

# CW3E Atmospheric River Outlook

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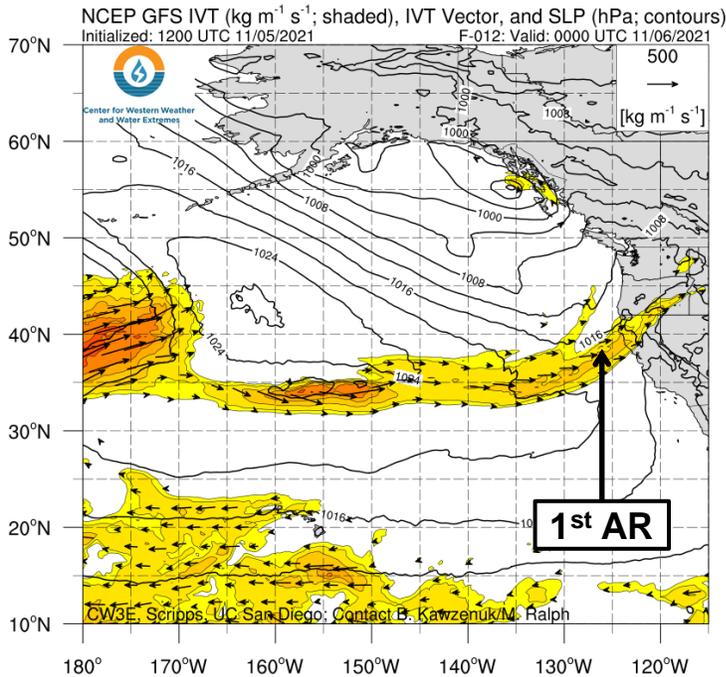
## **Model Forecasts Show Potential for Another Strong AR in California Next Week**

- A weak atmospheric river (AR) made landfall along the US West Coast this morning and will continue to impact Northern California, Oregon, and Washington through tomorrow
- A stronger AR is forecasted to make landfall across California next week, but there is considerable uncertainty in the timing, duration, and magnitude of AR conditions
- The 00Z GEFS control run is forecasting an AR 3 near Point Reyes, CA, and AR 1/AR 2 conditions elsewhere along the coast in Central and Northern California
- The 00Z ECMWF EPS control run is forecasting an AR 2 in the San Francisco Bay Area and AR 1 conditions elsewhere in Central and Northern California
- The second AR is forecasted to bring 2–4 inches of precipitation to the higher terrain in Northern California
- There is also potential for significant snowfall accumulations the Cascades and Sierra Nevada

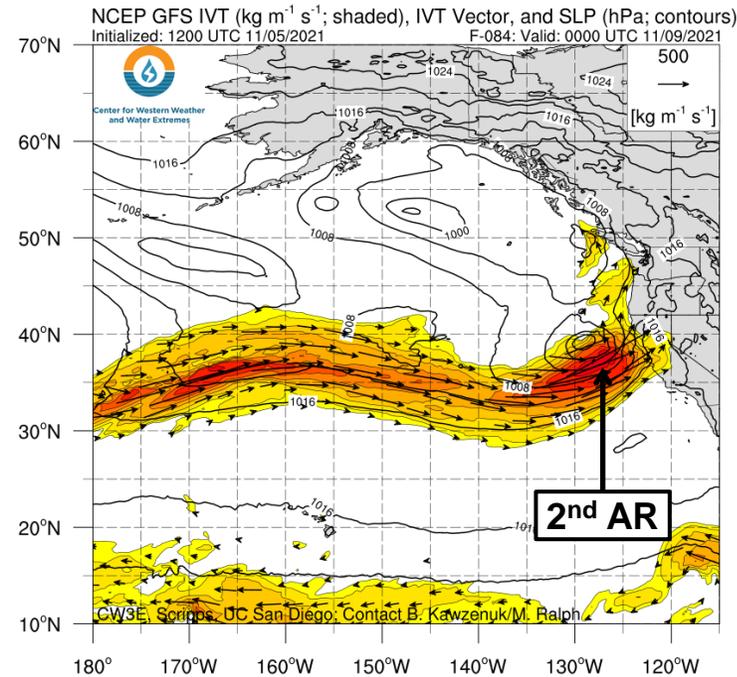
# AR Outlook: 5 Nov 2021

## GEFS IVT & IWV Forecasts

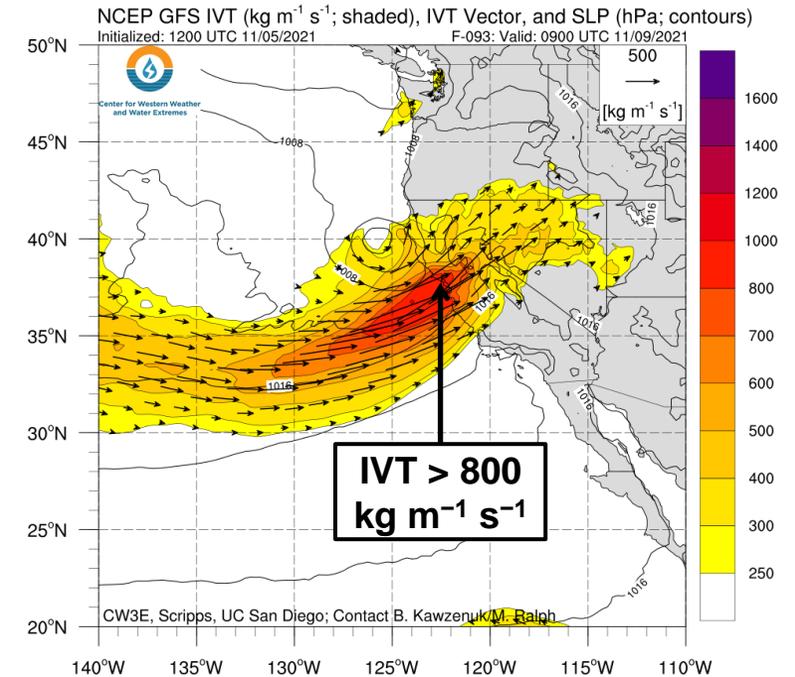
(A) Valid: 5 PM PT 5 Nov (F-12)



(B) Valid: 4 PM PT 8 Nov (F-84)



