

# CW3E Atmospheric River Outlook: 31 January 2025

## Continuous Atmospheric Rivers Conditions Forecast to Bring Heavy Precipitation to US West Coast

### **AR Summary:**

- Two pulses of moisture are forecast to bring long duration AR conditions to Northern California, with over 70 hours of AR conditions potentially impacting locations along the coast.
- The first moisture pulse has made landfall over the Pacific Northwest and will next impact California through 31 Jan.
- The second moisture pulse has developed north of Hawaii and is forecast to propagate toward the US West Coast through 31 Jan, making landfall shortly following the first pulse on 1 Feb. Back-to-back pulses will likely rank as an AR4 on the Ralph et al. (2019) AR Scale.

### **Precipitation Forecast and Uncertainty:**

- ECMWF forecast precipitation is higher than the GFS over Northern California, whereas the GFS forecast precipitation is higher than the ECMWF over the Northern/Central Sierra Nevada.
- The NWS Weather Prediction Center (WPC) is forecasting 6–15 inches of precipitation over the Northern California Coast Ranges and the Northern Sierra Nevada over the next 7 days.
- Freezing levels are forecast to remain high through 3 Feb before potentially dropping below 6,000 feet starting 4 Feb.
- Snowfall accumulations of at least 8 inches expected over the Cascades and over the Olympic Peninsula, with 24–48+ inches forecast over the Sierra Nevada and Klamath Mountains in the next 3 days.

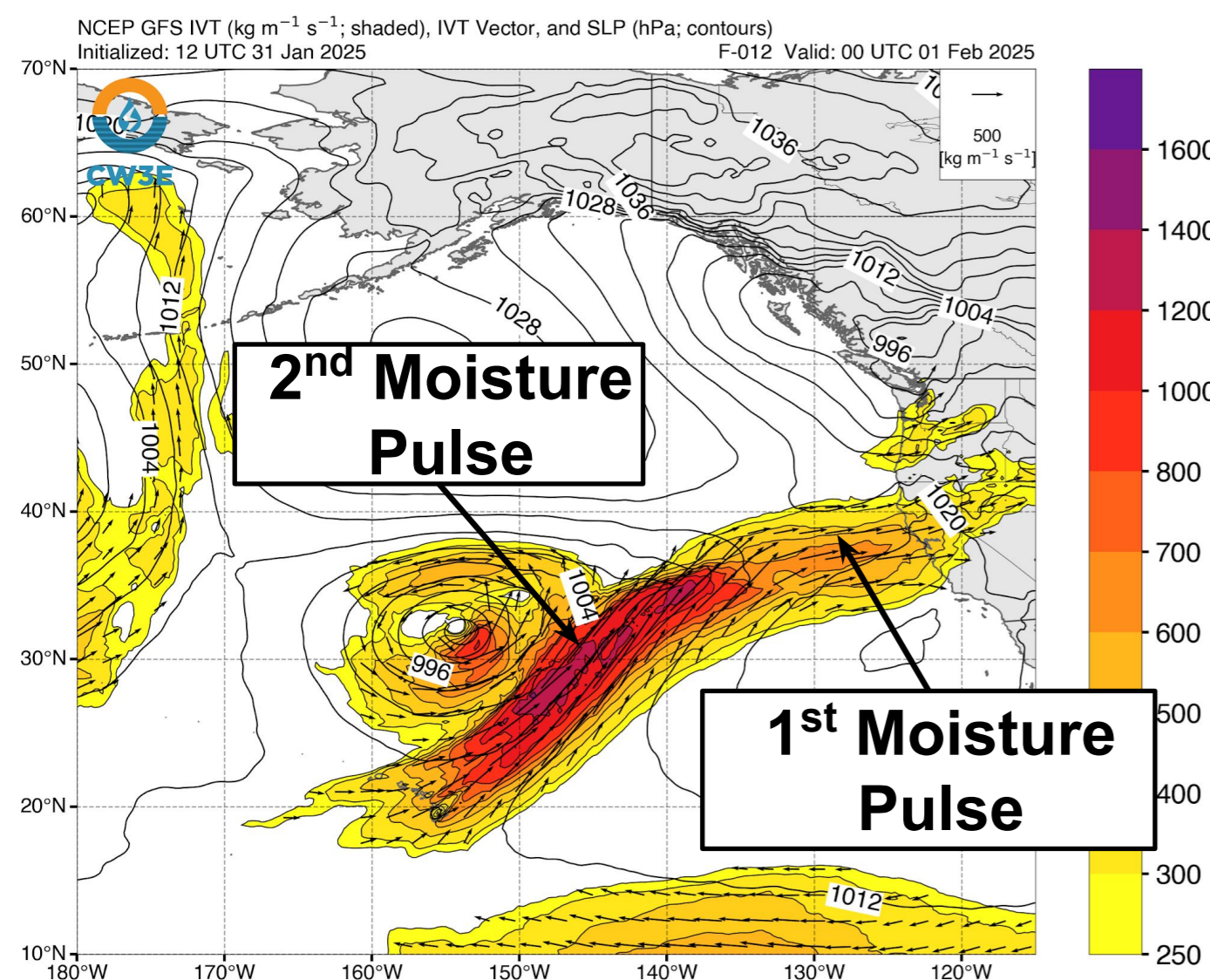
### **Flooding and Streamflow:**

- The NWS WPC has issued a slight risk Excessive Rainfall Outlook (level 2 of 4; 15% chance of flooding) over coastal Northern California and the Sierra Nevada on during 2-4 Feb.
- Stream levels are forecast to rise in southern Oregon and Northern and Central California, with the highest likelihood of flooding in Northern California.

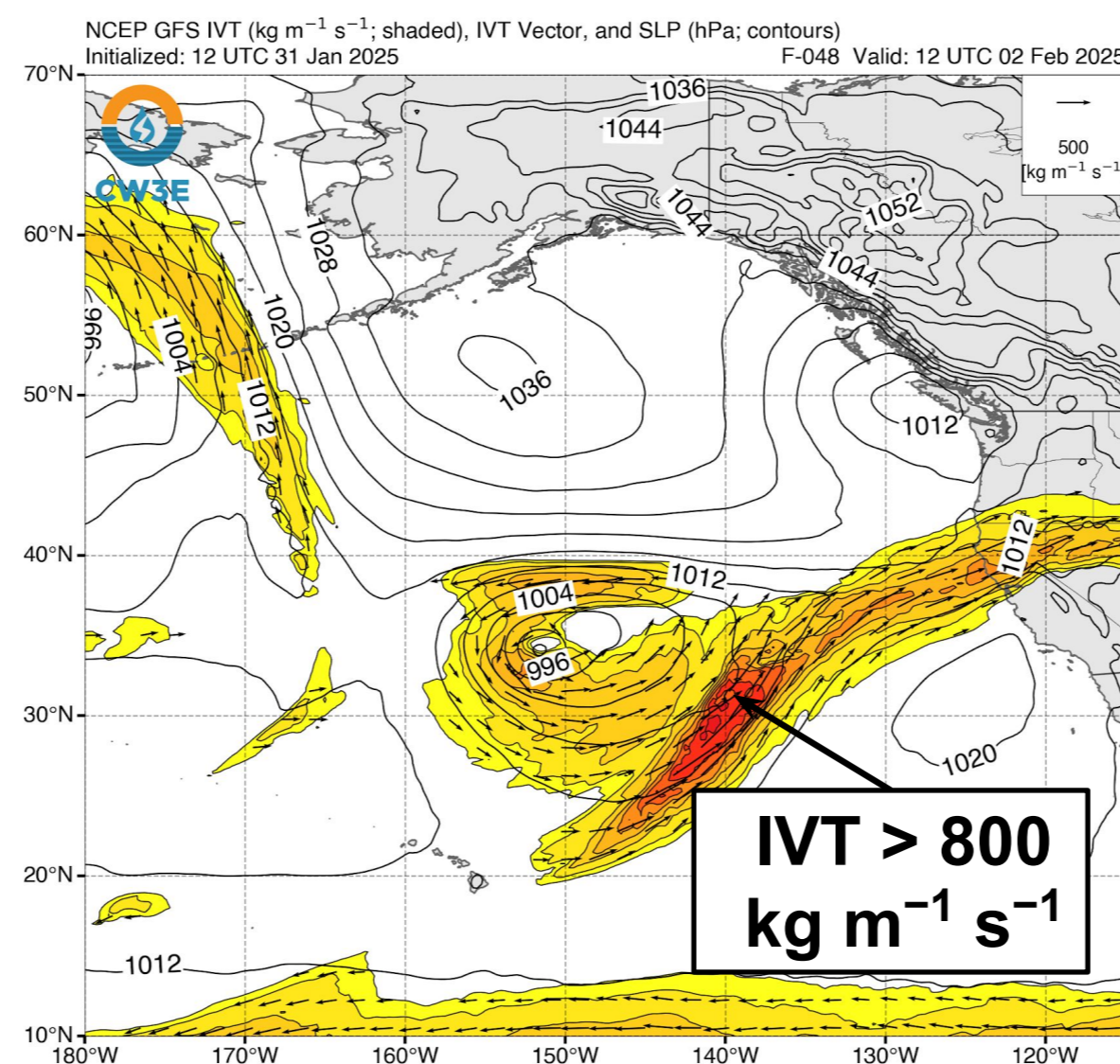
# AR Outlook: 31 January 2025

## GFS IVT & SLP Forecasts

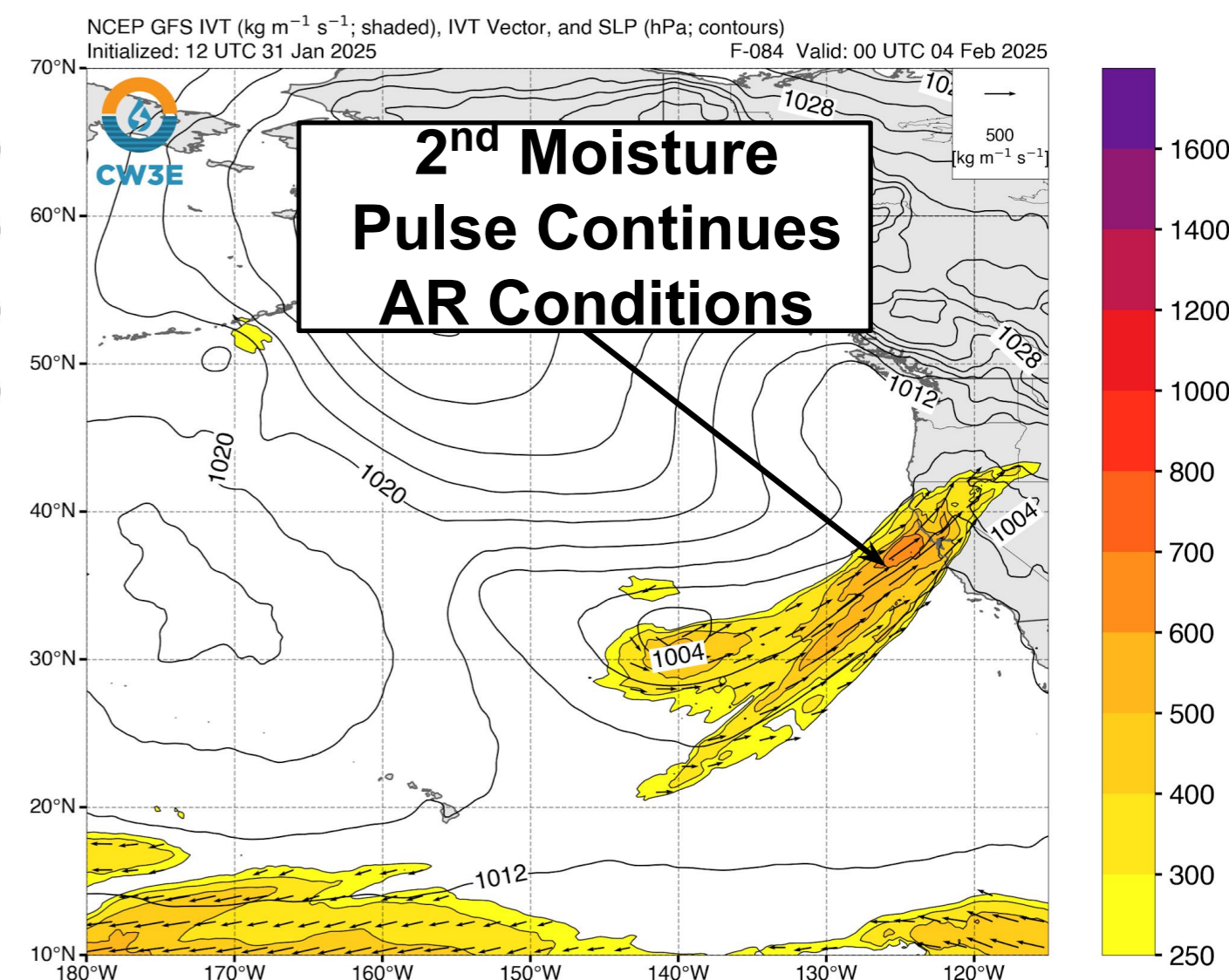
Valid: 4 PM PST 31 Jan (F-012)



Valid: 4 AM PST 2 Feb (F-048)



Valid: 4 PM PST 2 Feb (F-84)

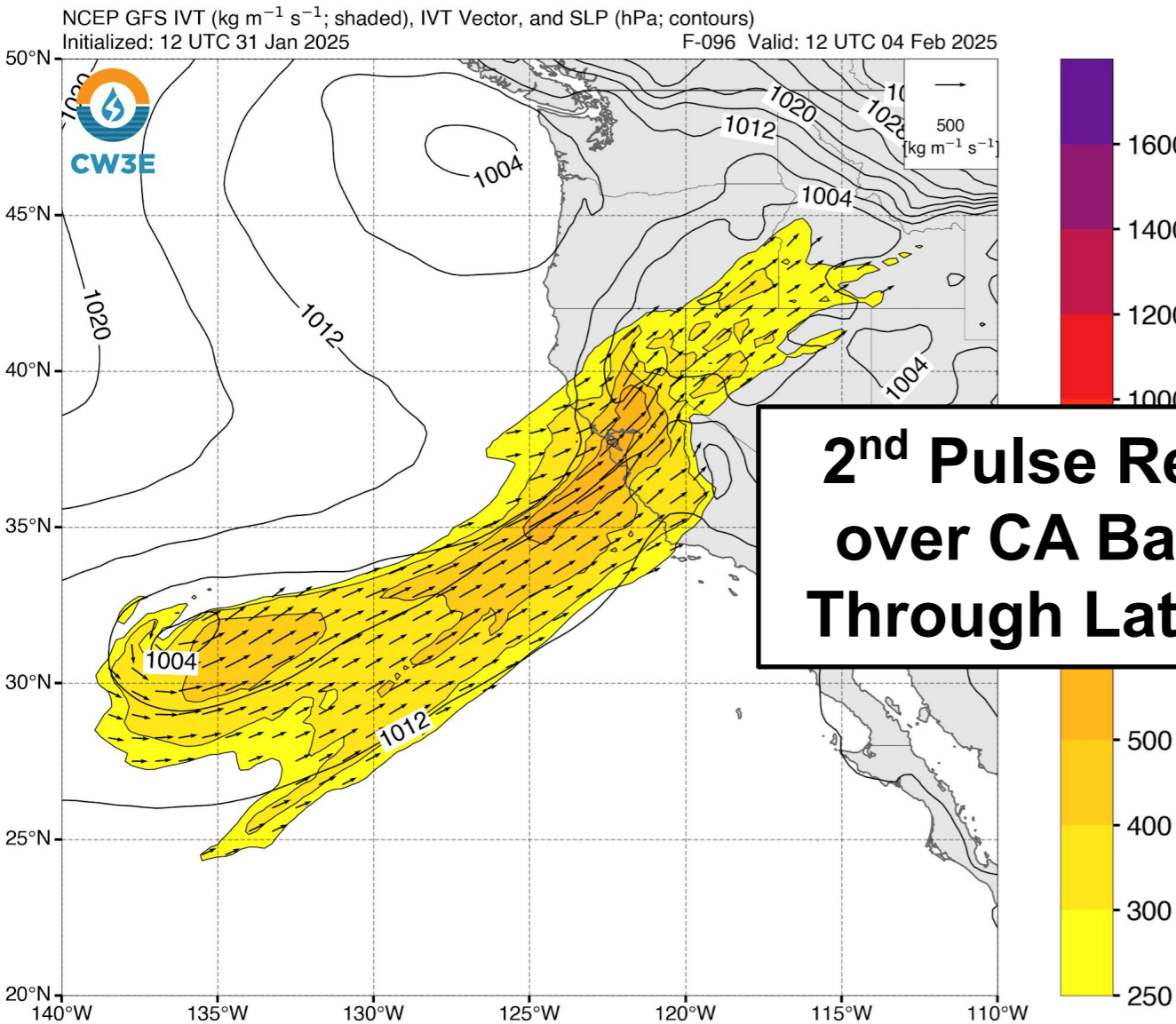


- The first of two moisture pulses brought AR conditions to the Pacific Northwest today, Jan 31, and is forecast to propagate down the coast through 31 Jan as the second moisture pulse propagates toward the US West Coast.
- The second moisture pulse, fueled by a tropical moisture, is forecast to make landfall late 1 Feb to early 2 Feb.
- The short time between the first and second pulses results in no break in AR conditions over much of coastal Northern and Central California from today through 4 Feb.

