CW3E Atmospheric River Outlook: 29 January 2025

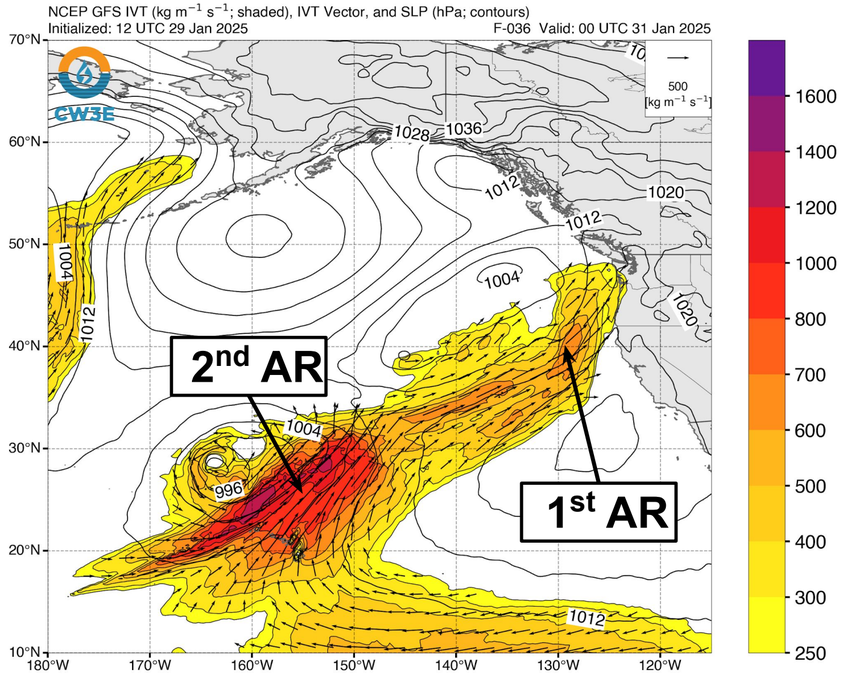
Pair of Atmospheric Rivers Forecast to Bring Heavy Precipitation to US West Coast

- Two atmospheric rivers (AR) are forecast to make landfall in quick succession over Northern and Central California resulting in potentially heavy precipitation.
- The first AR is forecast to make landfall late Thu 30 Jan over the Pacific Northwest and propagate down the coast into Sat 1 Feb.
- The second AR is forecast to develop near Hawaii within a tropical moisture export (TME) and propagate toward the US West Coast on Fri 31 Jan.
- There is much uncertainty between the ECMWF and GFS regarding landfall location and timing of the second AR, impacting where the highest precipitation is forecast to fall.
- The ECMWF is forecast highest precipitation totals over Northern California Coast Ranges while the GFS maximum is over the Northern and Central Sierra Nevada.
- The NWS Weather Prediction Center forecast is similar to the ECMWF, with 6–12 inches of precipitation forecast over the Northern California Coast Ranges and the Northern Sierra Nevada during the next 7 days.
- The Weather Prediction Center has issued a slight risk Excessive Rainfall Outlook (ERO) (level 2 of 4, 15% chance of flooding) has been issued over Del Norte, Humboldt, and Mendocino Counties for day 4 (precipitation ending 4 AM PT 2 Feb)
- Stream levels are forecast to rise in southern Oregon and Northern and Central California, with the largest likelihood of flooding in Northern California.
- Snowfall accumulations of 8–18 inches over the Cascades, 2–6 inches over the Sierra Nevada and 6-18 inches over the Klamath Mountains are forecast over the next three days.

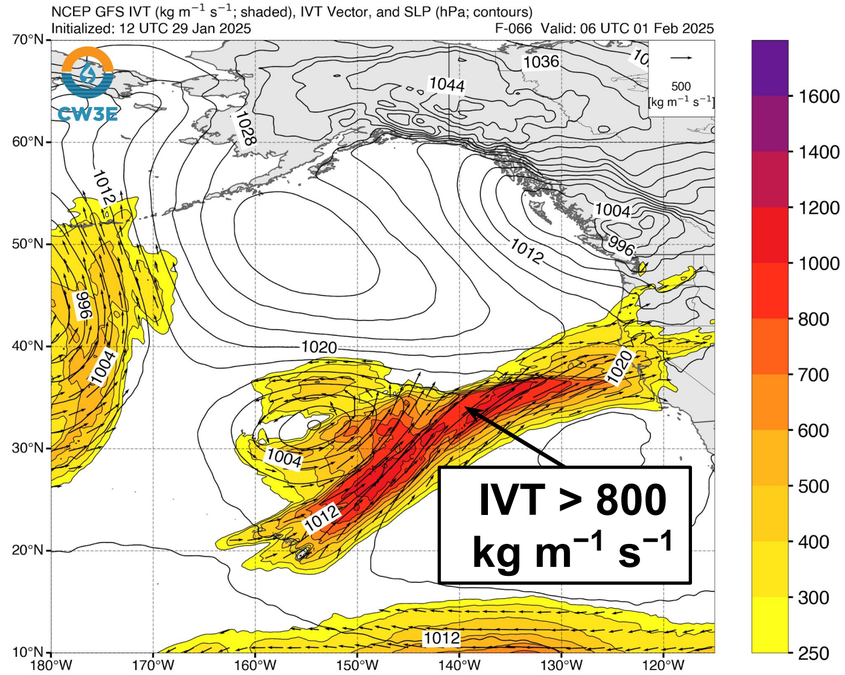
AR Outlook: 29 January 2025

GFS IVT & SLP Forecasts

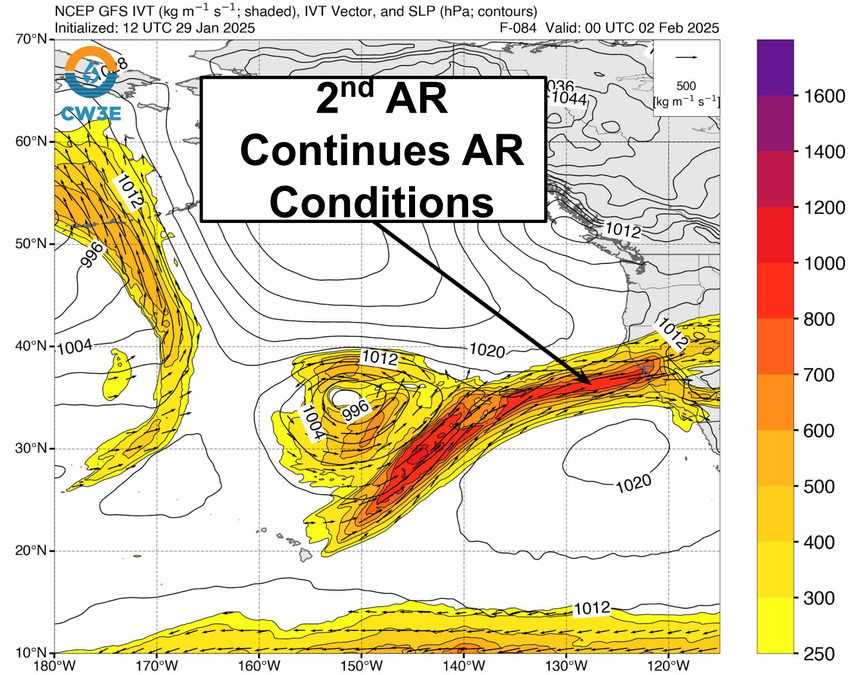
Valid: 4 PM PST 30 Jan (F-036)



Valid: 10 PM PST 31 Jan (F-066)



Valid: 4 PM PST 1 Feb (F-084)



- Two atmospheric rivers (AR) are forecast to make landfall in quick succession over Northern and Central California resulting in potentially heavy precipitation.
- The first AR is forecast to make landfall late Thu 30 Jan over the Pacific Northwest and propagate down the coast into Sat 1 Feb.
- The second AR is forecast to develop near Hawaii within a tropical moisture export (TME) and propagate toward the US West Coast on Fri 31 Jan.
- The short time between the first and second ARs results in no break in AR conditions over much of Northern and Central California

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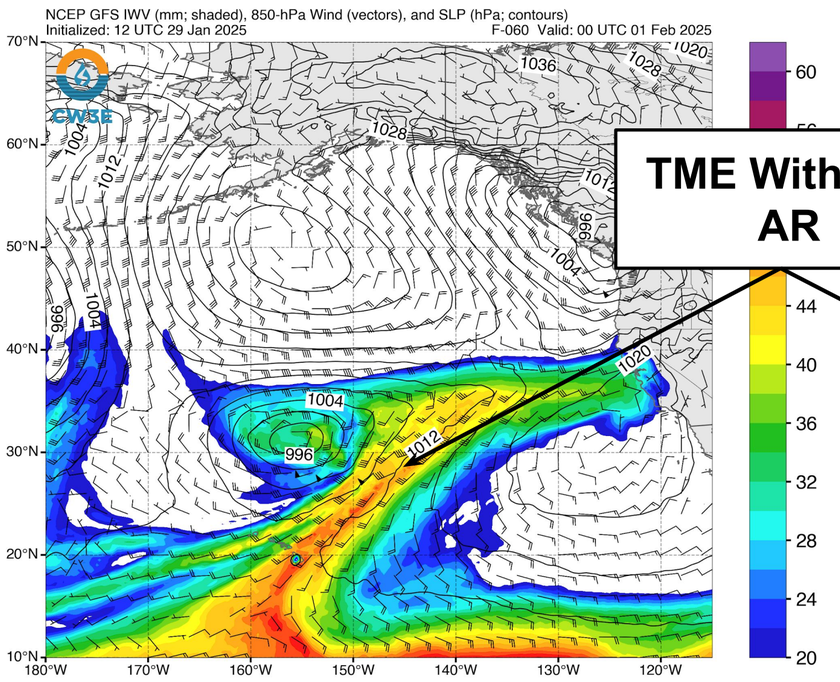
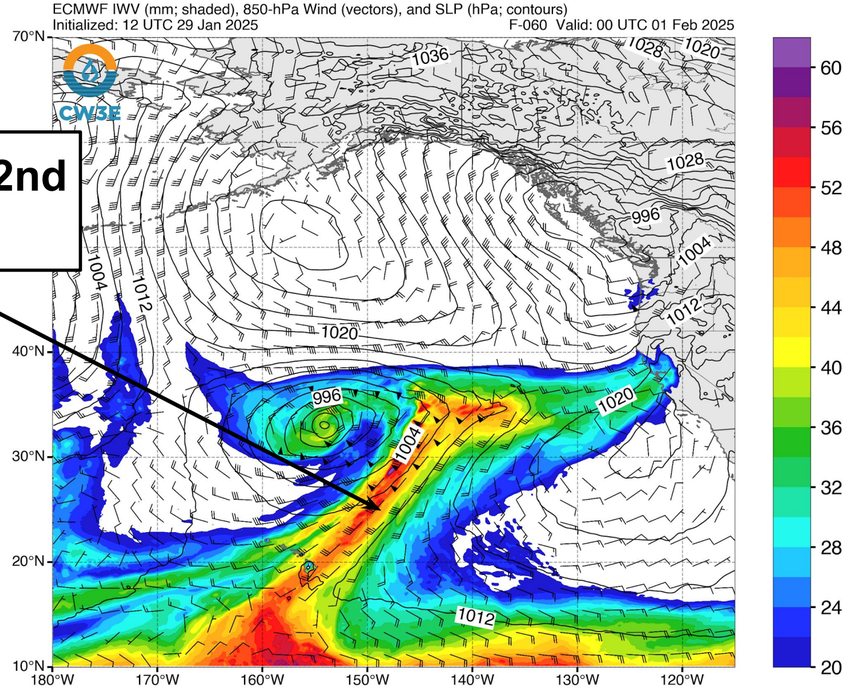
Comparison of GFS and ECMWF IWV Forecasts
Valid: 4 PM PST 31 Jan (F-060)

