

CW3E Event Summary: 18–20 February 2024

Low-Pressure System and Atmospheric River Produce Heavy Rain and Snow in CA

- An atmospheric river (AR) associated with a slow-moving area of low pressure brought widespread precipitation to California during 18–20 Feb.

The AR:

- A deepening mid-level trough off the US West Coast interacted with a remnant plume of subtropical moisture, leading to an AR landfall over California on 18 Feb.
- AR1–2 conditions (based on the Ralph et al. 2019 AR Scale) were observed in coastal Northern and Central California.
- As the eastward progression of the trough stalled and the synoptic-scale flow became more southerly, the AR briefly re-intensified over Southern California, prolonging precipitation over the Transverse Ranges.

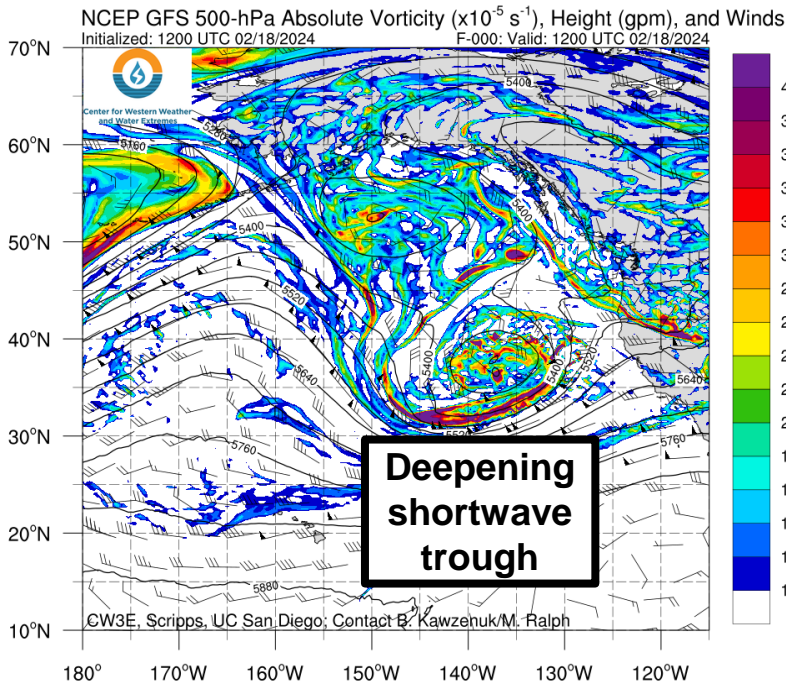
Impacts:

- The heaviest precipitation occurred in the western Transverse Ranges, with more than 10 inches in some locations.
- At least 1–3 feet of snow fell in the Sierra Nevada, with higher amounts in the vicinity of Lassen Peak.
- Heavy rain falling on moist soils caused minor riverine flooding in the Sacramento Valley.
- Flooding and mudslides closed portions of US-101, SR-1, SR-33, and SR-150 in Ventura and Los Angeles Counties.
- Portions of coastal Southern California have received more than 75% of their normal total annual precipitation during the first 3 weeks of February.
- Unusually cool and wet conditions during the month of February have facilitated a dramatic improvement in snowpack conditions throughout the state.

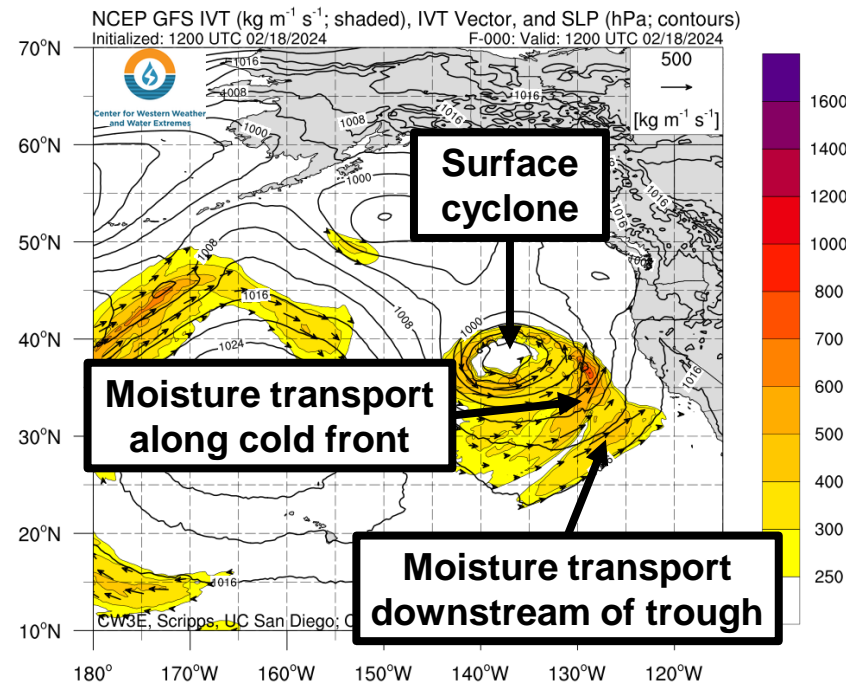
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GFS Model Analyses: Valid 4 AM PT 18 Feb 2024

