CW3E Atmospheric River Outlook: 14 Feb 2024

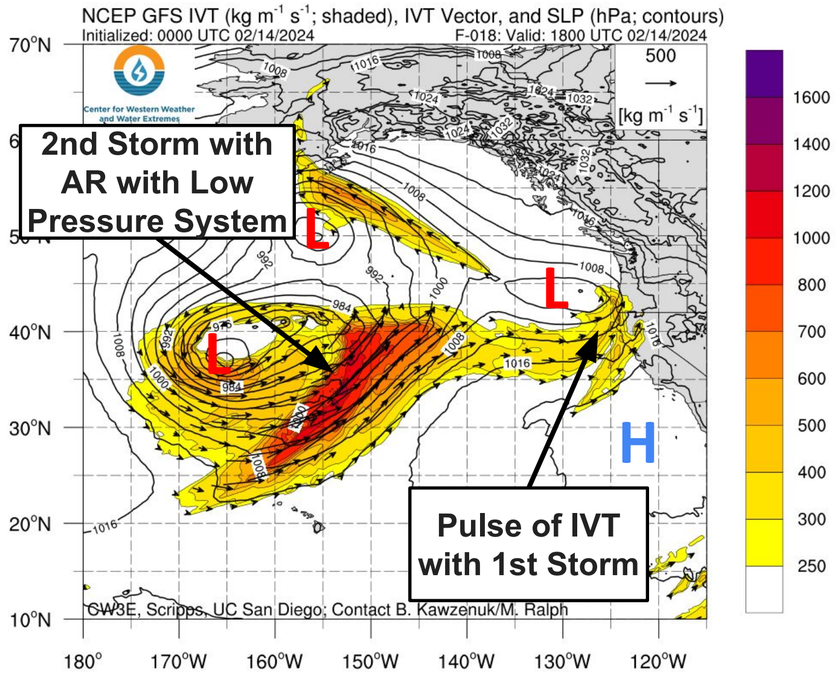
Trio of Storms To Bring Precipitation to California

- A trio of storms are forecast to make landfall over the US West Coast in the next 7 days.
- The first storm is driven by a low pressure system that brings a burst of IVT to the USWC on Wed 14 Feb. This low pressure system persists off the PNW coast through Thu 15 Feb as the second AR propagates toward the USWC.
- The second storm is an atmospheric river (AR) that makes landfall across the USWC on Fri 16 Feb. The landfall direction of the AR is likely to be suboptimal for precipitation, potentially limiting the precipitation potential of this system.
- The ECMWF EPS is forecasting greater probabilities of IVT > 250 kg m^{-1} s^{-1} making landfall over the PNW with the second AR than the GEFS.
- The third storm is a second AR that is forecast to make landfall alongside a low pressure system into central CA on Sun 18 Feb.
- There is uncertainty amongst GEFS and EPS ensemble members regarding the duration and strength of AR conditions with the second and third ARs across CA.
- The WPC is forecasting significant 7 day precipitation over the northern and central CA coasts and the Sierra Nevada.
- The WPC Excessive Rainfall Outlook indicates a Slight Risk (level 2 of 4, or at least 15% chance) for flash flooding over the northern CA coast for the 24 hour period ending 4 AM PT Sun 18 Feb with the second AR.
- The NWS WPC has issued Excessive Rainfall Outlooks highlighting the potential for flash flood conditions in various locations along the coast of California in association with precipitation during each of the three storms during this period.

