CW3E Atmospheric River Outlook: 26 March 2025

Pair of Atmospheric Rivers Forecast to Impact the US West Coast

AR Summary:

- An atmospheric river (AR) that made landfall today will continue to impact the Pacific Northwest into early Fri 28 Mar.
- There is potential for an impactful AR to landfall over California next week, but model-to-model uncertainty is high.
- The GFS is forecasting a strong AR to make landfall along the CA coast and penetrate inland to the Sierra Nevada with optimal landfall direction for orographic precipitation enhancement.
- The dynamics over the NE Pacific are much different in the ECMWF, resulting in the AR briefly making landfall along the USWC with suboptimal landfall direction, limiting the precipitation impact.

Precipitation Forecasts:

- The NWS Weather Prediction Center (WPC) is forecasting at least 4-7 inches inches of precipitation over the Olympic Peninsula, Oregon, and the Northern California Coast Ranges with the first AR.
- The GFS forecast for precipitation with the second AR is greater than the ECMWF due to the forecast differences in the AR.
- The GFS is forecasting 7+ inches across the California Coast Ranges and Sierra Nevada, with highest totals of 10+ inches over the Sierra Nevada while the ECMWF is forecasting 2-4 inches over the Northern Sierra Nevada and Oregon and Northern California Coast Ranges.

Flooding and Streamflow:

- The NWS WPC has issued a marginal risk Excessive Rainfall Outlook (ERO) (level 1 of 4, 5% chance of flash flood conditions) over the Cascades in Washington and Oregon on Day 1 (24-h period ending 5 AM PT Thu 27 Mar) and over coastal Washington, Oregon, and Northern California on Day 2 (24-h period ending 5 AM PT Fri 28 Mar).
- The NWS Northwest River Forecast Center is forecasting three gauges in Oregon to exceed minor flood stage and one gauge in Oregon to exceed moderate flood stage over the next 10 days.

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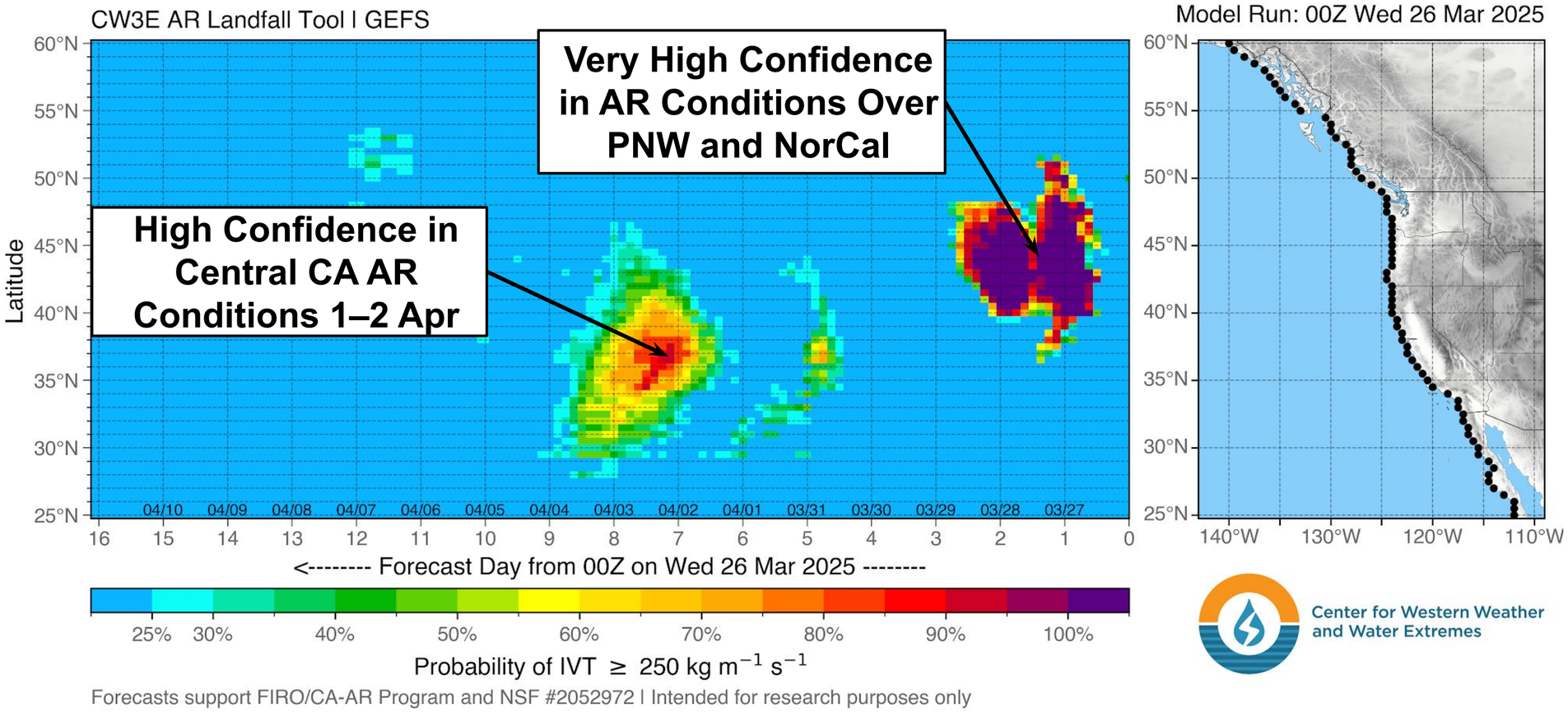
CW3E AR Landfall Tool: GEFS



- CW3E's AR Landfall Tool based on the GEFS shows very high confidence (100% probability) in AR conditions (IVT ≥ 250 kg m^{-1} s^{-1}) beginning over the Pacific Northwest and Northern California coasts today and continuing into Fri 28 Mar.
- The landfall tool is also showing high confidence (>80% probability) in AR conditions over Central California for 1–2 Apr. GEFS has shown a consistently strong signal for a landfalling AR in California for several days.

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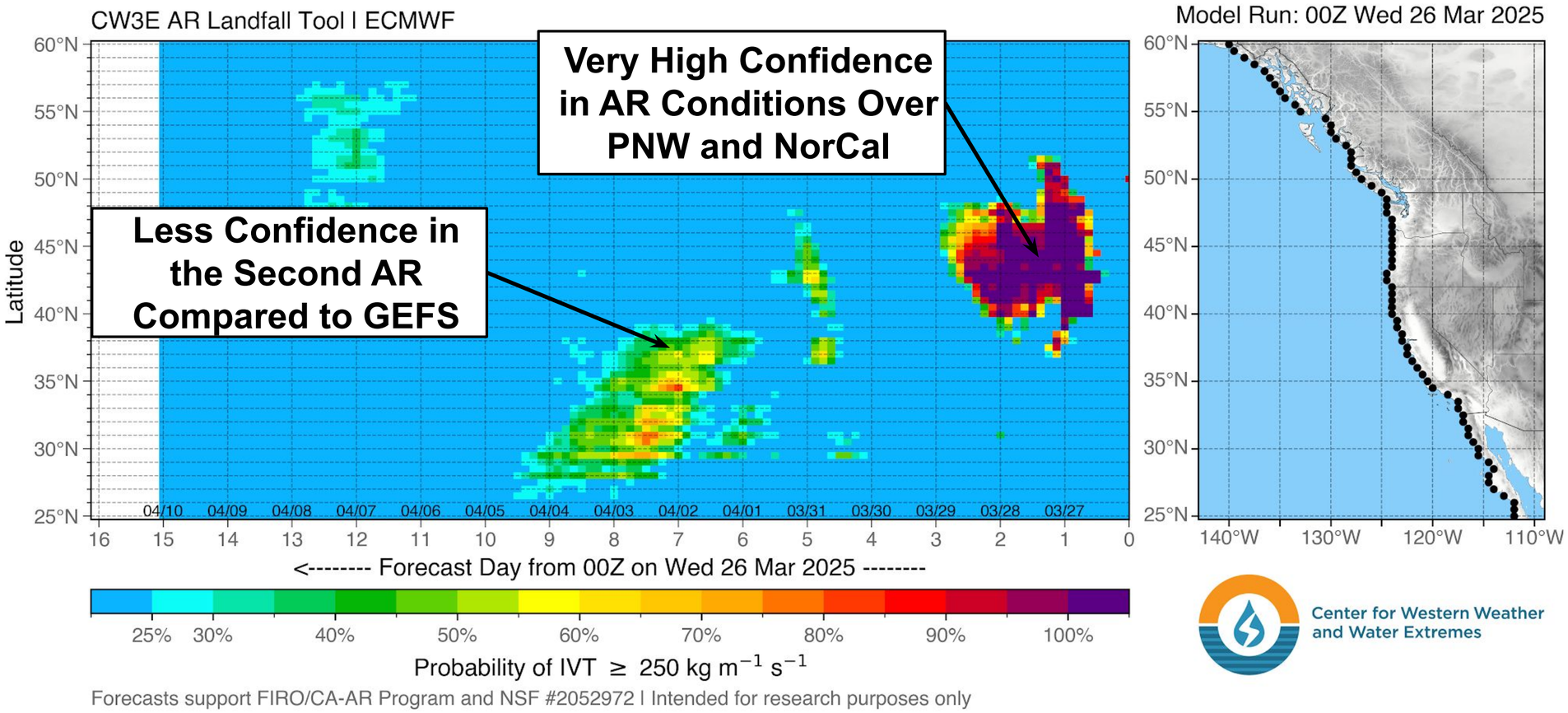
CW3E AR Landfall Tool: EPS



- CW3E's AR Landfall Tool based on the EPS also shows very high confidence (100% probability) in AR conditions over the Pacific Northwest and Northern California coasts today and continuing into Fri 28 Mar.
- The EPS members are showing less confidence in the later event than the GEFS, particularly over Central and Northern California.