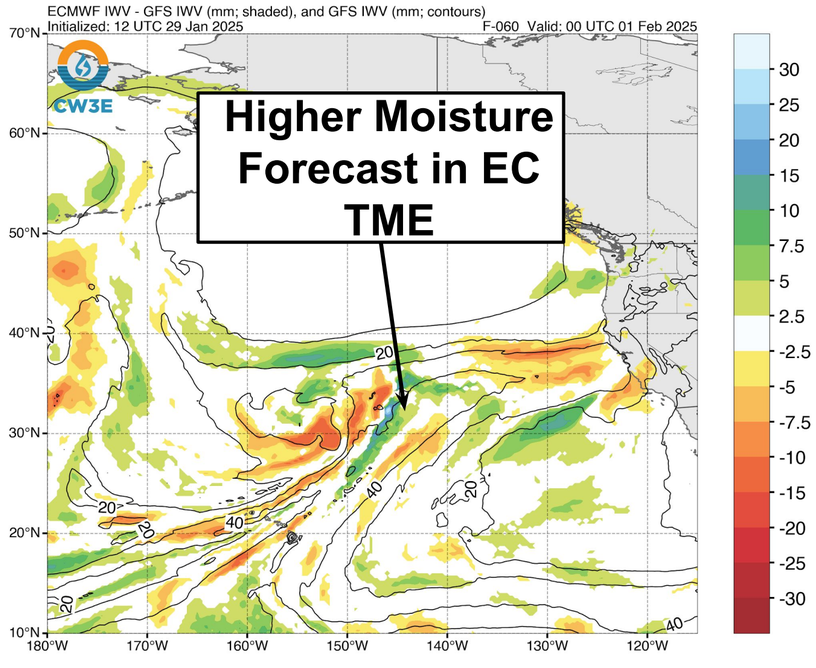
GFS IWV



ECMWF IWV



ECMWF IWV - GFS IWV



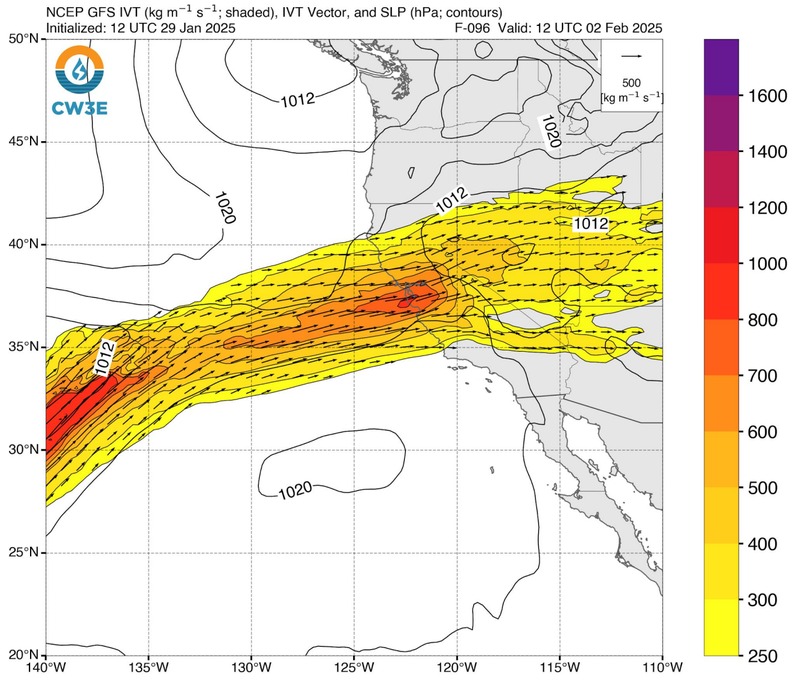
- The second AR is partially fueled by a robust TME as it propagates toward the USWC.

- The ECMWF is forecasting higher IWV values in the center of this TME than the GFS, potentially impacting the amount of moisture that reaches the coast, and therefore, precipitation totals.

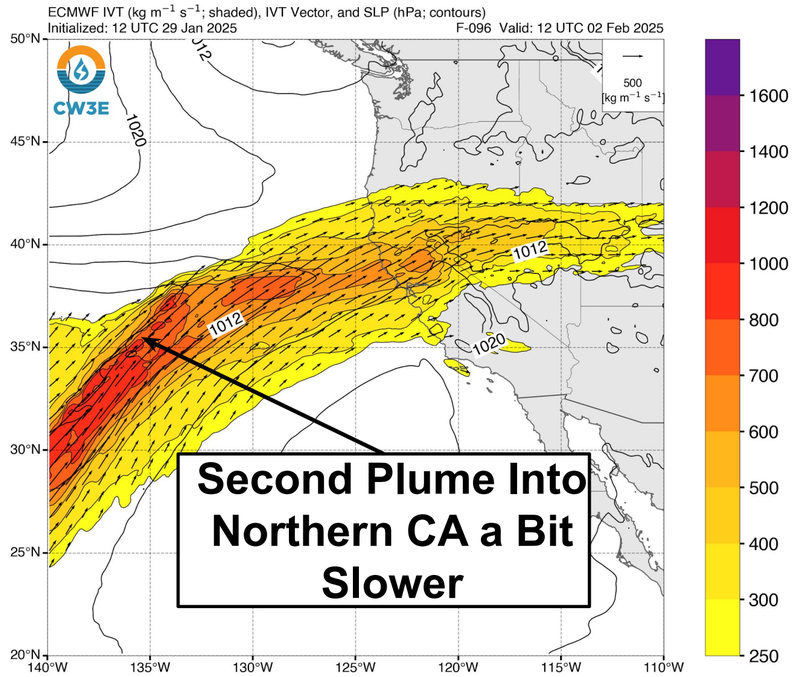
AR Outlook: 29 January 2025

Comparison of GFS and ECMWF IVT Forecasts
Valid: 4 AM PST 2 Feb (F-096)

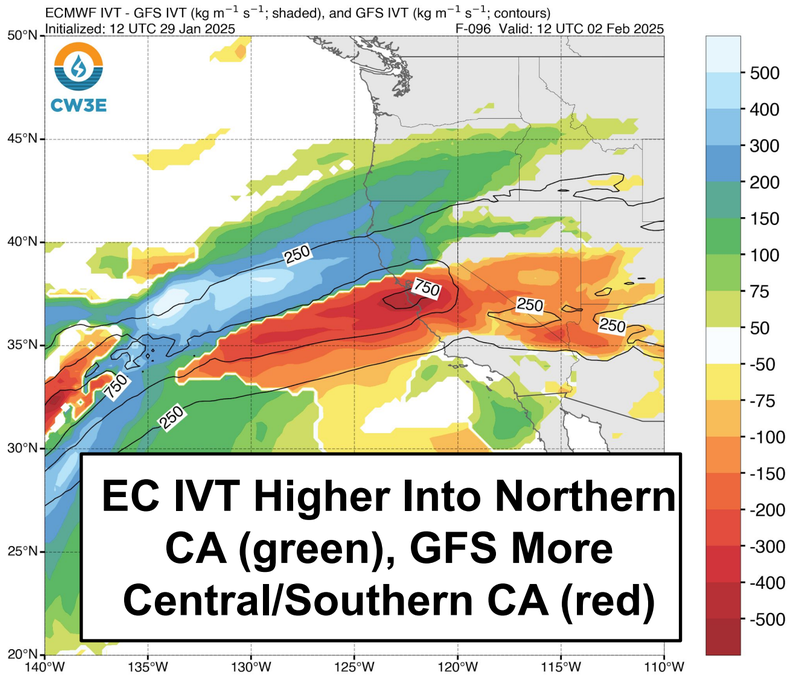
GFS IVT



ECMWF IVT



ECMWF IVT - GFS IVT

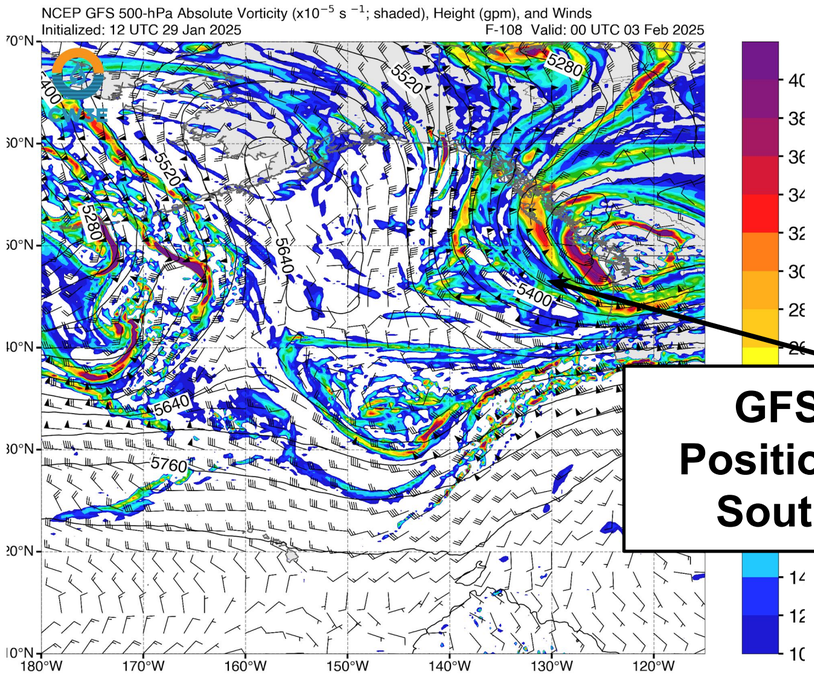


- There is uncertainty in the landfall timing and location of the second AR between the GFS and the ECMWF.
- The ECMWF is currently forecasting the second plume of IVT to make landfall slower and further north (see difference plot on right) than the GFS.
- These differences will impact the locations of highest forecast precipitation.

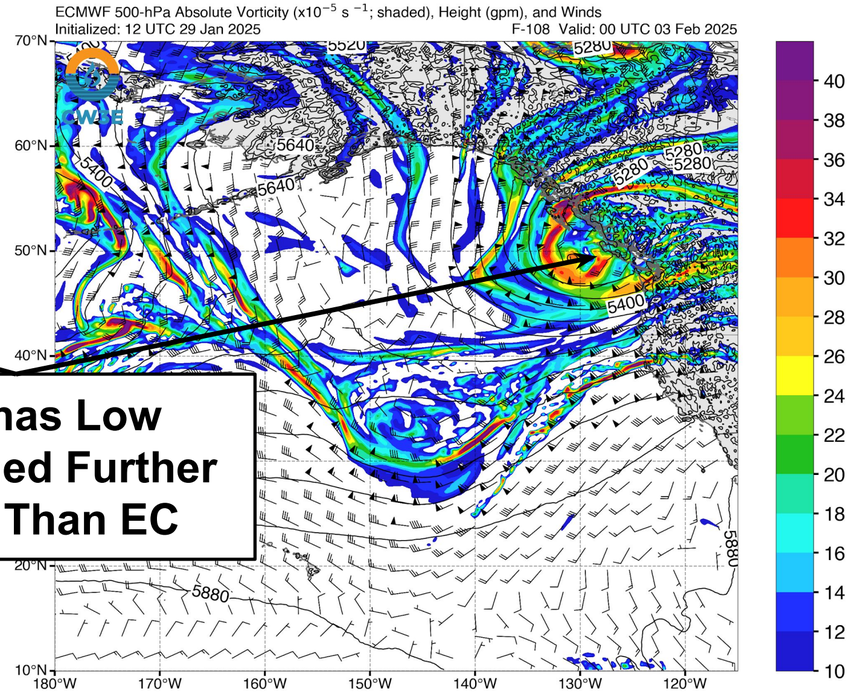
AR Outlook: 29 January 2025

Comparison of GFS and ECMWF 500-hPa Vorticity and Heights Forecasts
Valid: 4 PM PST 2 Feb (F-120)