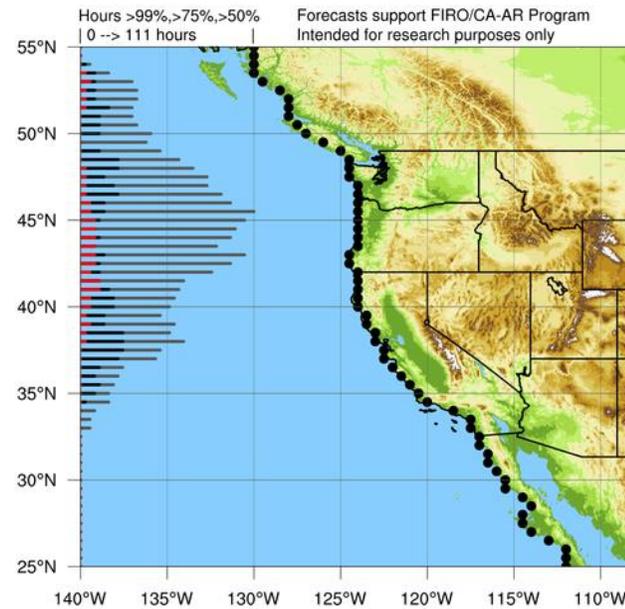
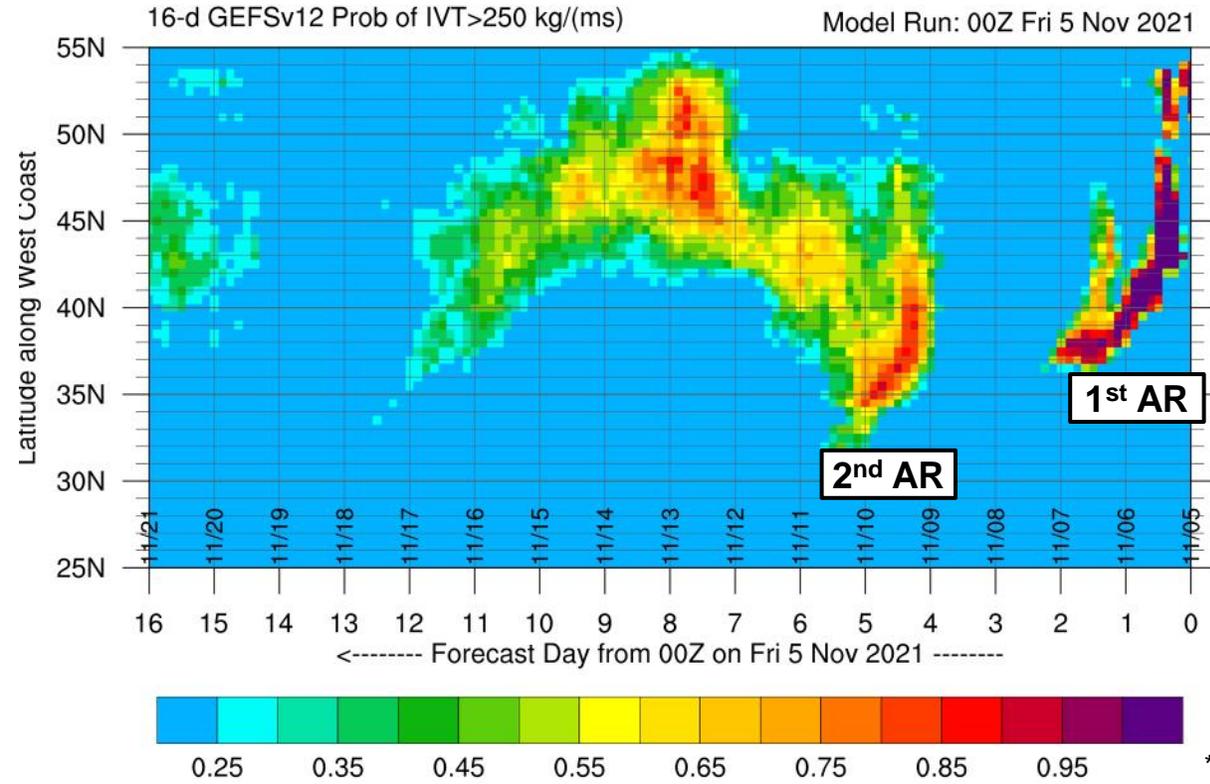
(C) Valid: 1 AM PT 9 Nov (F-93)



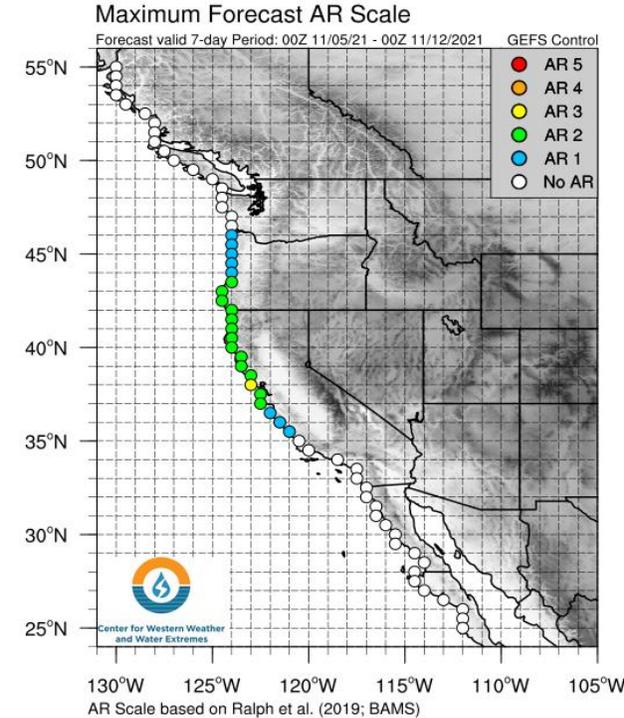
- The first AR made landfall along the US West Coast this morning and will continue to bring AR conditions to Northern California into tomorrow (Figure A)
- A stronger AR is forecasted to make landfall over California on 8 Nov (Figure B)
- The strongest moisture transport is forecasted to occur over the San Francisco Bay Area early on 9 Nov
- The 12Z deterministic GFS is forecasting maximum IVT values  $> 800 \text{ kg m}^{-1} \text{ s}^{-1}$

# AR Outlook: 5 Nov 2021

## Probability of AR Conditions Along Coast – GEFS



## AR Scale

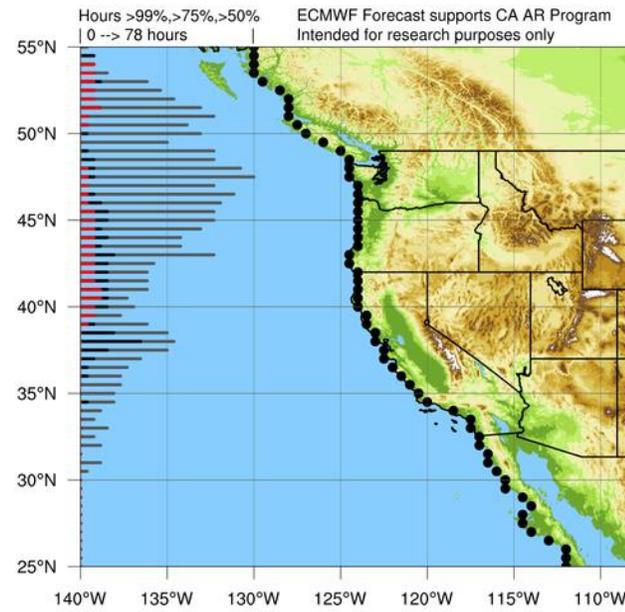
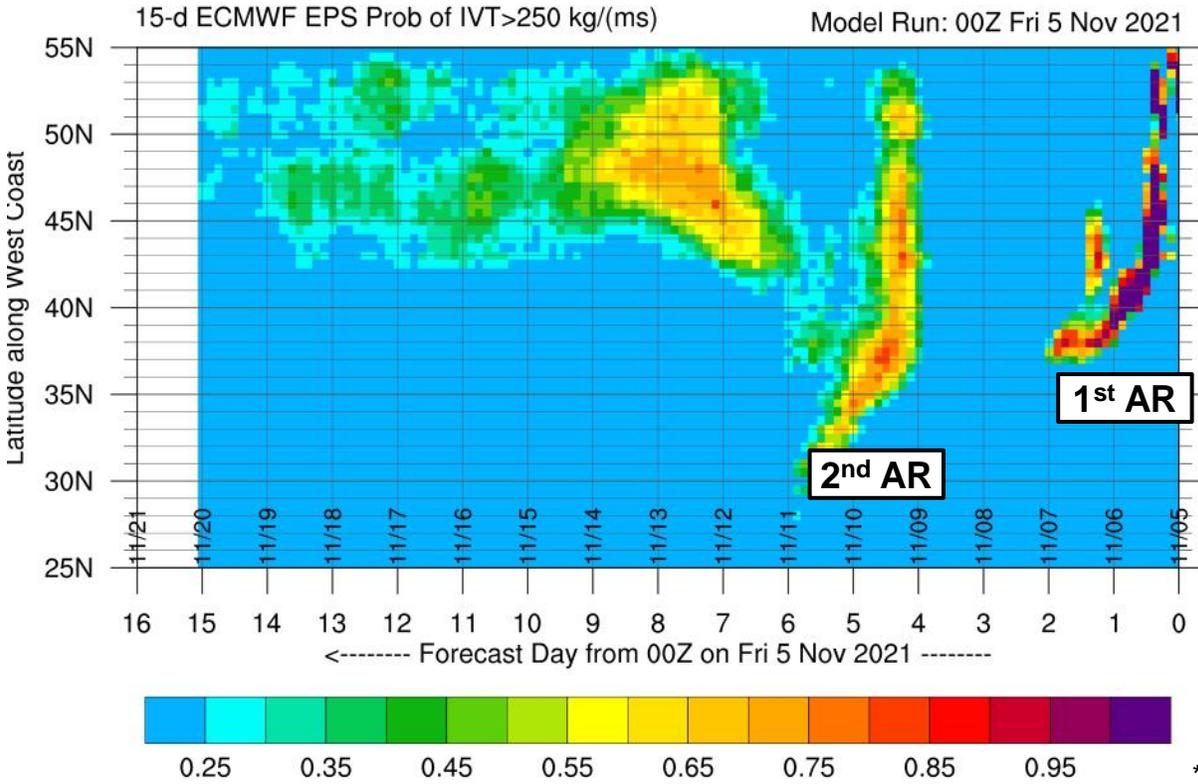


