

CW3E Atmospheric River Outlook: 28 March 2025

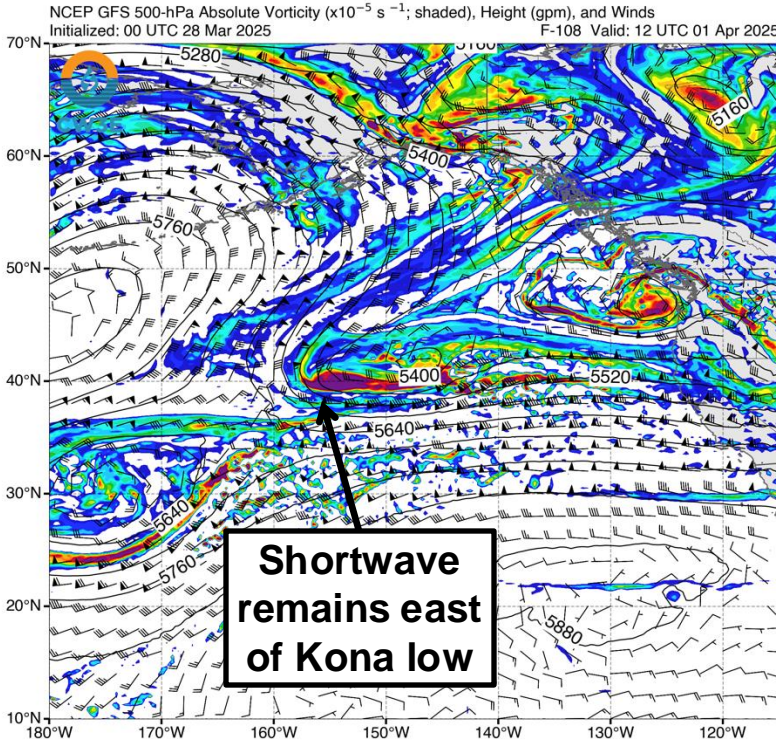
Forecast Update on Potential Atmospheric River Event Next Week

- CW3E's previous outlook (posted on Wed 26 Mar) highlighted the strong signal for a high-impact atmospheric river (AR) in California next week in NCEP model guidance, as well as the substantial model-to-model differences between NCEP and ECMWF.
- While today's 00Z model runs continued to show uncertainty in the forecast, the most recent 12Z NCEP guidance has shifted towards the ECMWF, which has been favoring a much weaker event for the past several days.
- Although a high-impact AR now appears unlikely, an unsettled weather pattern will bring precipitation to much of the western US through the middle of next week.
- A mid-level trough over the Northeast Pacific is forecast to produce 2–5 inches of precipitation in the Klamath Mountains, Shasta County, and Northern Sierra Nevada between Sun 30 Mar and Wed 2 Apr.
- The NWS Weather Prediction Center (WPC) has issued a **marginal risk** excessive rainfall outlook (ERO) for the Klamath Mountains and Northern California Coast Ranges Mon 31 Mar into early Tue 1 Apr.