GFS 500-hPa



ECMWF 500-hPa

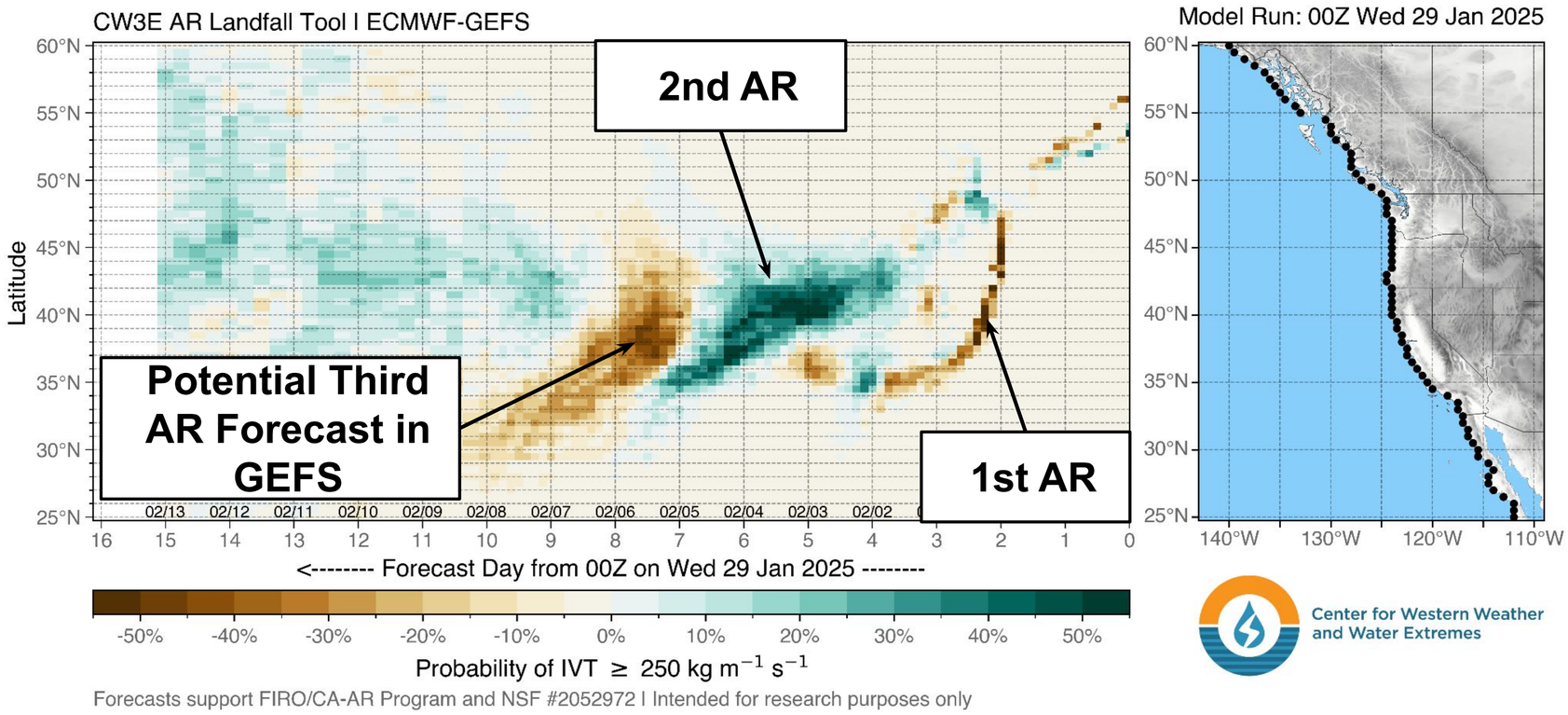


GFS has Low Positioned Further South Than EC

- There is further uncertainty in the location of a low pressure system that is forecast to dig down from Canada over the USWC.
- The trough and low pressure center are forecast to dig further southeast in the GFS than in the ECMWF. This may cause lower freezing levels and present some uncertainty in precipitation type.

AR Outlook: 29 January 2025

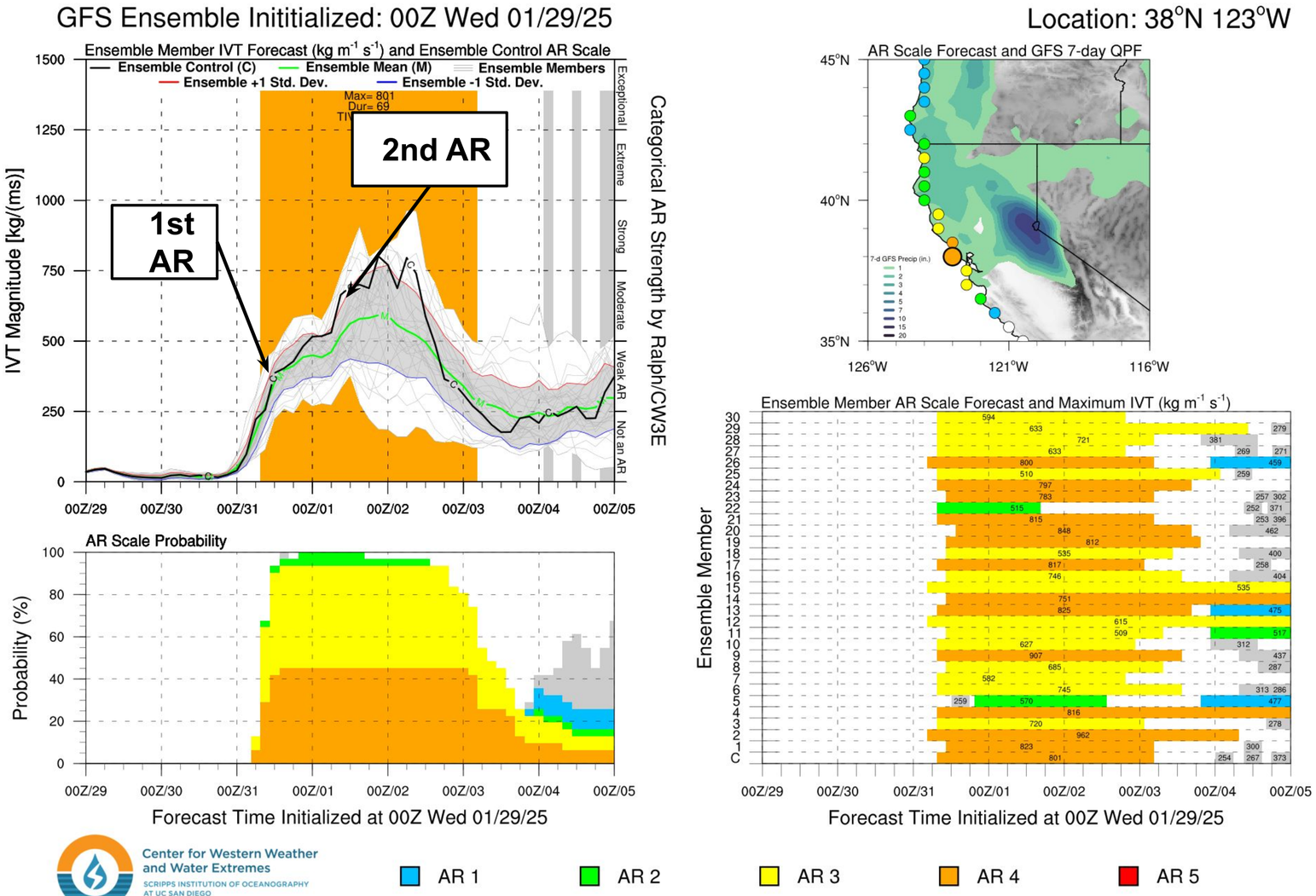
Difference Between GEFS and EPS Landfall Probabilities



- The 00Z GEFS is showing a faster propagation of the initial AR than the 00Z EPS, with landfall early Fri 31 Jan.
- The 00Z EPS is showing higher confidence in AR conditions (IVT > 250 kg m^{-1} s^{-1}) over Northern California and southwestern Oregon. Large discrepancies between the EPS and GEFS are also due to the GEFS forecasting quicker dissipation of AR.
- The GEFS is also showing higher confidence in a third AR making landfall over Northern and Central California on Wed 5 Feb.

AR Outlook: 29 January 2025

GEFS AR Scale and IVT Forecasts



- The 00Z GEFS control member is forecasting AR 2-4 conditions (based on the Ralph et al. 2019 AR Scale) over coastal Northern and Central California.
- The GEFS control member shows a quick fall off in AR conditions as the AR dissipates through Mon 3 Feb.
- 29/31 GEFS members are forecasting at least AR3 conditions for the point at 38ºN, 123ºW (near Sonoma County, CA).
- There is uncertainty in the timing of maximum IVT and duration of AR conditions amongst GEFS members.

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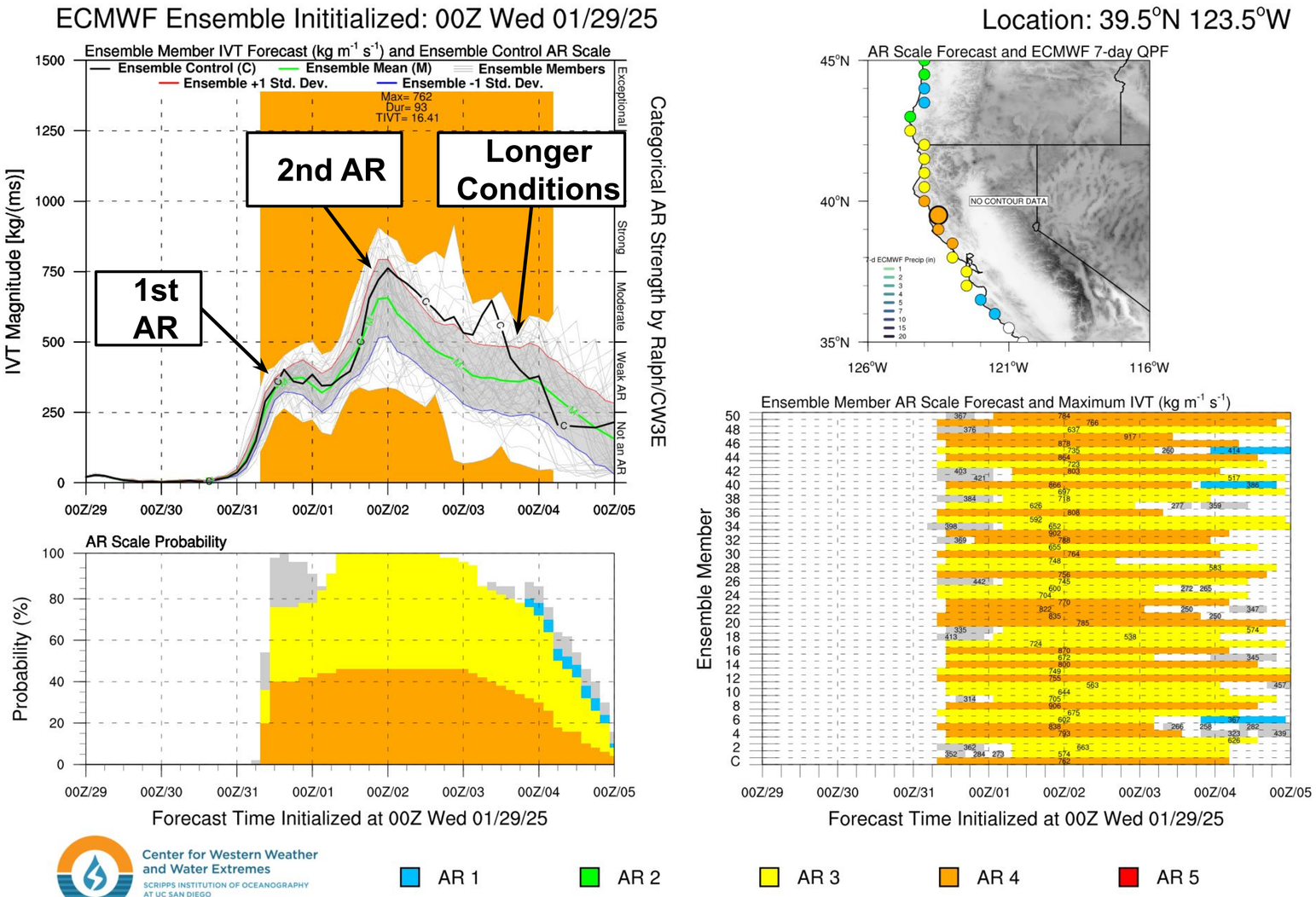
ECMWF EPS AR Scale and IVT Forecasts



- The 00Z ECMWF EPS control member is forecasting AR 3-4 conditions (based on the Ralph et al. 2019 AR Scale) over coastal Northern and Central California and for one point in southwestern Oregon.
- The EPS control member shows a longer duration of AR conditions over Central/Northern California as compared to the GEFS, with AR conditions continuing into Tue 4 Feb.
- Every EPS member is forecasting at least AR3 conditions for the point at 39.5ºN, 123.5ºW (near Mendocino County, CA).
- There is good agreement amongst EPS ensemble members on the timing of maximum IVT, but there is still uncertainty in the duration of AR conditions, both in time of onset and dissipation.