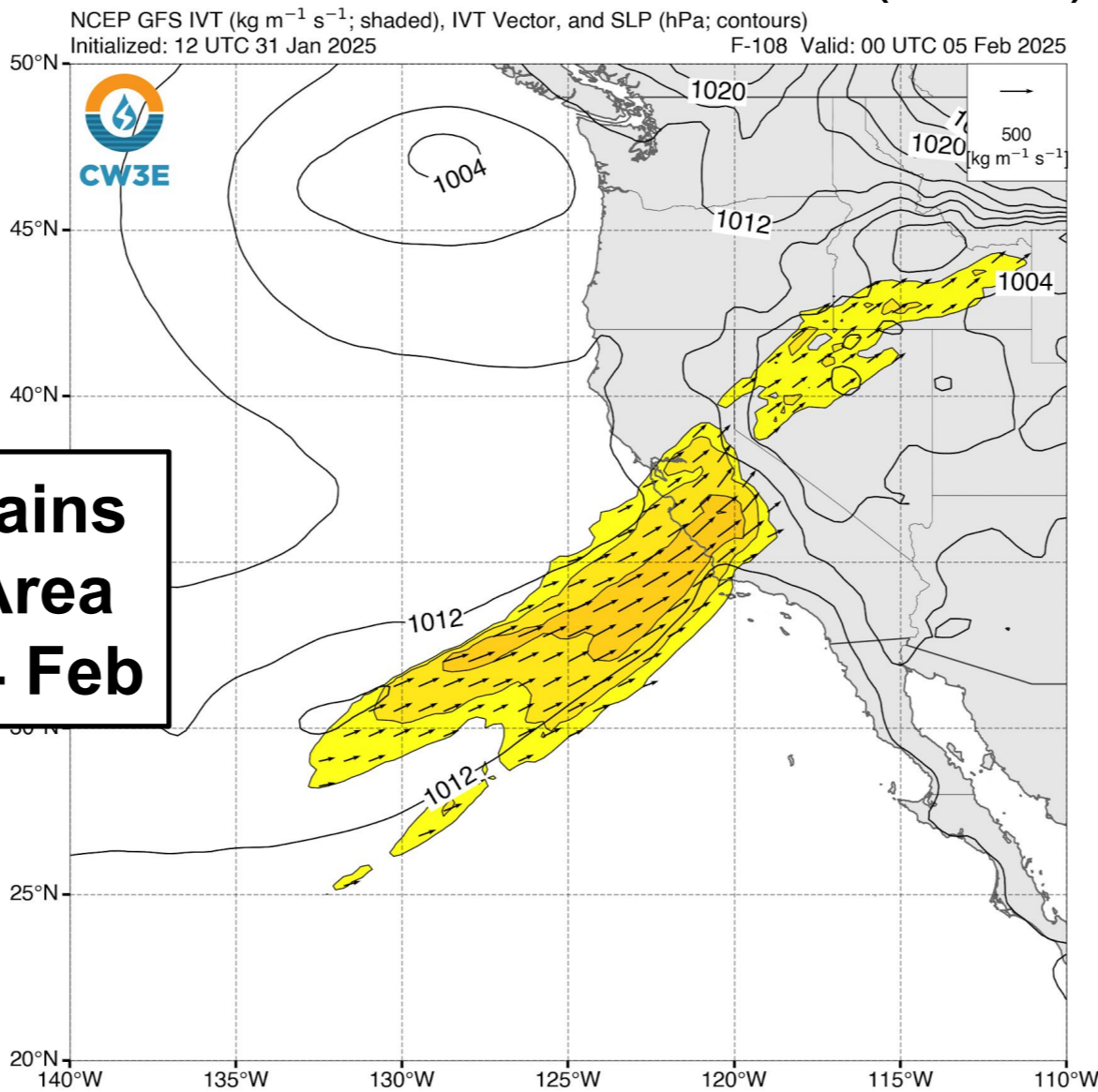
# AR Outlook: 31 January 2025

## GFS IVT & SLP Forecasts

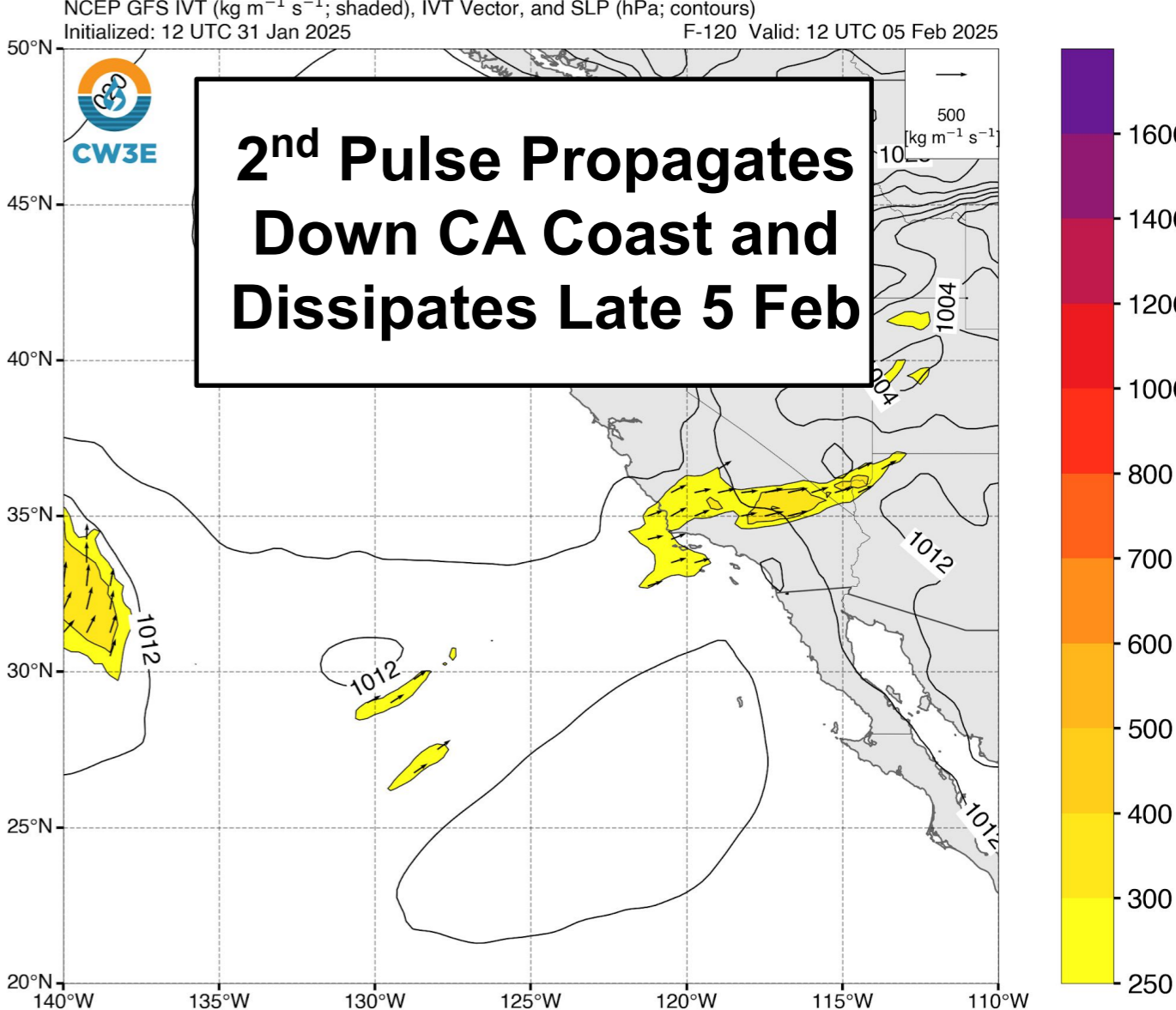
Valid: 4 AM PST 4 Feb (F-96)



Valid: 4 PM PST 4 Feb (F-108)



Valid: 4 AM PST 5 Feb (F-120)



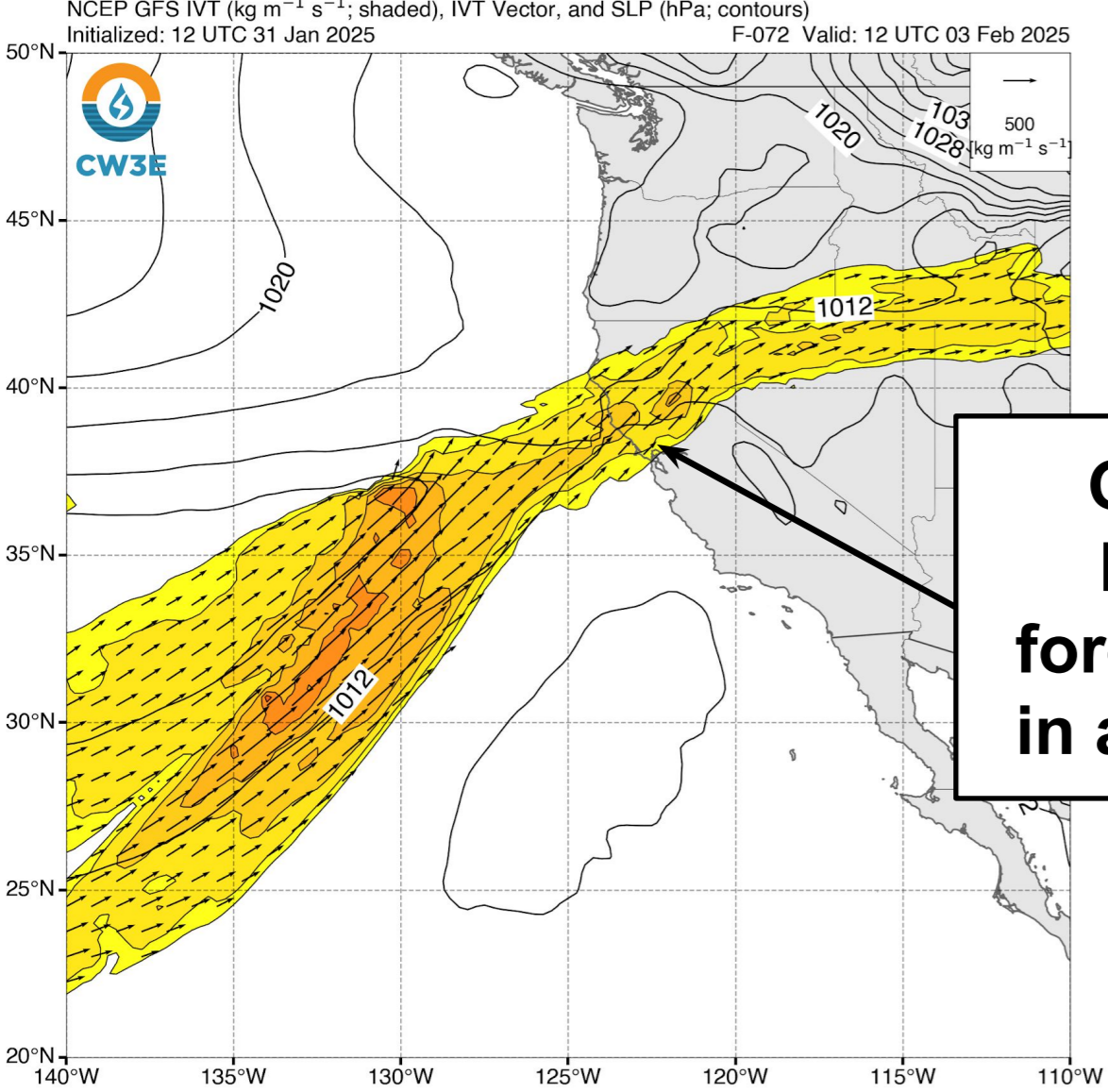
- The second moisture pulse is forecast to remain over the San Francisco Bay Area through 4 Feb, extending AR conditions in the region.
- The second moisture pulse is forecast to propagate down the California coast through 5 Feb, and dissipate over Southern California.

# AR Outlook: 31 January 2025

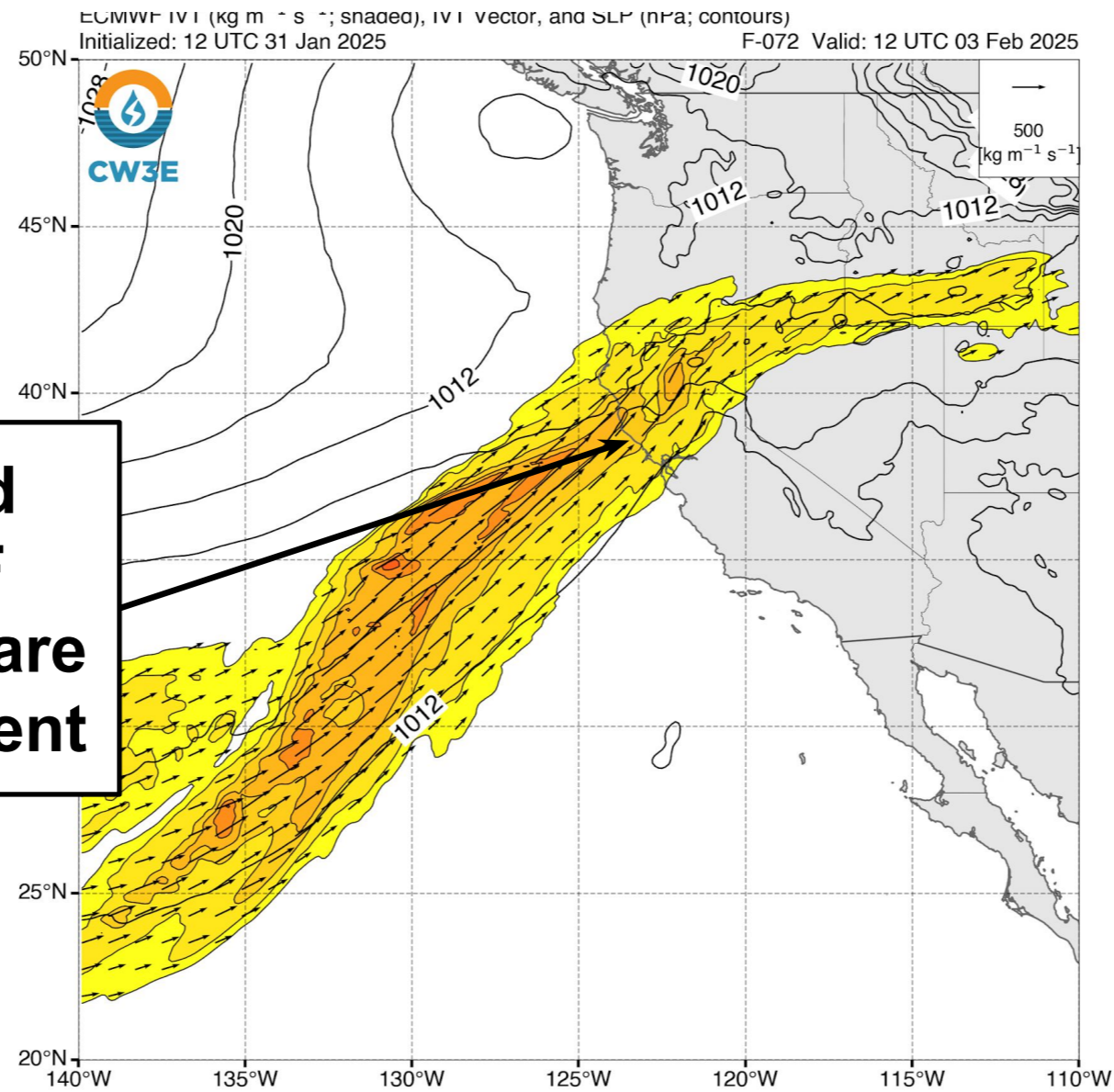
## GFS and ECMWF IVT Forecast Comparison

Valid : 12 UTC 2 Feb (F-072)

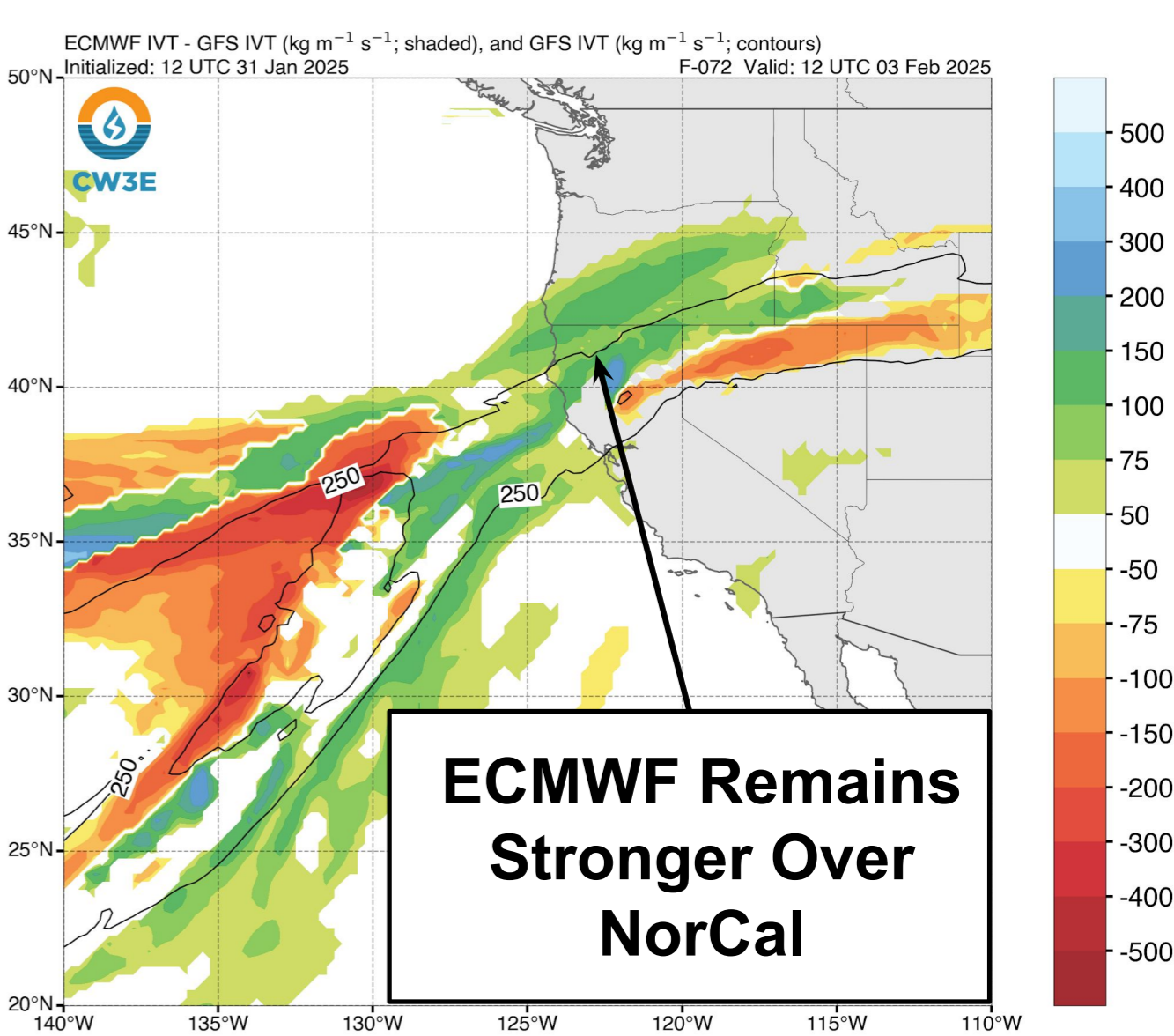
GFS IVT



ECMWF IVT



ECMWF IVT - GFS IVT



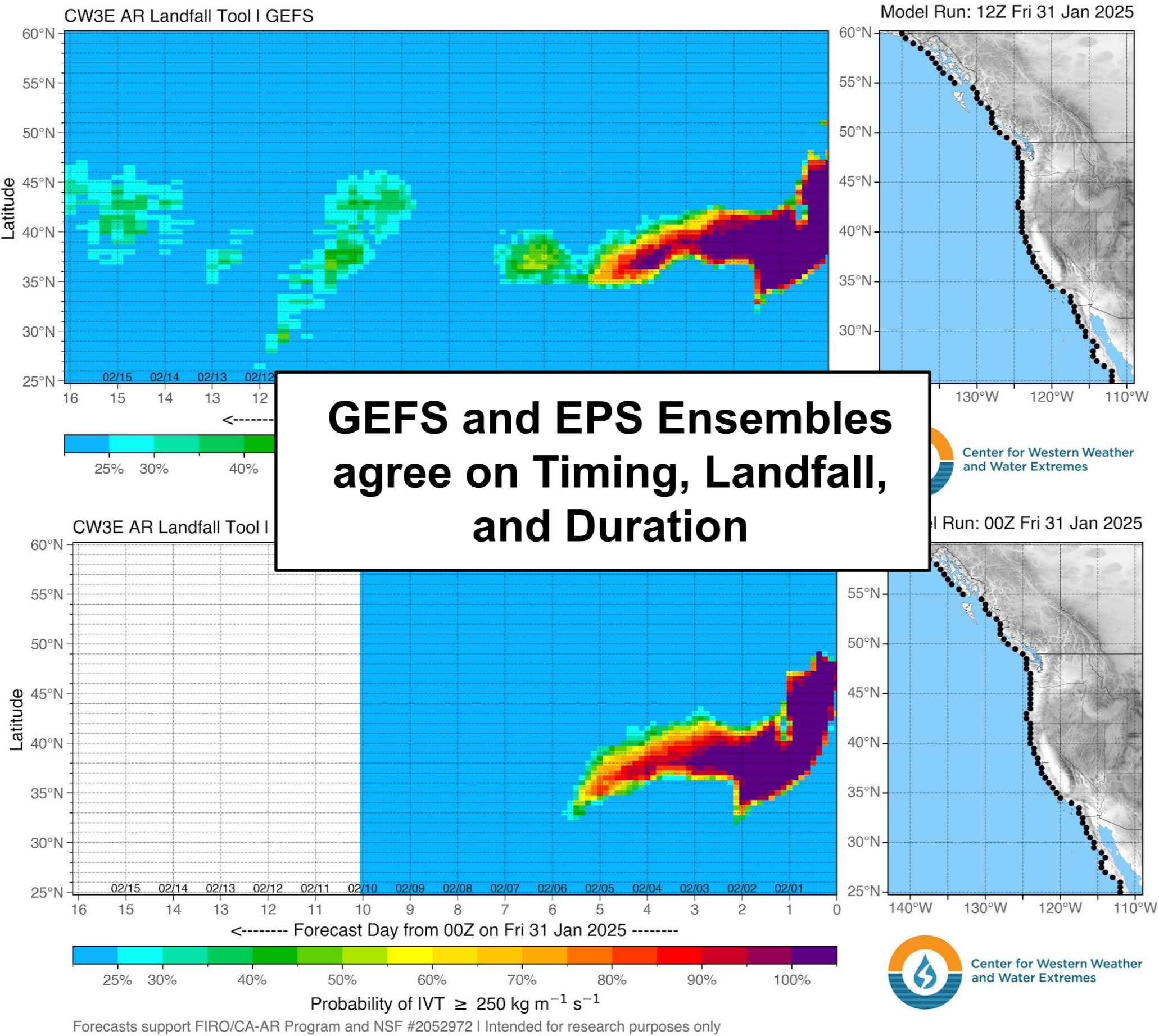
- In the latest model runs, the GFS forecast has shifted toward the north more in-line with ECMWF forecasts.
- While the GFS has shifted further to the north, the ECMWF continues to forecast higher IVT values into Northern California than the GFS.