\*GEFS = NCEP Global Ensemble Forecast System (United States)

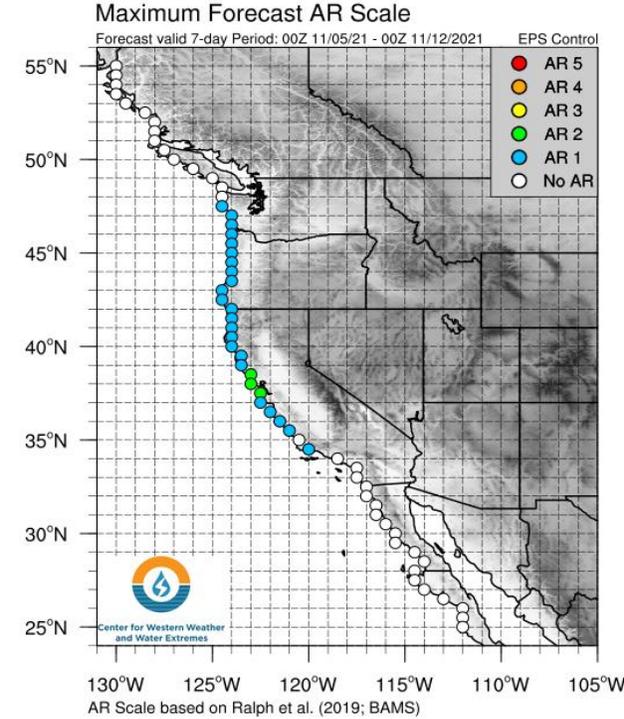
- The 00Z GEFS is showing very high confidence (> 95% probability) in a period of AR conditions (IVT > 250 kg m<sup>-1</sup> s<sup>-1</sup>) over coastal Northern California, Oregon, and Washington in association with the first AR
- The GEFS is also showing high confidence (> 80% probability) in landfalling AR activity over California on 8–9 Nov in association with the second AR
- Some ensemble members are forecasting AR conditions to persist after the second AR dissipates in Northern California and Oregon
- The GEFS control run is forecasting an AR 3 (based on the Ralph et al. 2019 AR Scale) near Point Reyes, CA, and AR 1/AR 2 conditions elsewhere in Central and Northern California

# AR Outlook: 5 Nov 2021

## Probability of AR Conditions Along Coast – ECMWF Ensemble



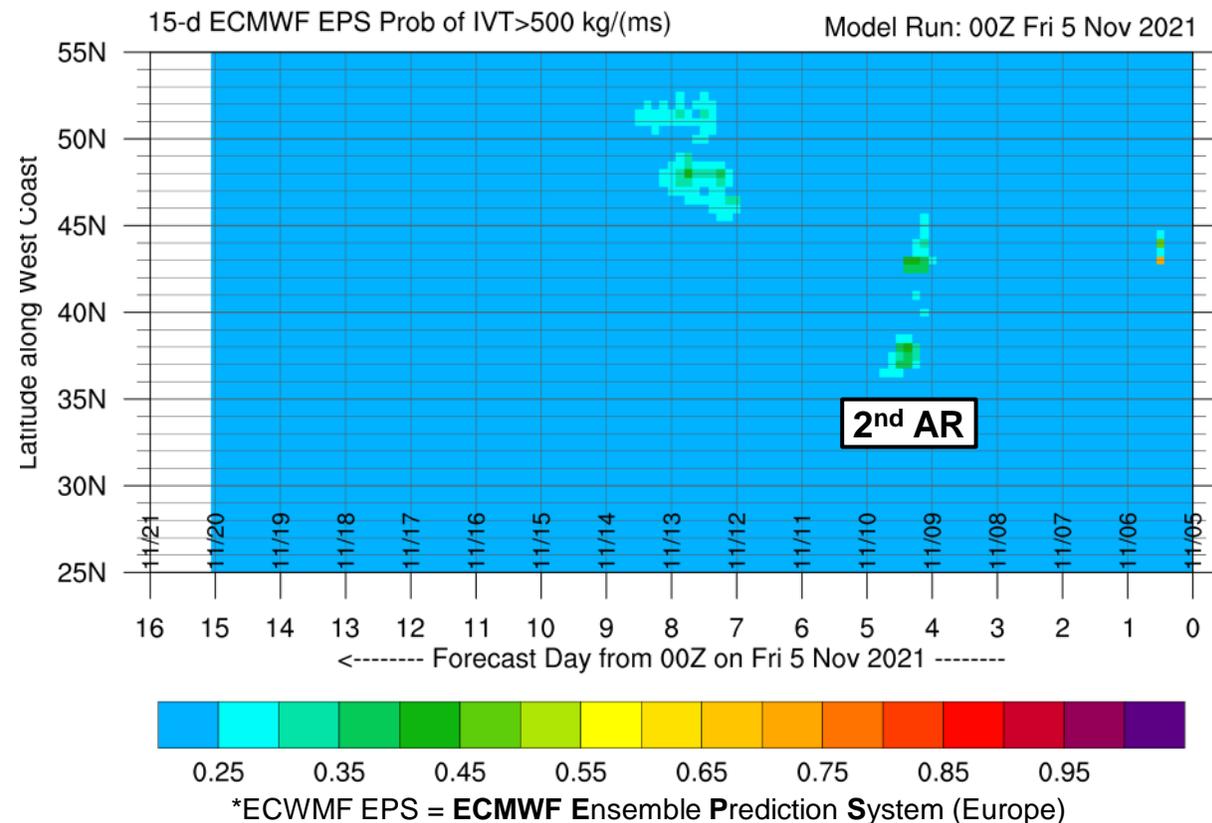
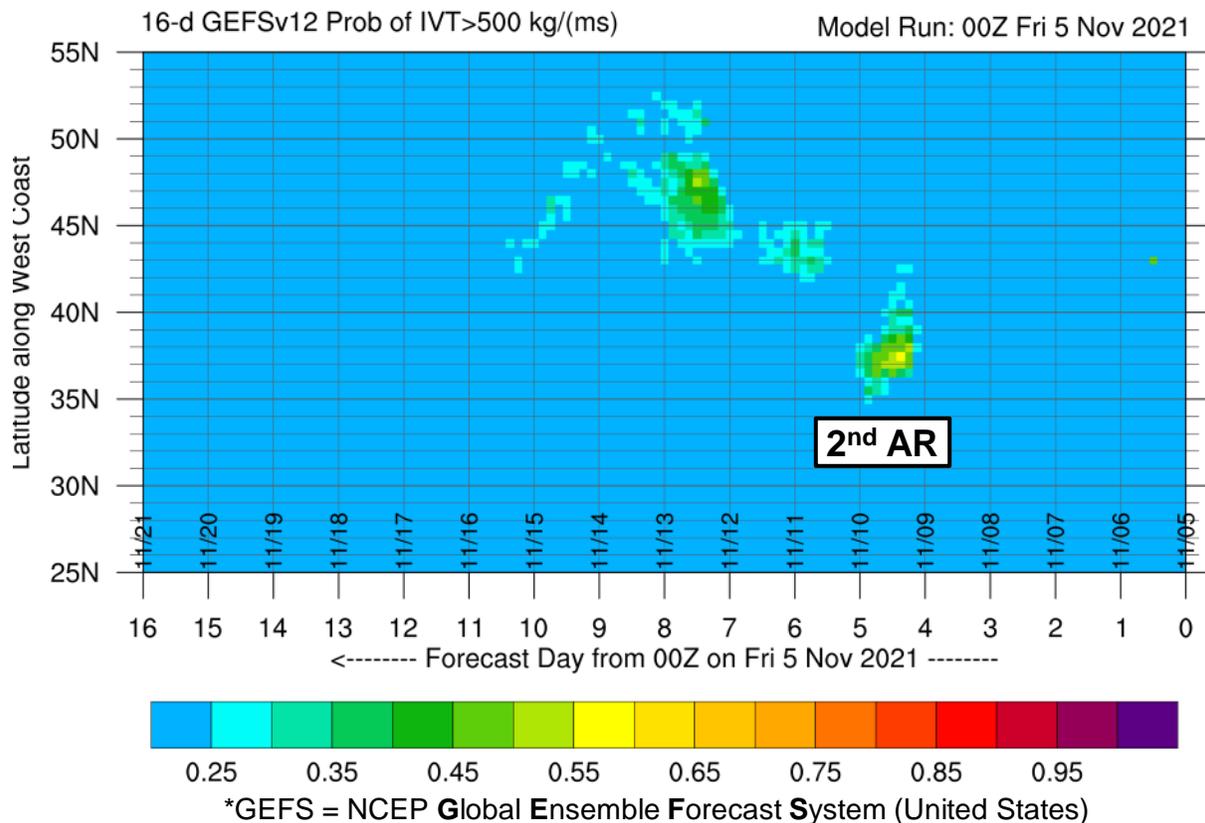
## AR Scale