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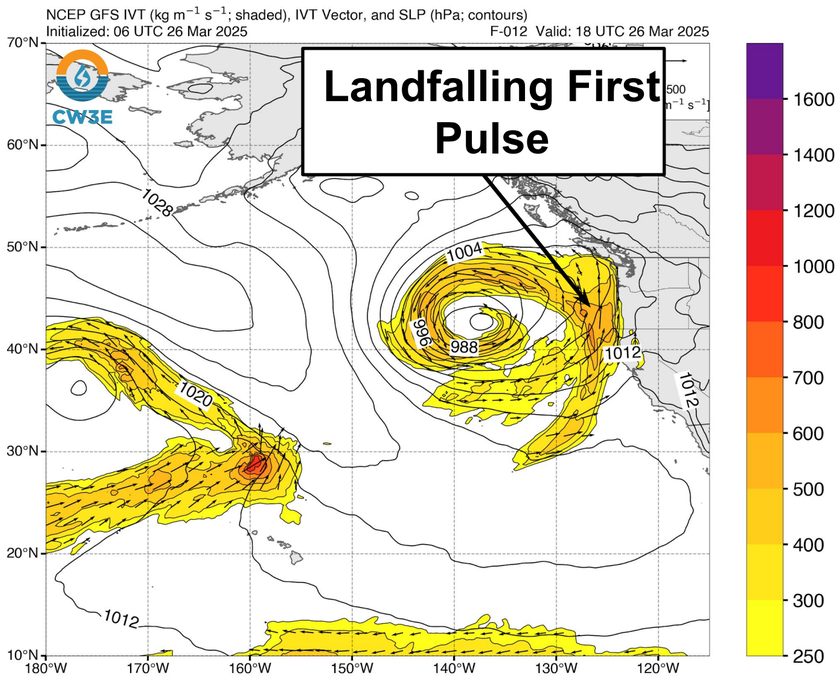
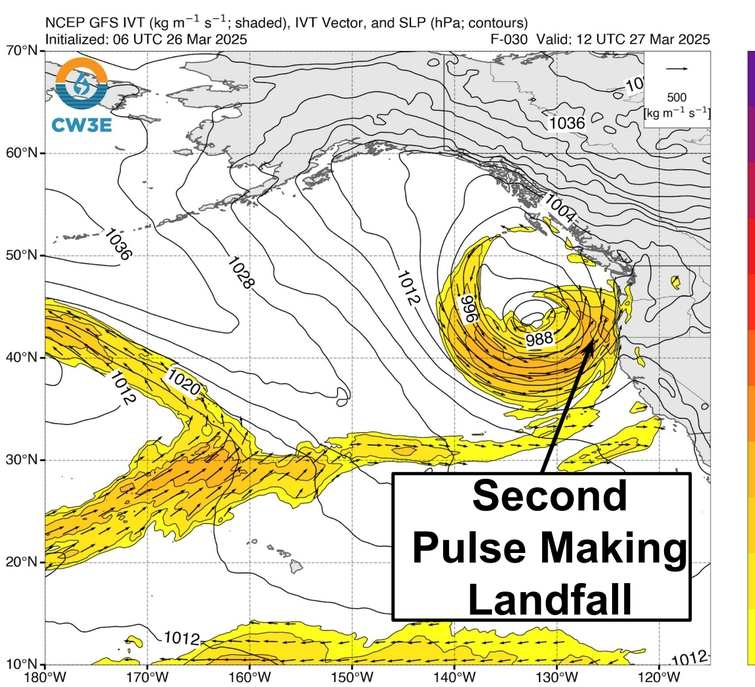
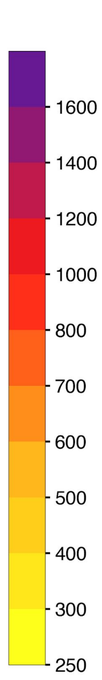
GFS IVT & SLP Forecasts: 1st AR

Valid: 10 AM PDT 26 Mar (F-012)

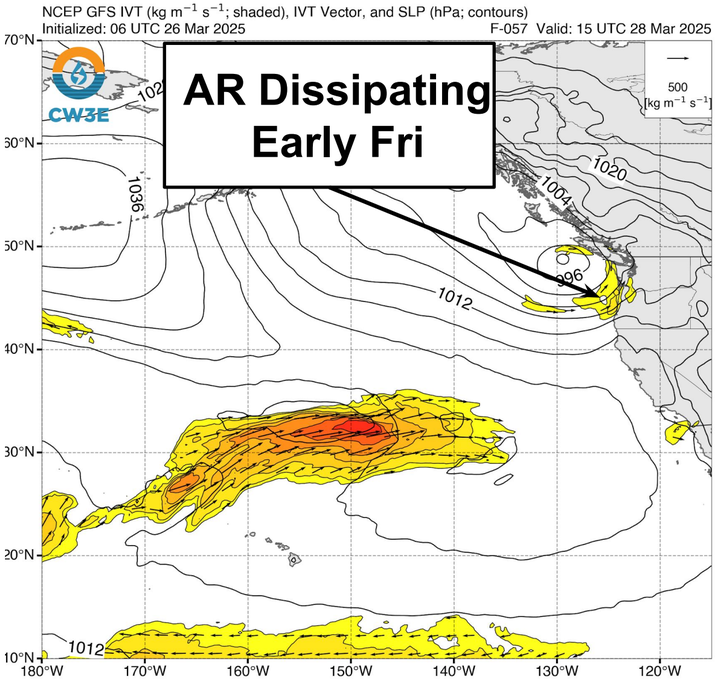


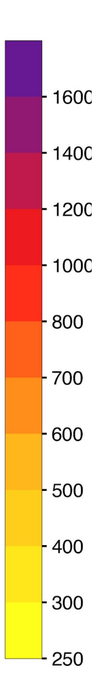
Valid: 5 AM PDT 27 Mar (F-030)





Valid: 8 AM PDT 28 Mar (F-57)





- The first AR made landfall along the Washington and Oregon coasts this morning.
- Southerly IVT in the first pulse may support precipitation enhancement over the Coastal Ranges in Northern California and Southern Oregon as well as the mountains on the Olympic Peninsula.
- Moisture transport around the associated low-pressure system will be brought into the Pacific Northwest following the first pulse early on Thu 27 Mar as the low pressure system shifts to the northeast.
- This second IVT pulse is forecast to continue into early Fri 28 Mar.

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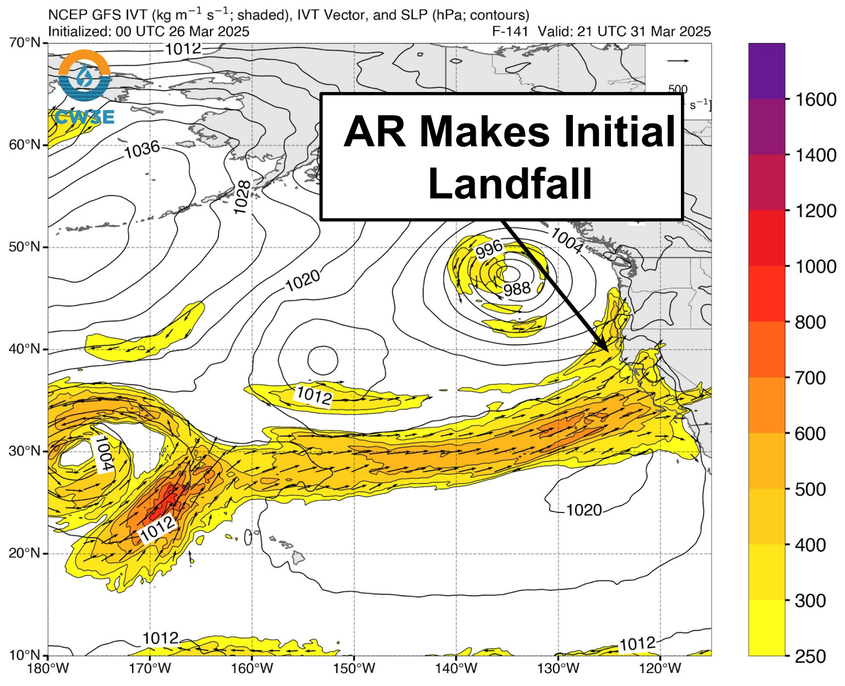
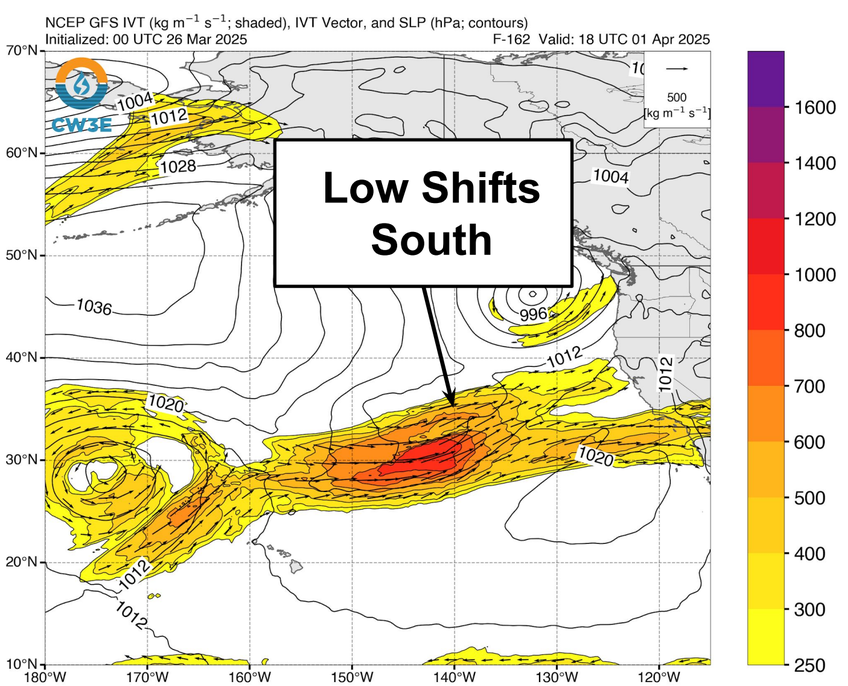
GFS IVT & SLP Forecasts: 2nd AR

