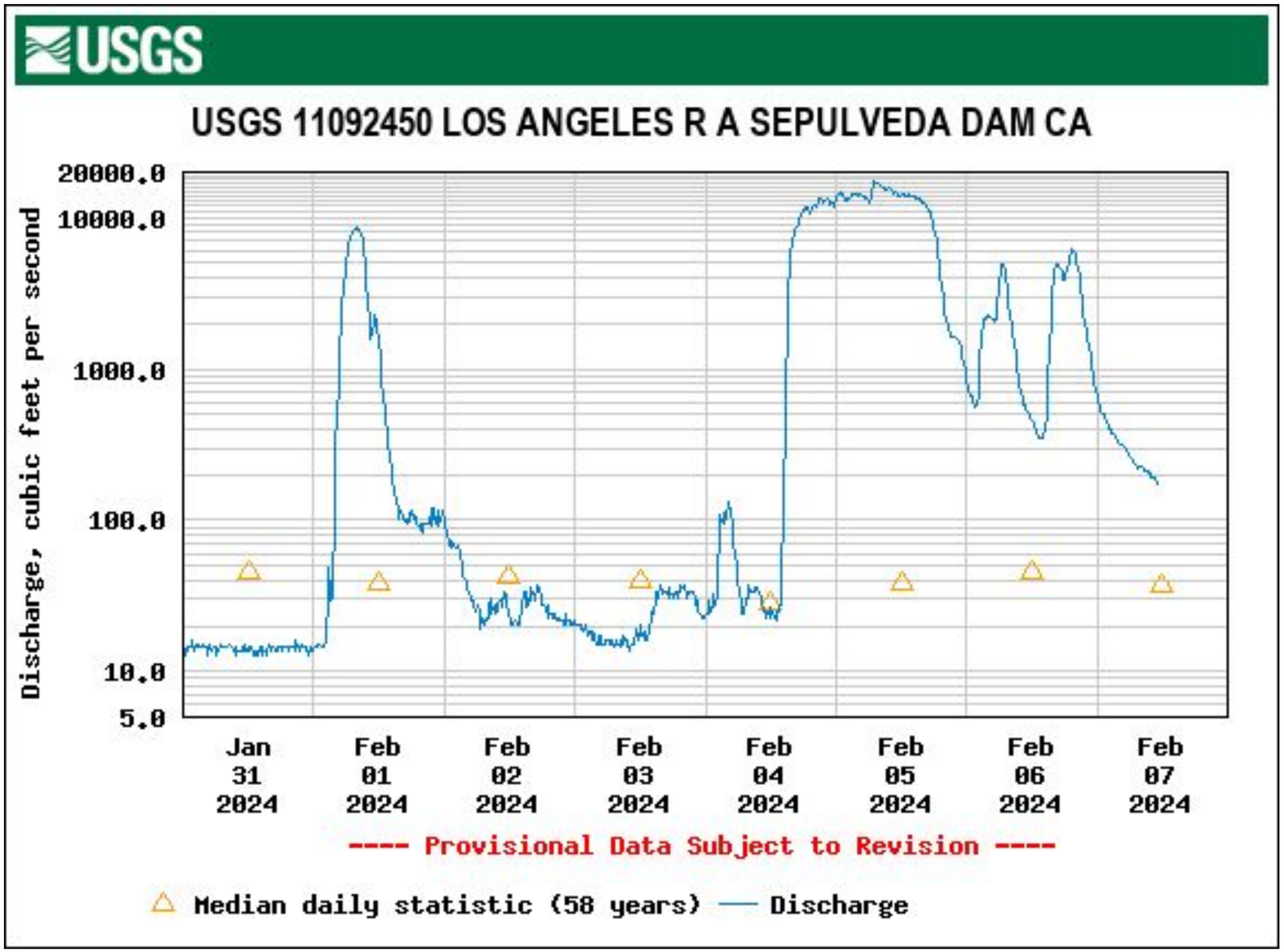


- The Los Angeles River near Sepulveda Dam reached a peak discharge of 17,300 cfs.
- Preliminary data indicate this is the second highest flow on record (since 1930).