\*ECMWF EPS = ECMWF Ensemble Prediction System (Europe)

- The 00Z ECMWF EPS is also showing an elevated probability of AR conditions over coastal California in association with the second AR, but forecast confidence in landfalling AR activity is somewhat lower in Central and Northern California compared to the GEFS
- The ECMWF EPS control run is forecasting an AR 2 in the San Francisco Bay Area and an AR 1 elsewhere in Central and Northern California

## Probability of Moderate AR Conditions Along Coast – GFS Ensemble vs ECWME Ensemble

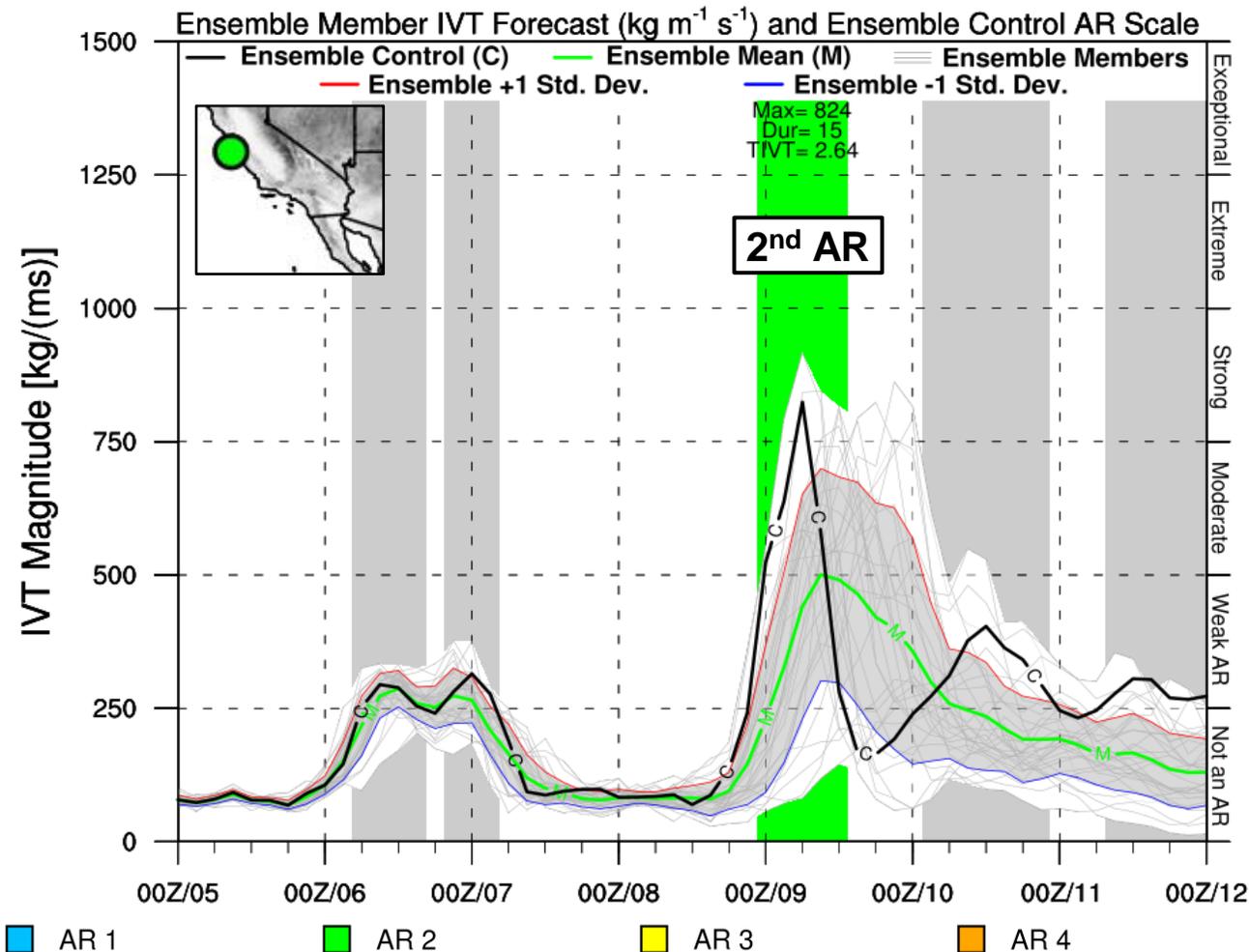


- The 00Z GEFS is showing higher confidence in a period of moderate AR conditions ( $IVT > 500 \text{ kg m}^{-1} \text{ s}^{-1}$ ) along the California coast between Monterey and Sonoma Counties compared to the 00Z ECMWF EPS
- The strongest moisture transport is most likely to occur Monday night/early Tuesday morning, shortly after the predicted AR landfall