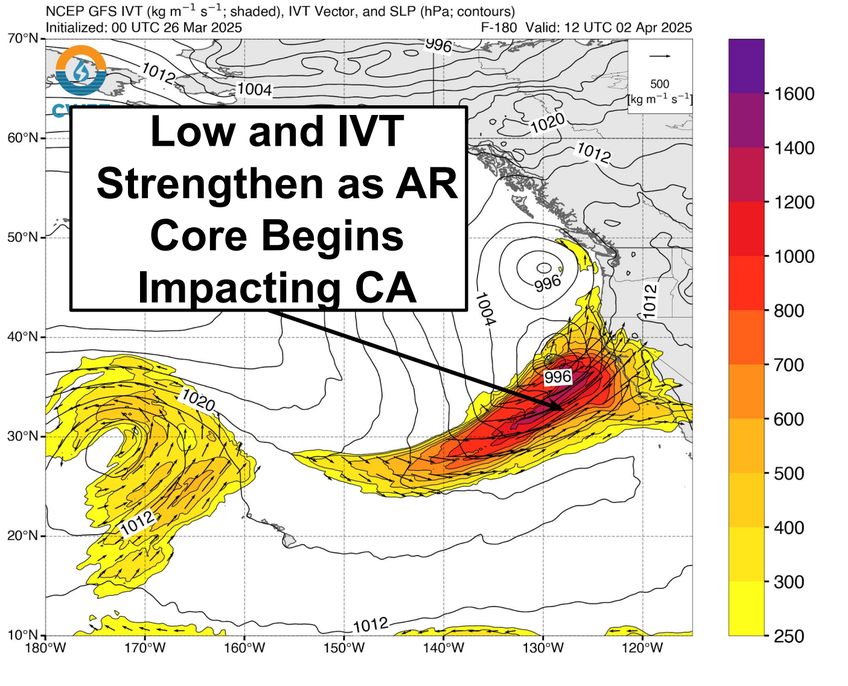
Valid: 2 PM PDT 31 Mar (F-141)



Valid: 11 AM PDT 1 Apr (F-162)



Valid: 5 AM PDT 2 Apr (F-180)



- The second AR is forecast to develop within a long tropical moisture export region extending from the Central Pacific.
- As the AR propagates toward the US West Coast, a mid-level trough deepens in the NE Pacific. As the trough approaches the USWC, a surface low-pressure system is forecast to form beneath the trough.
- As the trough and surface low-pressure system strengthen, the IVT on the backend of the AR also strengthens. This stronger core of the AR is forecast to impact CA on Wed 2 Apr.
- The southwesterly landfall direction of this AR is optimal for orographic precipitation enhancement over the Sierra Nevada and California Coast Ranges

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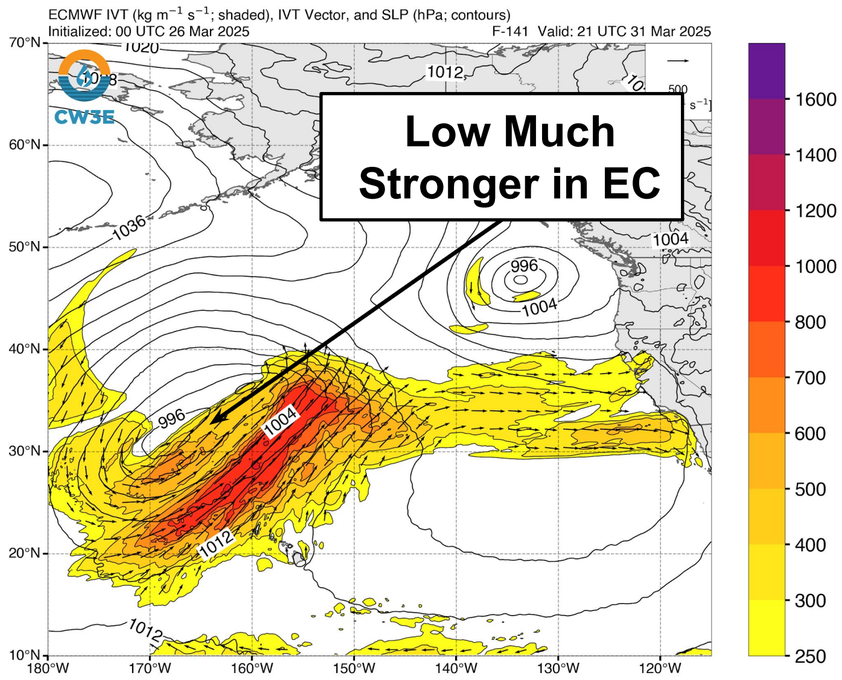
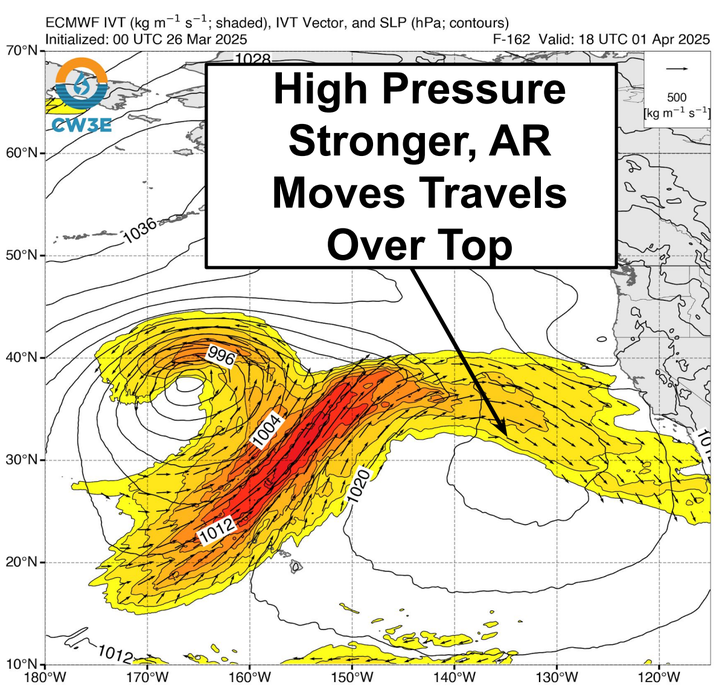
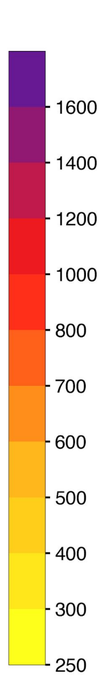
ECMWF IVT & SLP Forecasts: 2nd AR

Valid: 2 PM PDT 31 Mar (F-141)

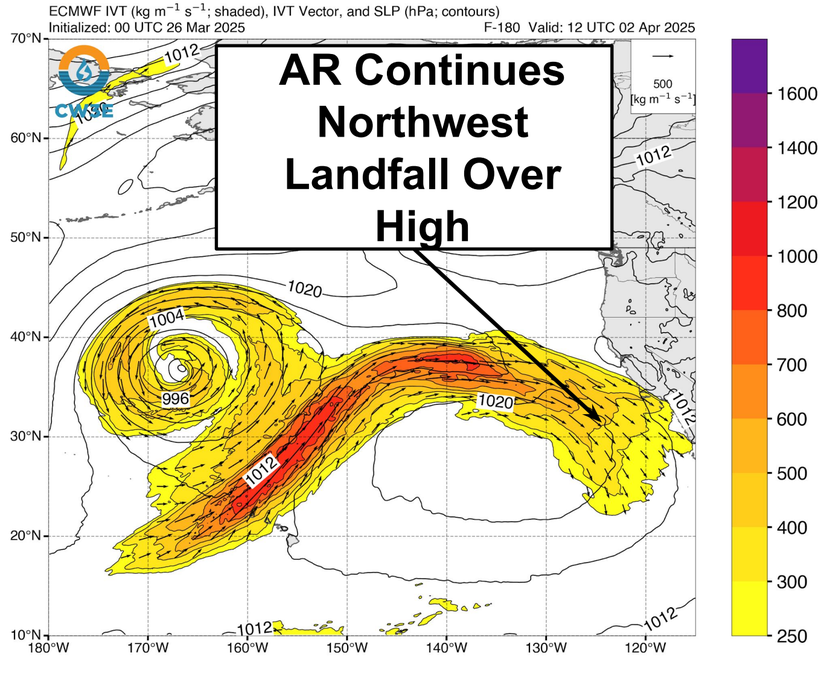


Valid: 11 AM PDT 1 Apr (F-162)





Valid: 5 AM PDT 2 Apr (F-180)



- The ECMWF's forecast of the dynamics over the NE Pacific vary greatly from the GFS. The GFS has the mid-level trough that deepens, whereas the ECMWF has the m-level trough extending to the east, helping to strengthen the low pressure system near 170ºW.
- The stronger low-pressure system combined with a more robust high-pressure system near the US West Coast alter the trajectory of the AR. The system is forced to propagate over the top of the high pressure, leading to northwesterly IVT along the Southern California coast and into the Baja Peninsula.

