

# CW3E Atmospheric River Outlook: 3 January 2023

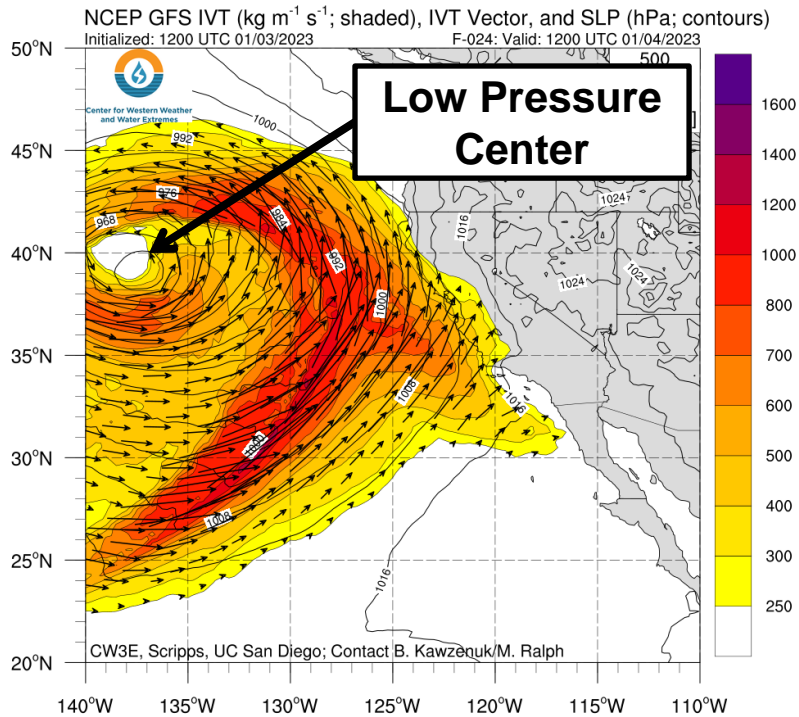
## Atmospheric River to Bring Significant Rainfall to Northern and Central California

- An atmospheric river in association with a strong low-pressure system over the North Pacific will bring significant precipitation to Northern California between Wednesday morning and Thursday afternoon
- IVT associated with this AR will exceed  $750 \text{ kg m}^{-1} \text{ s}^{-1}$  along the coast of Northern California, making this an AR 3 based on the Ralph et al. 2019 AR Scale
- This AR will be the first of three landfalling ARs over the next 7 days, with the following two ARs also forecast to impact Northern and Central California with additional precipitation over the weekend and into early next week
- The NWS Weather Prediction Center (WPC) has forecast 7-day precipitation totals to exceed 15 inches along the coast of Central California and the Northern Sierra Nevada
- NWS WPC has issued a moderate risk for excessive rainfall with the potential for flash flooding along much of coastal California over the coming days, highlighting the enhanced risk due to saturated antecedent soil conditions
- Precipitation forecasts over the next 7 days for watersheds in northern California and the Northern Sierra are between 6–8 inches, with the ECMWF forecasting higher precipitation totals along the coast and less in the Sierra Nevada compared to the GFS
- NWS Weather Forecast Offices have begun issuing watches and warnings for flood, high wind, and winter weather hazards in association with this AR.
- The NWS California Nevada River Forecast Center (CNRFC) has forecast multiple rivers to exceed flood stage in association with the precipitation from this AR
- **Stay alert to official NWS forecasts, watches, and warnings at [weather.gov](https://www.weather.gov) and follow guidance from local emergency management officials**

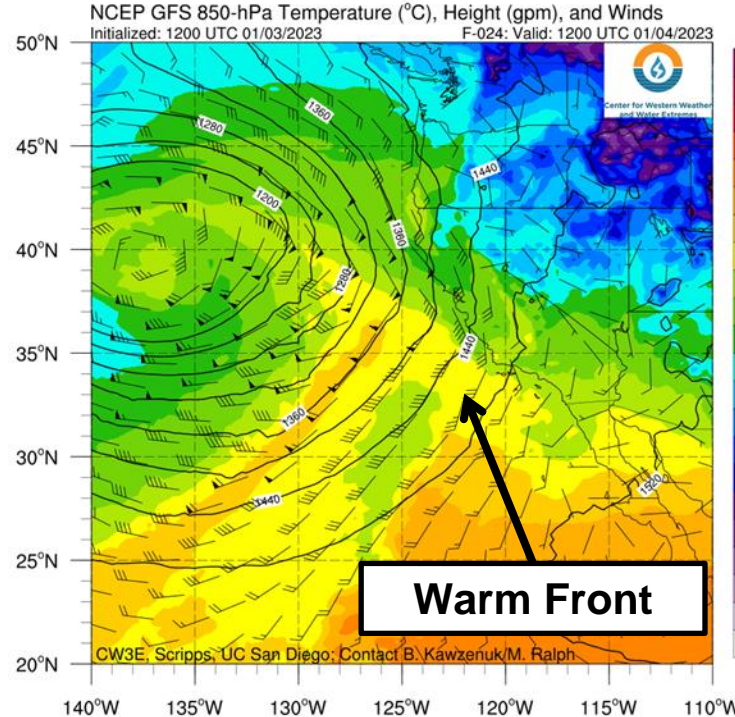
# CW3E AR Outlook: 3 January 2023

## GFS Model Forecast: Valid 4 AM PST 4 Jan (F-24)

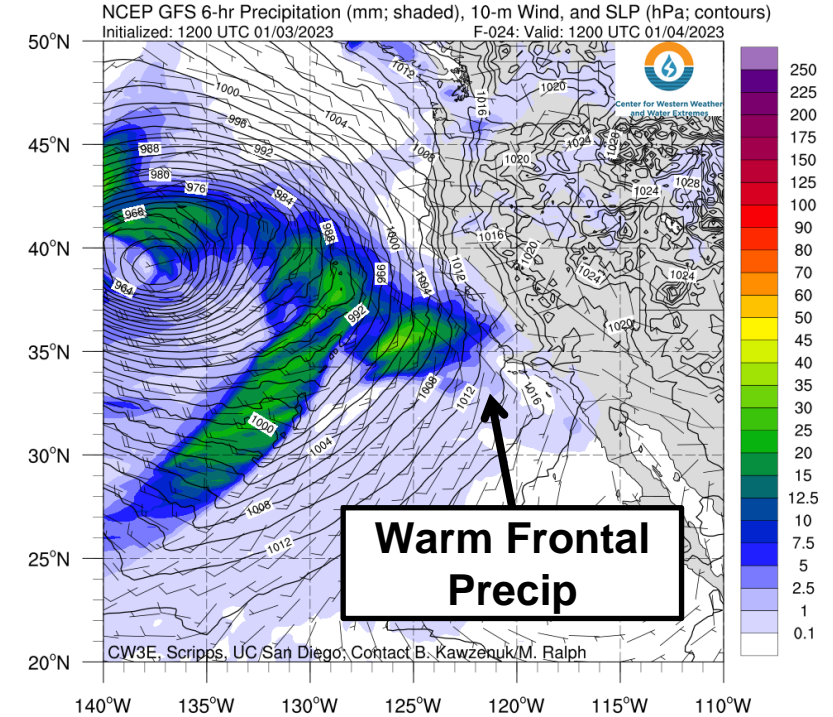
### 500-hPa Vorticity, Height, and Wind



### IWV, SLP, and 850-hPa Wind



### IVT and SLP

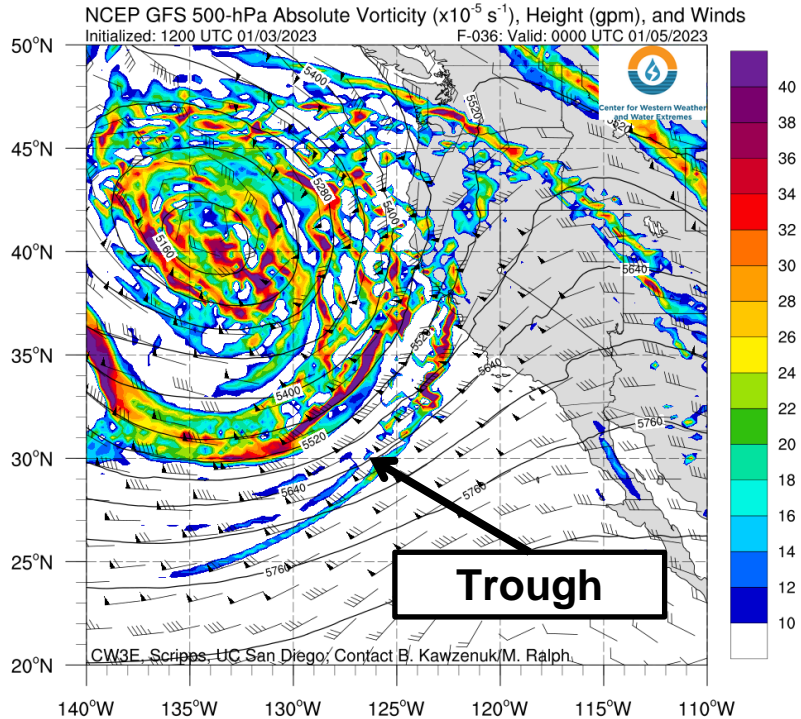


- A strong low-pressure system is forecast to develop offshore over the next 24 hours and approach the US West Coast tonight, bringing with it a strong, narrow corridor of IVT  $> 700 \text{ kg m}^{-1} \text{ s}^{-1}$  of IVT
- A warm front associated with the low-pressure system will move onshore along the US West Coast on Wednesday morning, bringing with it an initial period of precipitation to Central and Northern California

