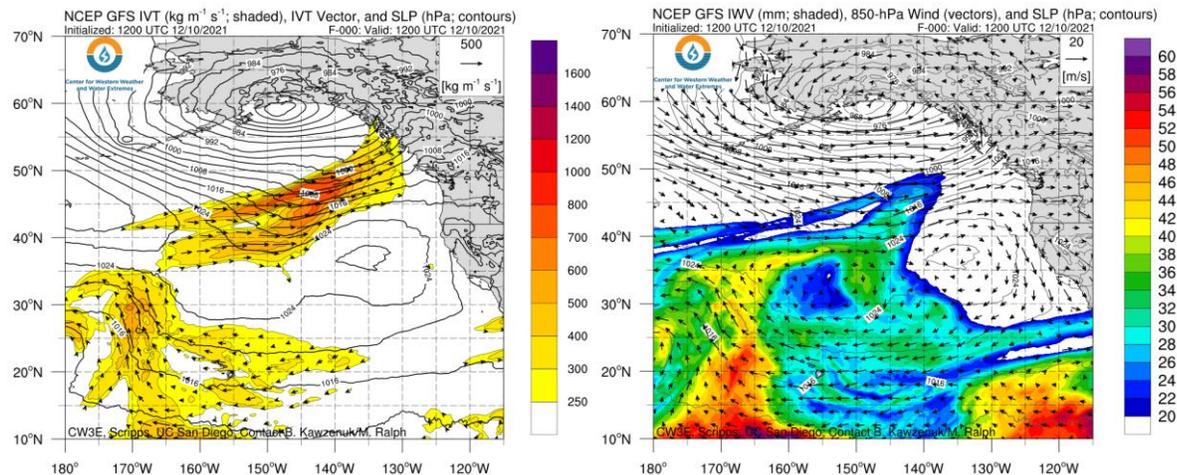


CW3E Atmospheric River Outlook

A long duration atmospheric river is forecast to bring substantial snowfall to the West Coast's mountains this weekend and into next week

- The AR is forecast to initially make landfall over the Pacific Northwest on Saturday morning, bringing IVT magnitudes between 600 and 700 $\text{kg}/\text{m s}$ to coastal Washington and Oregon
- The AR is then forecast to weaken as it moves southward over the coast, eventually bringing weak AR conditions to the Bay Area before stalling
- As the weak AR is stalled over the Northern California Coast, a separate frontal system is forecast to merge with the weak AR, intensifying and prolonging AR conditions over the region
- The GEFS is currently exhibiting high ensemble spread in association with the merger of the two separate systems over Northern California, resulting in high uncertainty in timing and magnitude of the re-intensification of the AR and the overall duration of the event
- The combination of low-freezing levels and the long duration of the event will result in substantial snowfall of 5 – 8 feet over the Sierra Nevada, resulting in treacherous travel conditions but an extremely beneficial contribution to the depleted California snowpack