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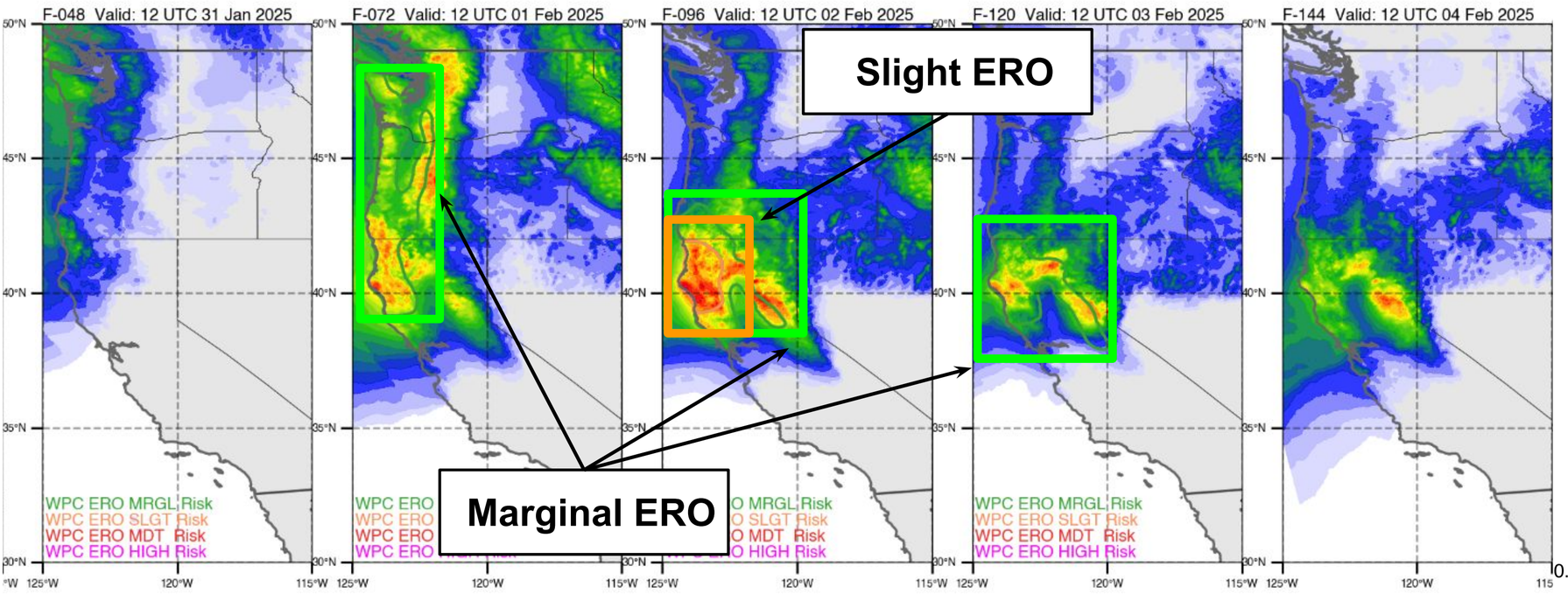
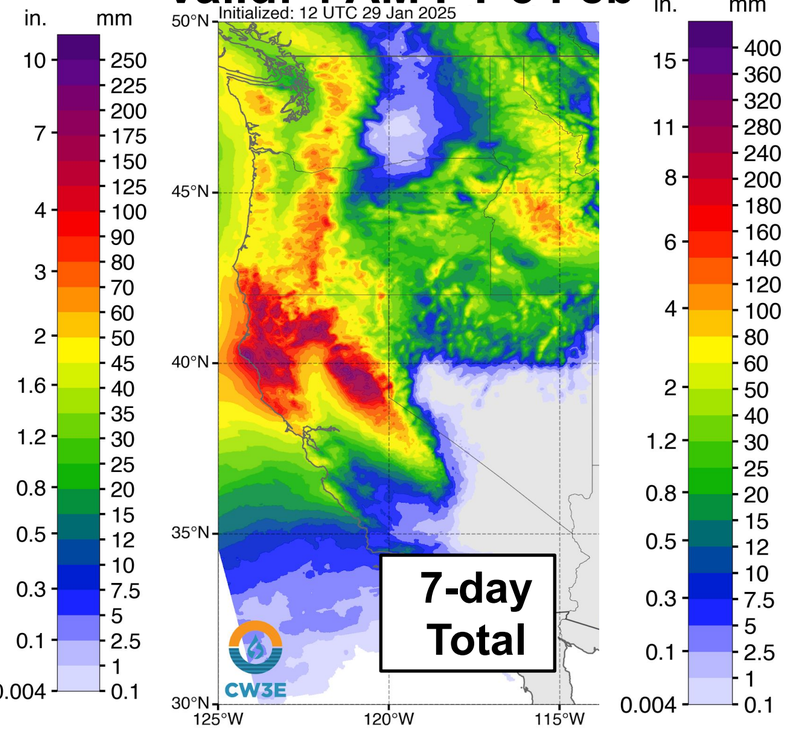
WPC Precipitation Forecasts

WPC 24-h Forecasts for Days 2-6
Valid: 4 AM PT 31 Jan- 4 Feb



WPC 168-h QPF
Valid: 4 AM PT 5 Feb



- The WPC is forecasting precipitation to begin along the USWC late on 30 Jan and continue into 4 Feb.
- The highest 7-day precipitation totals are expected over the Northern California Coast Ranges and the Northern Sierra Nevada, where at least 6-12 inches are expected. Precipitation totals of 3-5 inches are forecast over coastal Oregon and Washington and the Cascades.
- A slight risk Excessive Rainfall Outlook (ERO) (level 2 of 4, 15% chance of flooding) has been issued over Del Norte, Humboldt, and Mendocino Counties for day 4 (precipitation ending 4 AM PT 2 Feb).

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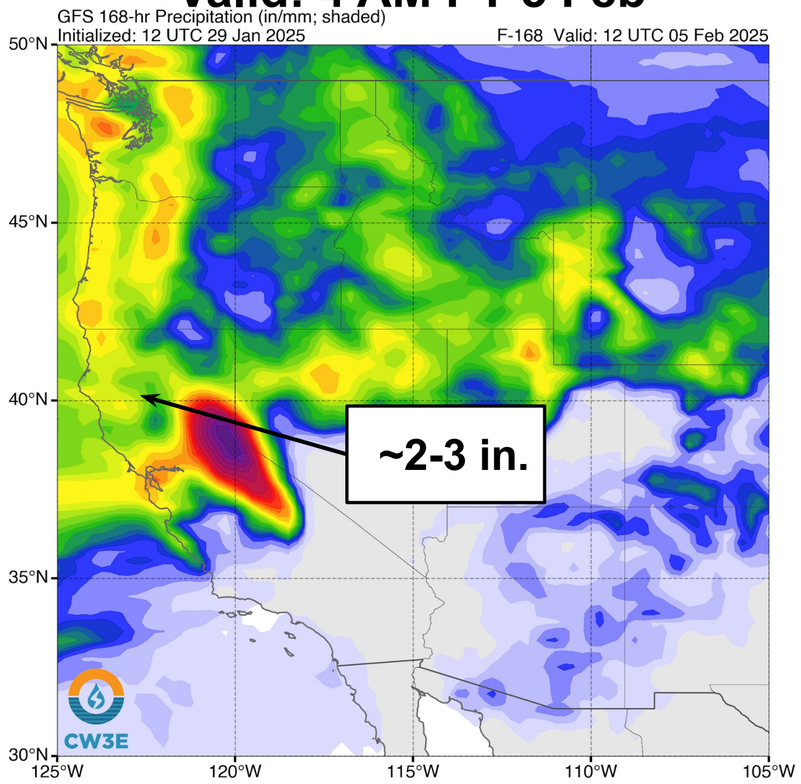
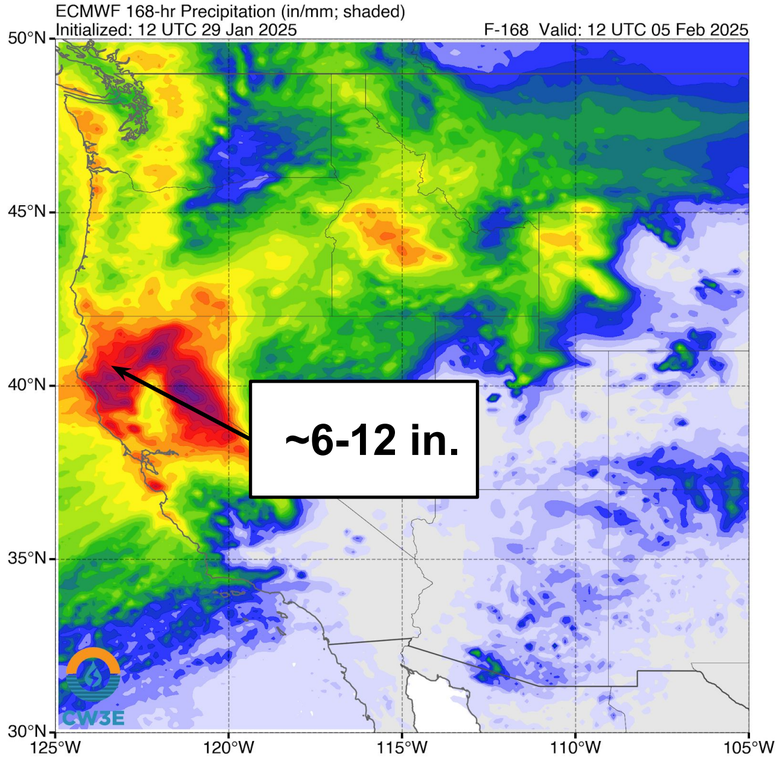
Precipitation Forecasts Comparison

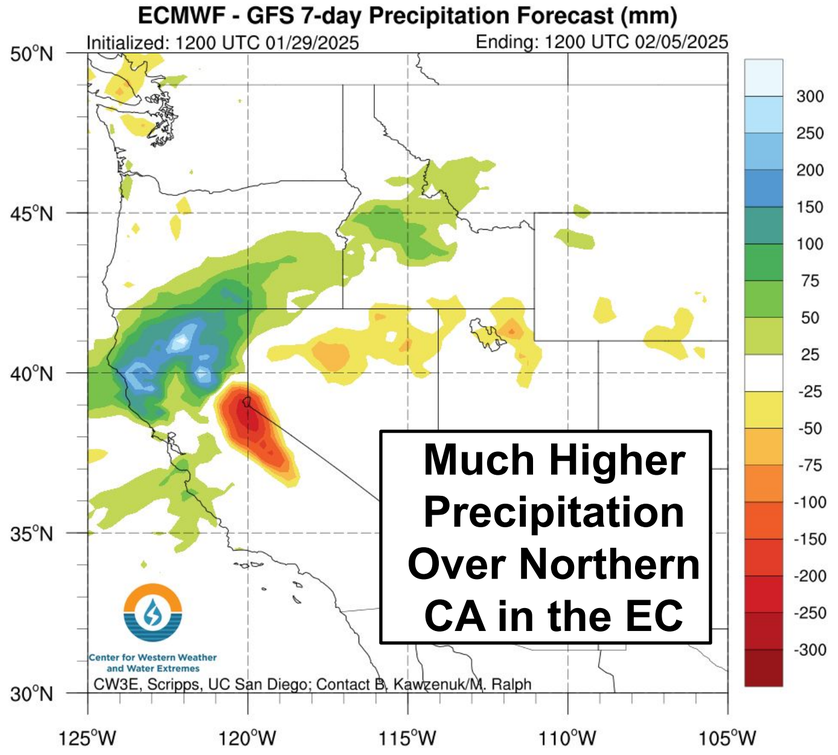
GFS 168-h QPF
Valid: 4 AM PT 5 Feb



ECMWF 168-h QPF
Valid: 4 AM PT 5 Feb



ECMWF-GFS 168-h QPF
Valid: 4 AM PT 5 Feb



- 7-day precipitation totals from the GFS differ significantly from the ECMWF
- While all both forecasts identify the possibility of heavy precipitation over the Northern Sierra Nevada (6-8+ inches), the GFS is forecasting at least 4-6 inches less precipitation over Northern California Coast Ranges than the ECMWF. GFS precipitation is also much higher over the Central Sierra Nevada than the ECMWF.
- This can largely be attributed to the differences in AR and moisture landfall location.