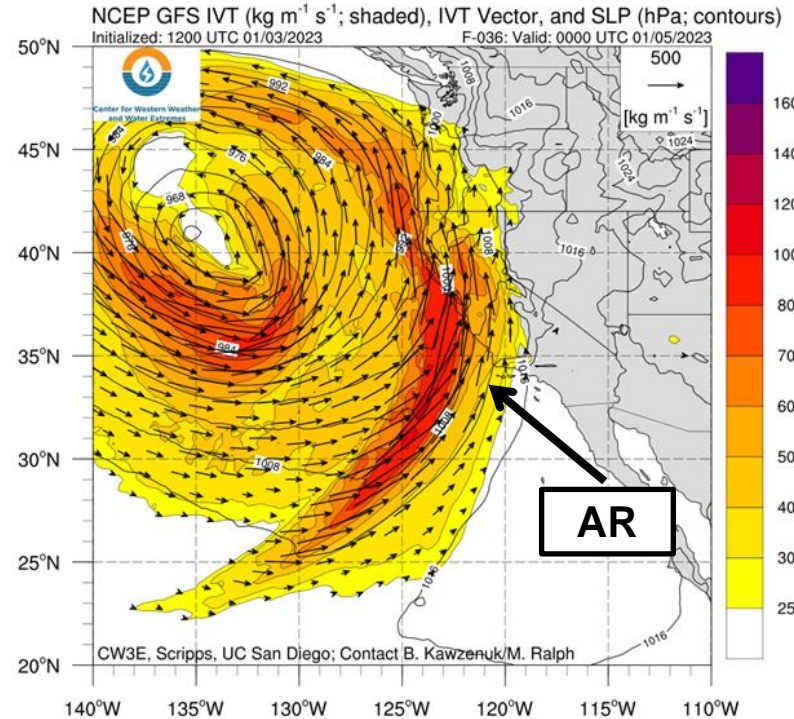
# CW3E AR Outlook: 3 January 2023

## GFS Model Forecast: Valid 4 PM PST 4 Jan (F-36)

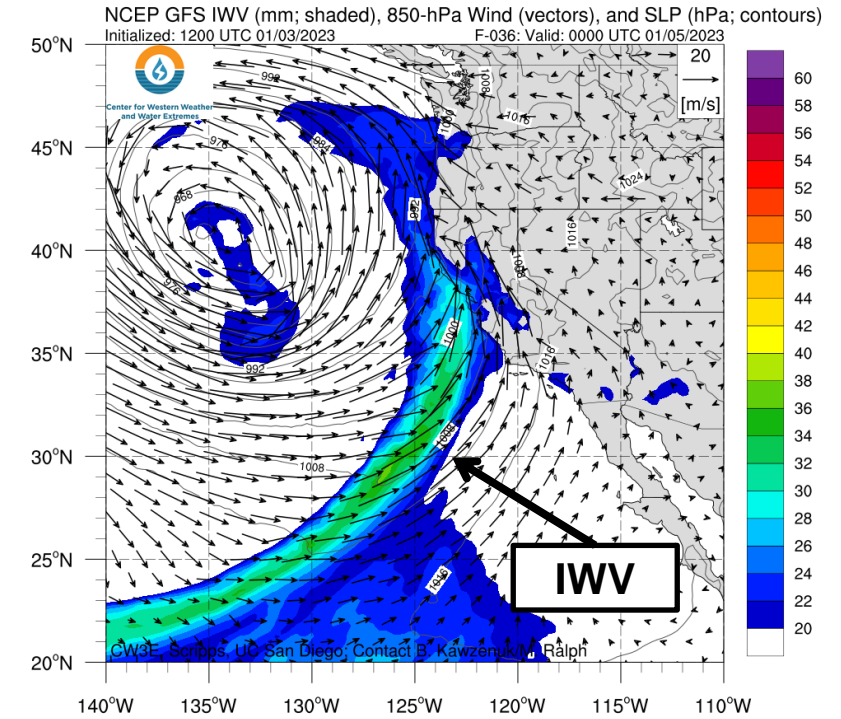
### 500-hPa Vorticity, Height, and Wind



### IWV, SLP, and 850-hPa Wind



### IVT and SLP

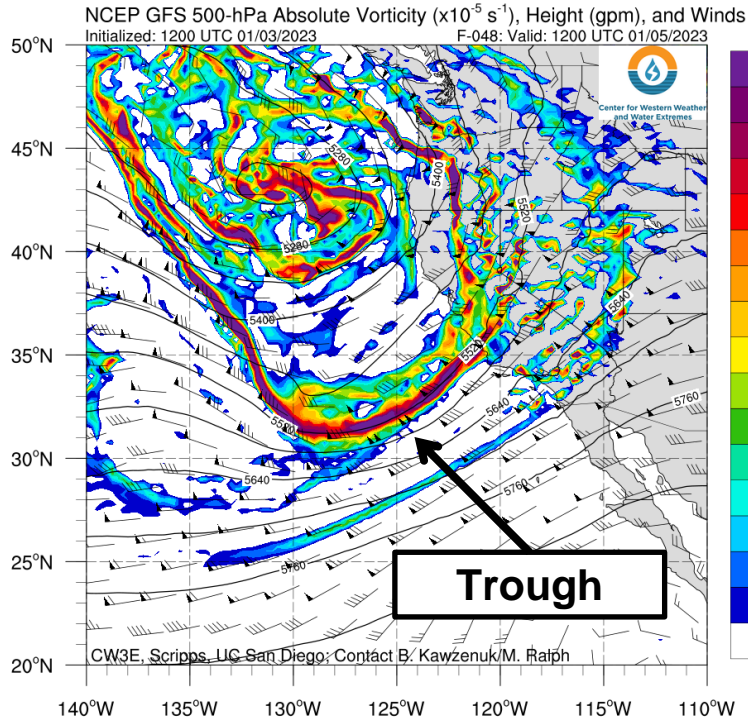


- As the mid-level trough and low-pressure system moves to the east on Wednesday afternoon, an associated AR will make landfall in Northern California, with  $> 800 \text{ kg m}^{-1} \text{ s}^{-1}$  of IVT in the core of the plume
- The narrow corridor of enhanced IVT is associated with a narrow plume of moist air extending from the subtropics, with embedded IWV values  $> 30 \text{ mm}$  reaching the US West Coast

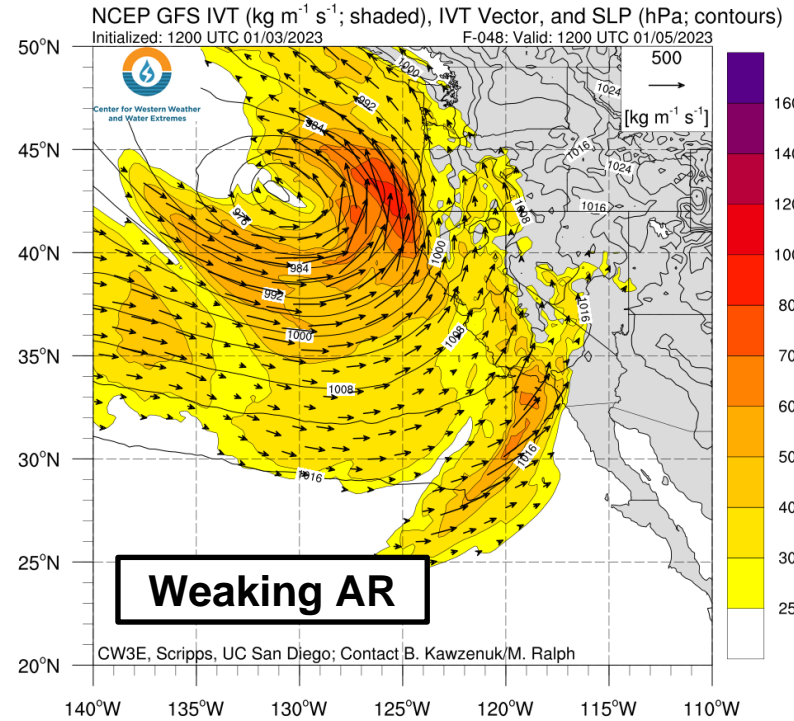
# CW3E AR Outlook: 3 January 2023

## GFS Model Forecast: Valid 4 AM PST 5 Jan (F-48)

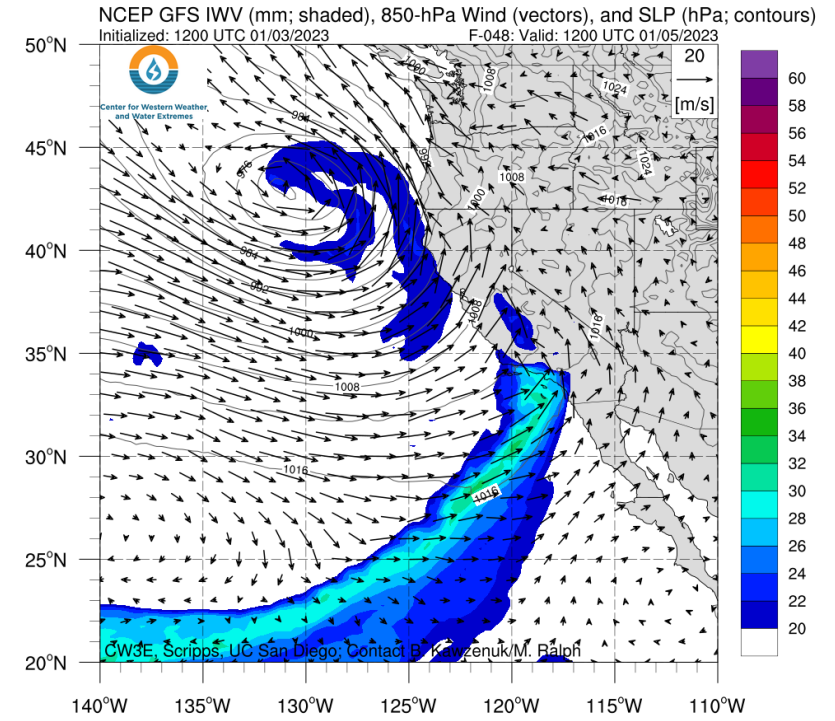
### 500-hPa Vorticity, Height, and Wind



### IWV, SLP, and 850-hPa Wind



### IVT and SLP

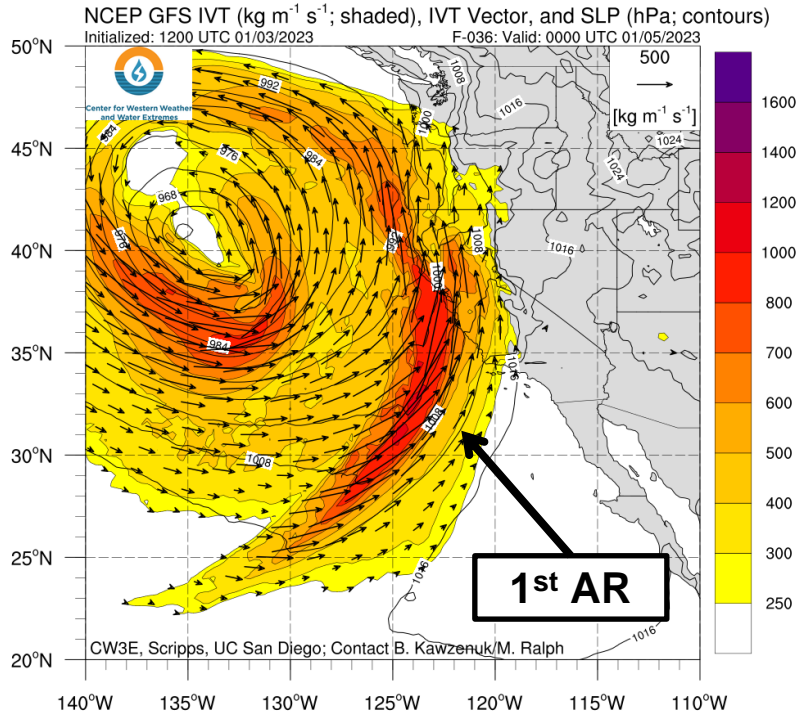


- As the trough moves closer to the US West Coast early Thursday morning, the AR will weaken along the coast
- The primary plume of  $> 500 \text{ kg m}^{-1} \text{ s}^{-1}$  of IVT will shift south along the coast of California, along with the primary corridor of moisture  $> 30 \text{ mm}$  of IWV