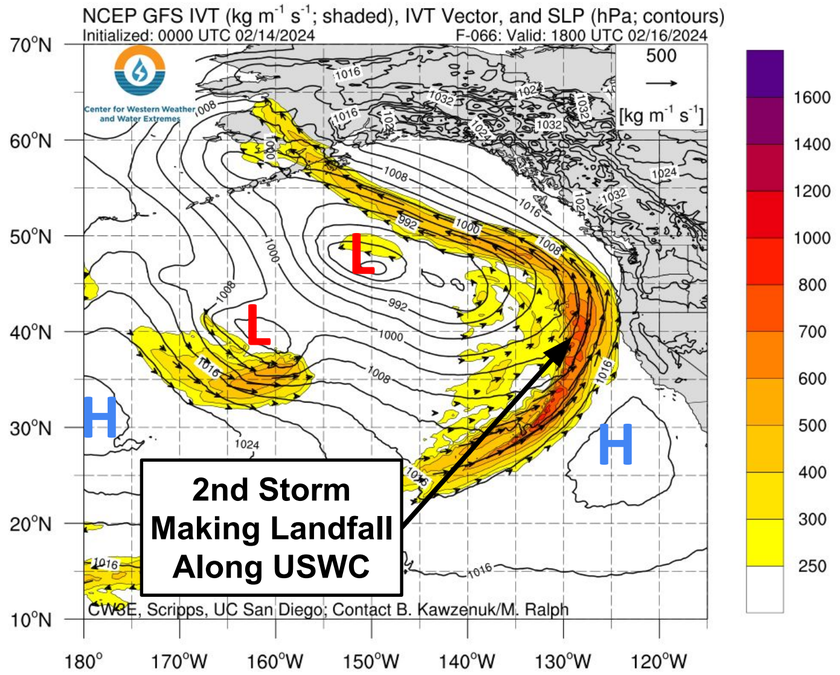
CW3E AR Outlook: 14 Feb 2024

GFS Init 00Z Wed 14 Feb 2024

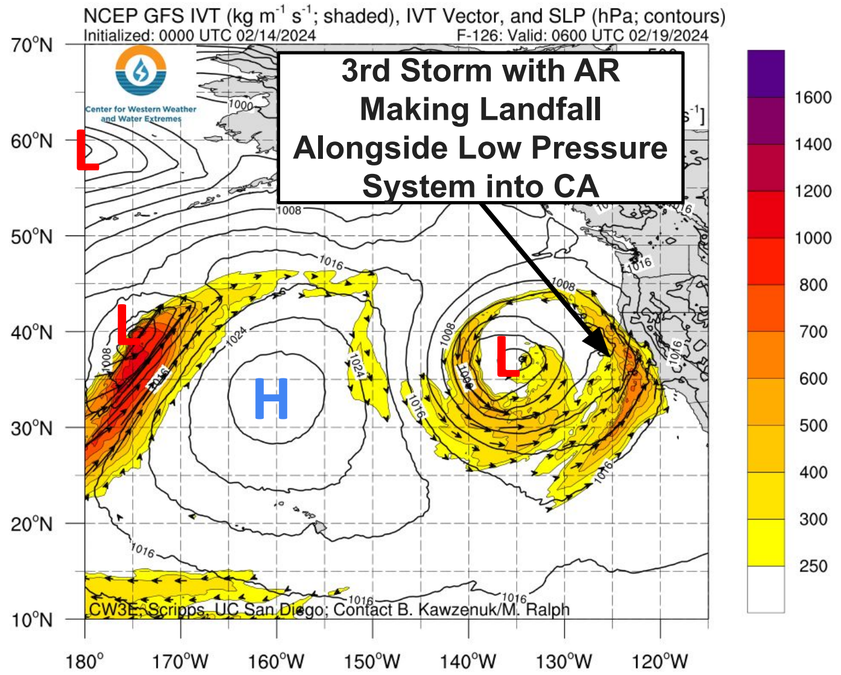
10AM PT Wed 14 Feb 2024



10AM PT Fri 16 Feb 2024



10PM PT Sun 18 Feb 2024

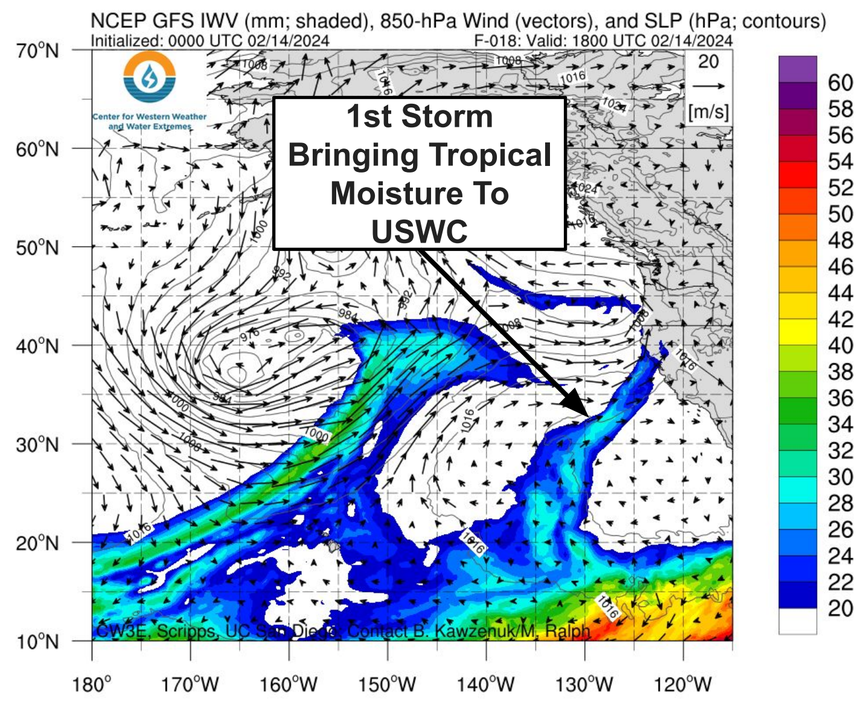


- The first storm made landfall into the PNW and northern CA today, Wed 14 Feb as a low pressure system brings a burst of IVT to the USWC. This low pressure system persists off the PNW coast through Thu 15 Feb.
- The second storm makes landfall with an AR along the USWC Fri 16 Feb, with the tail of the AR moving down the CA coast. The landfall direction of the IVT is **suboptimal** for orographic precipitation, potentially limiting the **potential** precipitation from this AR.
- The third storm system and potential AR make landfall into central CA on Sun 18 Feb, with the AR moving down the CA coast through Mon 19 Feb.

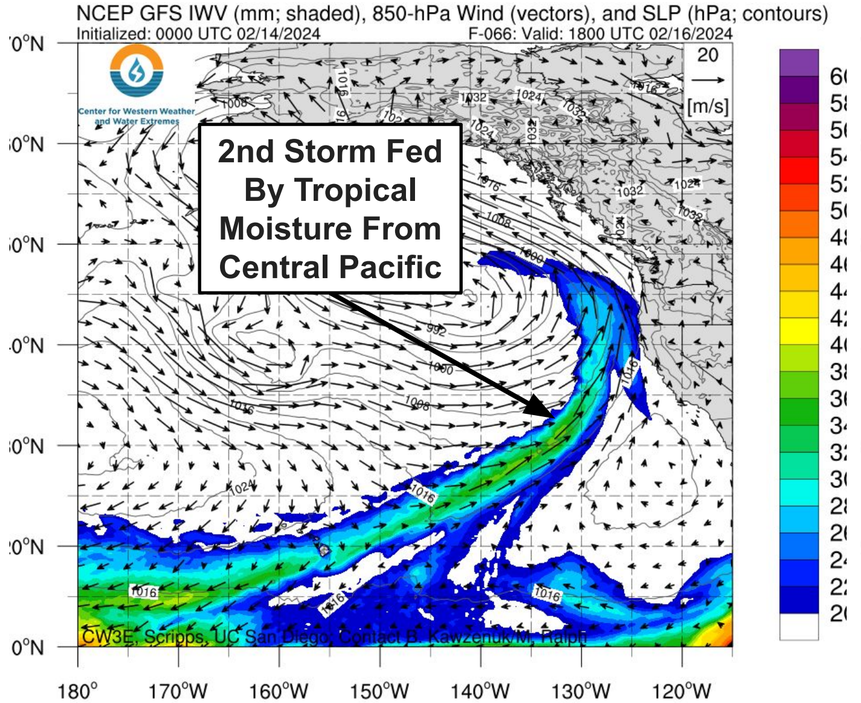
CW3E AR Outlook: 14 Feb 2024

GFS Init 00Z Wed 14 Feb 2024

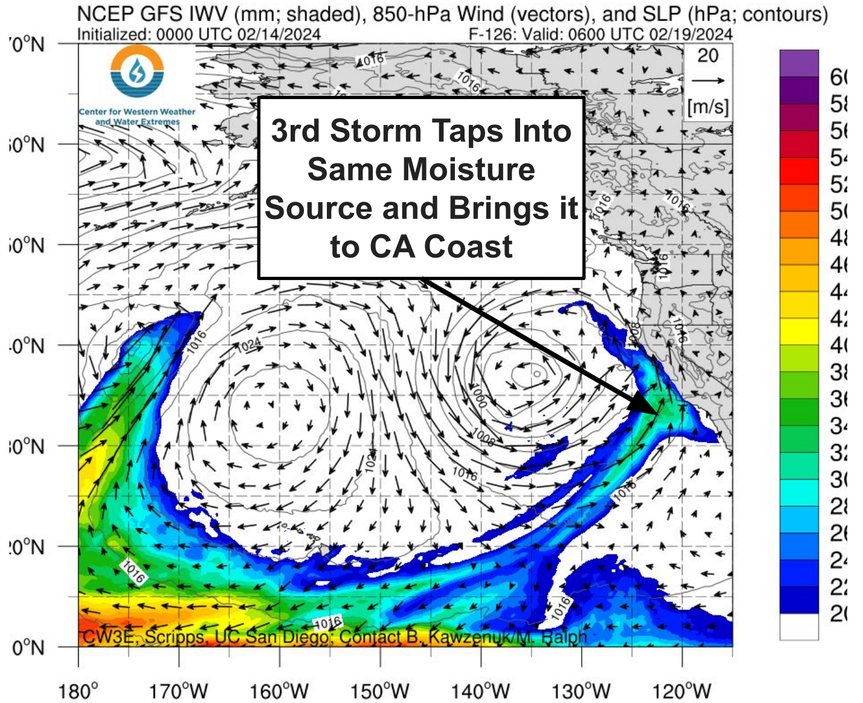
10AM PT Wed 14 Feb 2024



10AM PT Fri 16 Feb 2024



10PM PT Sun 18 Jan 2024



- The first storm brings tropical moisture from the eastern Pacific to the USWC.
- The AR with the second storm is fed by tropical moisture out of the central Pacific, with higher IWV values (IWV >30 mm) than what is brought to the coast with the first storm.
- The AR and low pressure system with the third storm are forecast to tap into the same moisture source that fueled the second storm, bringing IWV > 30 mm over the CA coast.