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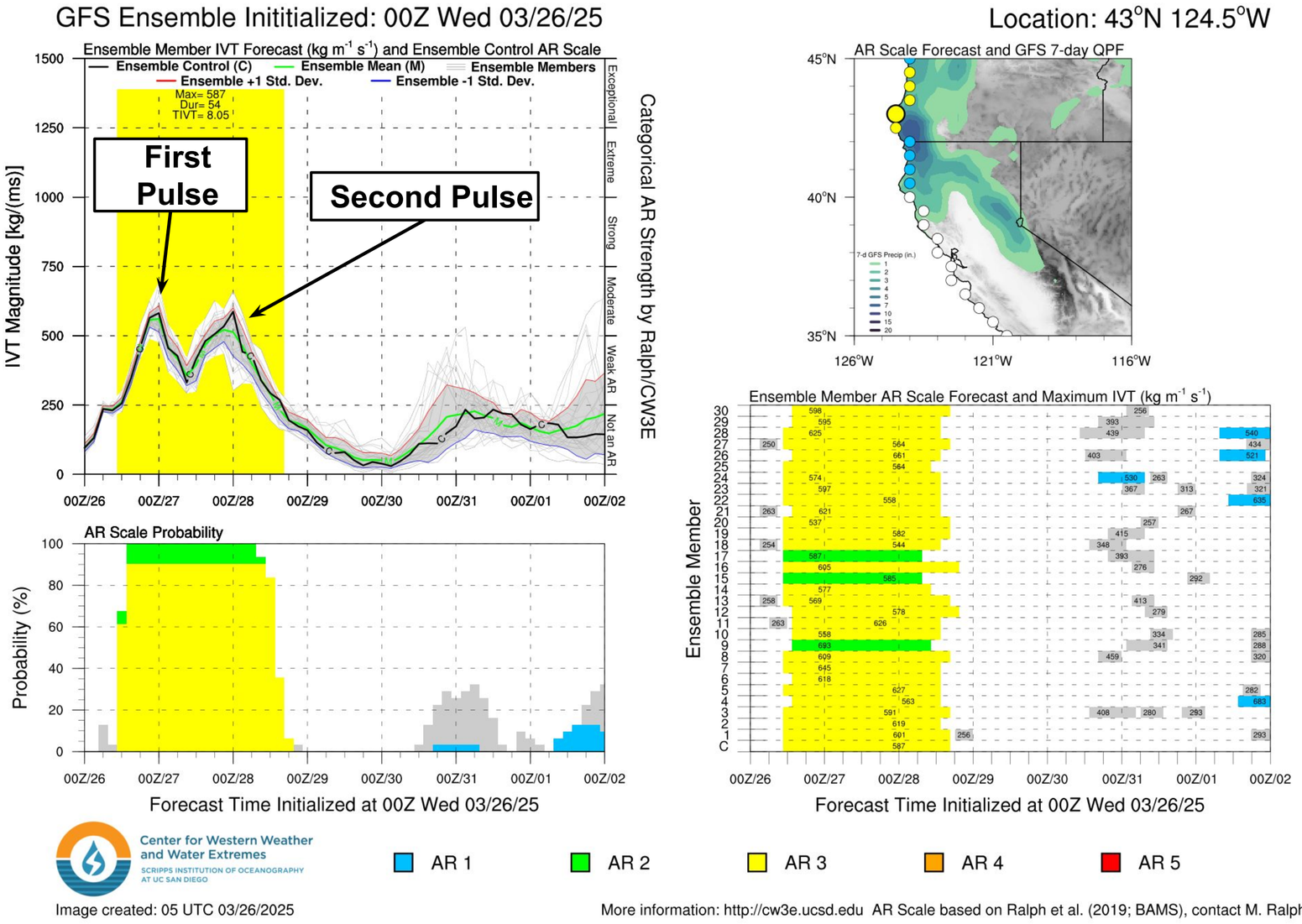
GEFS AR Scale and IVT Forecasts



- The 00Z GEFS control member is forecasting **AR1-AR3 conditions** (based on the Ralph et al. 2019 AR Scale) over coastal Washington, Oregon and Northern California for the first AR.
- 28/31 GEFS members are forecasting AR3 conditions for a coastal point at 43ºN, 124.5ºW (Coastal Coos County, OR).
- There is uncertainty amongst the GEFS members with the timing of maximum IVT

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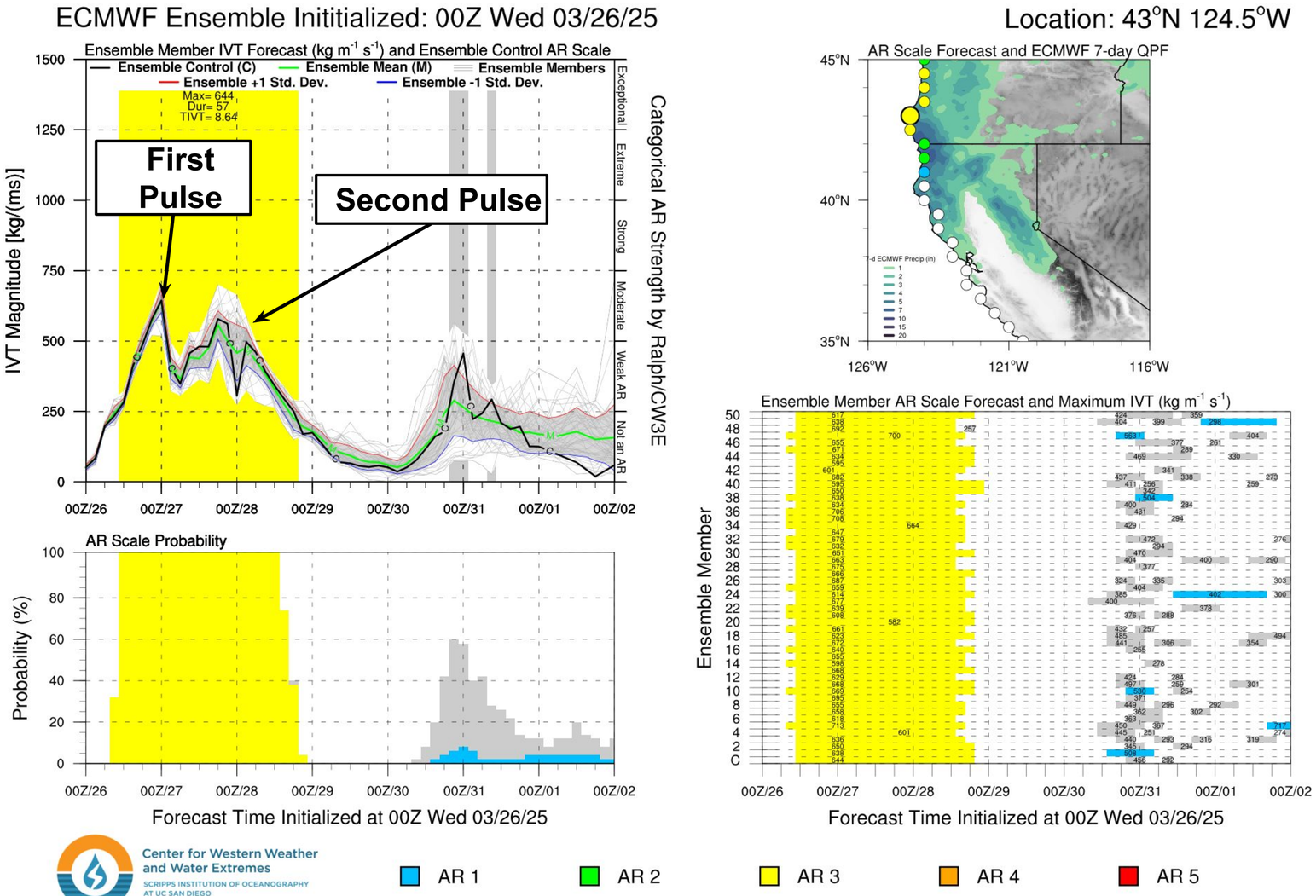
EPS AR Scale and IVT Forecasts



- The 00Z EPS control member is also forecasting **AR1-AR3 conditions** over coastal Washington, Oregon and Northern California for the first AR.
- 51/51 EPS members are forecasting AR3 conditions for a coastal point at 43ºN, 124.5ºW.
- Unlike GEFS, most EPS members are in strong agreement in forecasting the maximum IVT during the first IVT pulse
- EPS members are forecasting higher maximum IVT then the GEFS members.

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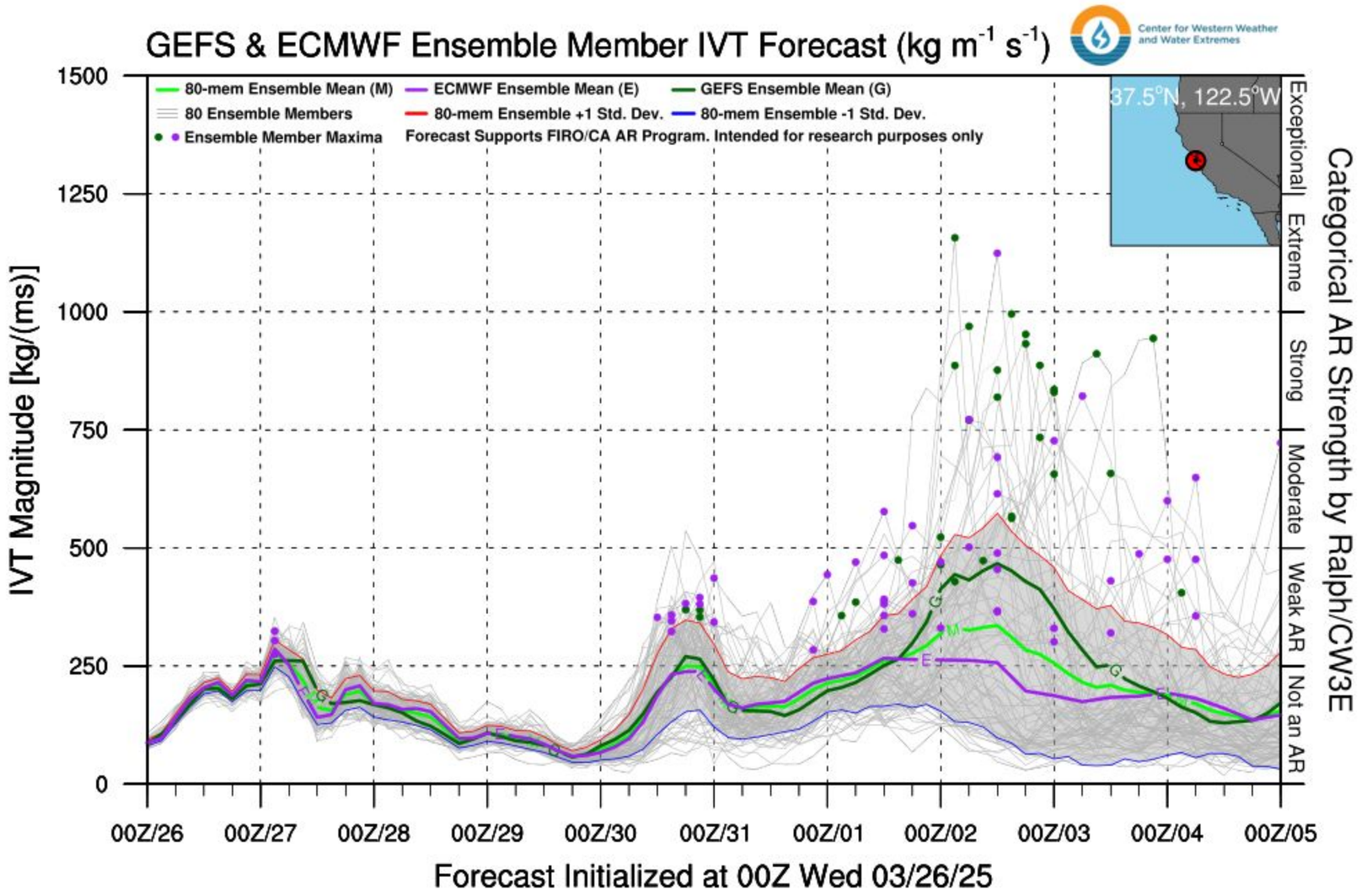
EPS, GEFS and West-WRF Ensemble IVT Plumes



- The IVT plumes for the EPS and GEFS ensemble members show the forecast IVT at a point over the next 10-days. The maximum IVT of a member is indicated by the purple (EPS) and green (GEFS).
- For a coastal point at 37.5ºN, 122.5ºW (San Francisco Bay Area), most ensemble members maximum IVT is forecast later in the period with the second AR.
- The GEFS mean IVT (green line) is higher than the EPS mean IVT (purple line) during the second AR.
- 13 GEFS and 3 EPS ensemble members are forecasting maximum IVT > 750 kg m^{-1} s^{-1} during the second AR on 2 and 3 Apr.