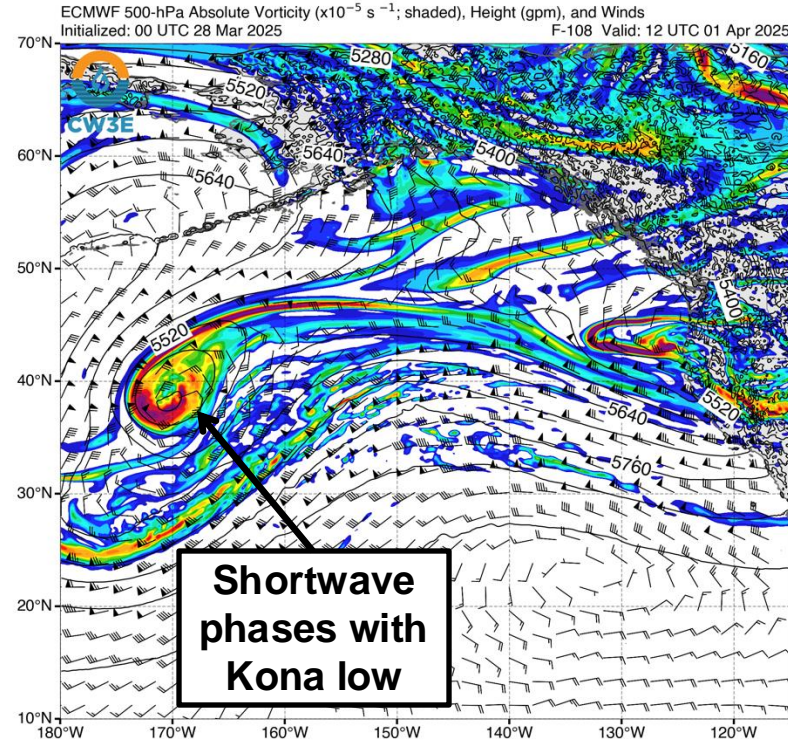
AR Outlook: 28 March 2025

Model 500-hPa Heights & Vorticity Comparison: Valid 5 AM PT 1 Apr

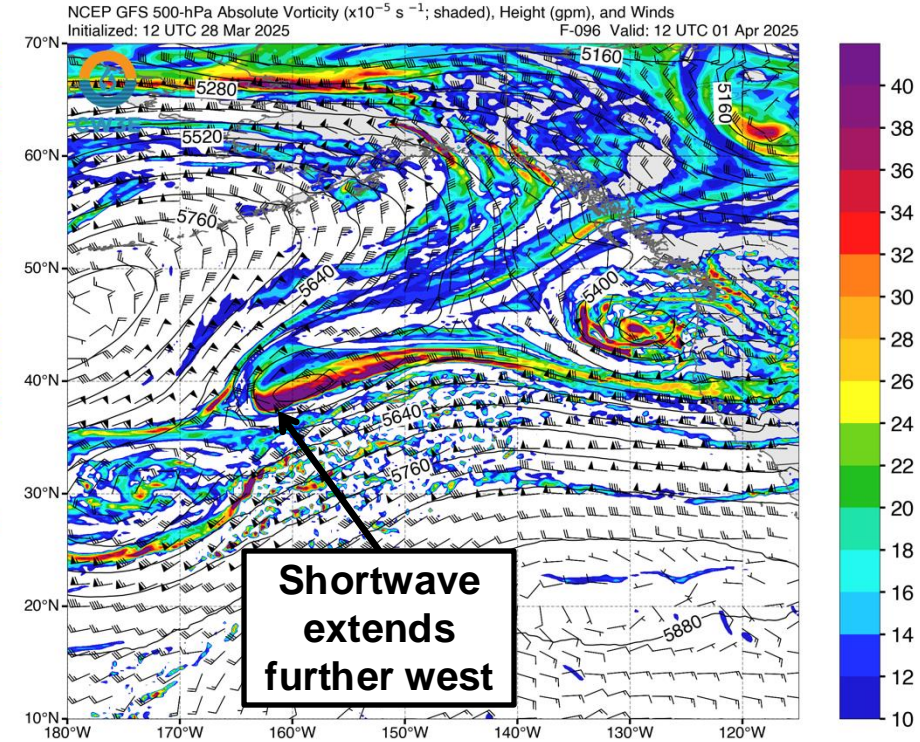
GFS Initialized 00 UTC 28 Mar



ECMWF Initialized 00 UTC 28 Mar



GFS Initialized 12 UTC 28 Mar



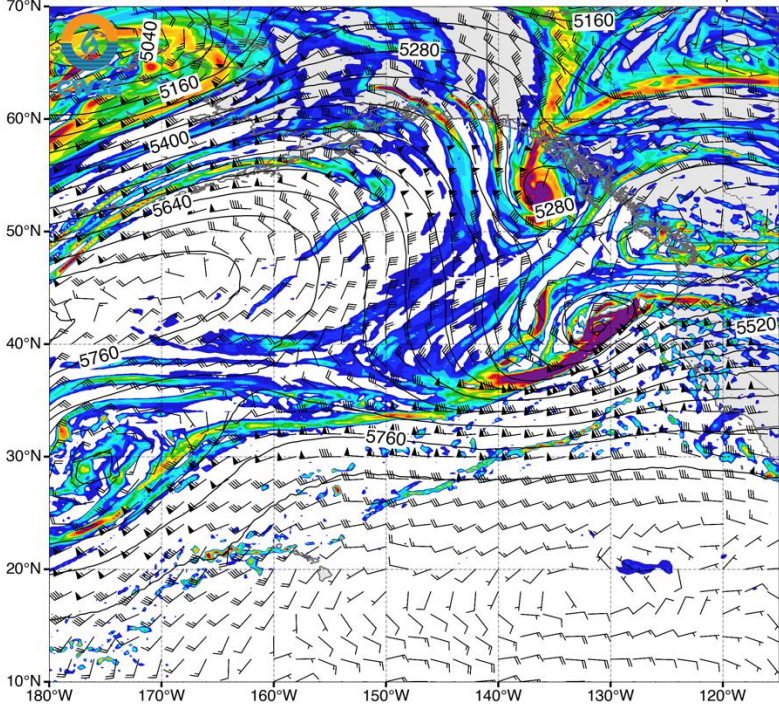
- Model-to-model disagreement in recent days was largely driven by uncertainty in the forecast evolution of a shortwave on the western periphery of a broad mid-level trough over the Northeast Pacific.
- The deterministic ECMWF has been forecasting this shortwave to extend further west and eventually phase with a Kona low west of Hawaii, leading to the formation of a downstream ridge.
- Up until the most recent 12Z GFS run, previous GFS runs have been forecasting a lack of phasing between these two features.

AR Outlook: 28 March 2025

Model 500-hPa Heights & Vorticity Comparison: Valid 5 AM PT 2 Apr

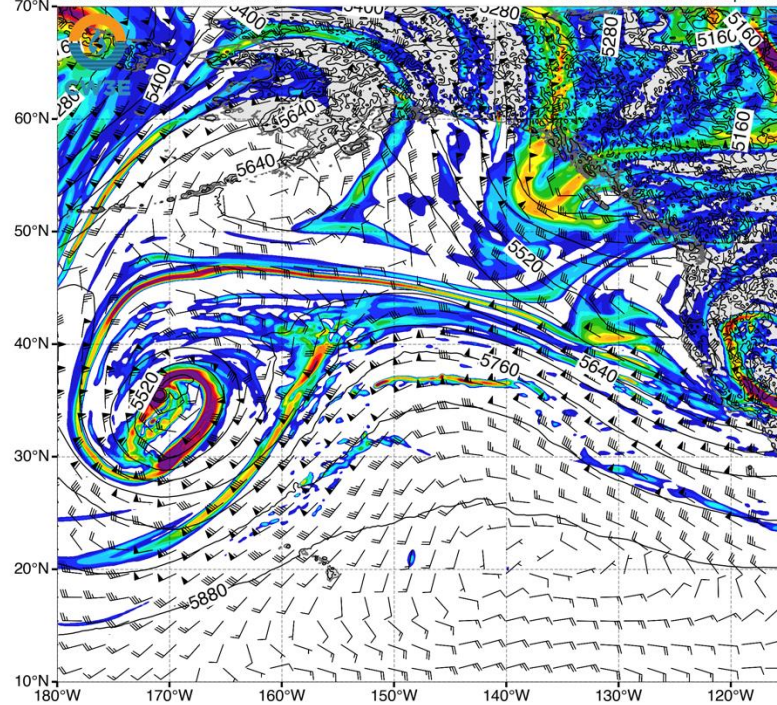
GFS Initialized 00 UTC 28 Mar

NCEP GFS 500-hPa Absolute Vorticity ($\times 10^{-5} \text{ s}^{-1}$; shaded), Height (gpm), and Winds
Initialized: 00 UTC 28 Mar 2025 F-132 Valid: 12 UTC 02 Apr 2025



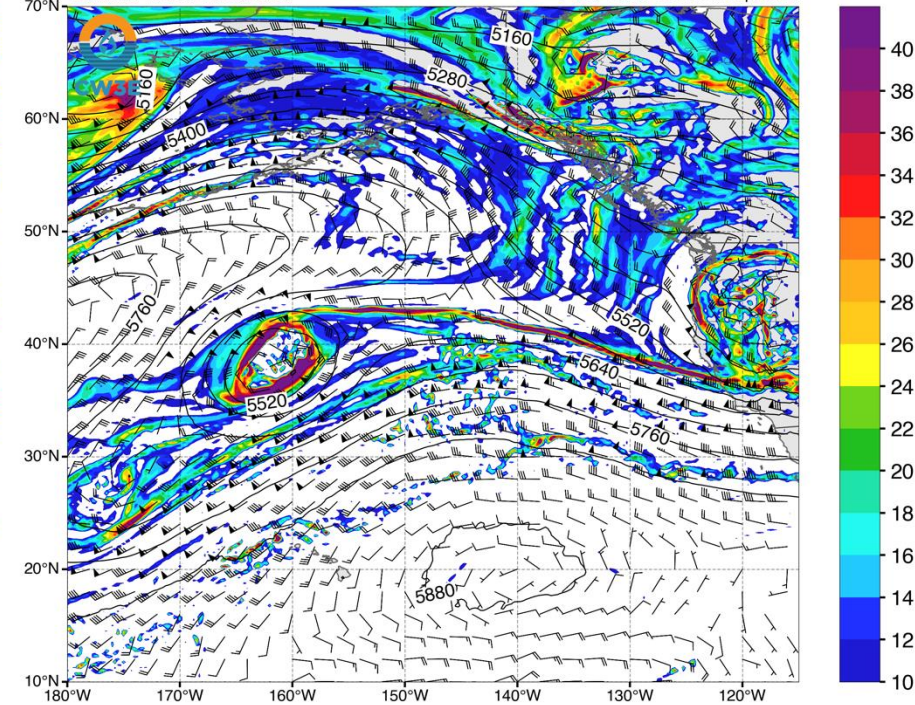
ECMWF Initialized 00 UTC 28 Mar

ECMWF 500-hPa Absolute Vorticity ($\times 10^{-5} \text{ s}^{-1}$; shaded), Height (gpm), and Winds
Initialized: 00 UTC 28 Mar 2025 F-132 Valid: 12 UTC 02 Apr 2025



GFS Initialized 12 UTC 28 Mar

NCEP GFS 500-hPa Absolute Vorticity ($\times 10^{-5} \text{ s}^{-1}$; shaded), Height (gpm), and Winds
Initialized: 12 UTC 28 Mar 2025 F-120 Valid: 12 UTC 02 Apr 2025