# AR Outlook: 31 January 2025

## CW3E AR Landfall Tool: GEFS (Top) and EPS (Bottom)

GEFS

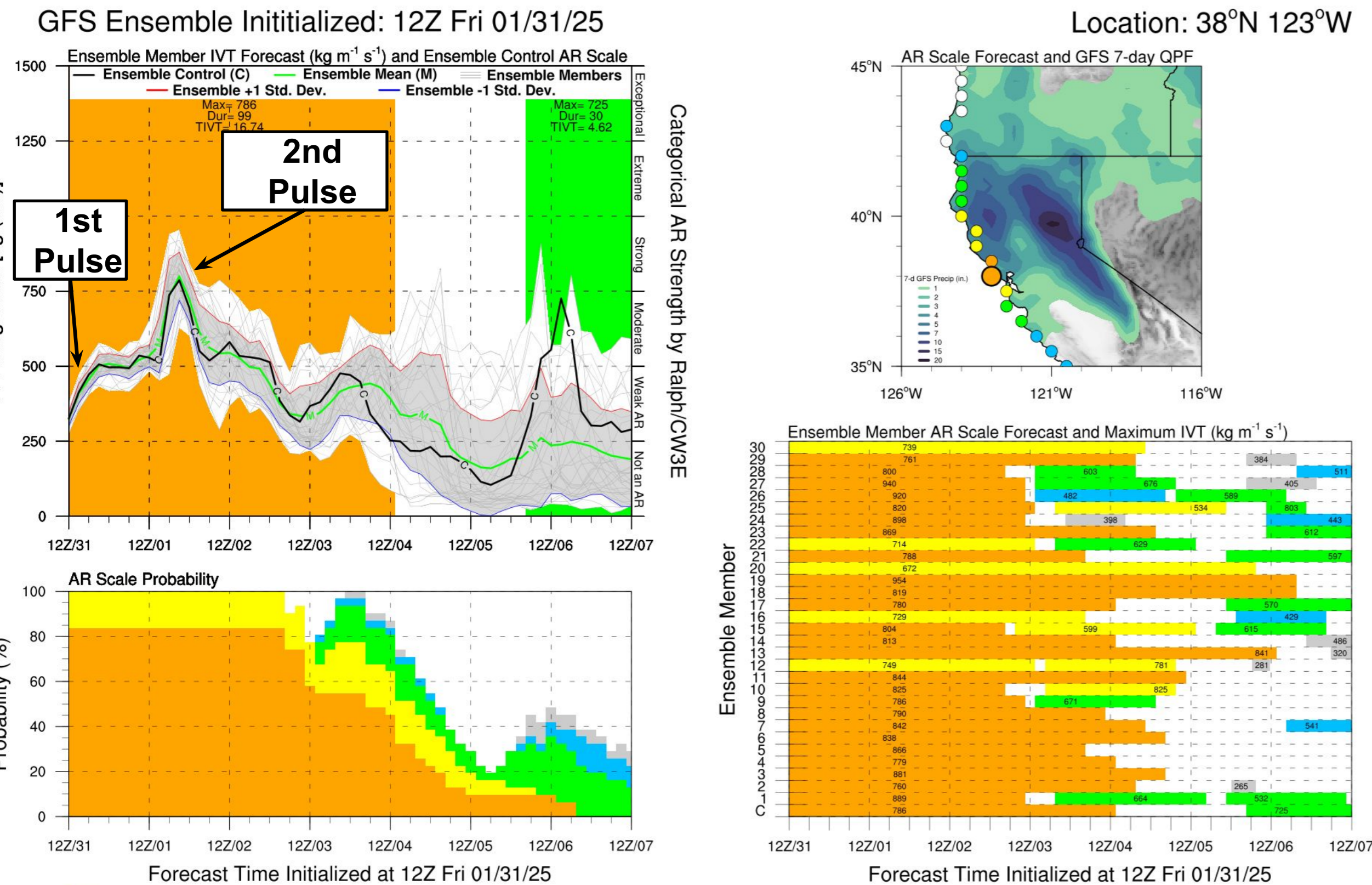
EPS



- The 00Z GEFS is showing much greater agreement with the ECMWF EPS.
- Both the GEFS and EPS are showing high confidence in AR conditions over Northern and Central California continuing through 4 Feb.

# AR Outlook: 31 January 2025

## GEFS AR Scale and IVT Forecasts



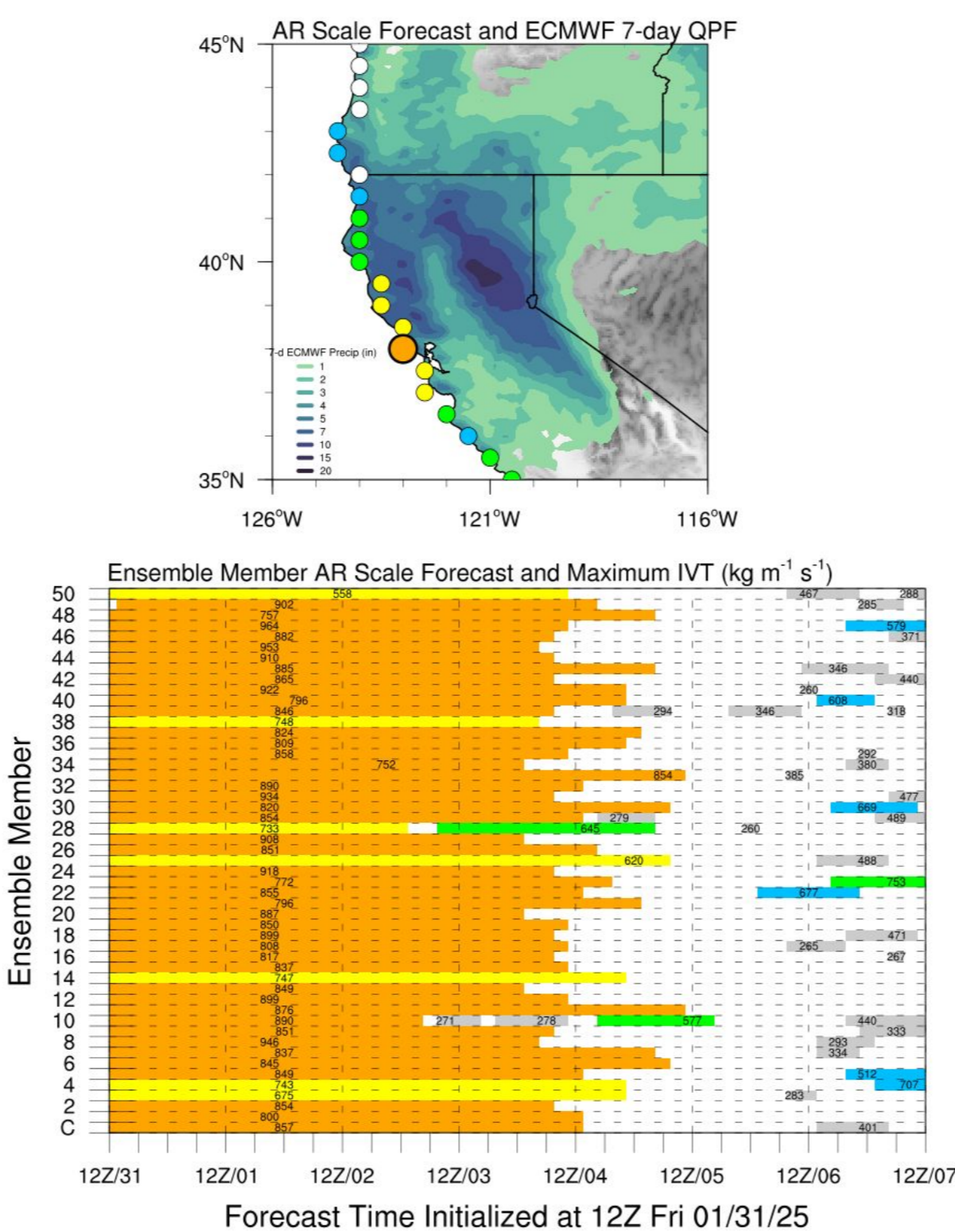
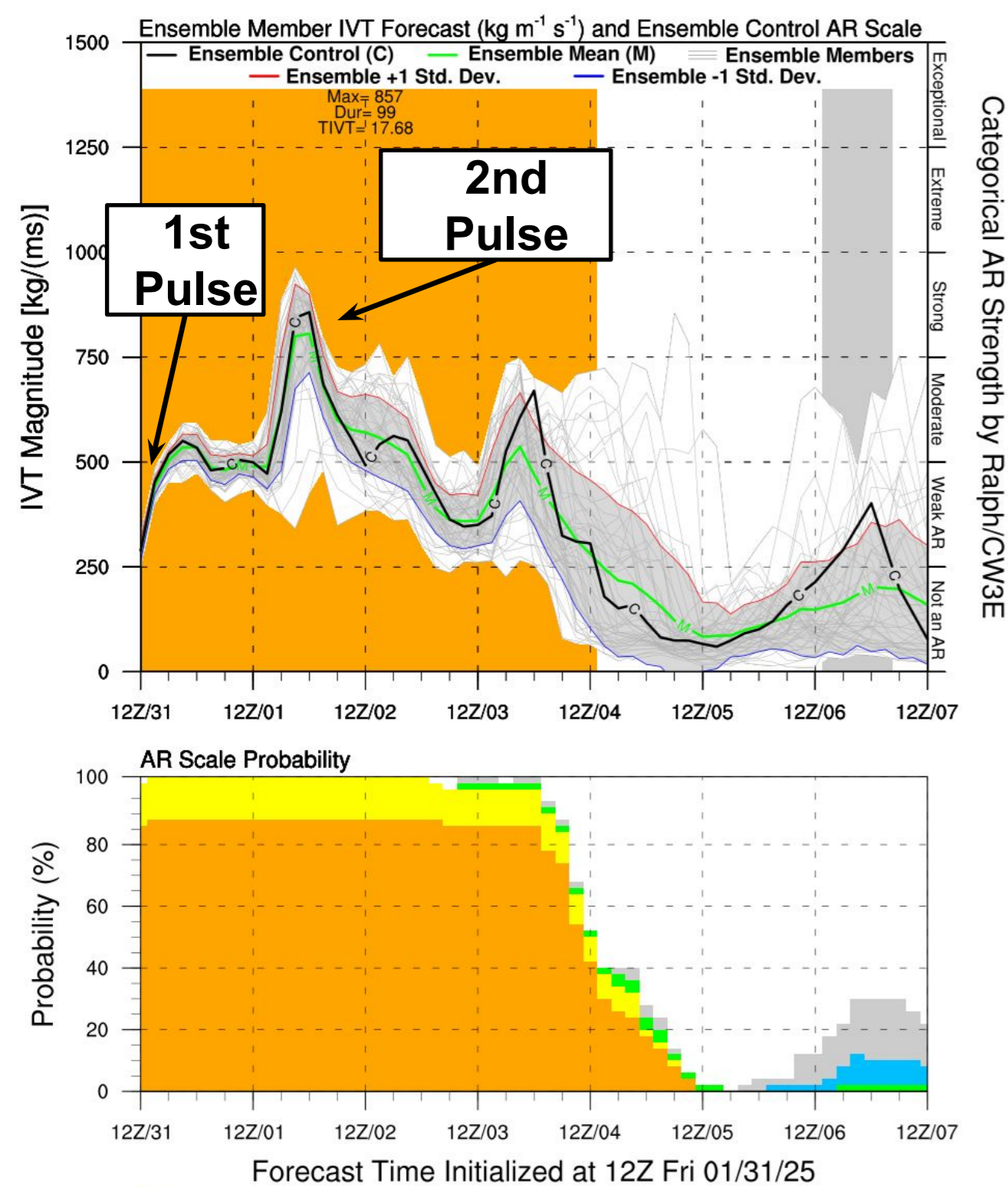
- The 12Z GEFS control member is forecasting **AR2-AR4 conditions** (based on the Ralph et al. 2019 AR Scale) over coastal Northern and Central California.
- 31/31 GEFS members are forecasting at least AR3 conditions for a coastal point at 38°N, 123°W (near Sonoma County, CA); **majority of members AR4.**
- There is some uncertainty among GEFS ensemble members as to the exact duration of the AR, with the highest uncertainty in the end time of AR conditions.

# AR Outlook: 31 January 2025

## ECMWF EPS AR Scale and IVT Forecasts

ECMWF Ensemble Initialized: 12Z Fri 01/31/25

Location: 38°N 123°W



- The 12Z EPS control member is forecasting **AR2-AR4 conditions** (based on the Ralph et al. 2019 AR Scale) over coastal Northern and Central California.
- 51/51 GEFS members are forecasting at least AR3 conditions for a coastal point at 38°N, 123°W (near Sonoma County, CA); **majority of members have AR4.**
- Much like the GEFS, there is uncertainty in timing of dissipation of AR conditions.



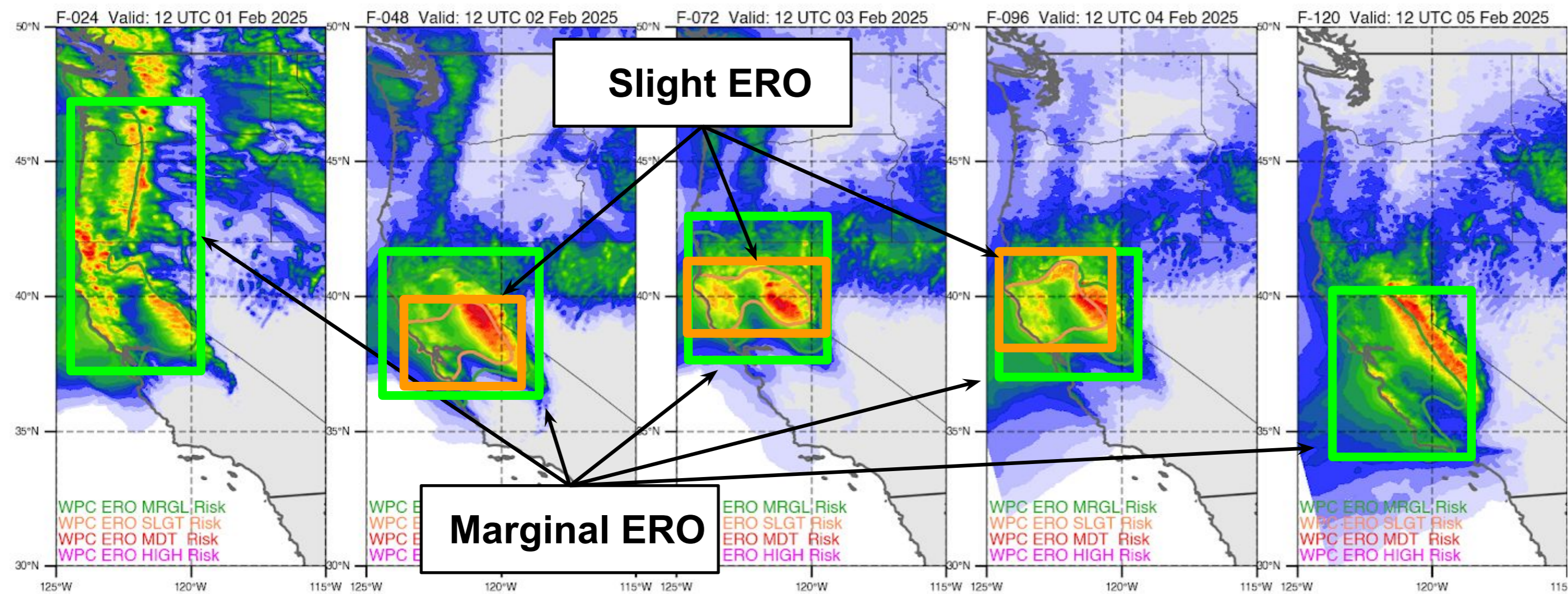
AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 20 UTC 01/31/2025

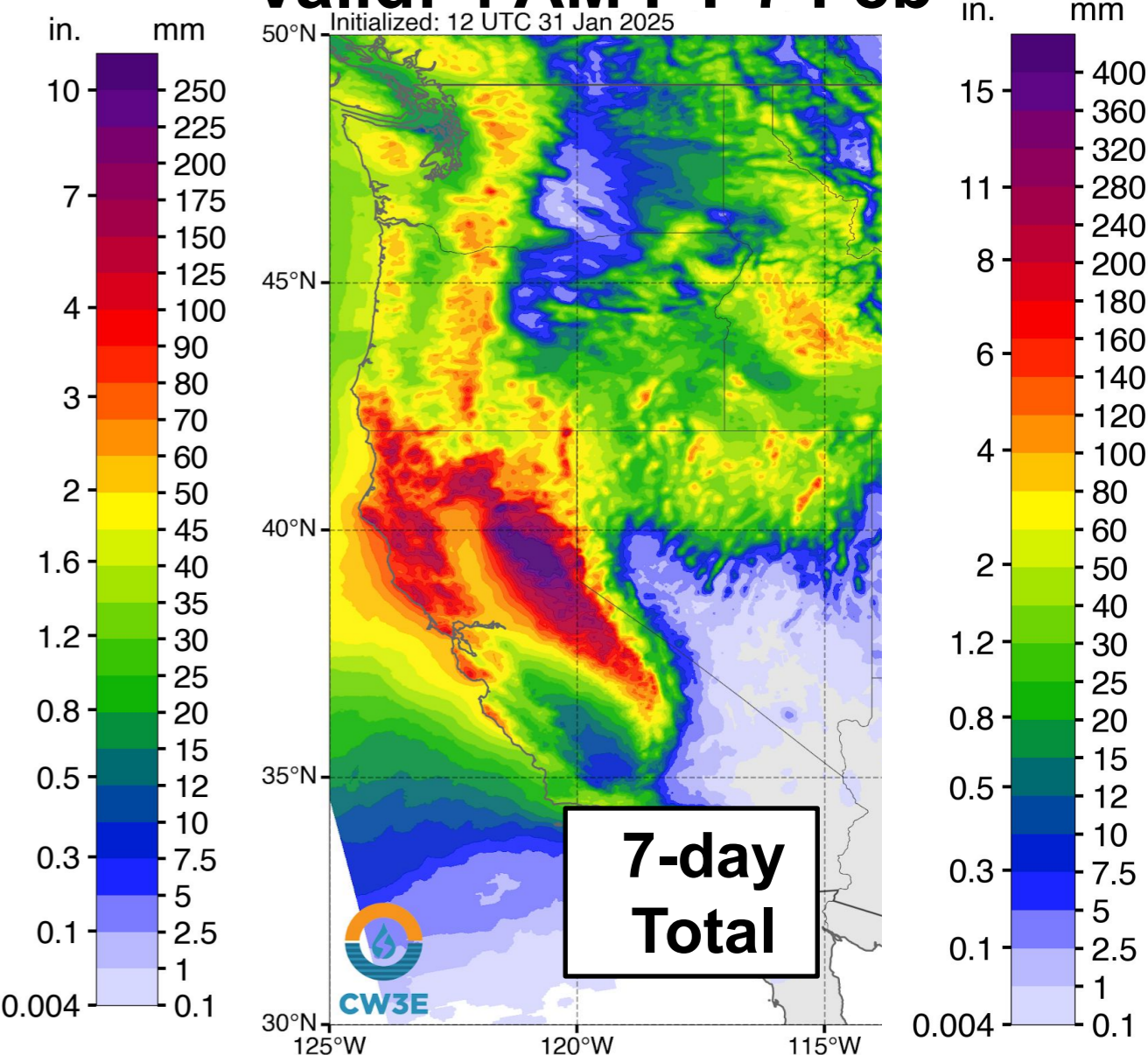
More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