# AR Outlook: 5 Nov 2021

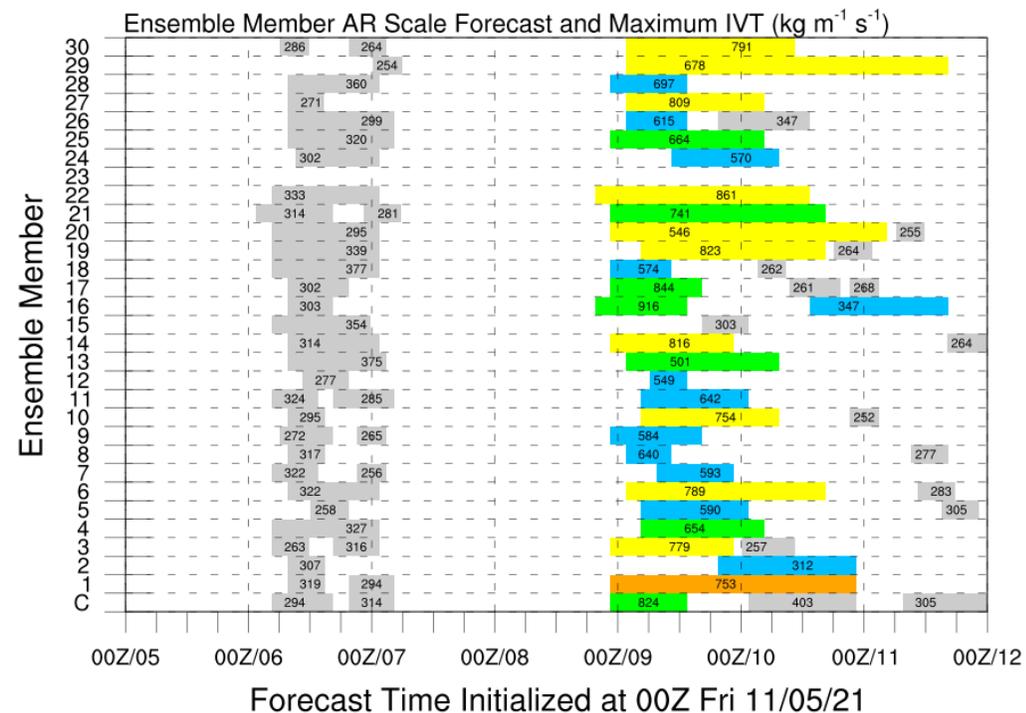
## GEFS AR Scale and IVT Forecasts

GFS Ensemble Initialized: 00Z Fri 11/05/21



Categorical AR Strength by Ralph/CW3E

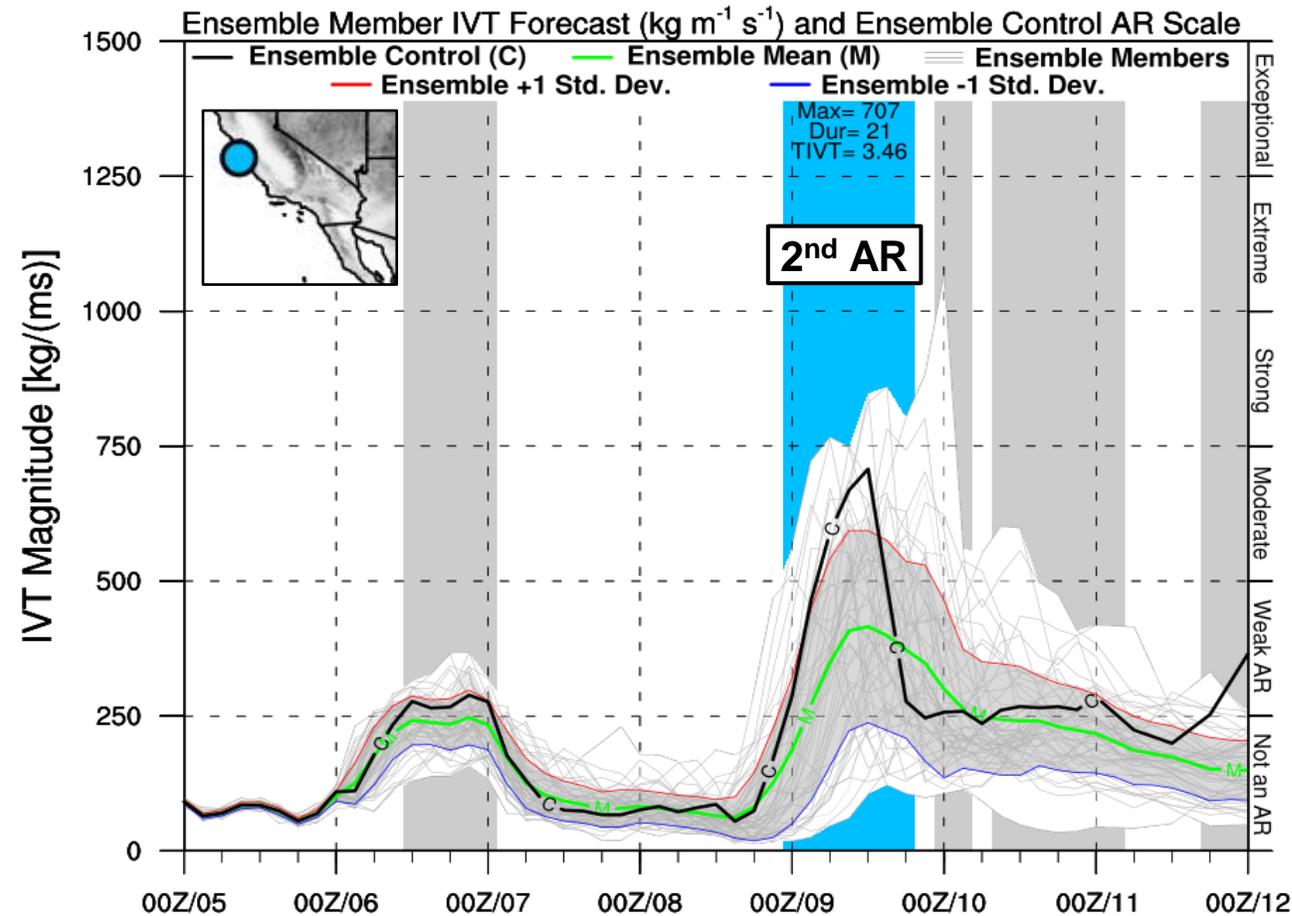
- The 00Z GEFS control run is forecasting an AR 2 at 37°N, 122.5°W (near Santa Cruz, CA) in association with the second AR
- There is a large degree of uncertainty in the timing, duration, and magnitude of AR conditions
- 35% of GEFS members are predicting an AR 3 or greater, 23% are predicting an AR 2, and 35% are predicting an AR 1