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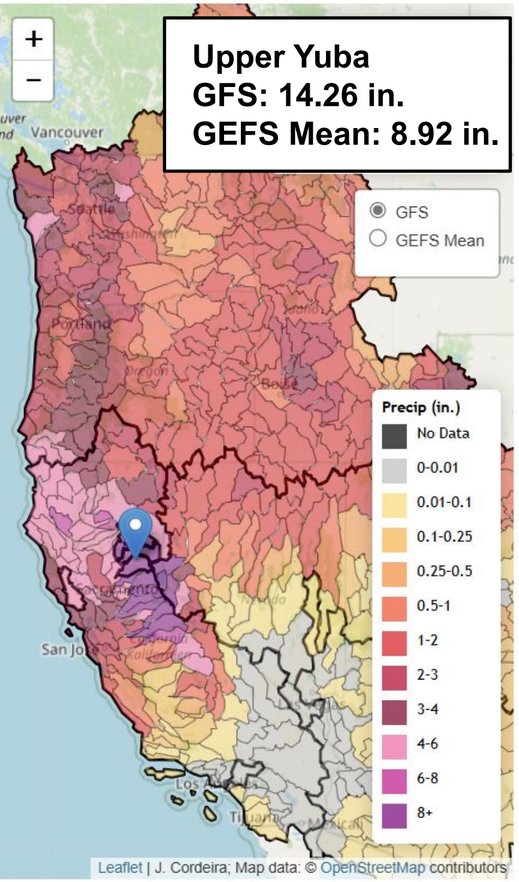
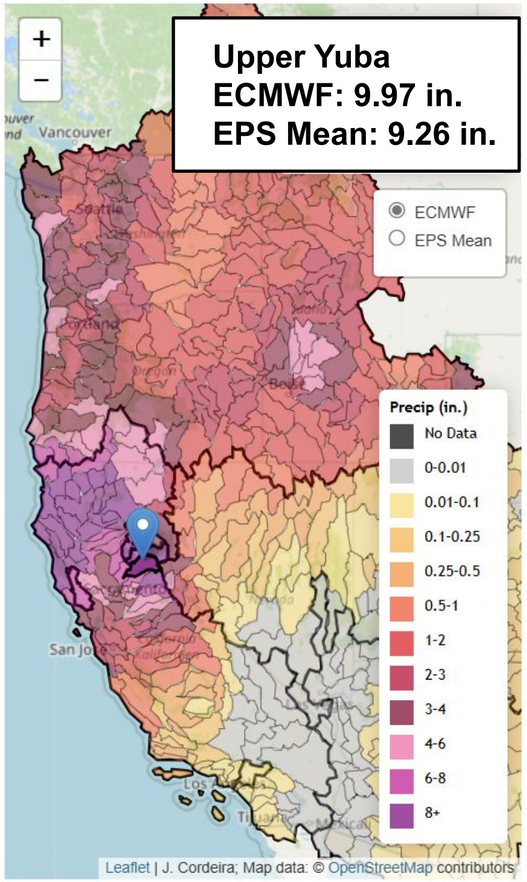
Watershed Precipitation Forecasts

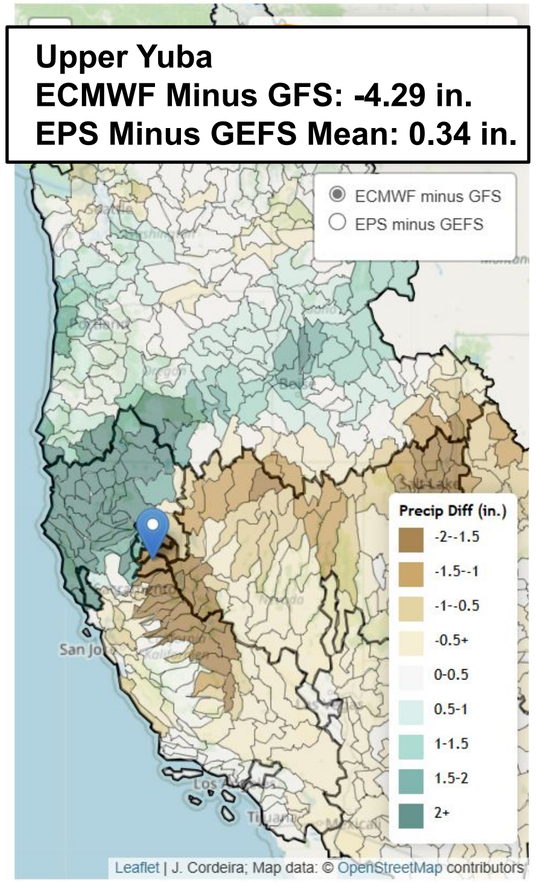
10-day GFS/GEFS Precipitation Forecasts

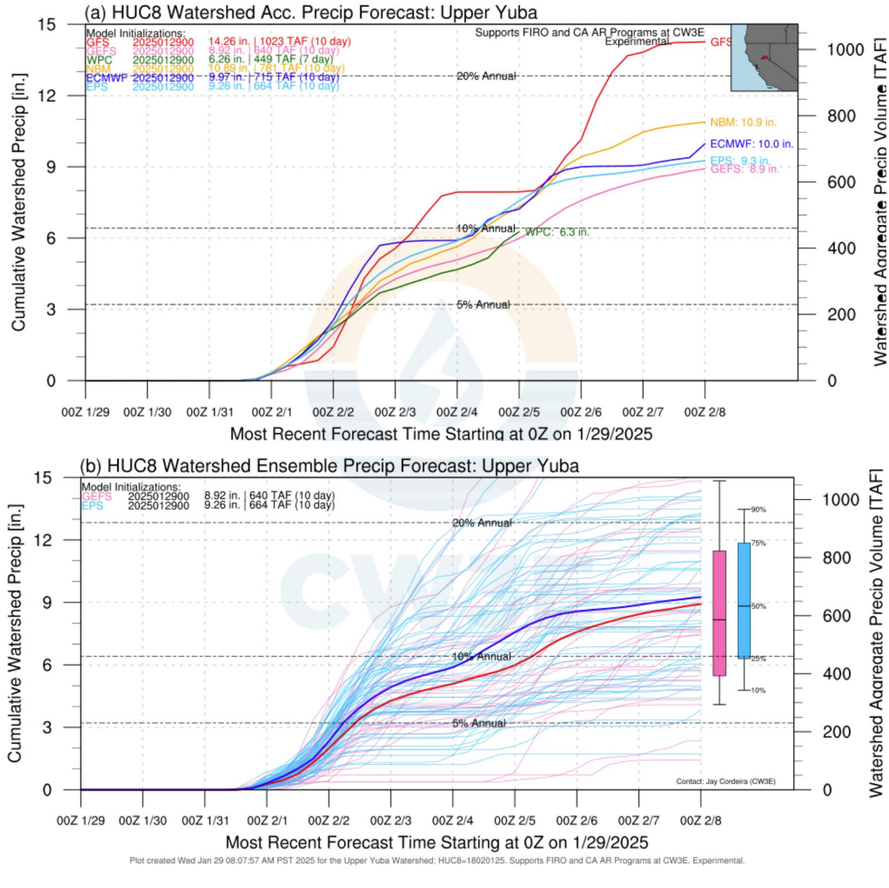


10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast





- Uncertainty in forecast location of these ARs is contributing to uncertainty in precipitation forecasts over the US West Coast.
- Overall, the 00Z GFS is forecasting higher precipitation totals over Sierra Nevada and less throughout the rest of Northern California and Southern Oregon during the next 10 days as compared to the 00Z ECMWF.
- In the Upper Yuba, the GFS is forecasting 14.26 inches of precipitation, exceeding all other models/ensemble forecasts by 3+ inches.
- Several EPS and GEFS members are indicating the possibility of 13+ inches of precipitation in this watershed (20% of normal annual precipitation).

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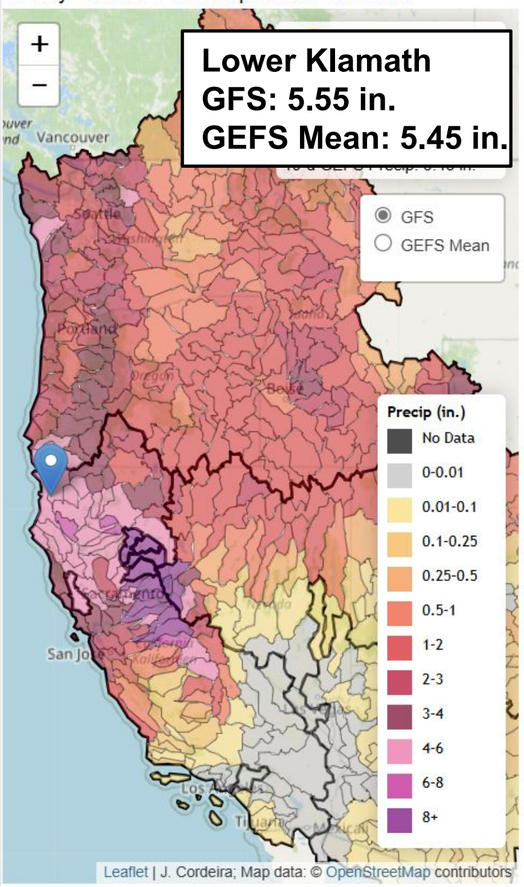
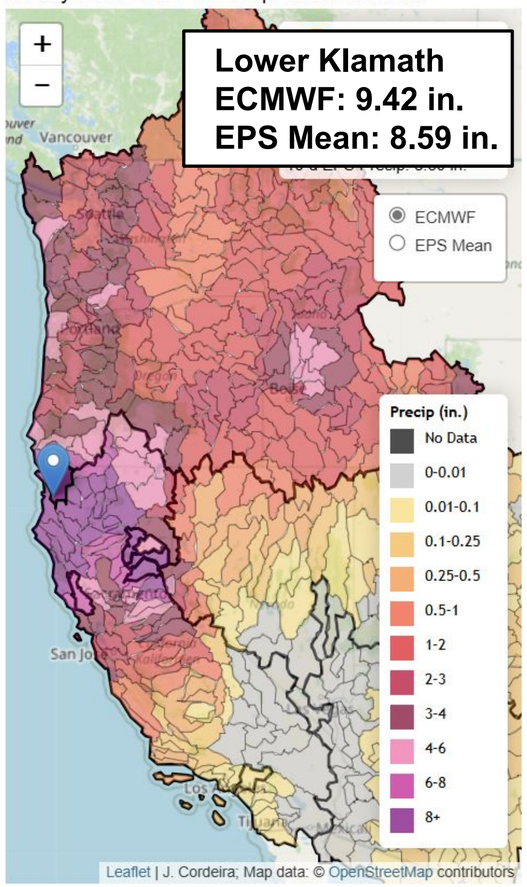
Watershed Precipitation Forecasts

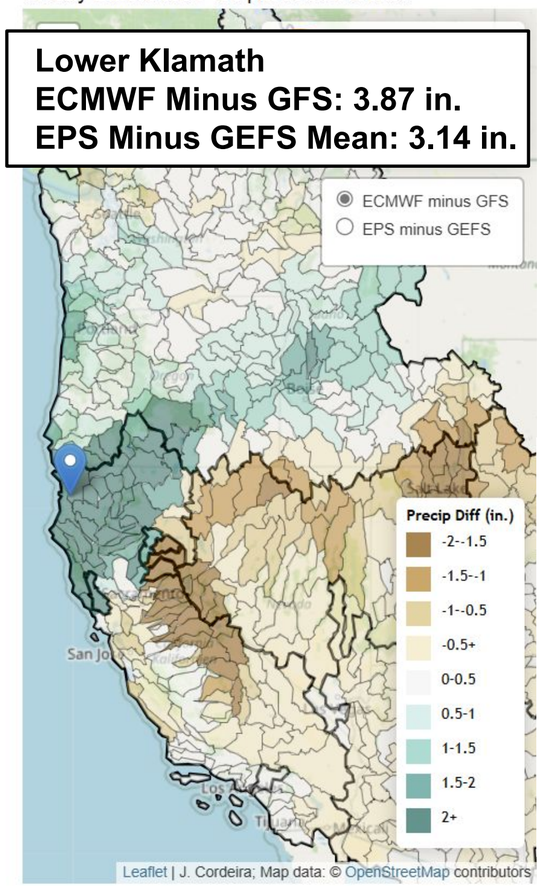
10-day GFS/GEFS Precipitation Forecasts

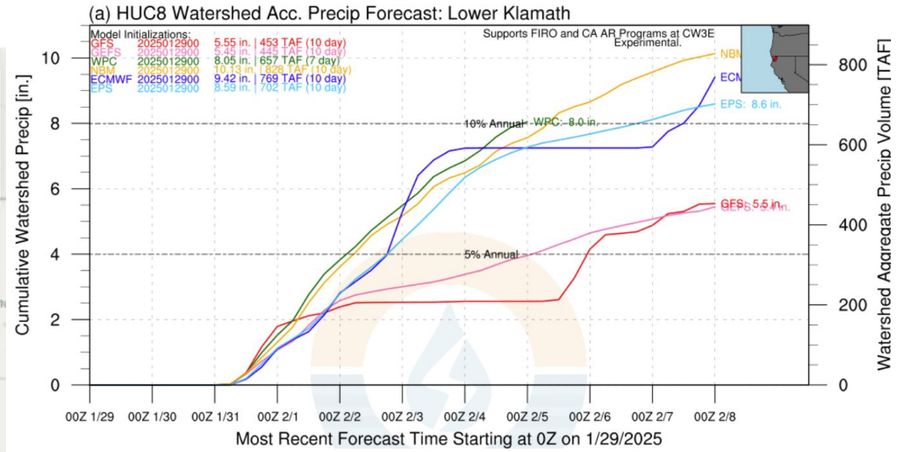


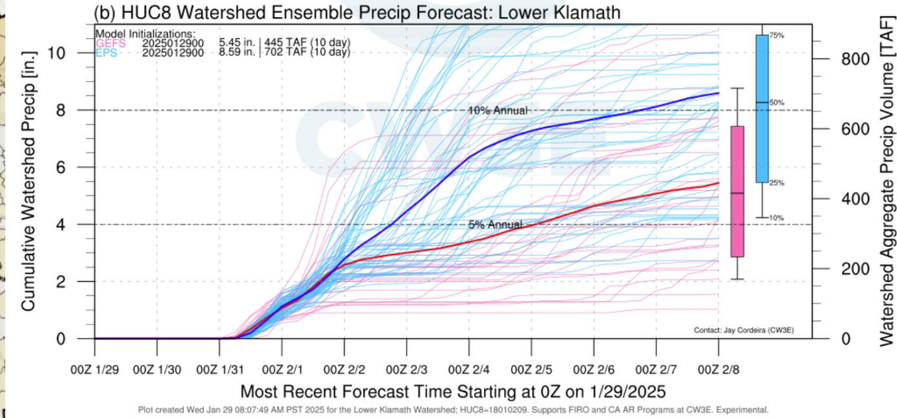
10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast







- EPS is forecasting much higher precipitation amounts than GEFS over most of Northern California during the next 10 days.
- For example, the EPS mean 10-day precipitation in the Lower Klamath is 3.14 inches higher than the GEFS mean. More than 50% of EPS members and <25% of GEFS members are forecasting 8+ inches of mean areal precipitation.
- The GEFS and EPS both have large ensemble spread, with some members forecasting >10 inches and some <4 inches.