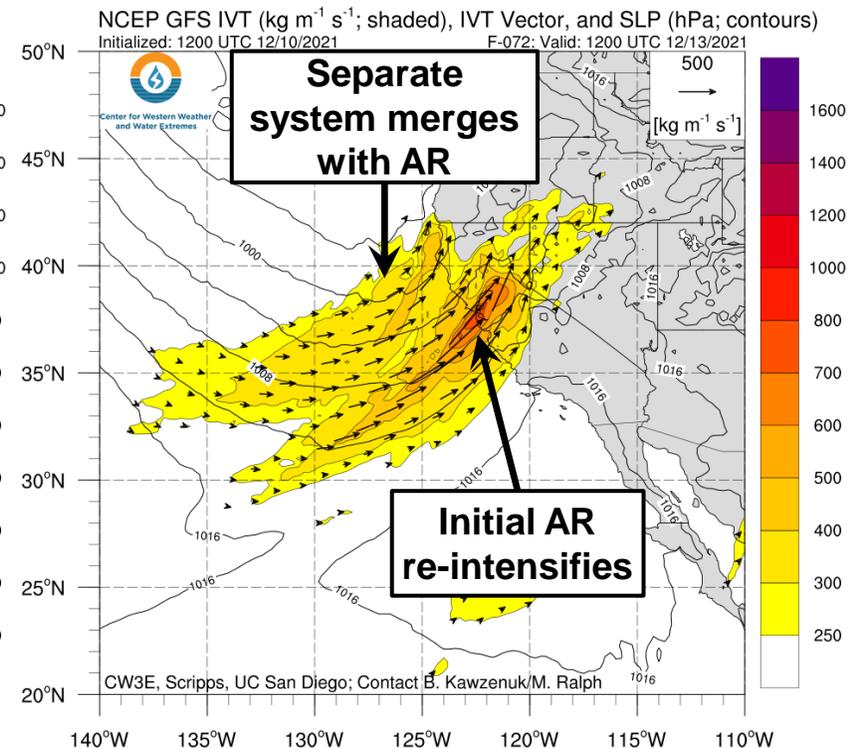
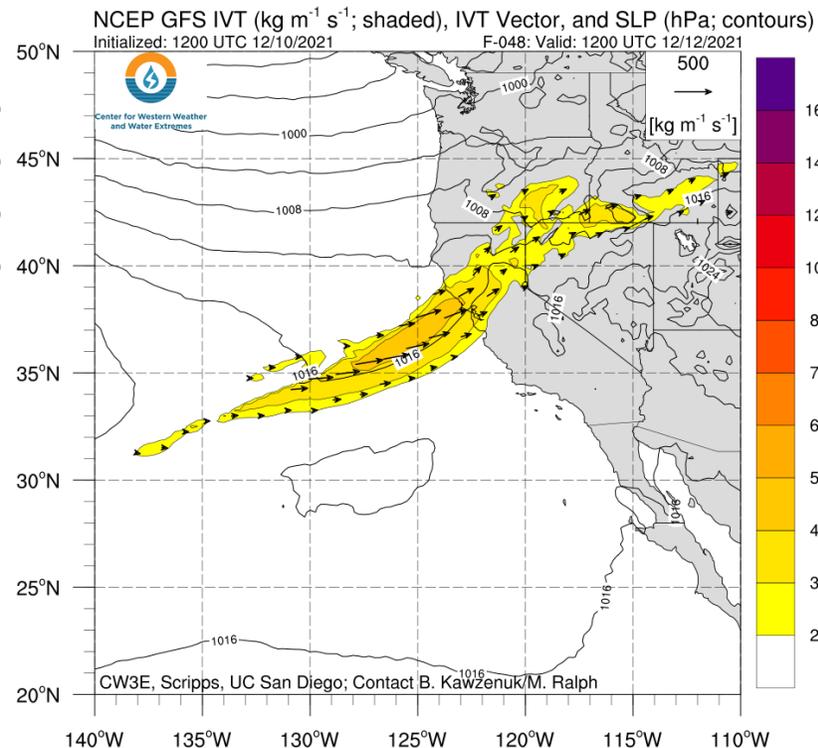
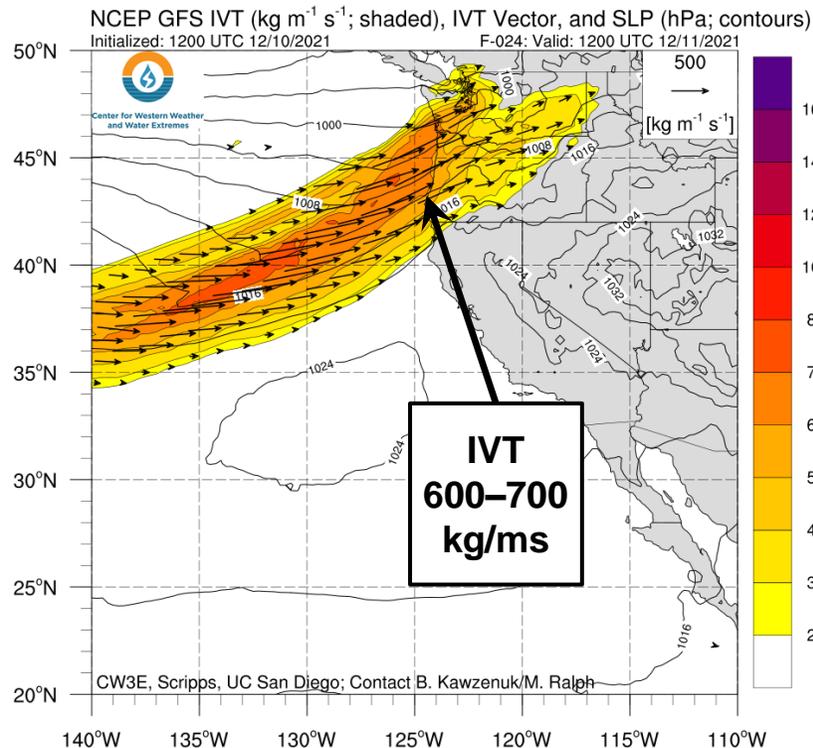