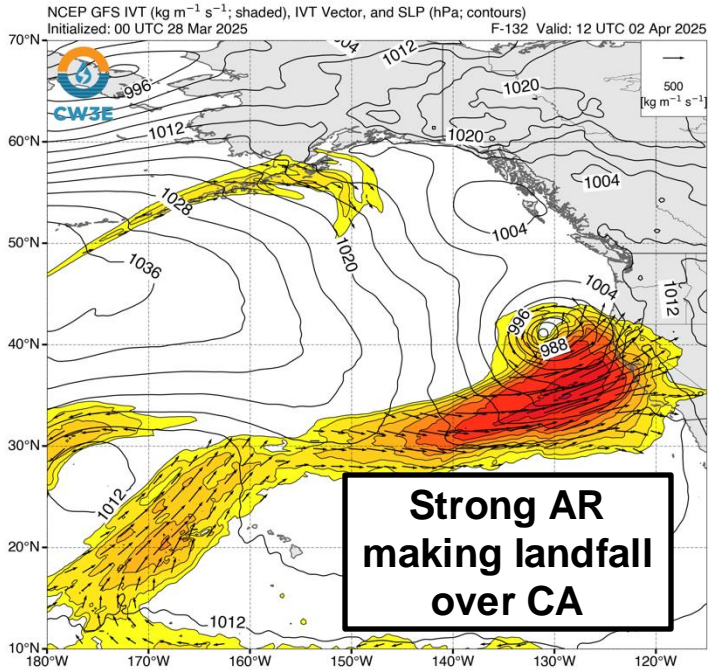


- The lack of phasing between the shortwave and the Kona low in previous GFS runs allowed the shortwave to propagate eastward toward the US West Coast and help guide a strong AR into California by Wed 2 Apr.
- In the 00Z ECMWF and 12Z GFS forecasts, the downstream ridge is forecast to continue to amplify and thereby prevent a strong AR from making landfall.

