CW3E Event Summary: 12–17 March 2025

Multiple Atmospheric Rivers Produce Heavy Rain, Heavy Snow, and Flooding in California and Oregon

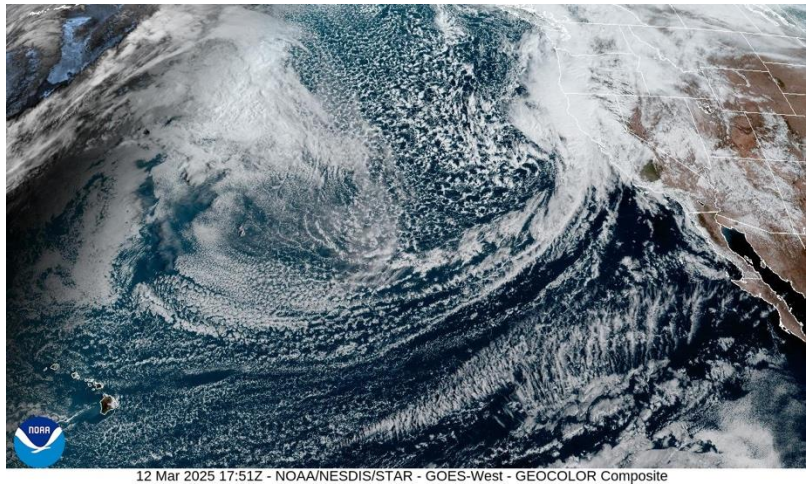
The ARs:

- The first atmospheric river (AR) made landfall over Northern California on 12 Mar and quickly propagated down the coast, bringing a brief period of weak AR conditions to much of coastal California.
- A second and stronger AR made landfall over southern Oregon on 15 Mar before eventually drifting southward and dissipating over Central California.
- An AR 2 (based on the Ralph et al. 2019 AR Scale) was observed in coastal Oregon and far Northern California in association with the second AR.

Impacts:

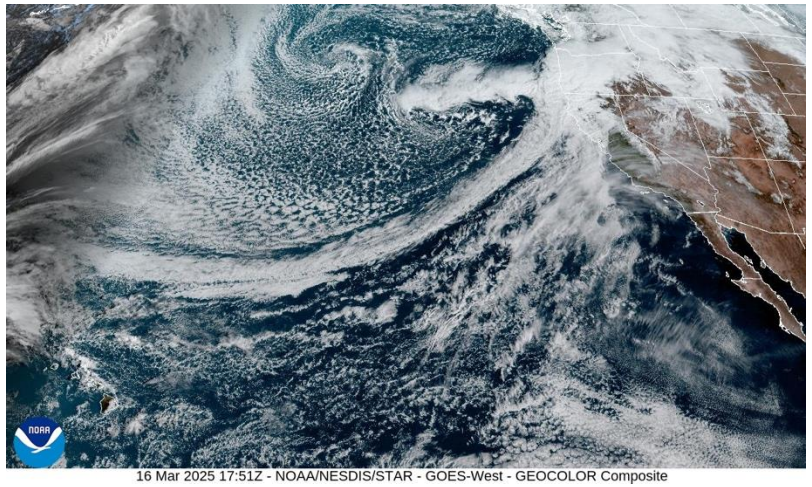
- The first AR produced widespread rain over coastal California and heavy snow in the Sierra Nevada and San Bernardino Mountains.
- The second AR produced heavy rain in southwestern Oregon and far Northern California, as well as heavy snow in the Oregon Cascades.
- Total rainfall from these storms exceeded 10 inches near the Oregon/California border. Total snowfall exceeded 48 inches in portions of the Oregon Cascades and Sierra Nevada.
- Rain from the first AR caused roadway flooding and landslides in California.
- Heavy rain falling on saturated soils during the second AR caused severe flooding in southwestern Oregon.

Satellite Image of First AR



12 Mar 2025 17:51Z - NOAA/NESDIS/STAR - GOES-West - GEOCOLOR Composite

Satellite Image of Second AR



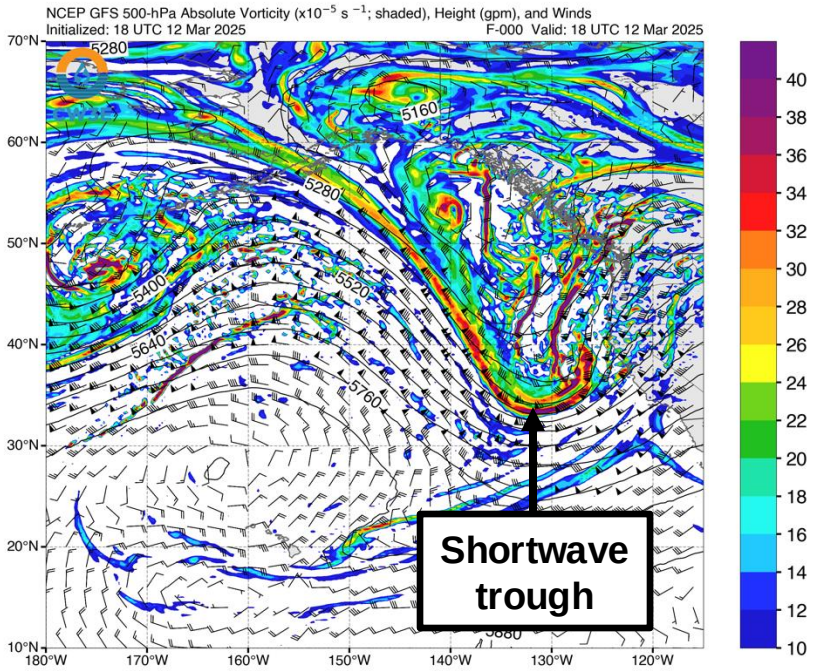
16 Mar 2025 17:51Z - NOAA/NESDIS/STAR - GOES-West - GEOCOLOR Composite

Source: NOAA/NESDIS Center for Satellite Applications and Research

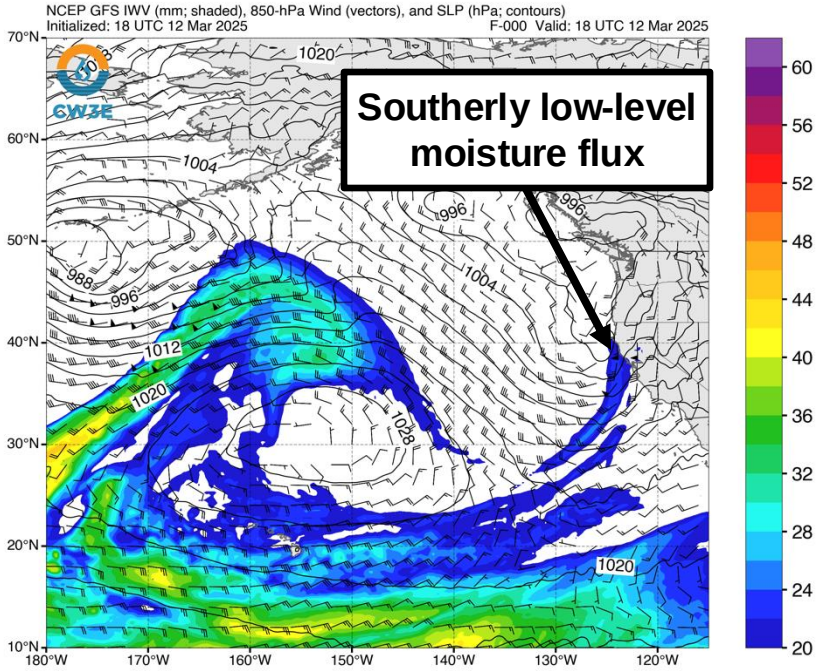
CW3E Event Summary: 12–17 March 2025

GFS Model Analyses of First AR

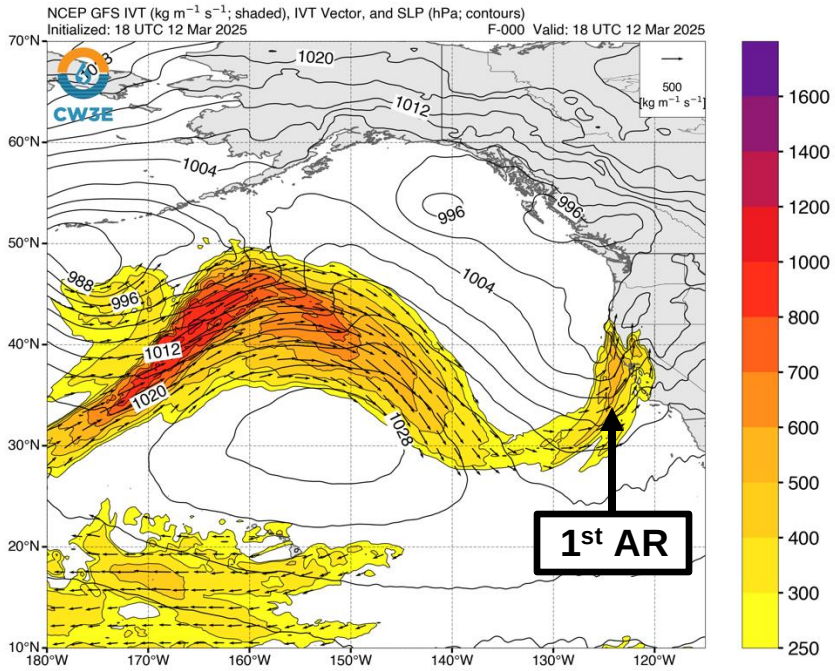
500-hPa Heights, Vorticity, & Wind
Valid: 11 AM PT 12 Mar



IWV, SLP, & 850-hPa Wind
Valid: 11 AM PT 12 Mar



IVT & SLP
Valid: 11 AM PT 12 Mar

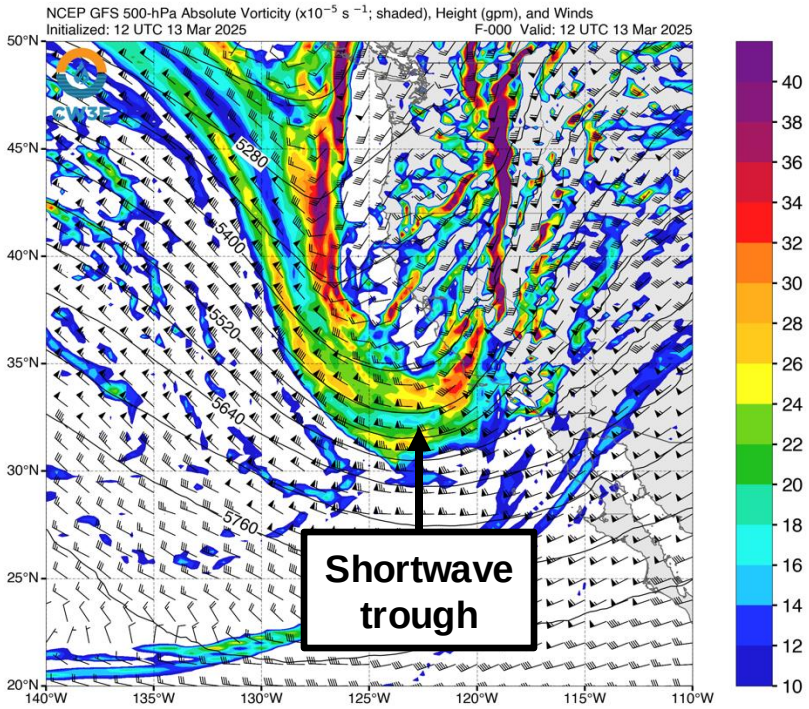


- The first AR initially approached the US West Coast late 11 Mar, bringing weak IVT (~300 kg m^{-1} s^{-1}) to coastal Oregon.
- An amplifying upstream shortwave trough facilitated intensification of the AR as it drifted southward into Northern California.
- Although moisture was somewhat limited (IWV ~20mm), strong southerly low-level winds supported upslope moisture flux over the California Coast Ranges, southern Cascades, and Northern Sierra Nevada.