GFS IVT Forecast

A) Valid: 4 AM PST 11 Dec 2021

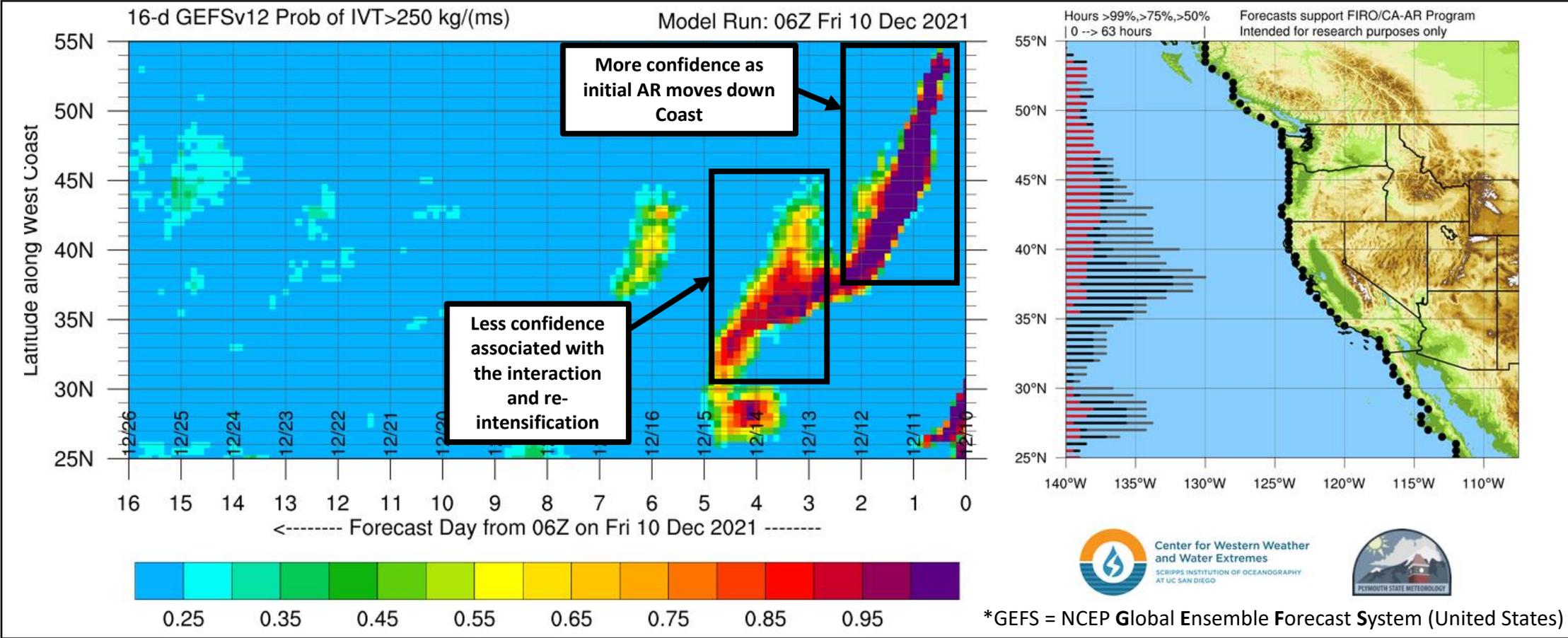
B) Valid: 4 AM PST 12 Dec 2021

C) Valid: 4 AM PST 13 Dec 2021



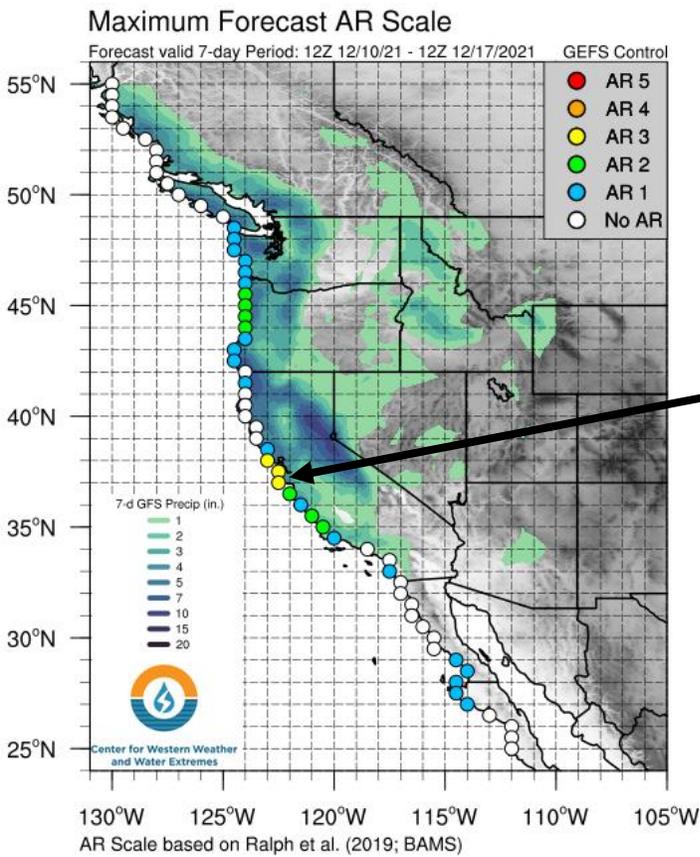
- The AR is forecast to initially make landfall over the Pacific Northwest in the early Saturday morning, bringing IVT magnitudes between 600 and 700 kg/ms to coastal Oregon and Washington
- The AR is then forecast to weaken and move southward over the coast, bringing IVT magnitudes between 400 and 500 kg/ms to coastal Northern California on Sunday morning
- As the initial AR is weakening, a separate frontal system moves in from the west, merging with the initial AR and re-intensifying IVT to $>700 \text{ kg/ms}$ and prolonging AR condition durations over the Bay Area on Monday morning

Probability of AR Conditions Along Coast



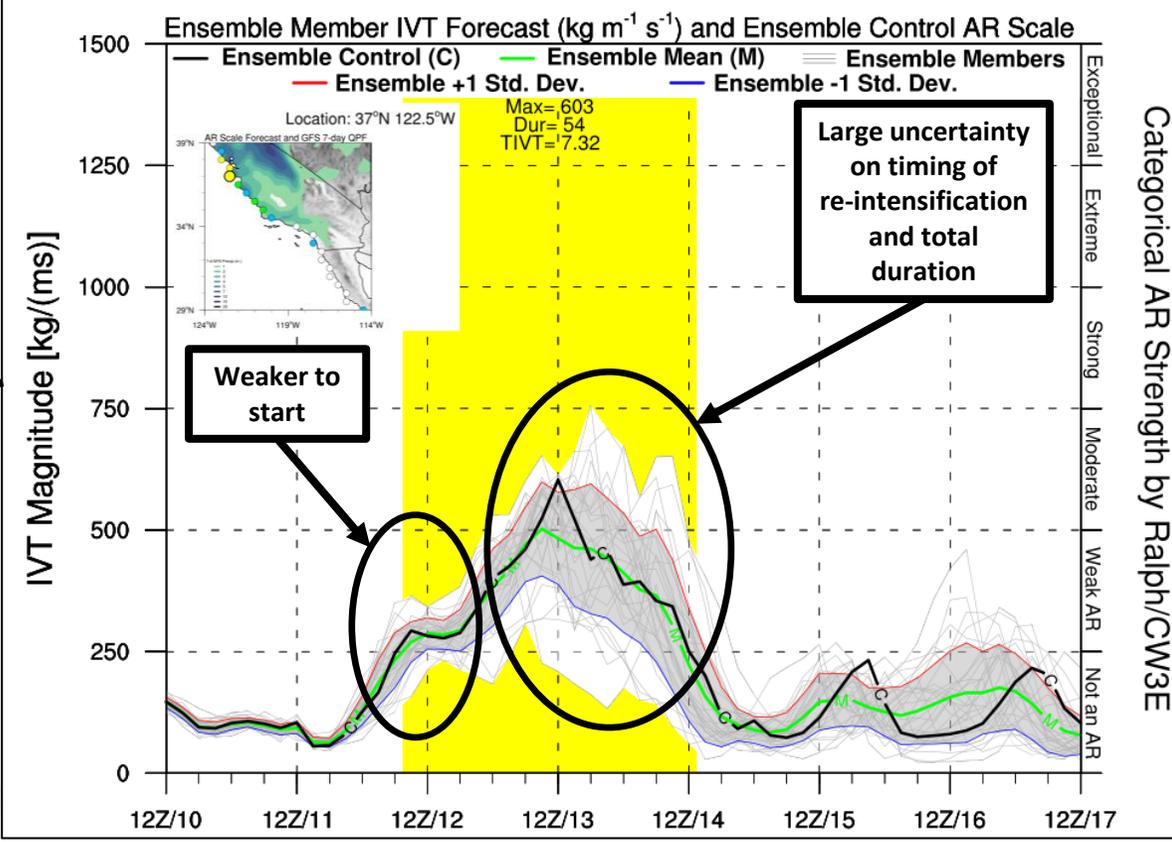
- The GEFS is currently showing high ensemble probabilities (~100%) of IVT > 250 kg/ms as the AR initially moves southward over the Coast from the Pacific Northwest to Northern California
- There is less ensemble agreement (<95%) associated with the latter portions of the event as a separate system interacts with the initial AR, intensifying IVT and prolonging the overall duration of the AR