# AR Outlook: 5 Nov 2021

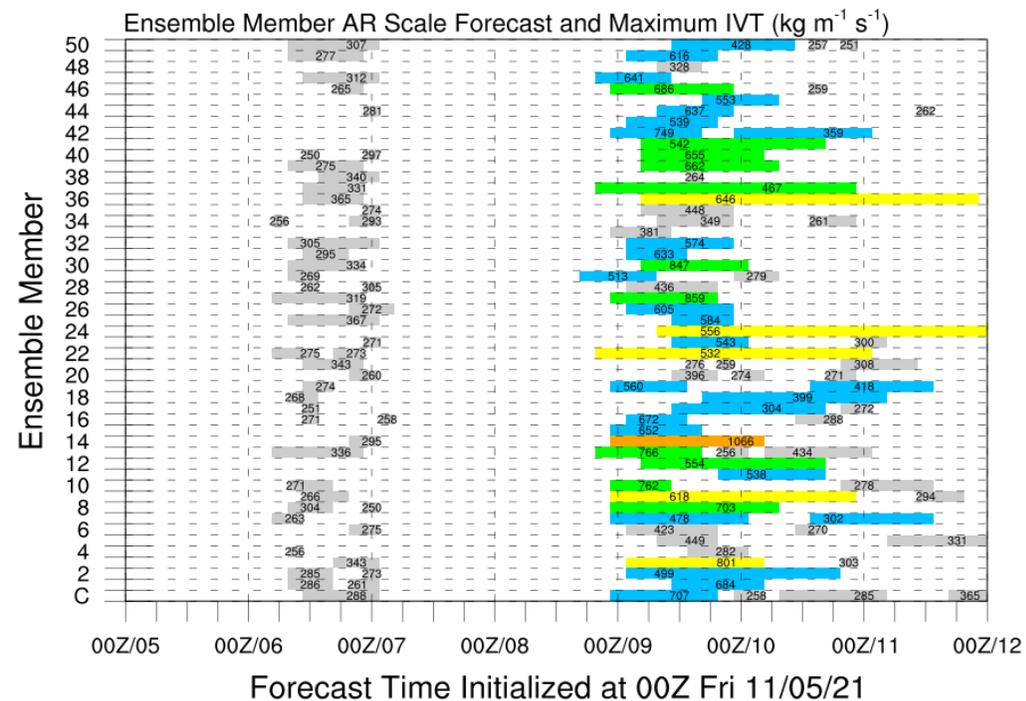
## GEFS AR Scale and IVT Forecasts

ECMWF Ensemble Initialized: 00Z Fri 11/05/21



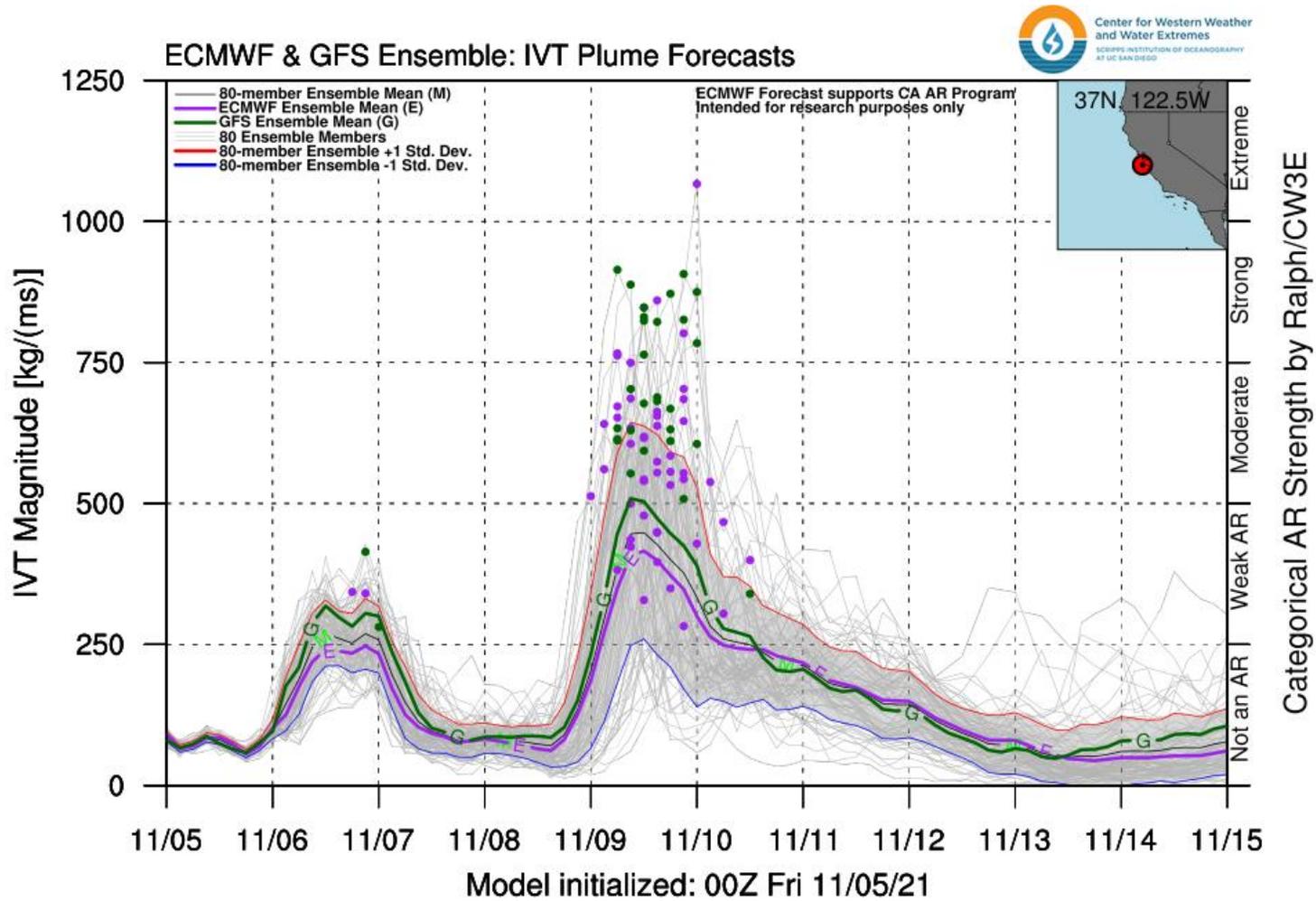
Categorical AR Strength by Ralph/CW3E

- The 00Z ECMWF EPS control run is forecasting an AR 1 at 37°N, 122.5°W (near Santa Cruz, CA) in association with the second AR
- Note that the forecast maximum IVT is lower and occurs 6 hours later compared to the GEFS control run
- Similar to GEFS, there is considerable uncertainty in the timing, duration, and magnitude of AR conditions
- Only 12% of ECMWF EPS members are predicting an AR 3 or greater, whereas 45% are predicting an AR 1



■ AR 1   
 ■ AR 2   
 ■ AR 3   
 ■ AR 4   
 ■ AR 5

# AR Outlook: 5 Nov 2021

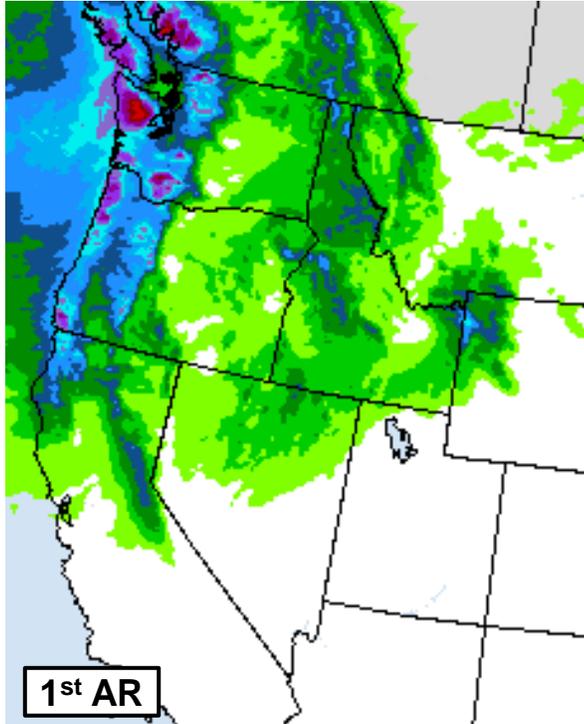


- As noted in the previous two slides, there is very large forecast spread in the IVT magnitude starting around 00Z 9 Nov (4 PM PT 8 Nov)
- The GFS ensemble mean peak IVT magnitude (green line) is about  $100 \text{ kg m}^{-1} \text{ s}^{-1}$  higher than the ECMWF ensemble mean peak IVT magnitude (purple line)
- The GEFS and ECMWF EPS control runs are both forecasting peak IVT values  $> 1$  standard deviation above the 80-member ensemble mean
- There is considerable uncertainty in the timing of the strongest moisture transport, as well as the duration of continuous AR conditions ( $\text{IVT} > 250 \text{ kg m}^{-1} \text{ s}^{-1}$ )

