

# CW3E Atmospheric River Outlook: 10 March 2023

## Atmospheric River Continues to Bring Moisture and High Snow Levels to California with another Atmospheric River Forecast to Make Landfall in Northern California Shortly After

- Current atmospheric river (AR) made landfall in Northern California around 10am PT 9 March and will continue to push moisture into California over the next couple days
- IVT will values remain above  $250 \text{ kg m}^{-1} \text{ s}^{-1}$  off the US West Coast ahead of the next AR which is forecast to make landfall on 14 March and bring AR2/3 conditions (based on the Ralph et al. 2019 AR Scale) to the majority of coastal Central California
- There is substantial uncertainty between the GFS and ECMWF global models in the timing and location of AR conditions, including direction of IVT, which is mostly due to how each model handles the location of a pair of mid-level troughs
- As compared to the GFS, the ECMWF EPS has more confidence in a broader area of AR3 conditions for coastal areas around the San Francisco Bay area

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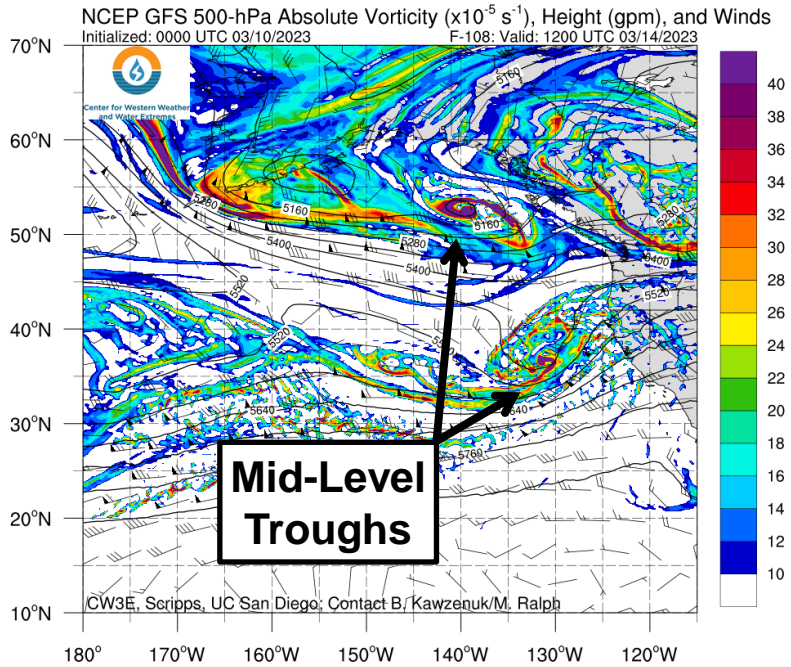
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- The NWS Weather Prediction Center (WPC) has forecast 48-hour precipitation totals >2 inches over the Coast Ranges of Northern and Central California, >3 inches for the Western Transverse Range of Southern California and >5 inches over the Sierra
- Experimental excessive rainfall outlooks have been issued by the WPC for Monday through Wednesday with a moderate risk (at least 40%) of rainfall exceeding flash flood guidance in the Northern Sierra and parts of the Northern California coast for Monday-Tuesday, and a moderate risk for the Sierra Nevada and Big Sur coast for Tuesday-Wednesday
- The 00Z GFS is forecasting 11.31 inches of mean areal precipitation in the Upper Yuba watershed over the next 7 days, while the 00Z ECMWF is forecasting 8.11 inches over the same watershed, however, these totals include precipitation forecasted to fall during the current AR
- Forecast freezing levels are expected to remain quite high (~2,000m) in the Sierra Nevada. This may lead to high fractions of most Sierra watersheds exposed to rain-on-snow

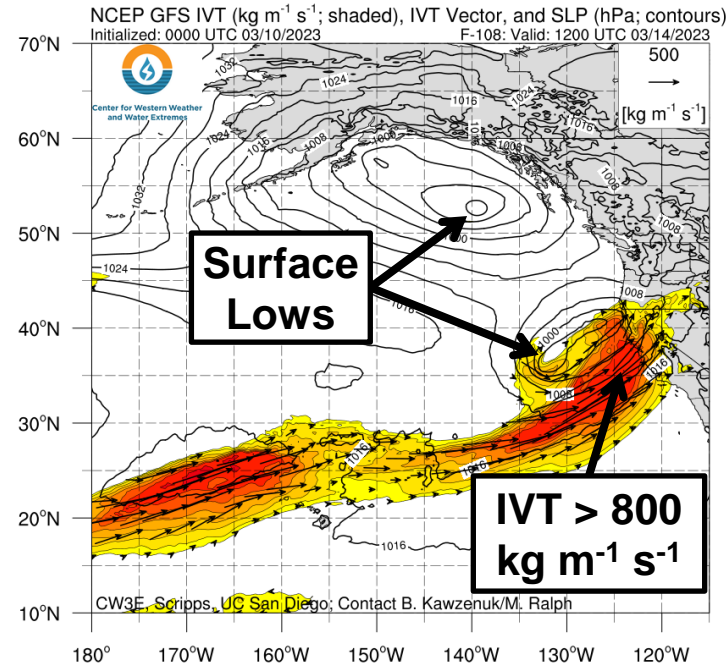
# CW3E AR Outlook: 10 March 2023

## GFS Model Forecast: Valid 4 AM PST 14 Mar (F-108)

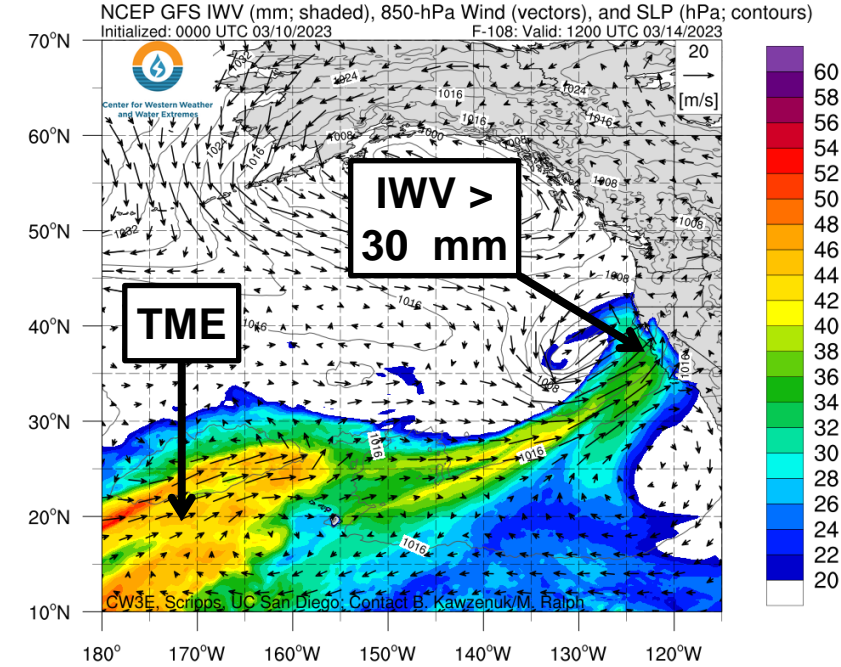
### A) 500-hPa Vorticity, Height, and Wind



