CW3E Atmospheric River Outlook: 8 Dec 2021

Potential for Long-duration Atmospheric River and Heavy Precipitation in California

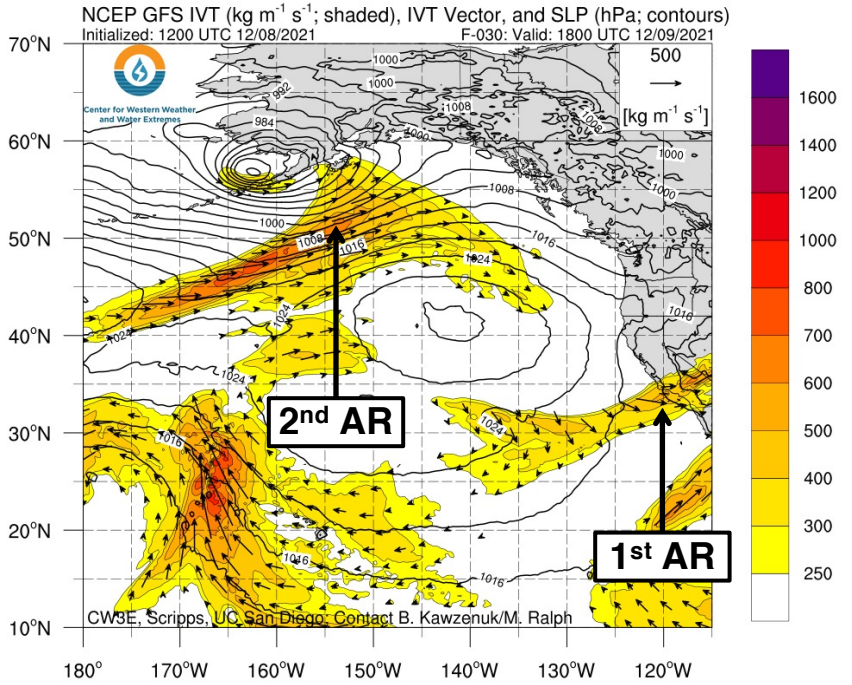
- A weak system will bring AR conditions and light-to-moderate precipitation to Southern California and the Colorado River Basin tomorrow
- A stronger and more complex system is forecasted to bring landfalling AR activity and heavy precipitation to much of California early next week
- There is still considerable uncertainty in the timing, magnitude, and duration of AR conditions and precipitation, but the forecast models are starting to converge toward a similar outcome
- The 00Z ECMWF EPS control run is forecasting AR 4 conditions over the San Francisco Bay Area, whereas the 00Z GEFS control run is only forecasting an AR 1 at this location
- The NWS Weather Prediction Center is forecasting more than 5 inches of total precipitation over the Pacific Coast Ranges and the Sierra Nevada during the next 7 days
- The 00Z GFS and ECMWF models were showing large differences in forecasted precipitation in association with the second AR over the Russian River watershed