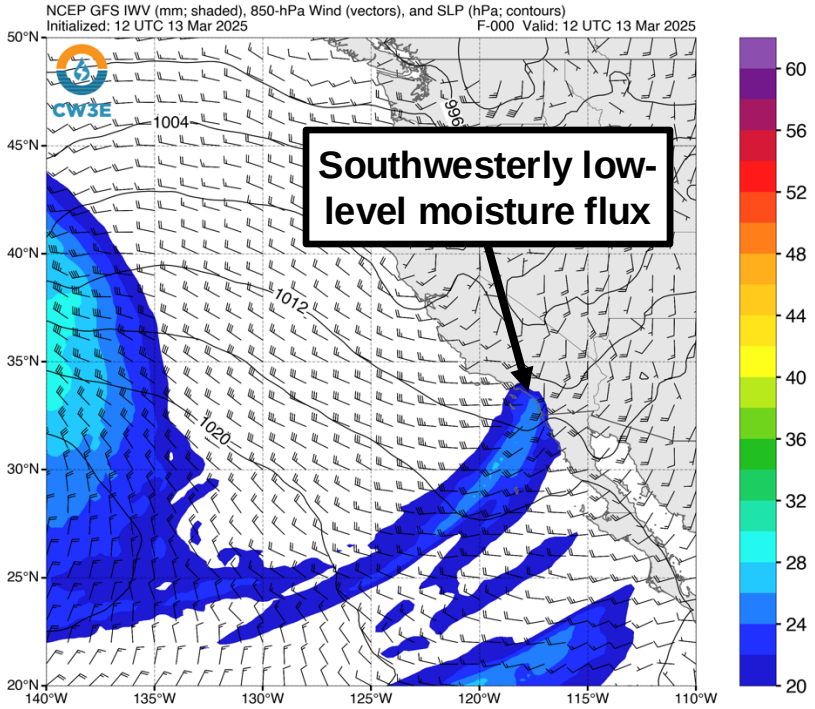
CW3E Event Summary: 12–17 March 2025

GFS Model Analyses of First AR

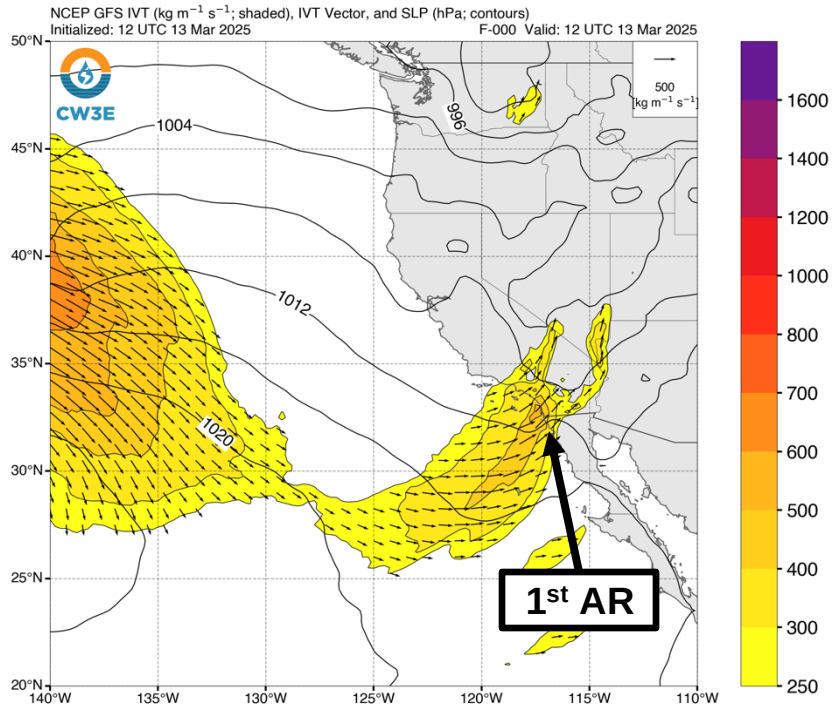
500-hPa Heights, Vorticity, & Wind
Valid: 5 AM PT 13 Mar



IWV, SLP, & 850-hPa Wind
Valid: 5 AM PT 13 Mar



IVT & SLP
Valid: 5 AM PT 13 Mar

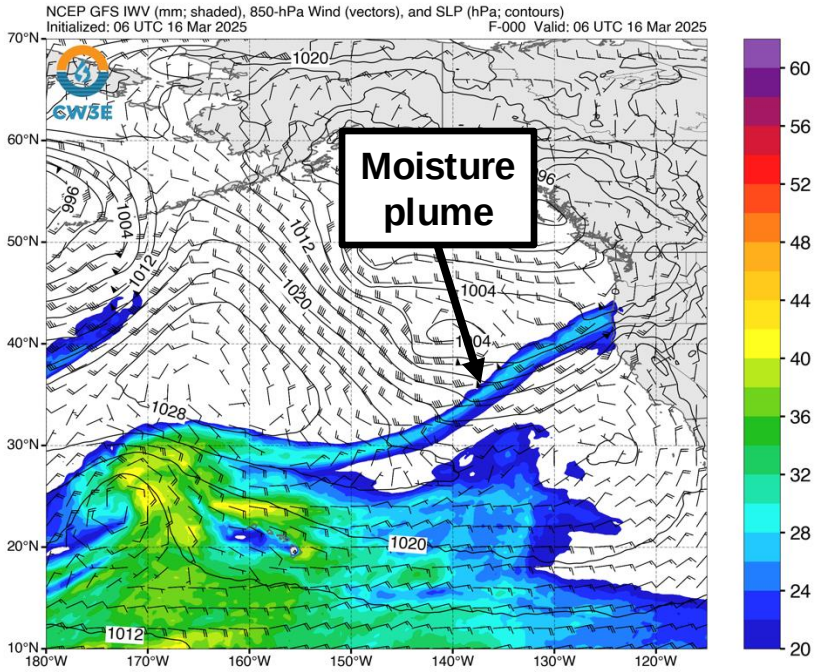


- Over the next 24 hours, the trough approached the Southern California coast and the AR rapidly passed through Central and Southern California.
- As the AR moved southward, southwesterly low-level moisture flux likely facilitated orographic enhancement of precipitation in the Southern Sierra Nevada, Transverse Ranges, and Peninsular Ranges.

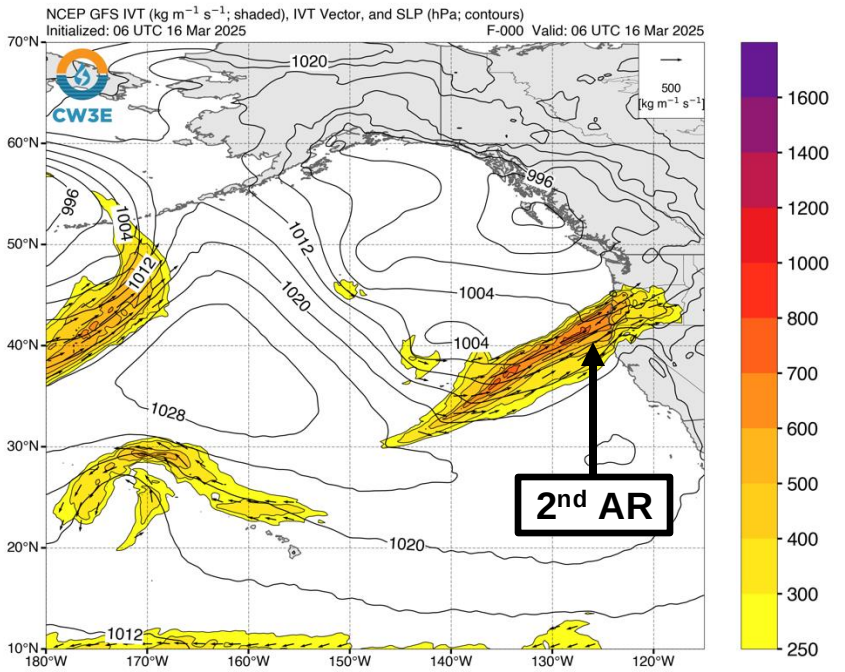
CW3E Event Summary: 12–17 March 2025

GFS Model Analyses of Second AR

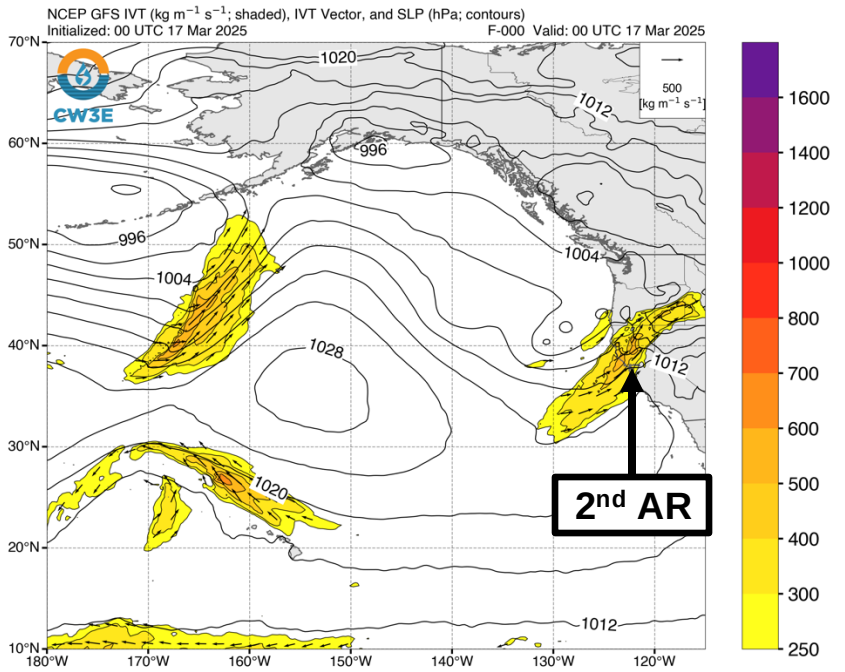
IWV, SLP, & 850-hPa Wind
Valid: 11 PM PT 15 Mar



IVT & SLP
Valid: 11 PM PT 15 Mar



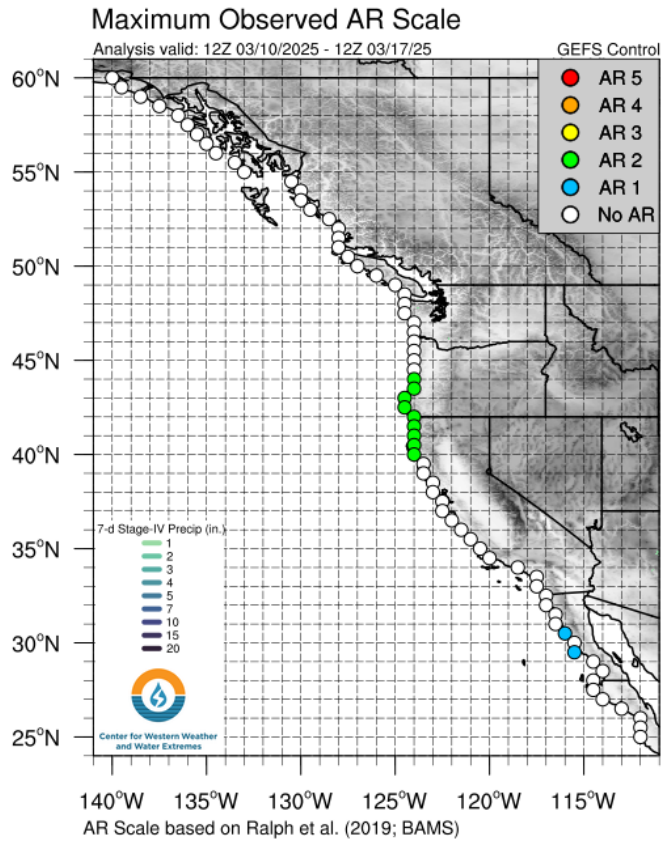
IVT & SLP
Valid: 5 PM PT 16 Mar

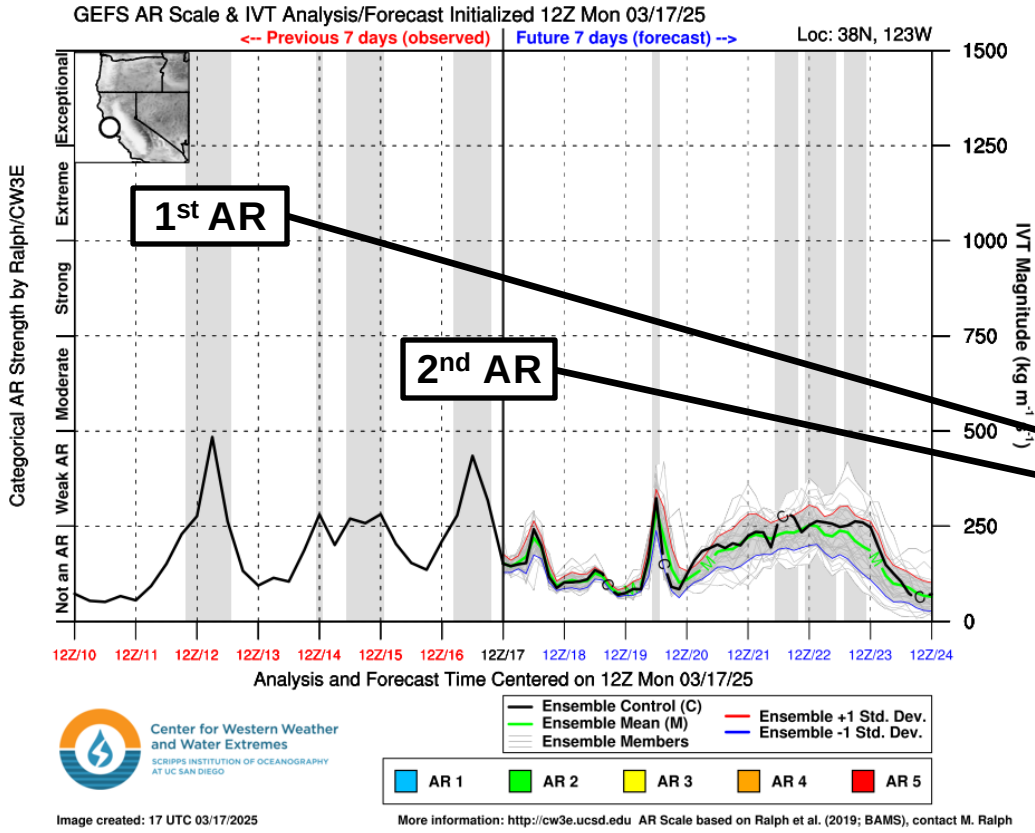


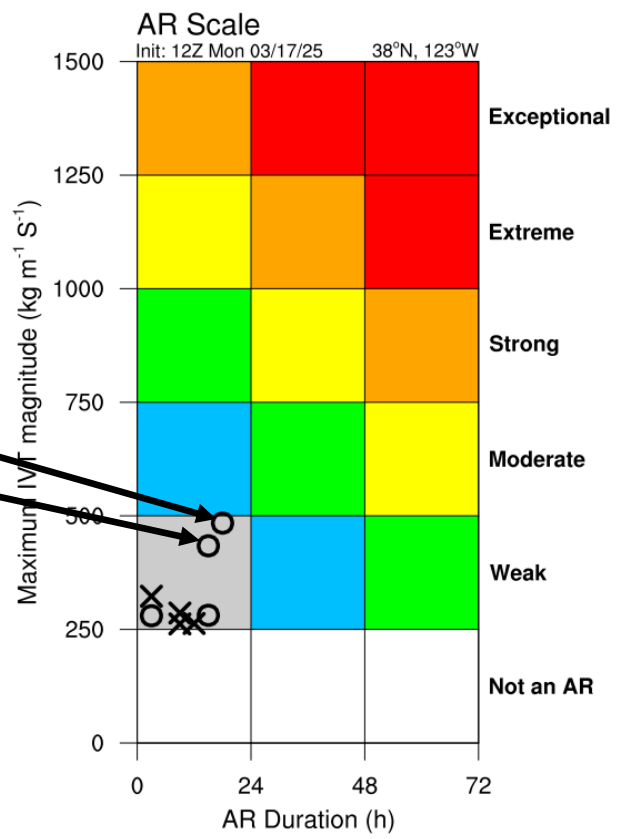
- A second and stronger AR (maximum IVT >600 kg m^{-1} s^{-1}) made landfall over southern Oregon on 15 Mar in association with a narrow plume of moisture extending from the central North Pacific Ocean.
- The AR temporarily stalled along the Oregon/California border before eventually swinging southward into Northern and Central California on 16 Mar.
- Favorable southwesterly moisture transport facilitated heavy precipitation over the Coast Ranges, Klamath Mountains, and Cascades in southwestern Oregon.