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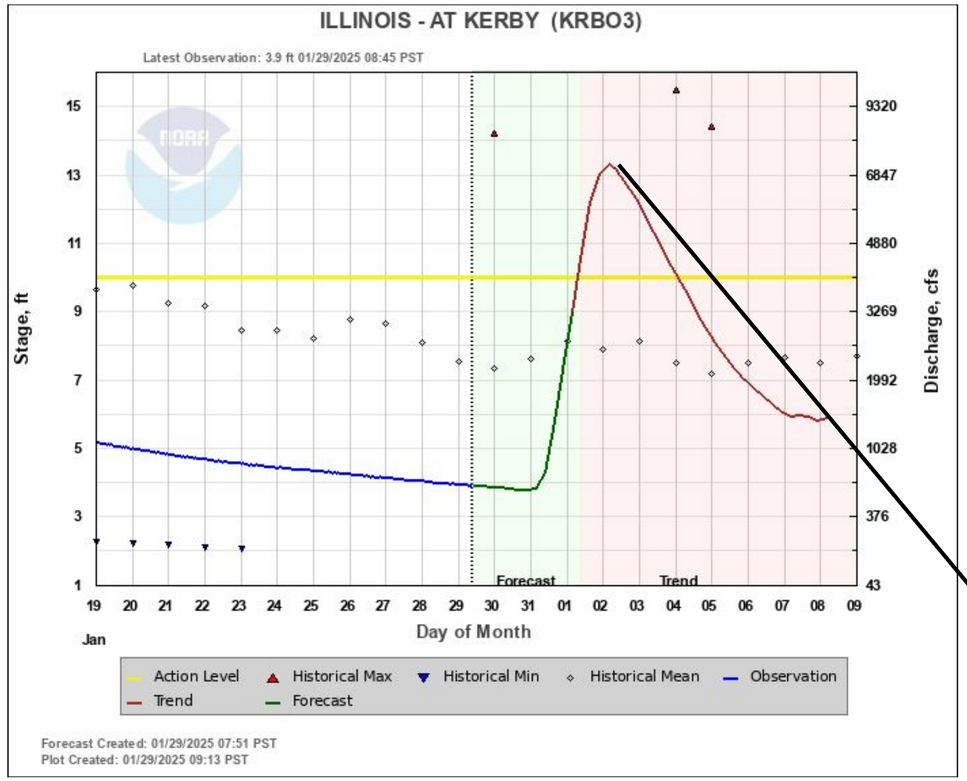
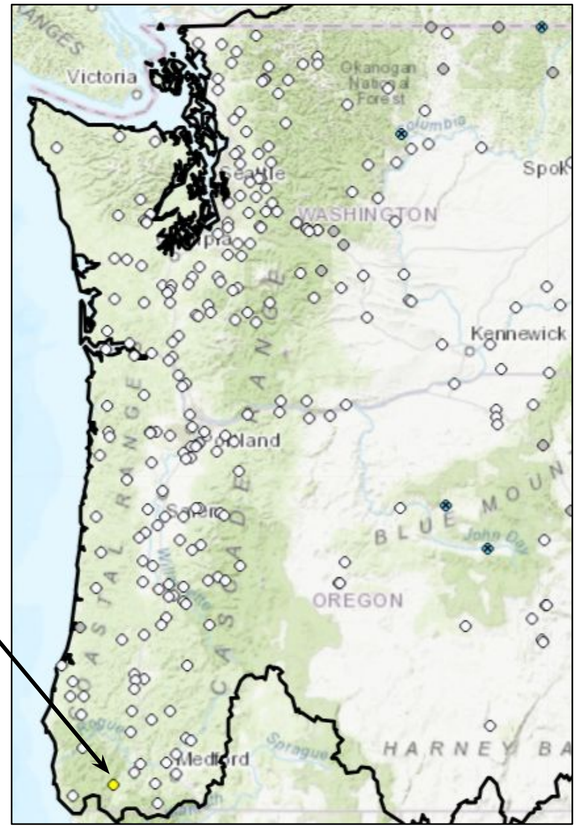
Hydrologic Forecasts: Pacific Northwest





- The NWS Northwest River Forecast Center is forecasting one stream gage (Illinois at Kirby, above) in southwestern Oregon over the next 10 days to exceed Action/Bankfull stage.

- While the heavy precipitation is expected to cause stream level increases across the region, most gages are not expected to reach flood levels given that stream levels are low across much of the Pacific Northwest.

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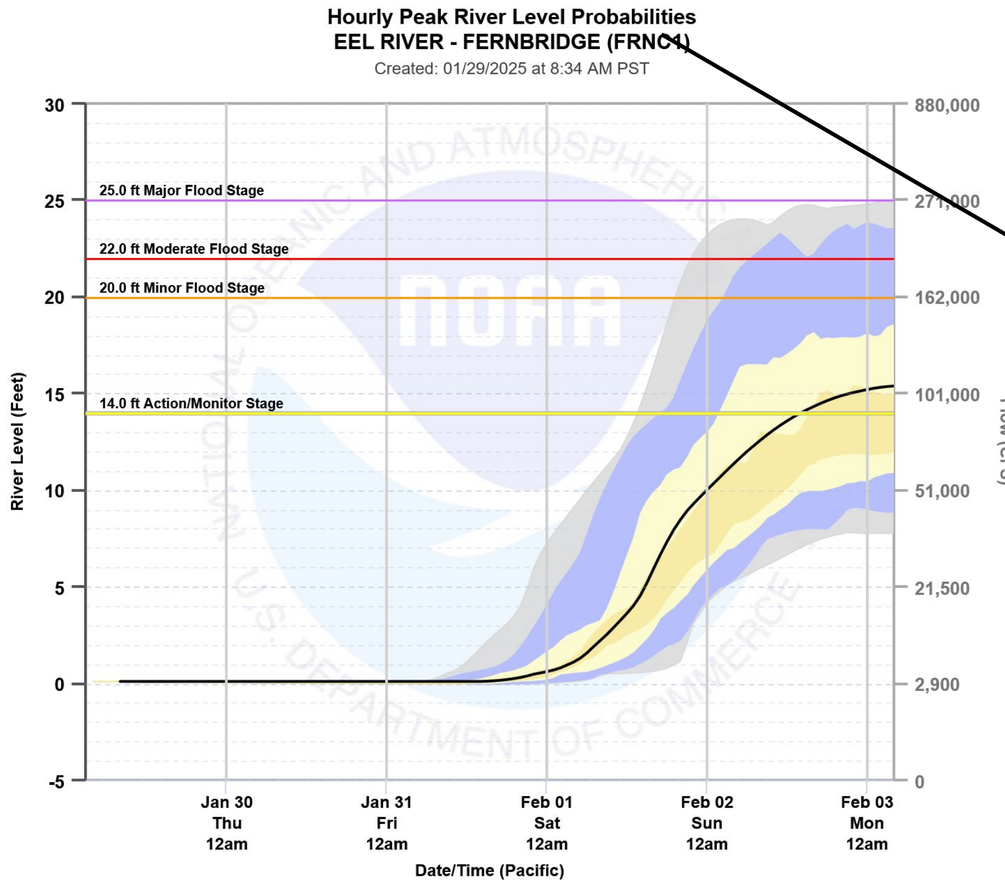
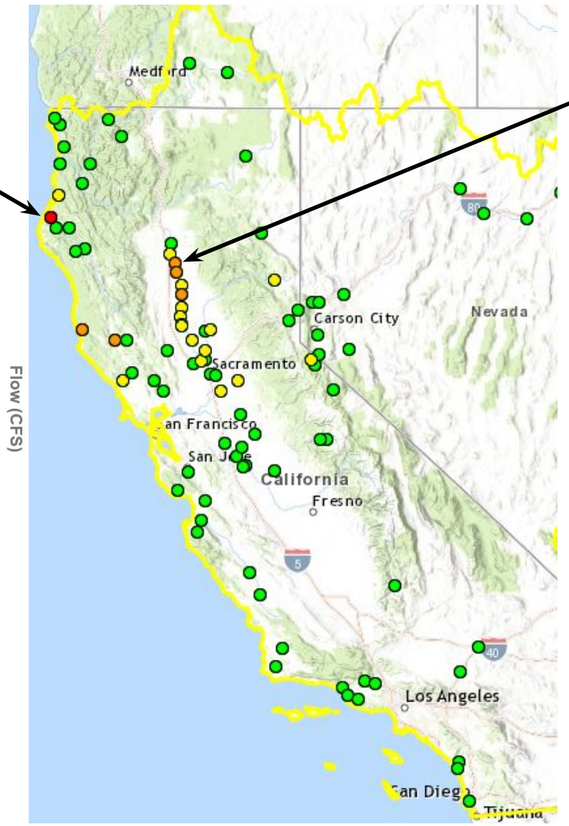
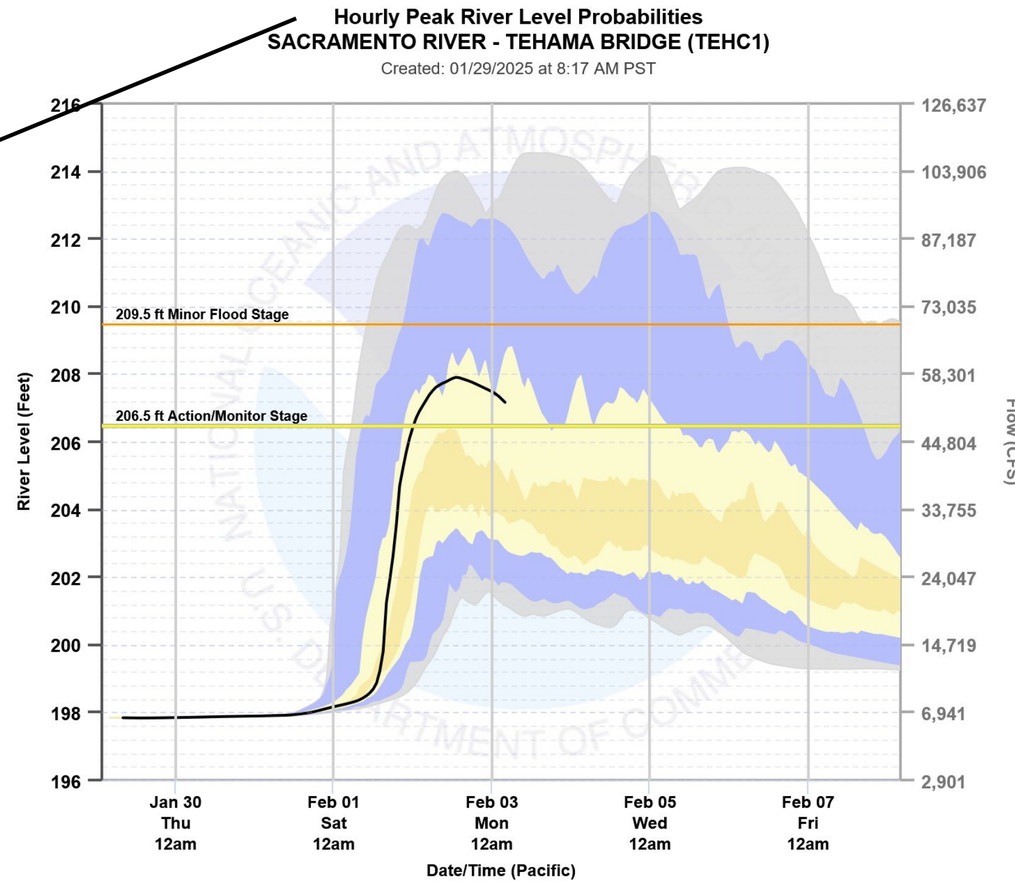
Hydrologic Forecasts: California







- The NWS California-Nevada River Forecast Center 10-day ensemble forecast for 25% exceedance probability show five stations with the potential to exceed minor flood stage (e.g., Sacramento River at Tehama Bridge, right) and one station with the potential to exceed moderate flood stage (Eel River at Fernbridge, left).