Atmospheric River Outlook: 8 Dec 2021

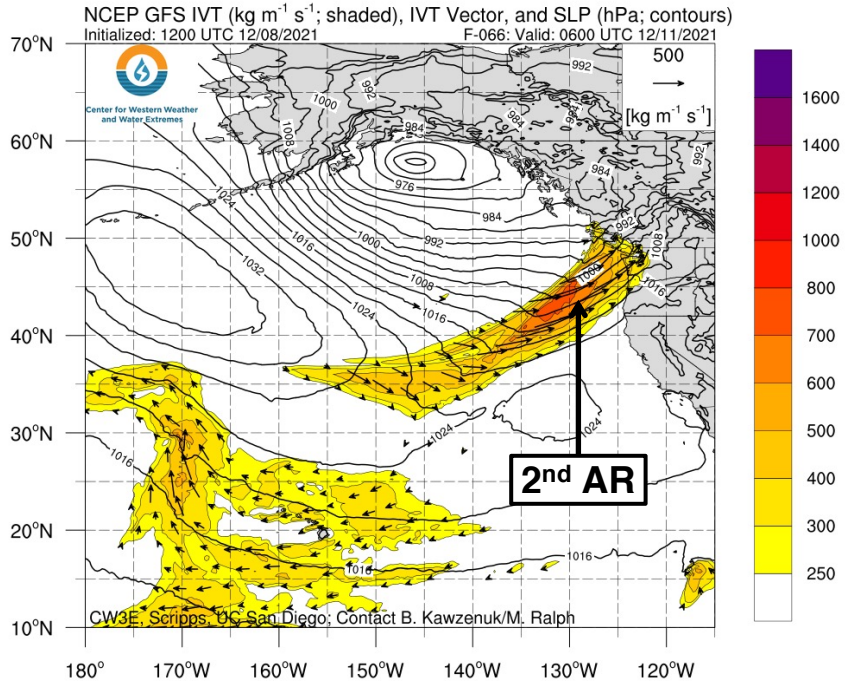
For California DWR's AR Program

GFS IVT & IWV Forecasts

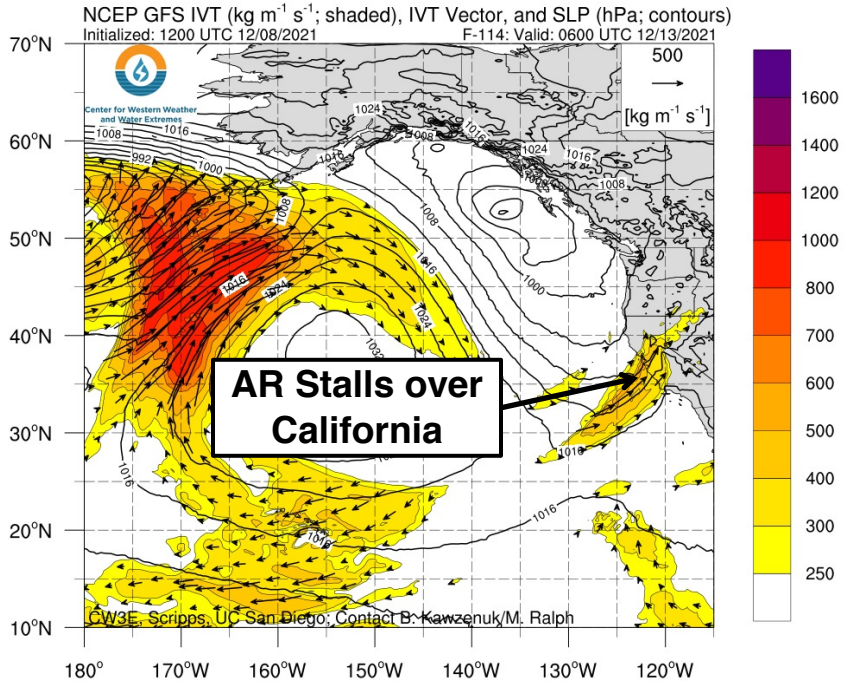
(A) Valid: 10 AM PT 9 Dec (F-30)



(B) Valid: 10 PM PT 10 Dec (F-66)



(C) Valid: 10 PM PT 12 Dec (F-114)



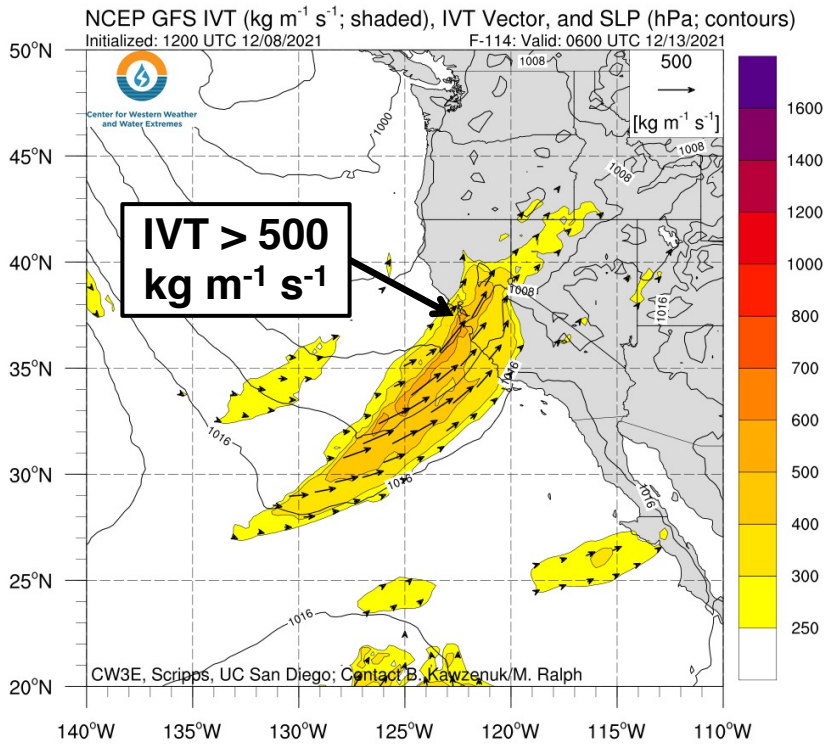
- A weak AR will make landfall over Central California tonight and impact Southern California and the Colorado River Basin tomorrow (Figure A)
- A second AR is forecast to make landfall over the Pacific Northwest on 10 Dec and gradually move down the US West Coast (Figure B)
- This AR is forecast to eventually stall and re-intensify over California as it interacts with an upper-level trough to the west