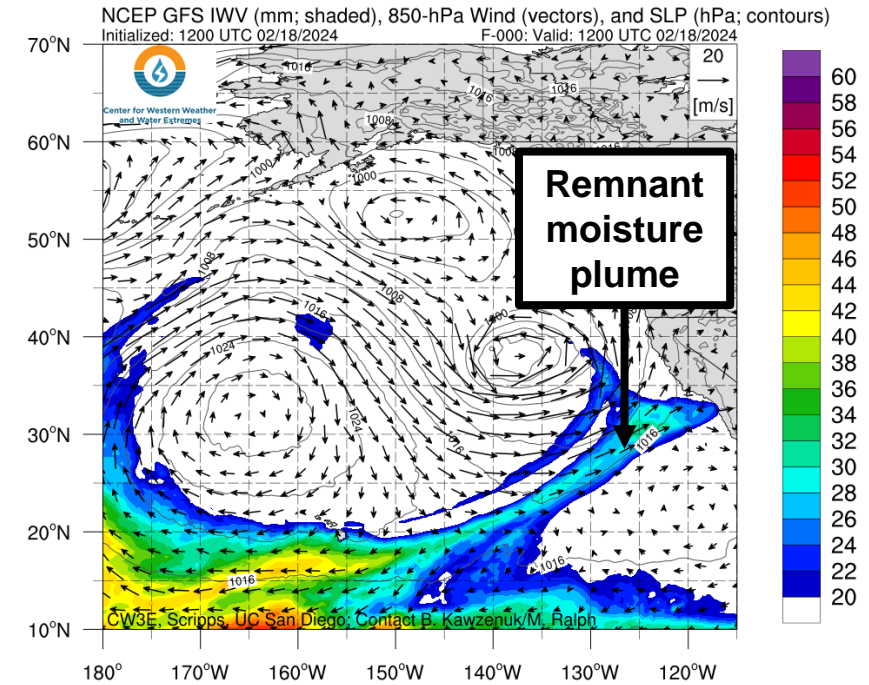
500-hPa Vorticity, Height, and Wind



IVT and SLP



IWV and 850-hPa Wind

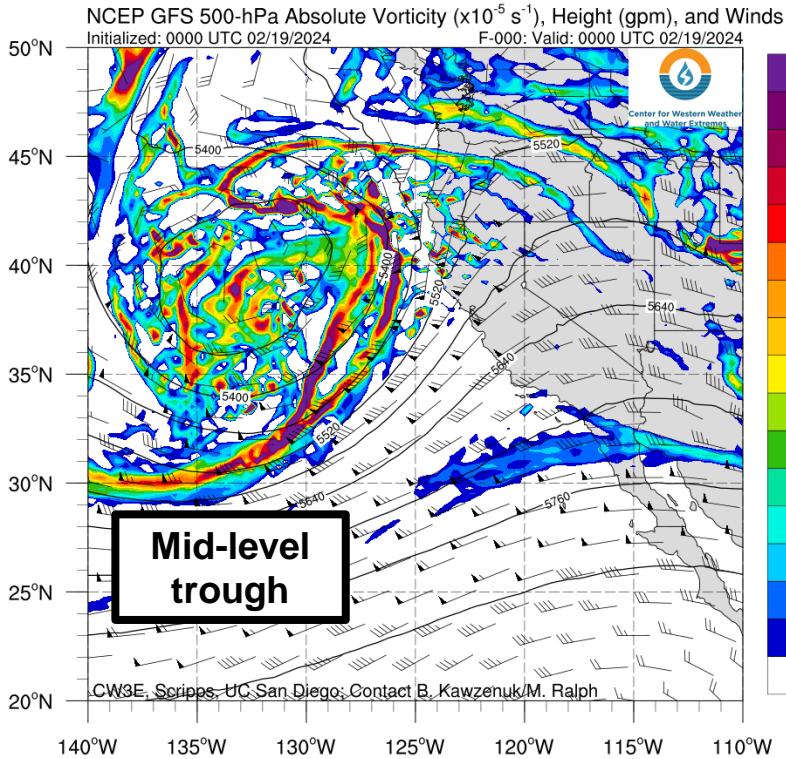


- A mid-level shortwave trough that initially formed northwest of Hawaii deepened into a closed low as it propagated eastward toward the US West Coast during 16–18 Feb.
- As the trough and associated surface cyclone moved eastward, these systems interacted with a remnant moisture plume over the subtropical Northeast Pacific, leading to a region of enhanced moisture transport downstream of the trough.
- This region of enhanced moisture transport eventually merged with another region of moisture transport along the cold front of the surface cyclone, culminating in an AR landfall over California.

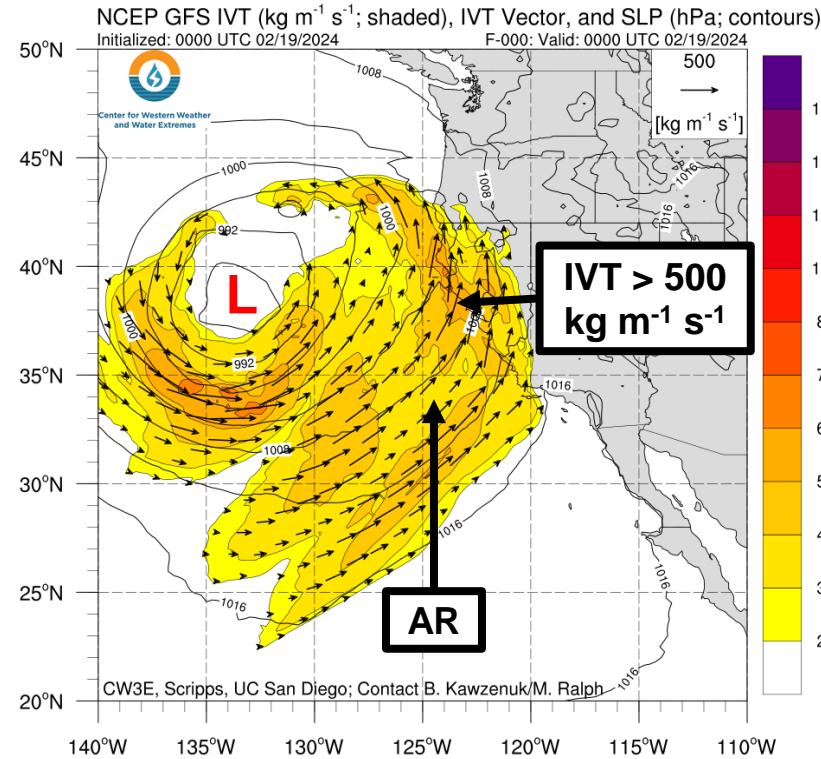
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GFS Model Analyses: Valid 4 PM PT 18 Feb 2024