CW3E Event Summary: 12–17 March 2025

GEFS AR Scale Analysis (Northern California)



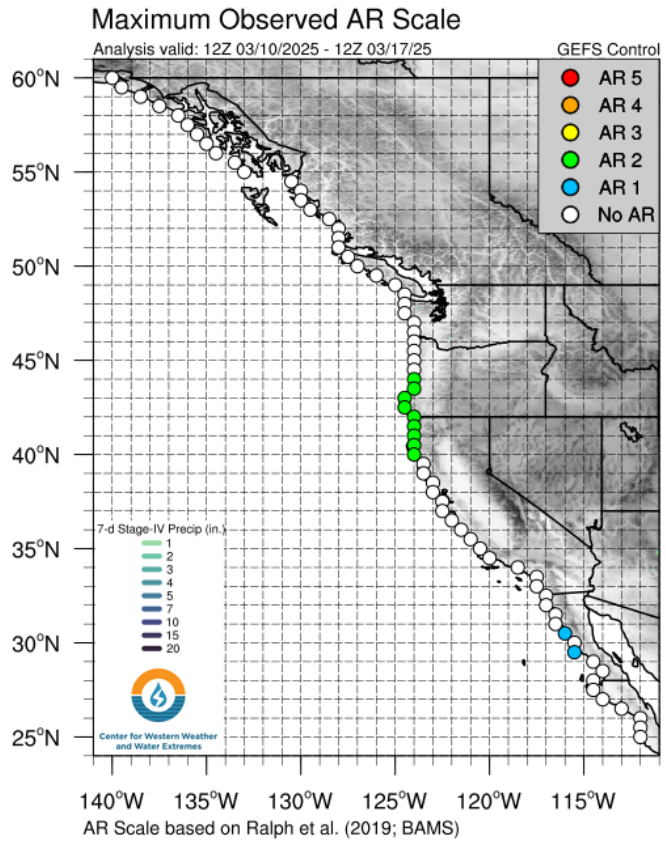


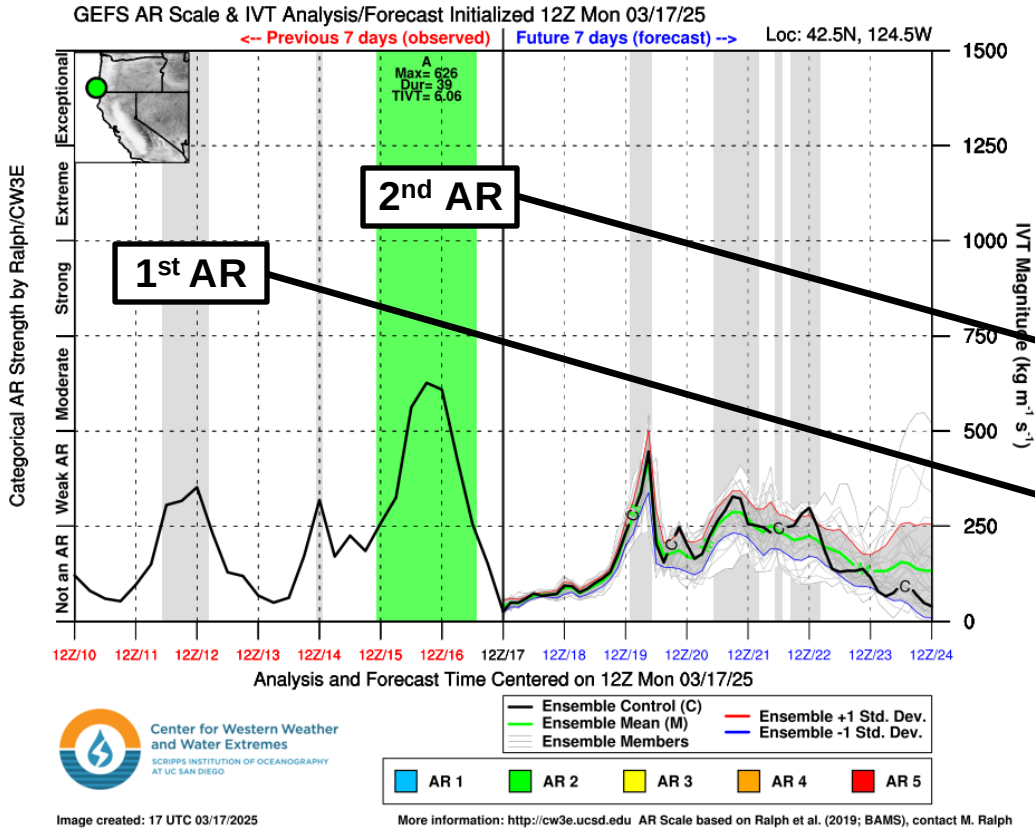


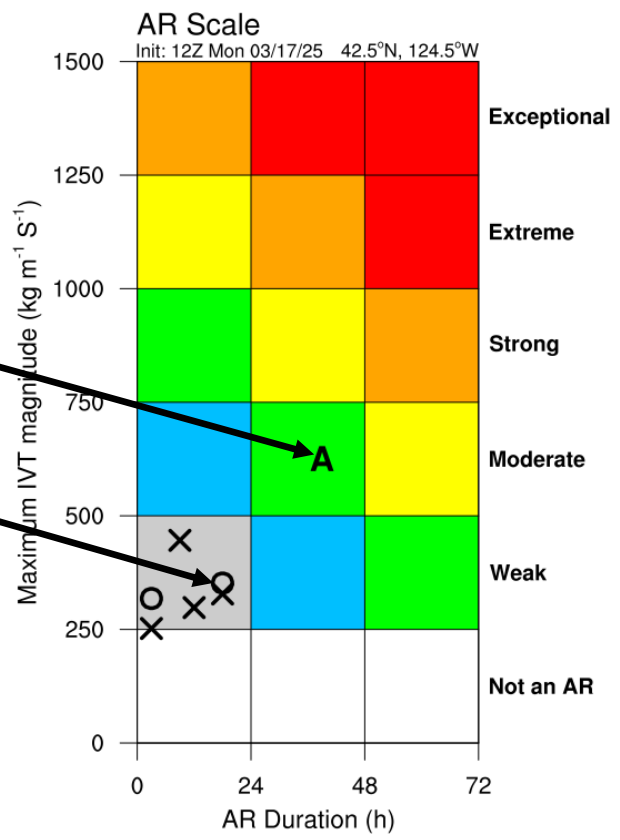
- Based on the GEFS analysis, the first and second ARs both brought weak AR conditions (IVT <500 kg m^{-1} s^{-1}) to the Bay Area.
- Neither AR met the criteria for AR Scale conditions due to the short AR durations (<24 hours of IVT ≥250 kg m^{-1} s^{-1}).

CW3E Event Summary: 12–17 March 2025

GEFS AR Scale Analysis (Southern Oregon)



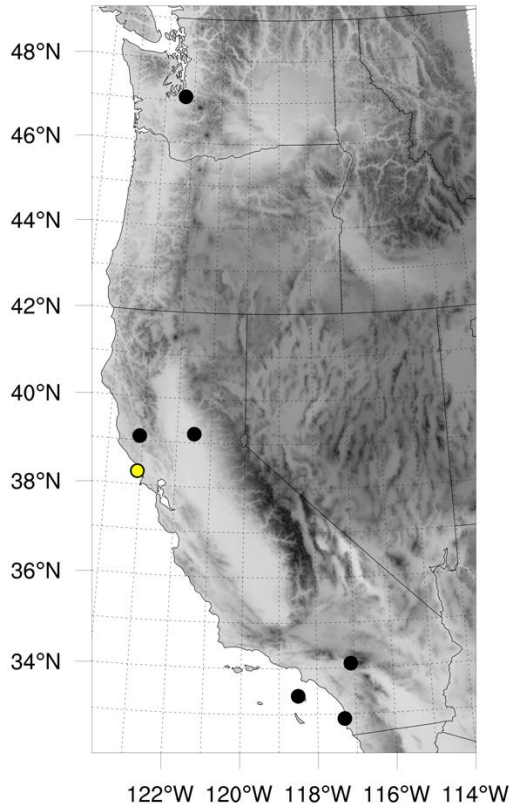


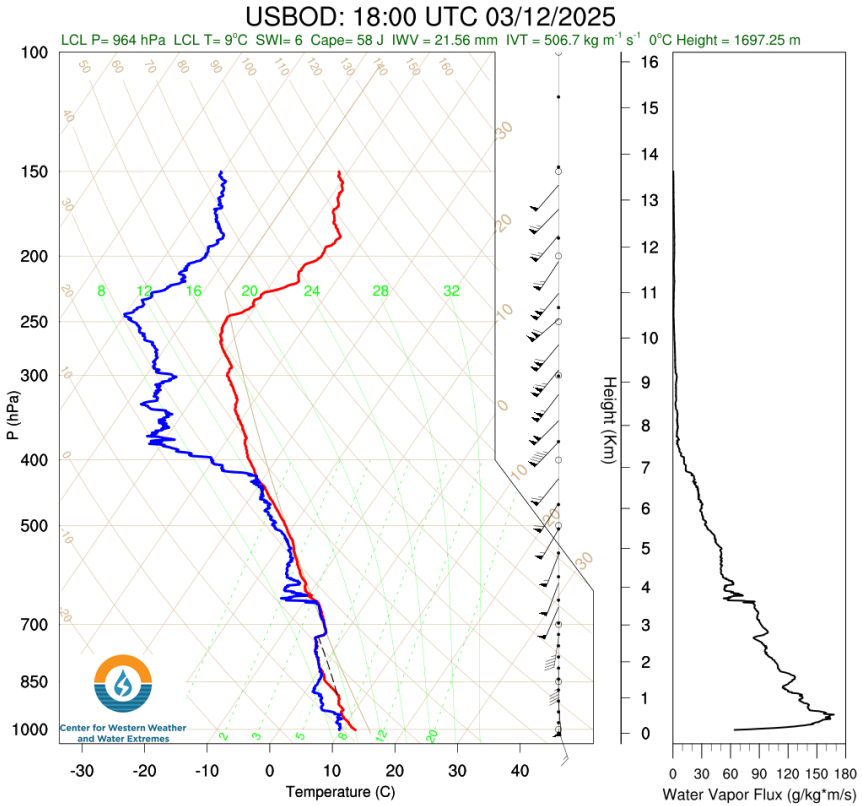


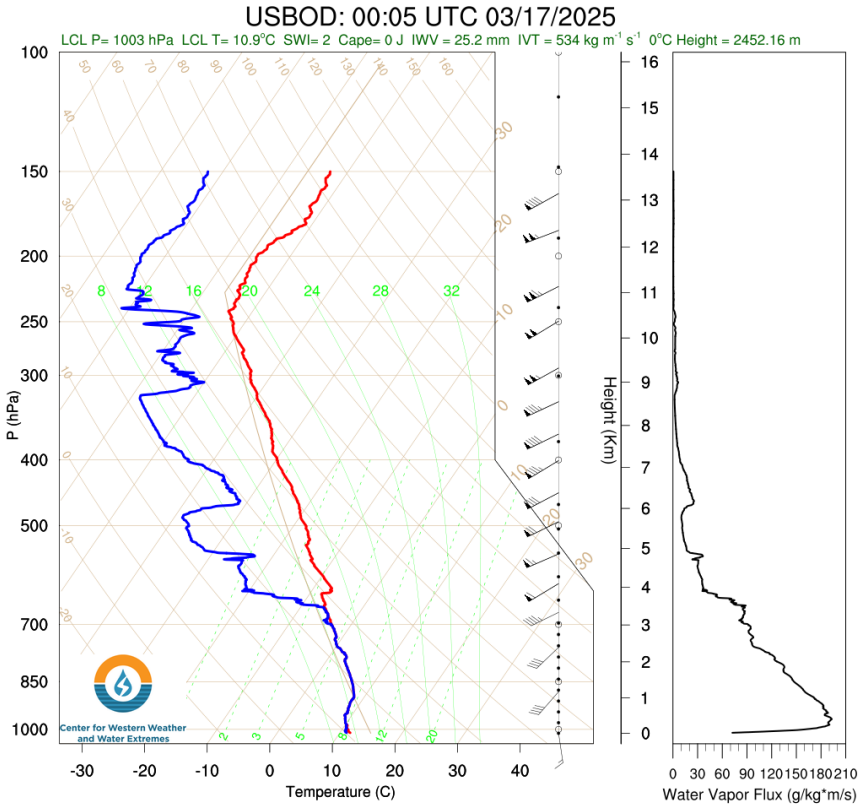
- Based on the GEFS analysis, the second AR produced AR 2 conditions in coastal southern Oregon and far Northern California.
- A maximum IVT magnitude of 626 kg m^{-1} s^{-1} and an AR duration of 39 hours were observed at 42.5°N, 124.5°W (Curry County, OR).