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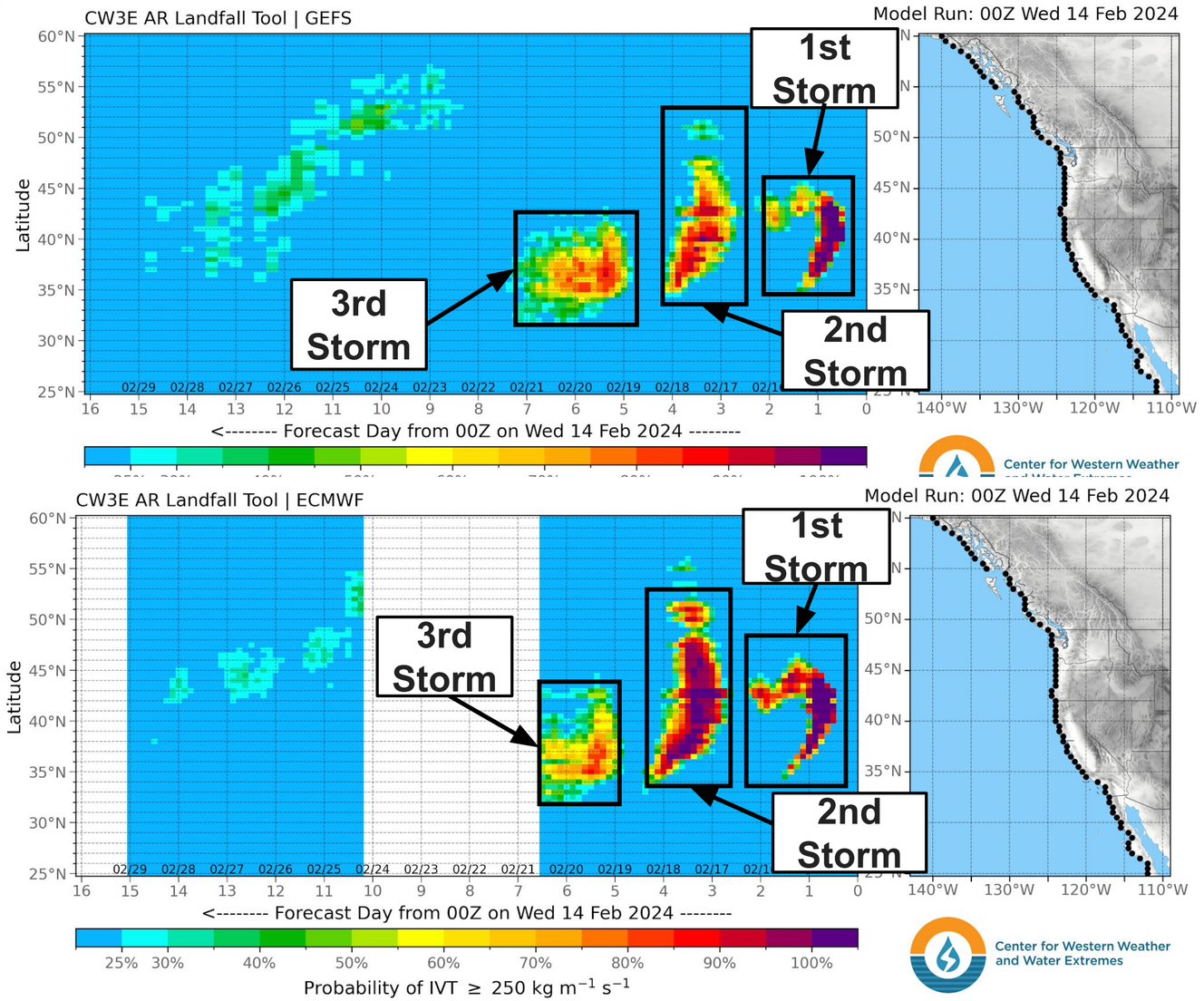
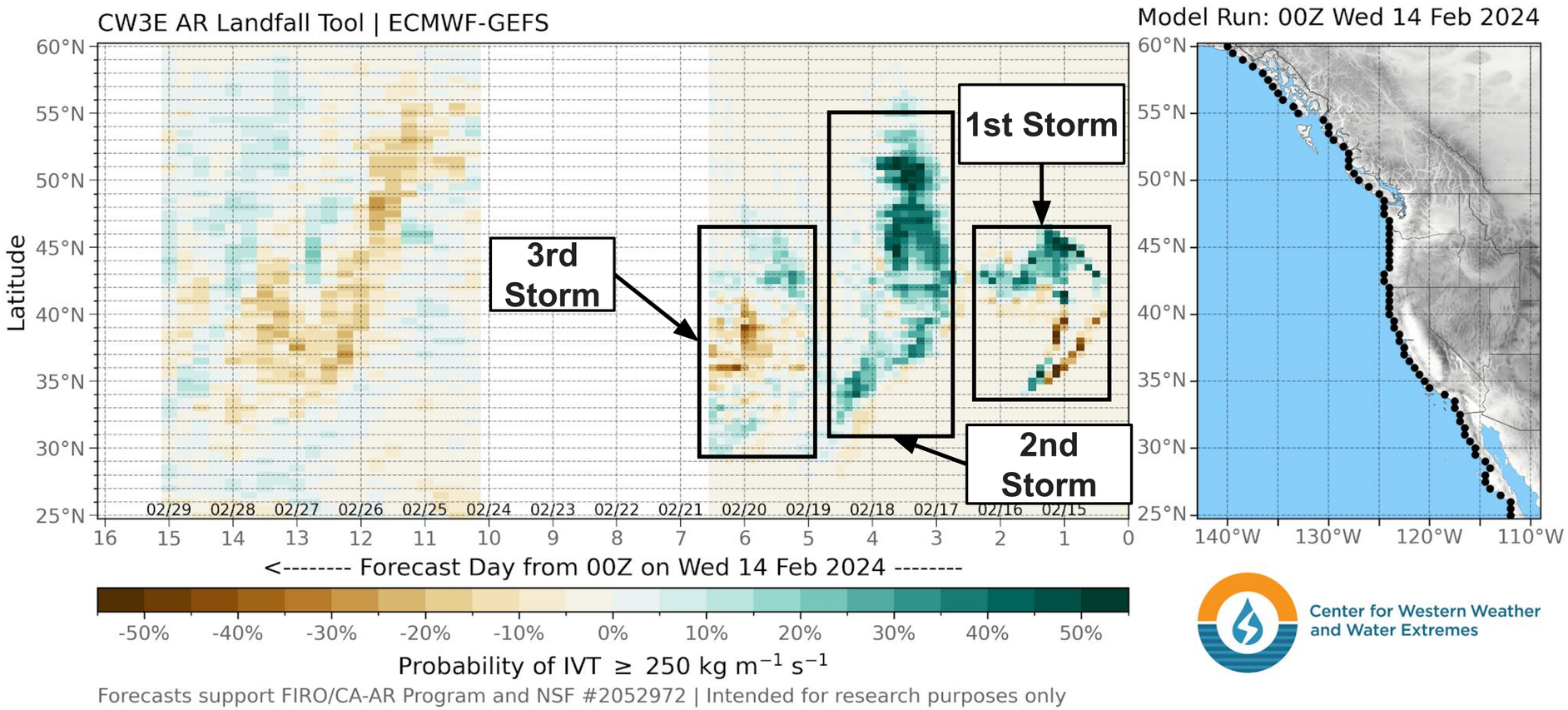


- CW3E's ensemble AR Scale Landfall tool illustrates the timing and intensity of the IVT associated with each of the three storms as they move onshore
- Both the GEFS (top) and EPS (bottom) are showing very high confidence (>90%) in IVT > 250 kg m^{-1} s^{-1} making landfall over the USWC for the 1st and 2nd storms
- The GEFS and the EPS are showing high confidence (>80%) in IVT > 250 kg m^{-1} s^{-1} making landfall over CA on Mon 19 Feb with higher probabilities into Tue 20 Feb with the possible third storm.

CW3E AR Outlook: 14 Feb 2024

Model Comparison: GEFS vs EPS ensembles



Center for Western Weather and Water Extremes

- The EPS is more confident in IVT > 250 kg m^{-1} s^{-1} making landfall during the 1st and 2nd storms.
- The EPS probabilities in the AR with the second storm are higher for much of the event, but specifically to the north, where the EPS has IVT > 250 kg m^{-1} s^{-1} into WA and BC
- The GEFS is showing greater confidence in IVT > 250 kg m^{-1} s^{-1} making landfall in Northern CA and for AR conditions to persist later in CA with the third storm.