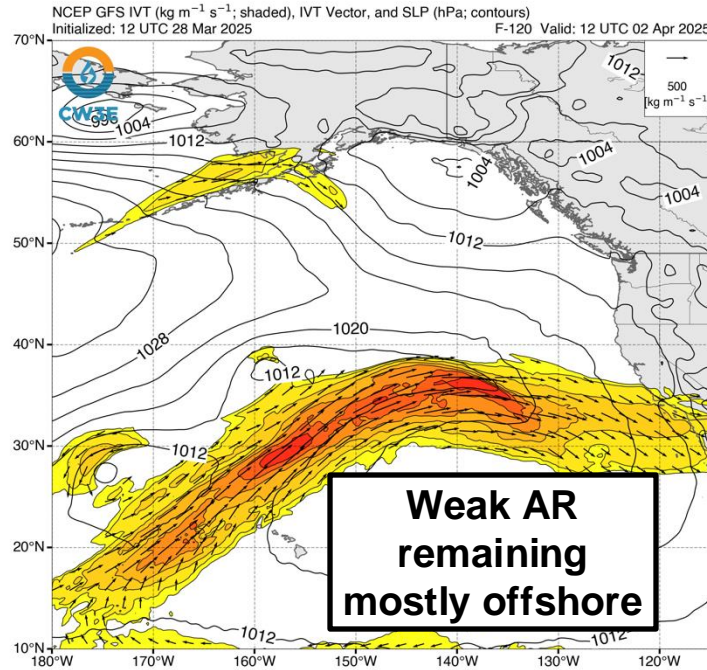
AR Outlook: 28 March 2025

GFS IVT dProg/dT: Valid 5 AM PT 2 Apr

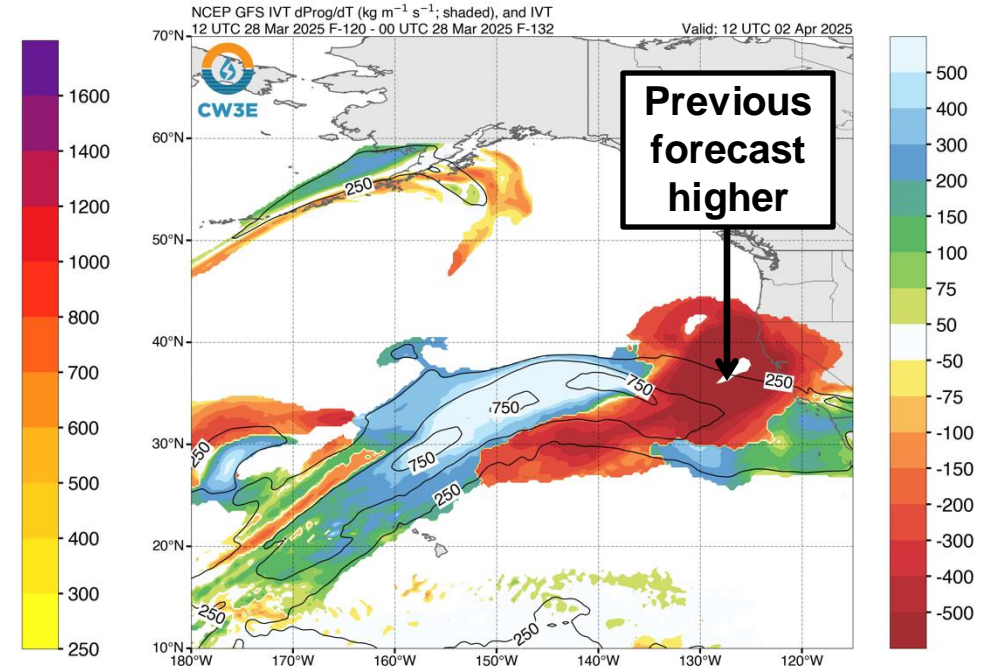
GFS Initialized 00 UTC 28 Mar



GFS Initialized 12 UTC 28 Mar

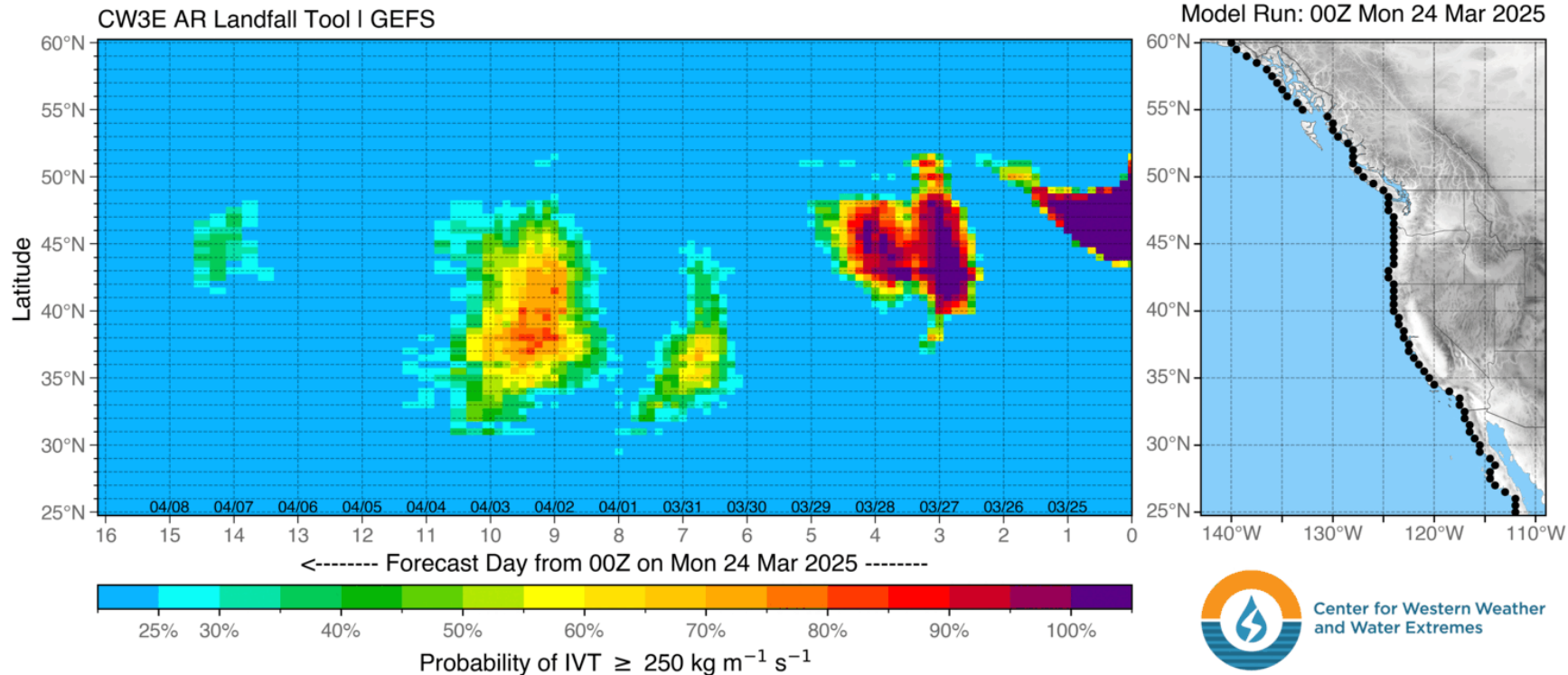


Difference (Current Minus Previous)



- Changes in the forecast evolution of the circulation pattern over the Northeast Pacific have led to significant changes in the forecast evolution of the potential AR event during 1–3 Apr.
- Today's 00Z GFS run was forecasting a strong AR making landfall over California with west-southwesterly IVT.
- The 12Z GFS run is now forecasting a weaker AR remaining mostly offshore with unfavorable west-northwesterly IVT along the coast of Southern California.

GEFS Probability of AR Conditions Along Coast (dProg/dt)

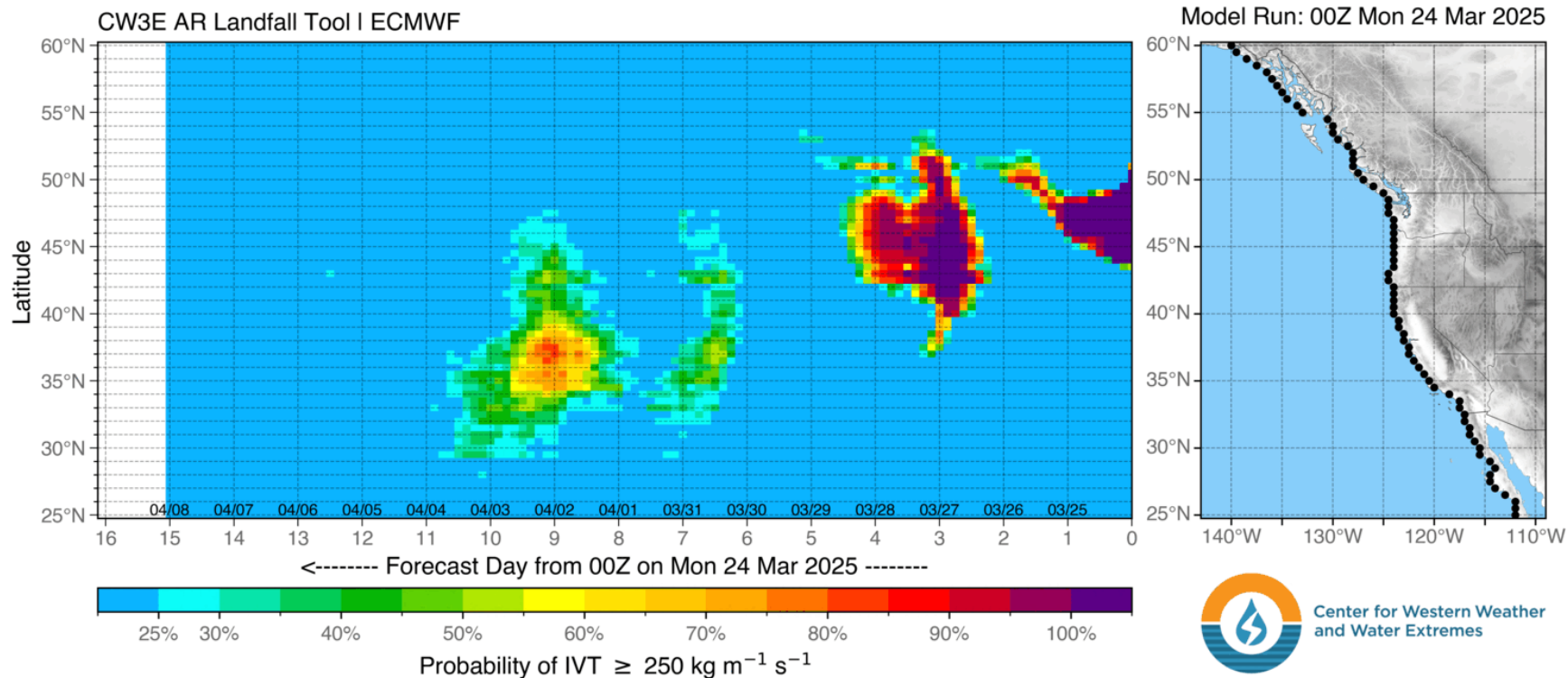


Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only

*GEFS = NCEP Global Ensemble Forecast System (United States)

- Prior to today's 00Z run, the GEFS had consistently showed a high likelihood (70–90% probability) of AR conditions ($IVT \geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$) over Central California on 1–2 Apr.
- The 12Z run is now showing <60% likelihood of AR conditions over much of California on 1–2 Apr, with the highest probabilities in Southern California.

EPS Probability of AR Conditions Along Coast (dProg/dt)



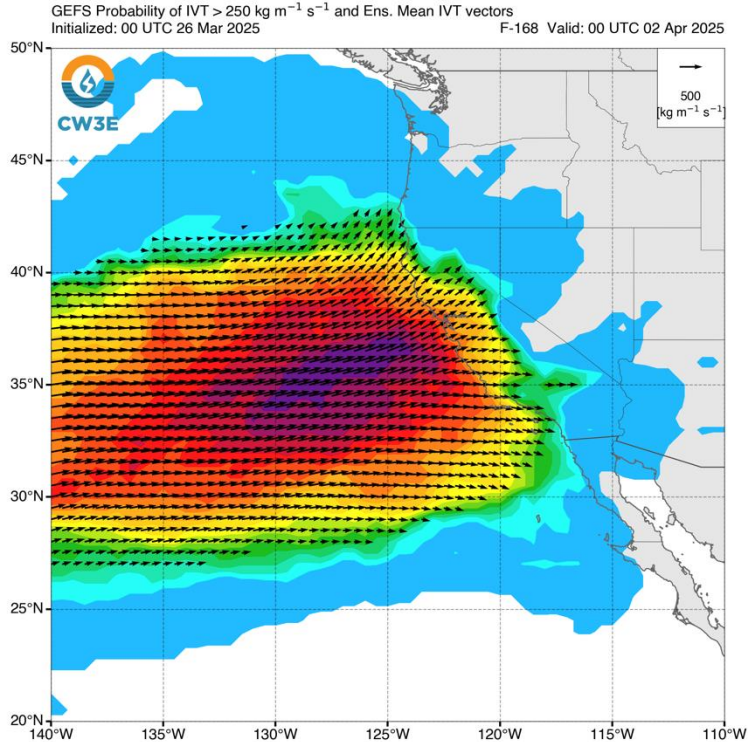
Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only