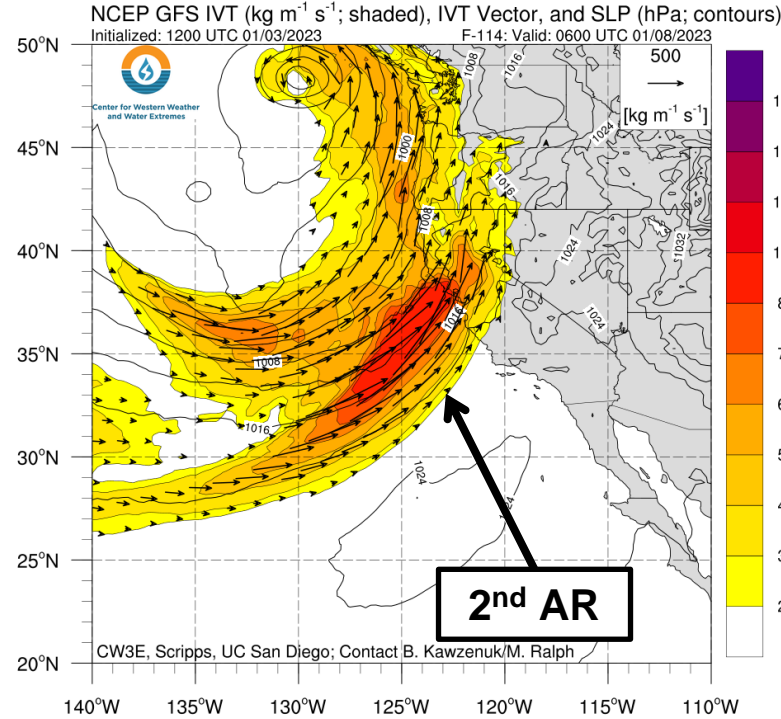
# CW3E AR Outlook: 3 January 2023

## Potential Sequence of ARs – GFS IVT & SLP

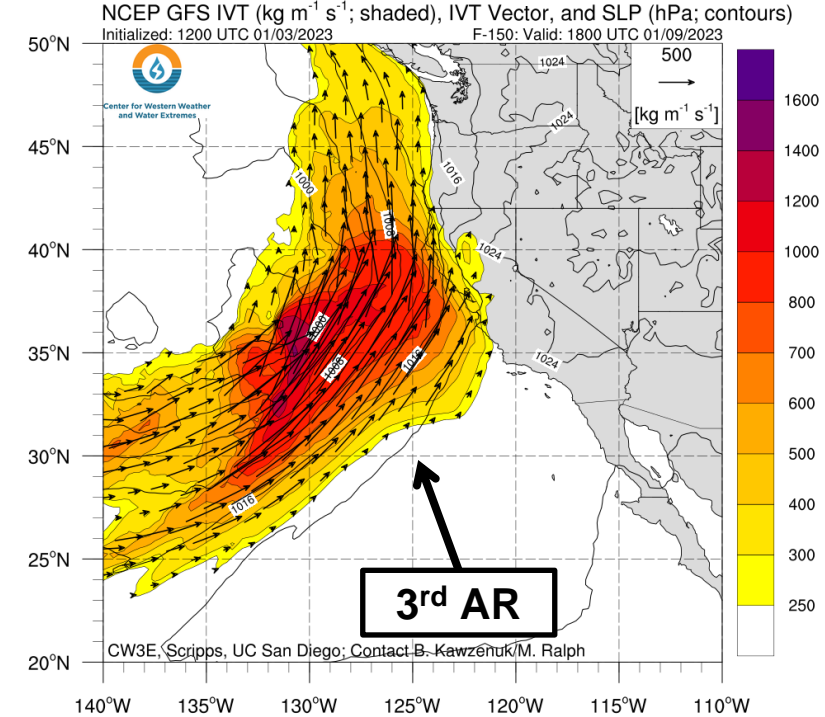
Valid: 4 PM PST 4 Jan



Valid: 10 PM PST 7 Jan



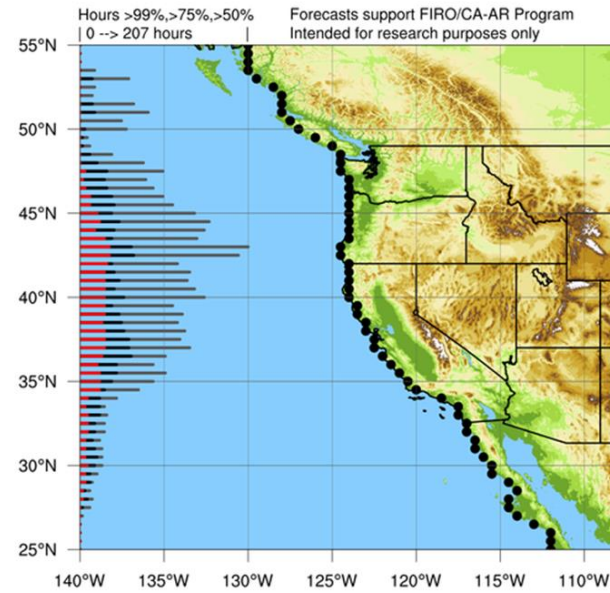
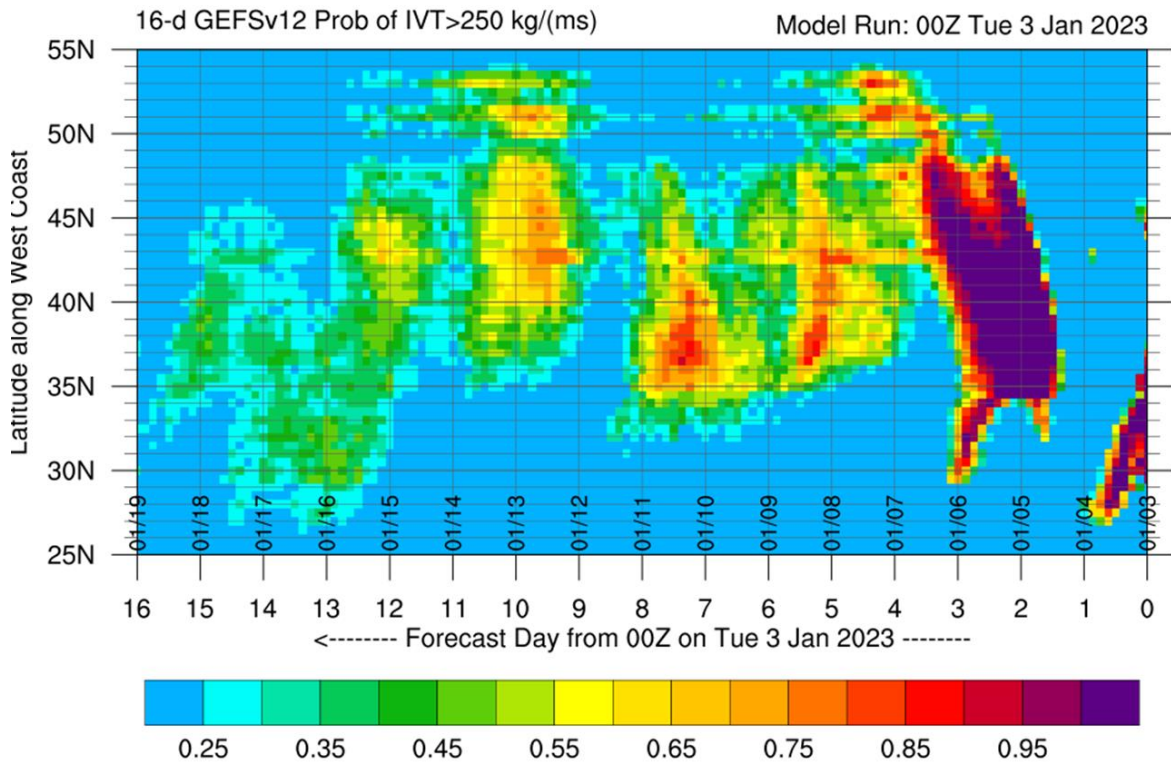
Valid: 10 AM PST 9 Jan



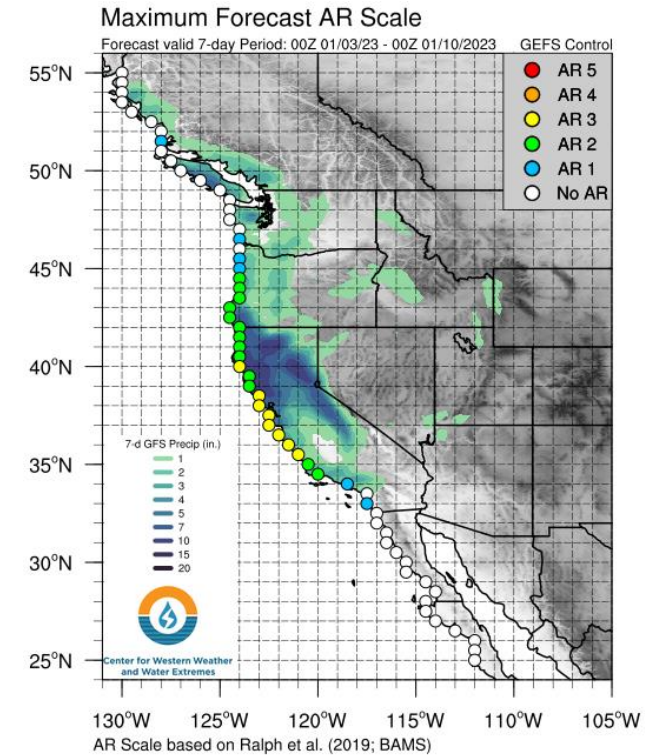
- This AR is the first of a series of 3 successive ARs forecast to make landfall along the US West Coast over the next 7 days
- The second AR with IVT  $> 500 \text{ kg m}^{-1} \text{ s}^{-1}$  is forecast to make landfall between 7–8 Jan in Northern California
- A third, stronger AR with IVT  $> 750 \text{ kg m}^{-1} \text{ s}^{-1}$  is also forecast to make landfall between 10–11 Jan along coastal California