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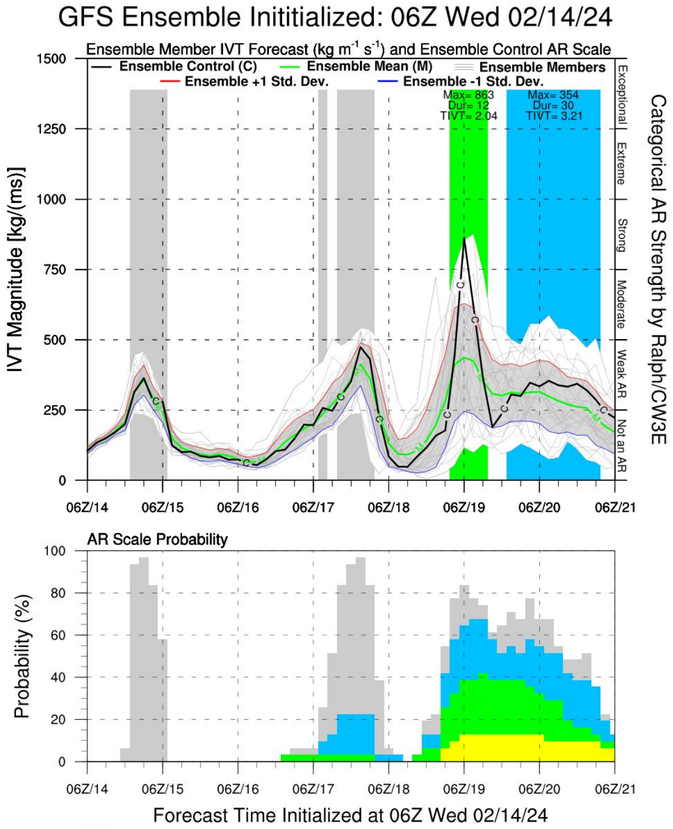
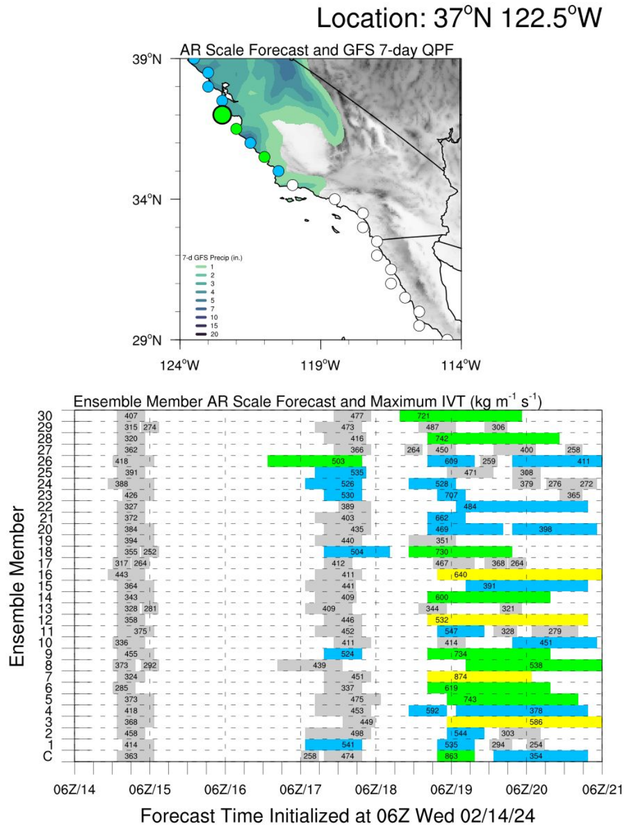
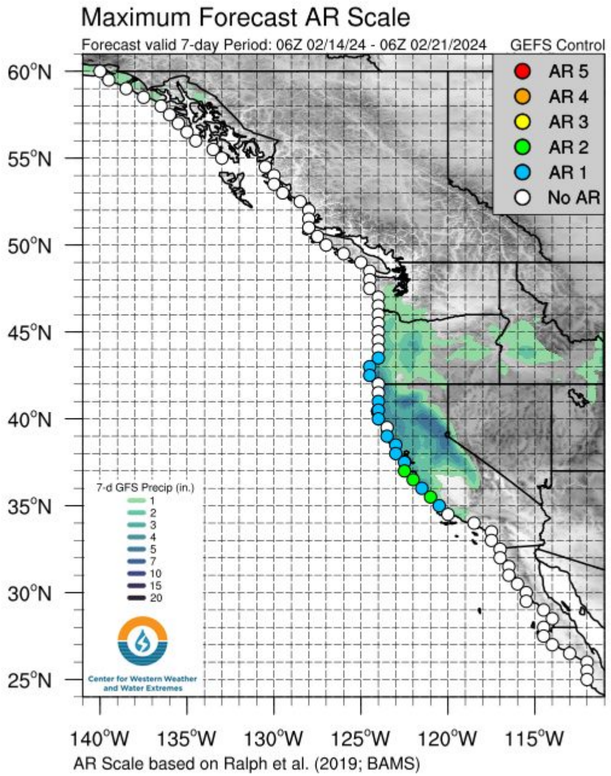
GEFS 7-day AR Scale and IVT Forecast