CW3E Event Summary: 12–17 March 2025

CW3E Soundings: Bodega Bay (USBOD)



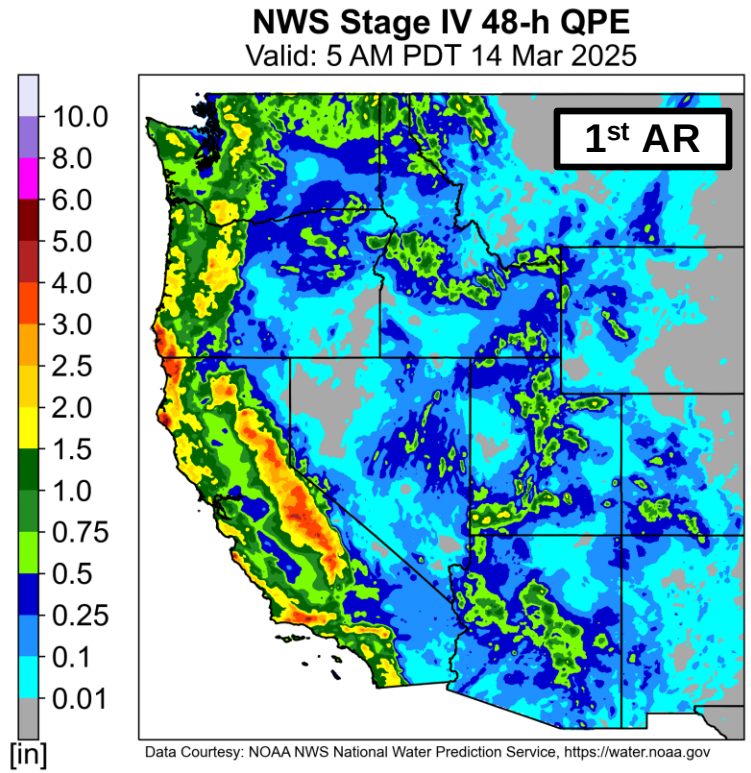


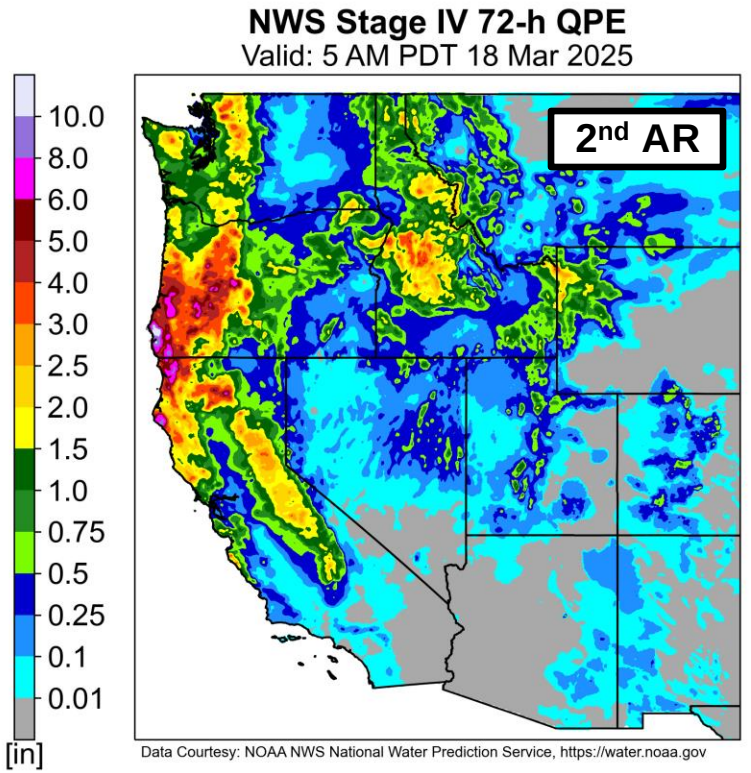


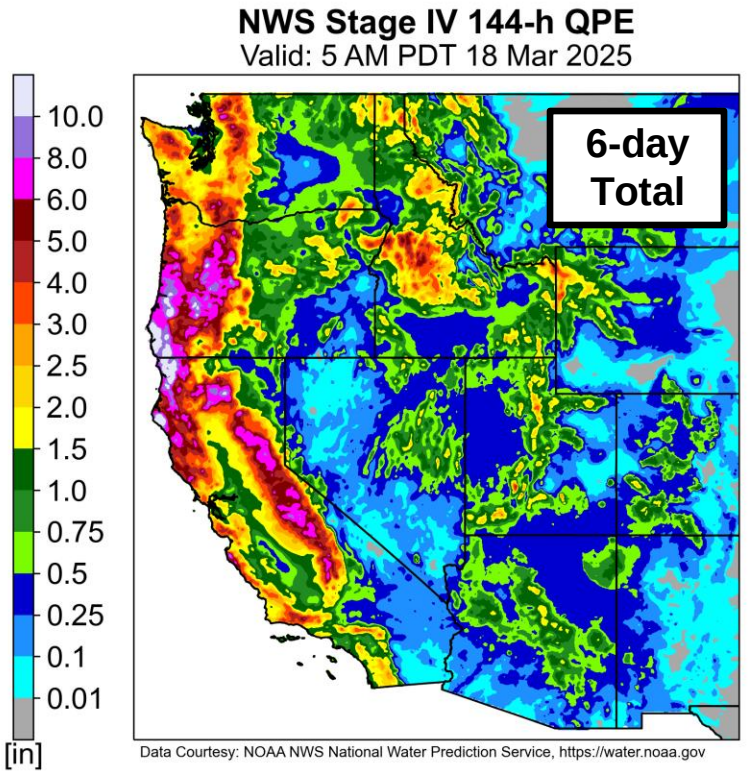
- The CW3E Field Team coordinated radiosonde launches from Bodega Bay (USBOD) and Marysville (USYUB) for both ARs.
- While the GEFS analyses showed only weak AR conditions in Sonoma County, CA, the USBOD radiosondes recorded maximum IVT >500 kg m^{-1} s^{-1} during both ARs (i.e., an AR 1 on the AR Scale given an AR duration <24 hours).
- The 1800 UTC 12 Mar USBOD sounding also captured the strong southerly low-level jet (50 kt winds ~1,500 feet above ground) in the core of the first AR.

CW3E Event Summary: 12–17 March 2025

Observed Precipitation







- The first AR produced 2–5 inches of precipitation near the Oregon/California border and in the Northern California Coast Ranges, Sierra Nevada, and Transverse Ranges. About 1–3 inches were observed elsewhere in coastal California and the Sierra foothills.
- The second AR produced at least 3–8 inches of precipitation in the Southern Oregon Coast Ranges, Oregon Cascades, Shasta County, and near the California/Oregon border. About 2–4 inches were observed in the North Cascades, Northern California Coast Ranges, Northern and Central Sierra Nevada, and west central Idaho.
- Total 6-day precipitation exceeded 6 inches in portions of the Oregon Coast Ranges, Northern California Coast Ranges, Cascades, and Sierra Nevada. Some locations near the California/Oregon border received >10 inches of total precipitation.

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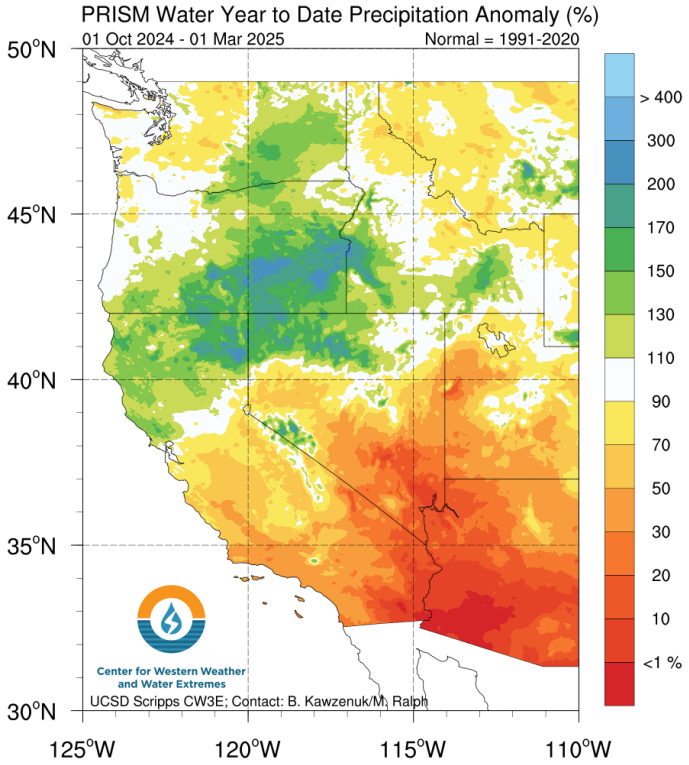
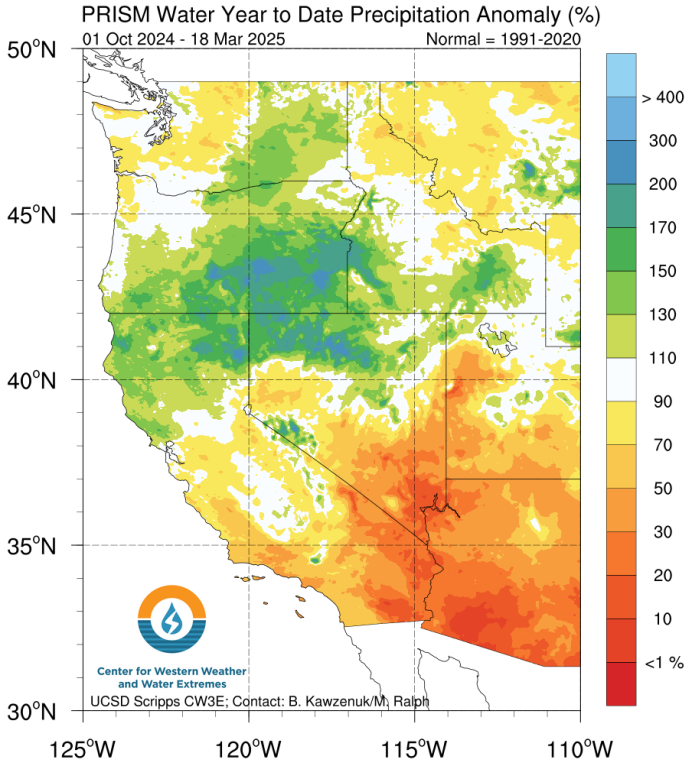
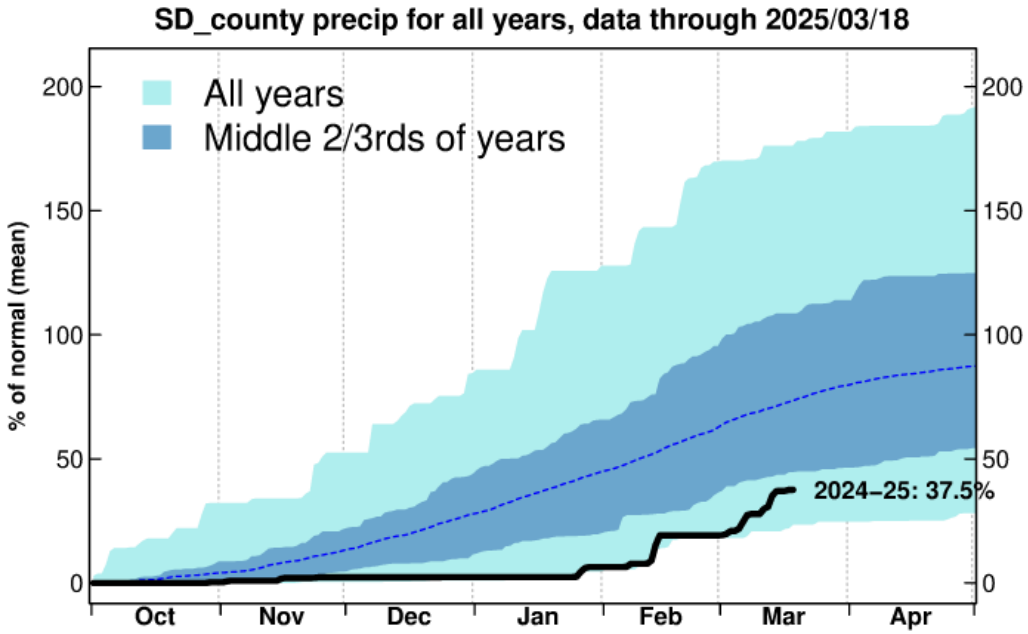
WY 2025 Precipitation

% of Normal Precipitation: 1 Mar



% of Normal Precipitation: 18 Mar





Credit: California–Nevada Applications Program

- Precipitation from these ARs and other storms earlier in March have improved the water year (WY) precipitation and drought outlook in Central and Southern California.
- Since the beginning of March, WY-to-date precipitation has increased from 50–90% of normal to 70–110% of normal in Central California and from 30–50% of normal to 50–70% of normal in much of coastal Southern California.
- As of 18 Mar, San Diego County has received 37.5% of its normal total WY precipitation (51% of normal WY-to-date).