### B) IVT and SLP



### C) IWV and 850-hPa Wind



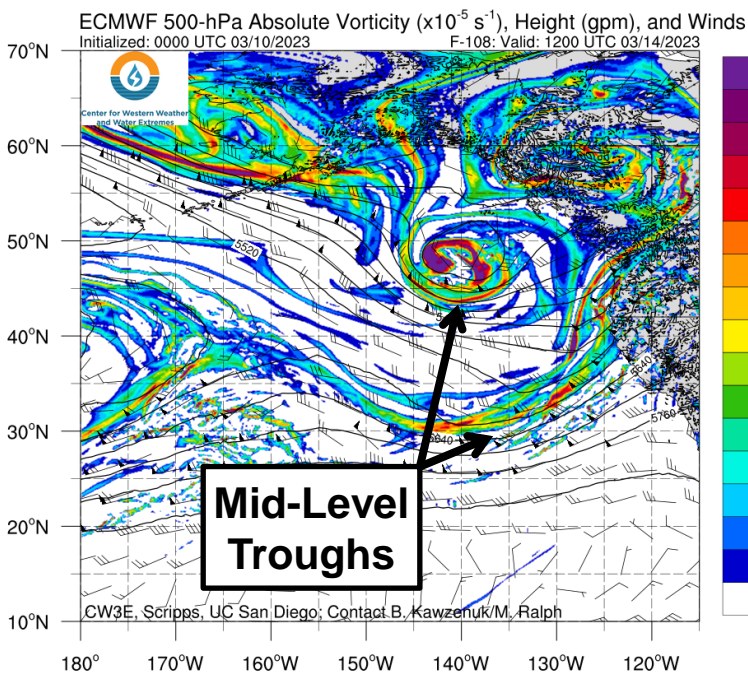
- The 00Z GFS deterministic model has a pair of mid-level troughs approaching the US West Coast (Figure A)
- A strong AR with southwesterly IVT magnitudes  $> 800 \text{ kg m}^{-1} \text{ s}^{-1}$  is forecast to make landfall in Northern California by 4 AM PT on 14 March in association with the southerly trough and surface low (Figure B)
- This event is supported by another Pineapple Express source region with strong tropical moisture export near Hawaii
- The AR is forecast to bring IWV values  $> 30 \text{ mm}$  off the California coast (Figure C) and eventually moves south through Southern California by 15 March



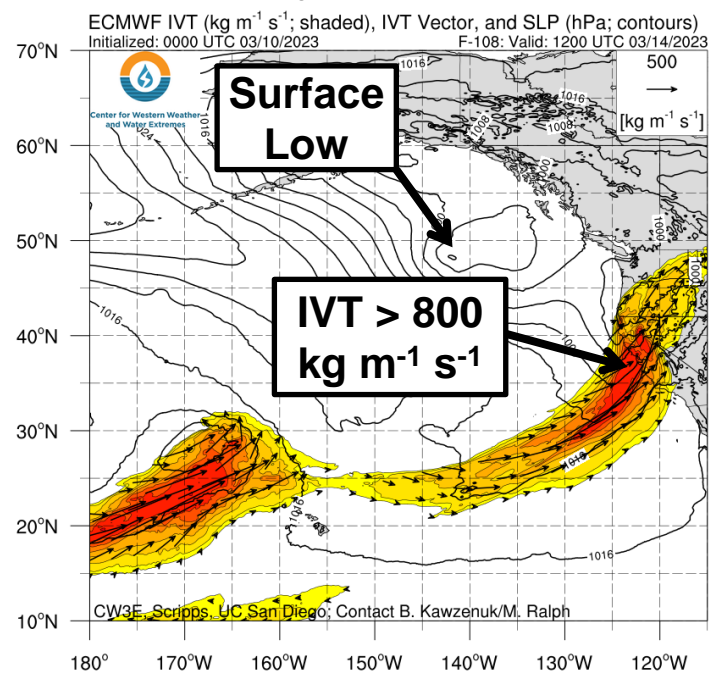
# CW3E AR Outlook: 10 March 2023

## ECMWF Model Forecast: Valid 4 AM PST 14 Mar (F-108)

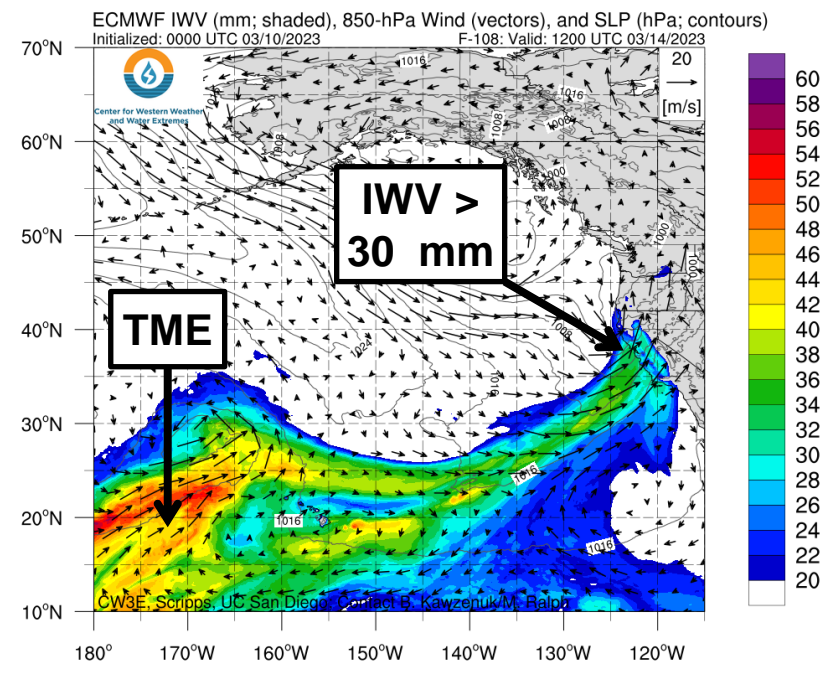
### A) 500-hPa Vorticity, Height, and Wind