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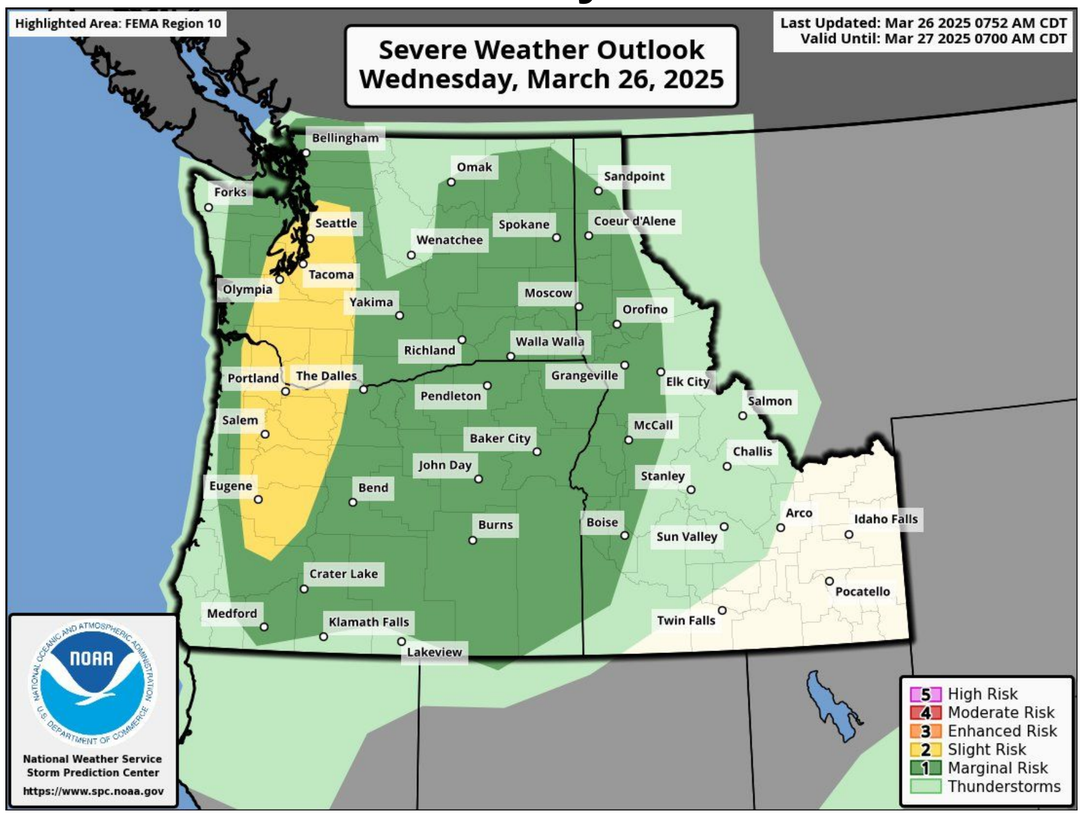
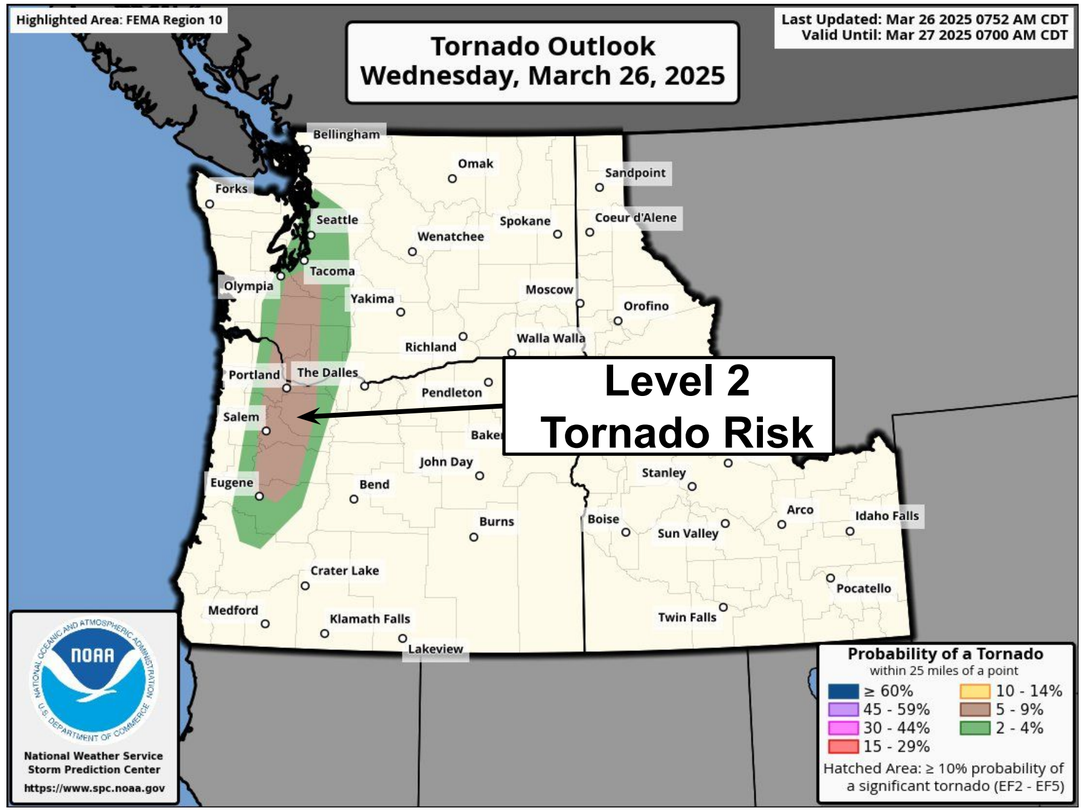
Storm Prediction Center Day 1 Outlook





- The Storm Prediction Center (SPC) has issued a **slight risk** of severe weather for an area west of the Cascades in Washington and Oregon today Wed 26 Mar.
- This outlook indicates that severe thunderstorms are expected and that supercells are possible within the yellow shaded region. These storms may produce hail, heavy winds, high winds and possibly a tornado.
- **The level two tornado risk (brown shaded region on the right) is the first of its kind issued in the Pacific Northwest**.

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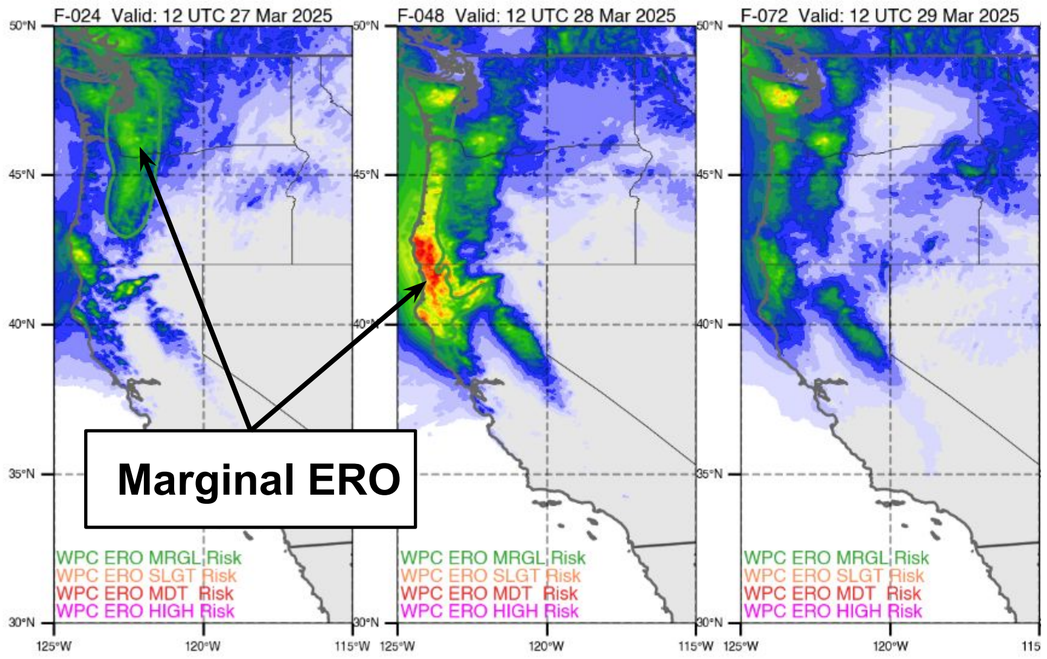
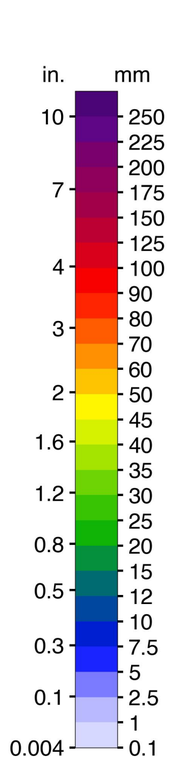
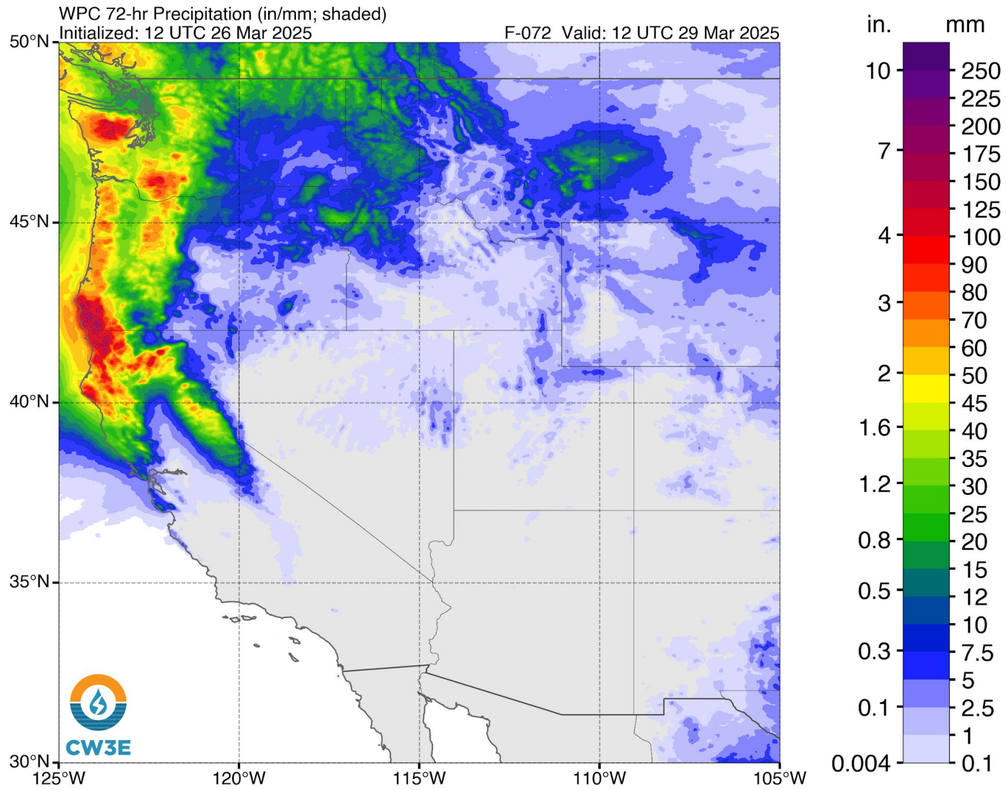
WPC Precipitation Forecasts: 1st AR