Atmospheric River Outlook: 8 Dec 2021

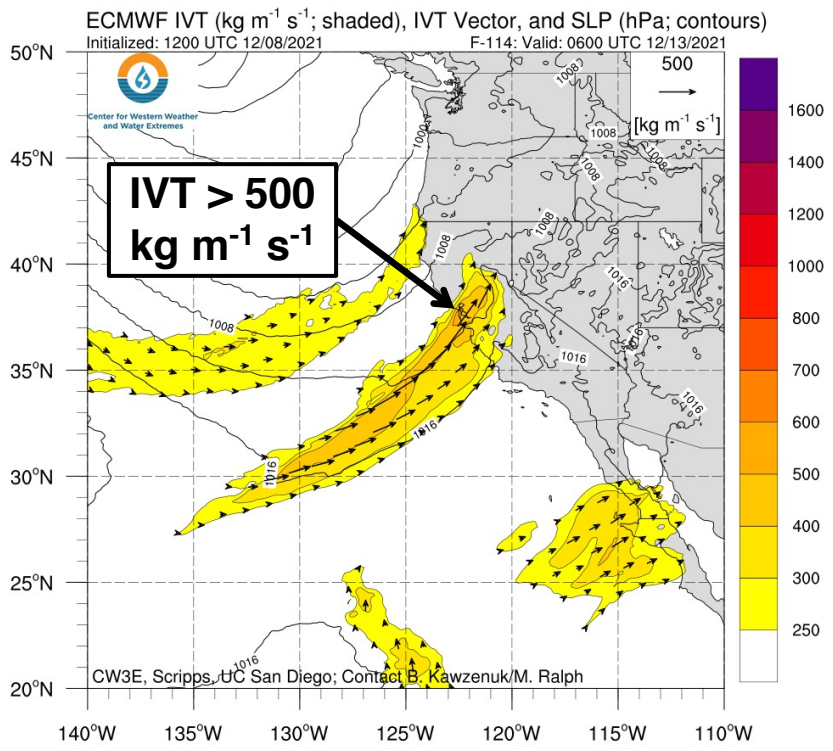
For California DWR's AR Program

GFS vs. ECMWF IVT Forecasts: Valid 10 PM PT 12 Dec (F-114)

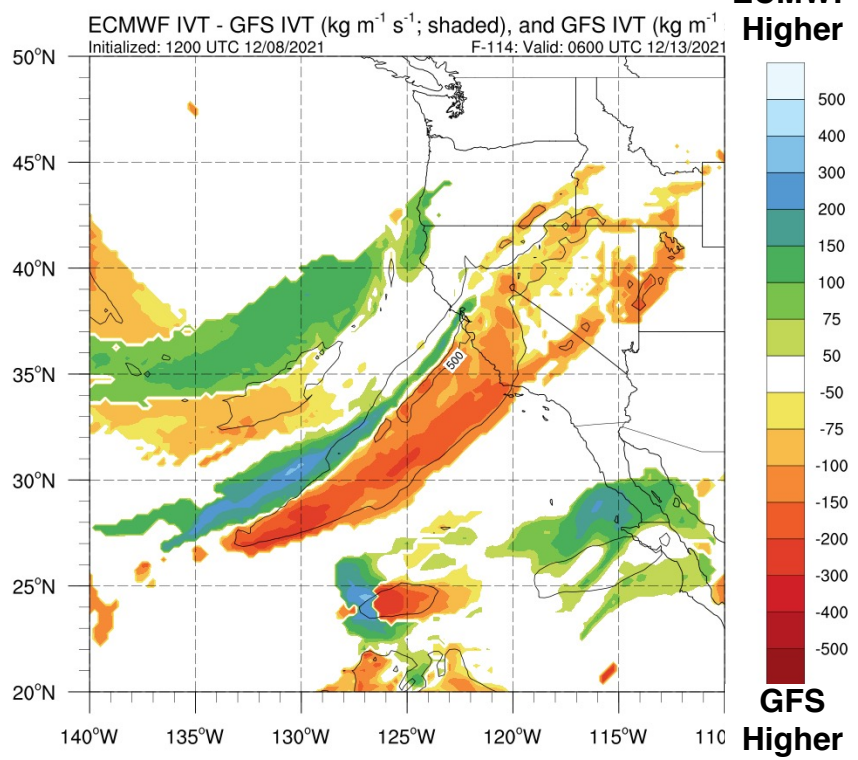
(A) GFS



(B) ECMWF



(C) ECMWF - GFS



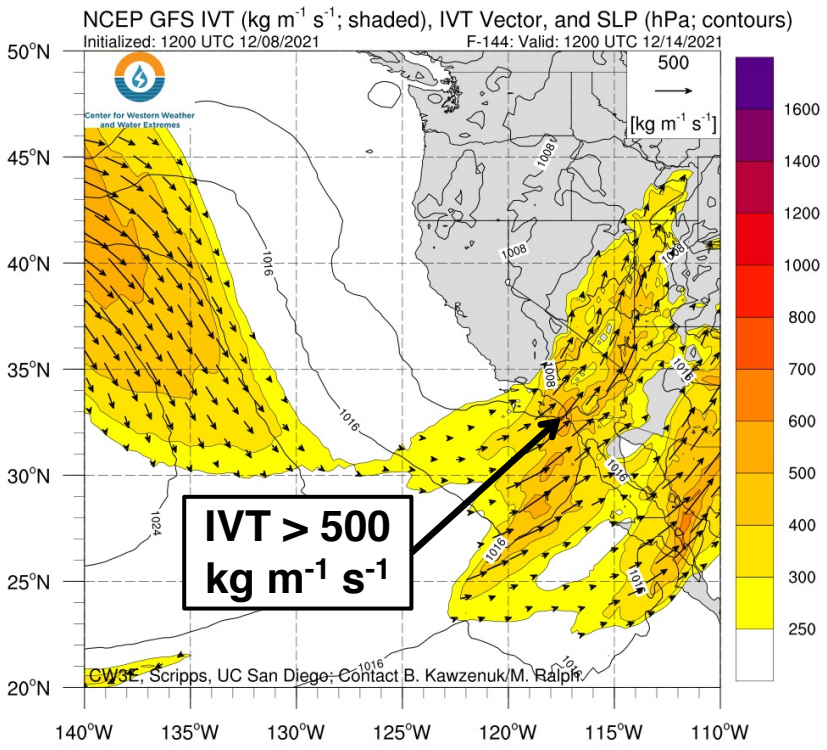
- The AR that is forecast to make landfall in the Pacific Northwest on 10 Dec will move down along the U.S. West Coast
- The 12Z GFS and 12Z ECMWF deterministic models are forecasting maximum IVT values between 400 and 500 kg m^{-1} s^{-1} near the San Francisco Bay Area (Figures A and B)
- Confidence in the timing and strength of this portion of the AR is growing as the models converge over time. However, the ECMWF forecast is slower in bringing IVT southward (Figure C)