WPC Precipitation Forecasts

WPC 24-h Forecasts for Days 1-5  
Valid: 4 AM PT 1-5 Feb



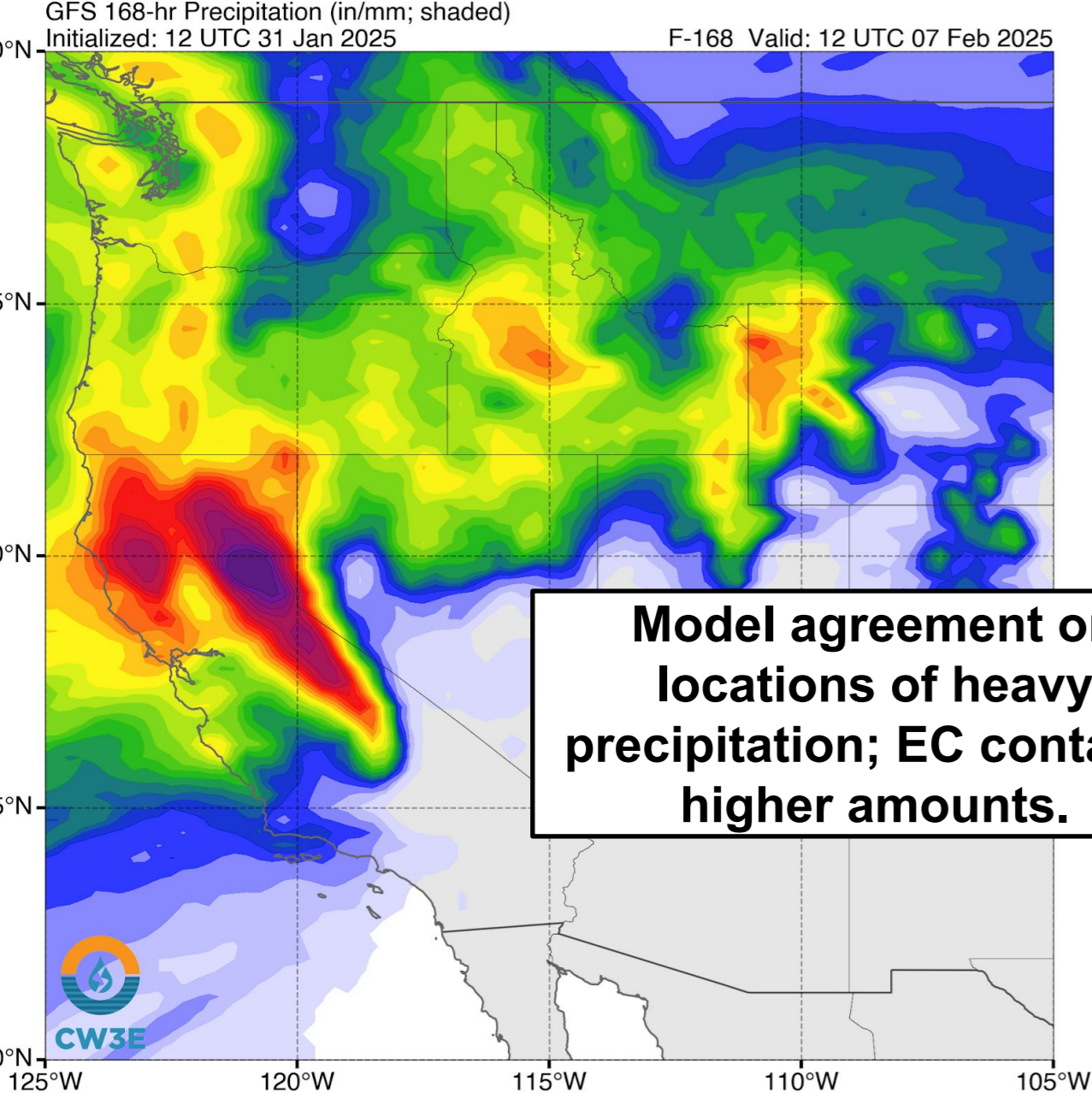
WPC 168-h QPF  
Valid: 4 AM PT 7 Feb



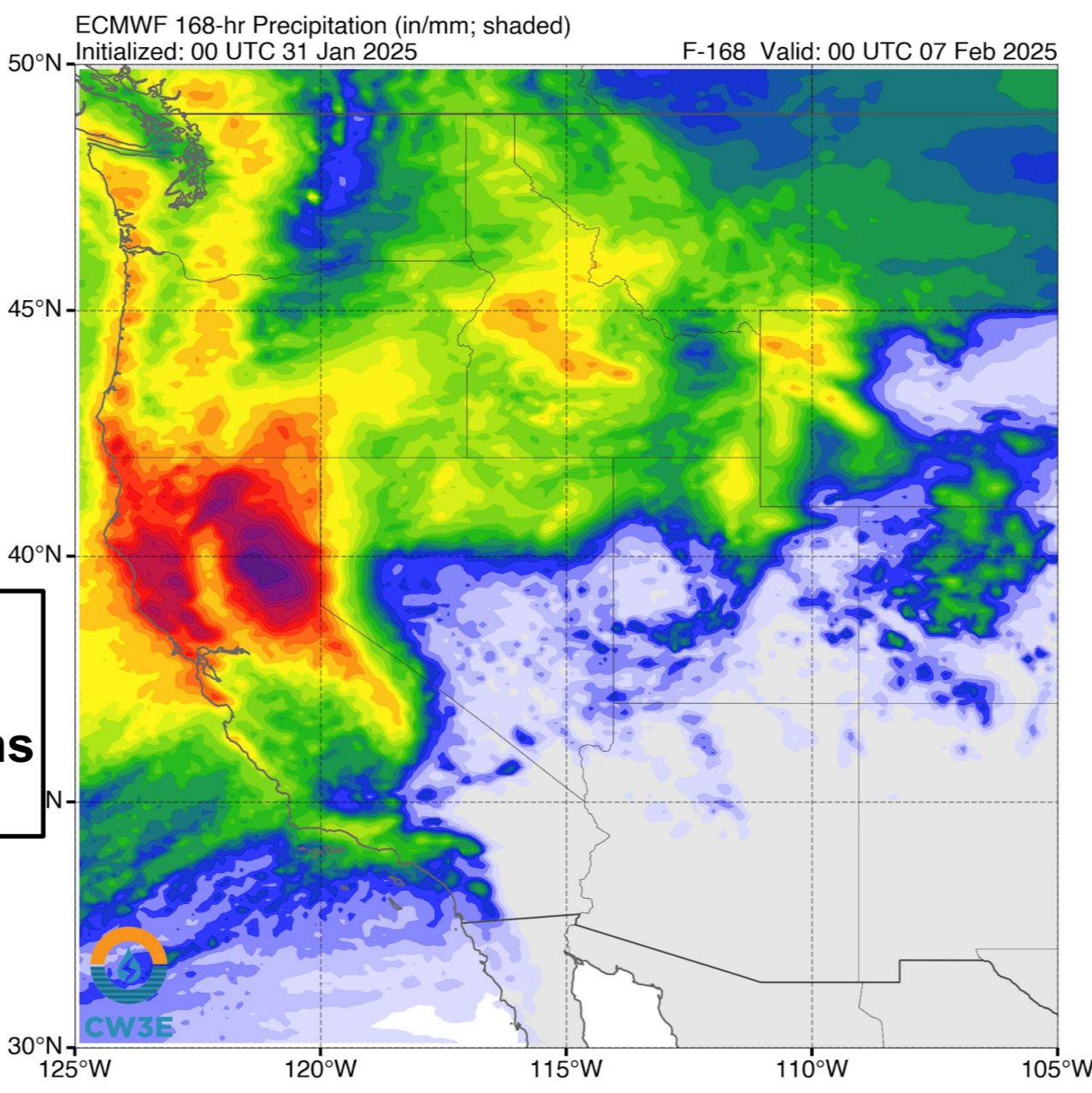
- The highest 7-day precipitation totals are expected over the Northern California Coast Ranges and the Northern Sierra Nevada, where **at least 6–15 inches are expected**. Precipitation totals of 3-5 inches are forecast over coastal Oregon and Washington and the Cascades.
- A slight risk Excessive Rainfall Outlook (ERO) (level 2 of 4, 15% chance of flooding) has been issued over northern coastal California and the Sierra Nevada in days 2, 3 and 4 (periods ending 4 AM PT 2-4 Feb).

## Precipitation Forecasts Comparison

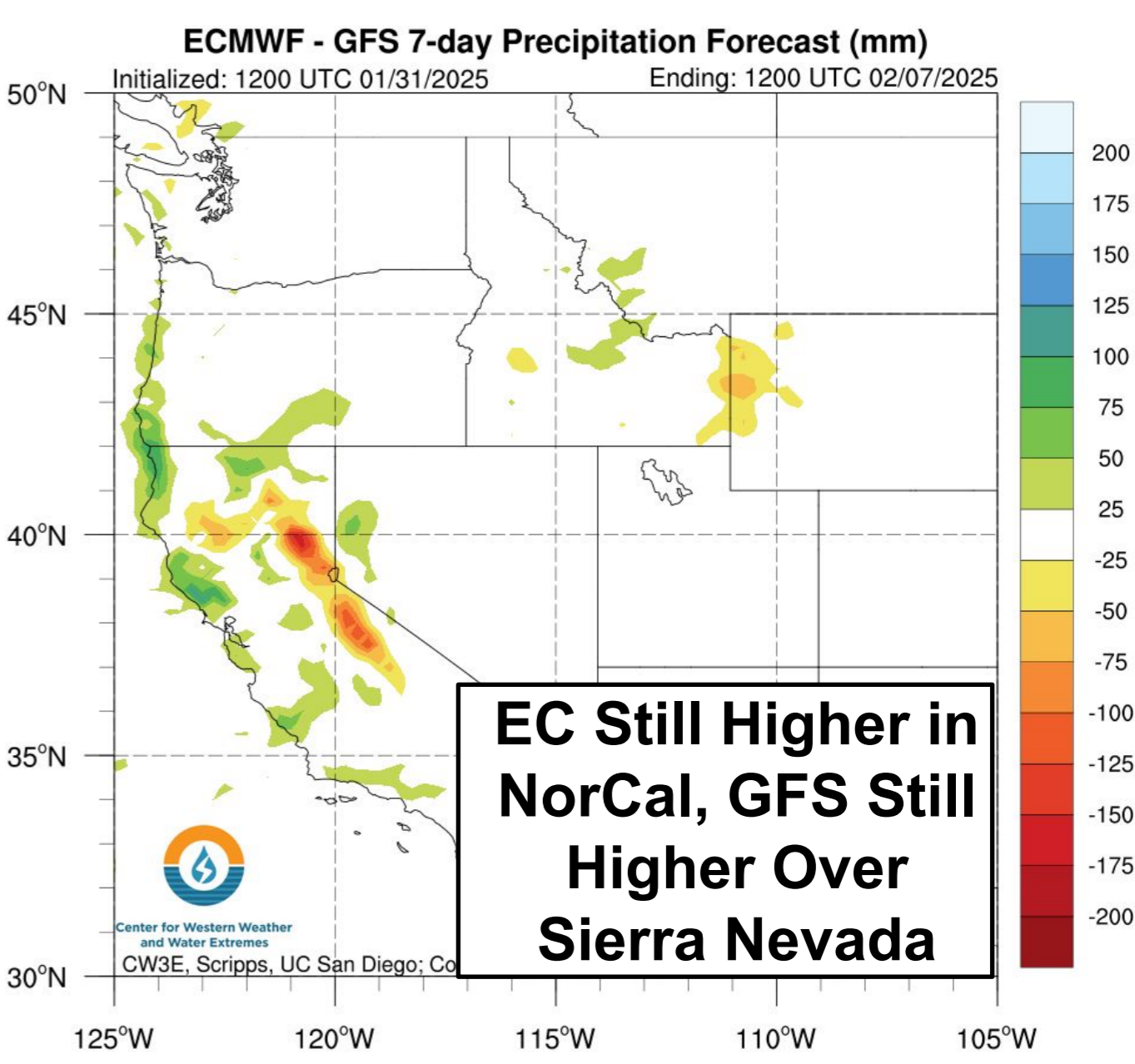
**GFS 168-h QPF**  
**Valid: 4 AM PT 7 Feb**



**ECMWF 168-h QPF**  
**Valid: 4 PM PT 6 Feb**



**ECMWF-GFS 168-h QPF**  
**Valid: 4 PM PT 6 Feb**



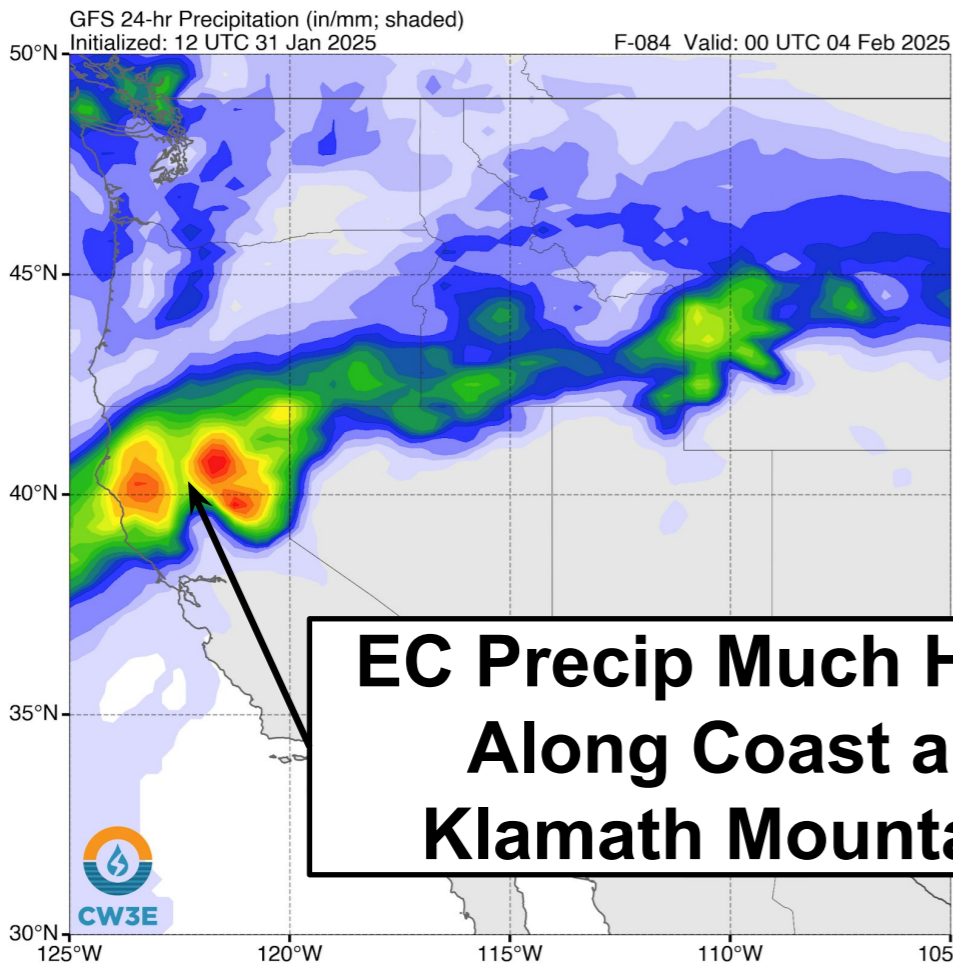
- Locations of heaviest precipitation are now similar across both the GFS and ECMWF models over the next seven days.
- ECMWF totals are higher over coastal Northern California.
- GFS totals are higher over Northern and Central Sierra Nevada.

## Precipitation Forecasts Comparison

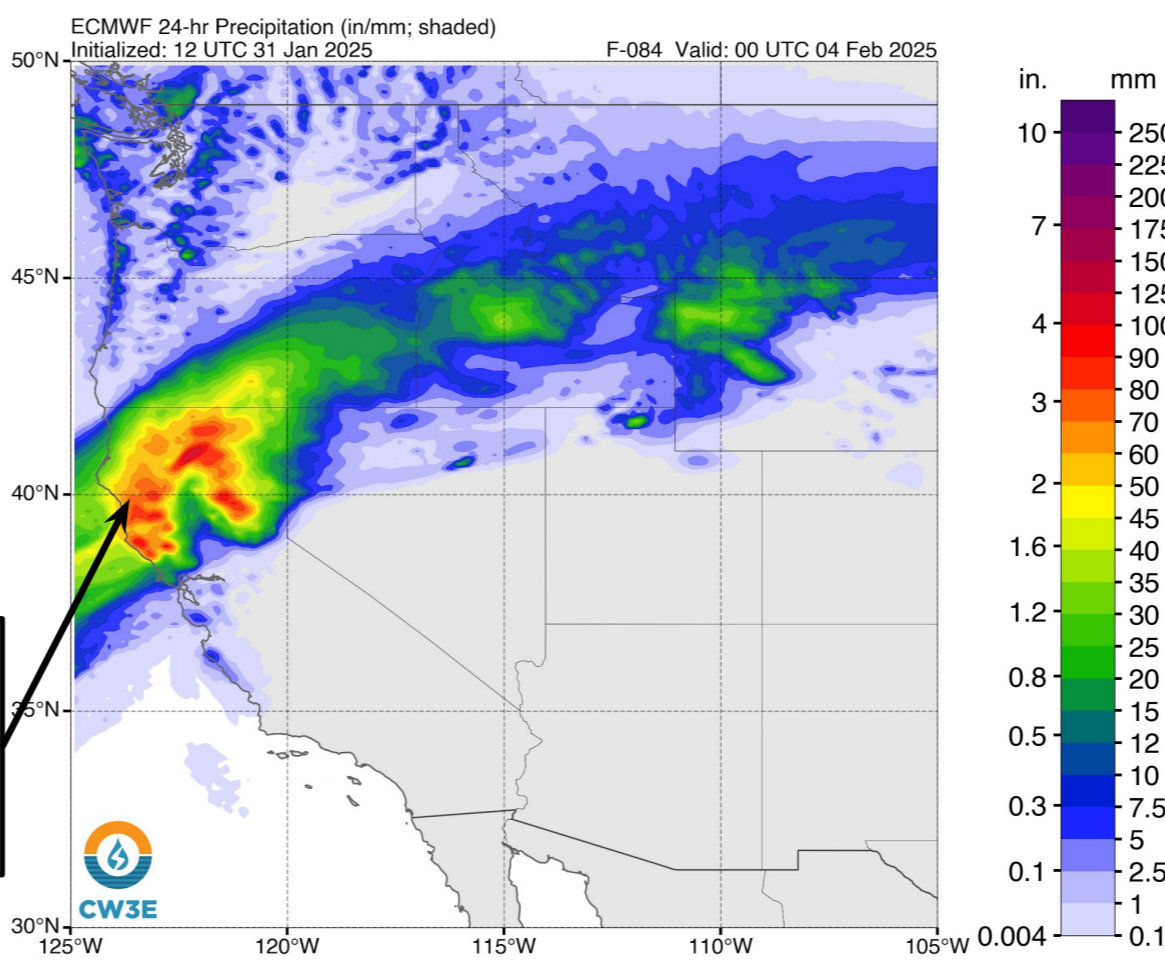
**GFS**

**ECMWF**

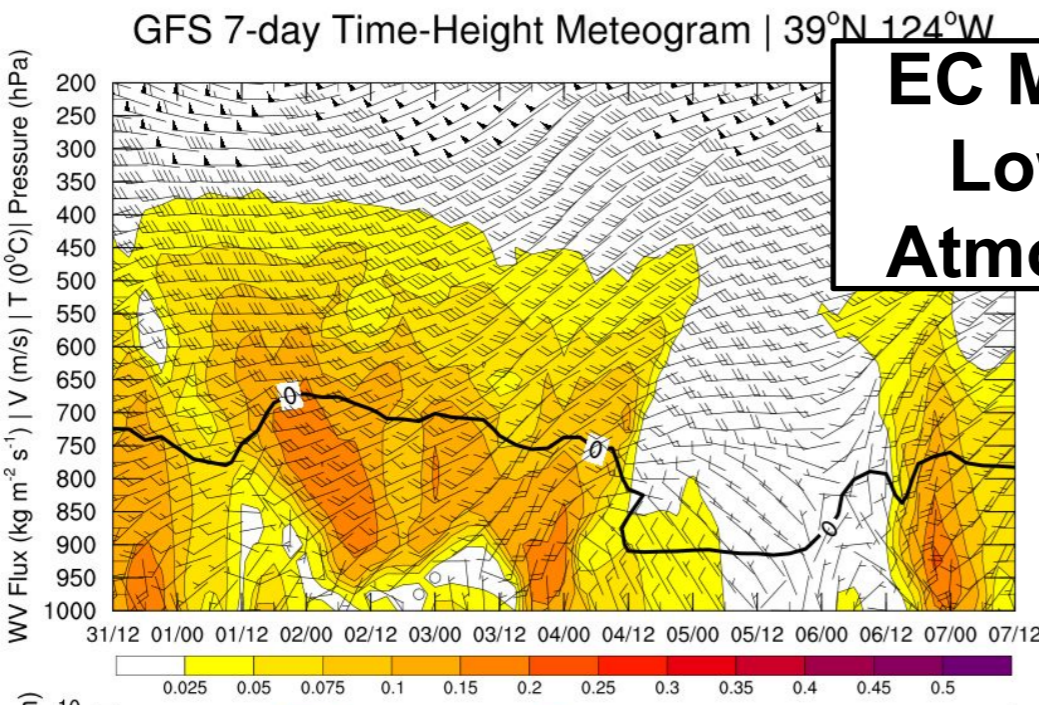
**24-hr  
Precipitation  
Ending  
4 PM PT 3  
Feb**



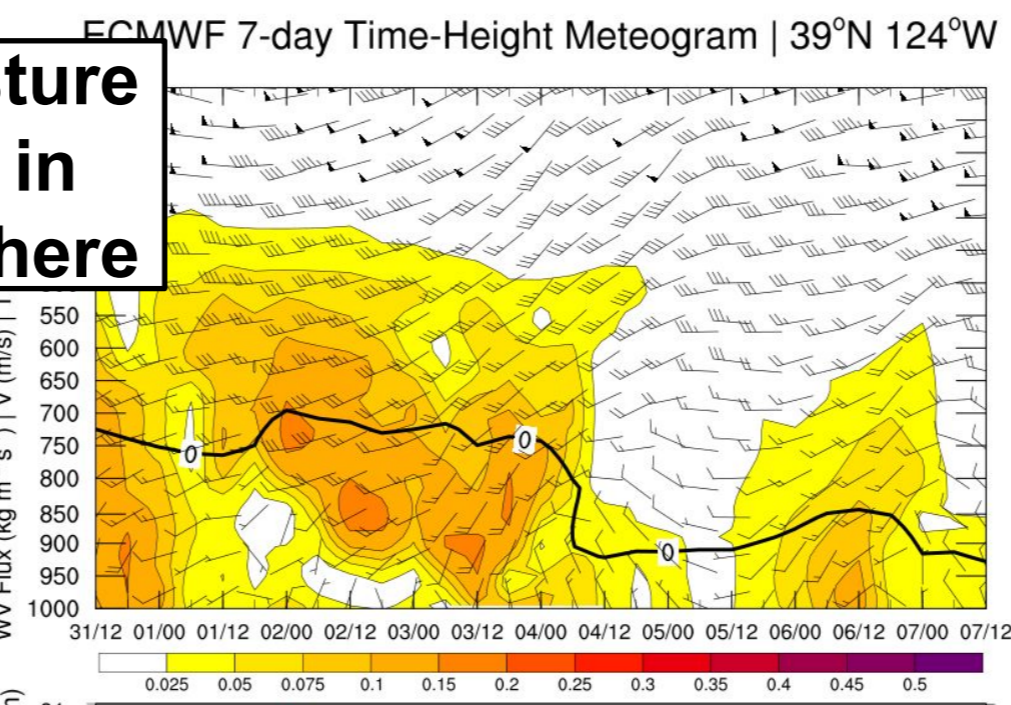
**EC Precip Much Higher  
Along Coast and  
Klamath Mountains**



**7-Day  
Time-Height  
Meteogram  
for IVT**



**EC Moisture  
Lower in  
Atmosphere**

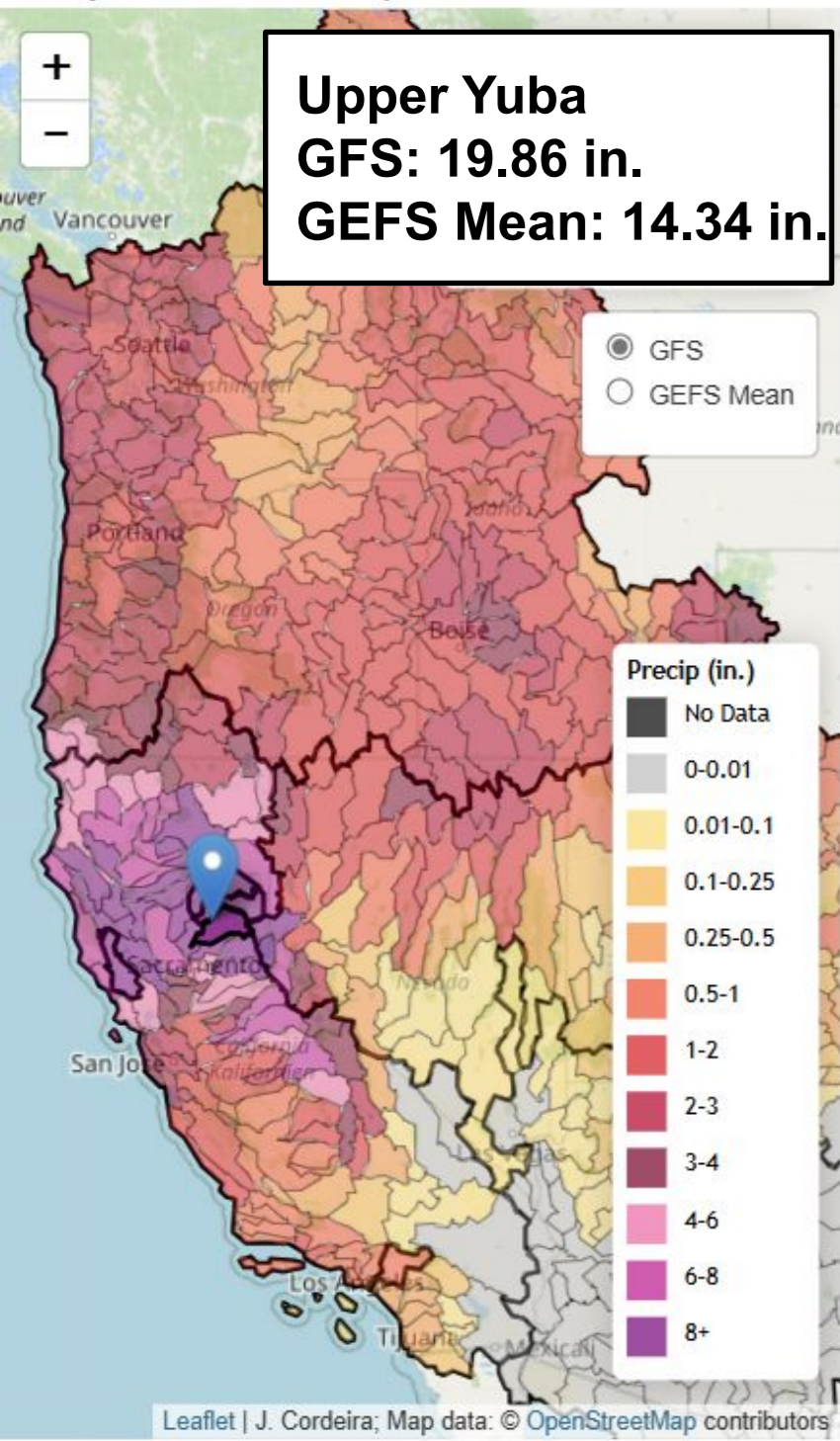


- Despite similarities in 7-day precipitation totals, there are still large differences on shorter time scales.
- For the 24-hr period ending 4 PM PT 3 Feb, the ECMWF (top right) is forecasting much greater precipitation in Northern California than the GFS (top left).
- This is a result of the ECMWF forecasting the atmospheric moisture transport to be lower in the atmosphere (lower right) than the GFS (lower left), resulting in more favorable orographic interaction.