Street view of the Los Angele River approaching Sepulveda Blvd. Source: Google Maps

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

State Route 4 Closure Due to Heavy Snow

Source: Caltrans District 10 on X: https://twitter.com/CaltransDist10/status/1754218853314486724?s=20

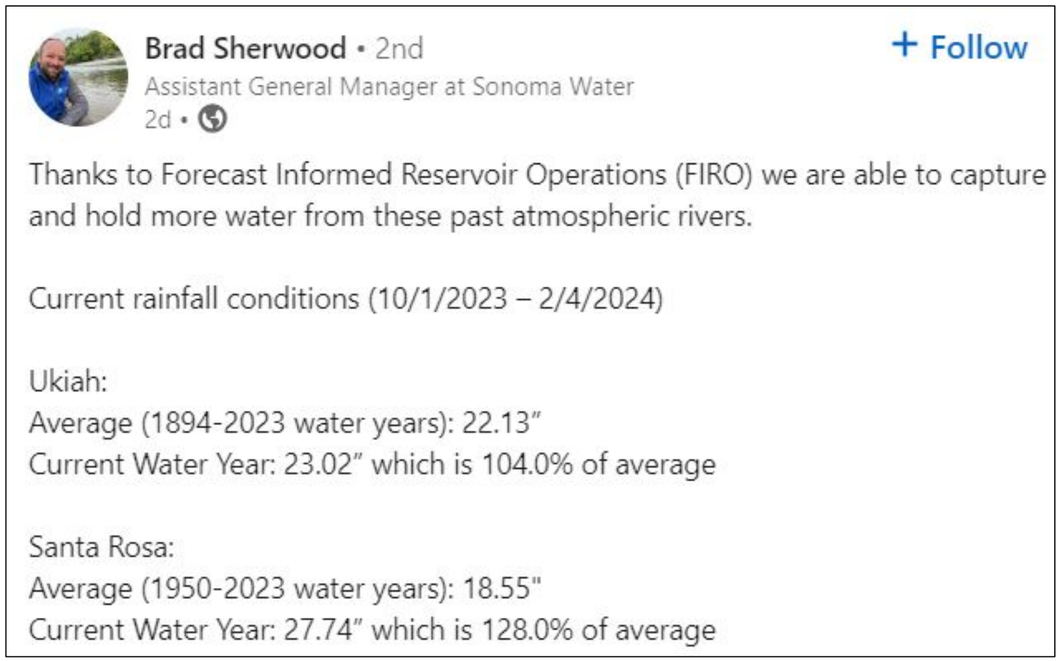
UC Berkeley's Central Sierra Snow Laboratory

Source: UC Berkeley Central Sierra Snow Laboratory on X: https://twitter.com/UCB_CSSL/status/1754904770161373353

Significant snow fell across the Sierra Nevada Mountains and Transverse Ranges, causing notable disruptions to travel.

CW3E Analysis: Major CA Winter Storm CA (4-6 Feb 2024)

In a recent LinkedIn post, Brad Sherwood of Sonoma Water highlighted the benefits of Forecast Informed Reservoir Operations (FIRO) which allowed water resources operators to hold additional precipitation from these ARs in their reservoir