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AR 1 AR 2 AR 3 AR 4 AR 5

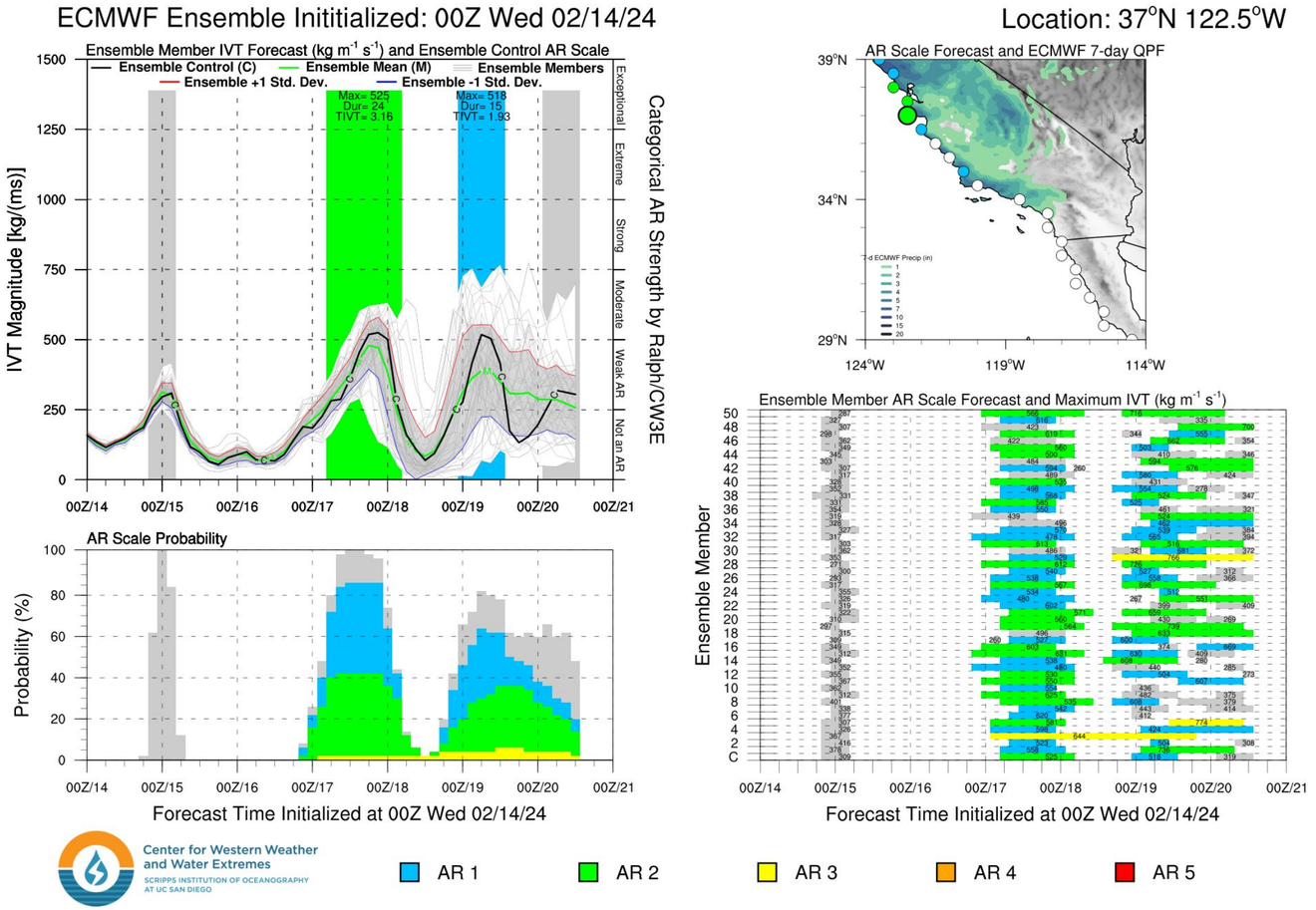
Image created: 11 UTC 02/14/2024

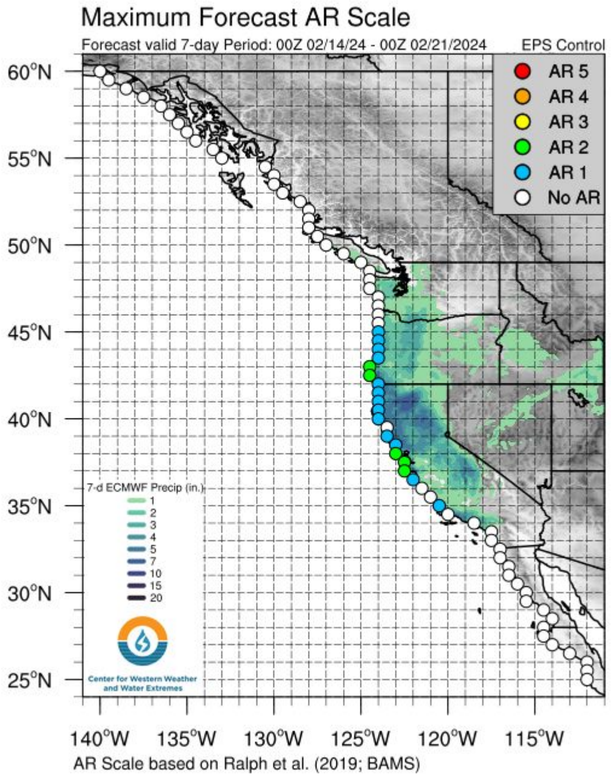
More information: http://cw3e.ucsd.edu AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

- The GEFS control member is forecasting two periods of AR conditions at 37º N, 122.5º W (near Santa Cruz CA) for 0Z Mon 19 Feb through 0Z Wed 21 Feb.
- 13/31 (42%) GEFS ensemble members are forecasting at least AR2 conditions during either AR period.
- 7/31 (23%) GEFS members are forecasting AR conditions for 6Z Sat 17 Feb through 6Z Sun 18 Feb.
- The highest uncertainty within the GEFS ensemble is for the exact duration and intensity of AR conditions associated with the third storm beginning on 19 Feb

CW3E AR Outlook: 14 Feb 2024

ECMWF EPS 7-day AR Scale and IVT Forecast

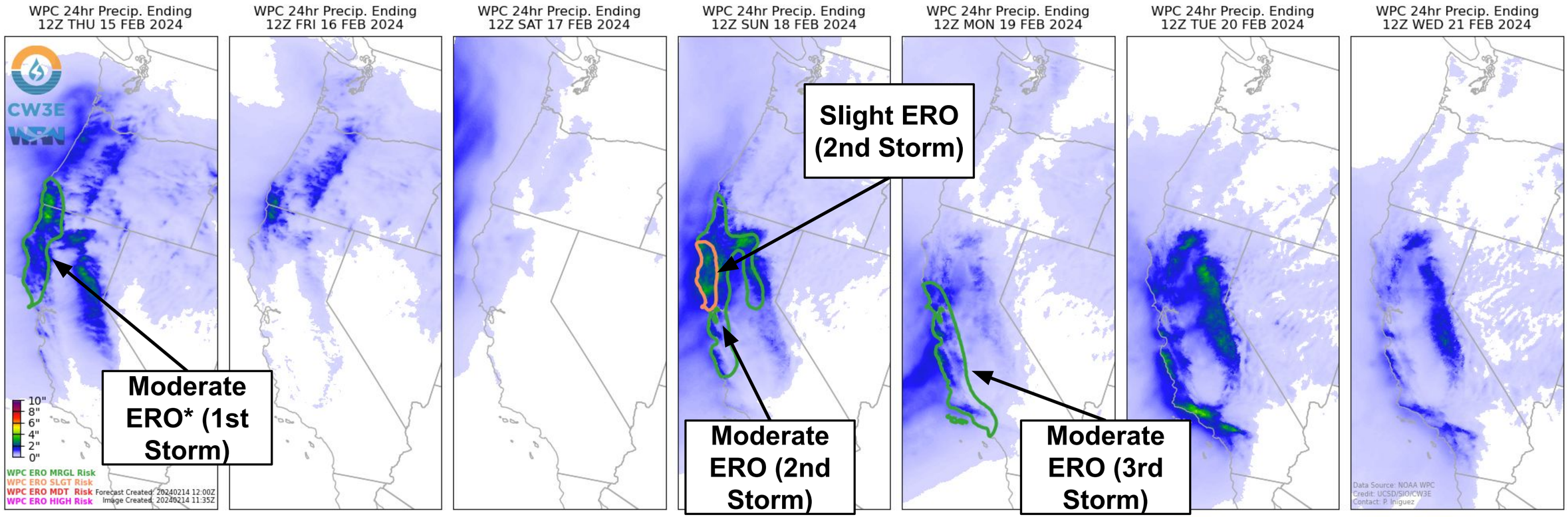




- The EPS control member is forecasting two periods of AR conditions at 37º N, 122.5º W (near Santa Cruz CA) for 00Z Sat 17 Feb through 12Z Mon 19 Feb.
- 21/51 (42%) EPS ensemble members are forecasting at least AR2 conditions during the first AR period.
- 19/51 (23%) EPS members are forecasting AR conditions for 00Z Mon 19 Feb through 00Z Wed 21 Feb.
- The EPS uncertainty is also highest with the third storm period, in terms of timing, intensity, and duration of potential AR conditions

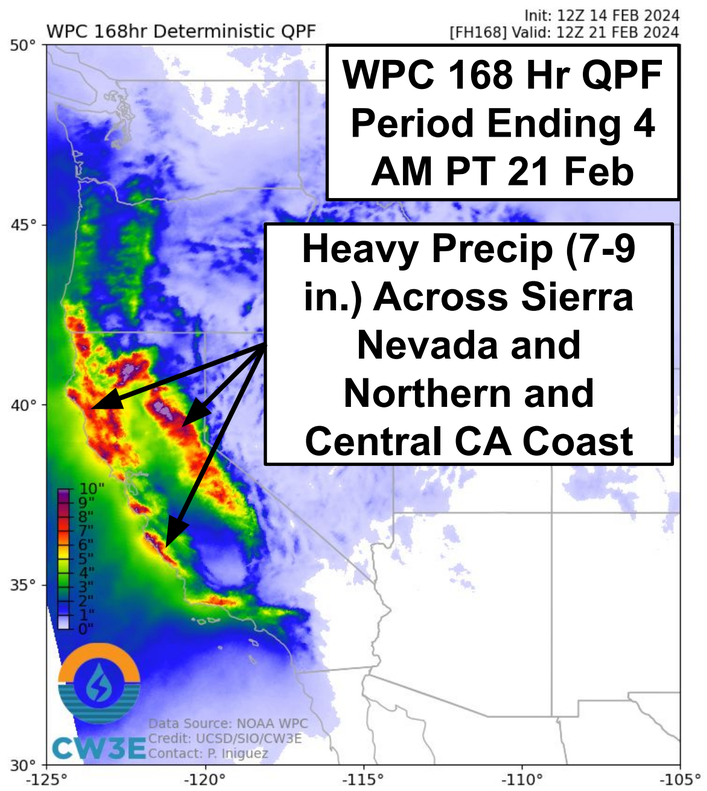
CW3E AR Outlook: 14 Feb 2024

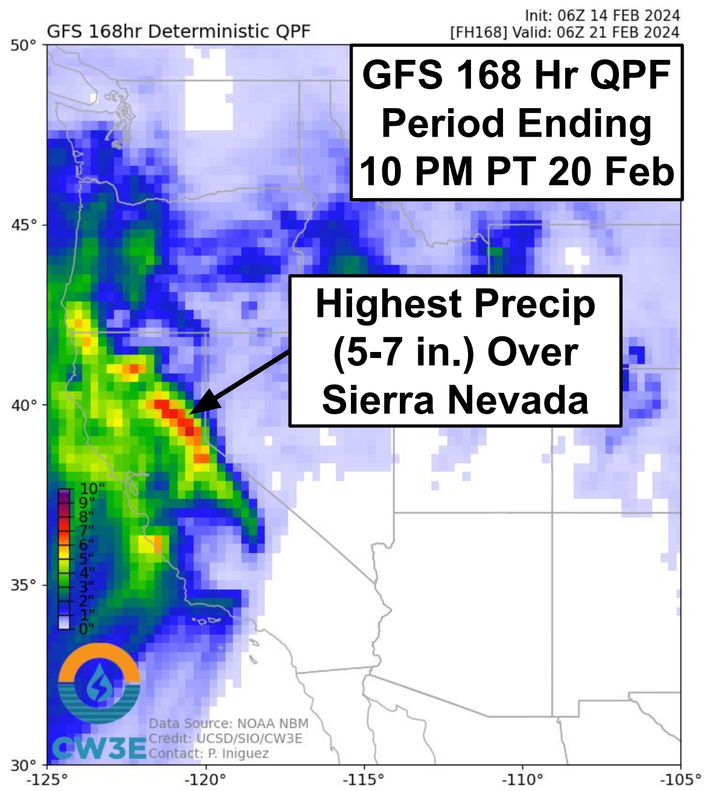
*Excessive Rain Outlook (ERO)