### B) IVT and SLP



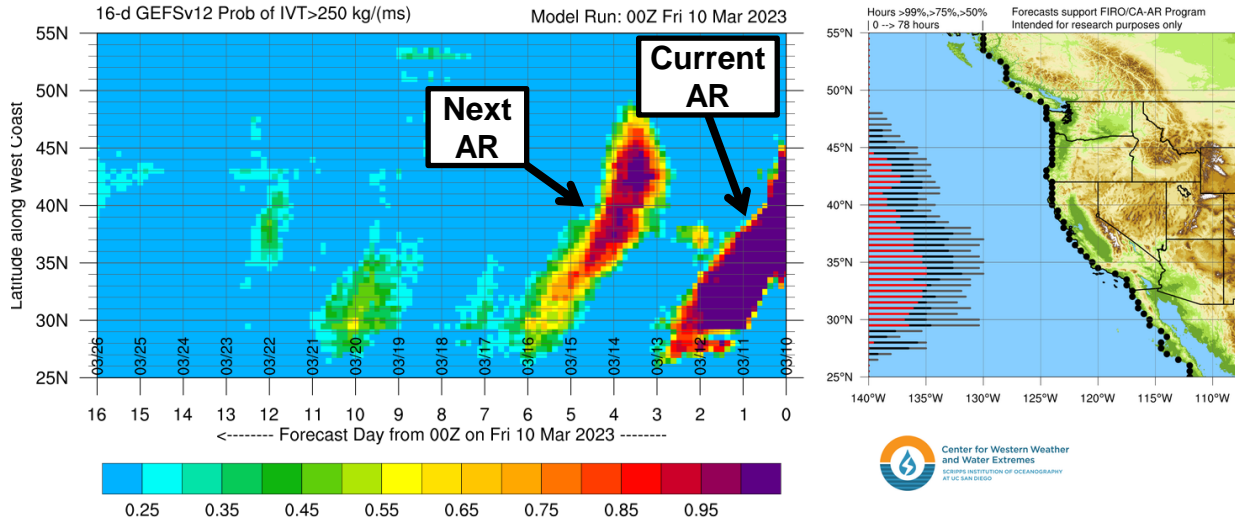
### C) IWV and 850-hPa Wind



- The 00Z ECMWF deterministic model also shows a pair of mid-level troughs approaching the US West Coast but are both located further south than in the GFS (Figure A)
- The forecast AR has similar IVT magnitudes and IWV values off the coast of California, however IVT is oriented more South-Southwesterly than in the GFS due to the influence of a single surface low (Figures B and C)
- The 00Z ECMWF deterministic model has the AR well into California by 4 AM PT on 14 March, with landfall approximately 12 hours prior to the GFS

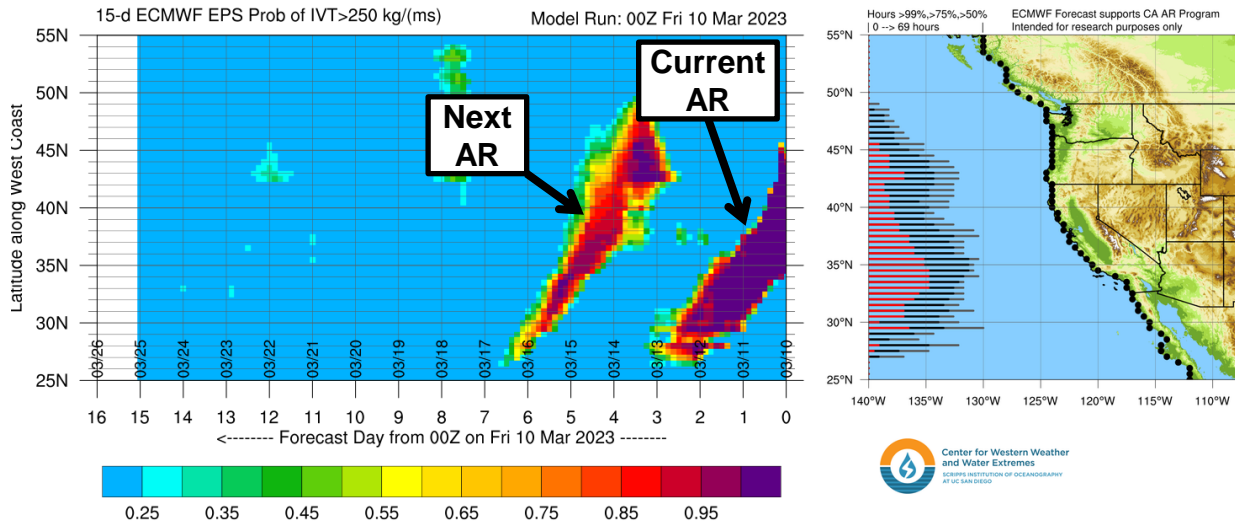
# CW3E AR Outlook: 10 March 2023

## Probability of AR Conditions Along Coast (GEFS)



- The 00Z GEFS is showing very high confidence (> 95%) in a period of AR conditions ( $IVT > 250 \text{ kg m}^{-1} \text{ s}^{-1}$ ) forecast along coastal Northern and Central California on 13 and 14 March with medium confidence (55-75%) in a period of AR conditions into Southern California
- Along coastal Northern California, the GEFS is showing AR conditions reaching the region a few hours sooner than the EPS

## Probability of AR Conditions Along Coast (EPS)



- The 00Z ECMWF EPS is showing high confidence (> 85%) in a period of AR conditions ( $IVT > 250 \text{ kg m}^{-1} \text{ s}^{-1}$ ) forecast along Central and Southern California on 14 and 15 March
- Compared to the 00Z GEFS, duration of AR conditions in Southern California and into Baja California is much less