WPC 24-h Forecasts for Days 1-3
Valid: 5 AM PT 27–29 Mar





WPC 72-h QPF
Valid: 5 AM PT 29 Mar



- The highest 3-day precipitation totals with the first AR are expected over the Olympic Peninsula and Oregon and Northern California Coast Ranges where at least 4–7 inches are forecast.
- A **marginal risk** Excessive Rainfall Outlook (ERO) (level 1 of 4, 5% chance of flash flood conditions) has been issued over the Cascades in Washington and Oregon on Day 1 (24-h period ending 5 AM PT Thu 27 Mar) and over coastal Washington, Oregon, and Northern California on Day 2 (24-h period ending 5 AM PT Fri 28 Mar).

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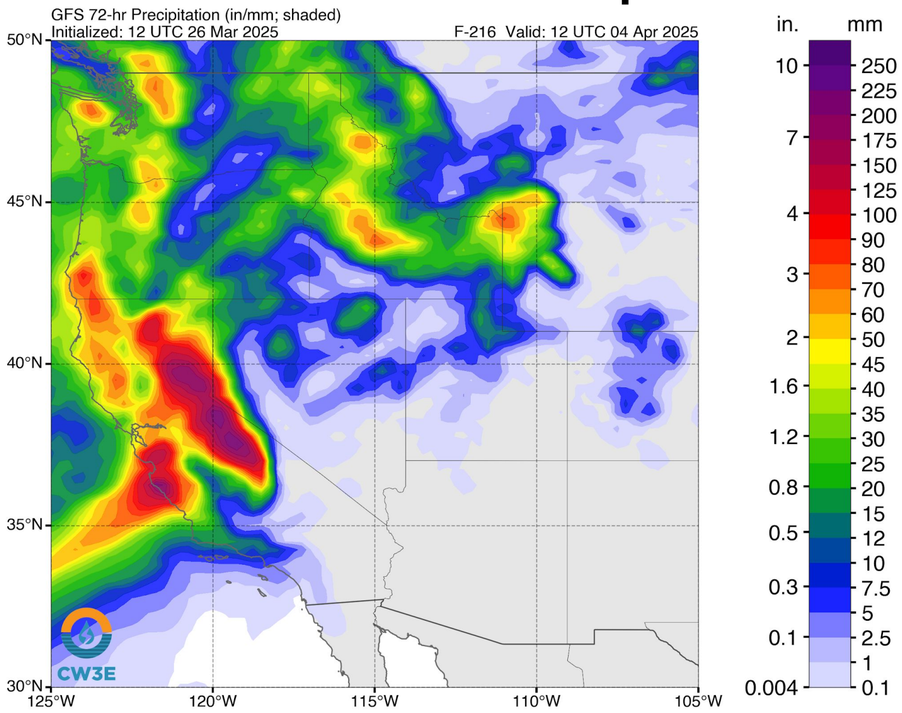
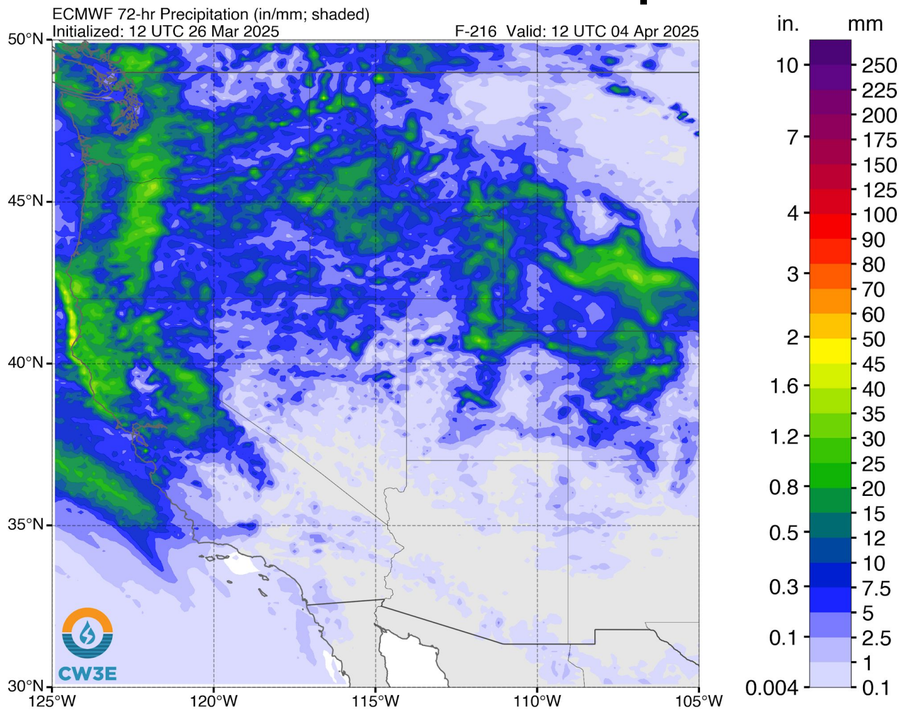
Precipitation Forecast Comparison: 2nd AR

GFS 72-h QPF
Valid: 5 AM PT 2 Apr



ECMWF 72-h QPF
Valid: 5 AM PT 4 Apr



- The differences in the second AR between the GFS and the ECMWF result in drastic differences in precipitation across California during 1–3 Apr.
- The GFS is forecasting 7+ inches across the Central California Coast Ranges and Sierra Nevada, with highest totals of 10+ inches over the Sierra Nevada.
- The ECMWF is forecasting 1–2 inches over the Northern Sierra Nevada and Oregon and Northern California Coast Ranges.

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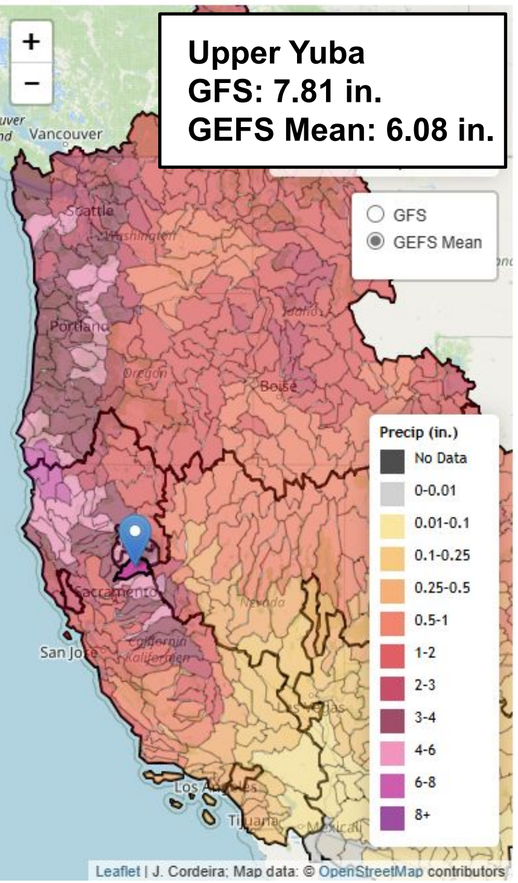
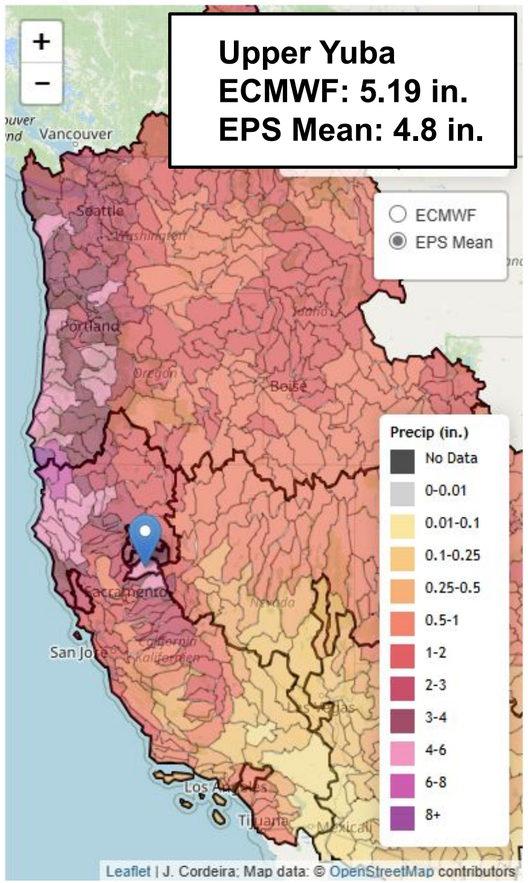
Watershed Precipitation Forecasts - Upper Yuba