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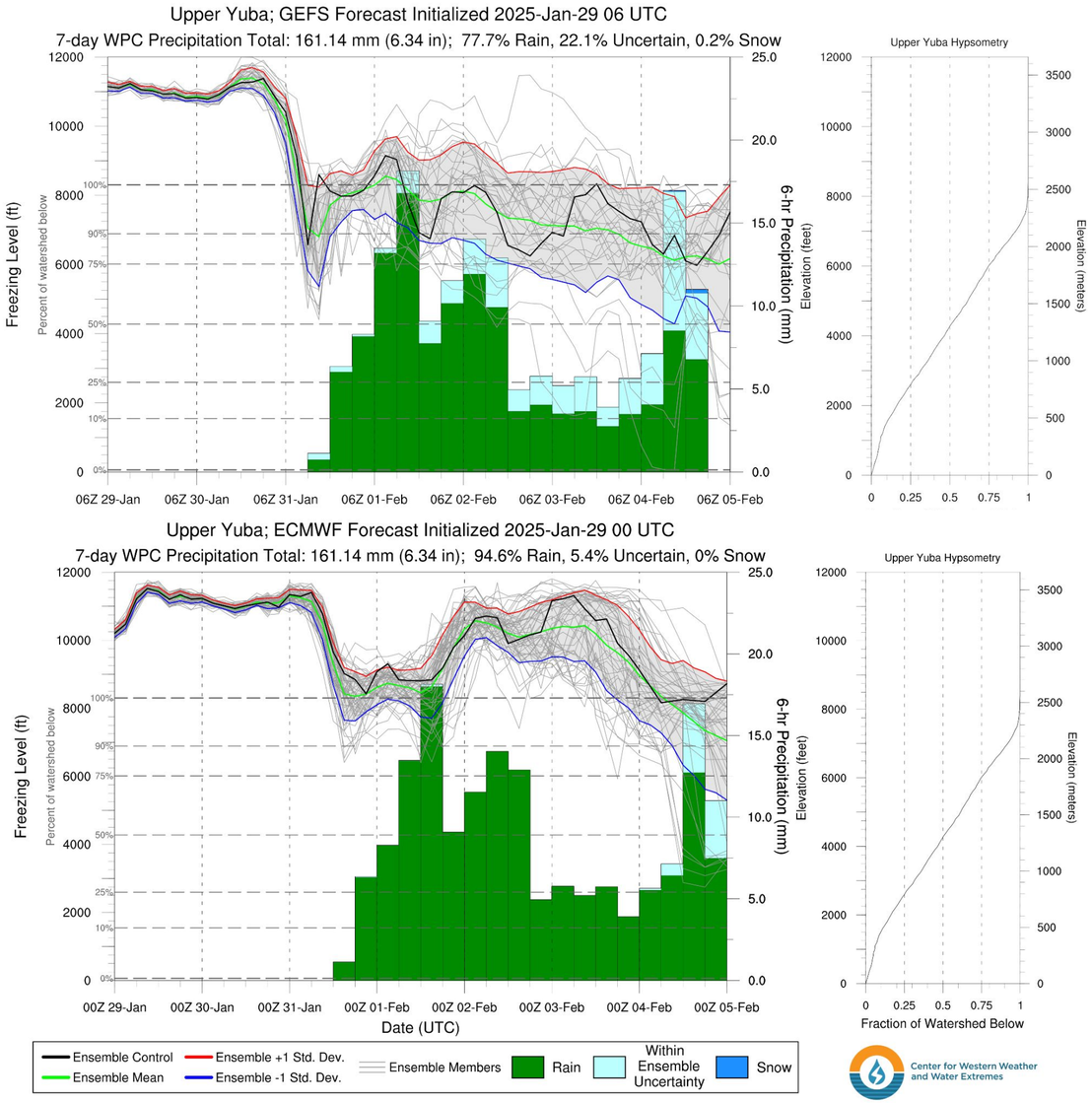
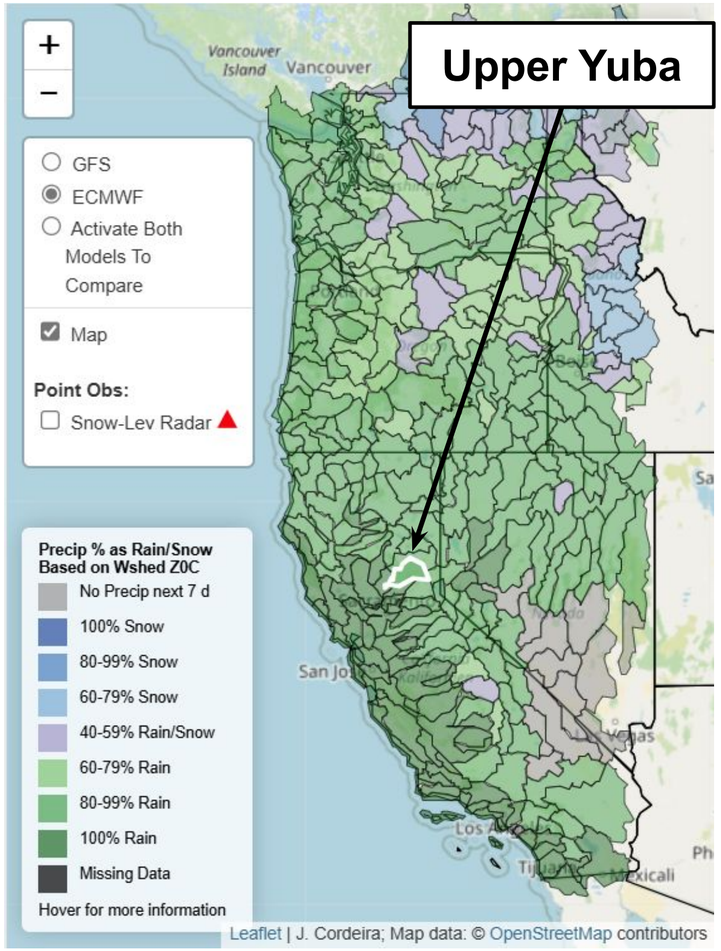
Watershed Freezing Level Forecast Comparison





- There is uncertainty in the freezing levels as a result of the mid-level forecast differences.
- The GFS/GEFS are forecasting the mid-level low propagating down the coast from the north to dig farther southeastward, resulting in lower freezing levels during the duration of the AR (upper left).
- Uncertainty in the freezing levels and position of this low have important implications for precipitation type and snowfall potential in the Sierra Nevada.
- Despite the uncertainty, snow levels are forecast to remain high leading to the majority of precipitation falling as rain and increasing runoff potential.

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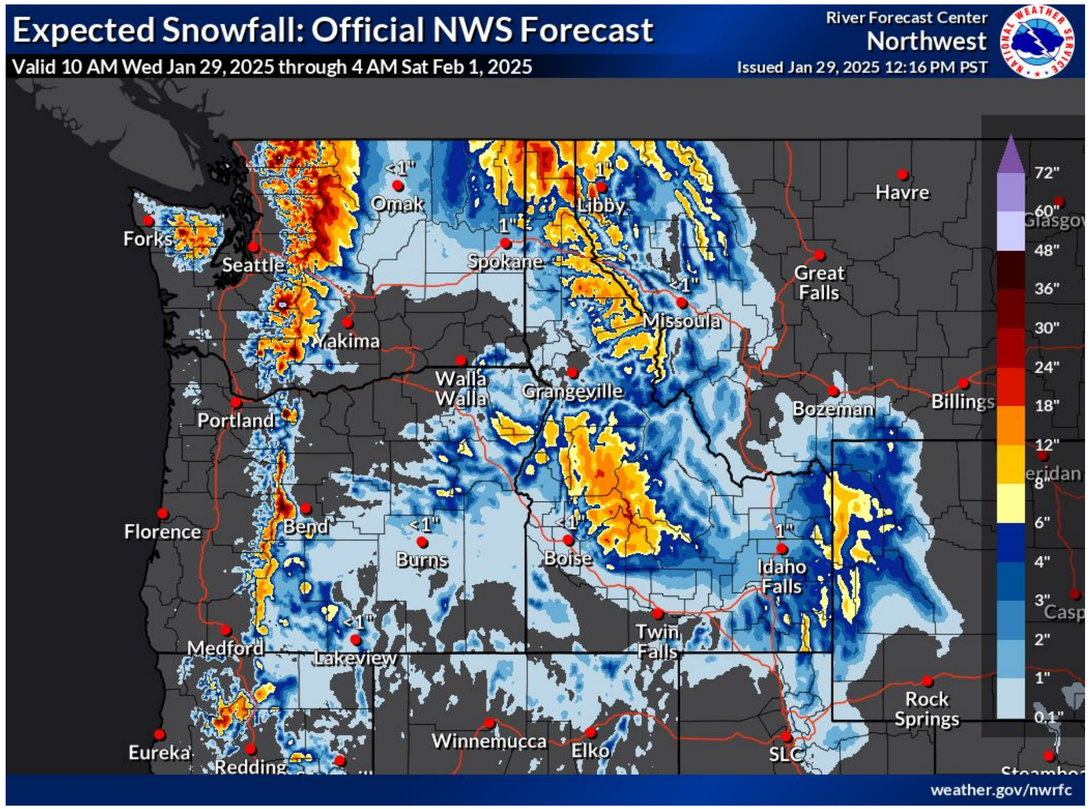
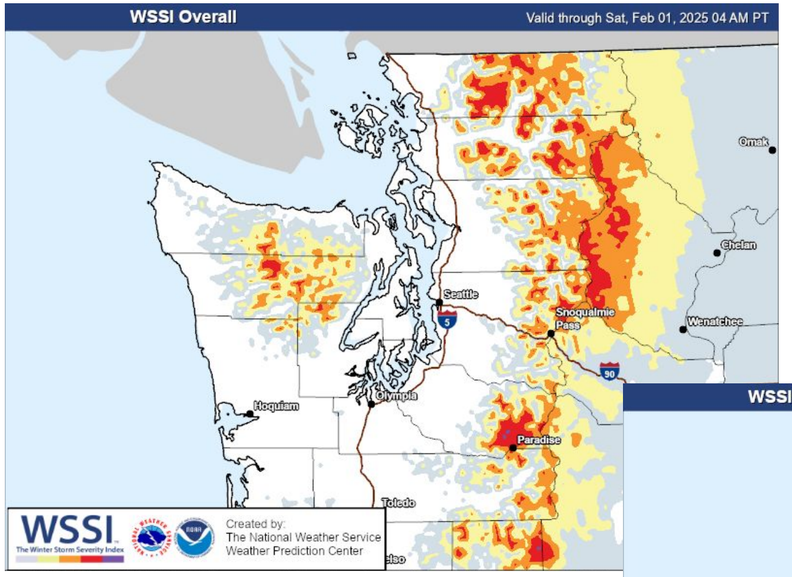
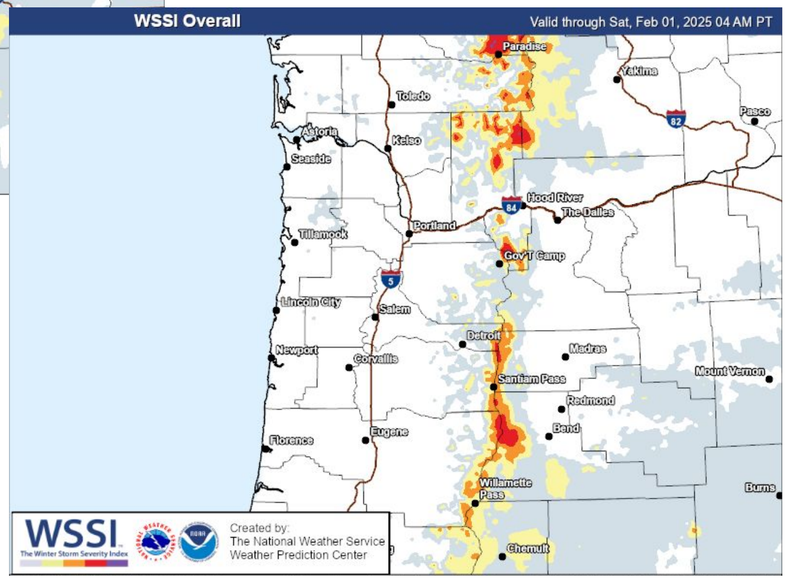
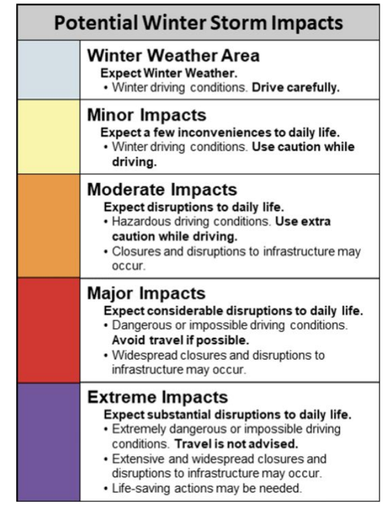
Winter Weather Hazards