# CW3E AR Outlook: 3 January 2023

## Probability of AR Conditions Along Coast (GEFS)



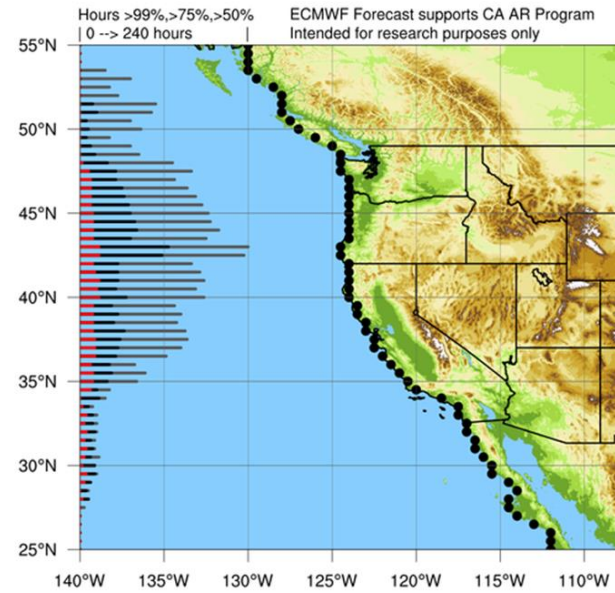
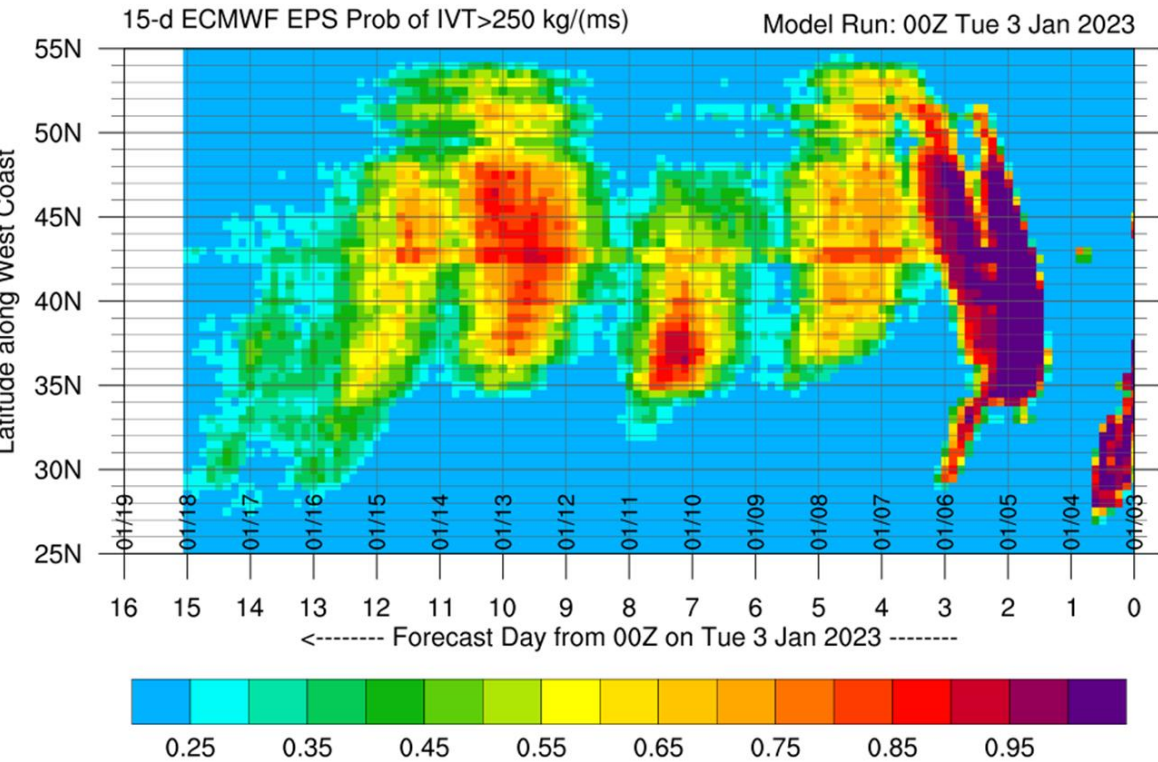
## AR Scale



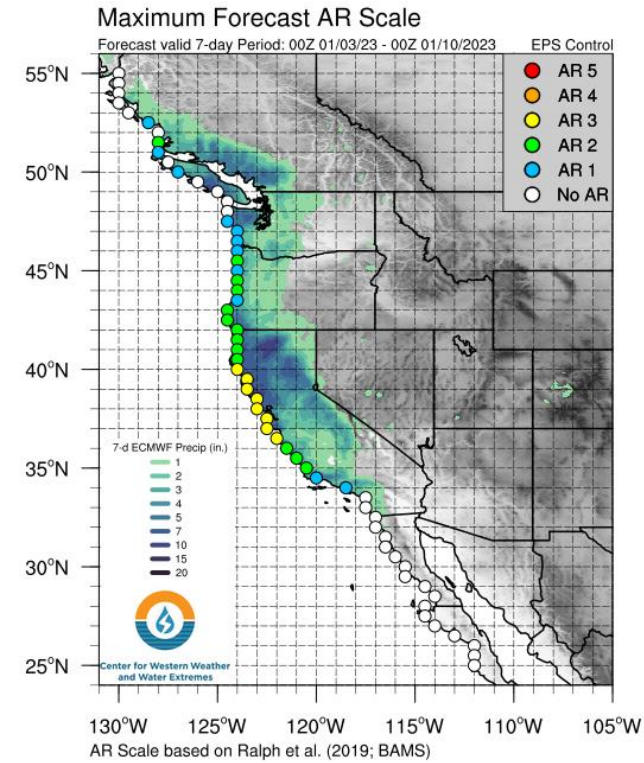
- The 00Z GEFS is showing high confidence (> 95%) in a period of AR conditions ( $IVT > 250 \text{ kg m}^{-1} \text{ s}^{-1}$ ) along the coast of Oregon, Northern, and Central California between 4 and 6 January in association with the first AR landfall
- Model confidence is slightly lower (60%–80%) for two periods of AR conditions ( $IVT > 250 \text{ kg m}^{-1} \text{ s}^{-1}$ ) between 7 Jan–11 Jan for locations along the coast of Central California
- The GEFS ensemble control member is forecasting AR 3 conditions over coastal Northern and Central California

# CW3E AR Outlook: 3 January 2023

## Probability of AR Conditions Along Coast (ECMWF EPS)



## AR Scale



- The 00Z ECMWF EPS is showing high confidence ( $> 95\%$ ) in a slightly shorter period of AR conditions ( $IVT > 250 \text{ kg m}^{-1} \text{ s}^{-1}$ ) along the coast of Oregon, Northern, and Central California between 4 and 6 January in association with the first AR landfall
- ECMWF EPS model confidence is slightly lower (60%–80%) in a sequence of 3 successive ARs making landfall between 00 Z 7 Jan–00 Z 15 Jan along the US West Coast between Oregon and Northern California
- The ECMWF EPS ensemble control member is forecasting AR 3 conditions over much of coastal Northern and Central California

# CW3E AR Outlook: 3 January 2023

## 7-day AR Scale and IVT Forecast: GFS & ECMWF Ensemble

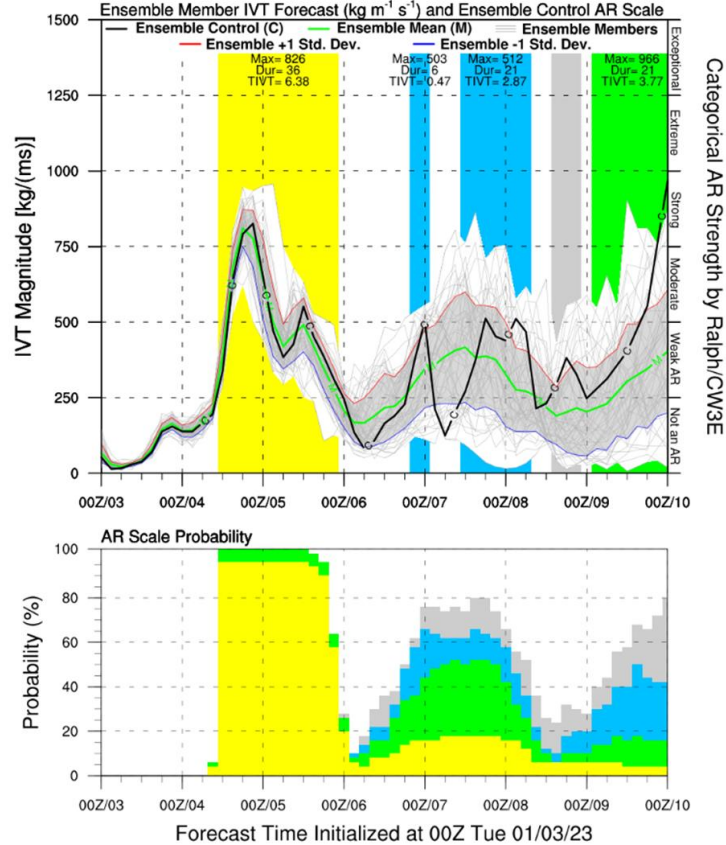
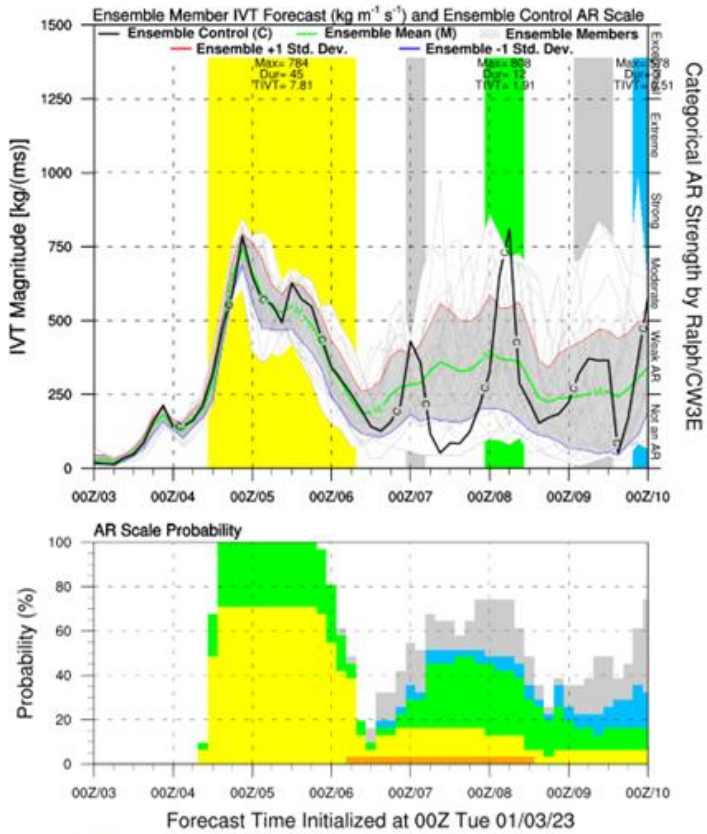
Landfall Point: 40°N, 124°W