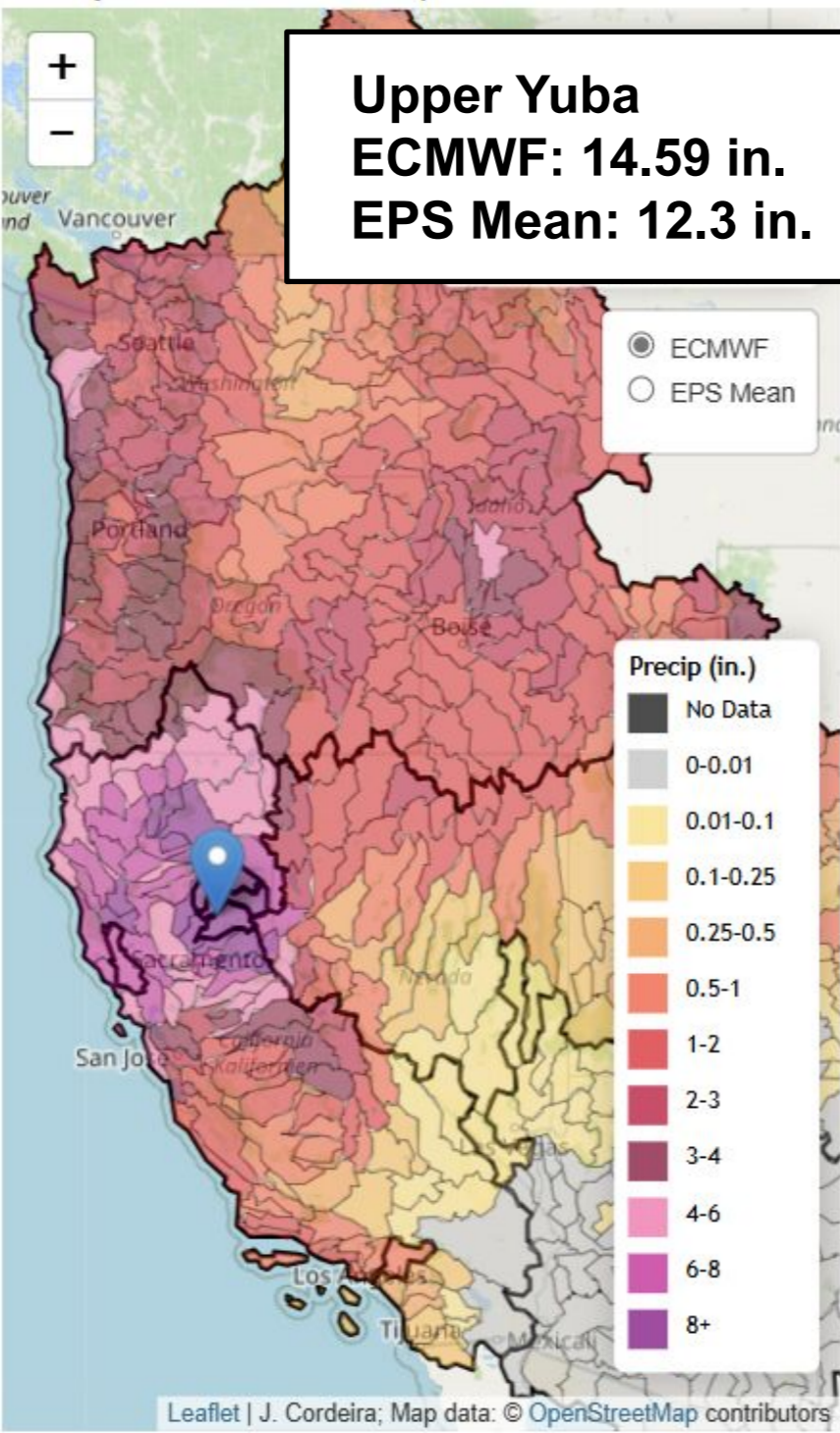
# AR Outlook: 31 January 2025

## Watershed Precipitation Forecasts - Upper Yuba

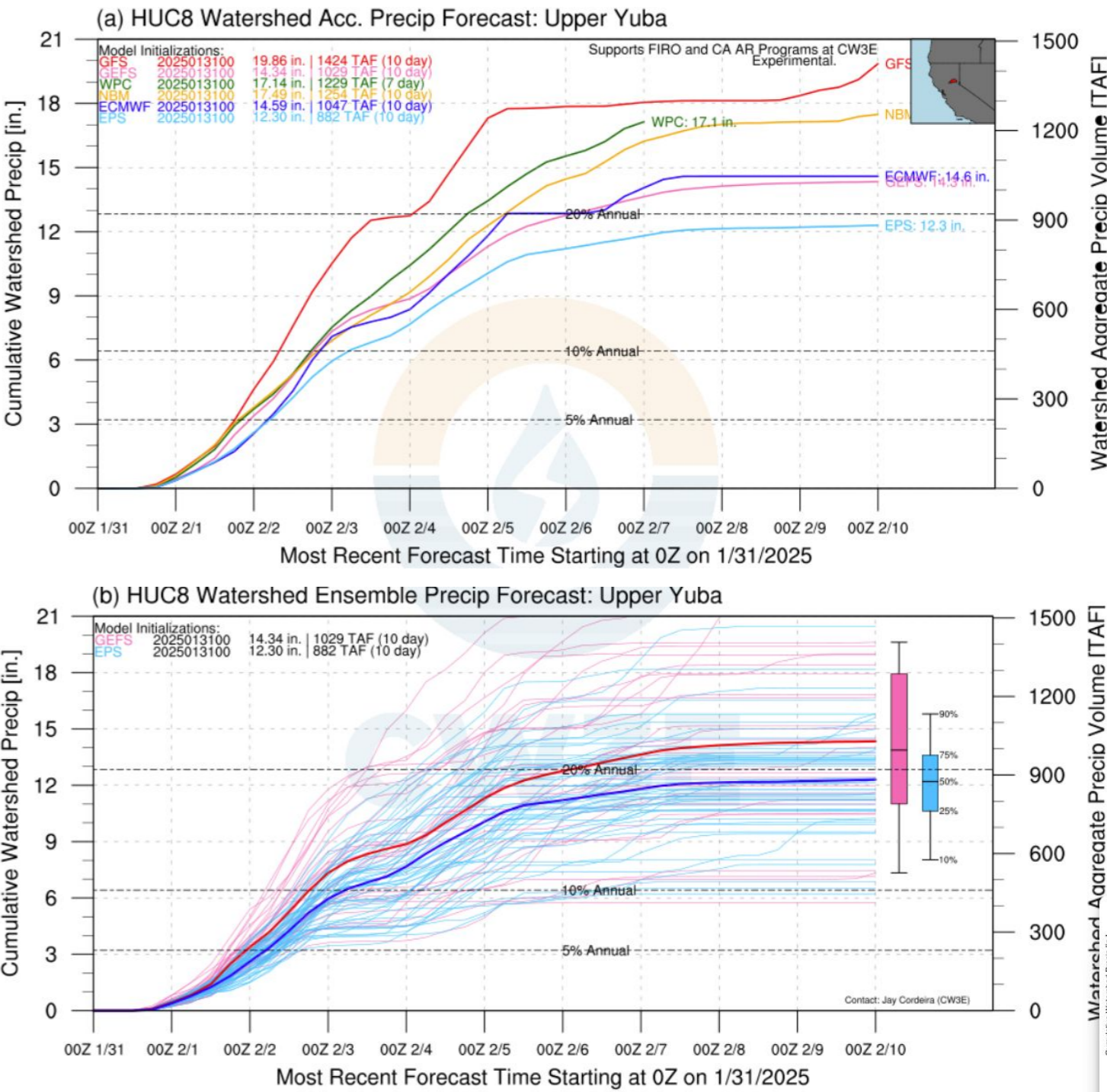
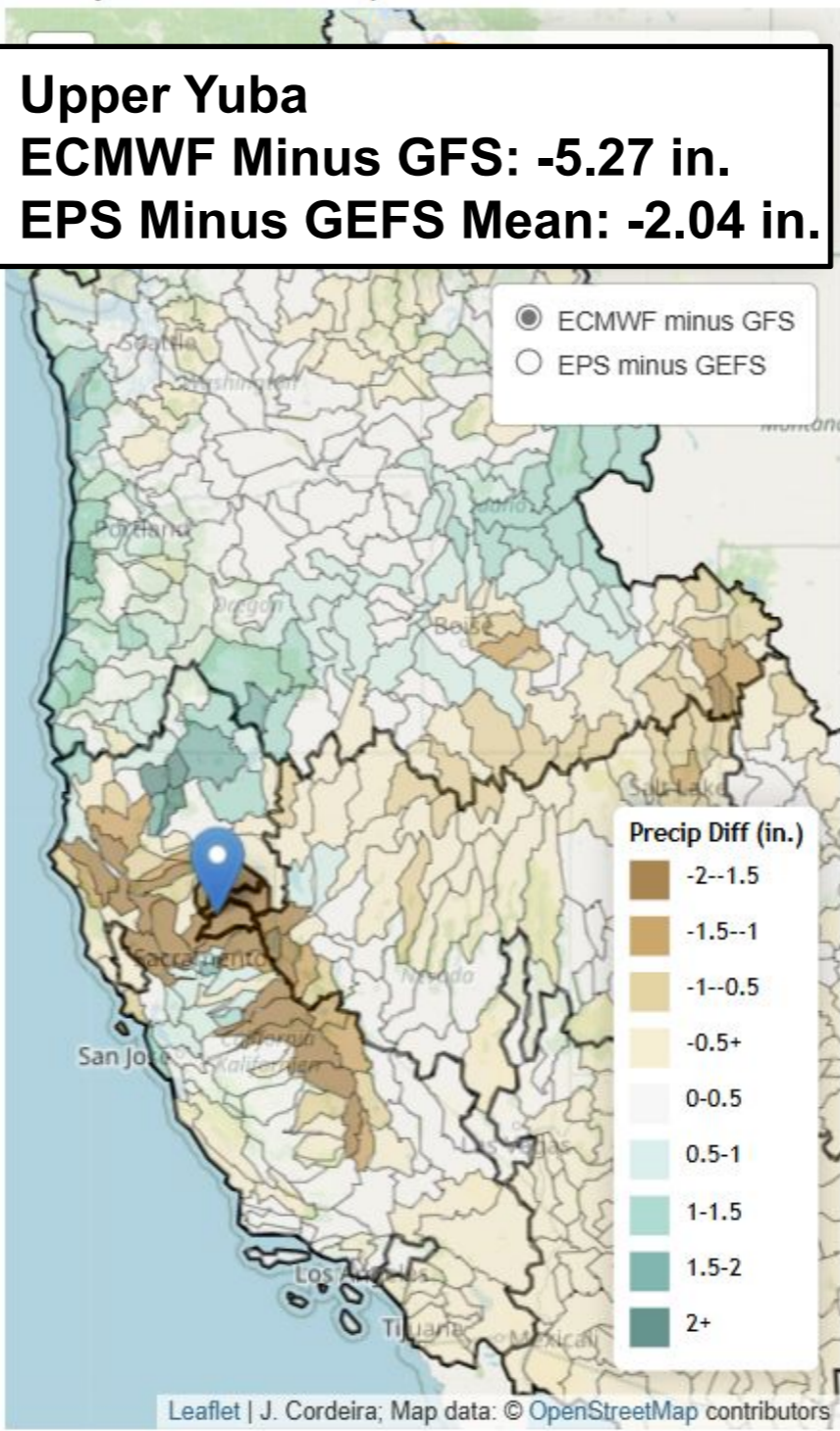
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast

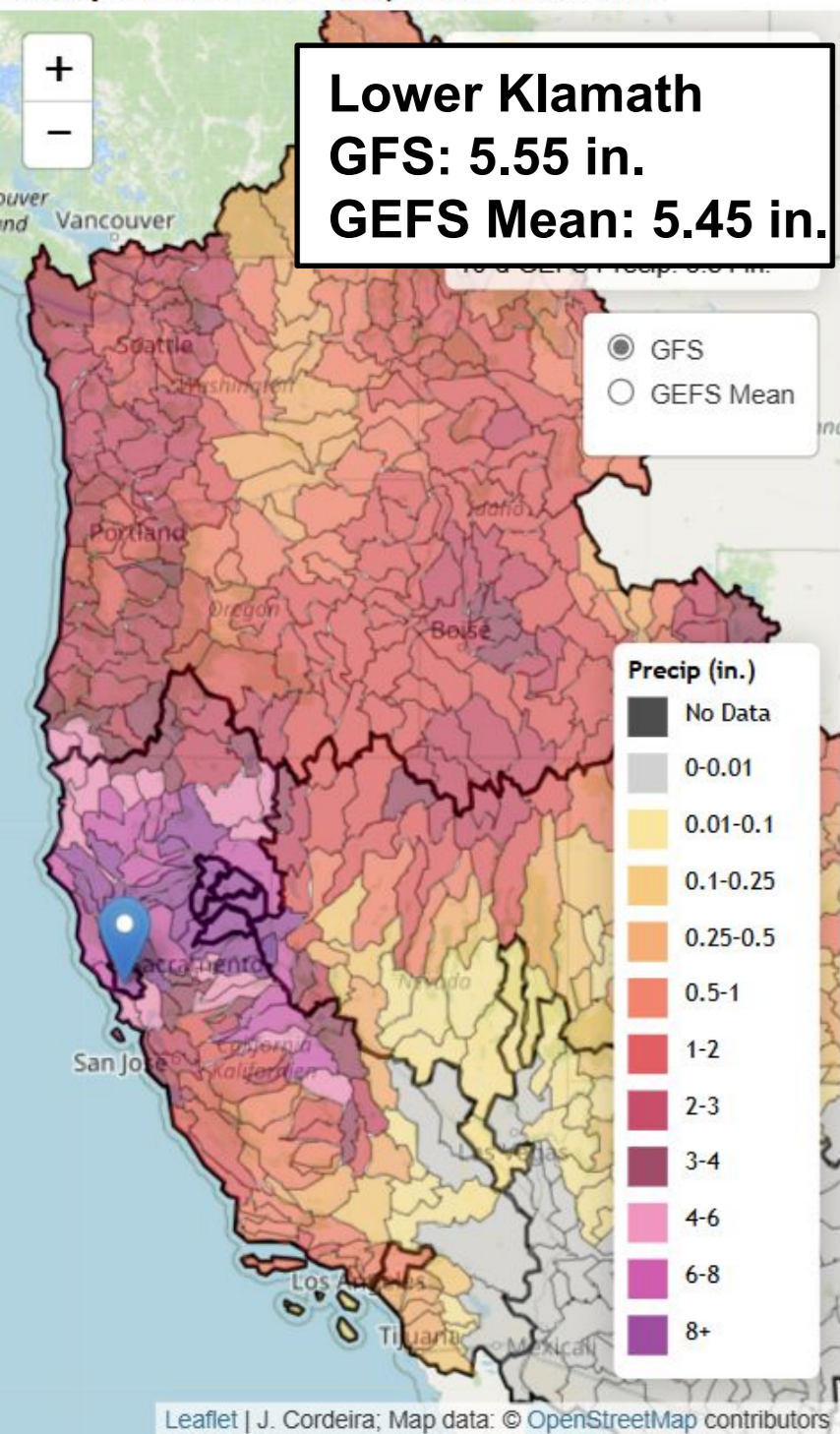


- All ensembles and models are forecasting at least 12 inches of precipitation in the Upper Yuba watershed over the next 10 days.
- 00Z GFS continues to forecast higher precipitation over the Sierra Nevada compared to the 00Z ECMWF.
- In the Upper Yuba, the GFS is forecasting 19.86 inches of precipitation, exceeding all other models/ensemble forecasts by 2–4+ inches.
- >50% of GEFS and ~40% of EPS members are forecasting 10-day precipitation totals to exceed **20% of normal annual precipitation** over this watershed.