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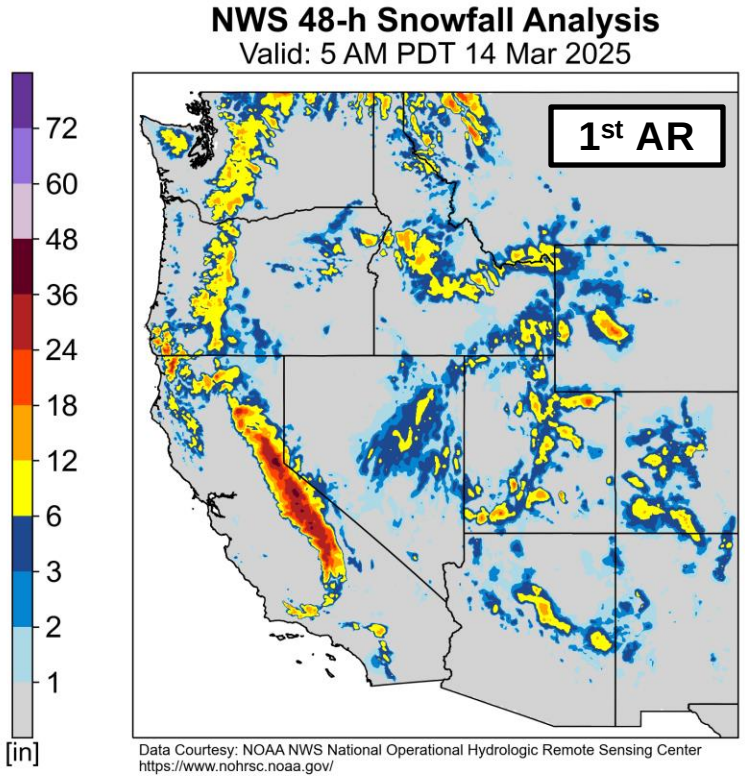
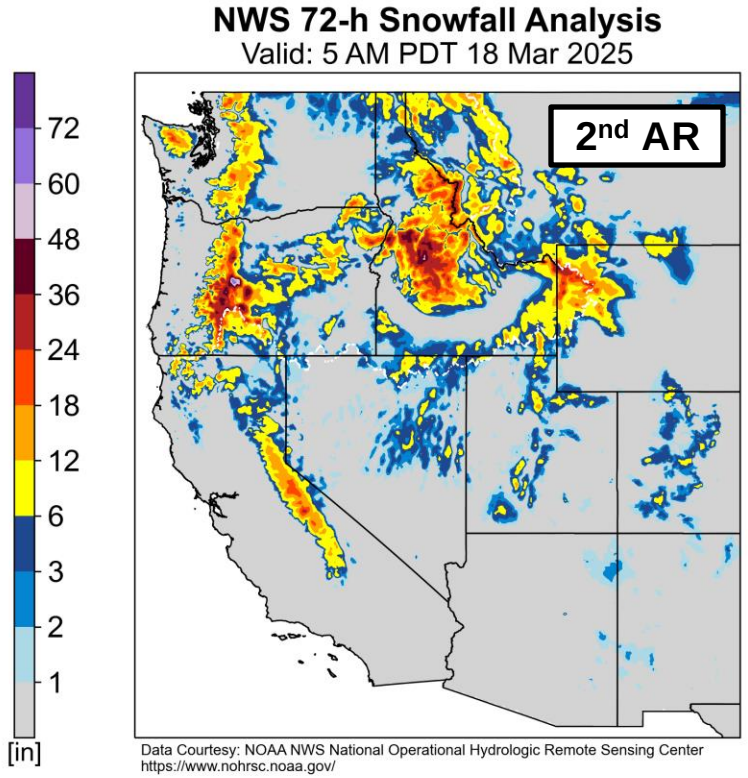
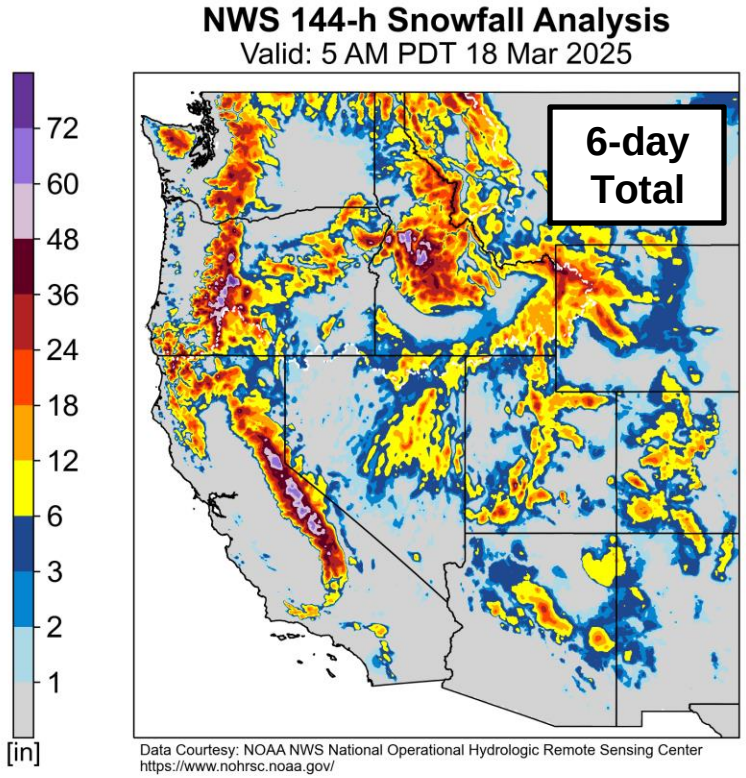
Observed Snowfall







- The first AR produced 12–36 inches of snowfall above 5,000 feet in the Sierra Nevada. Significant snowfall accumulations (>12 inches) were also reported above 6,000 feet in the San Bernardino Mountains.
- The second AR produced at least 24–48 inches of snowfall in the Oregon Cascades and west central Idaho, as well as 12–24 inches of snowfall in portions of the Olympic Mountains, Washington Cascades, and Sierra Nevada.
- Total 6-day estimated snowfall exceeded 48 inches in the higher terrain of the Oregon Cascades and the Central Sierra Nevada.

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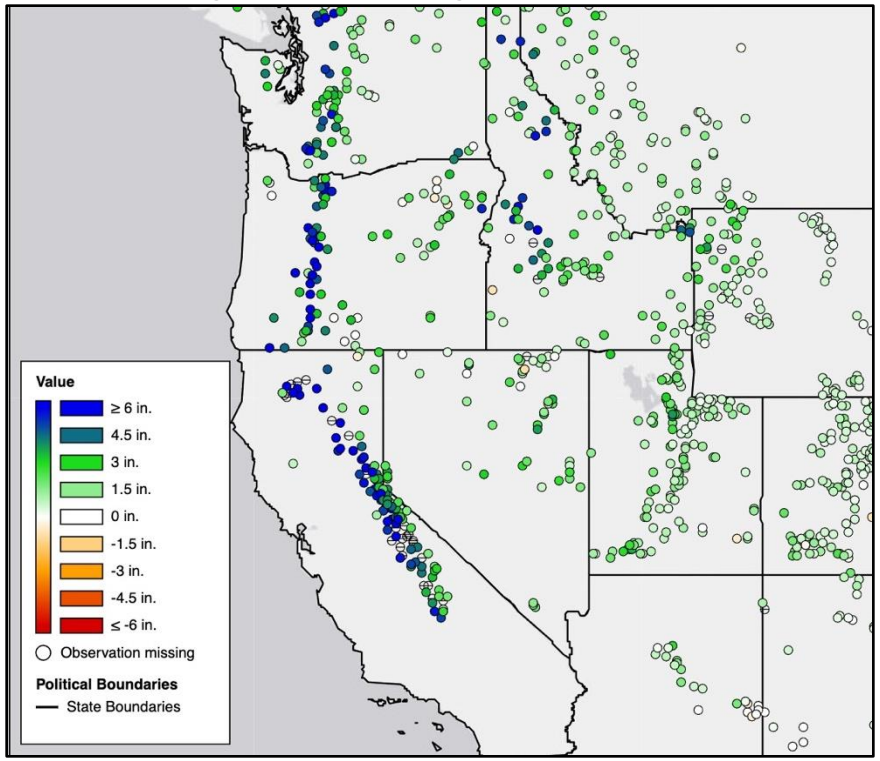
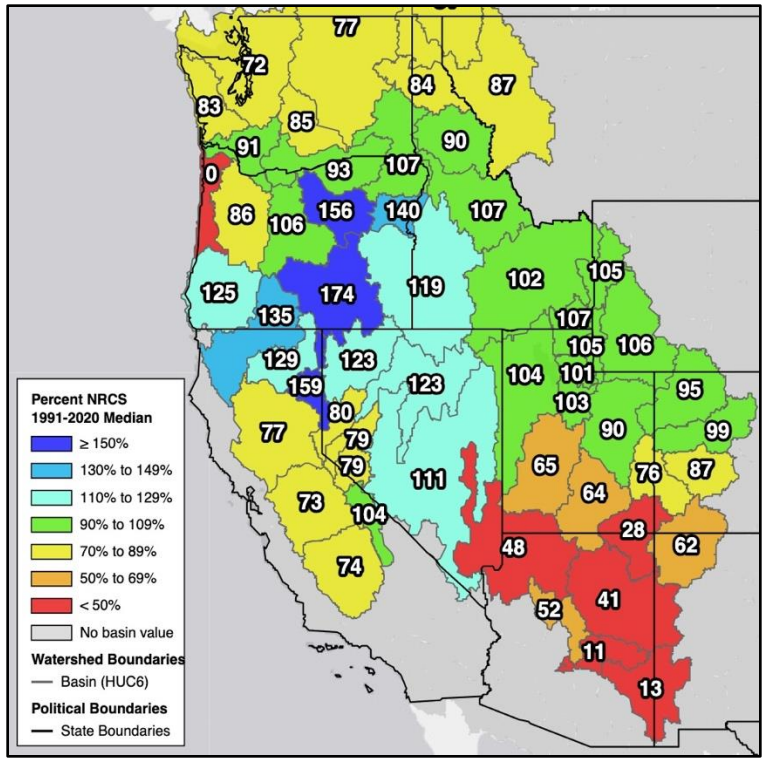
Changes in Snowpack

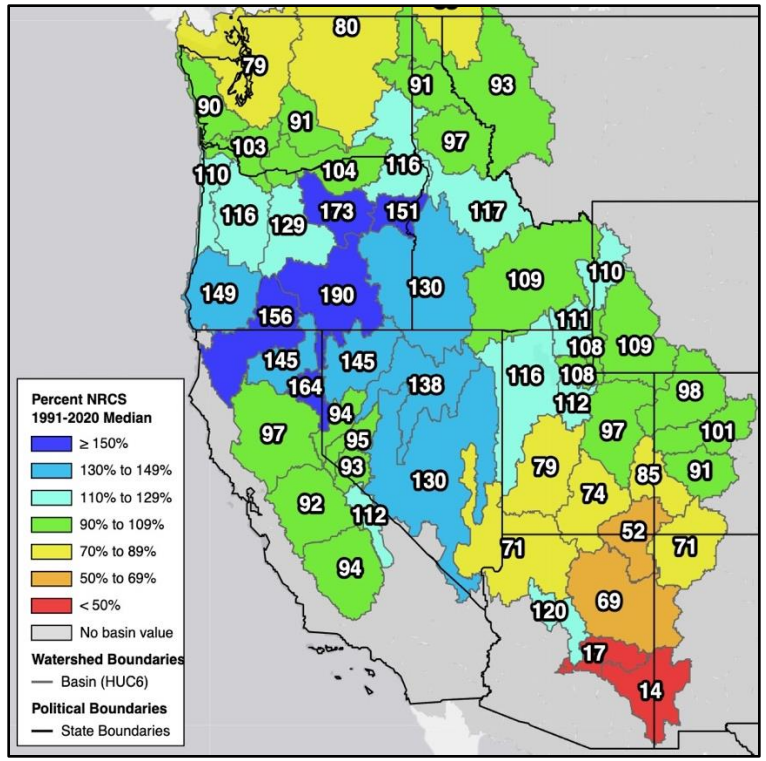
6-day SWE Change: Valid 18 Mar



SWE Percent of Median: Valid 12 Mar



SWE Percent of Median: Valid 18 Mar



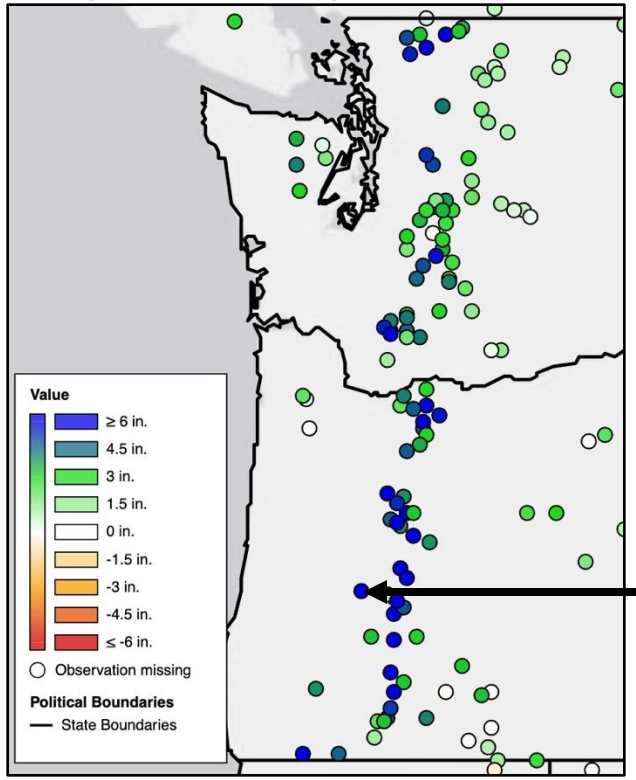
Credit: UCSD NRCS National Water and Climate Center