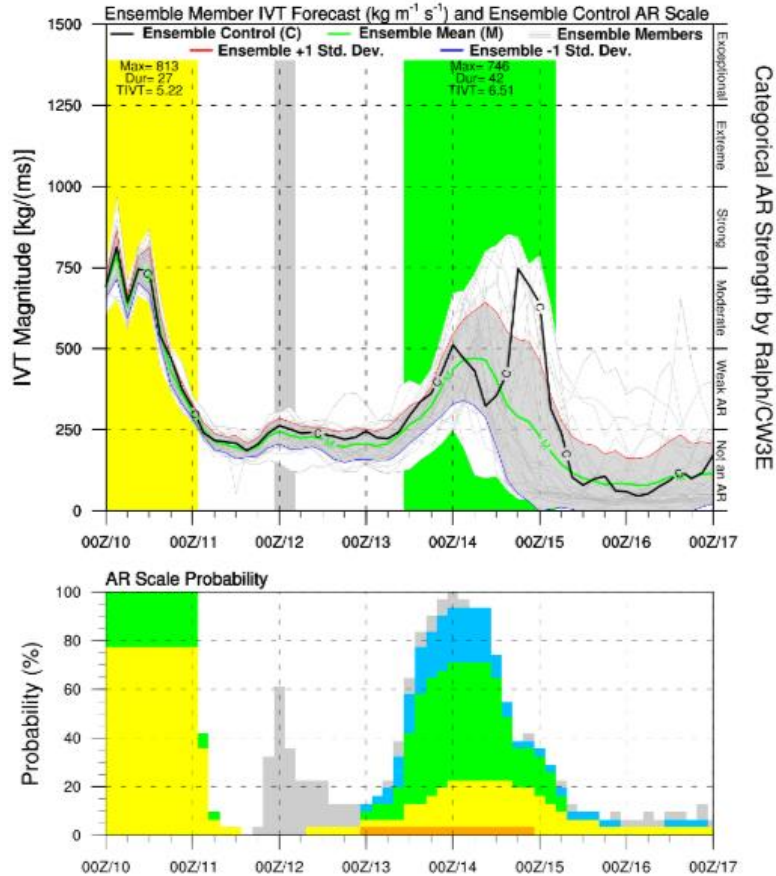
# CW3E AR Outlook: 10 March 2023

## 7-day AR Scale and IVT Forecast: 06Z GFS & ECMWF Ensemble

Landfall Point: 37.5°N, 122.5°W

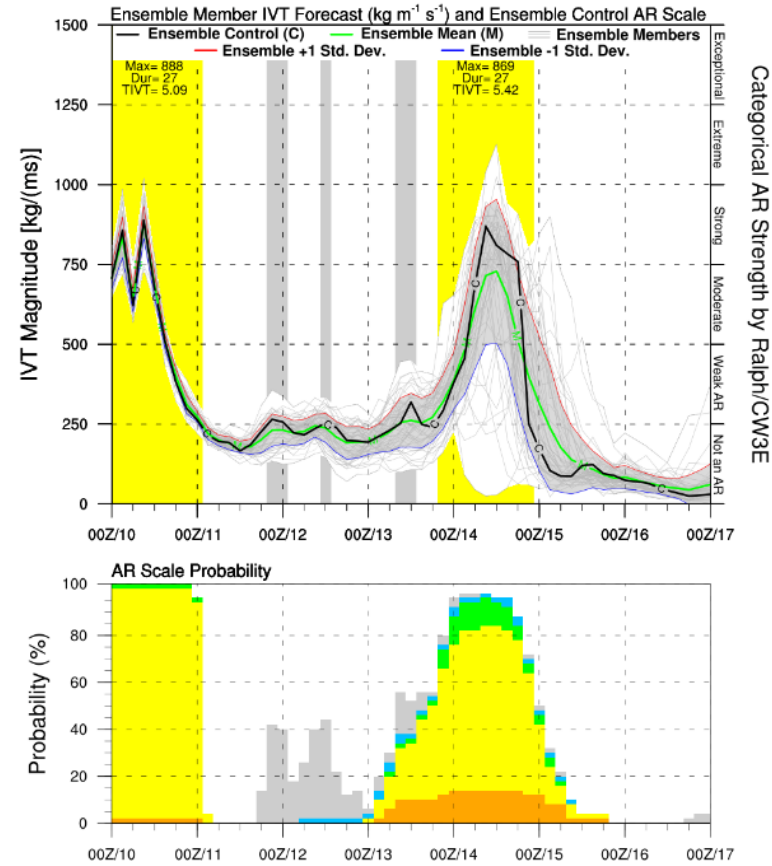
### 00Z GEFS Ensemble

GFS Ensemble Initialized: 00Z Fri 03/10/23



### 00Z ECMWF Ensemble

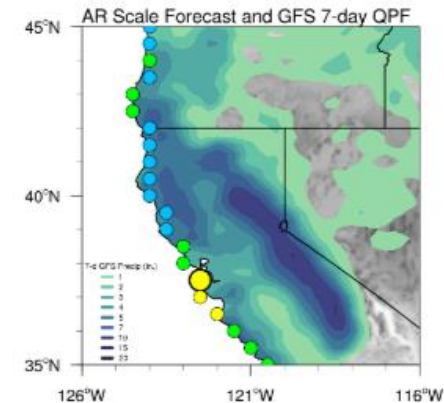
ECMWF Ensemble Initialized: 00Z Fri 03/10/23



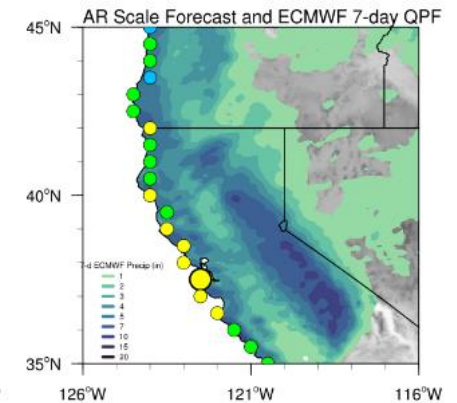
### AR Ensemble Forecast

- 22/31 (71%) **GEFS ensemble** members are forecasting at least AR2 conditions at this location with 7/31 (23%) that are at least AR3
- 42/51 (84%) **ECMWF ensemble** members are forecasting at least AR3 conditions at this location
- The ECMWF ensemble is more confident in forecasting at least AR3 conditions in the Bay Area