GEFS AR Scale Forecast



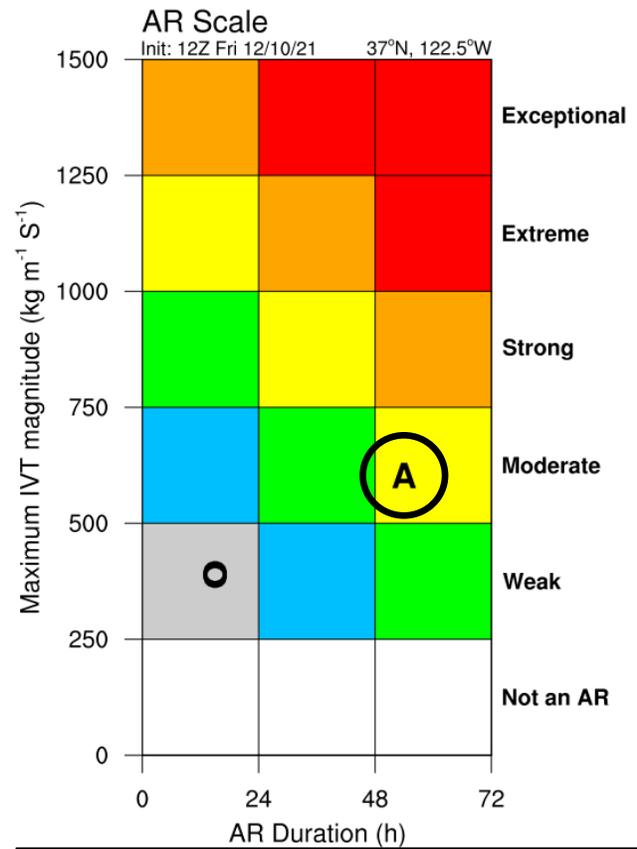
The GEFS control member is currently forecasting this AR to bring AR 1 and 2 conditions to the Pacific Northwest and AR 3 conditions to the San Francisco Bay Area

GFS Ensemble Initialized: 12Z Fri 12/10/21



- The IVT plume diagram for all ensembles shows the lower ensemble spread as the weak AR conditions begin impacting the Bay Area
- There is considerable spread associated with the re-intensification of the AR, with large differences in the overall magnitude and timing of the IVT peak

Categorical AR Strength by Ralph/CW3E



The GEFS control is currently predicting borderline AR 3 conditions, with a maximum IVT mag. of 603 kg/ms and a total duration of 54 hours