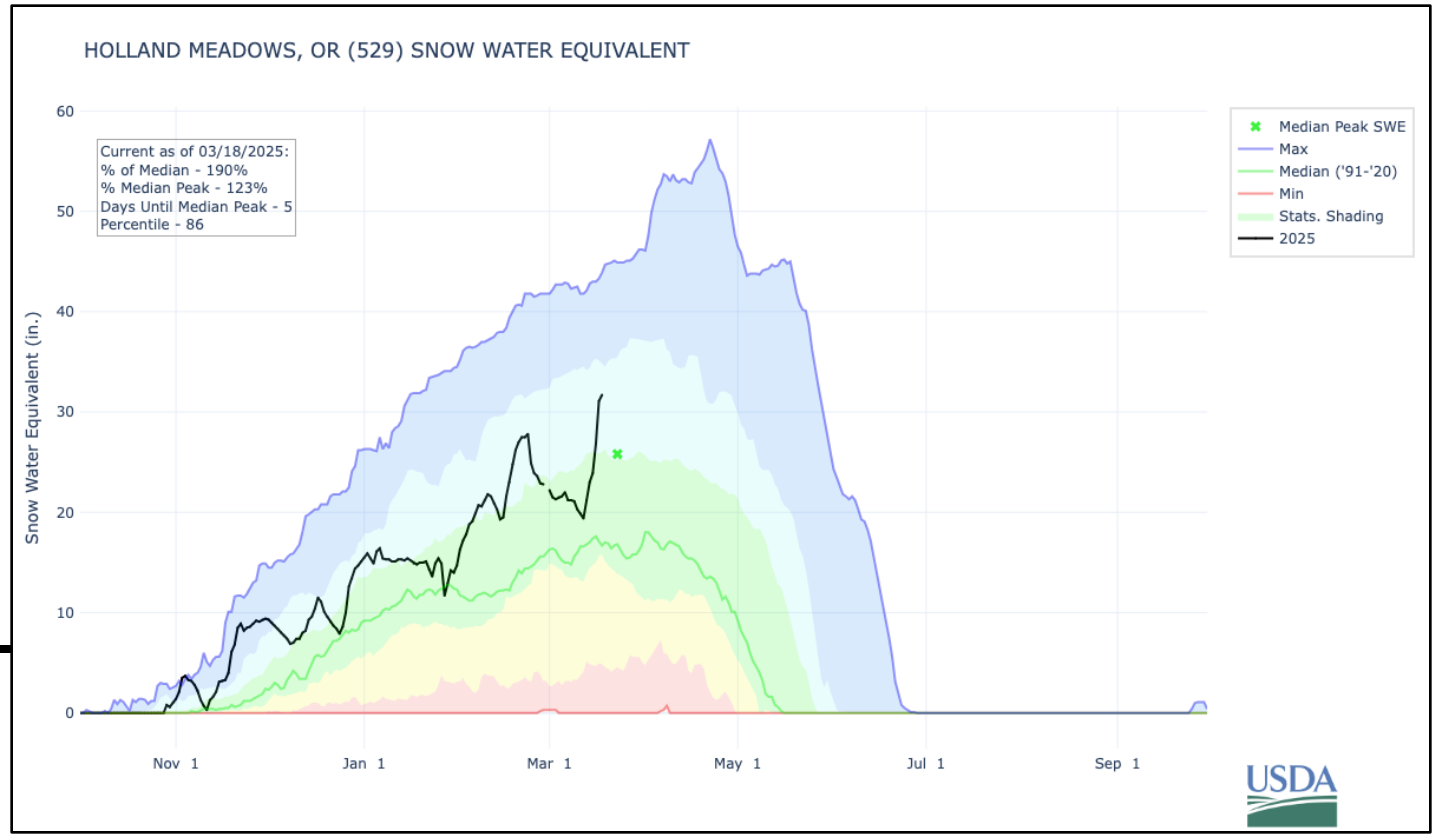
- These storms yielded substantial increases in snowpack above 4,000 feet in the Cascades and above 5,000 feet in the Sierra Nevada.
- Snowpack increased from 72–77% of climatological median on 12 Mar to 92–97% of climatological median on 18 Mar in the Lower Sacramento, San Joaquin, and Tulare basins.
- Notable improvements in snowpack were also observed over the Lower Colorado Basin and in the vicinity of Lake Tahoe.

CW3E Event Summary: 12–17 March 2025

Changes in Snowpack

6-day SWE Change: Valid 18 Mar





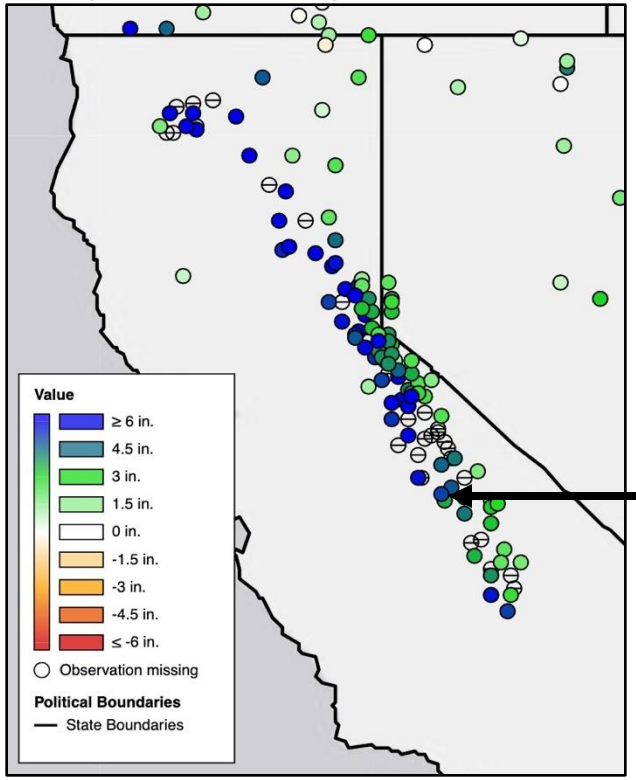
Credit: UCSD NRCS National Water and Climate Center

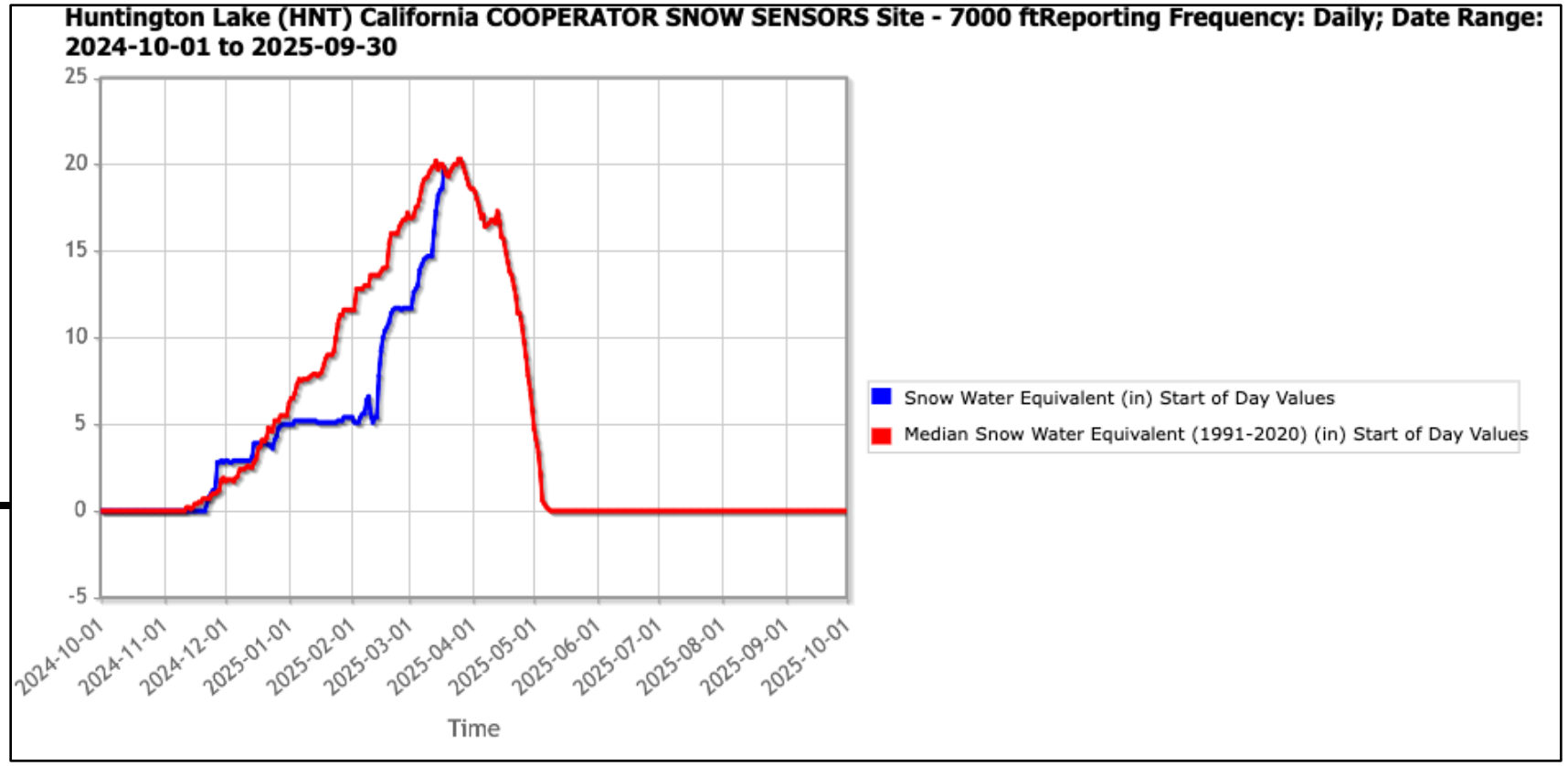
- Many SNOTEL stations in the Oregon Cascades recorded snow water equivalent (SWE) increases on the order of 5–10 inches during the 6-day period ending 18 Mar, with the largest increases observed during the second AR.
- The 6-day SWE increase of 12.3 inches at Holland Meadows represents 48% of the station's climatological median peak SWE. As of 18 Mar, snowpack at Holland Meadows is 190% of the climatological median for this time of year.

CW3E Event Summary: 12–17 March 2025

Changes in Snowpack

6-day SWE Change: Valid 18 Mar





Credit: UCSD NRCS National Water and Climate Center

- Significant increases in snowpack were also observed in the Northern and Central Sierra Nevada, while SWE increases of 2–6 inches were observed in the Southern Sierra Nevada,
- The 6-day SWE increase of 5.1 inches at Huntington Lake represents 24% of the station's climatological peak SWE. Following a very dry January, snowpack at Huntington Lake has increased from 47% of median on 1 Feb to 100% of median on 18 Mar.

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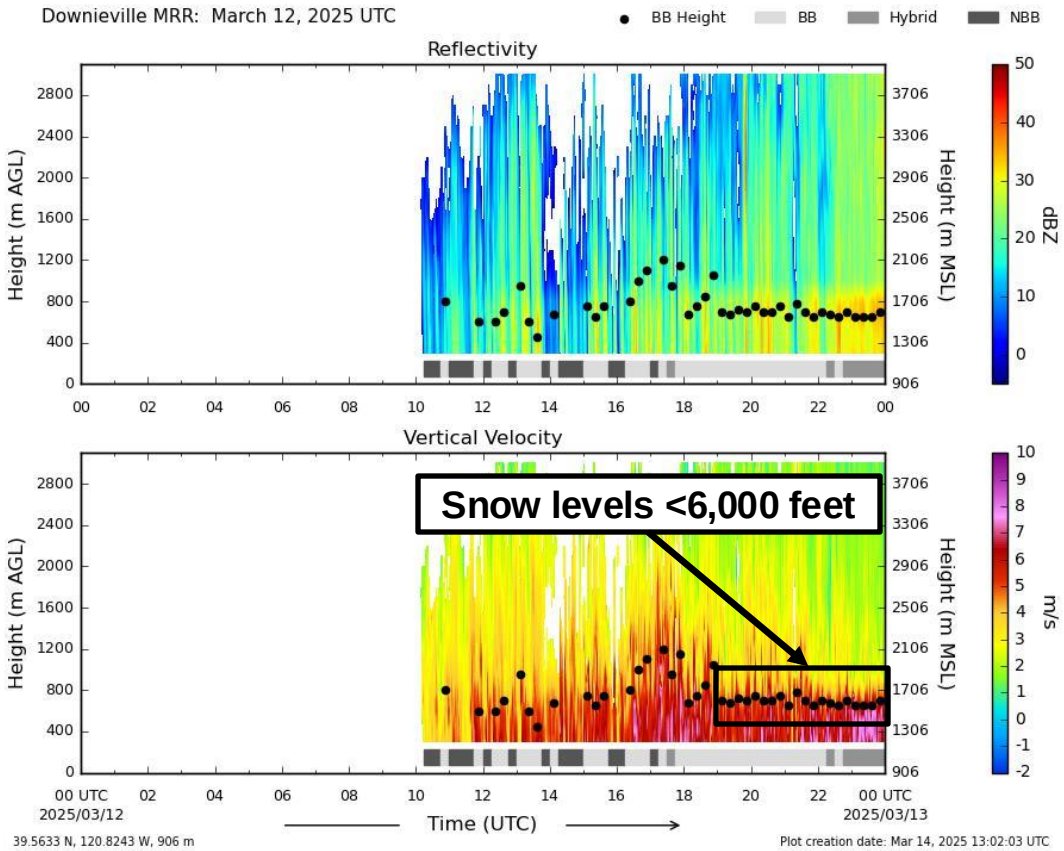
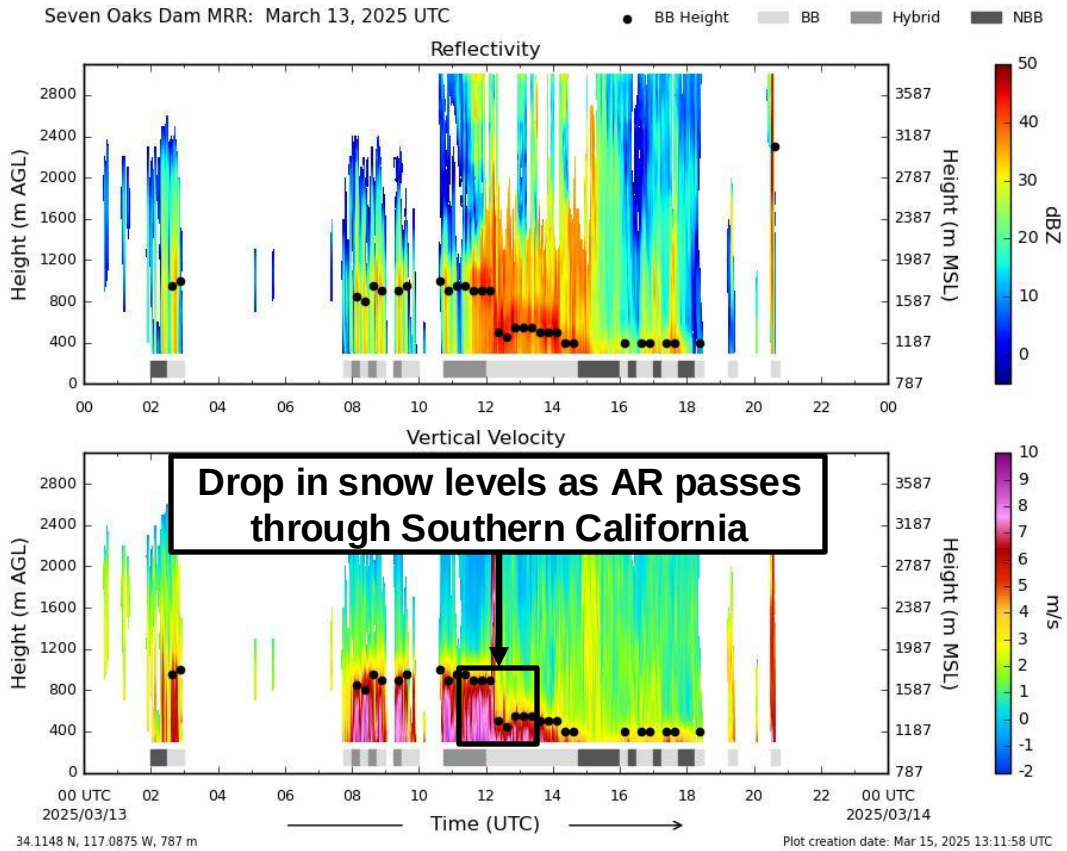
CW3E MicroRain Radar: Downieville and Seven Oaks Dam





- CW3E's MicroRain Radars (MRRs) at Downieville (left; Upper Yuba watershed) and Seven Oaks Dam (right; Santa Ana watershed) captured the low snow levels (indicated by bright band heights <6,000 feet) during the first AR.
- The Seven Oaks Dam MRR also captured an abrupt ~1,000-foot drop in snow levels as the AR passed through Southern California.