### GEFS Ensemble

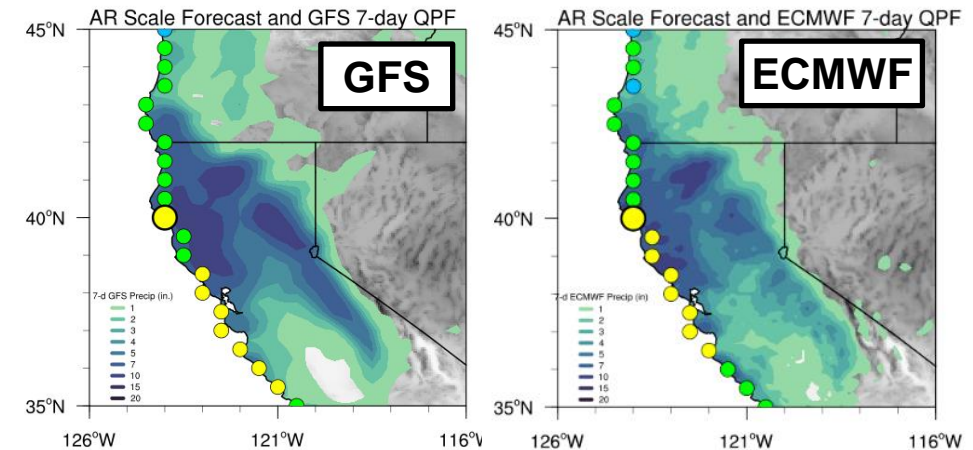
### ECMWF Ensemble

GFS Ensemble Initialized: 00Z Tue 01/03/23

ECMWF Ensemble Initialized: 00Z Tue 01/03/23



- 22/31 (71%) **GEFS ensemble** members are forecasting at least AR 3 conditions at this location
- 48/51 (94%) **ECMWF ensemble** members are forecasting at least AR 3 conditions at this location
- There is considerable forecast uncertainty for the period between 00Z 6 Jan - 00Z 10 Jan regarding timing and intensity of the upcoming series of ARs.



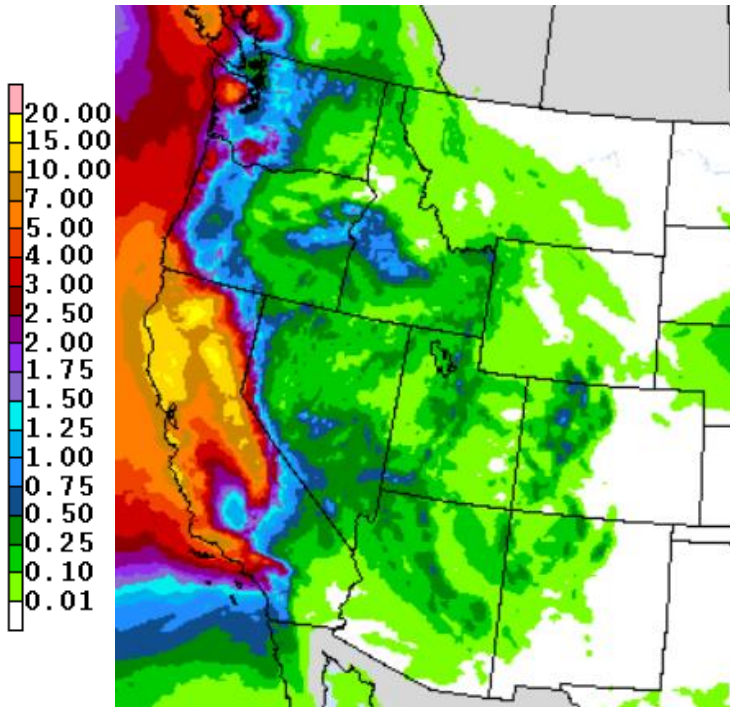


# CW3E AR Outlook: 3 January 2023

## Precipitation Forecast

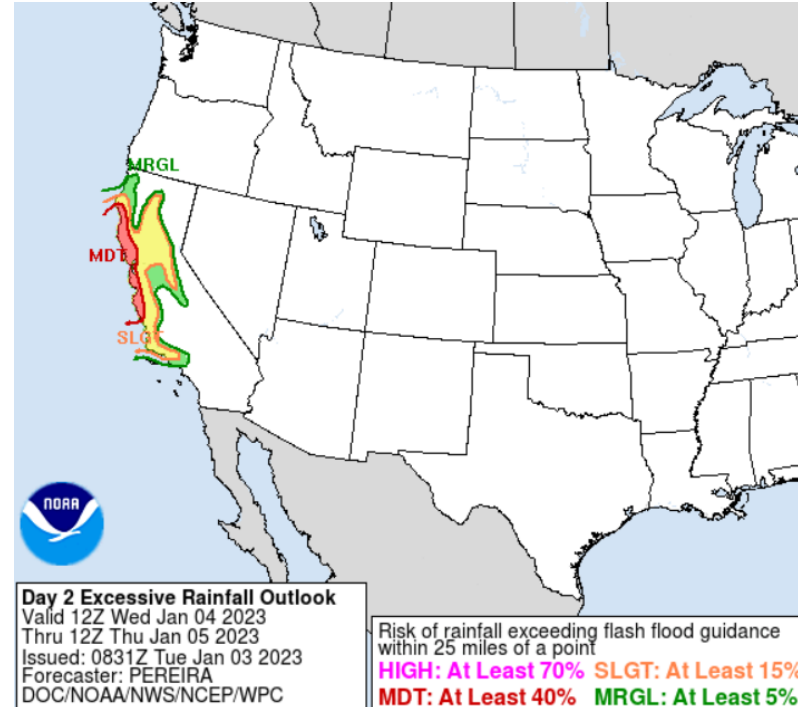
### WPC 7-day QPF:

Valid 4 AM PT 03-10 Jan



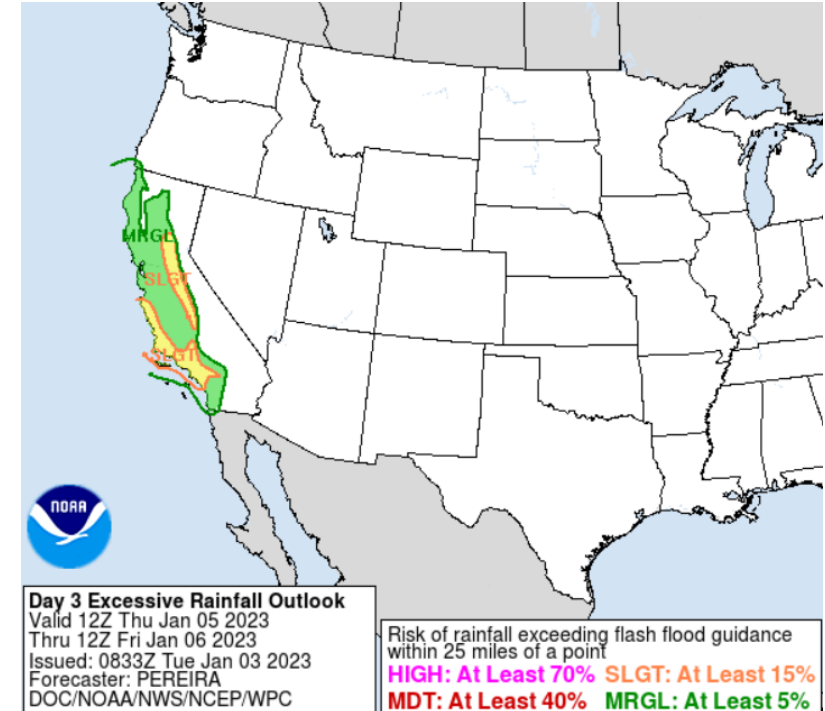
### WPC Day 2 Excessive Rainfall Outlook:

Valid 4 AM PT 04-05 Jan



### WPC Day 3 Excessive Rainfall Outlook:

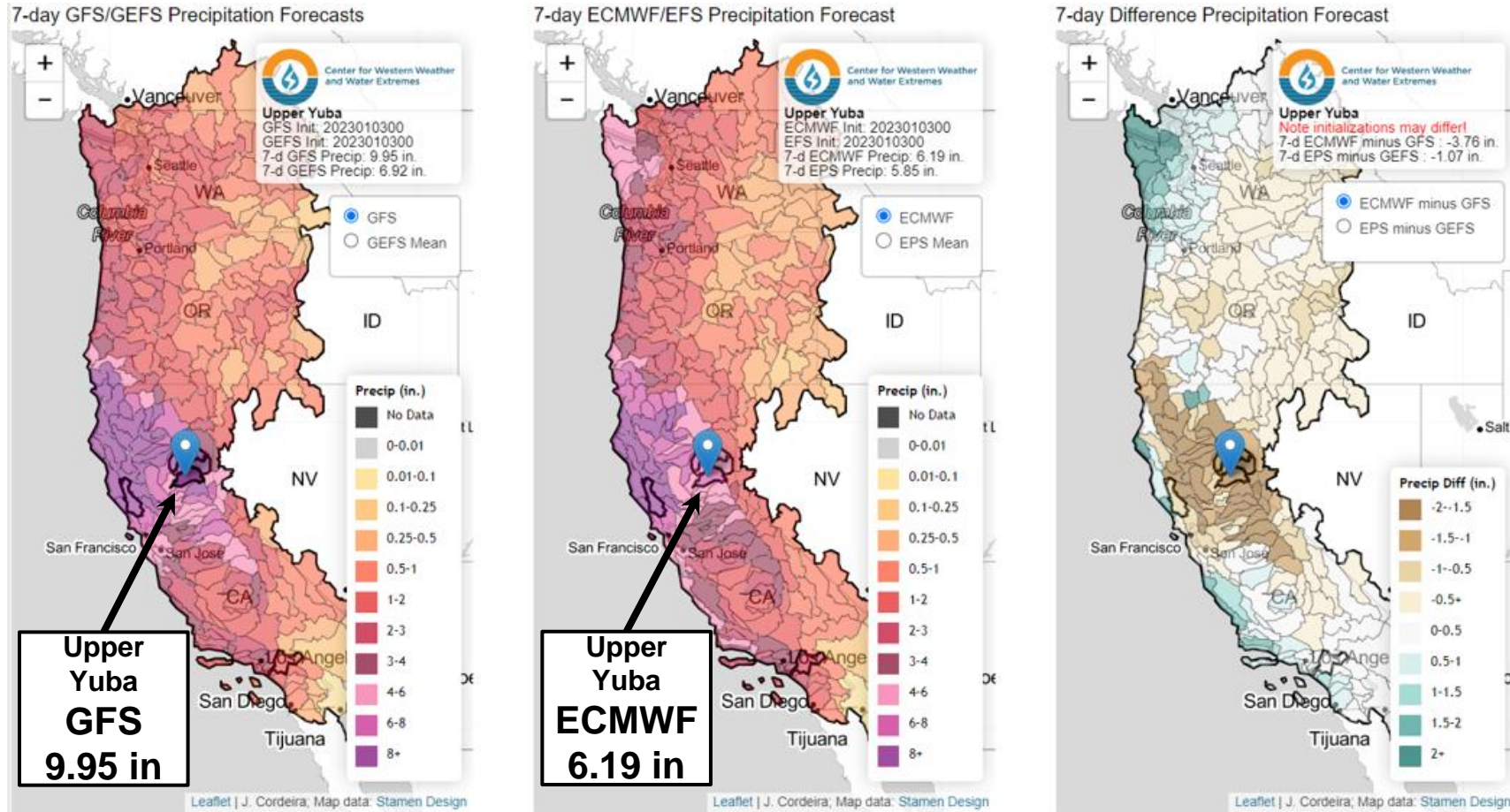
Valid 4 AM PT 05-06 Jan



- The WPC is forecasting precipitation totals exceeding 7 inches over the Sierra Nevada, Klamath Mountains, and California Coast Ranges over the next 7 days with some locations forecast to receive >15 inches
- The WPC has issued a moderate risk of excessive rainfall along the northern and central California Coast for 4AM PT 04-05 Jan with slight and marginal risks extending inland to the Sierra Nevada and southward to the Western Transverse Ranges
- The WPC has also issued a slight risk of excessive rainfall along the Sierra Nevada and Southern California Coast, including the Transverse Ranges for 4AM PT 05-06 Jan with marginal risks extending inland

# CW3E AR Outlook: 3 January 2023

## GFS/GEFS and ECMWF/EPS 7-day Watershed Precipitation Forecast (Initialized 00Z 03 Jan 2023)



- 7-day watershed precipitation forecasts across northern California and the Northern Sierra are >6–8”
- Compared to the ECMWF, the GFS is wetter in these same regions but drier along coastal California
- The GFS is forecasting 9.95 inches of mean areal precipitation in the Upper Yuba Watershed over the next 7 days, while the ECMWF is forecasting 6.19 inches over the same watershed

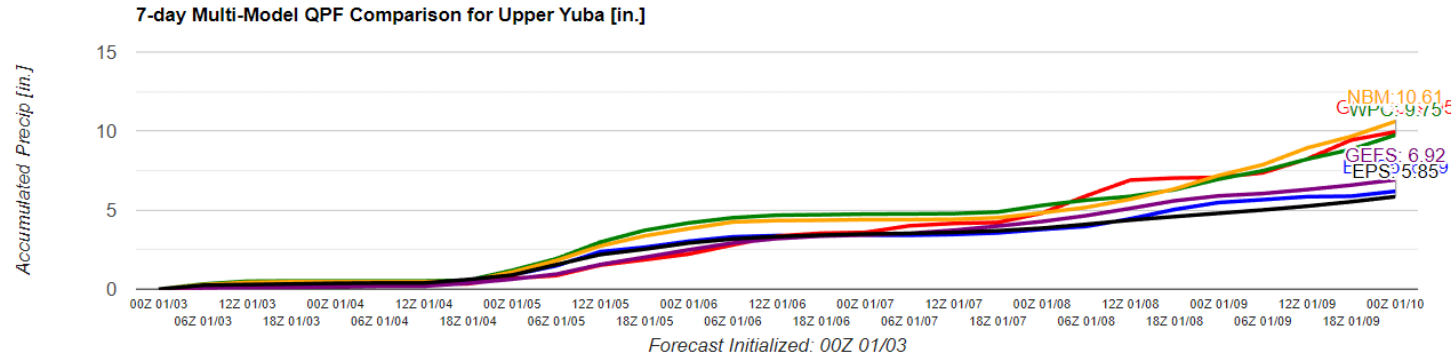
# CW3E AR Outlook: 3 January 2023

## Multi-model 7-day Watershed Precipitation Forecast (Initialized 00Z 03 Jan 2023)

Mult-Model Forecast Accumulated QPF: Upper Yuba  
Forecast initialized: 00Z 01/03 | Through F168

[Refresh Chart](#)

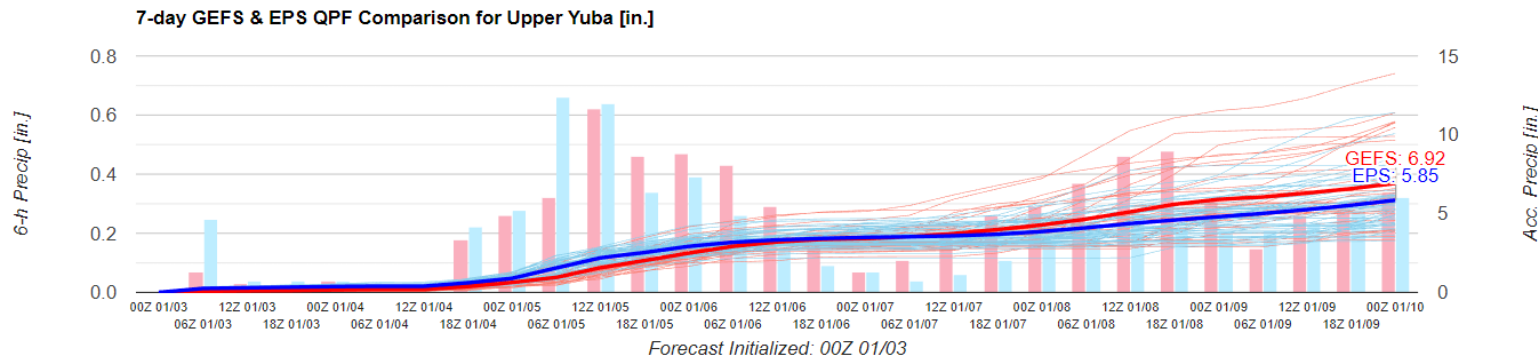
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GEFS and EPS Forecast QPF: Upper Yuba  
Forecast initialized: 00Z 01/03 | Through F168

[Refresh Chart](#)

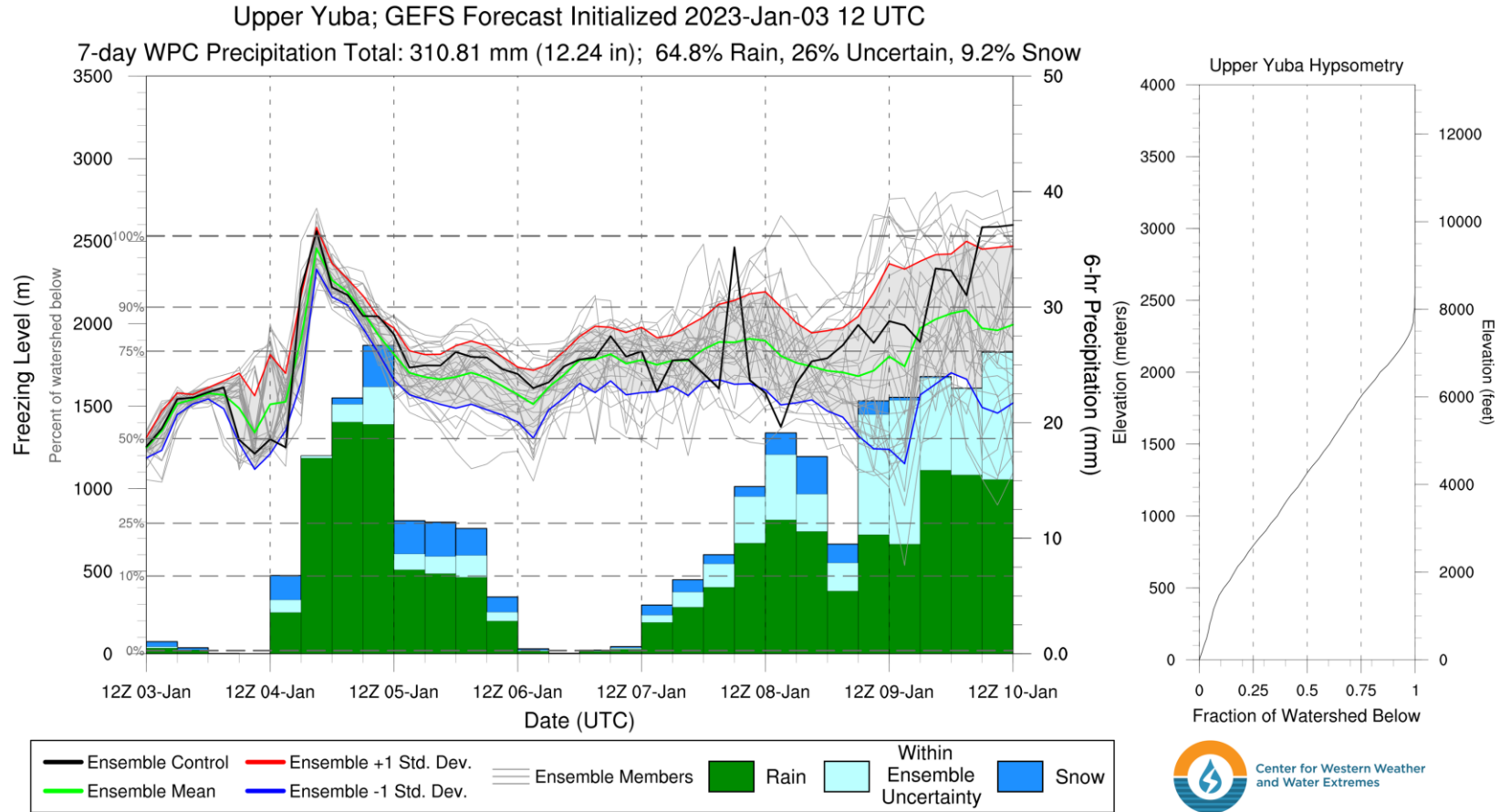
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- There are large model-to-model differences in the 7-day forecast precipitation for the Upper Yuba watershed
- The National Blend of Models, WPC, and the GFS are forecasting near or above 10 inches of precipitation
- The GEFS and EPS ensembles are forecasting ~7 inches and ~6 inches, respectively (range is between 3.3 and 13.9 inches)