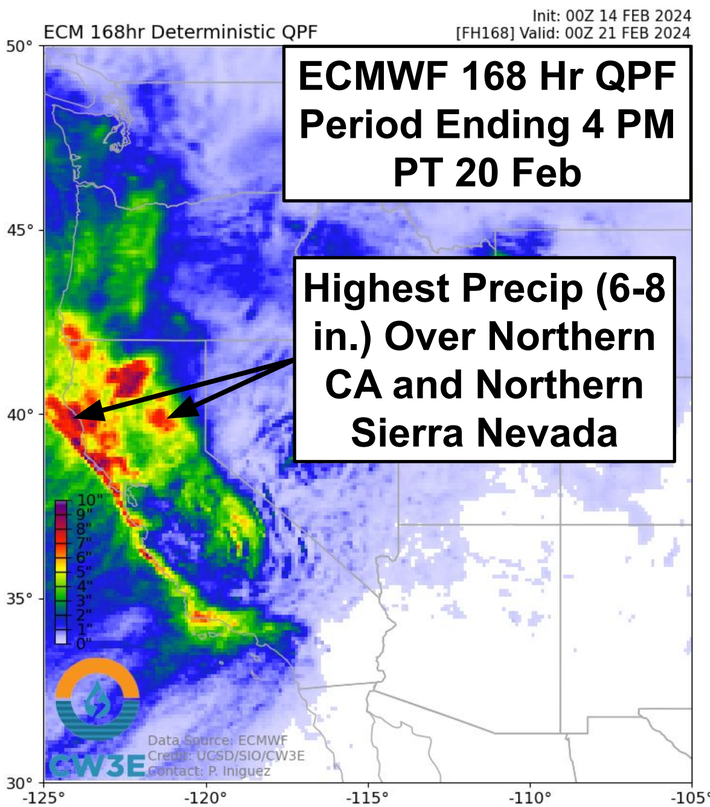


- The NWS WPC is forecasting the heaviest precipitation over the CA/OR border and the northern Sierra Nevada for the first storm (1-3 in.), in northern CA for the second storm (1-3 in.), and over the southern CA coast and Sierra Nevada with the third storm (2-4 in.).
- Slight Risk (level 2 of 4, or at least 15% chance) for flooding has been issued along the northern CA coast for the 24 period ending 4 AM PT Sun 18 Feb with the second storm.
- A Marginal Risk (level 1 of 4, or at least 5% chance) for flash flooding has been issued along the CA/OR border and northern CA coast for the 24 hour period ending 4 AM PT Thu 15 Feb and the northern and central CA coasts for the 24 hour periods ending 4 AM PT Sun 18 Feb and Mon 19 Feb.

CW3E AR Outlook: 14 Feb 2024







- WPC, GFS and ECMWF are forecasting significant precipitation in CA over the next 7 days, although there is uncertainty between forecast precipitation totals in the Sierra Nevada and along coastal California.
- WPC precipitation totals are higher than the GFS and ECMWF, with the highest precipitation over the Sierra Nevada (9+ In. in northern Sierra) and northern and central CA coasts.
- GFS is forecasting the lowest 7-day precipitation totals (3 to 5 in. for much of CA), with the highest precipitation over the Sierra Nevada (5-7 in.). ECMWF highest forecast precipitation is over the northern CA coast and northern Sierra Nevada (6-8 in.)

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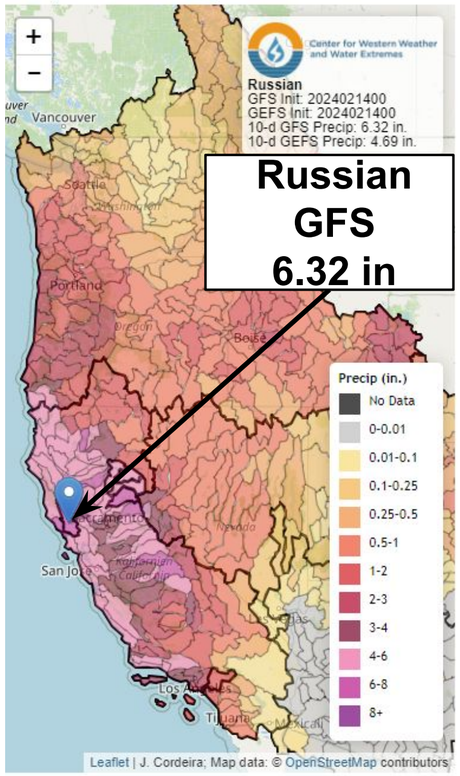
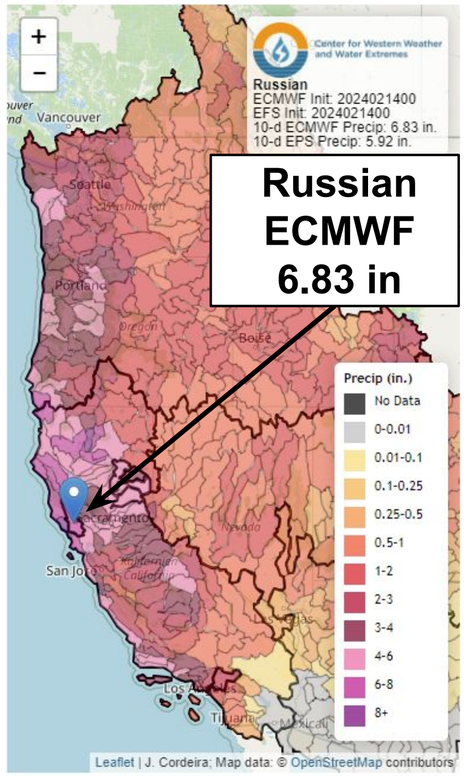
10-day Watershed Precipitation Forecasts (Initialized 00Z 14 Feb)