Atmospheric River Outlook: 8 Dec 2021

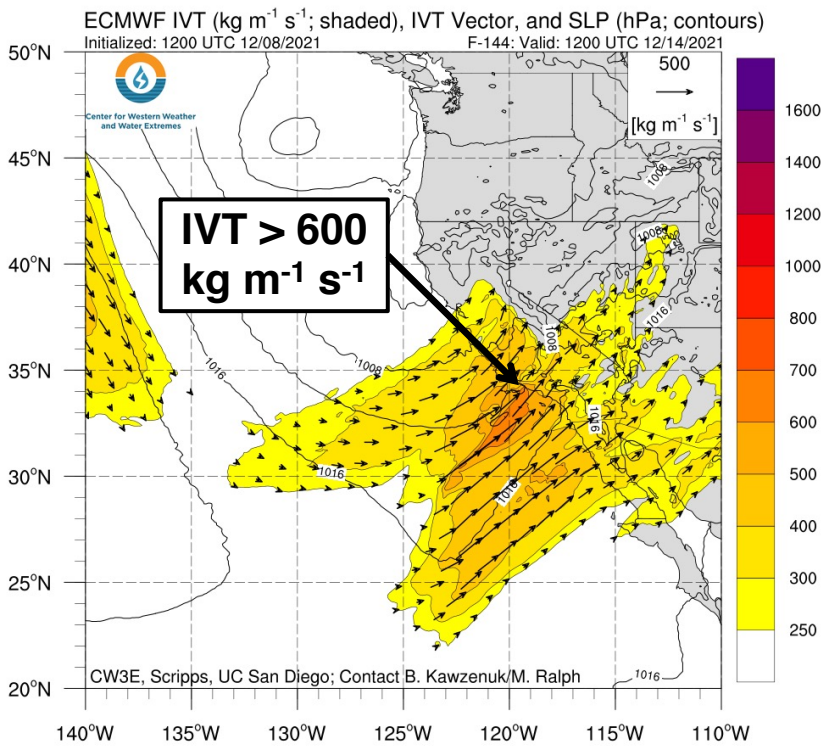
For California DWR's AR Program

GFS vs. ECMWF IVT Forecasts: Valid 4 AM PT 14 Dec (F-144)