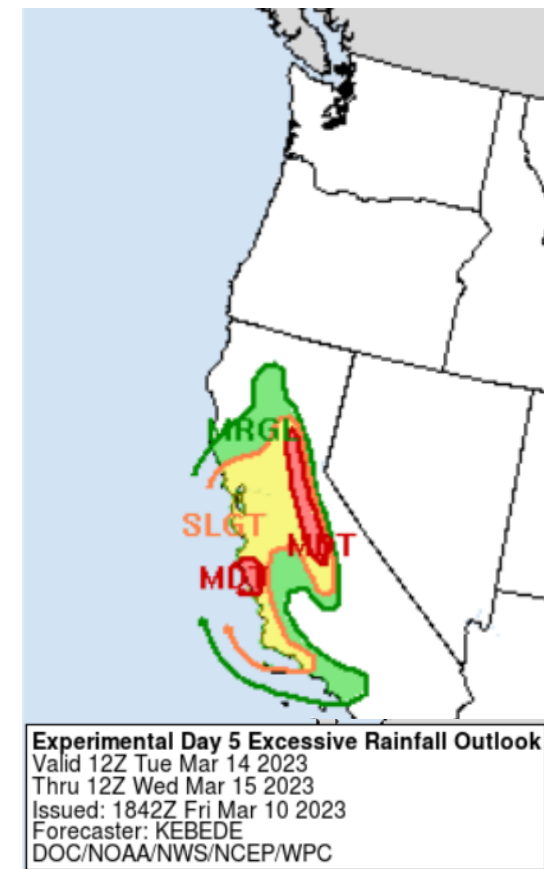
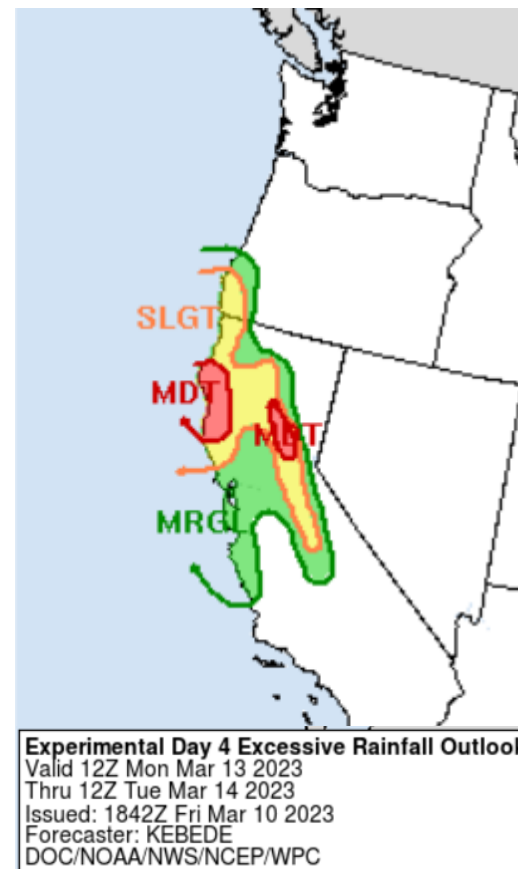
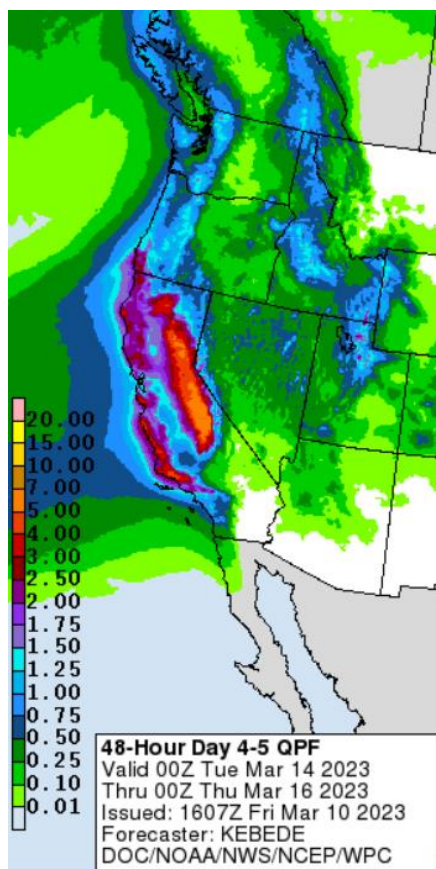
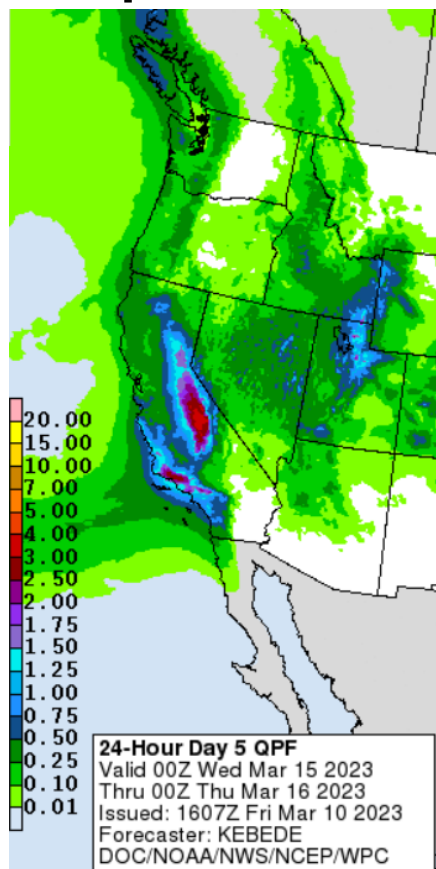
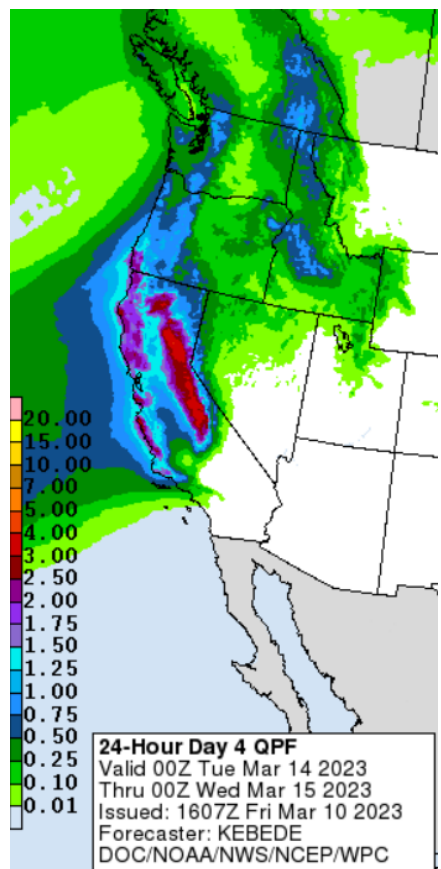
### GEFS Ensemble



### ECMWF Ensemble



## WPC Quantitative Precipitation Forecasts and Excessive Rainfall Outlook



- The NWS Weather Prediction Center (WPC) has forecast 48-hour precipitation totals >2 inches over the Coast Ranges of Northern and Central California, >3 inches for the Western Transverse Range of Southern California and >5 inches over the Sierra
- Experimental excessive rainfall outlooks have been issued by the WPC for Monday through Wednesday with a moderate risk (at least 40%) of rainfall exceeding flash flood guidance in the Northern Sierra and parts of the Northern California coast for Monday-Tuesday, and a moderate risk for the Sierra Nevada and Big Sur coast for Tuesday-Wednesday