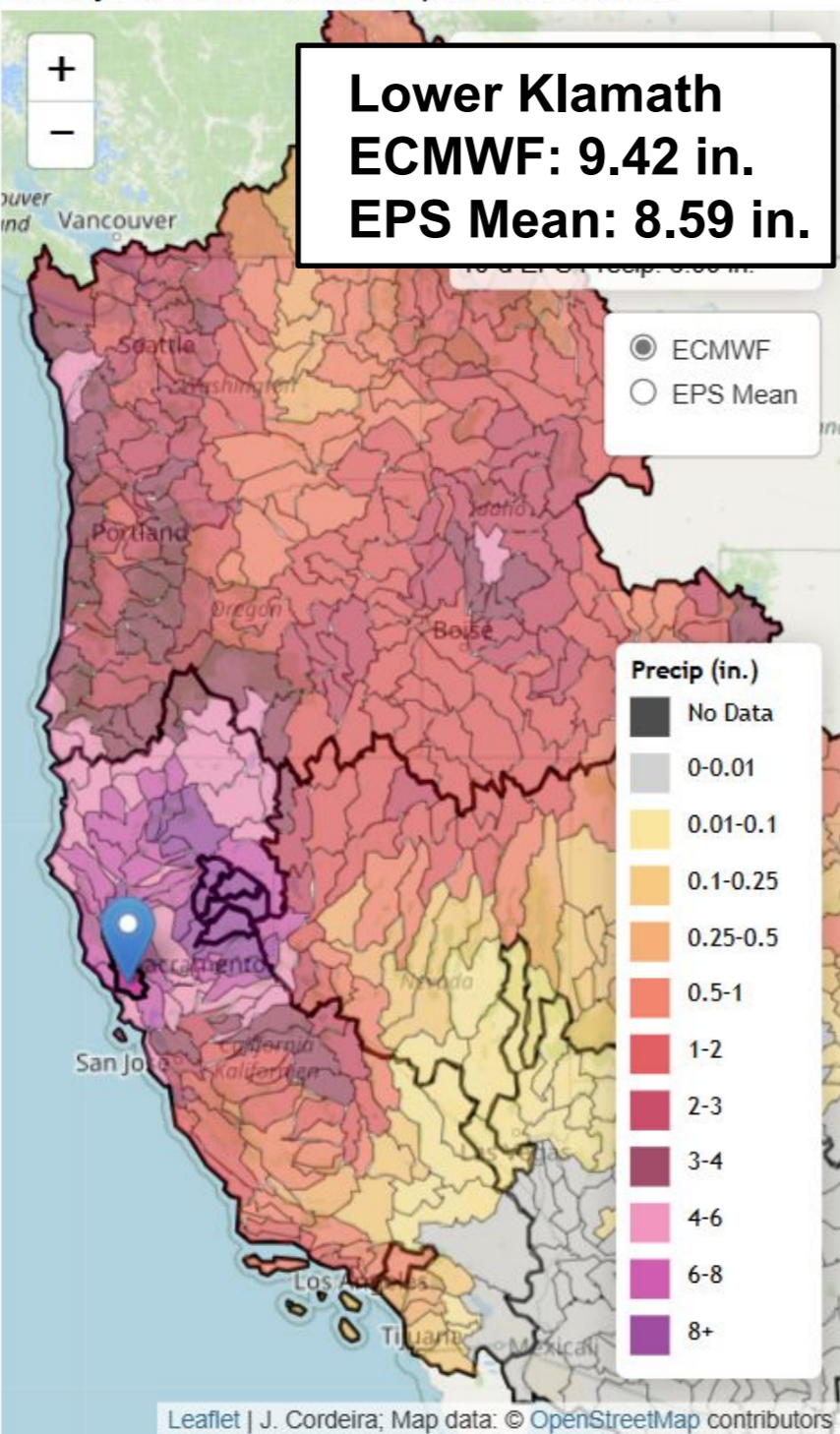
# AR Outlook: 31 January 2025

## Watershed Precipitation Forecasts - Lower Klamath

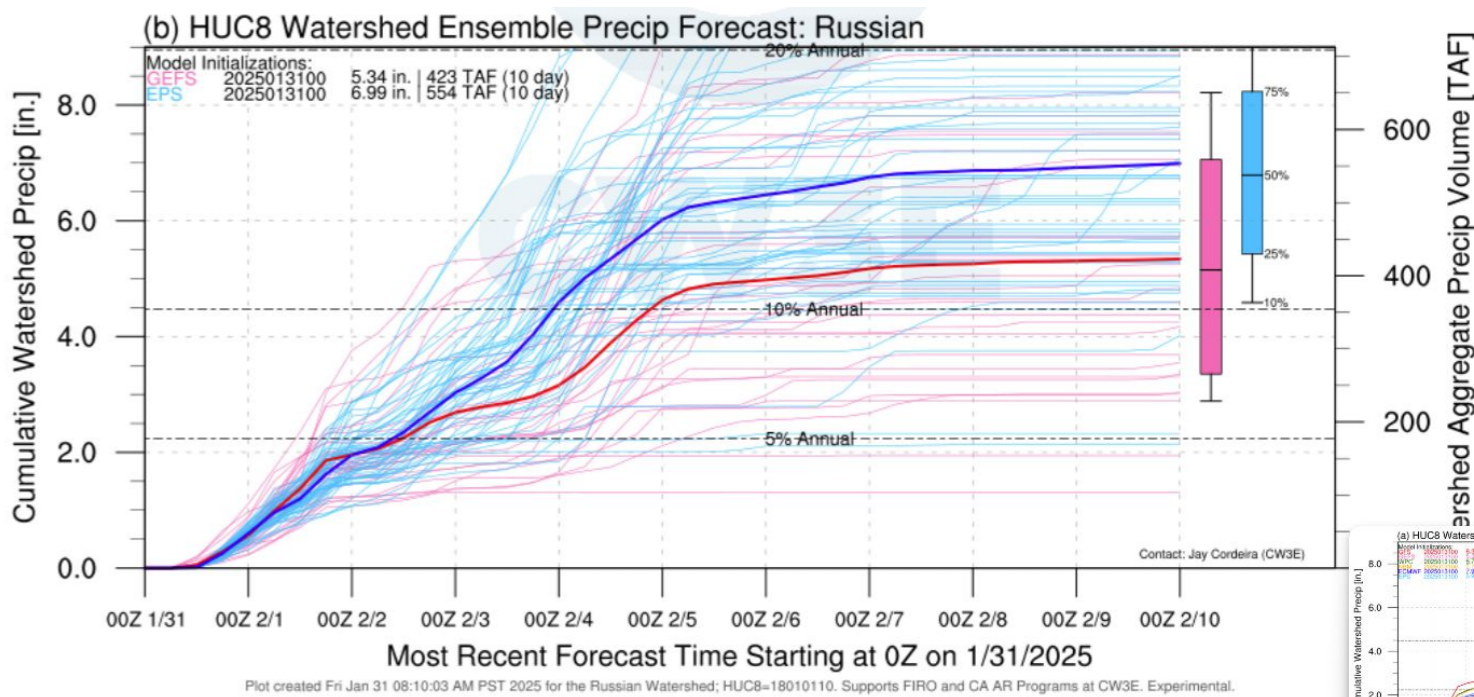
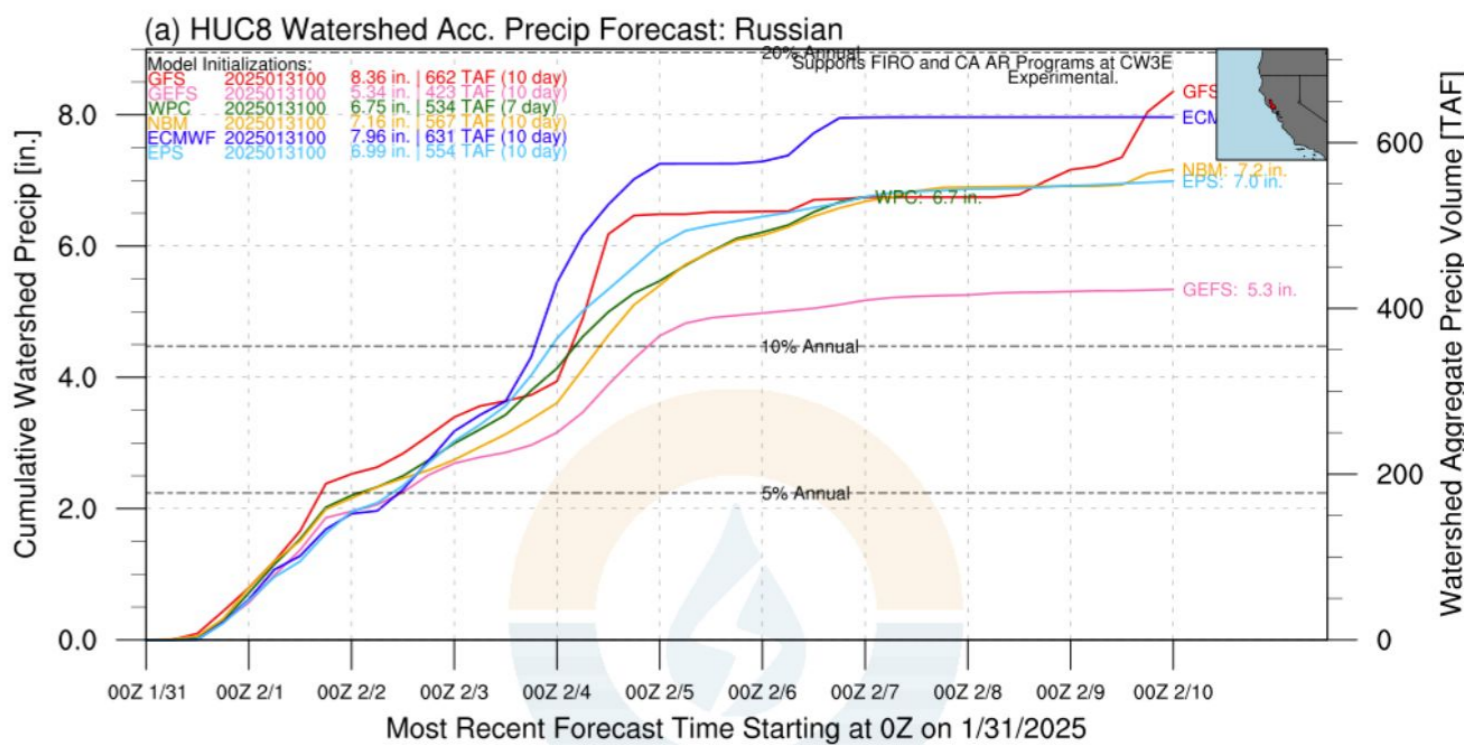
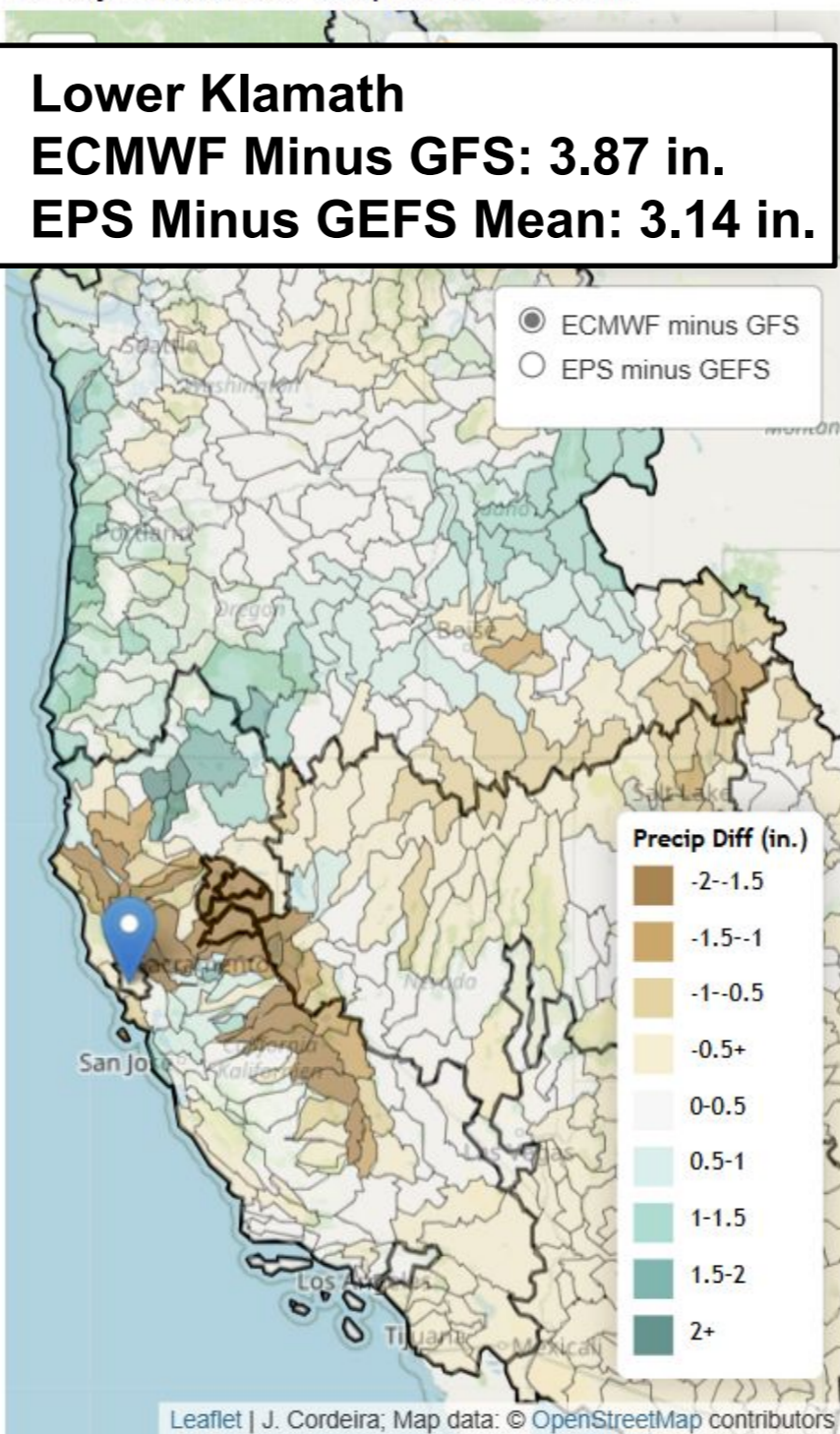
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EFS Precipitation Forecast



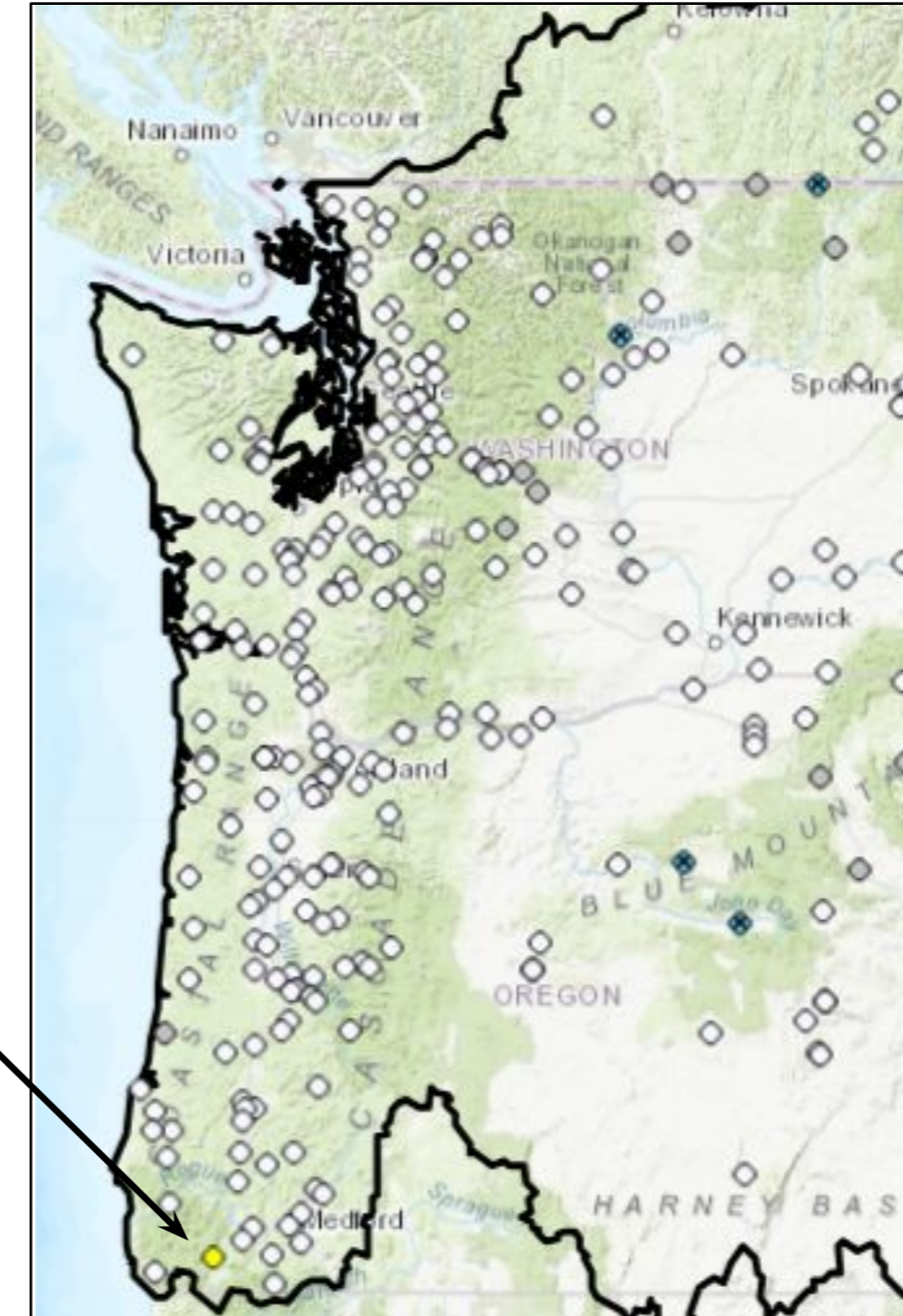
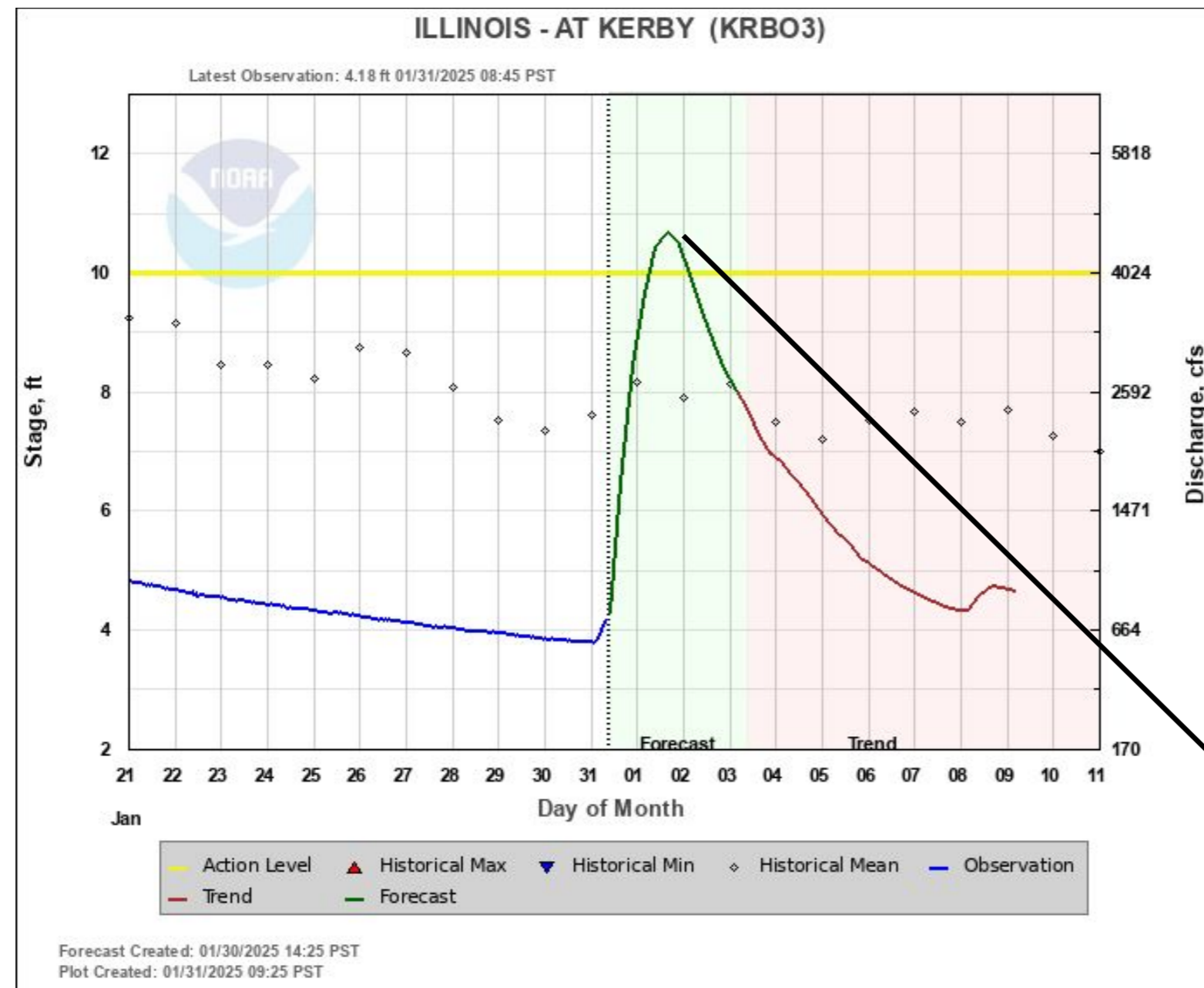
10-day Difference Precipitation Forecast



- GFS and GEFS coastal precipitation forecasts have increased and now exceed that of the ECMWF.
- The GFS, ECMWF, GEFS and EPS are all forecasting at least 10% of normal annual watershed precipitation over the Russian River watershed in the next 10 days.
- The GEFS and EPS both have large ensemble spread, with some members forecasting greater than 10 inches and some less than 3 inches.