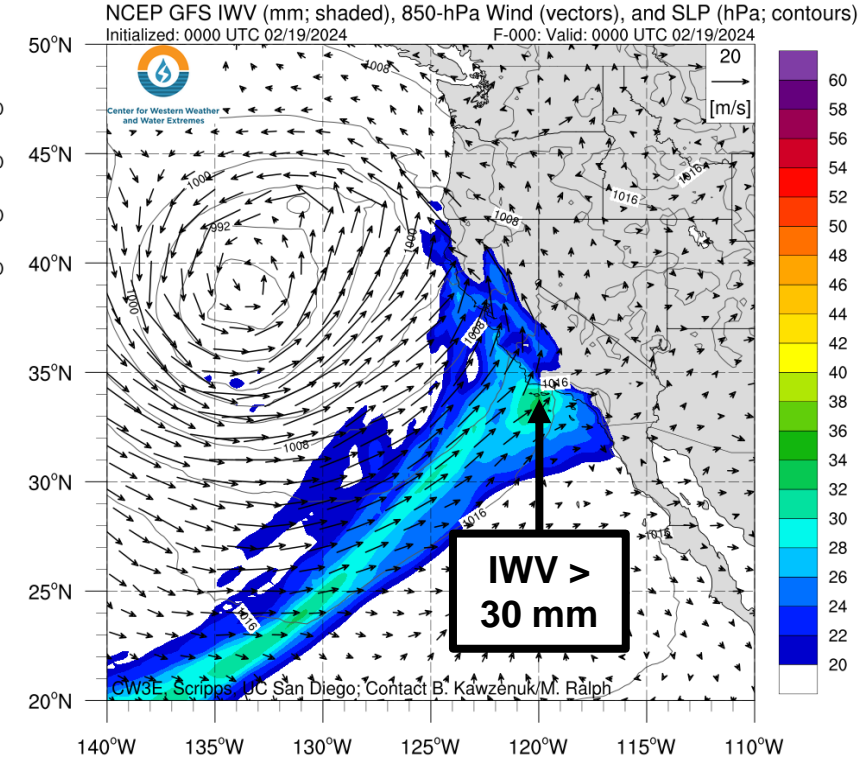
500-hPa Vorticity, Height, and Wind



IVT and SLP



IWV and 850-hPa Wind

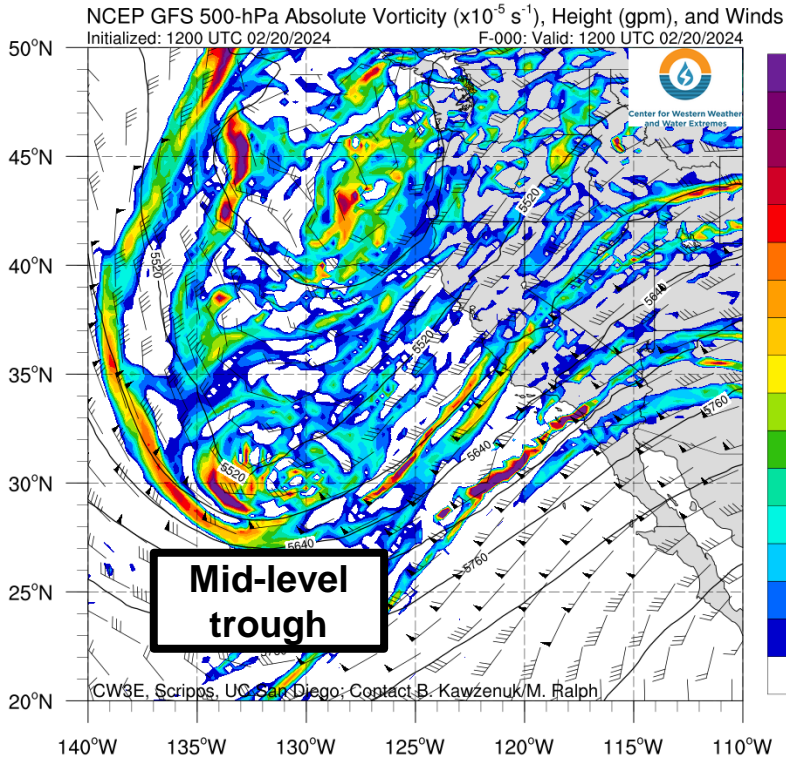


- The AR made landfall around midday on 18 Feb, bringing moderate AR conditions ($\text{IVT} > 500 \text{ kg m}^{-1} \text{ s}^{-1}$) to Northern and Central California, and weak AR conditions ($\text{IVT} > 250 \text{ kg m}^{-1} \text{ s}^{-1}$) to Southern California.
- The combination of strong low-level southwesterly winds and ample moisture (IWV values approaching 30 mm near Point Conception) created favorable conditions for orographic enhancement of precipitation, especially in the western Transverse Ranges.

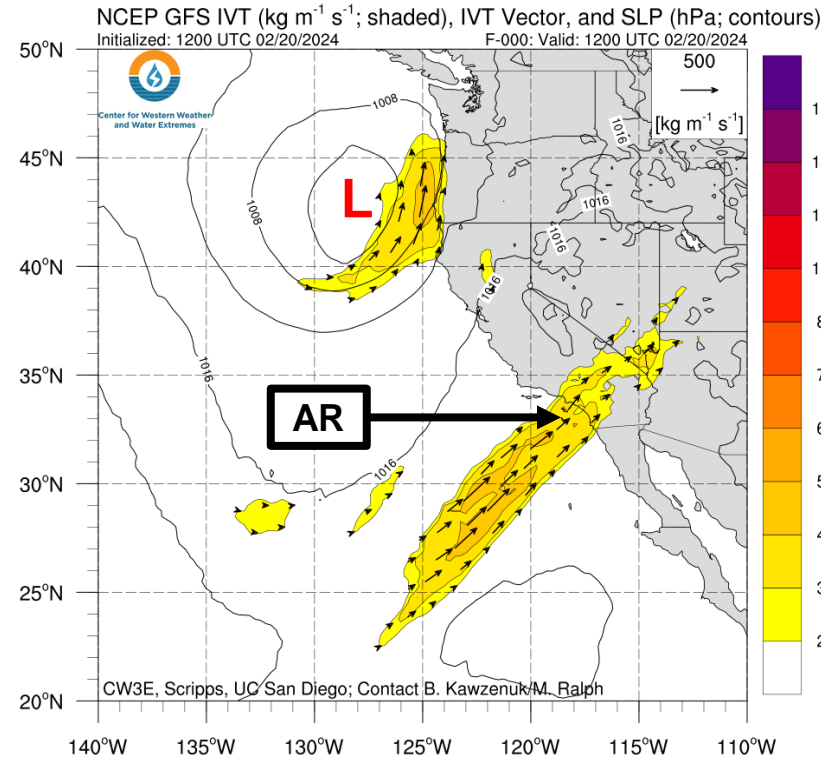
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GFS Model Analyses: Valid 4 AM PT 20 Feb 2024

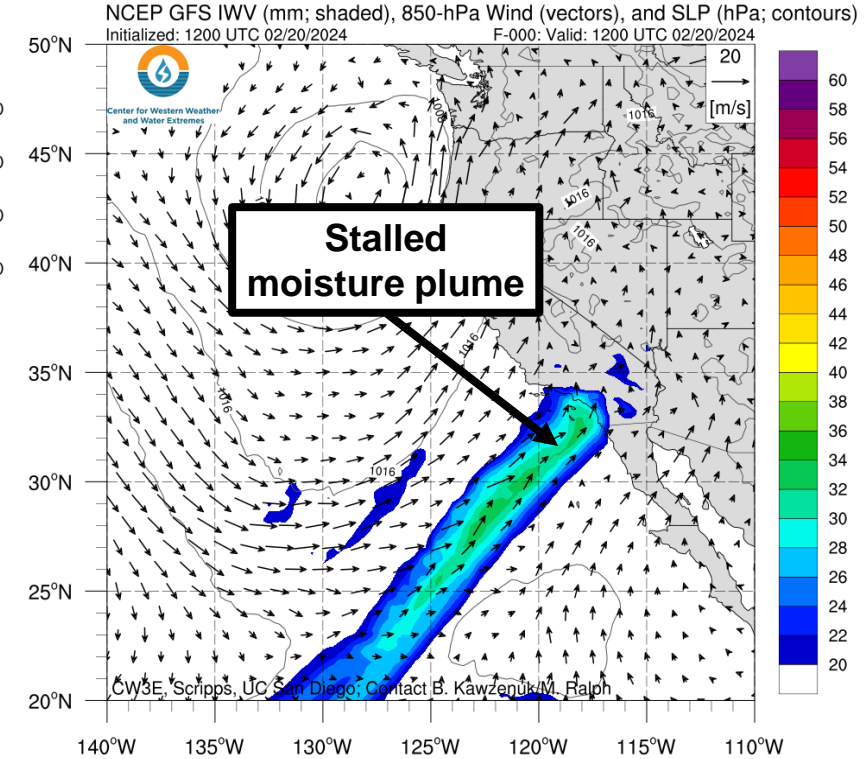
500-hPa Vorticity, Height, and Wind



IVT and SLP



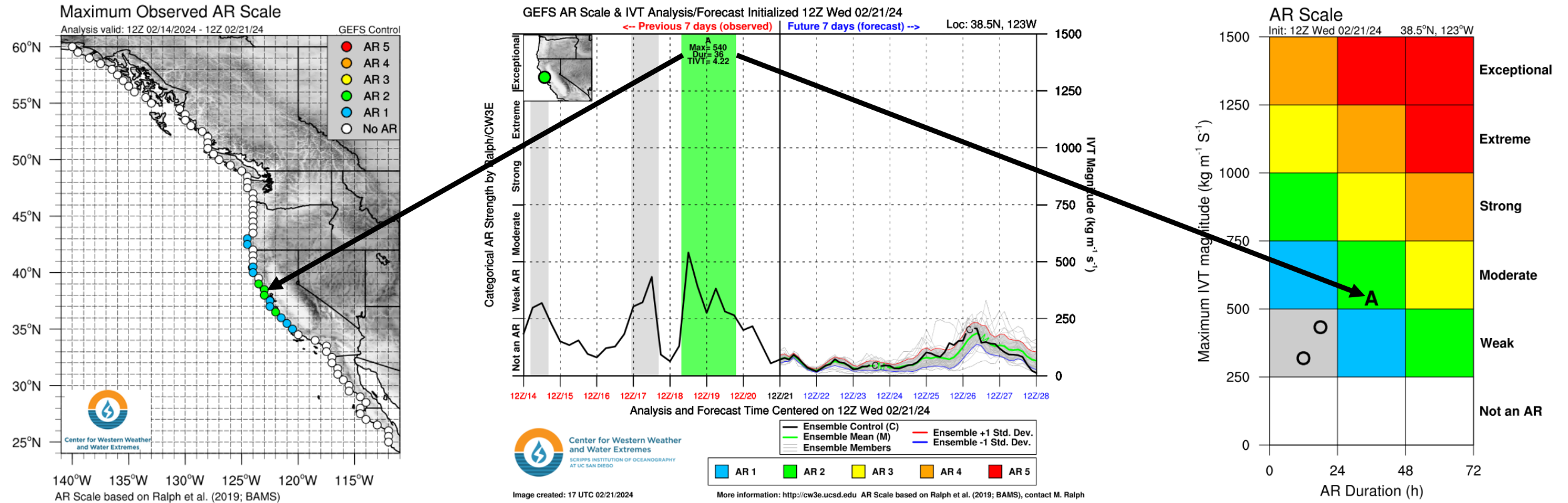
IWV and 850-hPa Wind



- As time progressed, the eastward progression of the trough stalled and the synoptic-scale flow became more southerly, allowing the AR to briefly re-intensify over Southern California.
- Sustained low-level southwesterly moisture flux helped prolong precipitation over the eastern Transverse Ranges and Peninsular Ranges through much of 20 Feb.