*EPS = ECMWF Ensemble Prediction System (Europe)

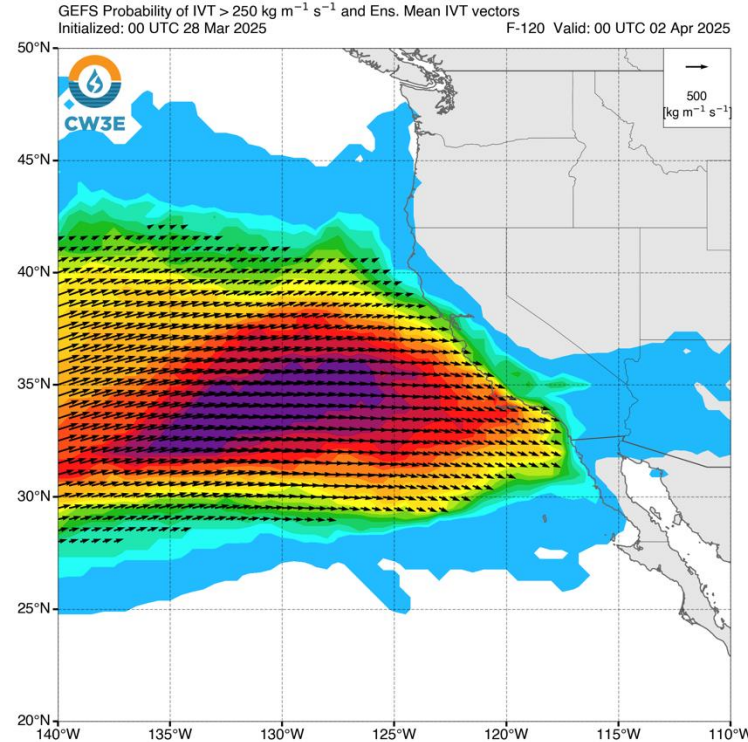
- In contrast, the EPS has been steadily trending towards lower confidence (note the decreasing probabilities) in landfalling AR activity over much of California during 1–2 Apr since early this week.

Probability of AR Conditions: Valid 5 PM PT 1 Apr

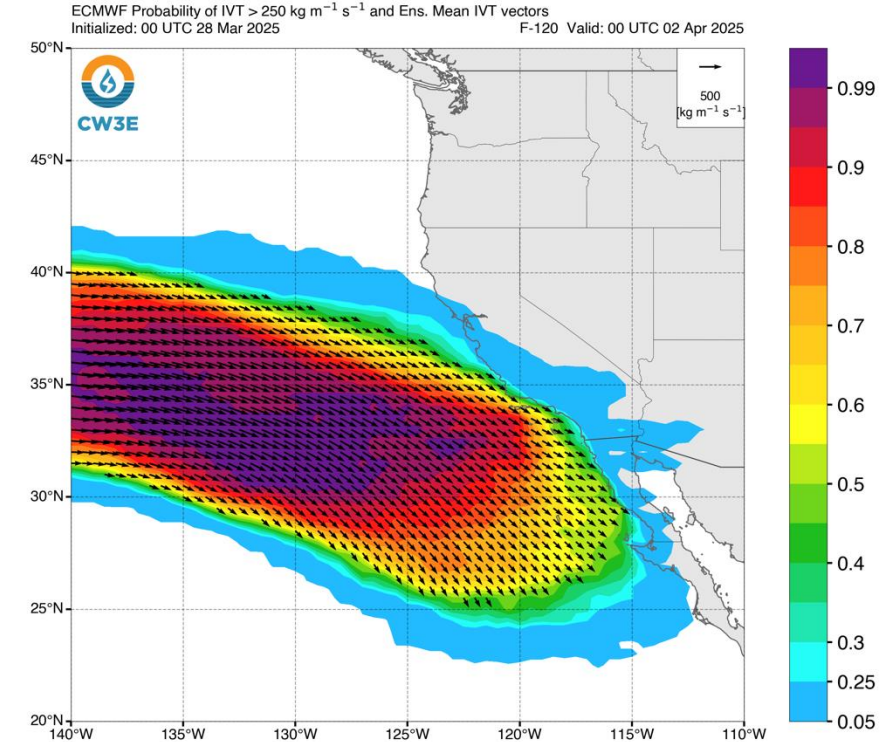
GEFS Initialized 00 UTC 26 Mar



GEFS Initialized 00 UTC 28 Mar



EPS Initialized 00 UTC 28 Mar



- GEFS forecasts initialized earlier this week showed a high likelihood (~80% probability) of an AR making landfall over the Bay Area on Tue 1 Apr, with a west-southwesterly IVT direction that would be favorable for orographic enhancement over the Coast Ranges and Sierra Nevada.
- Today's 00Z GEFS forecast was more closely aligned with the EPS, which has been keeping AR activity primarily offshore and forecasting west-northwesterly IVT that is suboptimal for precipitation in California.

AR Outlook: 28 March 2025

GEFS AR Scale and IVT Forecasts

GFS Ensemble Initialized: 00Z Fri 03/28/25

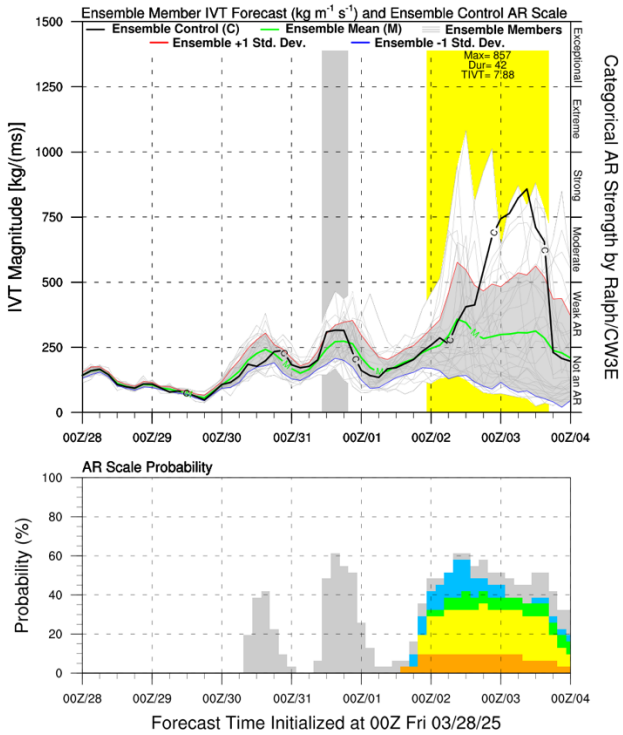
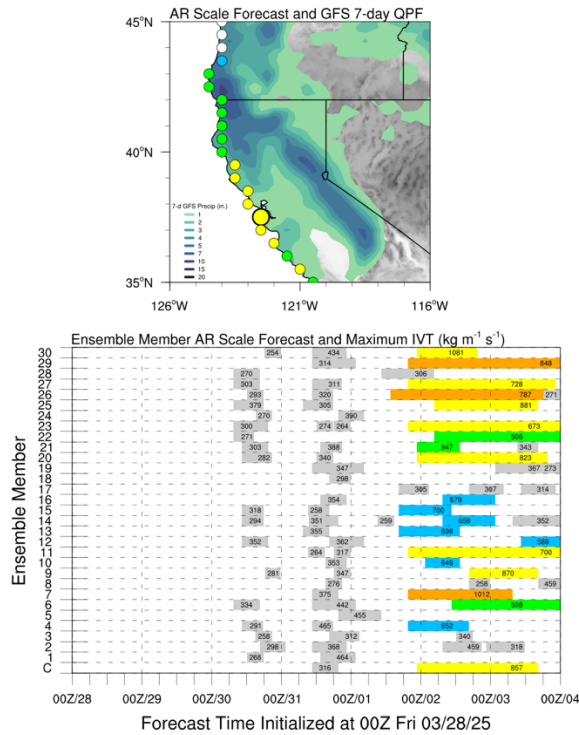