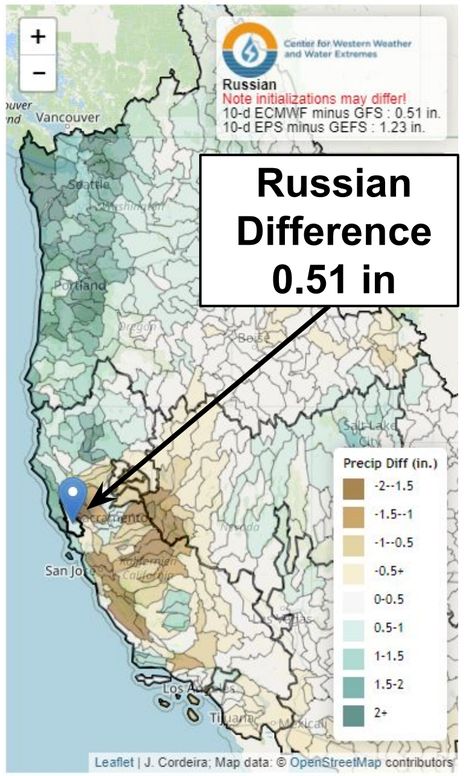
10-day GFS/GEFS Precipitation Forecasts

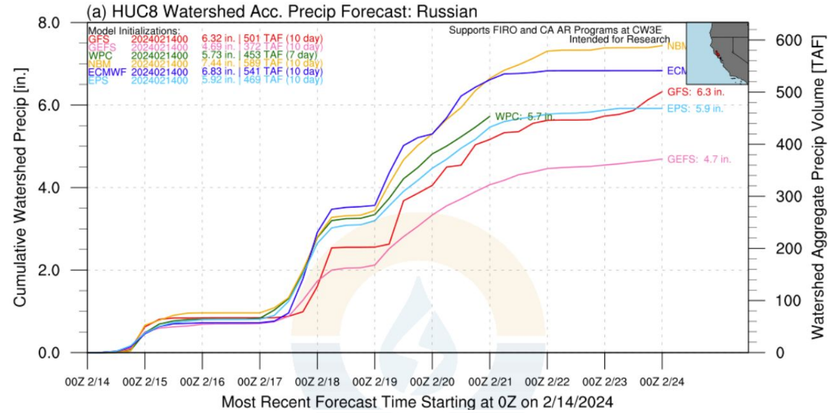


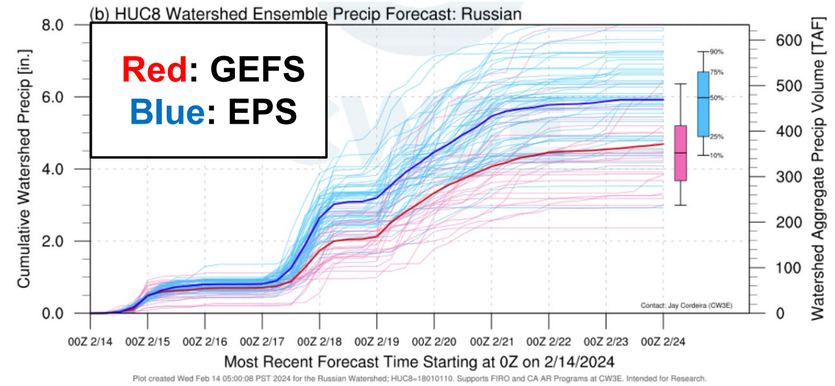
10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast







- The 00Z GFS and 00Z ECMWF 10-day watershed precipitation totals vary for CA during the period, where the GFS is forecasting greater precipitation in central CA watersheds and the ECMWF is higher in Northern CA and Sierra Nevada watersheds.
- The 00Z ECMWF 10-day watershed precipitation is higher across the PNW than the 00Z GFS.
- The 00Z GFS is forecasting 6.32” of mean areal precipitation in the Russian River watershed over the next 10 days, while the 00Z ECMWF is forecasting 6.83” over the same watershed. Both ensembles’ members show uncertainty in the 10-day totals.

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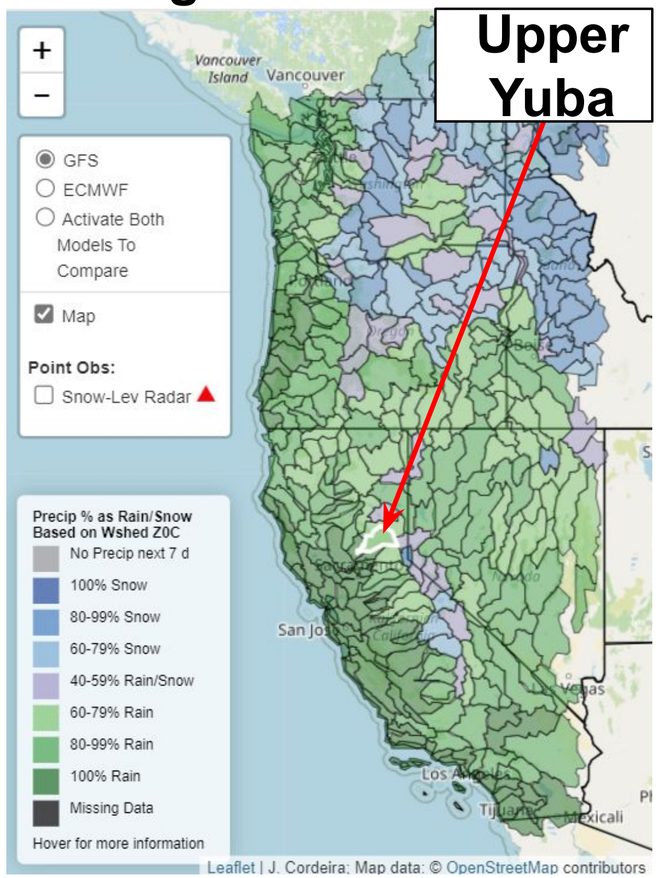
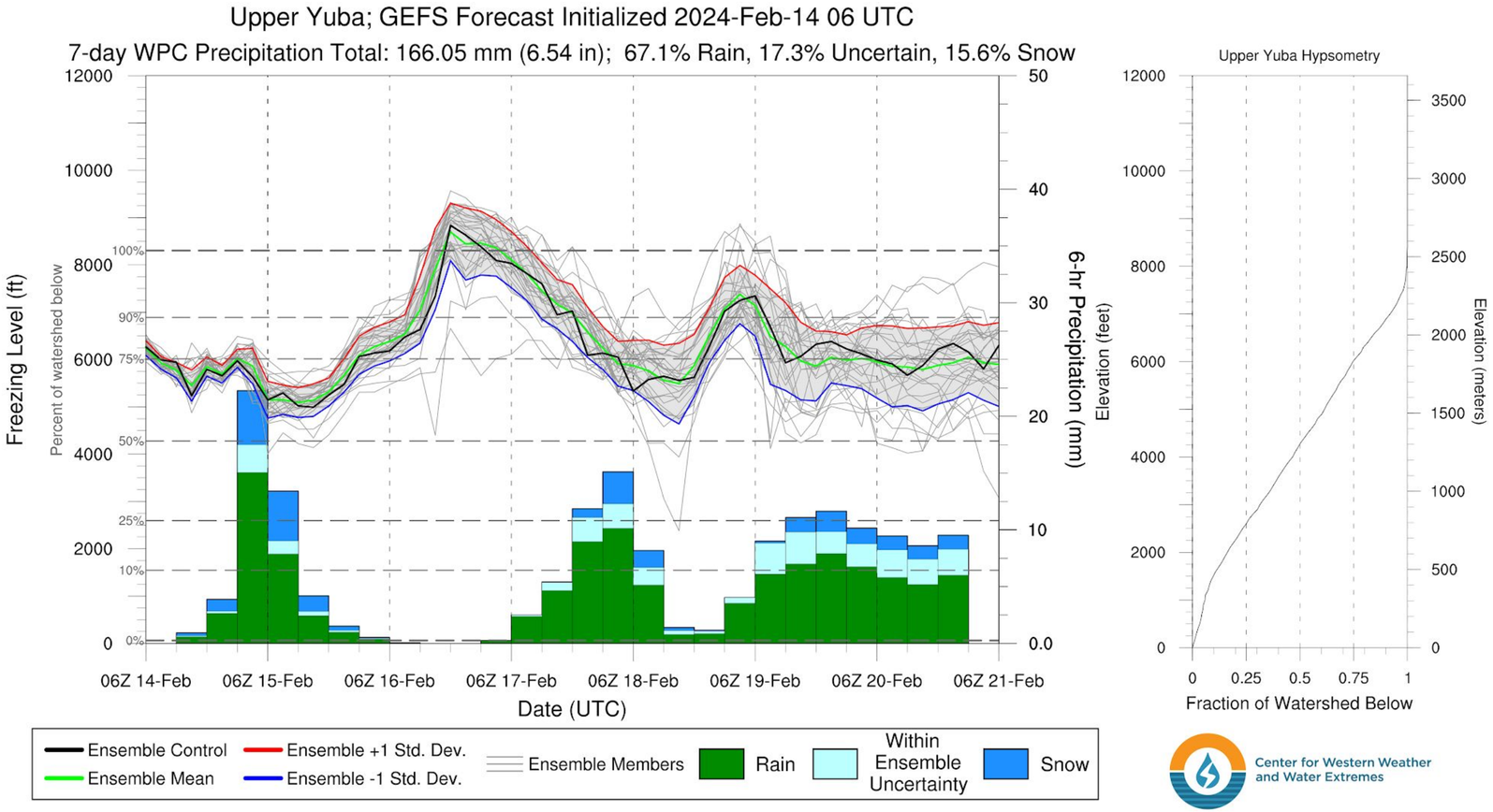
Freezing Level Forecast





- The freezing level is forecast to be between ~4000 and ~6000 feet above Mean Sea Level (MSL) during the first storm and remain around ~6000 to ~7000 feet MSL during the second and third storms in the Upper Yuba watershed.
- The freezing level forecast in the Upper Yuba results in the majority of ensemble members forecasting the precipitation to fall as rain (67.1%).