# CW3E AR Outlook: 10 March 2023

## 7-day Watershed Precipitation Forecasts (Initialized 4 PM PT 9 Mar)

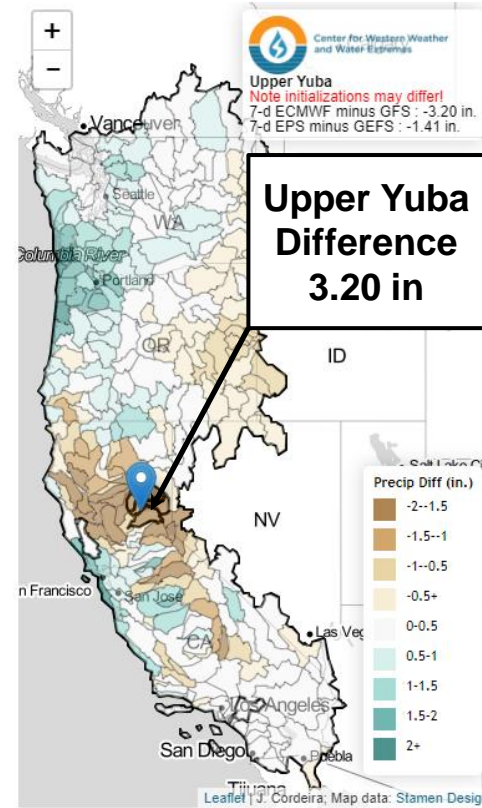
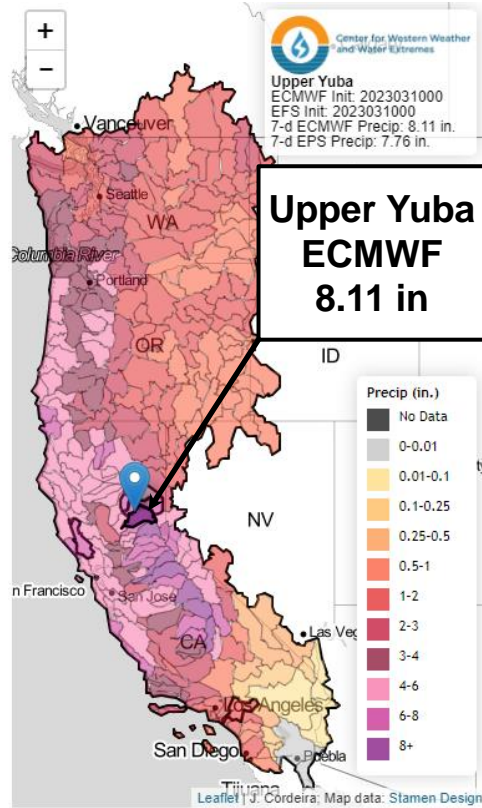
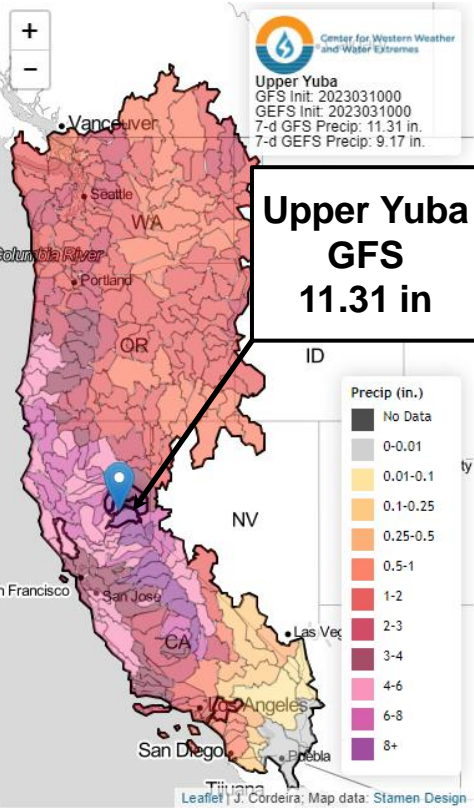
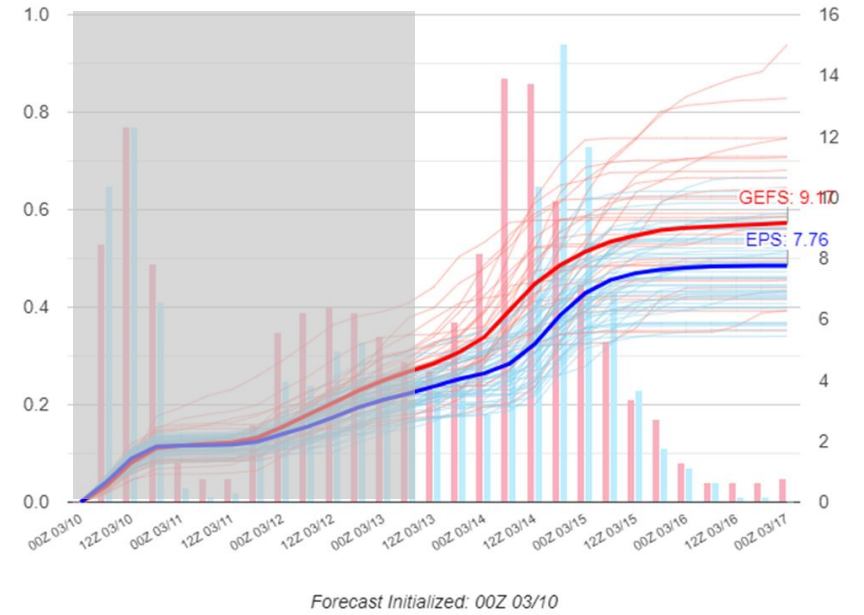
GFS

ECMWF

ECMWF minus GFS

7-day GEFS and EPS Forecast QPF: Upper Yuba

7-day GEFS & EPS QPF Comparison for Upper Yuba [in.]