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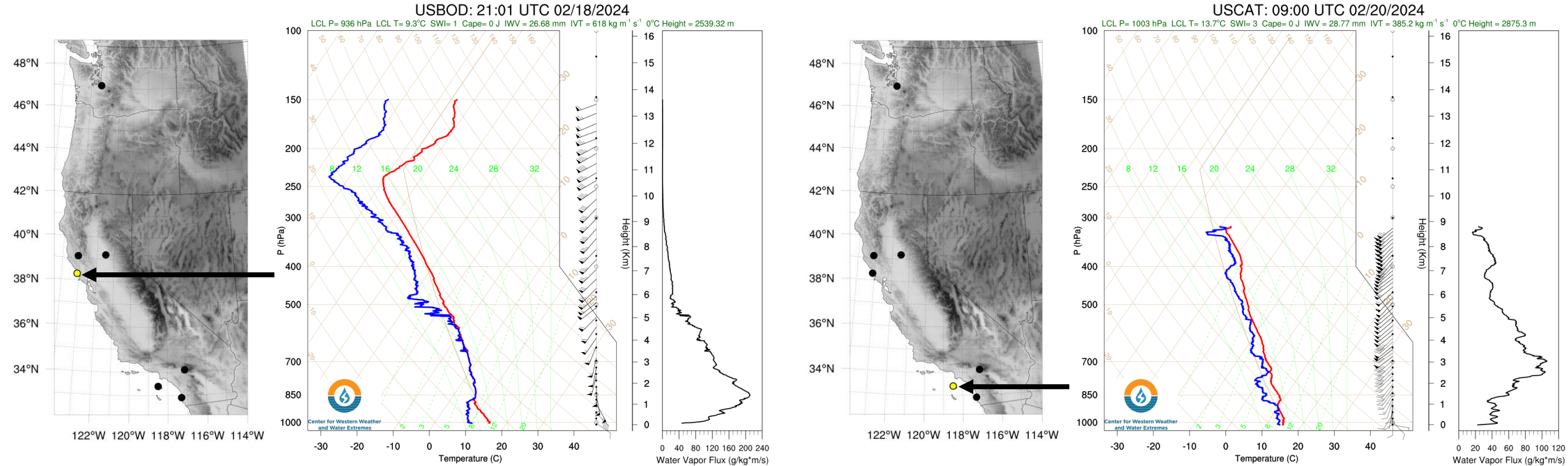
GEFS AR Scale Analysis



- Based on the GEFS analysis, this AR produced AR1–2 conditions over much of coastal Northern and Central California.
- An AR duration of 36 hours and a maximum IVT of $540 \text{ kg m}^{-1} \text{ s}^{-1}$ (i.e., an AR2) were observed in Sonoma County, CA.

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CW3E Observations: Radiosondes

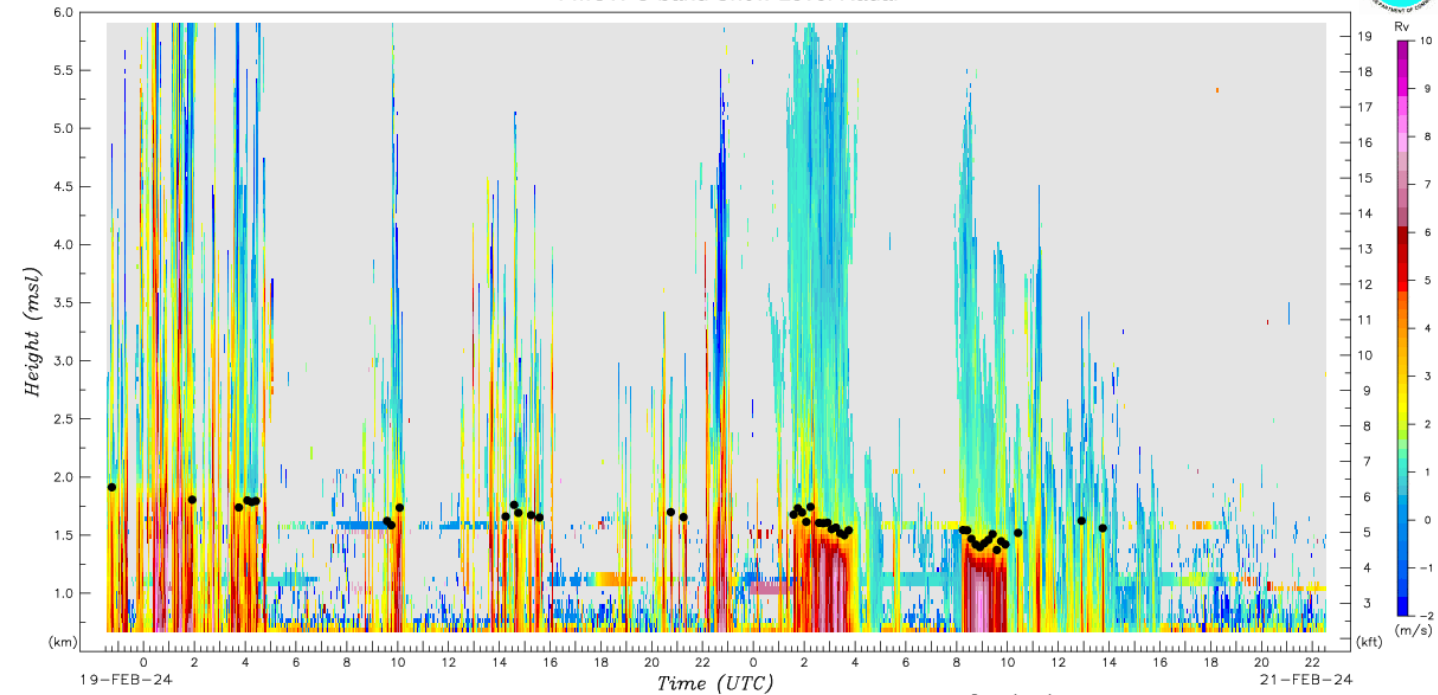


- The CW3E Field Team released radiosondes every 3 hours at Bodega Bay, CA (USBOD), and Catalina Island (USCAT) throughout the duration of the event at each location.
- A max IVT of 618 kg m⁻¹ s⁻¹ and ~36 hours of continuous AR conditions (i.e., an AR2) were observed at USBOD.
- A max IVT of 385 kg m⁻¹ s⁻¹ and ~24 hours of continuous AR conditions (i.e., an AR1) were observed at USCAT.