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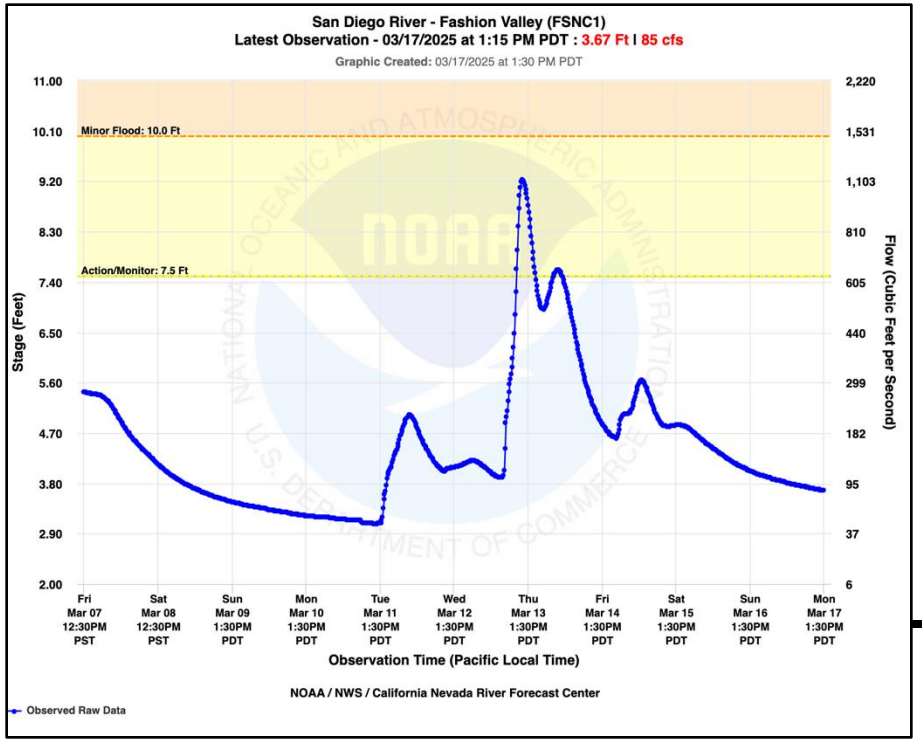
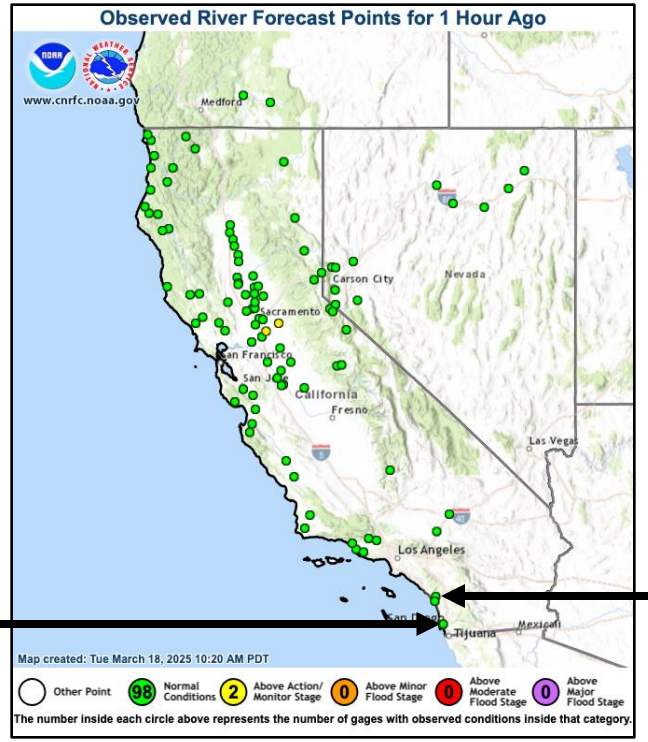
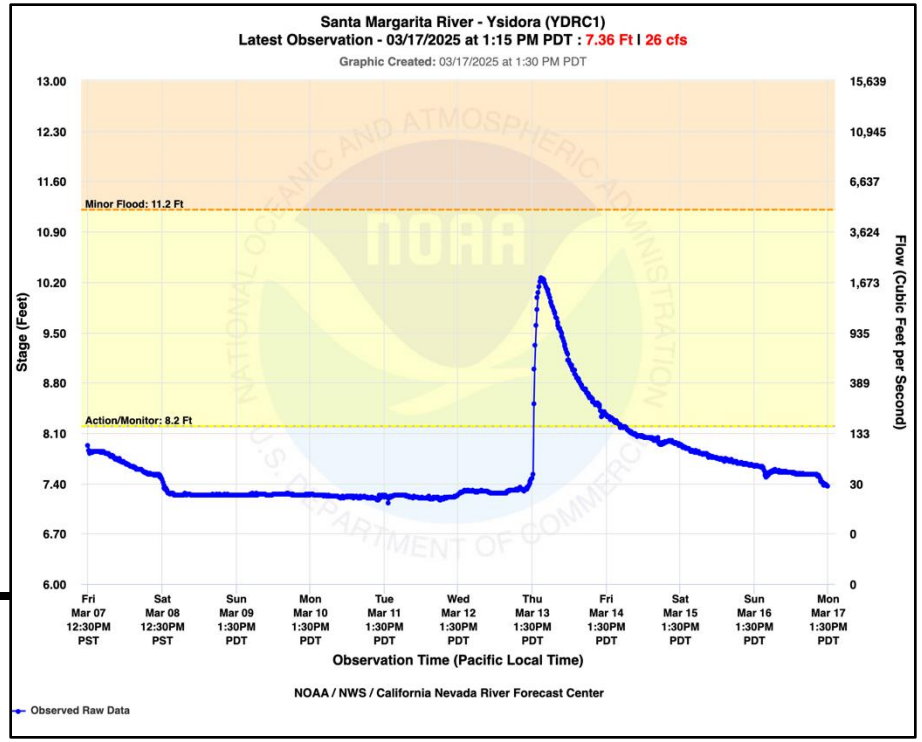
Hydrologic Impacts: First AR



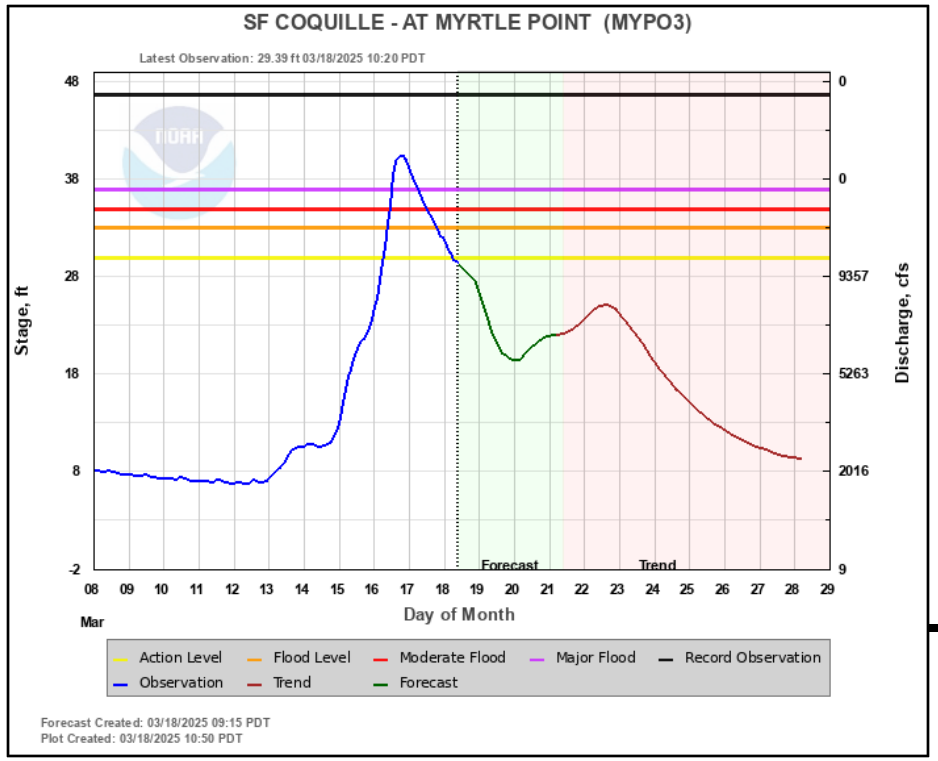


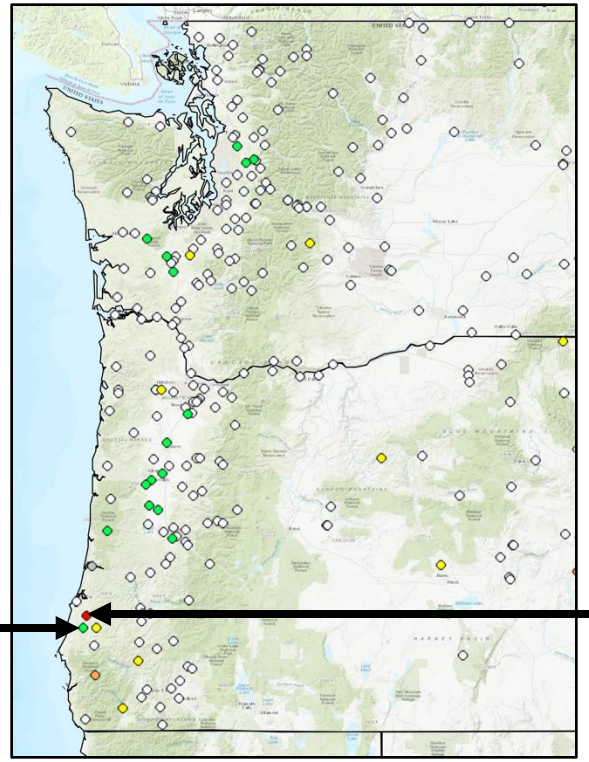


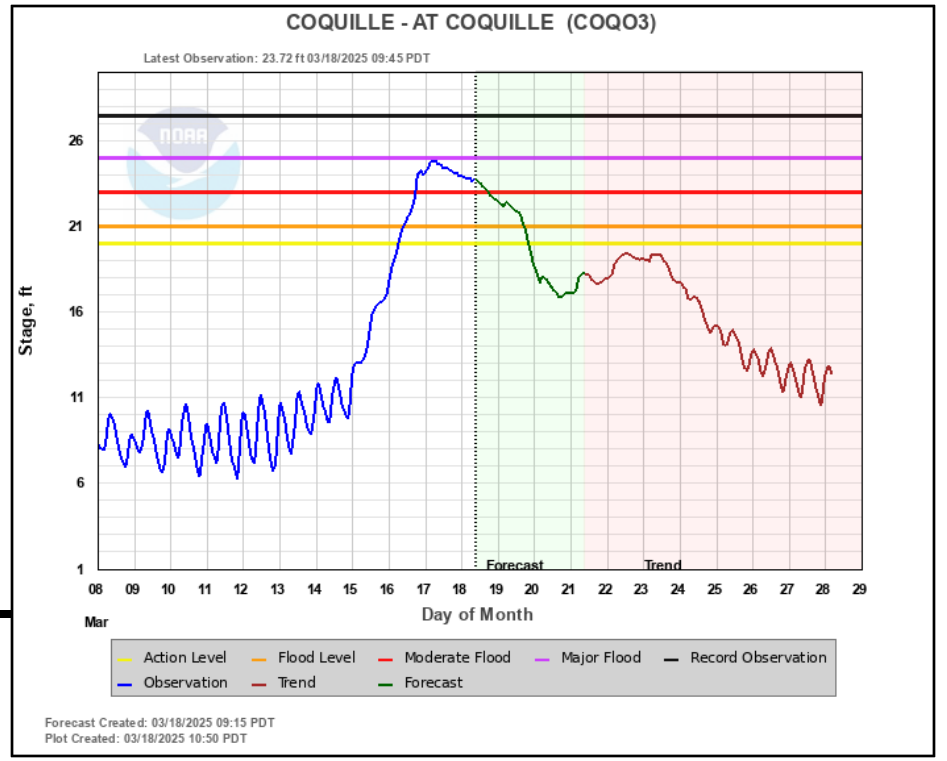
- Although the first AR only brought a brief period of AR conditions to Southern California, several hours of moderate-to-heavy rainfall triggered rapid streamflow responses on rivers and creeks in Orange and San Diego Counties.
- The San Diego River at Fashion Valley (FSNC1) and the Santa Margarita River at Ysidora (YDRC1) both crested above action/monitor stage on 13 Mar.