Image created: 05 UTC 03/28/2025

AR 1 AR 2 AR 3 AR 4 AR 5

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

Location: 37.5°N 122.5°W



GFS Ensemble Initialized: 12Z Fri 03/28/25

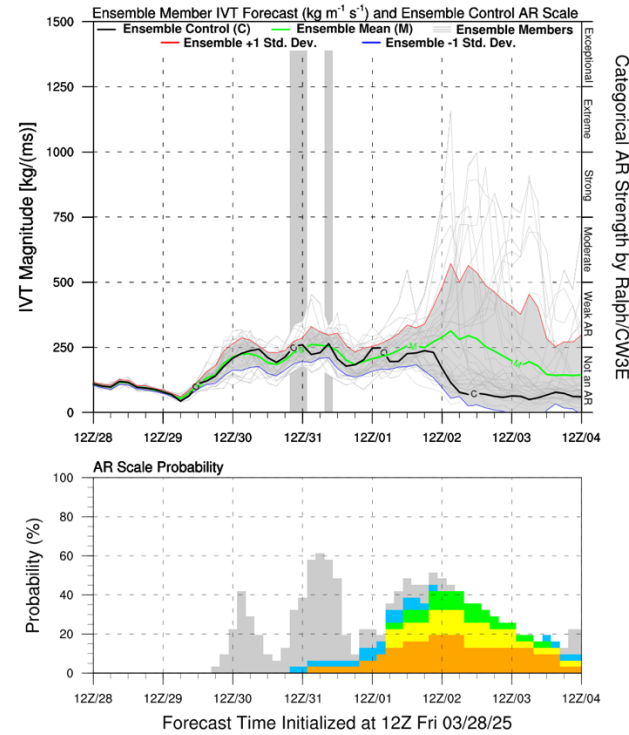
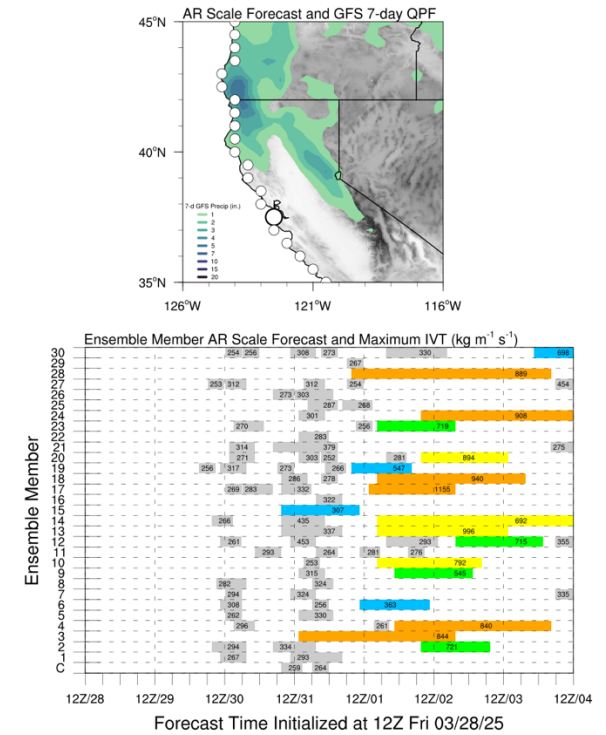


Image created: 17 UTC 03/28/2025

AR 1 AR 2 AR 3 AR 4 AR 5

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

Location: 37.5°N 122.5°W

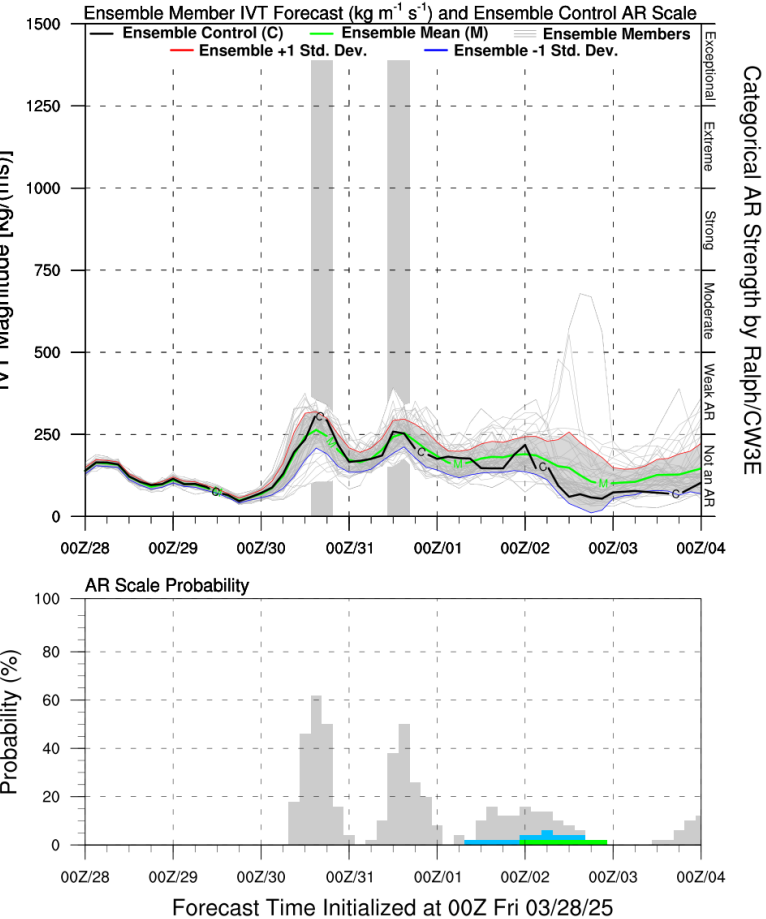


- Today's 00Z GEFS control run was forecasting an AR 3 over portions of coastal Northern and Central California (based on the Ralph et al. 2019 AR Scale). The most recent 12Z GEFS control run is not forecasting AR Scale conditions in these areas.
- While there is still some uncertainty in forecast IVT during the 1–3 Apr period, >40% of GEFS members are not forecasting AR Scale criteria to be met during the next 7 days at 37.5°N, 122.5°W (San Mateo County, CA).