Atmospheric River Outlook: 10 December 2021

For California DWR's AR Program

GEFS AR Scale Forecast

Location: 37°N 122.5°W

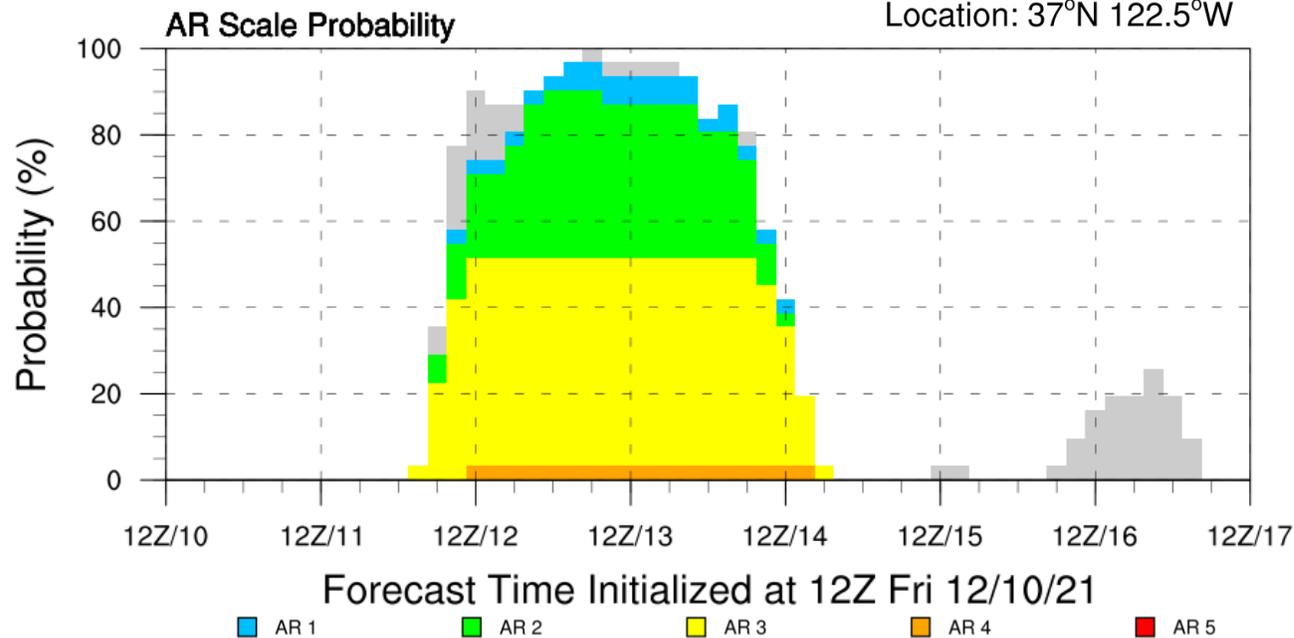
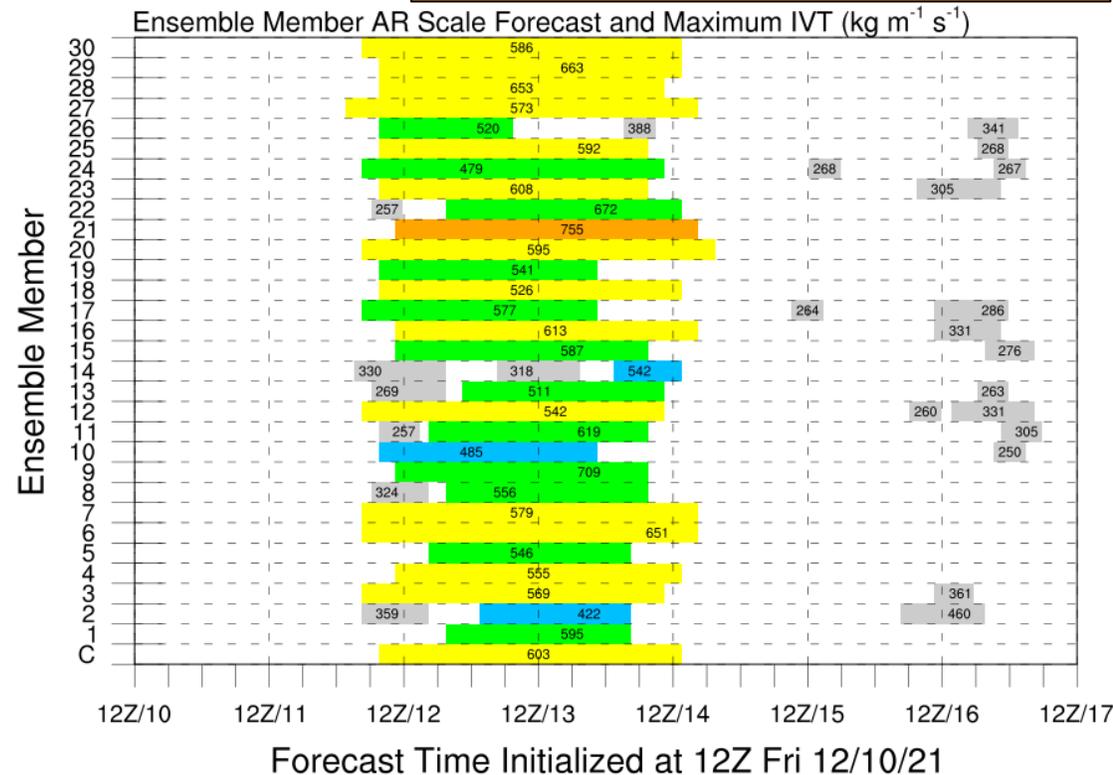


Image created: 17 UTC 12/10/2021

More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

- Due to the large uncertainty surrounding the interaction of the initial AR with a separate system on the 13th, there continues to be some uncertainty in the forecast of the AR Scale over the Bay Area
- While there is some uncertainty, a majority of the ensembles (87%) are predicting AR 2 or 3 conditions over the Bay Area



AR Scale	# of Ensembles	% of Ensembles
1	3	~10%
2	12	~39%
3	15	~48%
4	1	~3%

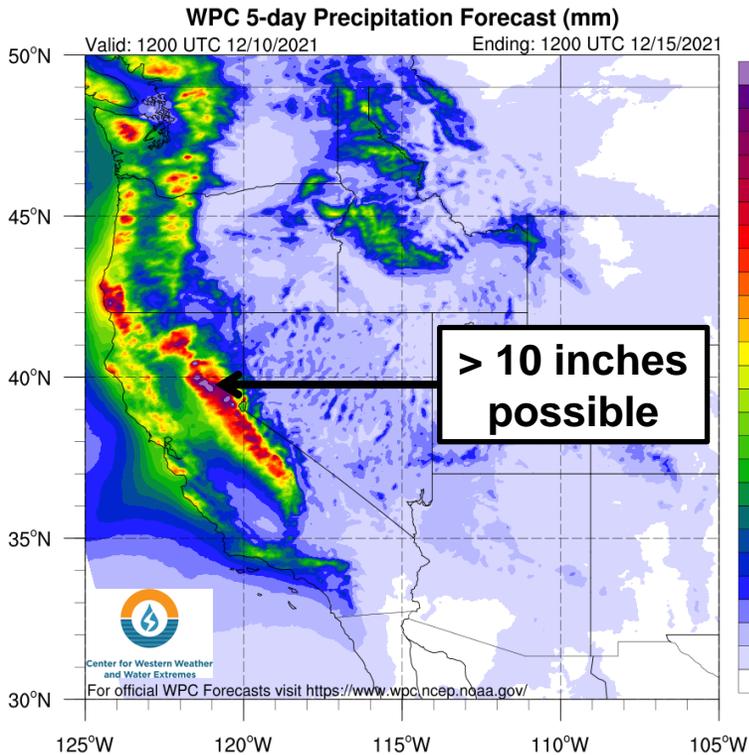
Atmospheric River Outlook: 10 December 2021