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Profiler Snow Level Radar: Colfax, CA

NOAA Physical Sciences Laboratory
FMCW S-band Snow Level Radar



Colfax, CA (CFF)
39.0800 N, 120.9400 W, 644 m

• Snow Level

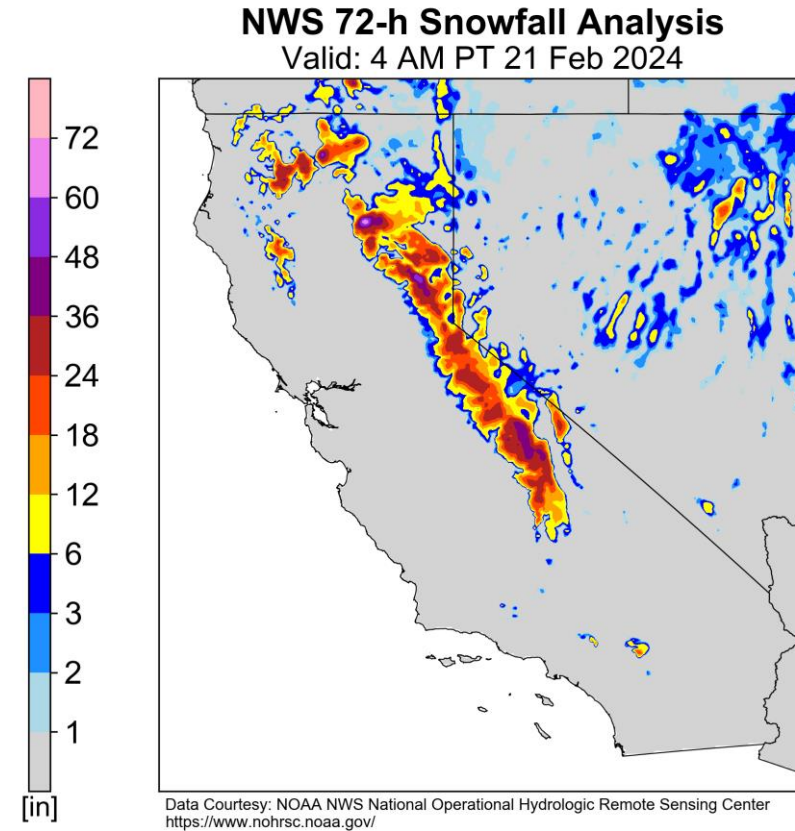
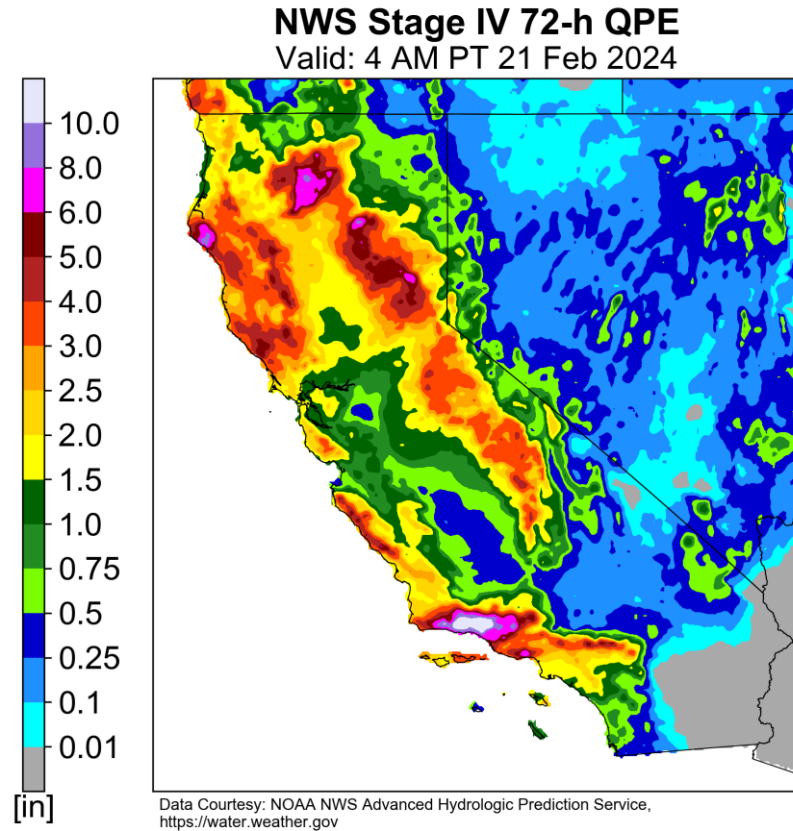
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Snow Level (m)	1912	none	none	1805	none	1788	none	none	none	none	none	1622	none	none	none	1660	1692	1651	none	none	none	none	1676	none
Snow Level (ft)	6271	none	none	5920	none	5866	none	none	none	none	none	5320	none	none	none	5444	5549	5415	none	none	none	none	5498	none
Sfc Temp (C)																								

Time (UTC)	2300	00 0	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200
Snow Level (m)	none	none	none	1695	1584	1520	none	none	none	1542	1444	1433	none	none	1623	1560	none	none	none	none	none	none	none	none
Snow Level (ft)	none	none	none	5559	5195	4985	none	none	none	5059	4736	4701	none	none	5323	5116	none	none	none	none	none	none	none	none
Sfc Temp (C)																								

- The S-band snow level radar at Colfax, CA (located in the North Fork American subbasin), measured snow levels between 5,000 feet and 6,000 feet during much of this event.
- Snow levels < 6,000 feet allowed for significant snowfall accumulations in the Northern Sierra Nevada.