# AR Outlook: 31 January 2025

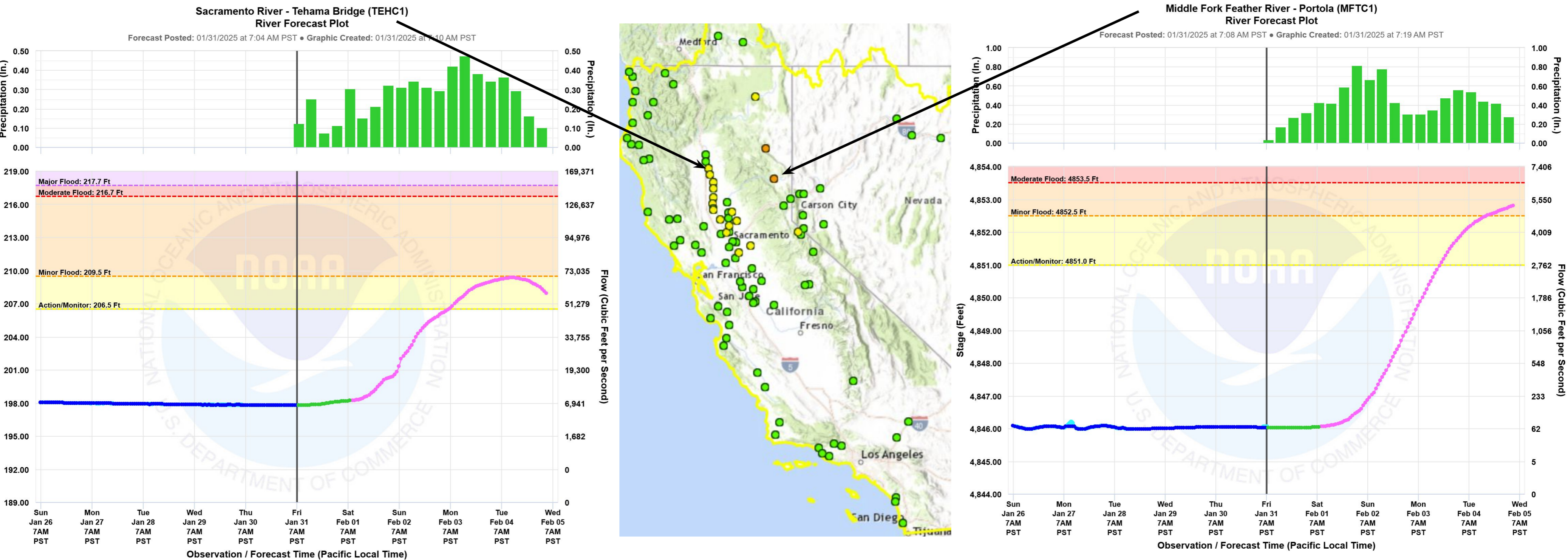
## Hydrologic Forecasts: Pacific Northwest



- Heavy precipitation over the region from these two moisture pulses is forecast to cause stream level rises across the Pacific Northwest. However, given stream levels are currently low, these large stream rises are not forecast to exceed flood levels at any station.
- One stream gage is currently forecast to exceed action/bankfull stage in southwestern Oregon (e.g., Illinois River at Kerby, left)

# AR Outlook: 31 January 2025

## Hydrologic Forecasts: California

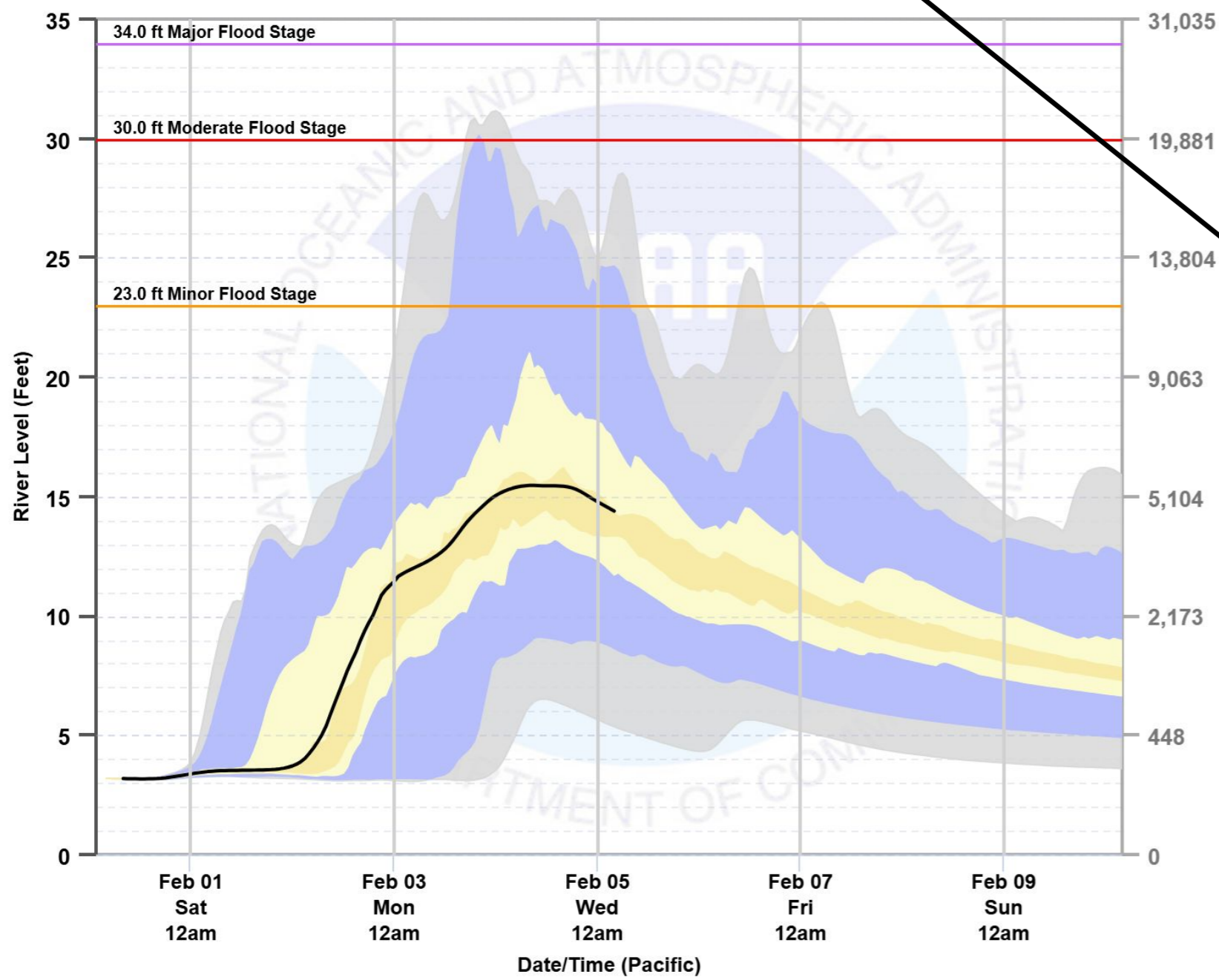


- The NWS California-Nevada River Forecast Center is forecasting two stations to rise above minor flood stage (e.g., Middle Fork Feather River at Portola (right)) and 17 stations above action/bankfull stage (e.g., Sacramento River at Tehama Bridge (left)) over the next five days with the precipitation from the two moisture pulses.

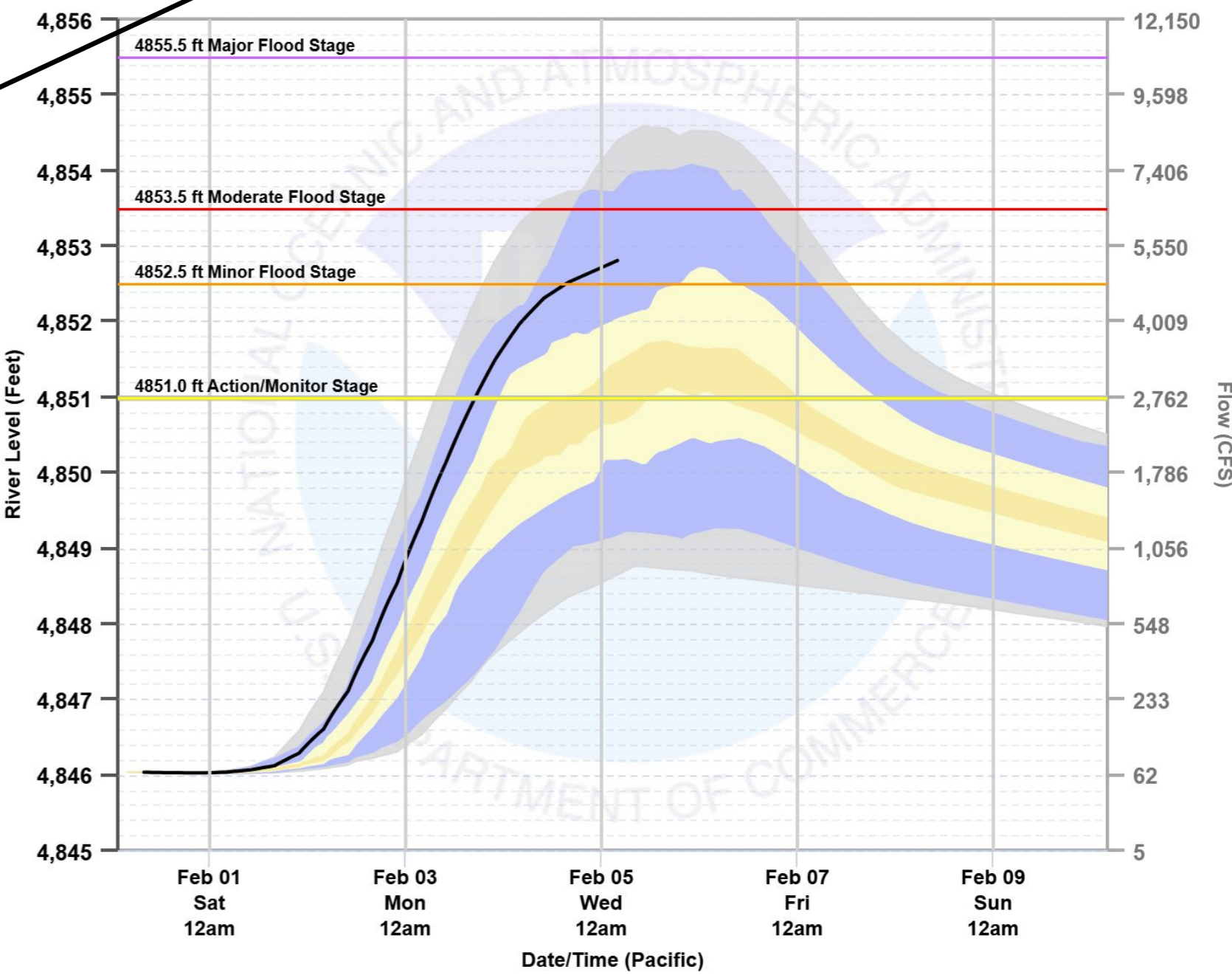
# AR Outlook: 31 January 2025

## Hydrologic Forecasts: California

Hourly Peak River Level Probabilities  
NAVARRO RIVER - NAVARRO (NVR1)  
Created: 01/31/2025 at 8:18 AM PST

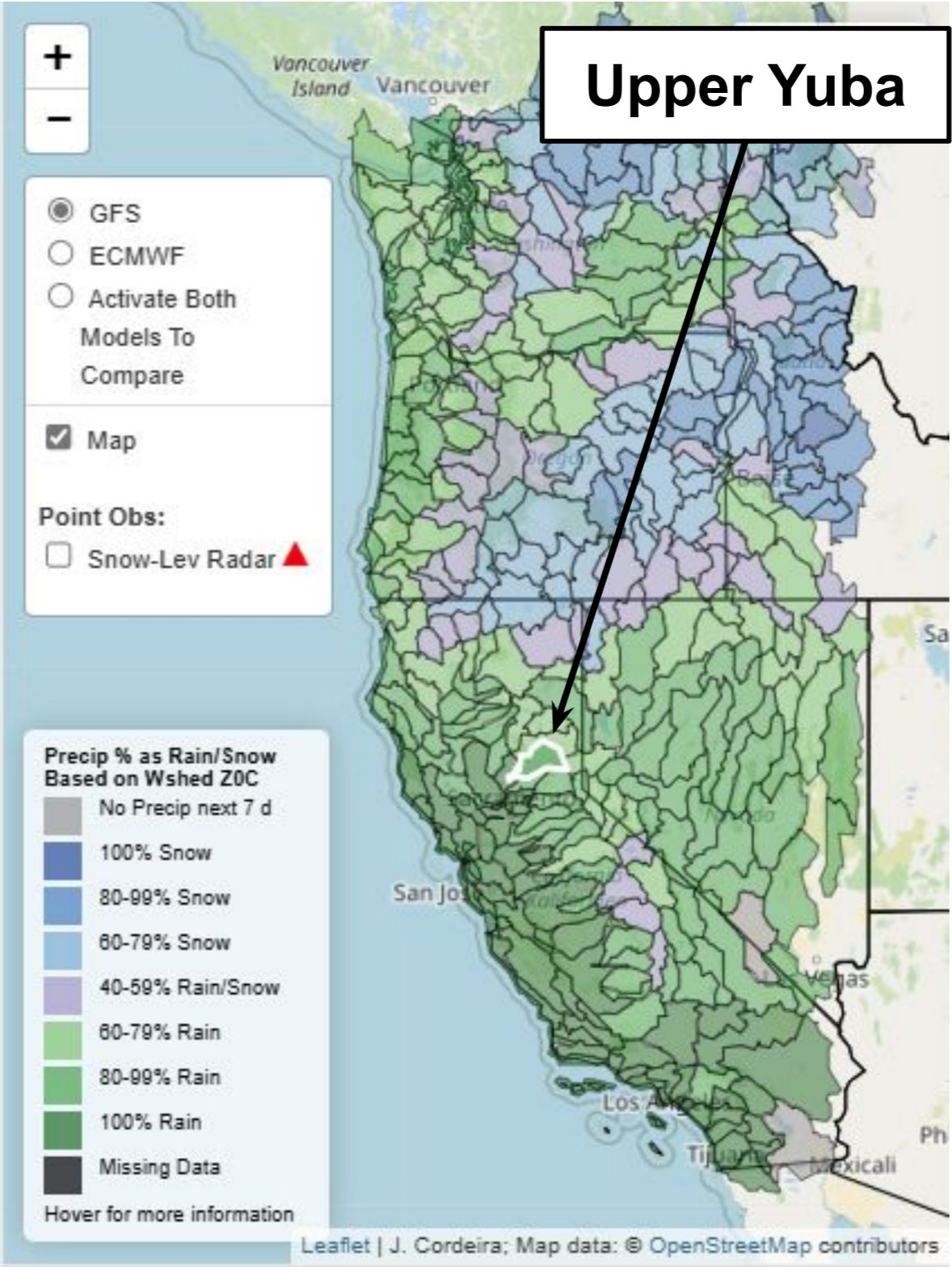
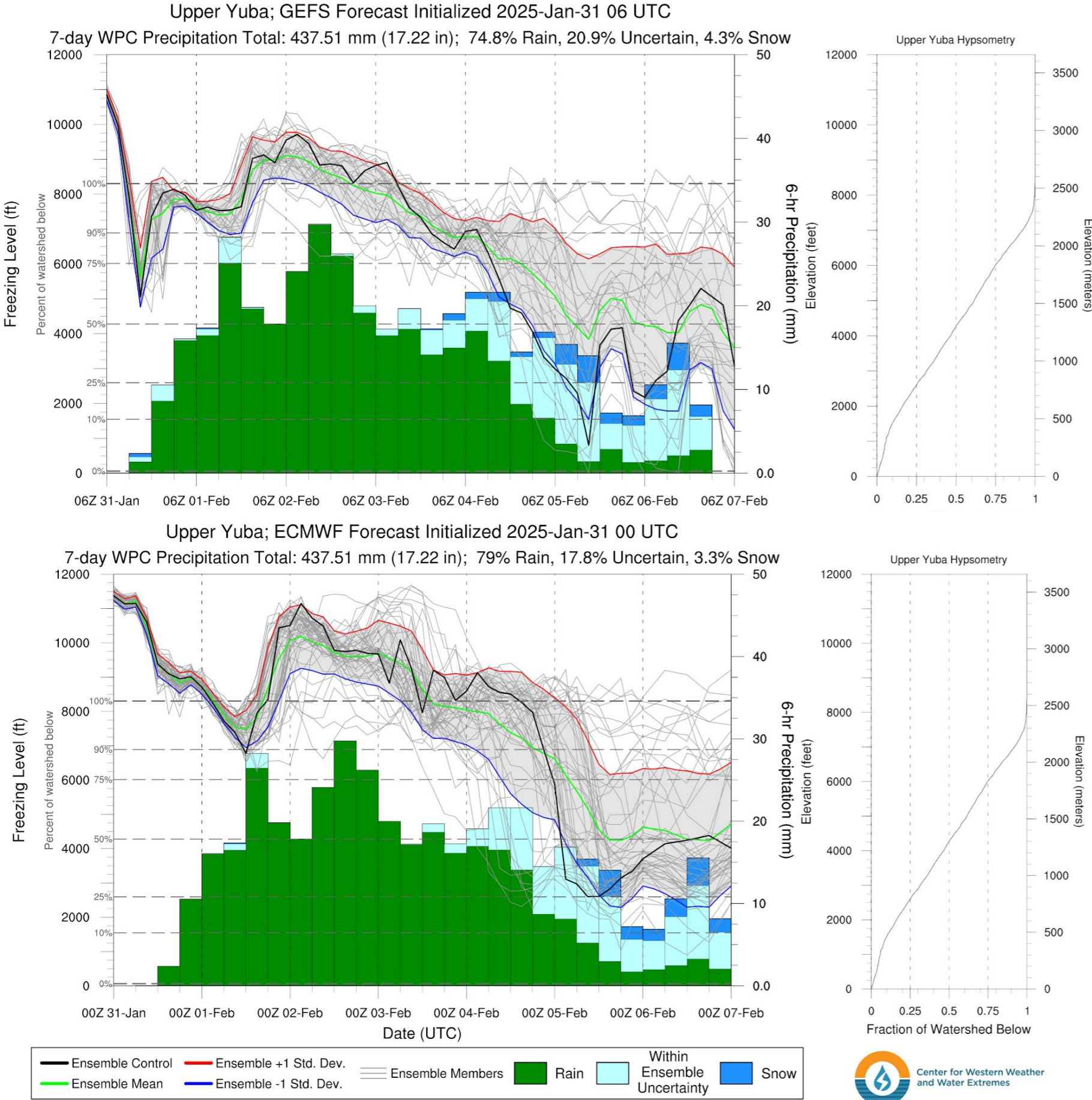


Hourly Peak River Level Probabilities  
MIDDLE FORK FEATHER RIVER - PORTOLA (MFTC1)  
Created: 01/31/2025 at 7:39 AM PST



- The NWS California-Nevada River Forecast Center 10-day ensemble forecast for 25% exceedance probability show seven stations with the potential to exceed minor flood stage (e.g., Navarro River at Navarro (left) and Middle Fork Feather River at Portola (right)) and 18 stations with the potential to exceed action/bankfull stage.