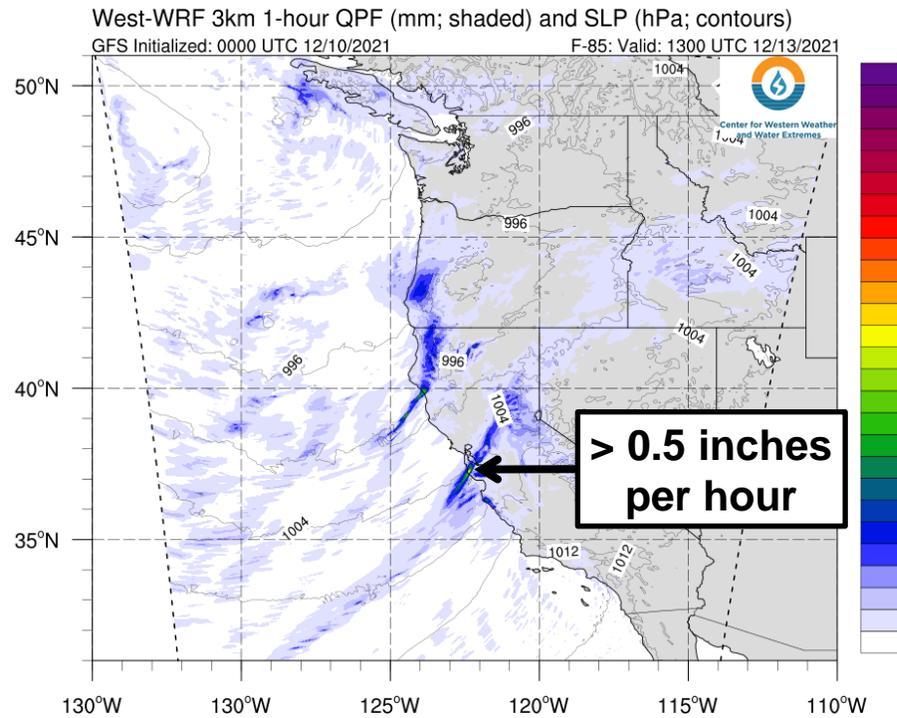
For California DWR's AR Program

Precipitation Impacts

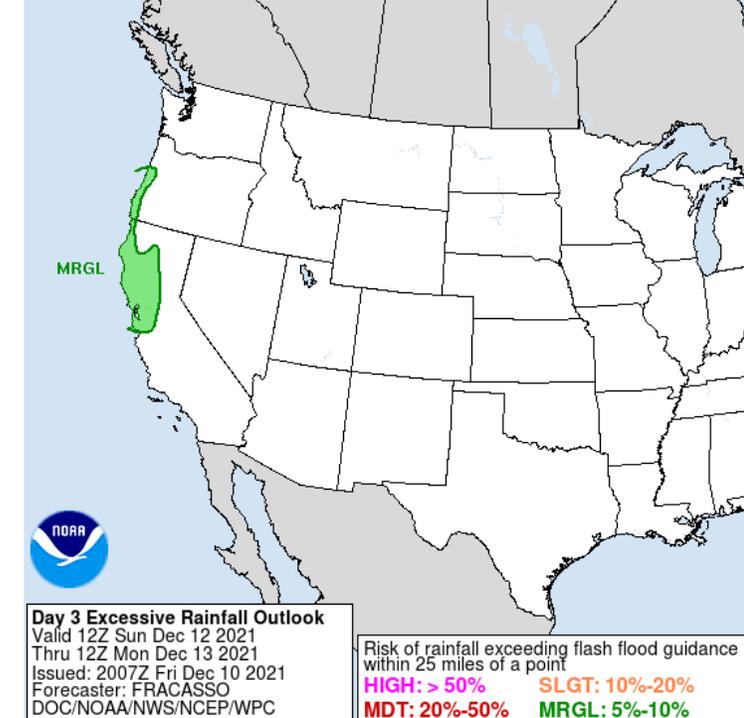
WPC 5-day QPF: Valid 4 AM PT 10–15 Dec



West-WRF 1-h QPF: Valid 5 AM 13 Dec



WPC Day 3 Excessive Rainfall Outlook



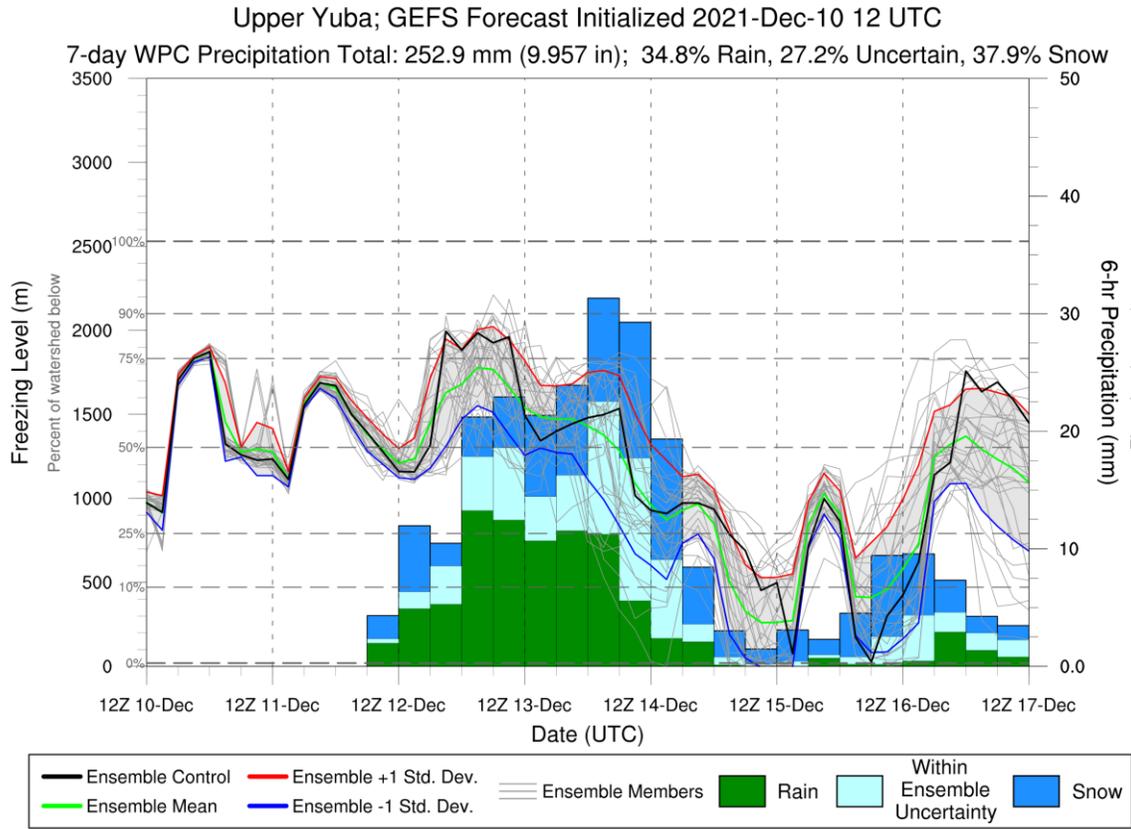
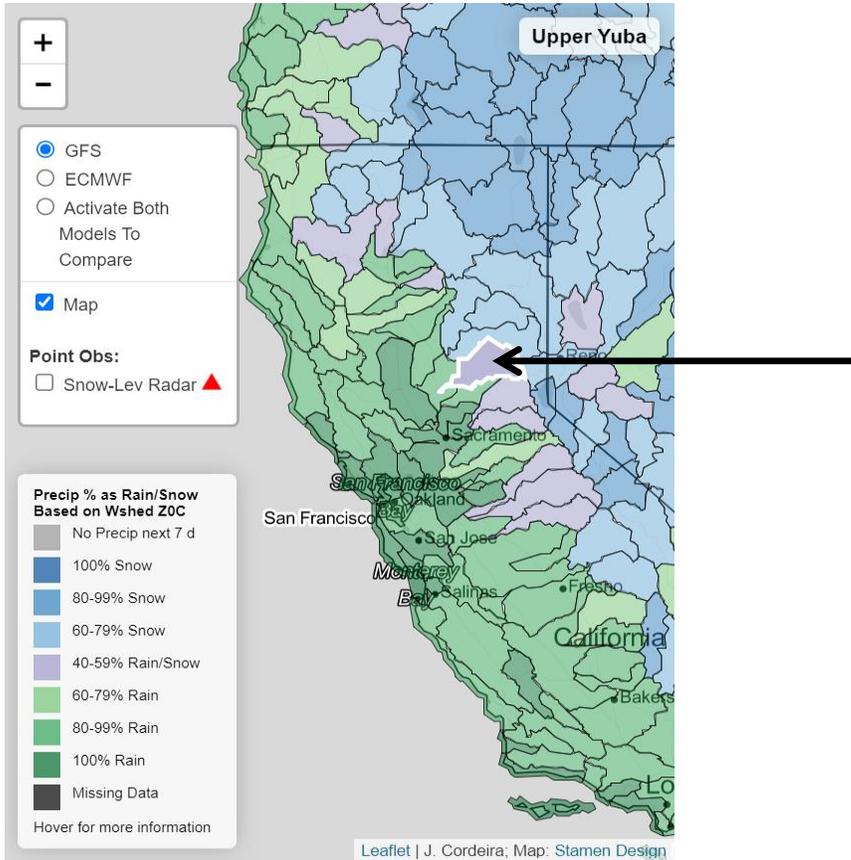
Source: NOAA/NWS Weather Prediction Center

- This AR is expected to bring widespread heavy precipitation to the US West Coast over the next several days
- At least 5–10 inches of precipitation is forecasted across much of the Pacific Coast Ranges, Cascades, and Sierra Nevada over the next 5 days
- Locally higher amounts (> 10 inches) are possible along the western slopes of the Northern Sierra Nevada
- The 00Z West-WRF is forecasting a burst in rainfall intensity (peak rates > 0.5 inches/hour) as the AR re-intensifies near the Bay Area during the morning of 13 Dec