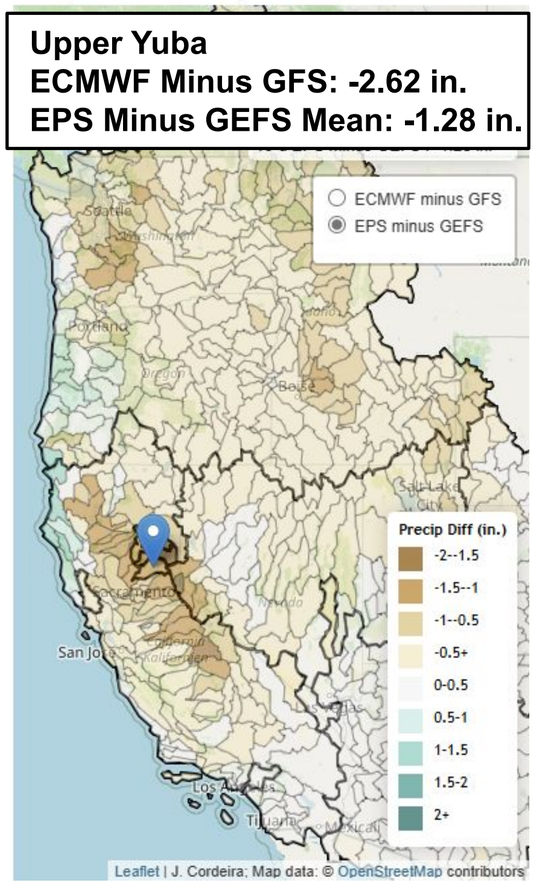
10-day GFS/GEFS Precipitation Forecasts

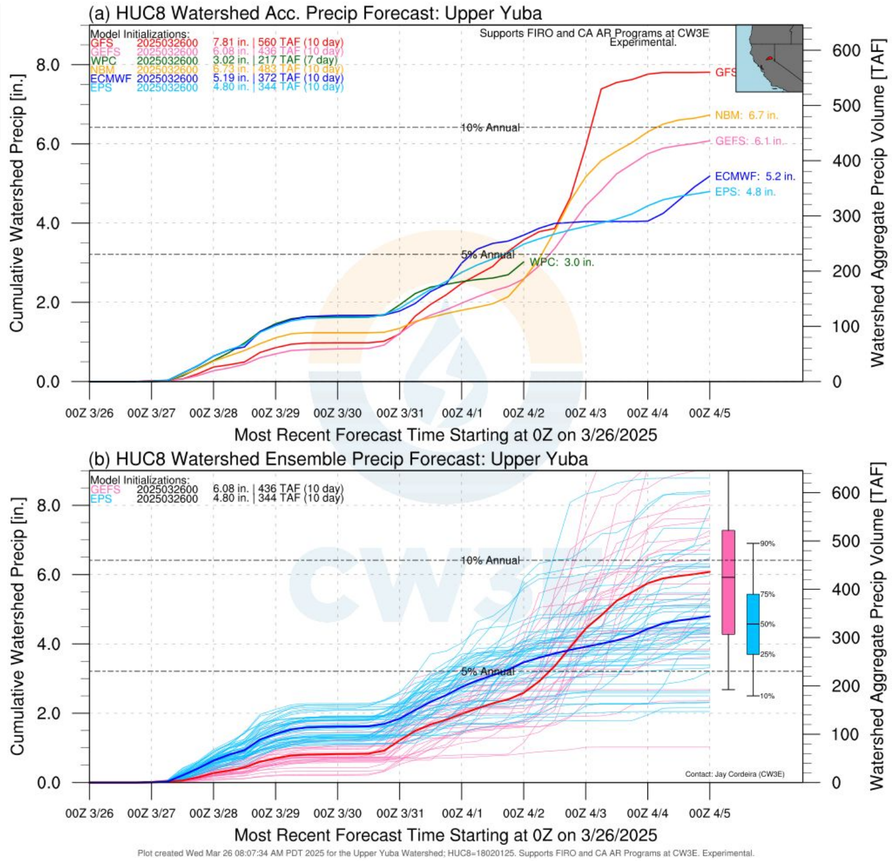


10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast





- The GFS and GEFS are forecasting much more precipitation for 1 through 3 Apr than the ECMWF and EPS (*upper right*)
- >75% of GEFS and EPS members are forecasting 10-day precipitation totals to exceed **5% of normal annual precipitation** over this watershed.
- More than 25% of GEFS members and >10% of EPS members members are forecasting 10-day precipitation totals that exceed **10% of normal annual precipitation** as heavier precipitation associated with the second AR potentially impacts the region.

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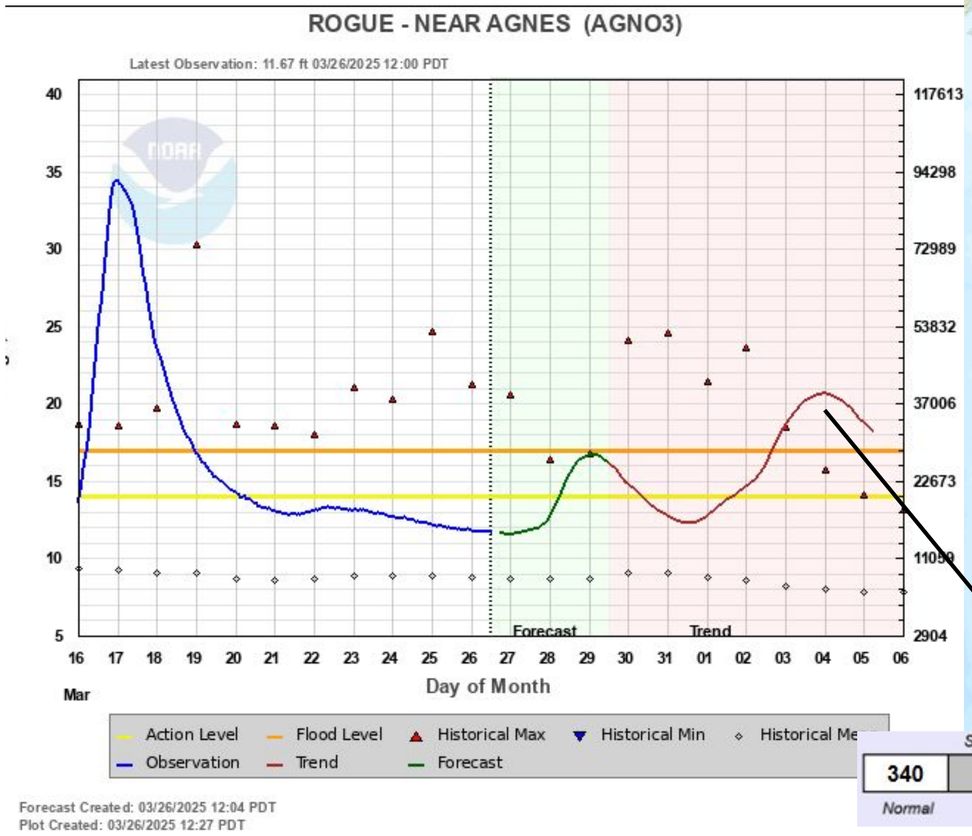
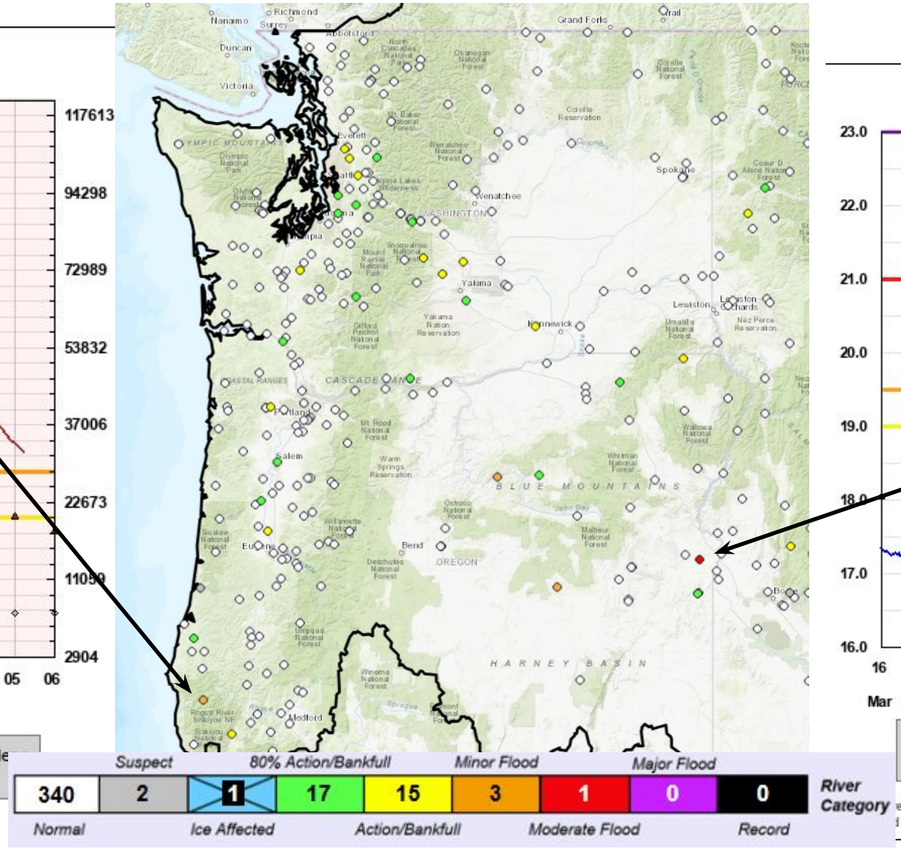
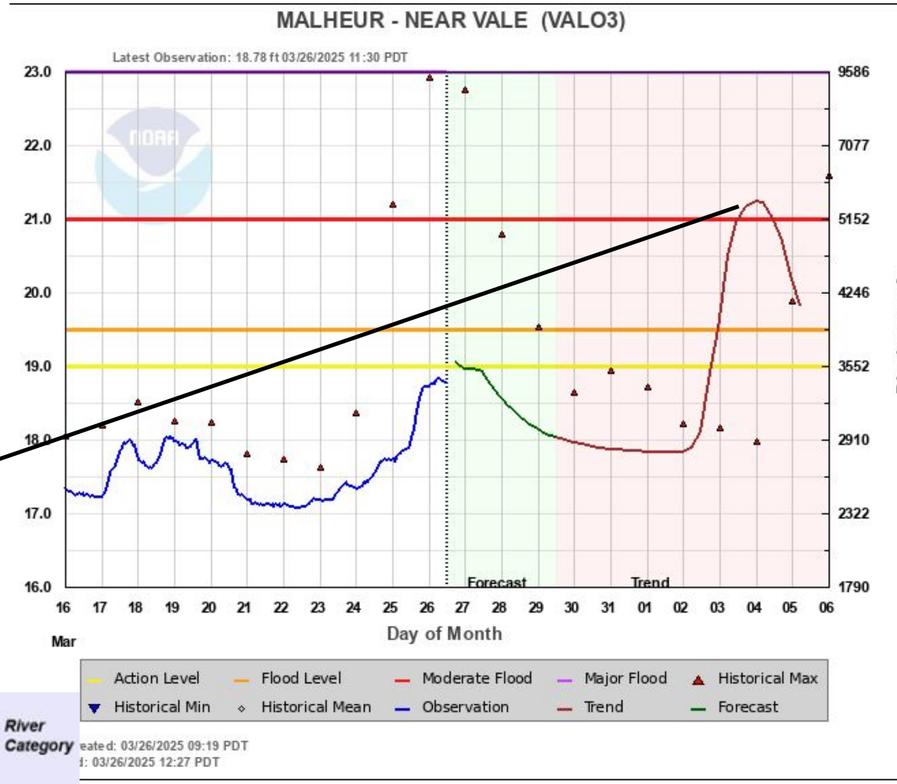
Hydrologic Forecasts: Pacific Northwest