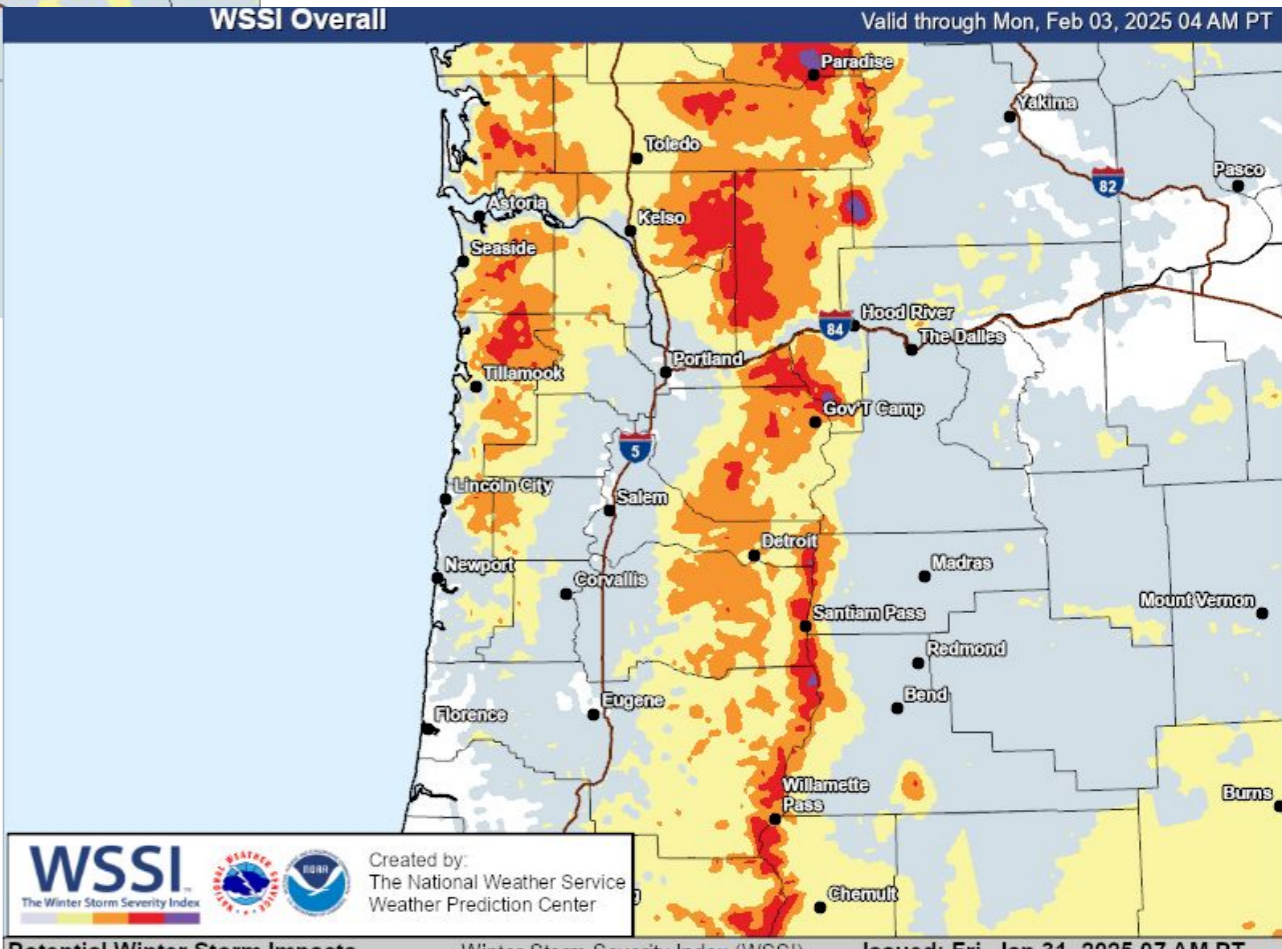
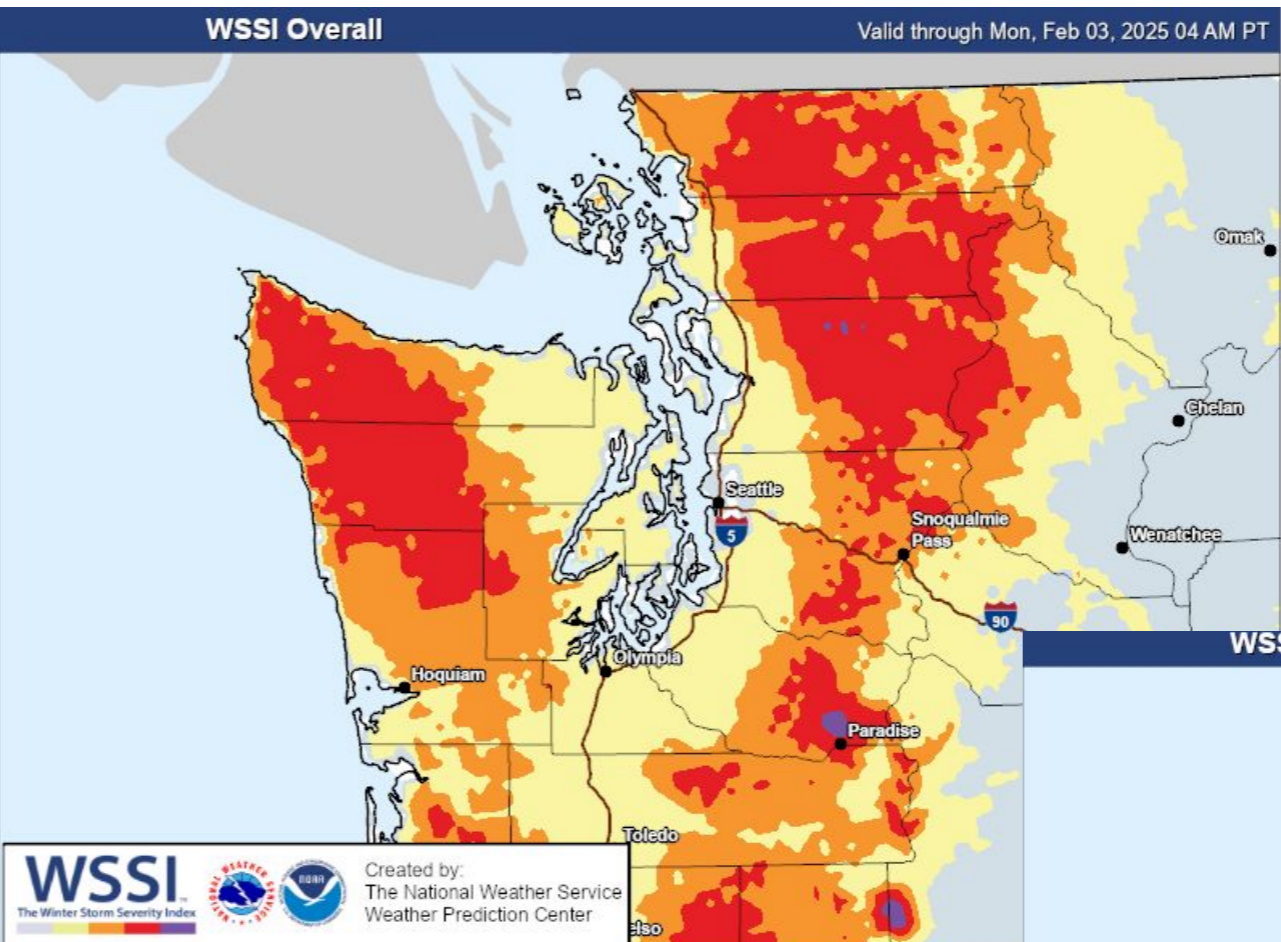
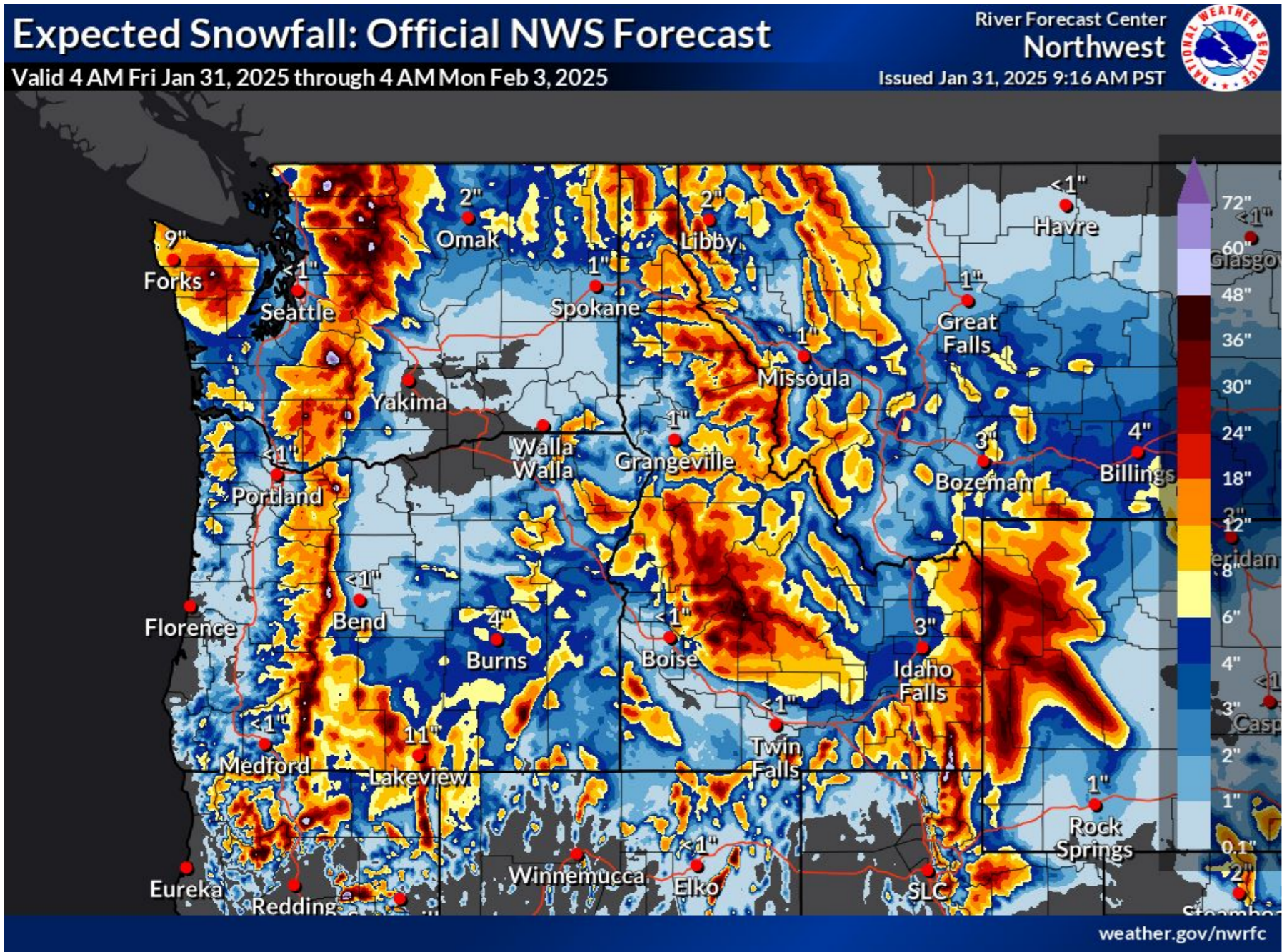
## Watershed Freezing Level Forecast Comparison



- Freezing levels are forecast to remain high through 3 Feb before potentially dropping below 6,000 feet starting 4 Feb.
- There is some uncertainty in the freezing levels forecast over the Upper Yuba watershed.
- While the GEFS and EPS are more similar than recent forecasts, the EPS forecasts the freezing levels to end up lower over the watershed than the GEFS.
- Lower freezing levels over the Upper Yuba later in the period results in greater uncertainty in precipitation type.

# AR Outlook: 31 January 2025

## Winter Weather Hazards

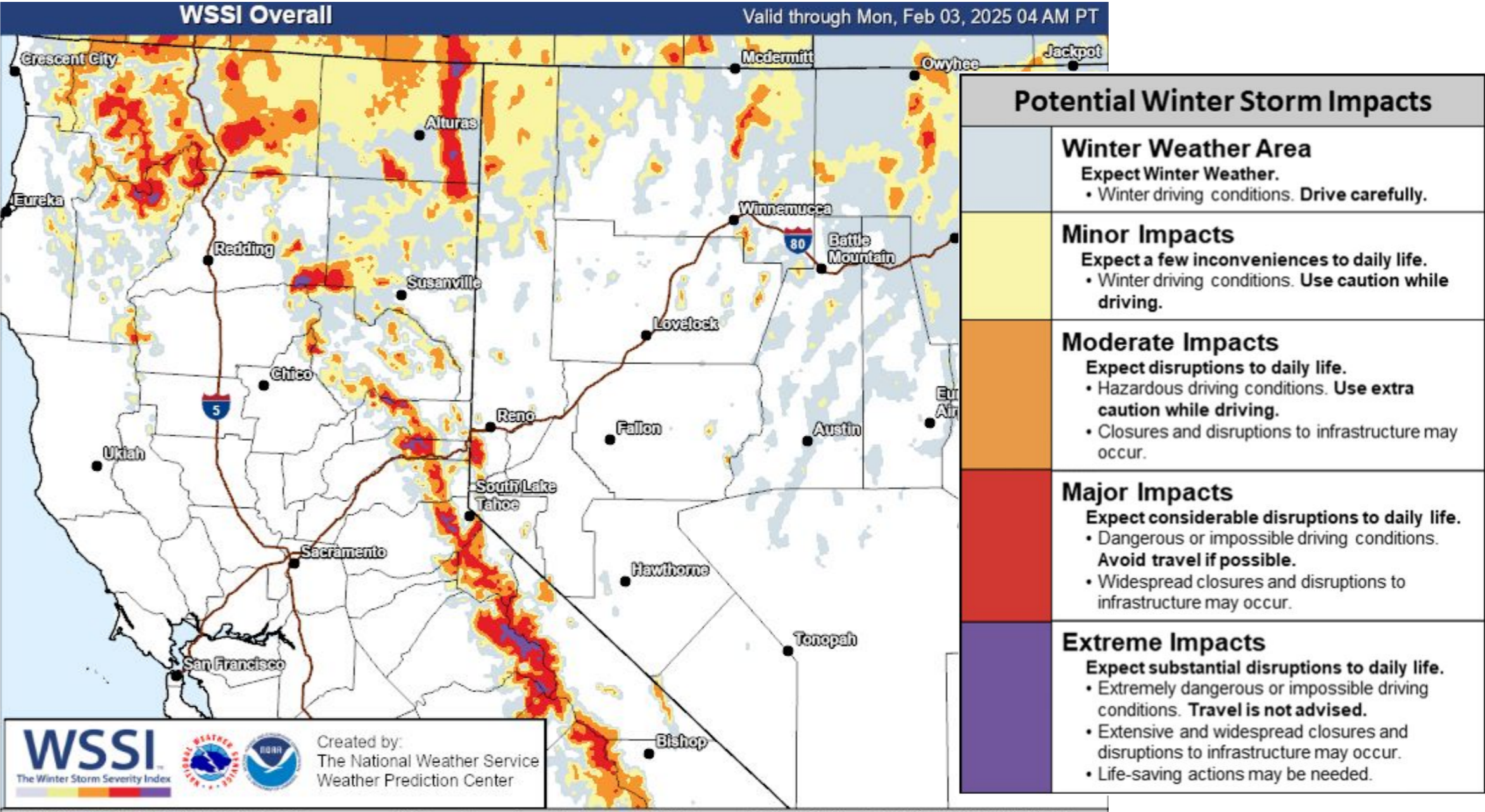
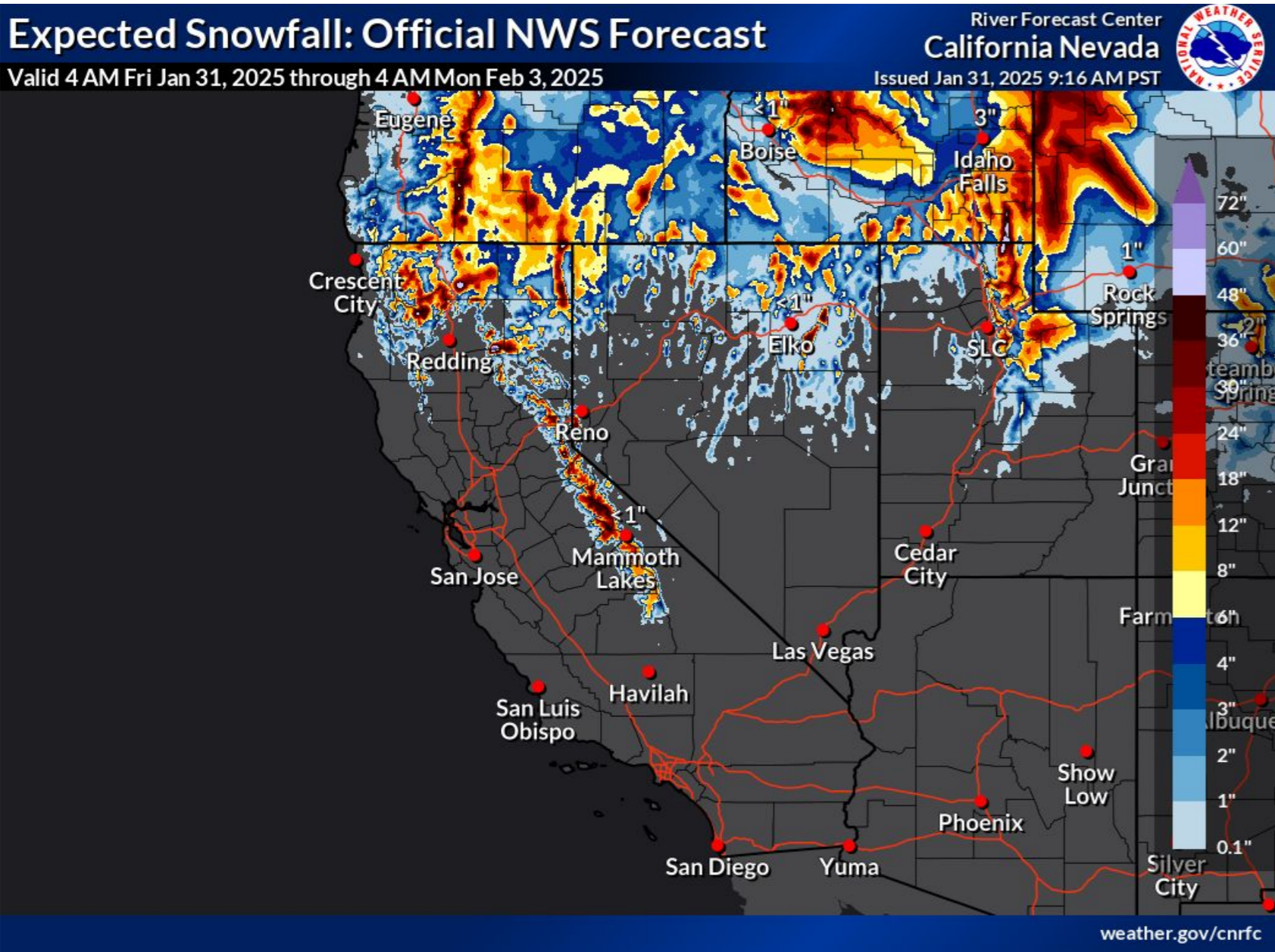


Potential Winter Storm Impacts	
<b>Winter Weather Area</b> Expect Winter Weather. • Winter driving conditions. Drive carefully.	
<b>Minor Impacts</b> Expect a few inconveniences to daily life. • Winter driving conditions. Use caution while driving.	
<b>Moderate Impacts</b> Expect disruptions to daily life. • Hazardous driving conditions. Use extra caution while driving. • Closures and disruptions to infrastructure may occur.	
<b>Major Impacts</b> Expect considerable disruptions to daily life. • Dangerous or impossible driving conditions. Avoid travel if possible. • Widespread closures and disruptions to infrastructure may occur.	
<b>Extreme Impacts</b> Expect substantial disruptions to daily life. • Extremely dangerous or impossible driving conditions. Travel is not advised. • Extensive and widespread closures and disruptions to infrastructure may occur. • Life-saving actions may be needed.	

- Snowfall accumulations of at least 8 inches are forecast across the Cascades and over the Olympic Peninsula with the highest elevations forecast to exceed 48 inches.
- WPC's Winter Storm Severity Index (WSSI) are showing major impacts forecast across the Cascades and Olympic Peninsula.



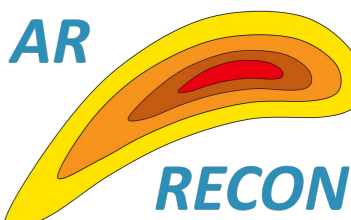
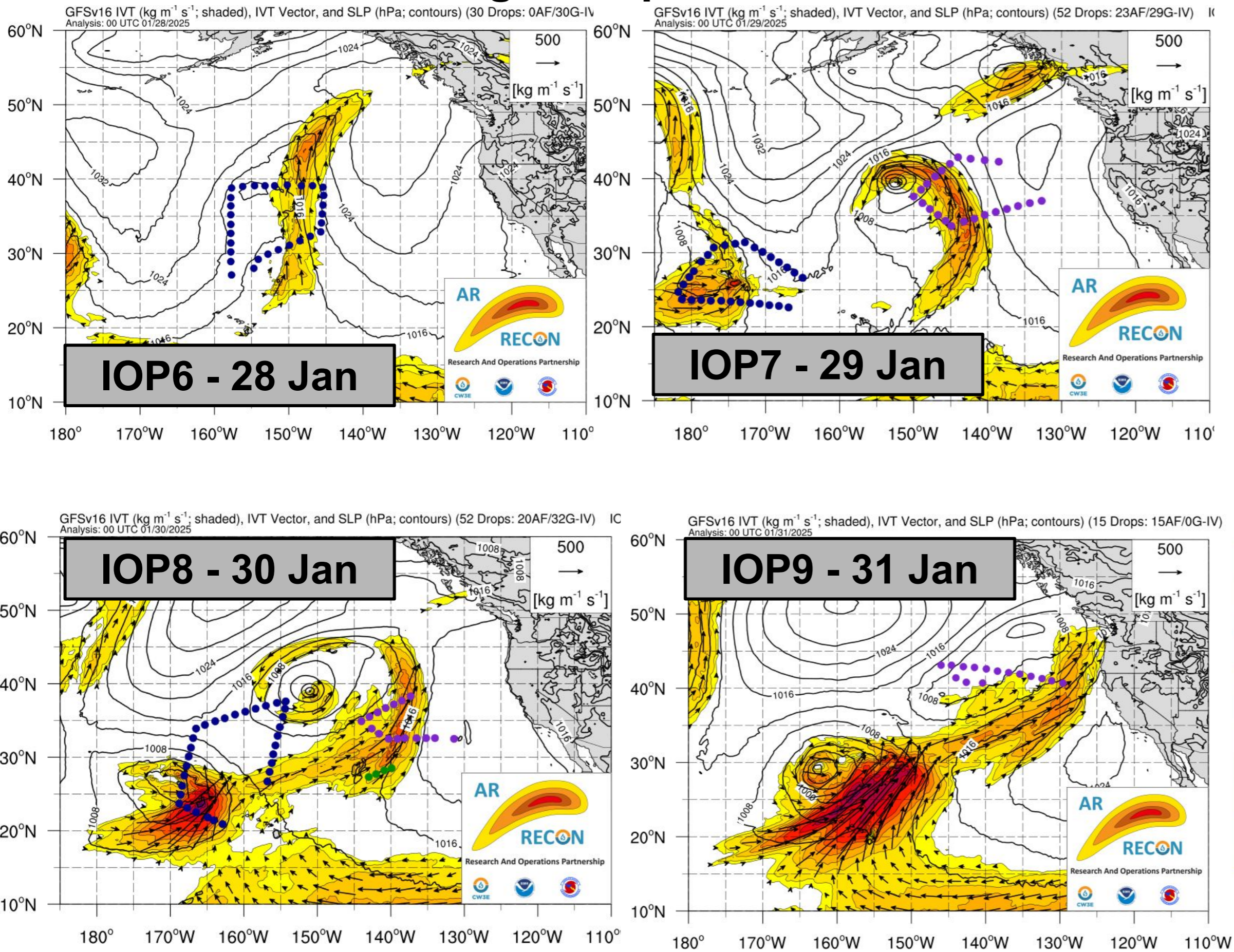
## Winter Weather Hazards



- Snowfall accumulations of 24-48 inches are expected over the Sierra Nevada and Klamath Mountains in the next three days
- WPC's Winter Storm Severity Index (WSSI) is showing major-to-extreme winter storm impacts across the Sierra Nevada and Klamath Mountains.

# AR Outlook: 31 January 2025

## Current AR Recon Flight Sequence



Research And Operations Partnership

- CW3E's AR Reconnaissance (AR Recon) field campaign continues in WY2025, with the most recent sequence of flights focusing on the development of the current AR storms.
- AR Recon completed 4 IOPs, departing from Sacramento, CA and Honolulu, HI to fly over and around ARs in the eastern N. Pacific; the team continues to meet and plan flights for this sequence
- These 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.