# CW3E AR Outlook: 3 January 2023

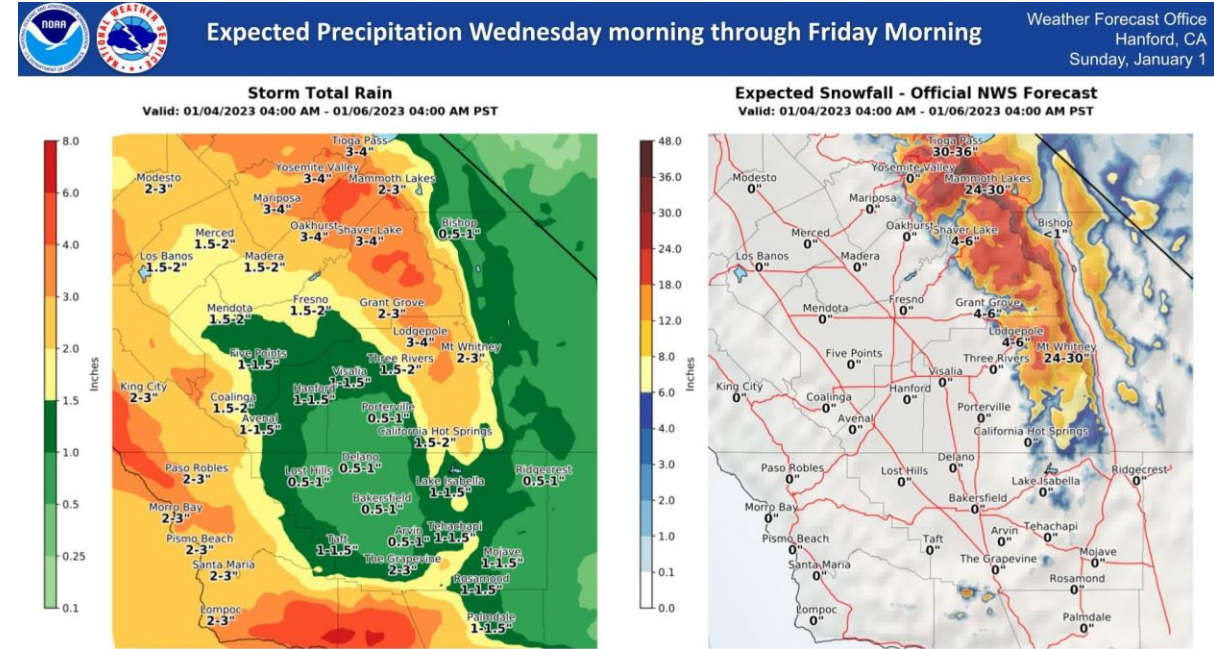
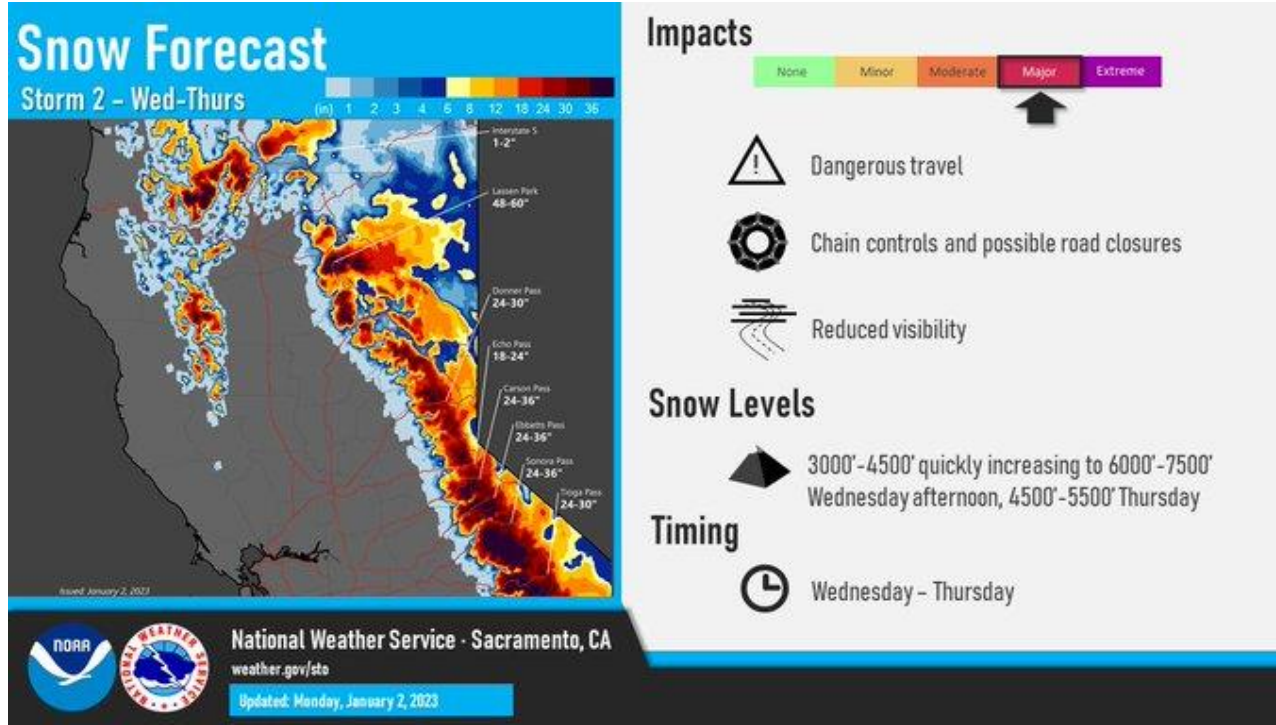
## Upper Yuba Watershed 7-day GEFS Freezing Level Forecast (Initialized 12Z 03 Jan 2023)



- Freezing levels are expected to climb to 2250 meters (~7400 ft) during the onset of precipitation with the first AR almost completely above the Upper Yuba watershed
- The freezing level is expected to fall for the remainder of the storm, but the exact elevation is uncertain. With this uncertainty, precipitation may fall as rain in 60-75% of the watershed through 06 Jan

# CW3E AR Outlook: 3 January 2023

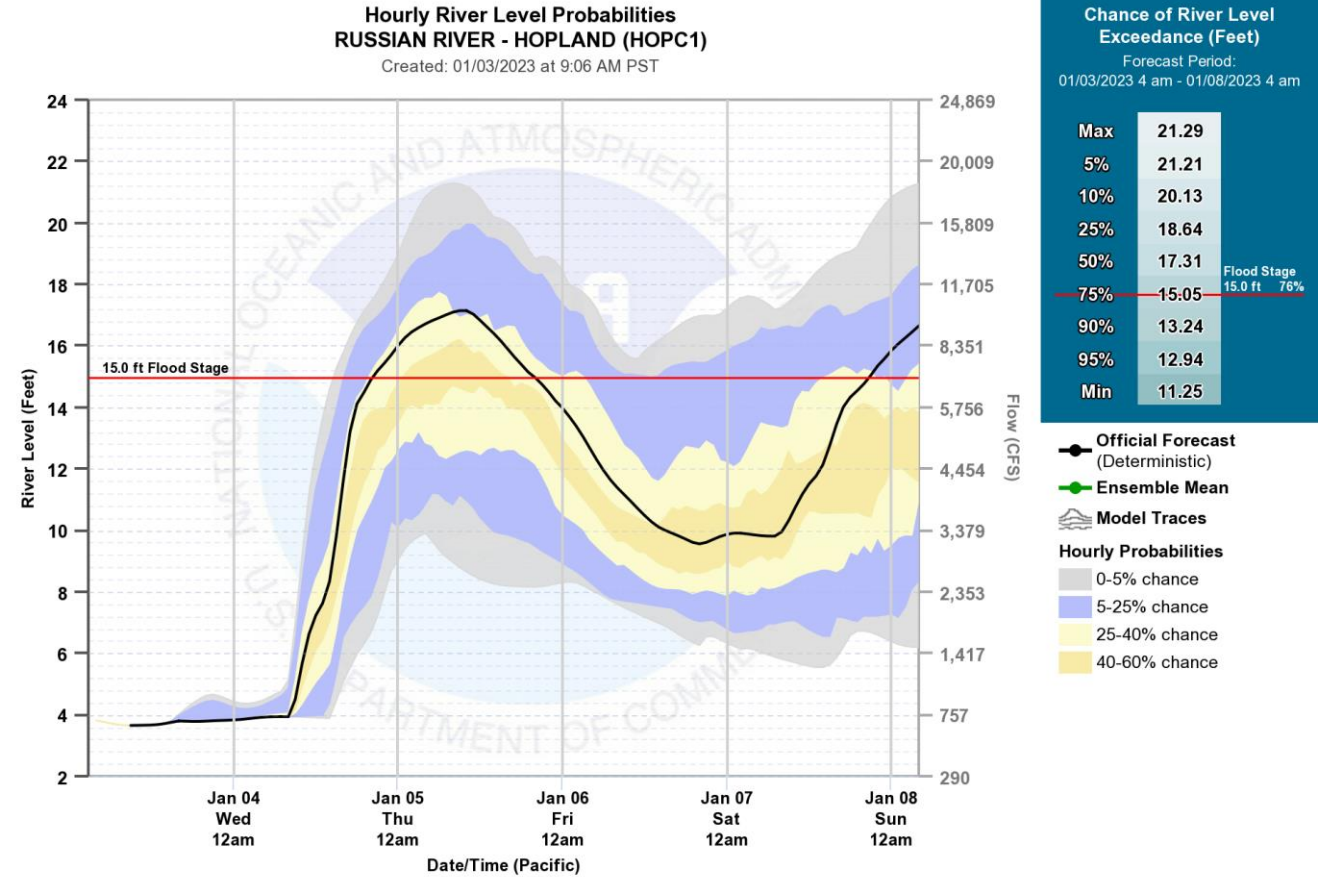
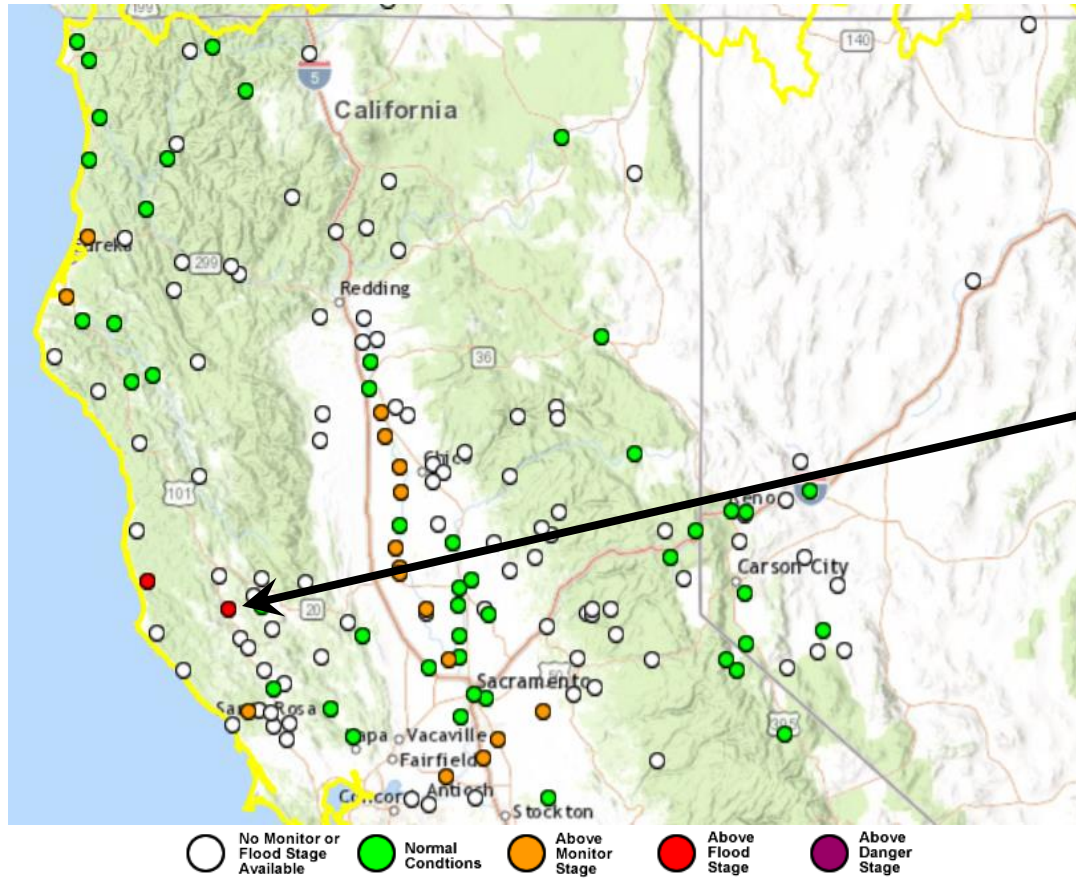
## Snow Forecast