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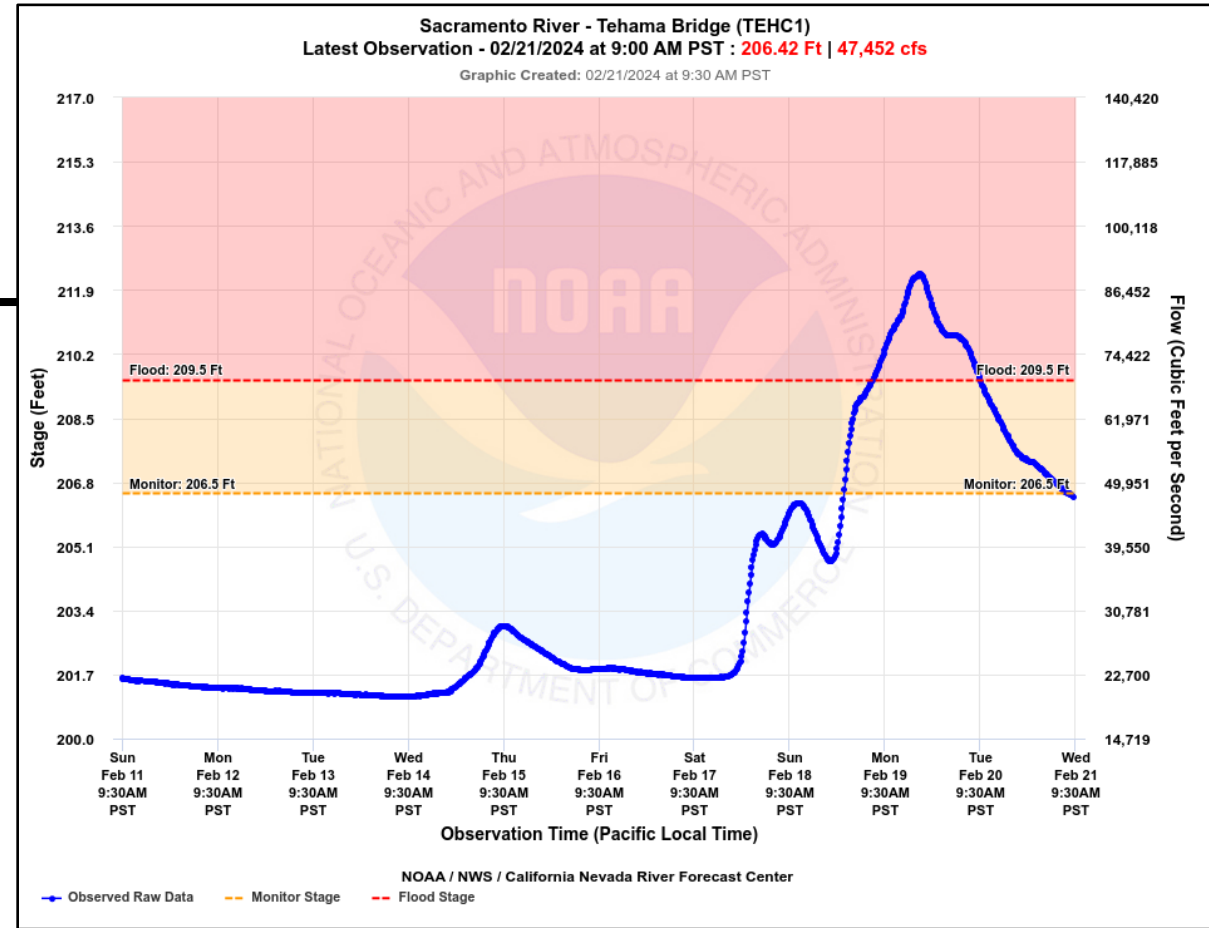
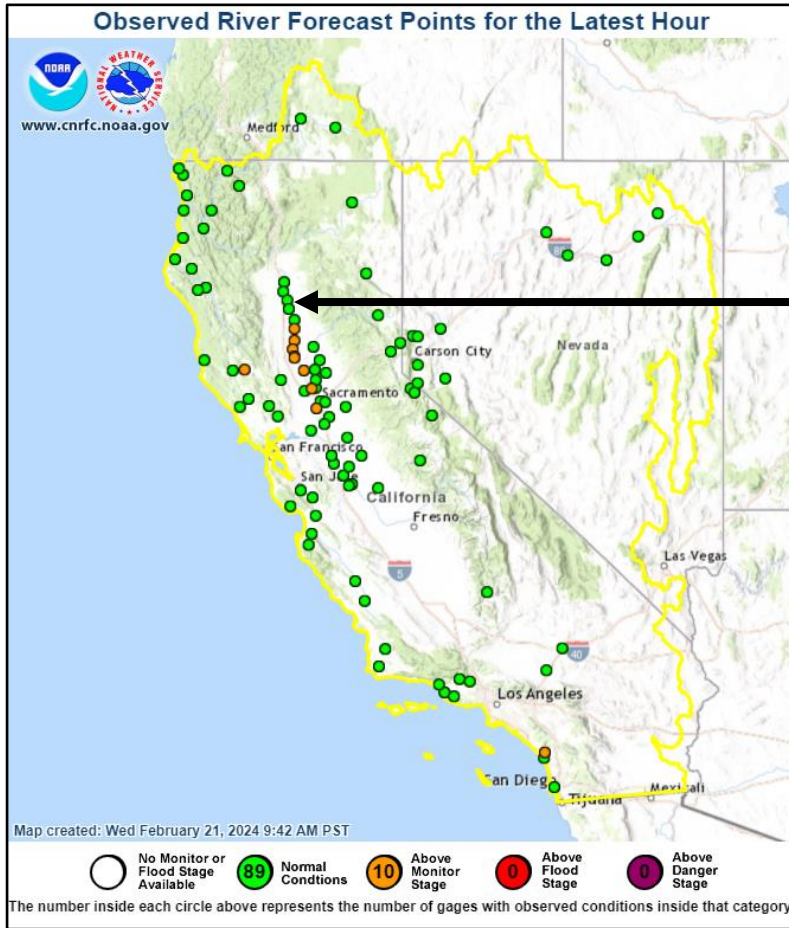
Storm-Total Precipitation



- This AR produced widespread precipitation over California, with the highest amounts (at least 4–8 inches) in the Northern California Coast Ranges, southern Cascades, Northern Sierra Nevada, and western Transverse Ranges.
- Some locations in Santa Barbara and Ventura Counties received more than 10 inches of total precipitation.
- At least 1–3 feet of snow fell in the Sierra Nevada, with higher amounts near Lassen Peak.

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Hydrologic Impacts



- Heavy rain during 18–19 Feb caused minor riverine flooding in the Sacramento Valley.
- The Sacramento River at Tehama Bridge rose above minor flood stage (209.5 feet) on 19 Feb, reaching a peak stage of 212.32 feet.

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Impacts: Flooding and Landslides

Flooding on US-101 in Ventura



Credit: Caltrans District 7

Mudslide on SR-1 in Malibu



Credit: Caltrans District 7

Storm Related Closures – Los Angeles & Ventura Counties

As of 5:35 p.m. Feb. 19. Updates at [QuickMap.dot.ca.gov](https://www.quickmap.dot.ca.gov).
Reduce speeds during rain & do not drive through flooding. Be Work Zone Alert.

- On southbound I-5 the right lane has been REOPENED from Stadium Way to State Route 110 and the southbound I-5 connector to southbound SR-110 has been REOPENED. Slide and fence repair.
- On US-101 from Seaward Avenue to California Street in the city of Ventura the northbound left lane and up to two southbound lanes are CLOSED for the duration of the storm due to flooding in an area where drainage repairs are underway.
- State Route 1 (Pacific Coast Highway) is CLOSED each night in both directions from Sycamore Canyon Road to Las Posas Road in Ventura County until further notice due to erosion of the southbound shoulder between postmiles 4.8 and 5.2. The closure hours are from 6 p.m. to 7 a.m. or later. Reopening times will vary based on conditions that affect motorists' safety.
- On State Route 33 ALL lanes have been REOPENED from Canada Larga Road to Sulphur Mountain Road in the city of Ventura/Casitas Springs from earlier mudslides.
- The Skirball Center Drive/Mulholland Drive off-ramp from northbound I-405 in the Sepulveda Pass is CLOSED until further notice due to a sink hole.
- State Route 150 is CLOSED in both directions between Stonegate Road and Topa Lane in Santa Paula in Ventura County due to slides and storm related damage.