Brad Sherwood • 2nd
Assistant General Manager at Sonoma Water
2d •

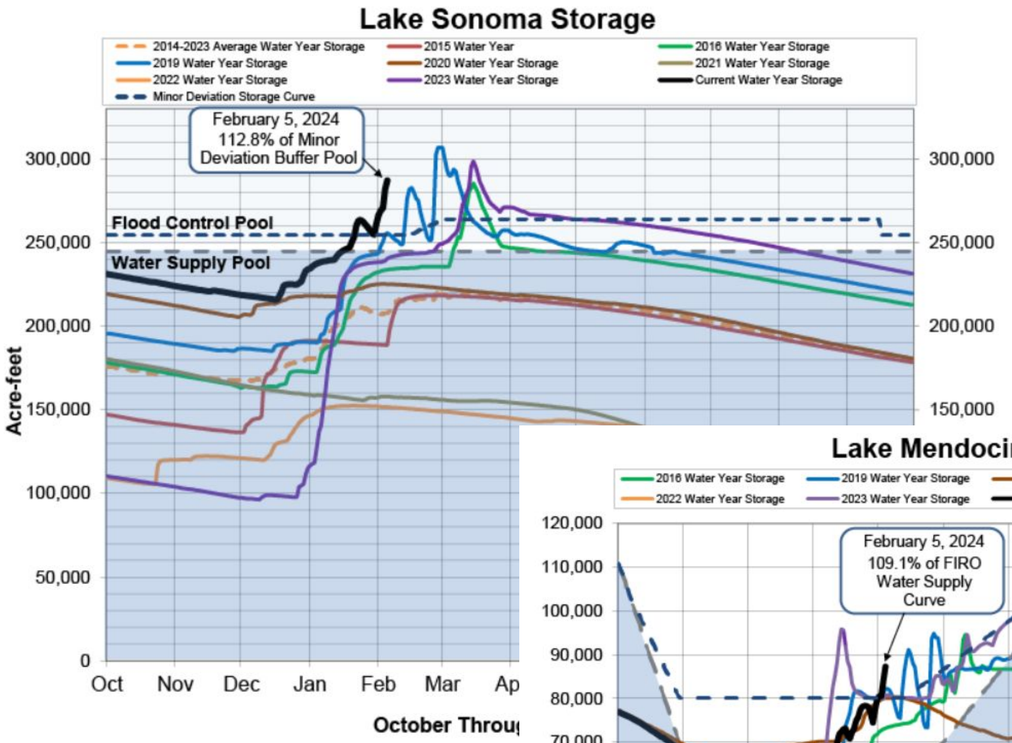
+ Follow

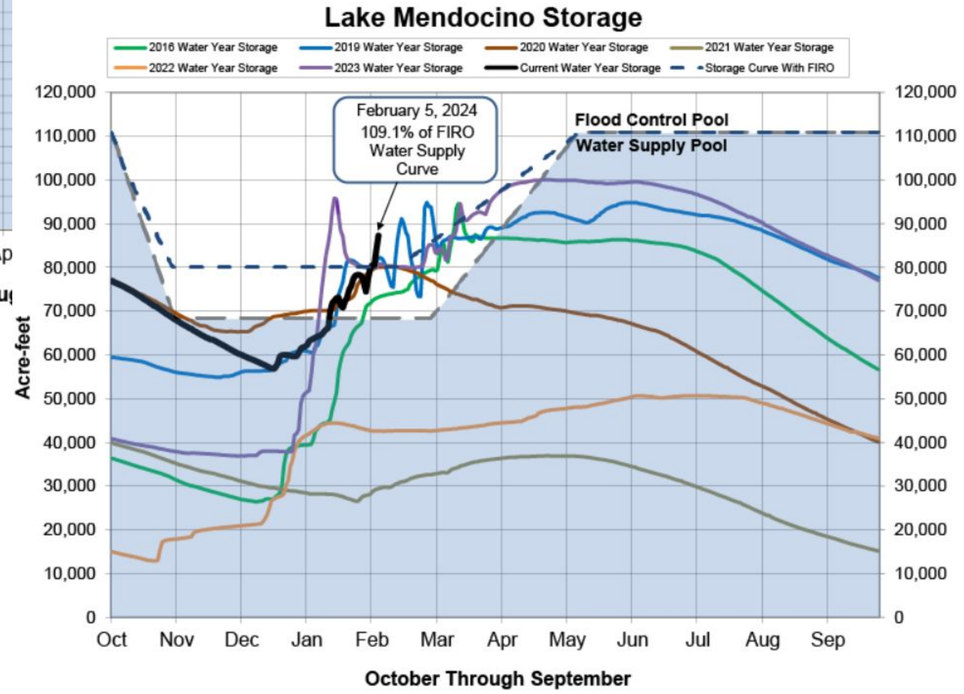
Thanks to Forecast Informed Reservoir Operations (FIRO) we are able to capture and hold more water from these past atmospheric rivers.

Current rainfall conditions (10/1/2023 – 2/4/2024)

Ukiah:
Average (1894-2023 water years): 22.13"
Current Water Year: 23.02" which is 104.0% of average

Santa Rosa:
Average (1950-2023 water years): 18.55"
Current Water Year: 27.74" which is 128.0% of average





FIRO has allowed both Lake Sonoma and Lake Mendocino to store additional water during the winter months

https://www.sonomawater.org/current-water-supply-levels