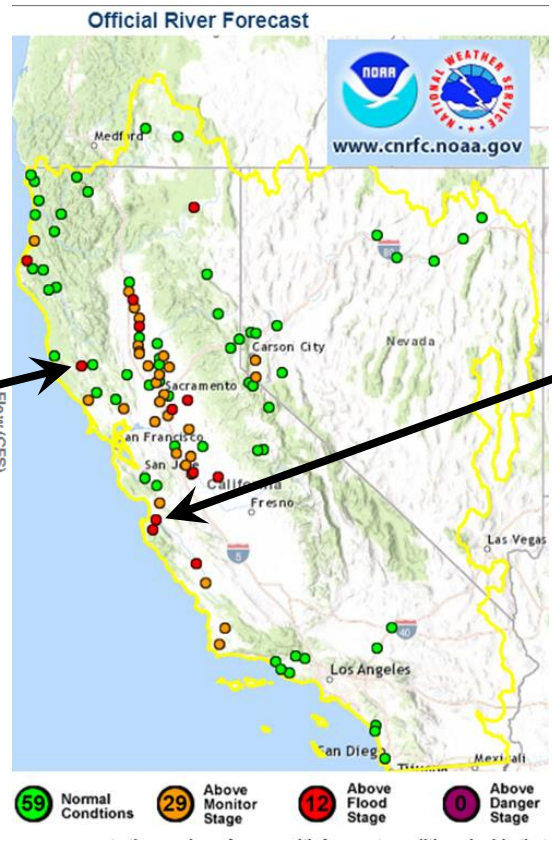
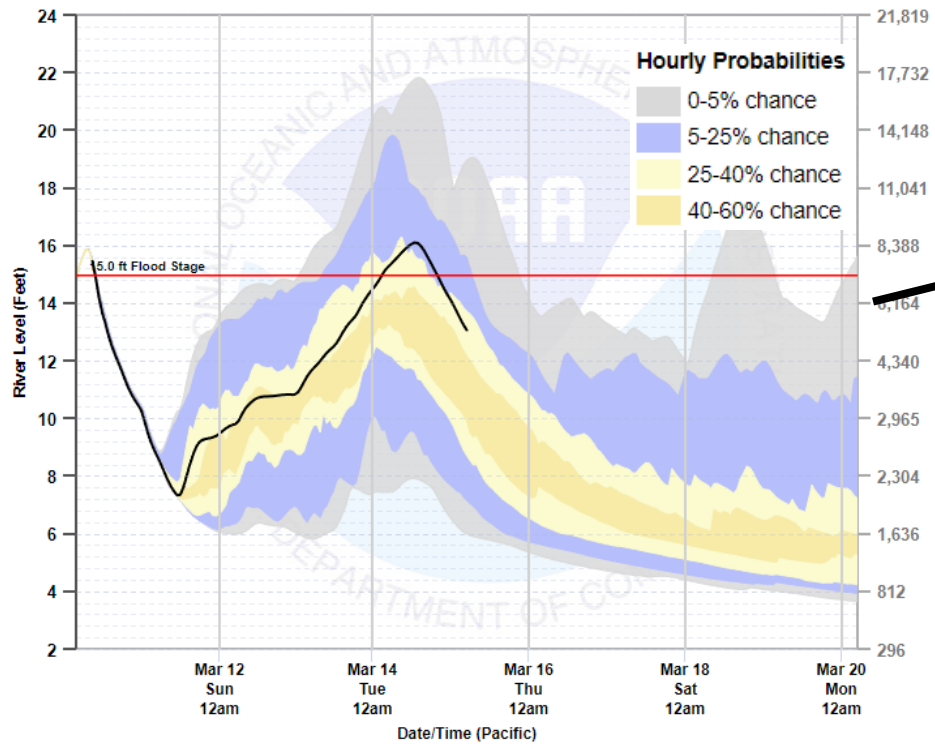
- The 00Z GFS is forecasting higher 7-day watershed precipitation totals in the northern Sacramento Valley and Sierra Nevada, while the 00Z ECMWF is forecasting higher precipitation totals in the Coast Ranges of Central California
- The 00Z GFS is forecasting 11.31 inches of mean areal precipitation in the Upper Yuba watershed over the next 7 days, while the 00Z ECMWF is forecasting 8.11 inches over the same watershed
- Some of the watershed totals include precipitation forecasted to fall during the current AR as shown on the timeseries plot



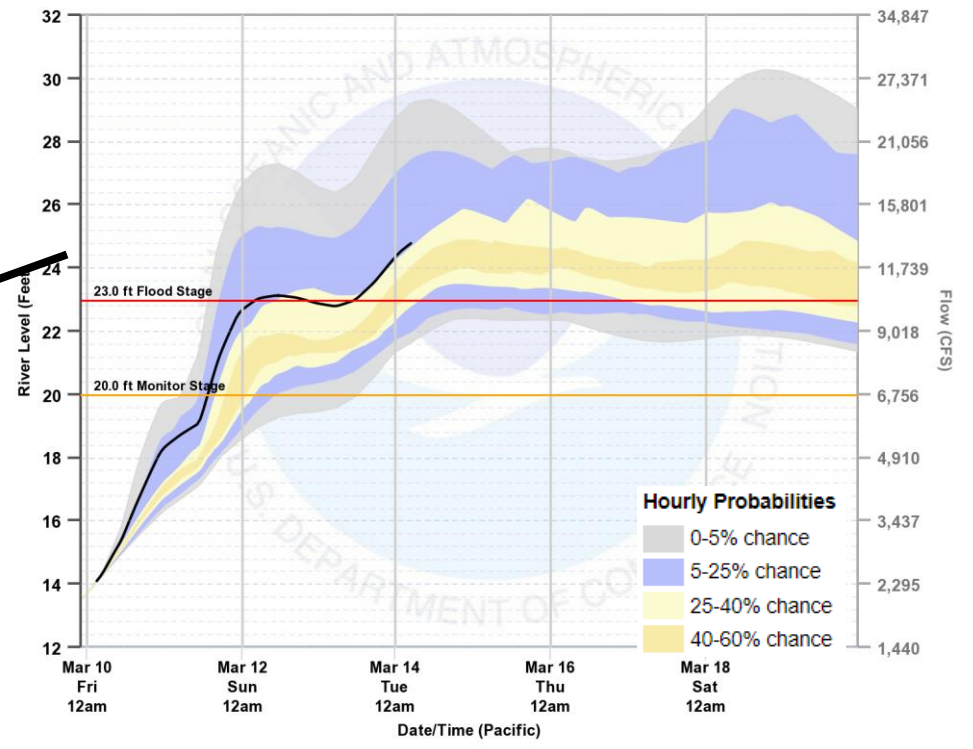
# CW3E AR Outlook: 10 March 2023

## NWS CNRFC River Stage Forecast

Hourly River Level Probabilities  
RUSSIAN RIVER - HOPLAND (HOPC1)  
Created: 03/10/2023 at 9:39 AM PST