- The NWS WPC has issued a marginal risk of rainfall exceeding flash flood guidance for portions of Northern California, including the Bay Area

Atmospheric River Outlook: 10 December 2021

For California DWR's AR Program

Watershed Freezing Level and Precipitation Forecasts: Upper Yuba



- The NWS WPC is forecasting nearly 10 inches of mean areal precipitation in the Upper Yuba watershed during the next 7 days
- Freezing levels are forecasted to remain below 6,000 ft for most of the event, steadily dropping as the event progresses
- Low freezing levels suggest that a significant portion of the precipitation in the Yuba-Feather region will likely fall in the form of snow, particularly during the second half of the event

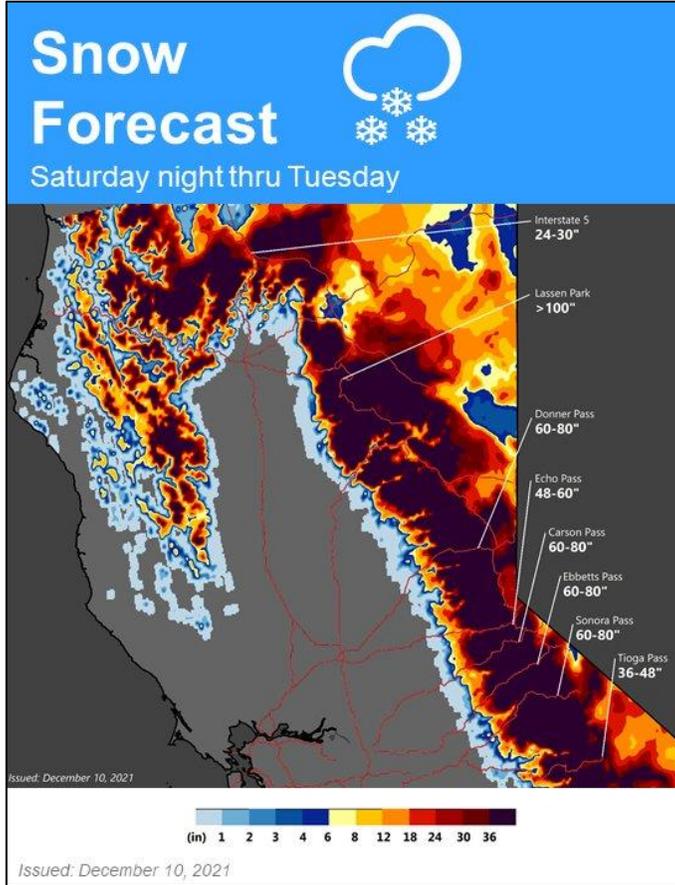
Atmospheric River Outlook: 10 December 2021