- The first AR is forecast to produce at least 2–3 feet of snow over much of the Sierra Nevada with 4-5 feet over Lassen Peak
- Significant snowfall accumulations are also possible in the higher terrain of the Klamath Mountains and Coast Ranges
- Heavy snow and strong winds will likely cause very dangerous travel conditions, especially near mountain passes

# CW3E AR Outlook: 3 January 2023

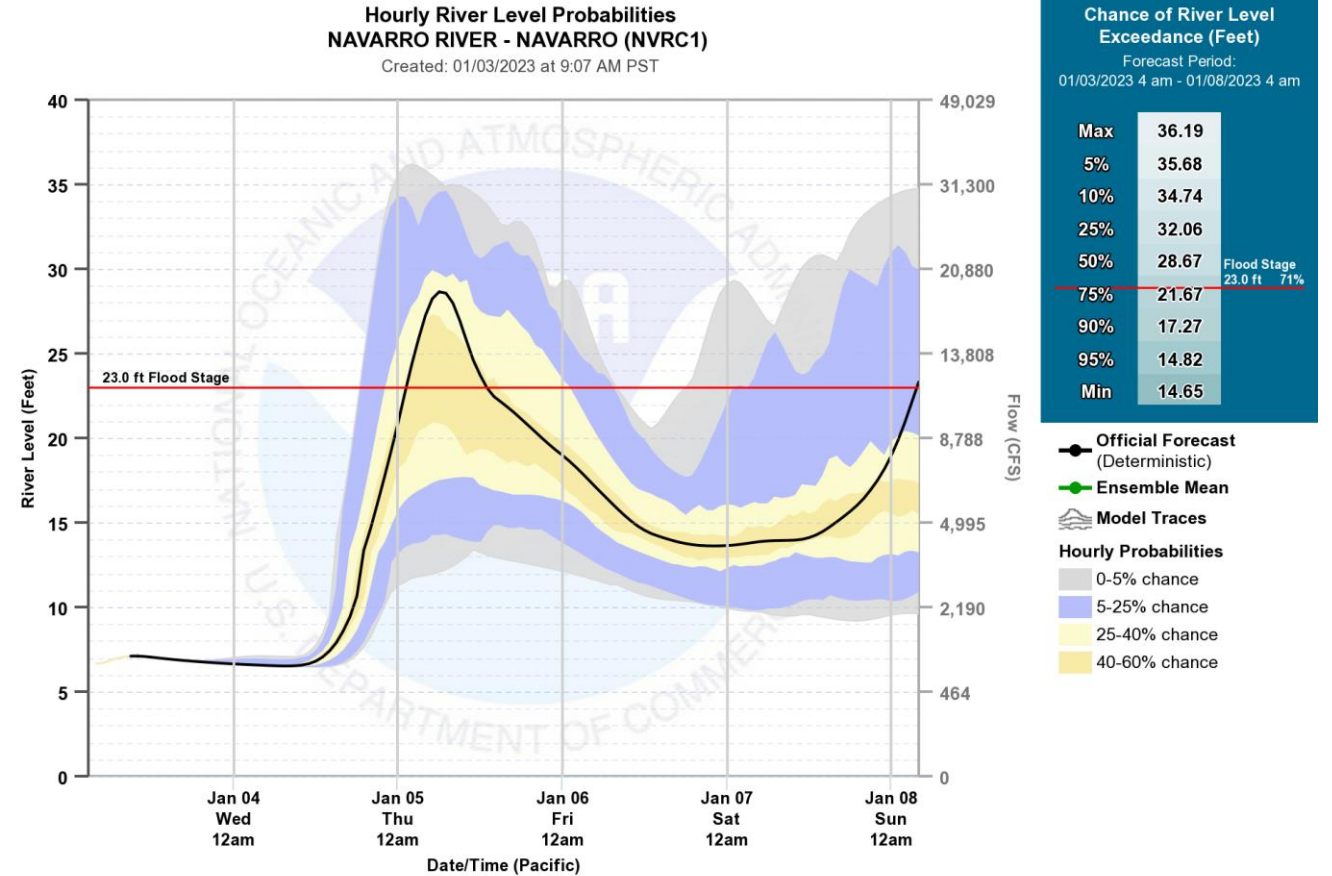
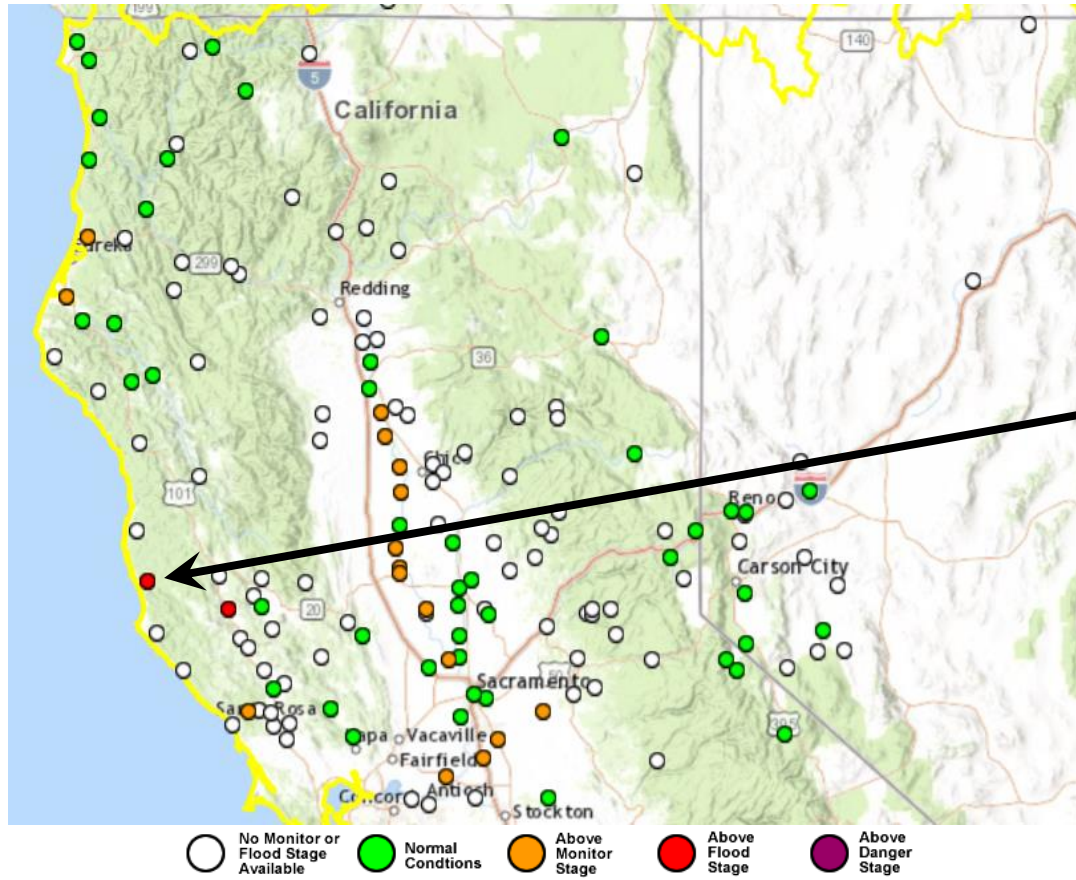
## NOAA/NWS CNRFC River Stage Forecast



- Heavy rainfall associated with the first AR is expected to bring the Russian River at Hopland above flood stage (15 ft) with an official forecast peak of 17.1 ft on 5 Jan at 9am PST
- The official forecast at this location indicates it will remain above flood stage for ~24 hours
- Ensemble-based odds of reaching flood stage are 76%

# CW3E AR Outlook: 3 January 2023

## NOAA/NWS CNRFC River Stage Forecast



- Heavy rainfall associated with the first AR is expected to bring the Navarro River at Navarro above flood stage (23 ft) with an official forecast peak of 28.6 ft on 5 Jan at 6am PST
- The official forecast at this location indicates it will remain above flood stage for ~12 hours
- Ensemble-based odds of reaching flood stage are 71%