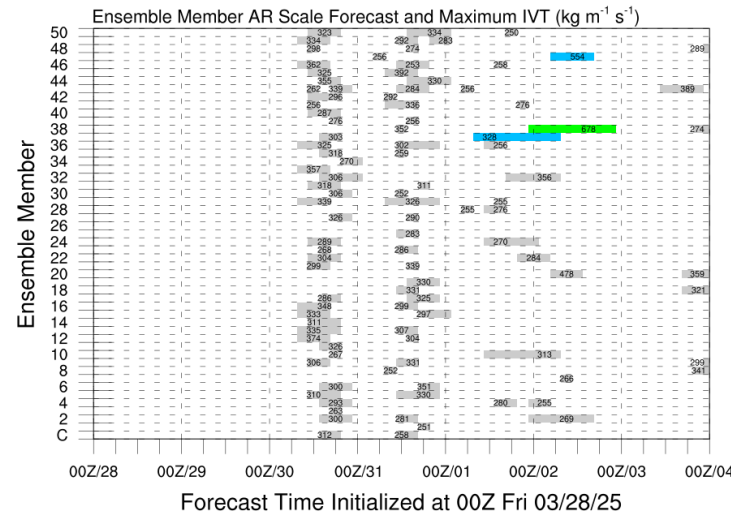
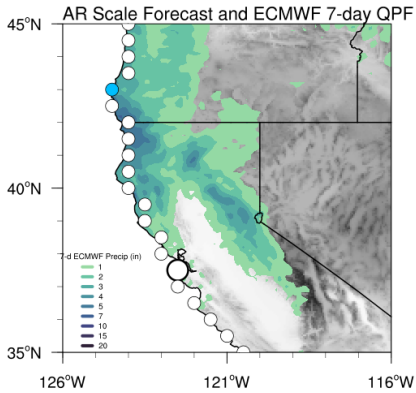
AR Outlook: 28 March 2025

EPS AR Scale and IVT Forecasts

ECMWF Ensemble Initialized: 00Z Fri 03/28/25



Location: 37.5°N 122.5°W



- While the 12Z GEFS control run is now very similar to the 00Z EPS control run, the EPS ensemble continues to show much lower probabilities of AR Scale conditions over Northern and Central California.
- Only 6% (3/51) EPS members are forecasting AR Scale criteria to be met at 37.5°N, 122.5°W during the next 7 days.



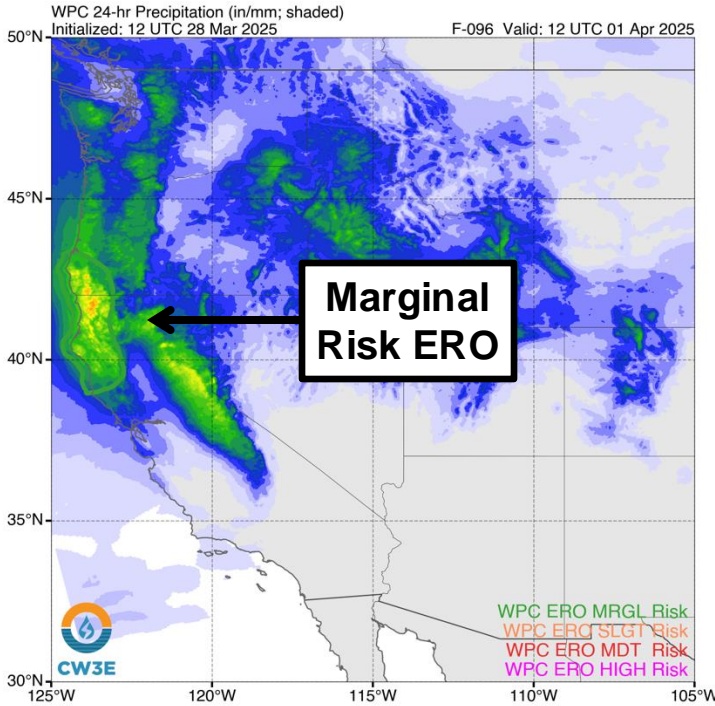
AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 08 UTC 03/28/2025

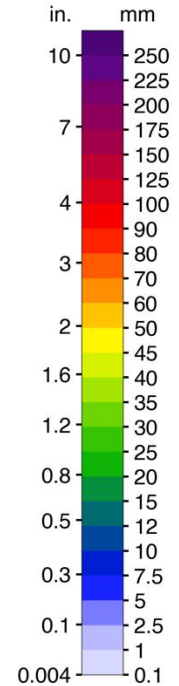
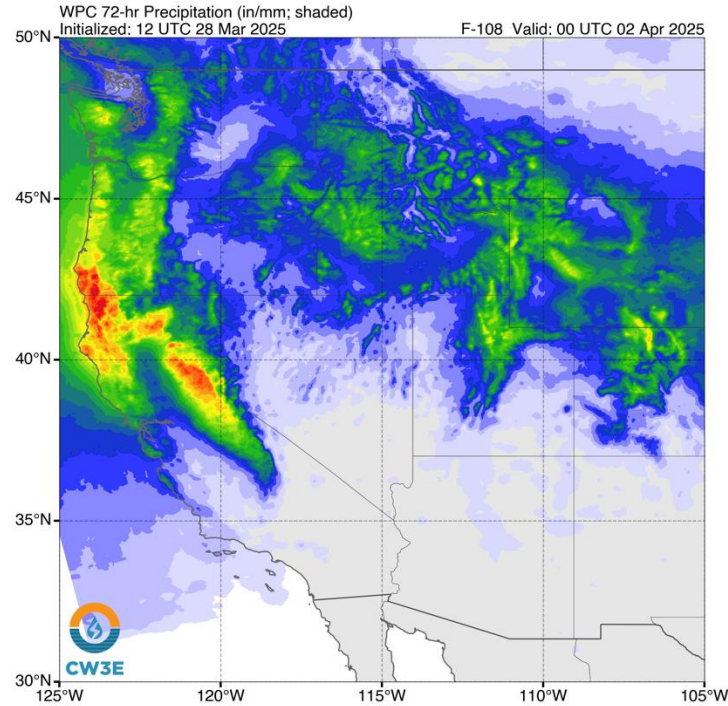
More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