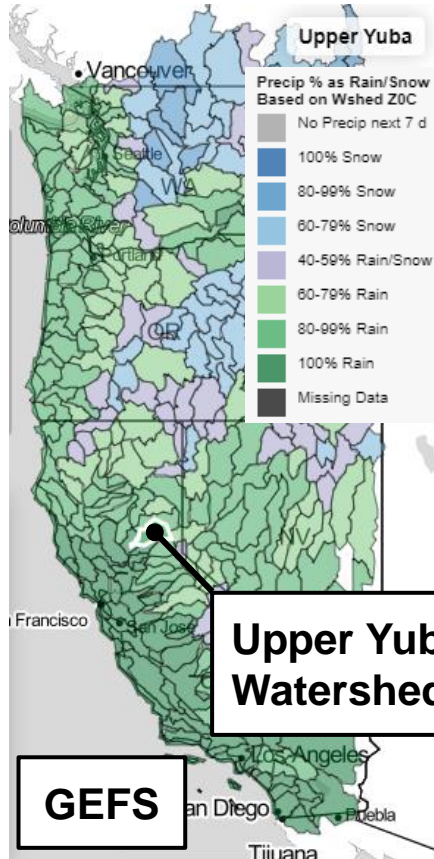


Hourly River Level Probabilities  
SALINAS RIVER - SPRECKELS (SPRC1)  
Created: 03/10/2023 at 3:44 AM PST

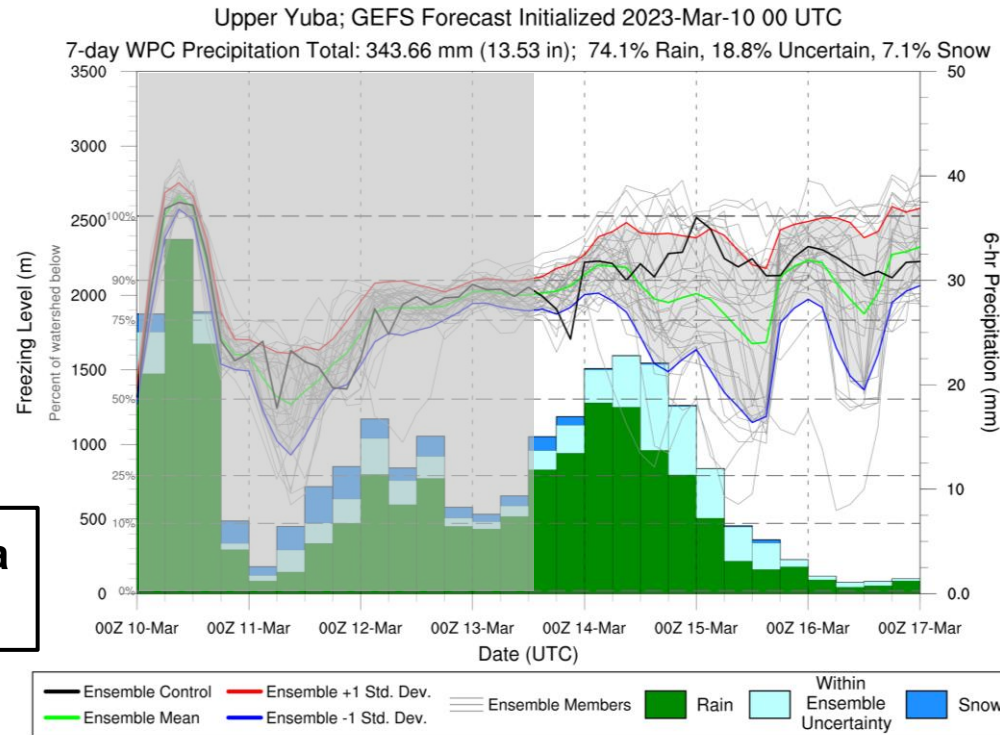


- NWS CNRFC has forecast 12 locations to rise above flood stage and 29 locations to rise above monitor stage over the next 5 days
- There is between a 25-40% chance for the Russian River at Hopland to again exceed flood stage (15 ft) on 14 March, local time. The official deterministic forecast has a peak stage of 16.10 feet
- There is very high probabilities for the Salinas River at Spreckels to exceed flood stage (23 ft) on 12 March, local time, in association with the current AR and for the river to remain above flood stage for all of next week. The official deterministic forecast has a peak stage of 24.77 feet

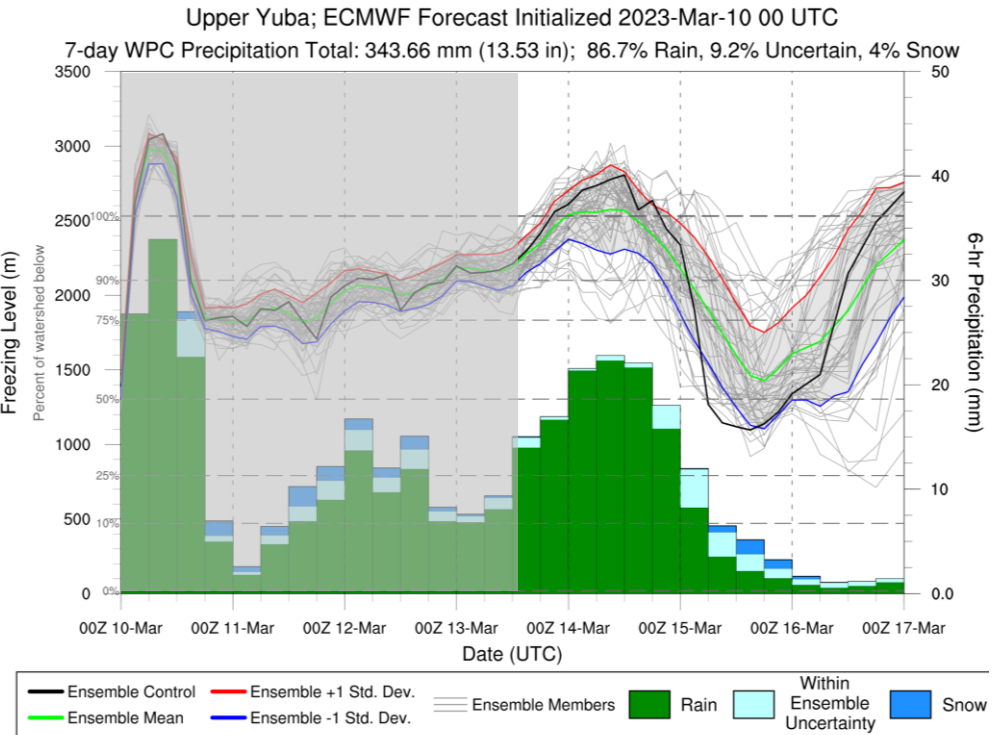
## GEFS & EPS Freezing Level Forecast



### GEFS Ensemble



### ECMWF Ensemble



- The 00Z GEFS control member is forecasting lower freezing levels (~2100m) during the early portion of the next AR as compared to the EPS (~2,700m). The ECMWF EPS control member is showing a drop in the freezing level to ~1,200m during the later portion of the storm. However, there is still much uncertainty between the individual ensemble members.
- The 00Z ECMWF EPS is forecasting a greater percentage of the Upper Yuba watershed to experience rain (86.7%) during the forecast period as compared to the GEFS (74.1%)