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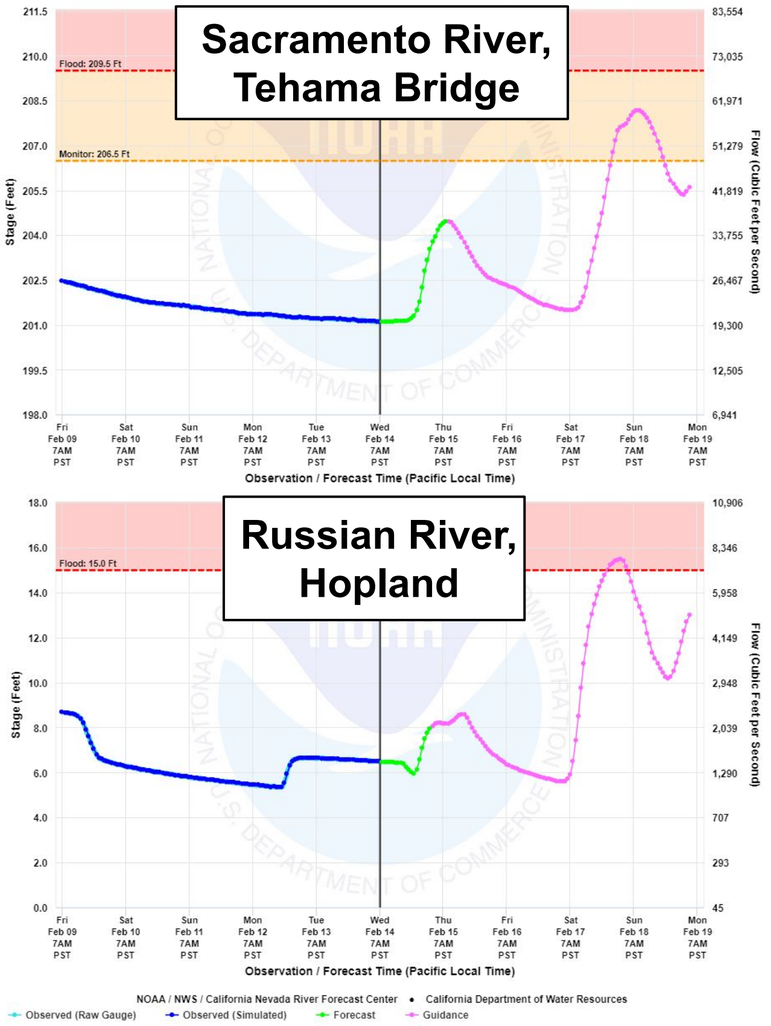
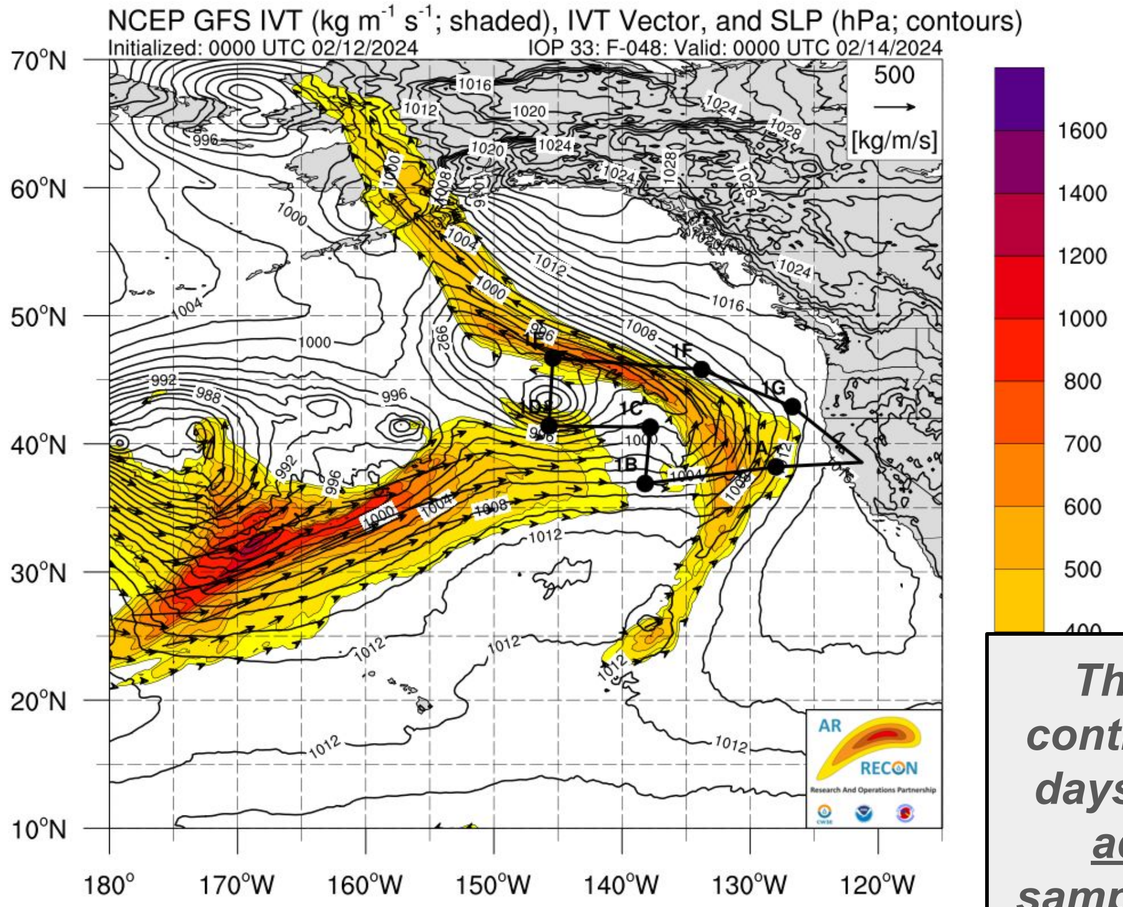
NWS CNRFC River Stage Forecasts



- River levels in CA are forecast to rise as a result of the precipitation from the storms during this period.
- CNRFC is currently forecasting 8 gages to exceed monitor stage and 1 gages to exceed flood stage in the next 5 days (first and second storms).
- The Sacramento River at Tehama Bridge (top left) guidance shows the river reaching monitor stage from late Sat 17 Feb to Sun 18 Feb with the second storm.
- The Russian River at Hopland (bottom left) guidance shows the river reaching flood stage for a short time late Sat 17 Feb with the second storm.

CW3E AR Outlook: 14 Feb 2024

Current AR Recon Planned Flight Sequence



IOP33 - 14 Feb 2024

This sequence will continue in the coming days, with at least <u>two additional flights</u> sampling the AR and its associated atmospheric features

- CW3E's Atmospheric River Reconnaissance (AR Recon) field campaign continues in WY2024, with the most recent sequence of flights focusing on the development of the current AR.
- The AR Recon team planned multiple flights, departing from Sacramento, CA to fly over and around ARs in the eastern N. Pacific
- These sampling missions provide data in near real-time to the global forecast models to improve weather forecasts. Data from these missions are archived for future AR research.
- Flights sample the atmosphere and it's essential atmospheric structures, in addition to regions of forecast sensitivity.