Precipitation Forecasts

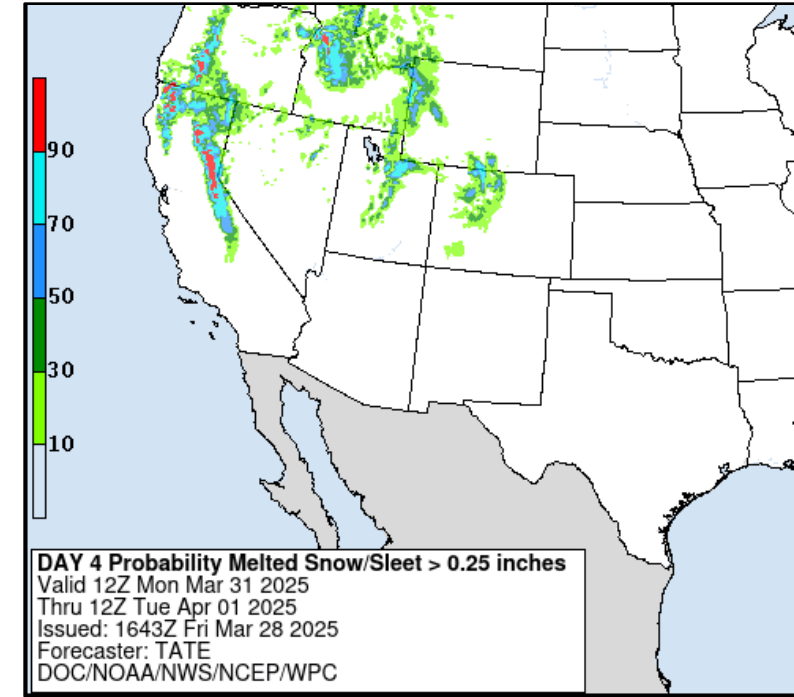
WPC Day 4 24-h QPF
Valid 5 AM PT 1 Apr



WPC 72-h Total QPF
Valid 5 PM PT 1 Apr



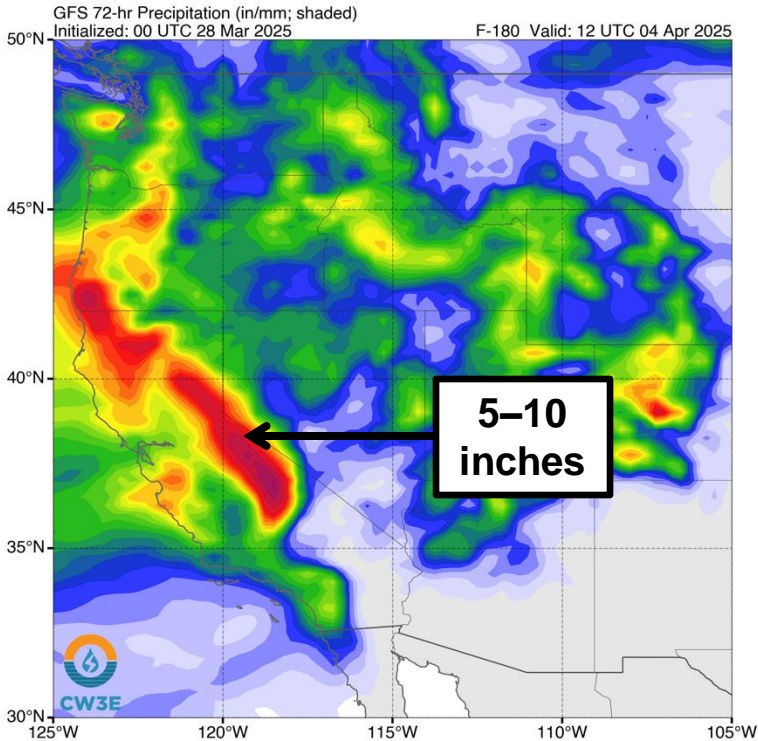
WPC Day 4 Probability of Frozen Precip
>0.25 inches: Valid: 5 AM PT 1 Apr



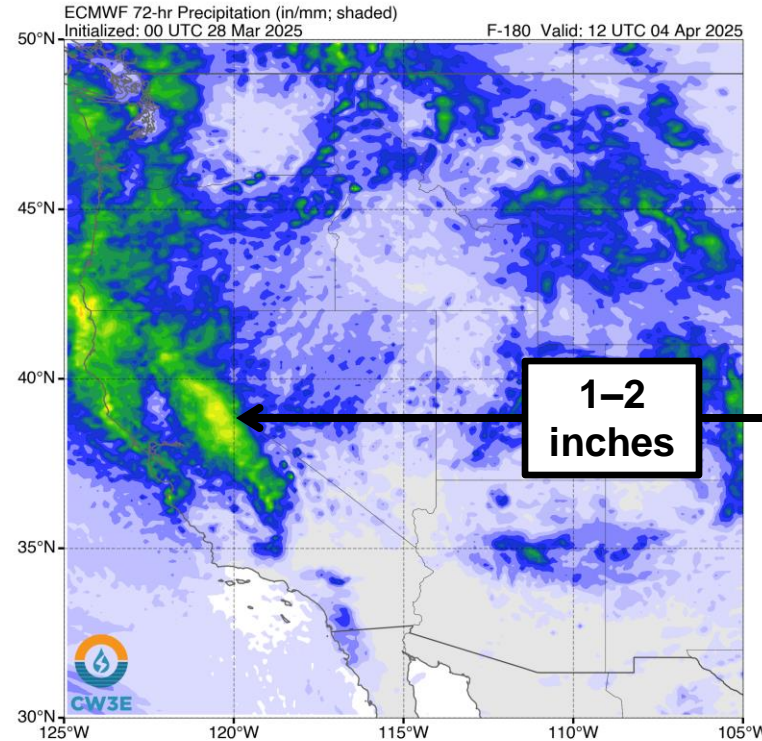
- The NWS Weather Prediction Center (WPC) is forecasting 2–5 inches of precipitation in the Klamath Mountains, Shasta County, and Northern Sierra Nevada in association with the offshore trough. About 1–2 inches are forecast elsewhere in western Oregon and coastal Northern California, as well as in western Washington and the Central Sierra Nevada.
- A **marginal risk** excessive rainfall outlook (ERO) has been issued for the Klamath Mountains and Northern California Coast Ranges Mon 31 Mar into early Tue 1 Apr.
- WPC is also showing a high likelihood (>70% probability) of hazardous snowfall in portions of the Oregon Cascades and Sierra Nevada.

Model 72-h Precipitation Forecasts: Valid 5 AM PT 4 Apr

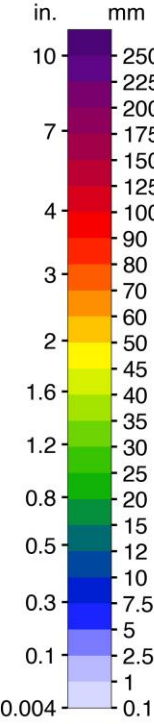
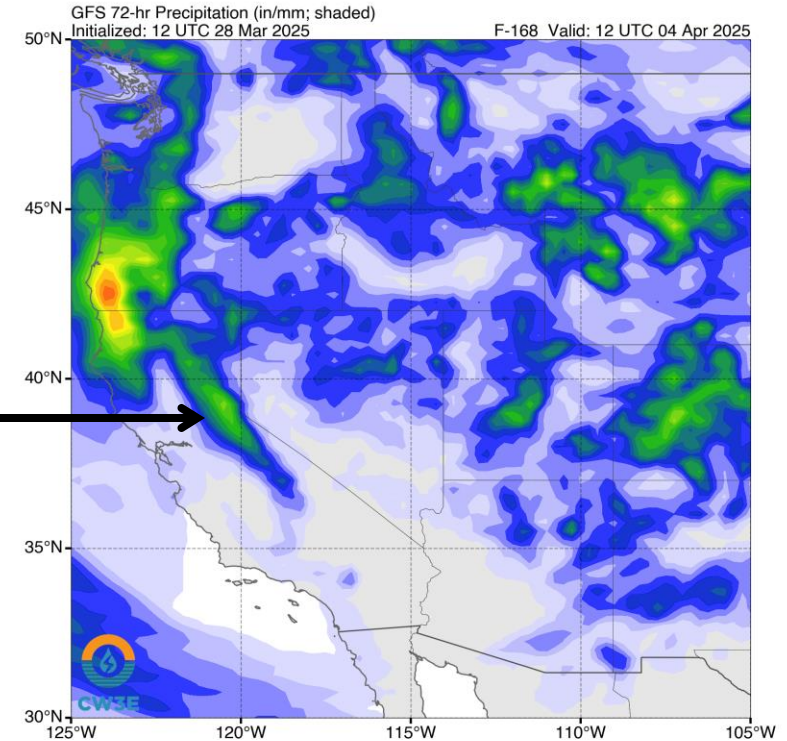
GFS Initialized 00 UTC 28 Mar



ECMWF Initialized 00 UTC 28 Mar



GFS Initialized 12Z UTC 28 Mar



- Compared to today's 00Z GFS run, the most recent 12Z GFS run is forecasting much lower precipitation amounts in Northern and Central California during 1-3 Apr, particularly over the Sierra Nevada.
- The 12Z GFS precipitation forecasts are now much more similar to the 00Z ECMWF precipitation forecasts.