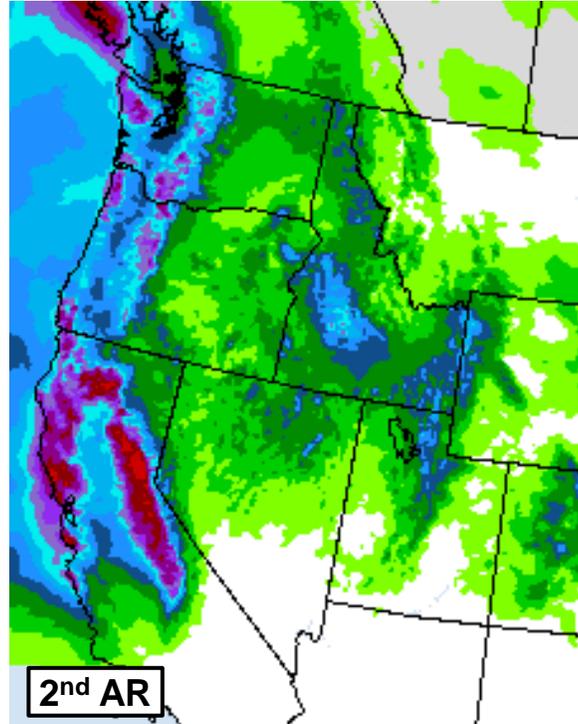
# AR Outlook: 5 Nov 2021



WPC 48-h QPF:  
Valid 00Z 6–8 Nov

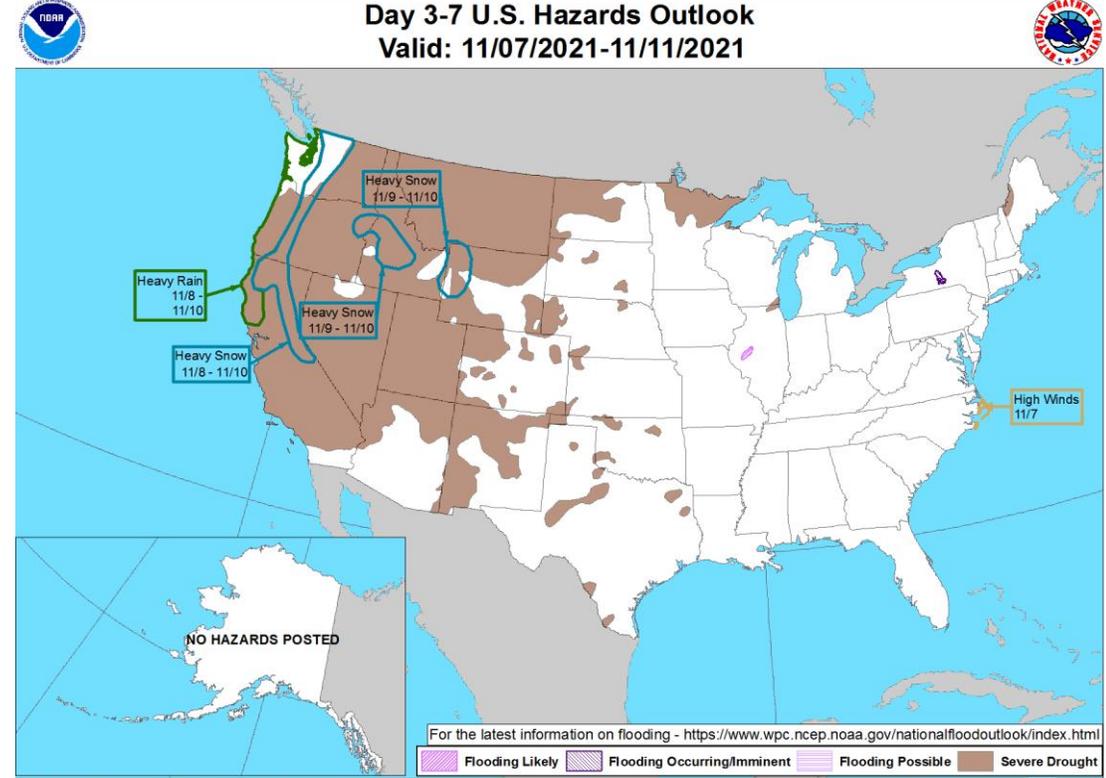


WPC 48-h QPF:  
Valid 00Z 9–11 Nov



Source: NOAA/NWS WPC, <https://www.wpc.ncep.noaa.gov/>

Day 3-7 U.S. Hazards Outlook  
Valid: 11/07/2021-11/11/2021



Weather Prediction Center

Made: 11/04/2021 3PM EDT

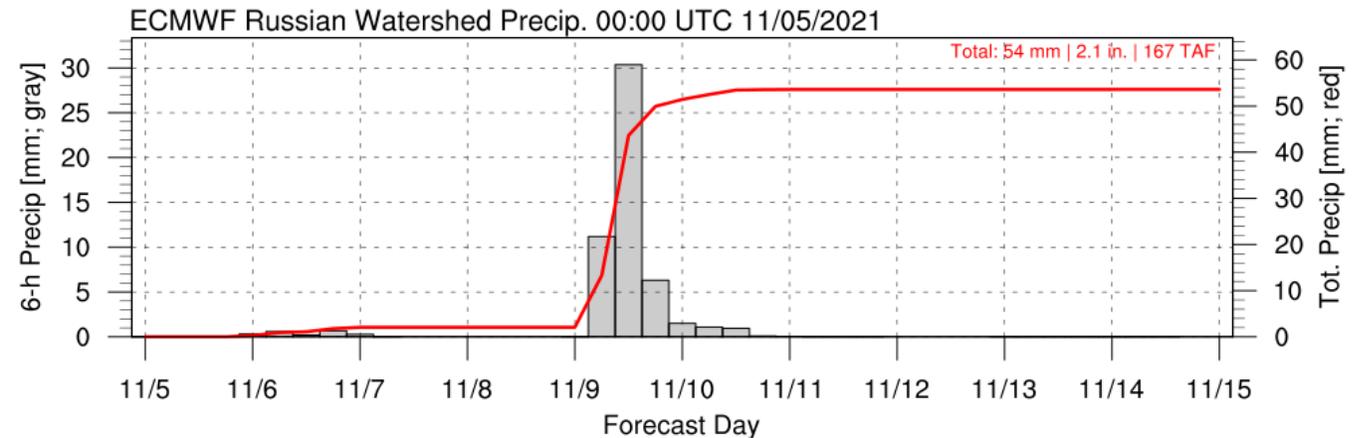
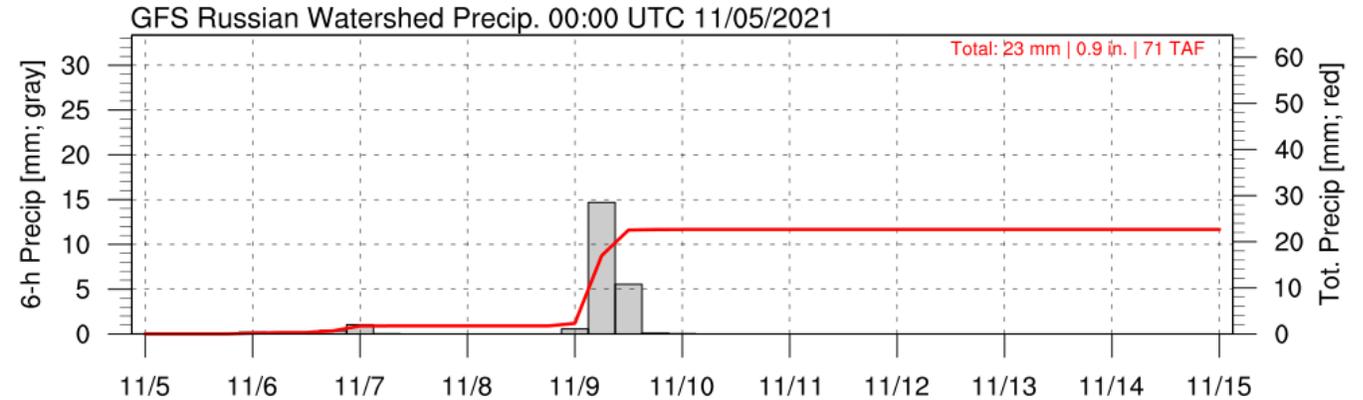
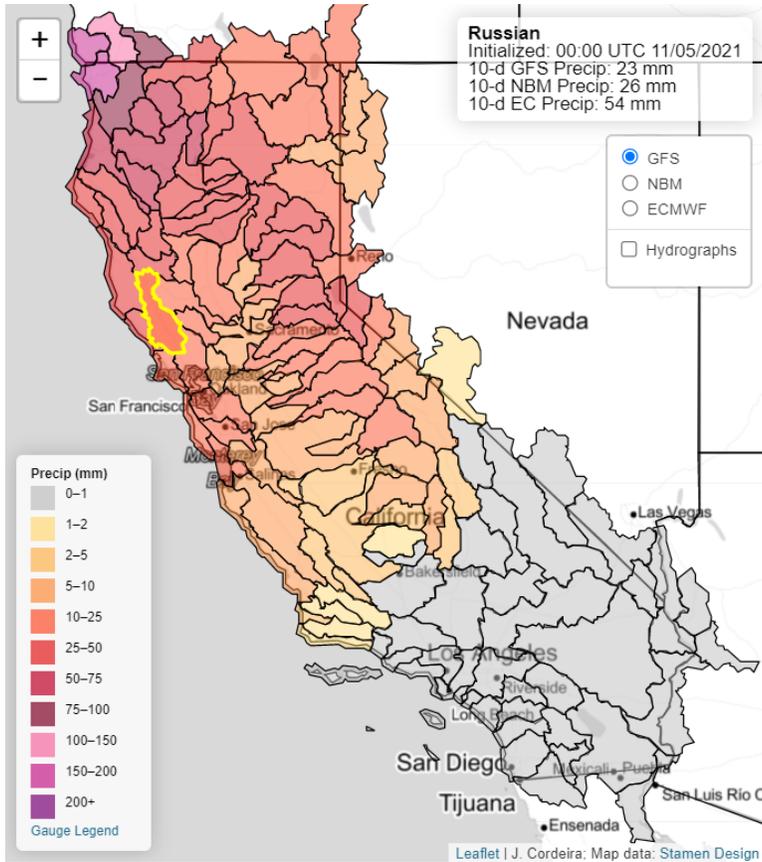
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- The first AR is forecasted to produce an additional 1–4 inches of precipitation in the Cascades and the Coast Ranges in Washington, Oregon, and far northern California
- The second AR is forecasted to bring 2–4 inches of precipitation to the Northern and Central California Coast Ranges, the Klamath Mountains, and the Sierra Nevada
- The NWS Weather Prediction Center (WPC) continues to highlight the possibility of heavy rain along the US West Coast and heavy snow in the Cascades and Sierra Nevada during 8–10 Nov