For California DWR's AR Program



Go to weather.gov for up-to-date and point-specific forecasts, watches and warnings



Impact

None Minor Moderate Major Extreme

↑

- Chain controls and possible road closures
- Dangerous travel with excessive delays
- Significant reduction in visibility with whiteout condition at times
- Possible downed trees, tree branches and power outages

Snow levels

4000 to 5000 feet falling to 2500 to 3500 feet Tuesday morning

Timing

Saturday night – Tuesday. Heaviest Sunday night – Monday night.

National Weather Service | Sacramento

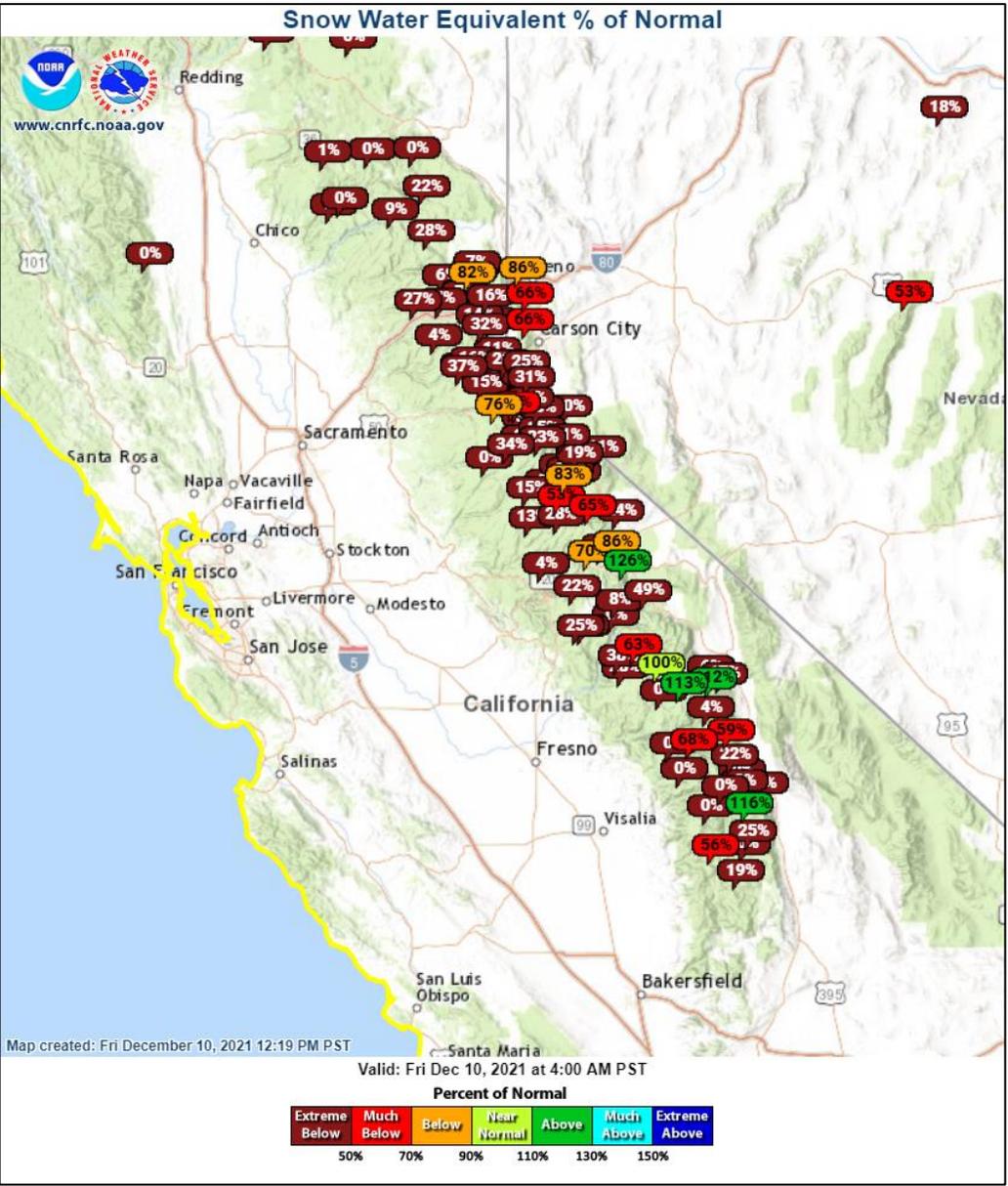
Numerous National Weather Service Forecast Offices have issued Winter Storm Watches and Warnings across the high elevations of the U.S. West Coast

The NWS Sacramento office is forecasting this long-duration AR to bring between 5 and 8 feet of snow to the Sierra Nevada, resulting in major impacts to travel across the mountain passes

Atmospheric River Outlook: 10 December 2021



For California DWR's AR Program



The California-Nevada River Forecast Center's data shows that a large majority of the Sierra Nevada is below to extremely below the average snow water equivalent to date

While this AR will likely bring significant impacts in terms of travel across the mountains, it will likely contribute a significant amount to the annual snowpack that is extremely crucial for California's water supply and resources

Not only will this AR bring extremely beneficial snowfall for water resources, but it will likely increase tourism as numerous ski resorts throughout the Sierra are planning to open this weekend in preparation for the heavy snow

Source: NOAA/NWS California-Nevada River Forecast Center