Source: Caltrans District 7

Mud/rockslide on Malibu Canyon Rd



Credit: LA County Fire Department

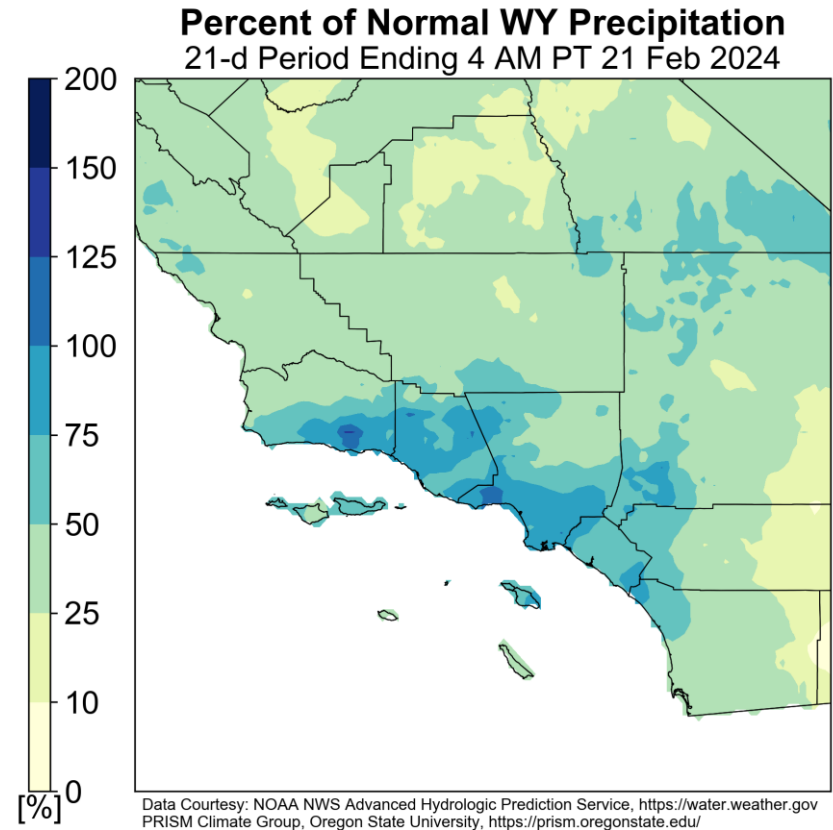
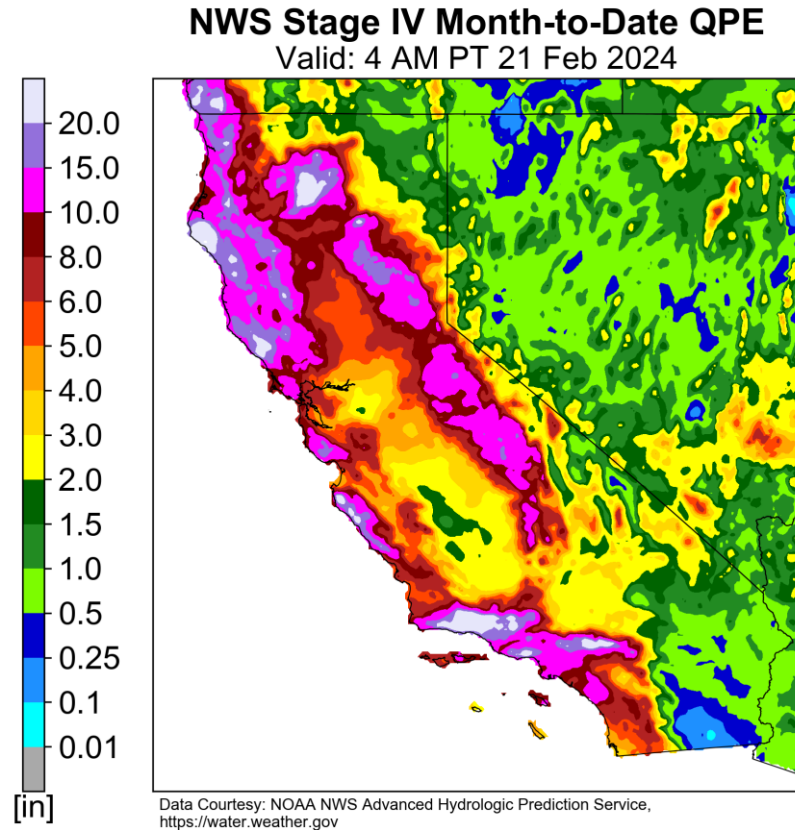
Mudslide on SR-150 in Santa Paula



Credit: Caltrans District 7

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February 2024 Precipitation

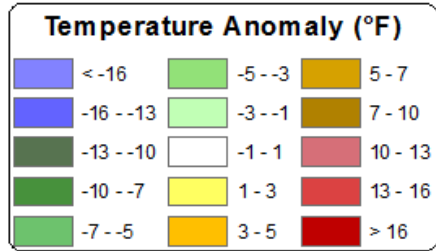
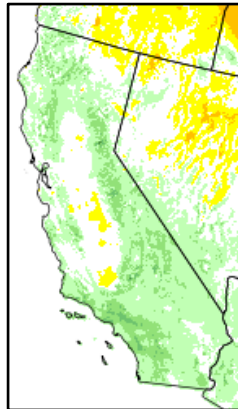


- Heavy precipitation from this AR and previous storms have led to impressive precipitation totals during the first 3 weeks of February 2024, particularly over coastal Southern California.
- An estimated 10–20 inches of total precipitation have fallen across much of Santa Barbara, Ventura, and Los Angeles Counties, with even higher amounts in the western Transverse Ranges.
- Some areas received more than 75% of their normal total water year precipitation during this 3-week period.

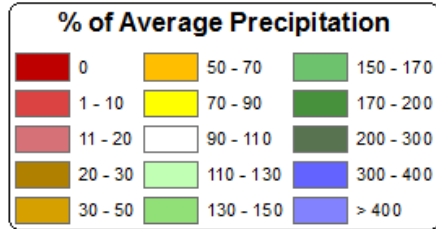
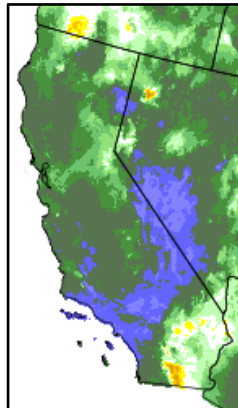
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Snowpack Conditions