- The NWS Northwest River Forecast Center (NWRFC) is forecasting 15 gauges across the Pacific Northwest forecast to exceed **bankfull** stage, three gauges in Oregon (Rogue River near Agnes, *left*) are forecast to exceed **minor flood** stage in the next 10 days.
- One gauge in Oregon (Malheur River near Vale, *right*) is forecast to exceed **moderate flood** later in the period due to inland penetration of the second AR.

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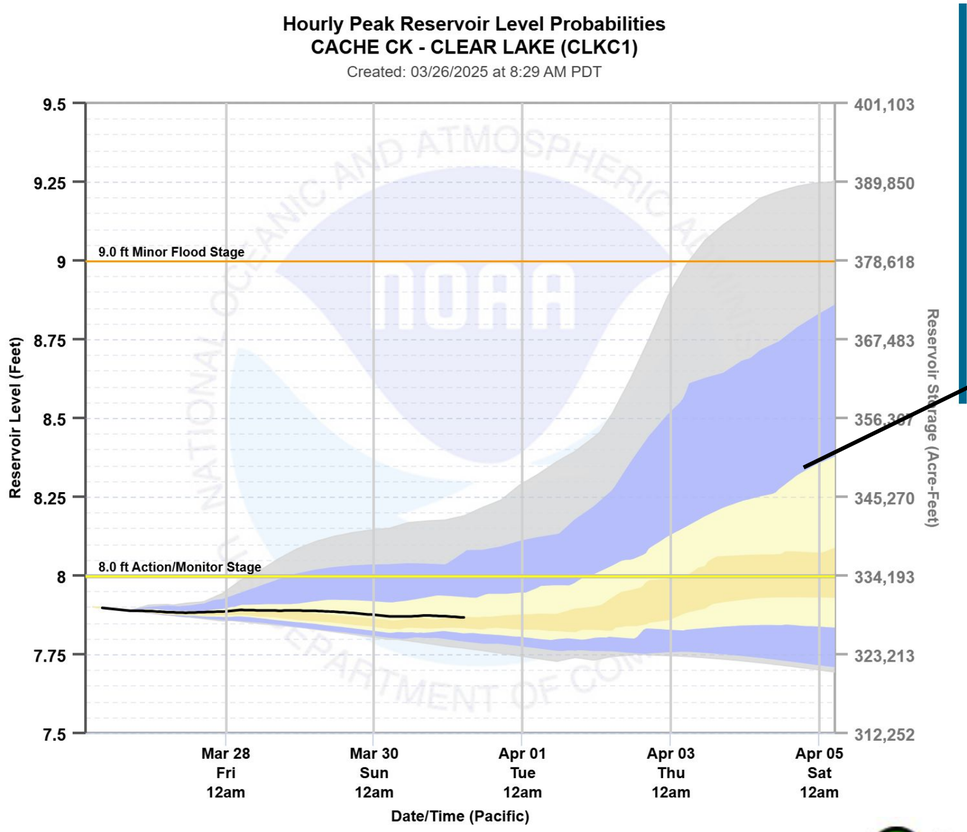
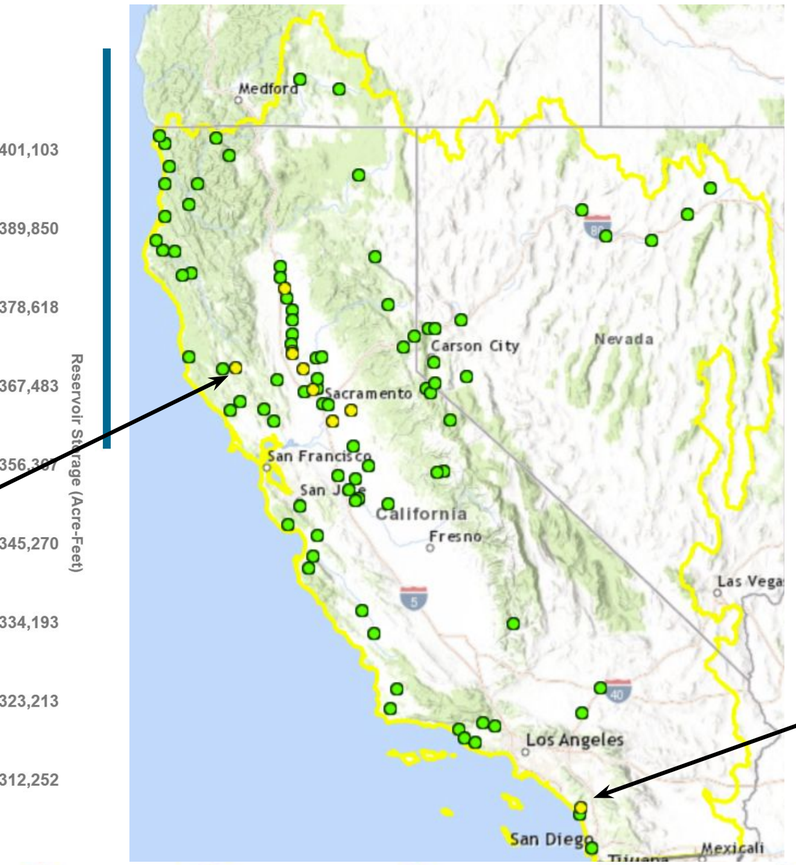
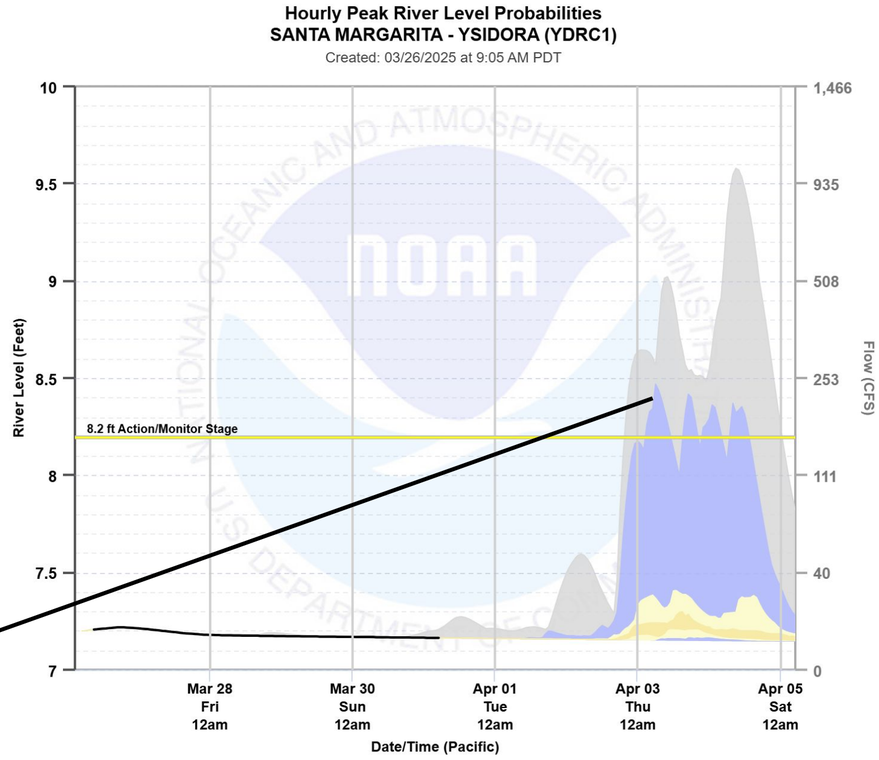
Hydrologic Forecasts: California







85 Normal Conditions | 9 Above Action/Monitor Stage | 0 Above Minor Flood Stage | 0 Above Moderate Flood Stage | 0 Above Major Flood Stage

- The NWS California-Nevada River Forecast Center (CNRFC) ensemble 10-day streamflow 25% exceedance probabilities show 9 stations exceeding action stage, primarily driven by the precipitation later in the period associated with the second AR.