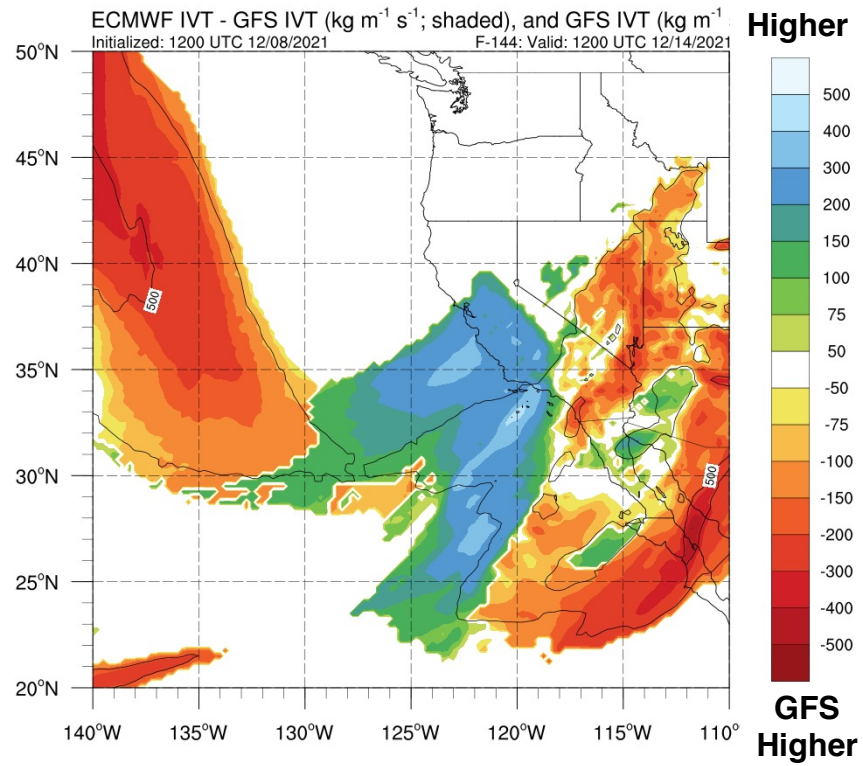
(A) GFS



(B) ECMWF



(C) ECMWF - GFS



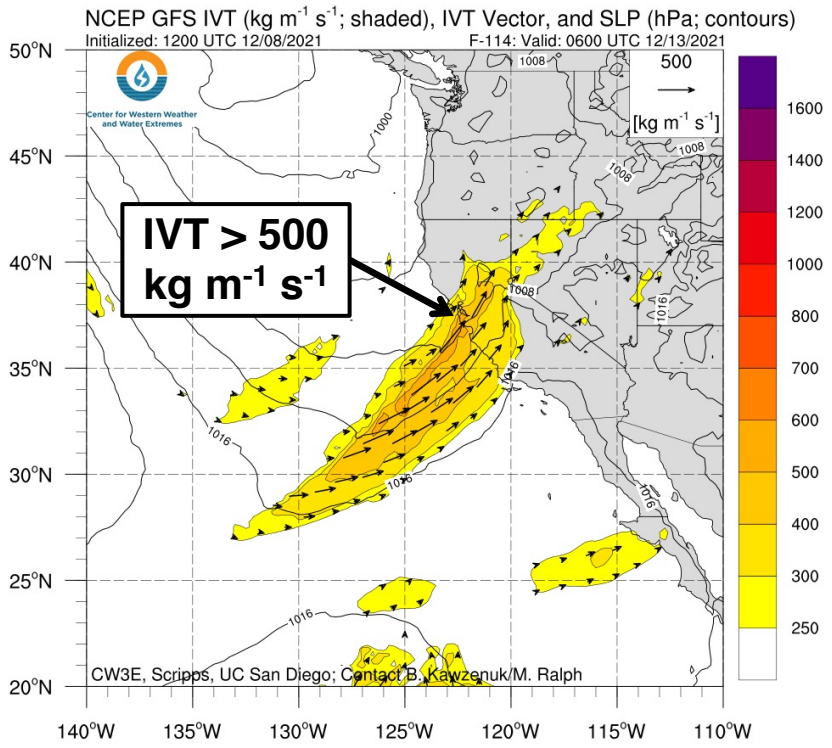
- The 12Z GFS deterministic model is forecasting maximum IVT values between 500 and 600 kg m^{-1} s^{-1} along the coast of San Diego County during the morning of 14 Dec (Figure A)
- The 12Z ECMWF is much slower in bringing the core of AR conditions into Southern California, with maximum IVT values between 600 and 700 kg m^{-1} s^{-1} forecasted off the coast near Oxnard, CA (Figures B and C)