CW3E Event Summary: 12–17 March 2025

Hydrologic Impacts: Second AR





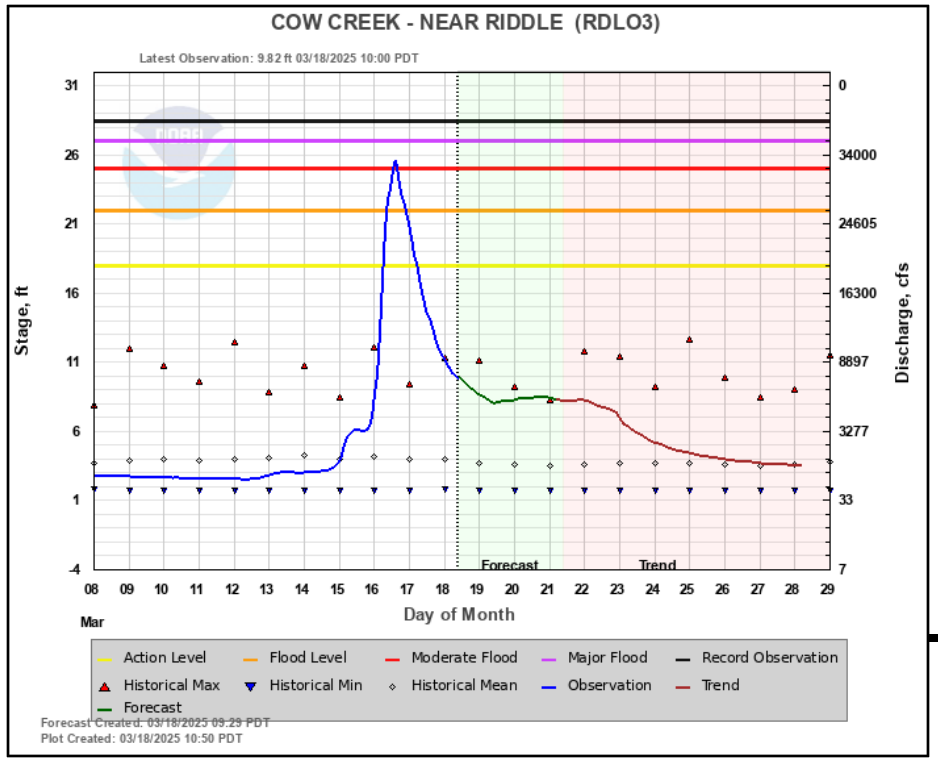


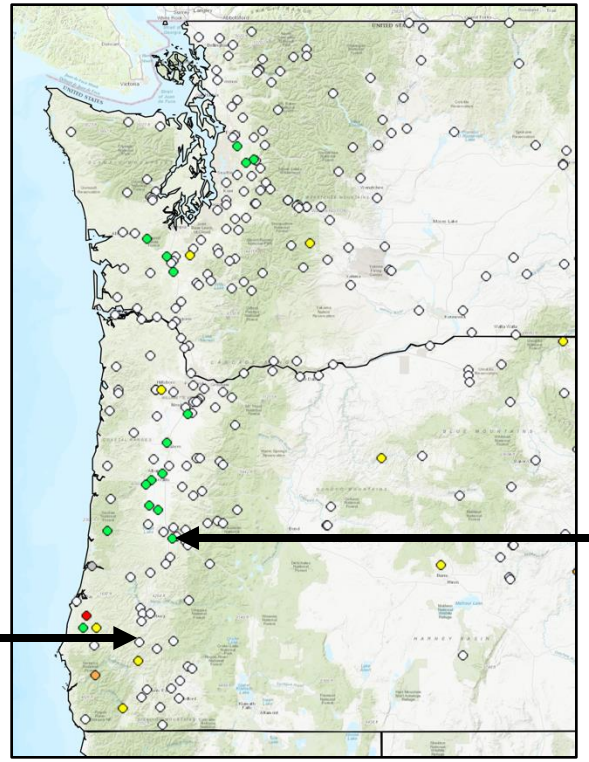
Credit: NOAA/NWS Northwest River Forecast Center

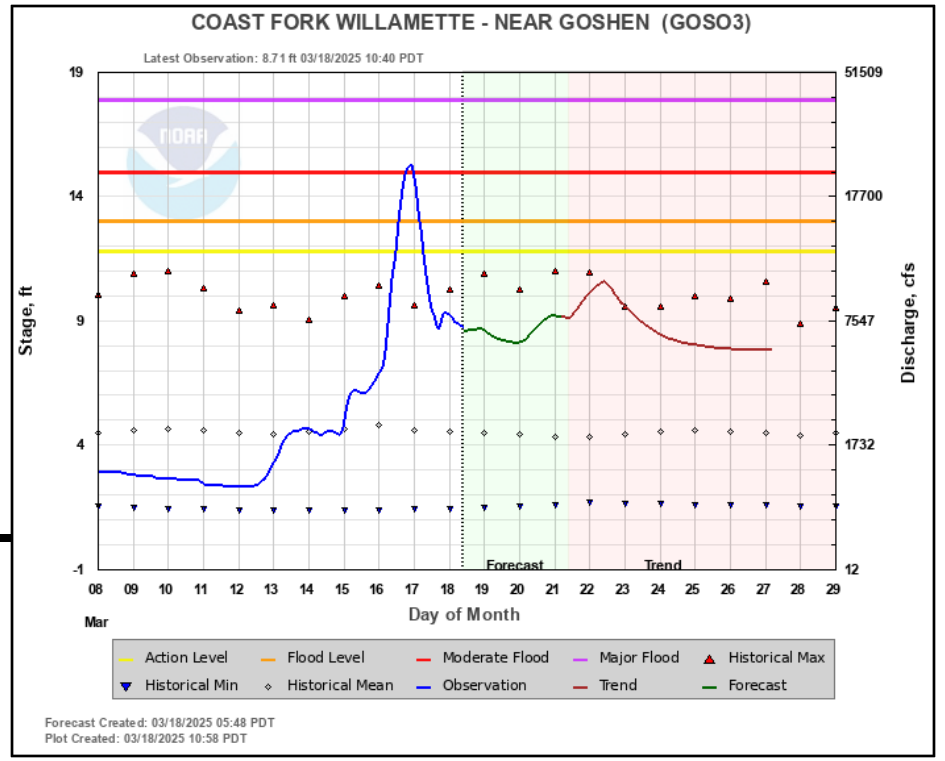
- Heavy rain falling on saturated soils during the second AR caused significant riverine flooding in southwestern Oregon.
- The South Fork Coquille River at Myrtle Point (MYPO3) rose nearly 30 feet in 48 hours, cresting above **major flood stage** during the evening of 16 Mar.
- The Coquille River at Coquille (COQO3) crested just below **major flood stage** during the morning of 17 Mar.
- The peak stage of 24.84 feet at COQO3 is the 8th highest stage at this location since records began in WY 1956.

CW3E Event Summary: 12–17 March 2025

Hydrologic Impacts: Second AR







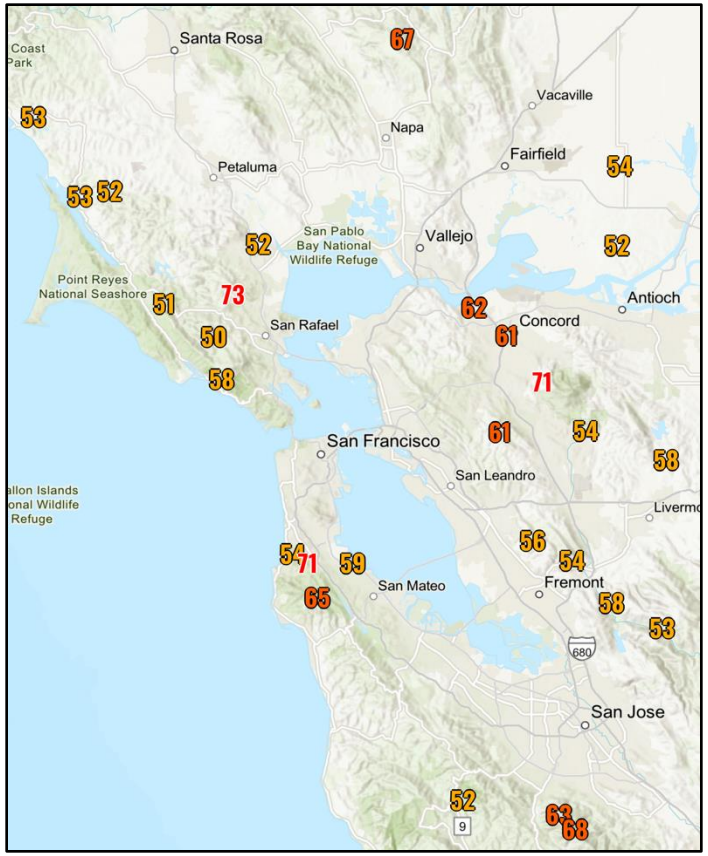
Credit: NOAA/NWS Northwest River Forecast Center

- Cow Creek near Riddle (RDLO3) and the Coast Fork Willamette River near Goshen (GOSO3) both exceeded **moderate flood stage**.
- The peak stage of 25.64 feet at RDLO3 is the 7th highest stage at this location since records began in WY 1951.

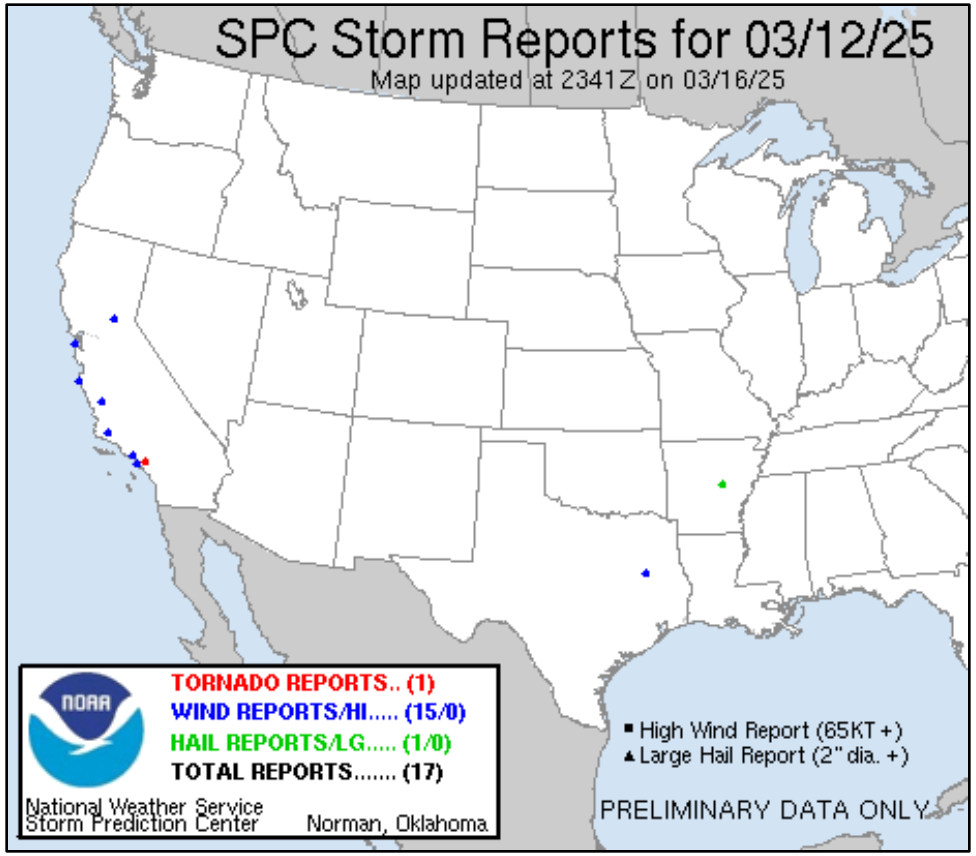
CW3E Event Summary: 12–17 March 2025

Impacts: First AR

Max Observed Wind Gust: 12 Mar



Credit: NOAA/NWS Western Region Headquarters



- As the first AR made landfall over California, high winds were observed in association with a southerly low-level jet.
- Numerous stations in the Bay Area reported peak wind gusts >50 mph. A few PG&E stations at higher elevations recorded wind gusts >70 mph.
- Strong winds damaged trees as well as structures.
- An EF0 tornado with estimated wind speeds of 85 mph was confirmed in Pico Rivera, CA, about 10 miles southeast of Downtown Los Angeles.

CW3E Event Summary: 12–17 March 2025

Impacts: First AR

- Heavy snow during the first AR created hazardous travel conditions in the Sierra Nevada, leading to multiple vehicle crashes.
- Heavy rain caused roadway flooding in the Bay Area, metro Los Angeles, and Central Valley, as well as landslides in Del Norte and Humboldt Counties.
- Debris flows were reported in Mariposa and Orange Counties. Orange County Fire Authority rescued a person whose vehicle was caught in floodwaters near Trabuco Creek in San Juan Capistrano, CA.

Vehicle Crash on SR 89 in Alpine County

Credit: California Highway Patrol South Lake Tahoe

Slide on SR 36 in Humboldt County

Credit: Caltrans District 1

Vehicle Carried by Floodwaters Near Trabuco Creek

Credit: KTLA and Orange County Fire Authority

CW3E Event Summary: 12–17 March 2025

Impacts: Second AR

- Heavy rain associated with the second AR caused severe flooding across southwestern Oregon, particularly in Josephine and Douglas Counties. Floodwaters inundated numerous roads and prompted multiple emergency rescues.

- Landslides were also reported in Coos and Douglas Counties, one of which blocked both lanes of Highway 138 east of Glide, OR.

- Heavy snow and high winds created dangerous travel conditions at higher elevations, leading to closures of Highway 58 and the Mt. Ashland Ski Area.

Slide on Highway 138 in Douglas County

Credit: Oregon DOT and KLCC Eugene

Flooding in Josephine County

Credit: Rural Metro Fire - Josephine County and The Oregonian

Flooding in Elkton, OR

Credit: Chris Pietsch/The Register-Guard