- Snowfall accumulations of 8–18 inches are forecast above 7,000 feet in the Washington Cascades over the next three days, with the highest peaks forecast to receive greater than 30 inches.
- WPC's Winter Storm Severity Index (WSSI) is showing minor-to-moderate winter storm impacts across much of these regions, with major impacts expected over the higher peaks.

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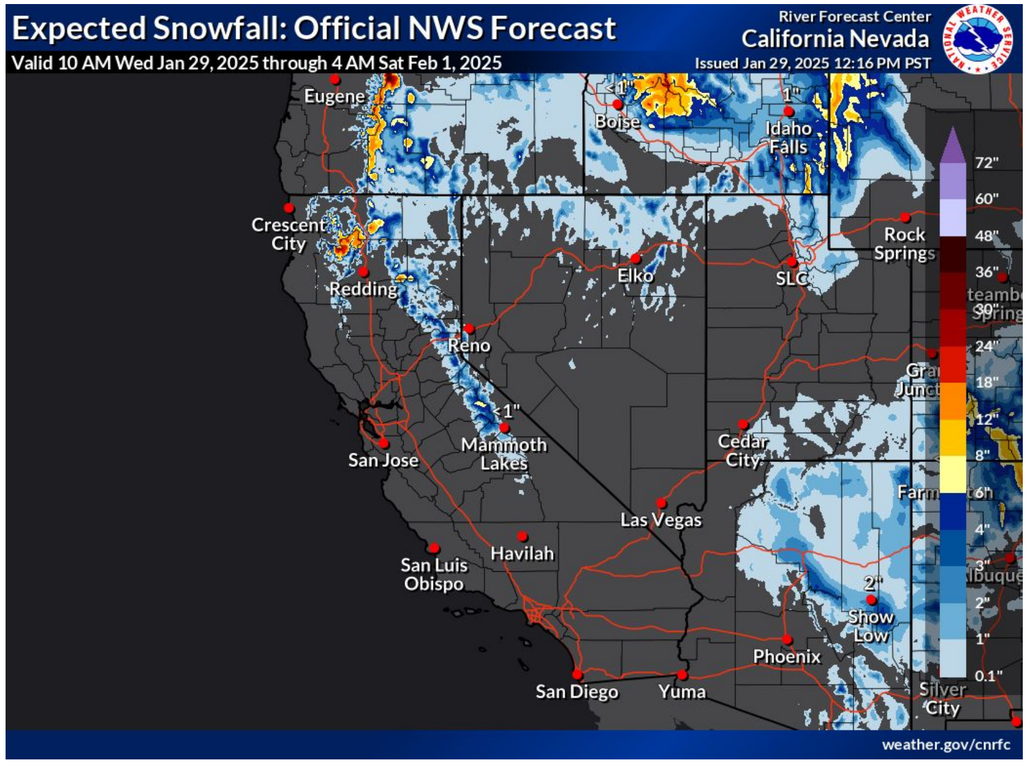
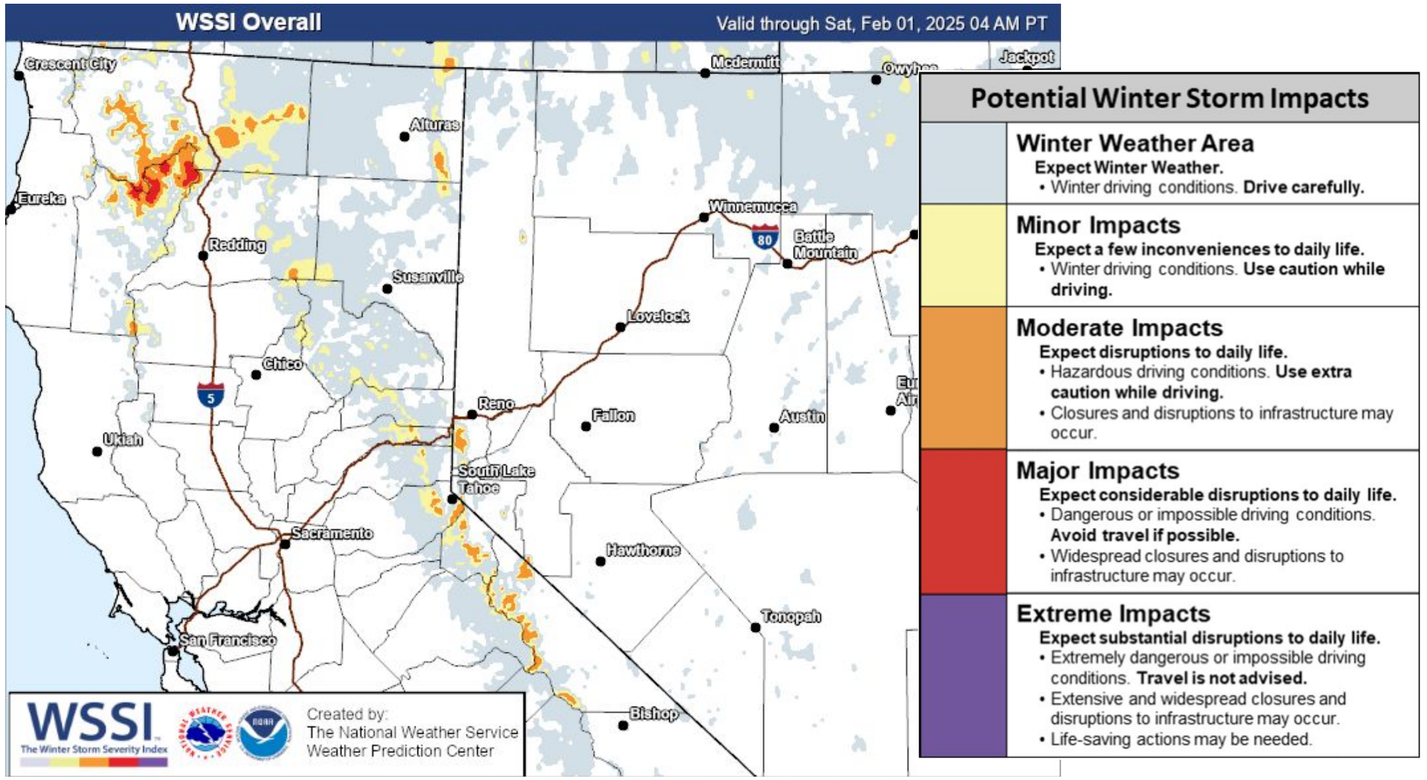
Winter Weather Hazards



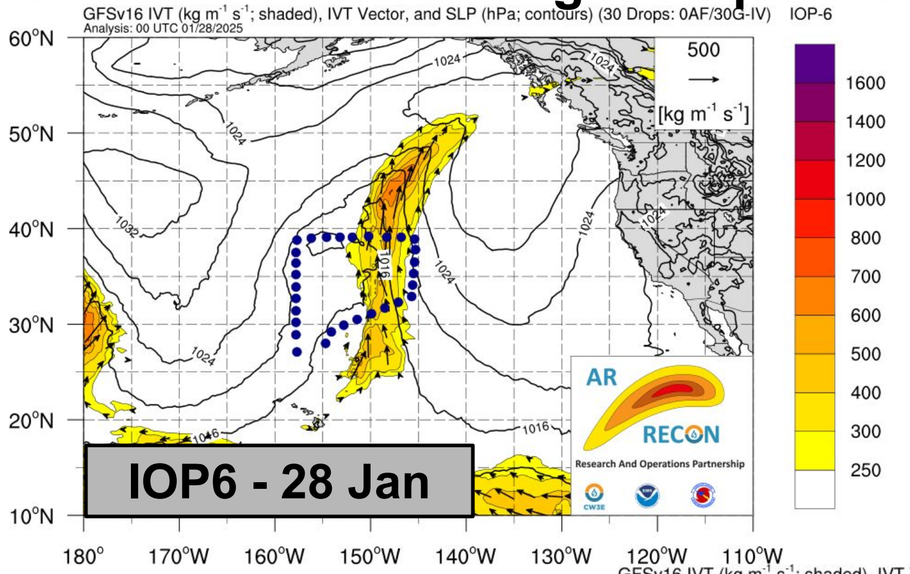


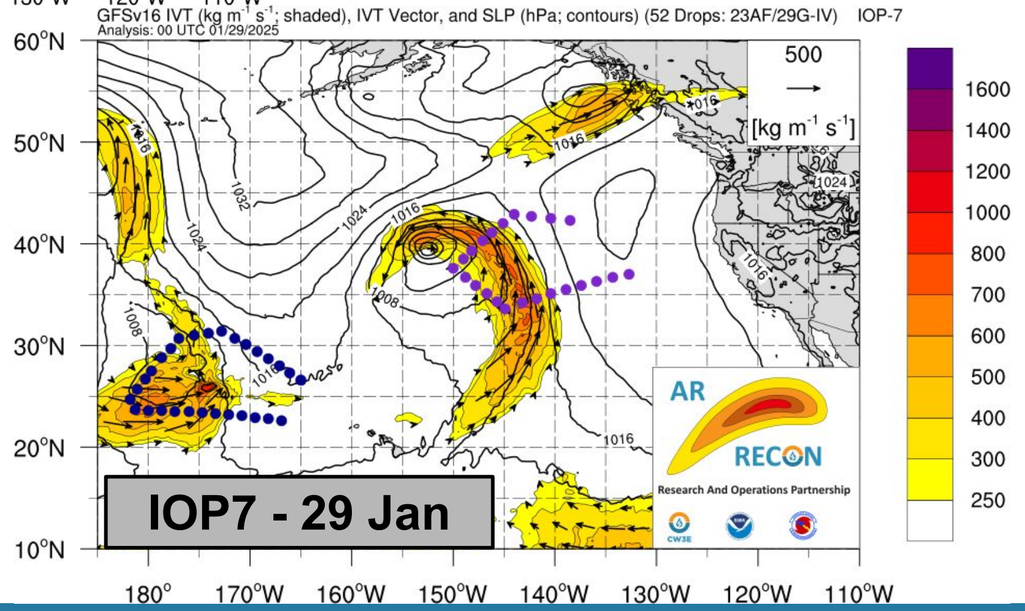
- Snowfall accumulations of 2–6 inches are forecast over the Sierra Nevada and 6-18 inches over the Klamath Mountains over the next three days.

- WPC's Winter Storm Severity Index (WSSI) is showing minor-to-moderate winter storm impacts across portion of the Sierra Nevada and minor-to-major impacts over the Klamath Mountains.

AR Outlook: 29 January 2025

Current AR Recon Flight Sequence





The AR Recon team has completed <u>two</u> storm sampling flights during this sequence with more flying today, and will continue to meet to facilitate additional flights

- CW3E's Atmospheric River Reconnaissance (AR Recon) field campaign continues in WY2025, with the most recent sequence of flights focusing on the development of the current sequence of storms.
- The AR Recon team planned multiple flights, departing from Sacramento, CA and Honolulu, HI 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 its essential atmospheric structures, in addition to regions of forecast sensitivity.