Atmospheric River Outlook: 8 Dec 2021

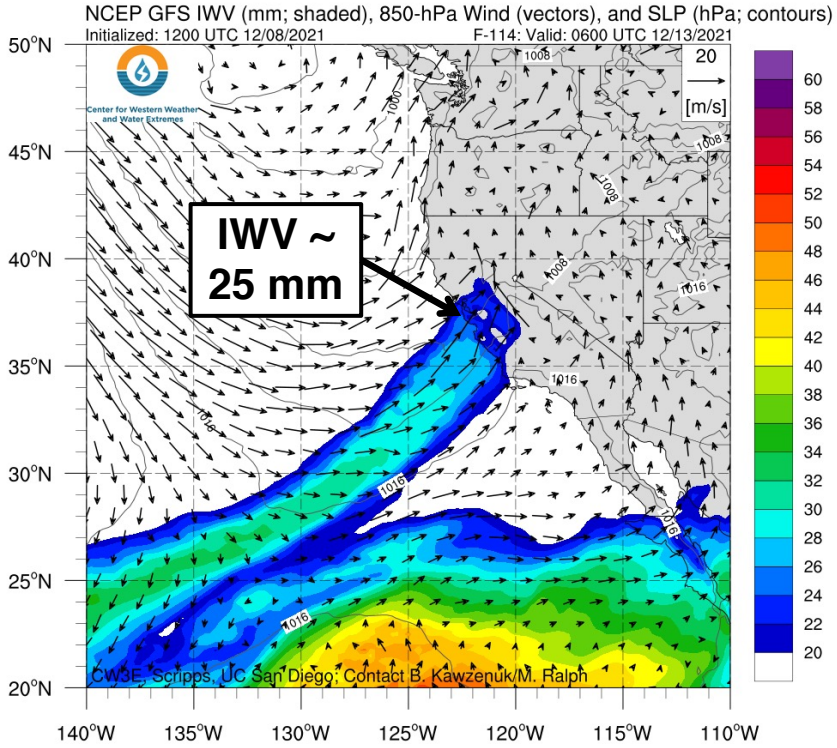
For California DWR's AR Program

GFS IVT, IWV, and 500-mb Forecasts

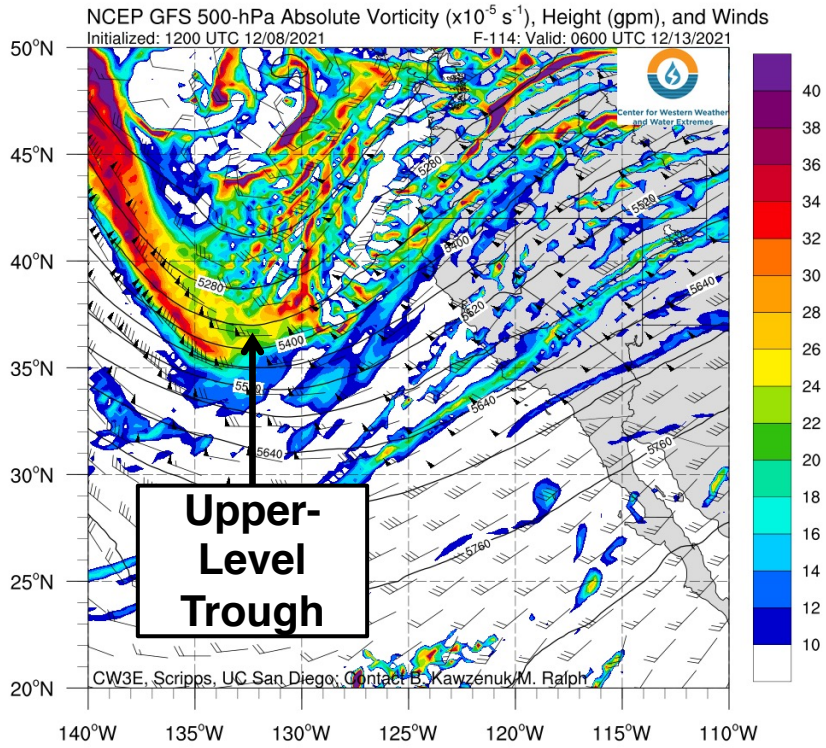
(A) Valid: 10 PM PT 12 Dec (F-114)



(B) Valid: 10 PM PT 12 Dec (F-114)



(C) Valid: 10 PM PT 12 Dec (F-114)