PRISM Daily Mean Temperature Anomaly: 1–22 Feb 2024



PRISM Month-to-Date Precipitation Anomaly: 1–22 Feb 2024

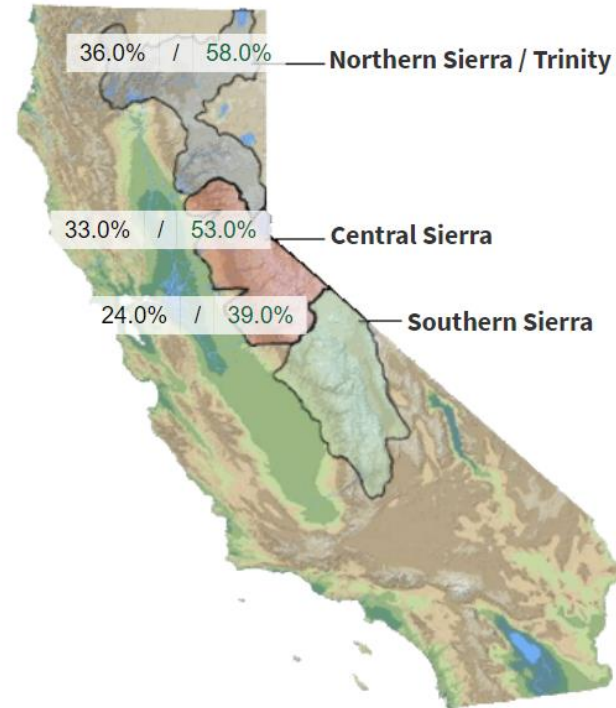


Source: PRISM Climate Group, Oregon State University

Provided by the California Cooperative Snow Surveys

Data For: 31-Jan-2024

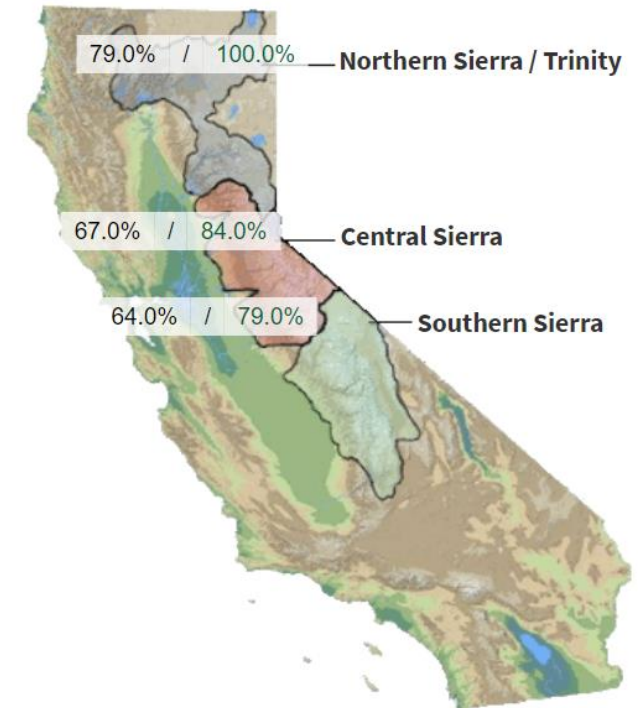
% Apr 1 Avg. / % Normal for this Date



Provided by the California Cooperative Snow Surveys

Data For: 21-Feb-2024

% Apr 1 Avg. / % Normal for this Date



Source: California Department of Water Resources

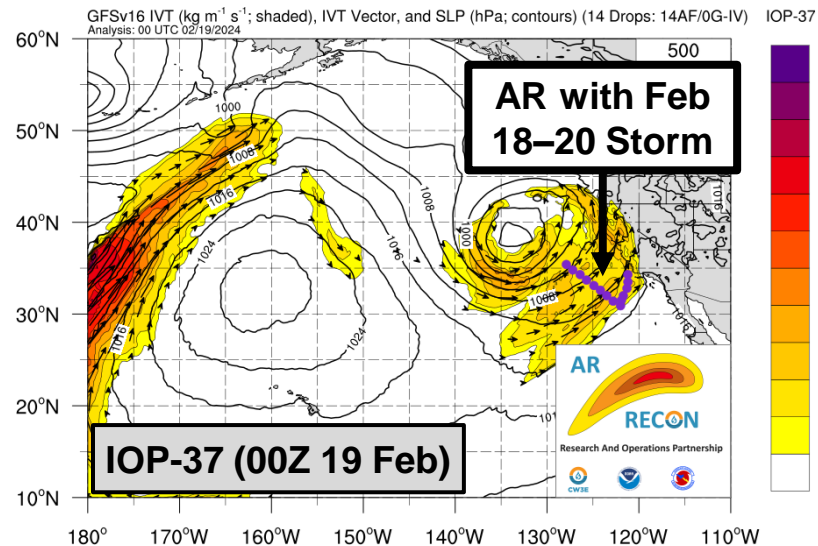
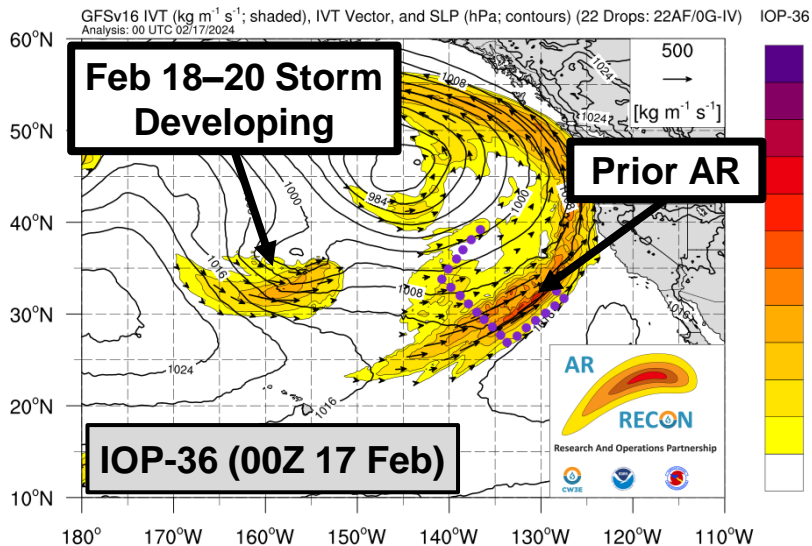
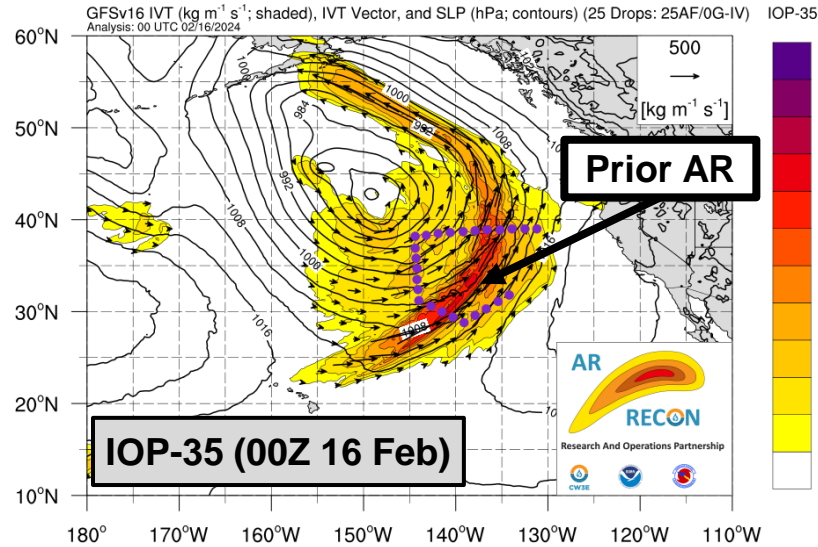
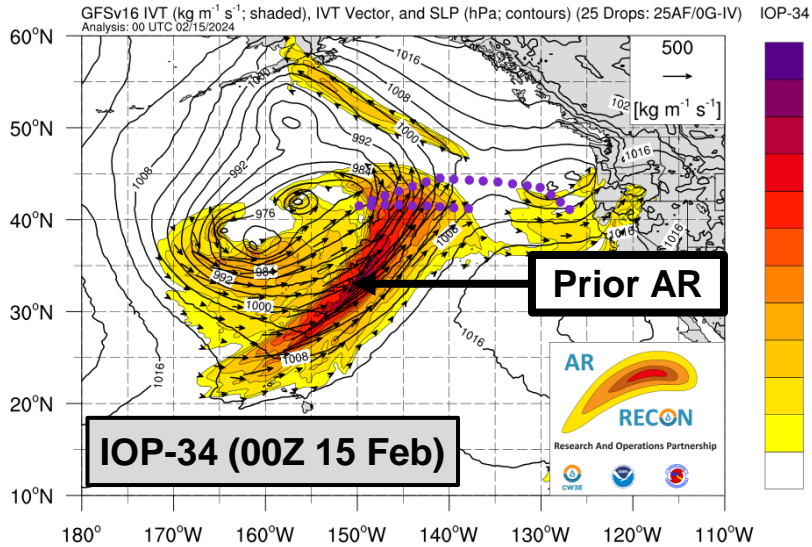
- An unusually cool and wet February has resulted in a dramatic improvement in seasonal snowpack across California.
- During the first 3 weeks of February, snowpack increased from just 39% of normal to 79% of normal in the Southern Sierra Nevada, and from 58% of normal to 100% of normal in the Northern Sierra Nevada/Trinity Mountains.

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Atmospheric River Reconnaissance

IOP: Intensive Observation Period



- In the days leading up to this storm, the US Air Force 53rd Weather Reconnaissance Squadron provided operational support over the eastern North Pacific as part of CW3E's AR Recon field campaign.
- 86 dropsondes were deployed during four missions, collecting valuable atmospheric observations that were ingested into the global forecast models in real-time and archived for future research purposes.
- During this sequence of IOPs, sampling flights targeted multiple ARs and associated essential atmospheric structures. Remnant moisture from the first AR played a role in intensifying the second AR (the focus of this summary) over Southern CA on 18–19 Feb.