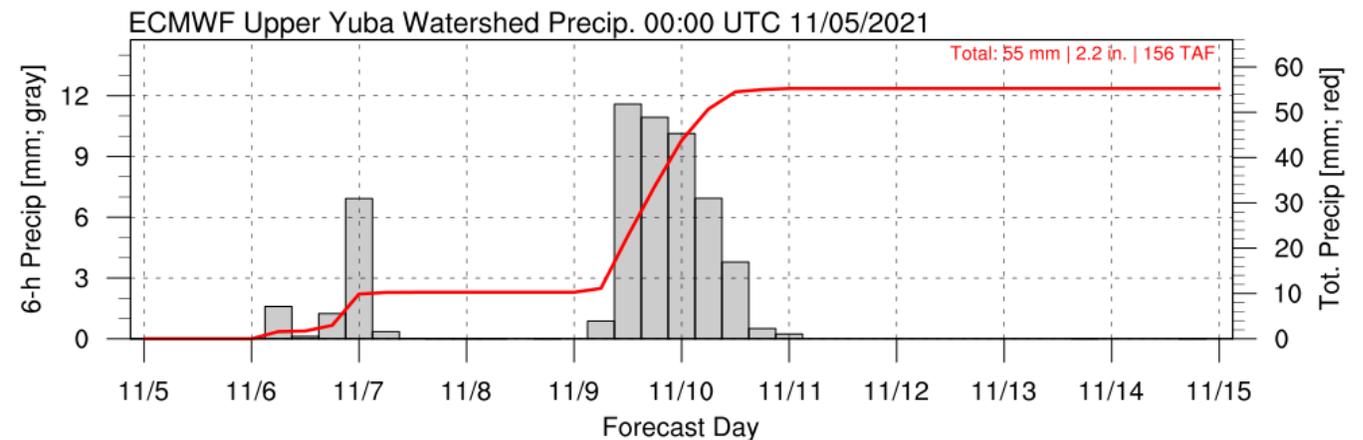
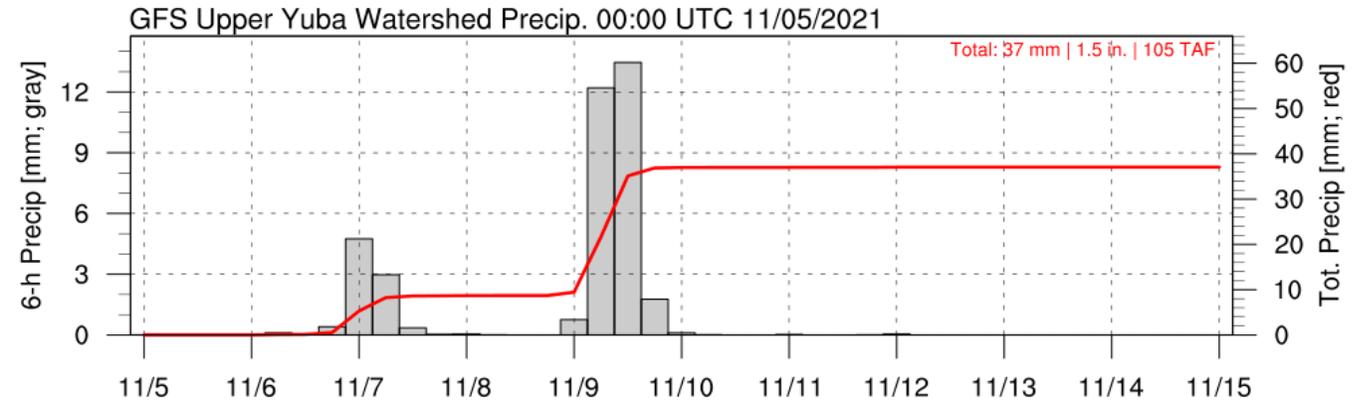
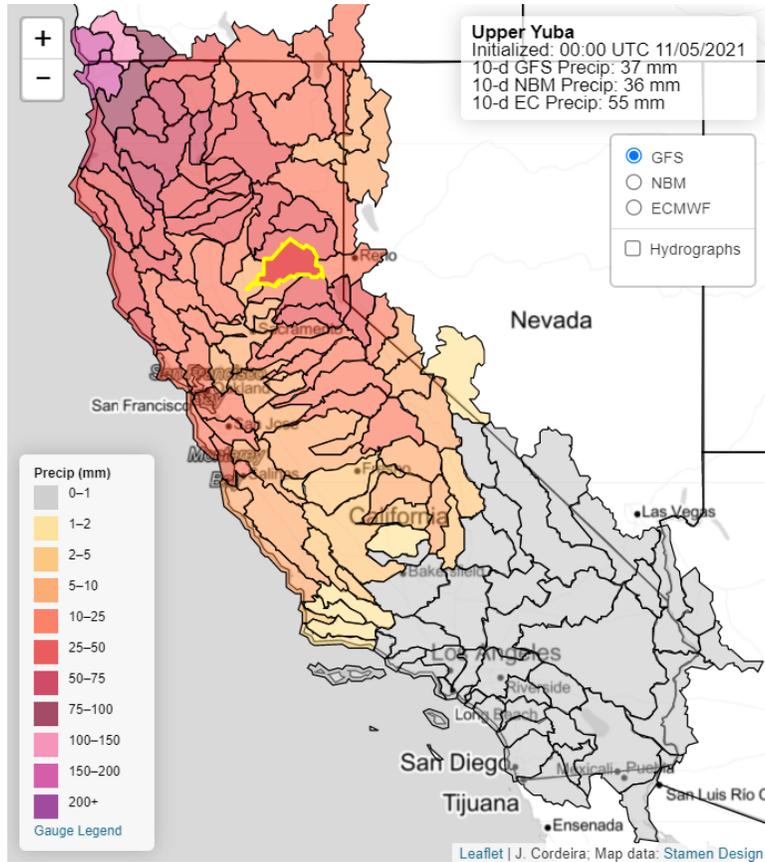
# AR Outlook: 5 Nov 2021

## 10-day Watershed Precipitation Forecasts: Russian River Watershed



- The 00Z deterministic GFS and ECMWF models are forecasting 0.9 inches (71 TAF) and 2.1 inches (167 TAF) of total areal mean precipitation, respectively, in the Russian River watershed over the next 10 days
- The timing of the most intense precipitation during the second AR is about 6 hours earlier in the GFS model
- The ECMWF model is forecasting a longer-duration precipitation event, with precipitation continuing into 10 Nov

## 10-day Watershed Precipitation Forecasts: Upper Yuba Watershed



- The 00Z deterministic GFS and ECMWF models are forecasting 1.5 inches (105 TAF) and 2.2 inches (156 TAF) of total areal mean precipitation, respectively, in the Upper Yuba watershed over the next 10 days
- The onset of the heaviest precipitation associated with the second AR is 6 hours earlier in the GFS model
- The ECMWF model is forecasting a longer-duration precipitation event, with precipitation continuing into 10 Nov