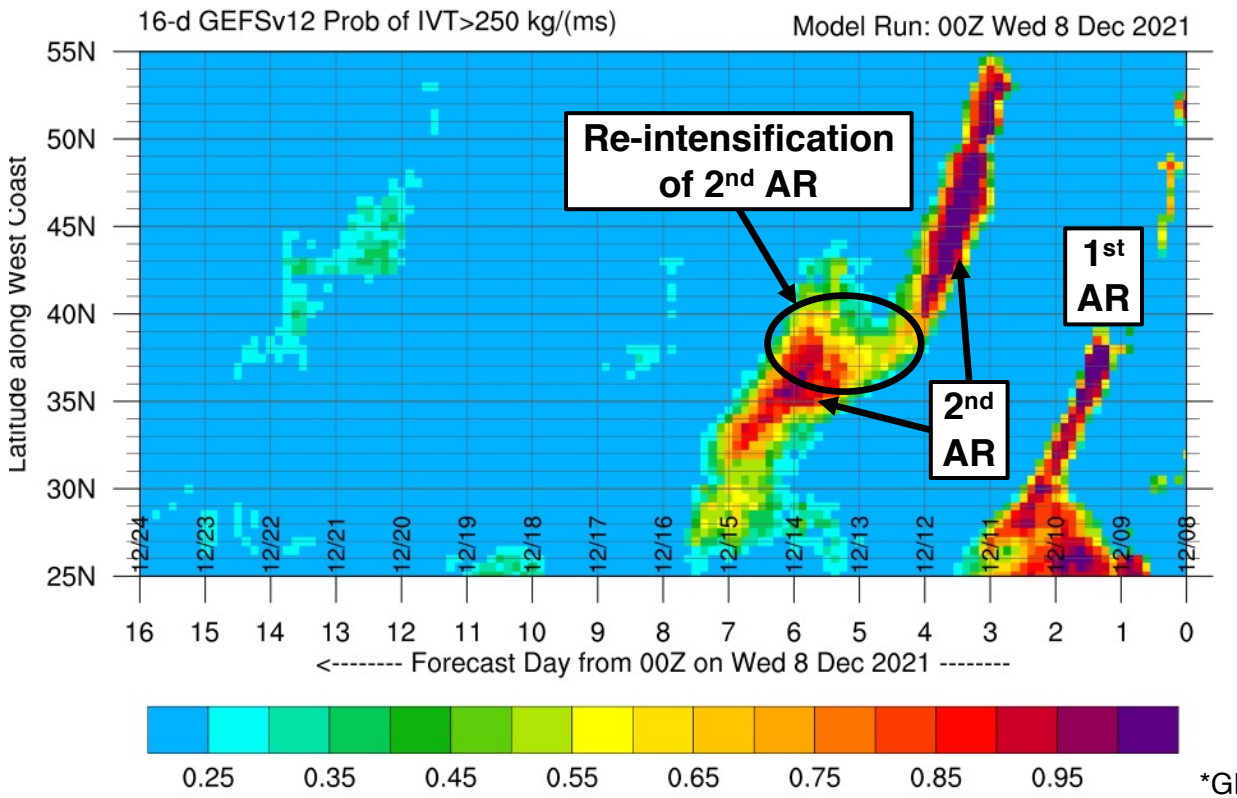


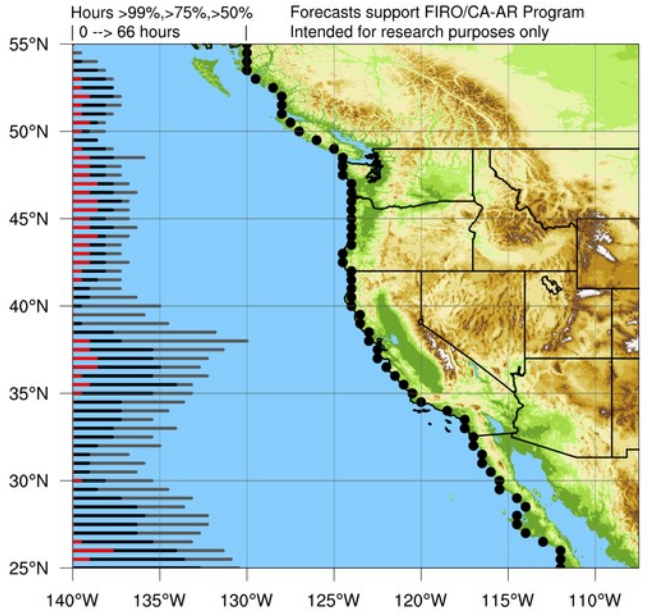
- The 12Z GFS deterministic model is forecasting maximum IVT values between 400 and 500 kg m^{-1} s^{-1} and maximum IWV values ~25 mm near the San Francisco Bay Area (Figures A and B)
- This moisture reaches the US West Coast ahead of an amplifying upper-level trough that eventually sweeps inland across Central California (Figure C)

Atmospheric River Outlook: 8 Dec 2021

For California DWR's AR Program

NCEP Probability of AR Conditions Along Coast

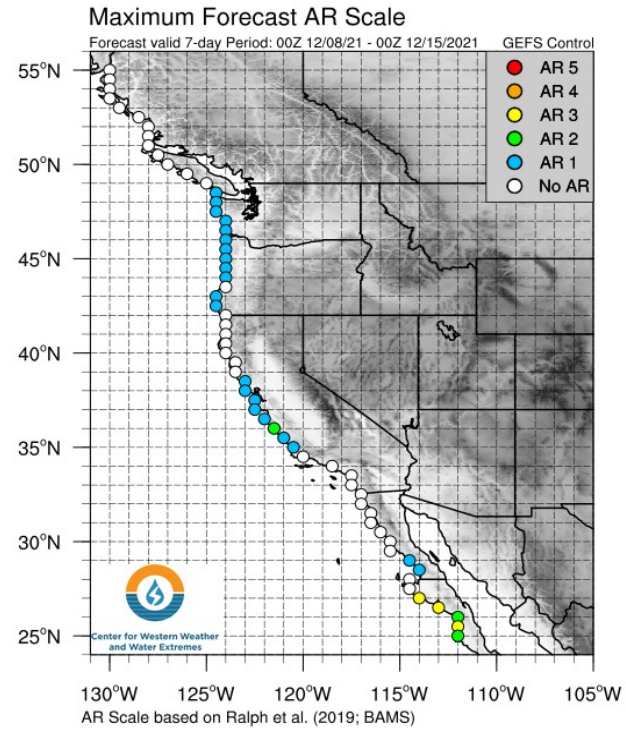




Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

PLYMOUTH STATE METEOROLOGY

AR Scale



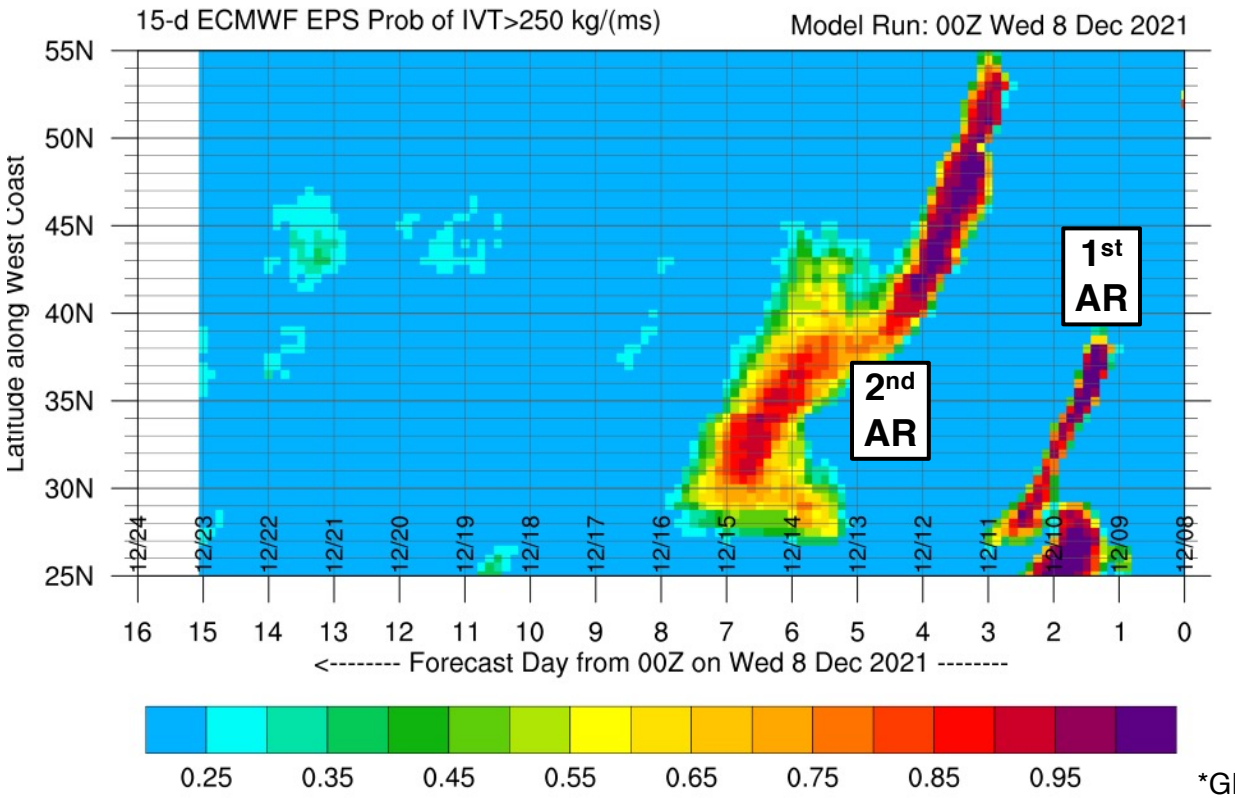
*GEFS = NCEP **G**lobal **E**nsemble **F**orecast **S**ystem (United States)

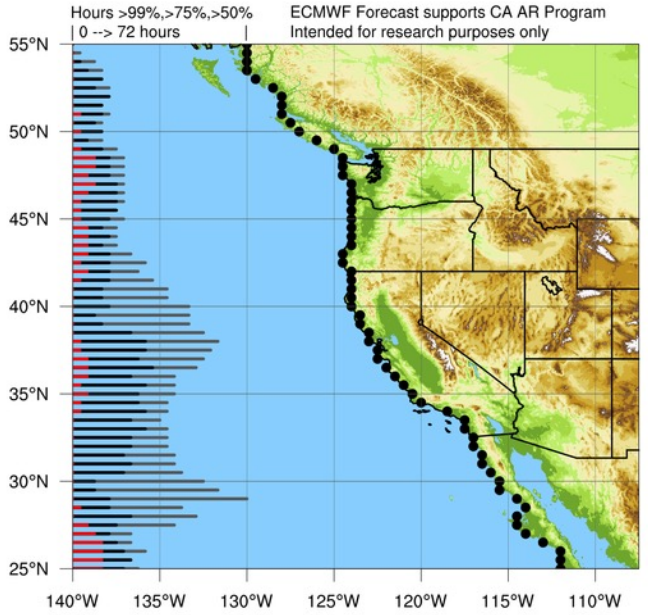
- The 00Z GEFS is showing high confidence (> 90% probability) in a brief period of AR conditions (IVT > 250 kg m^{-1} s^{-1}) over Central and Southern California tonight into tomorrow
- The 00Z GEFS is also showing very high confidence (> 95% probability) in a period of AR conditions between Northern California and southern British Columbia in association with the second AR on 11 Dec
- There is increasing confidence (now > 80% probability) in a period of AR activity over much of California on 13–14 Dec as the second AR interacts with an upper-level trough and re-intensifies
- The 00Z GEFS control run is forecasting AR 1/AR 2 conditions along the Central California coast in association with the second AR

Atmospheric River Outlook: 8 Dec 2021

For California DWR's AR Program

ECMWF Probability of AR Conditions Along Coast





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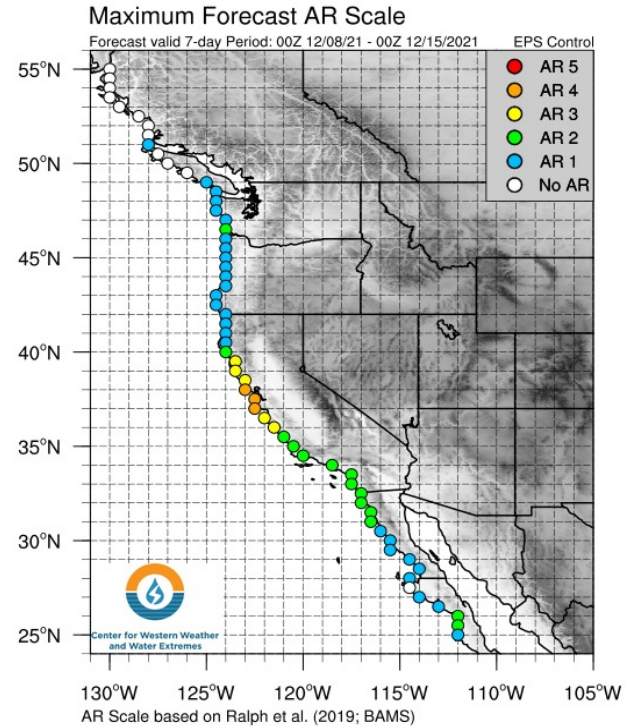
PLYMOUTH STATE METEOROLOGY

AR Scale



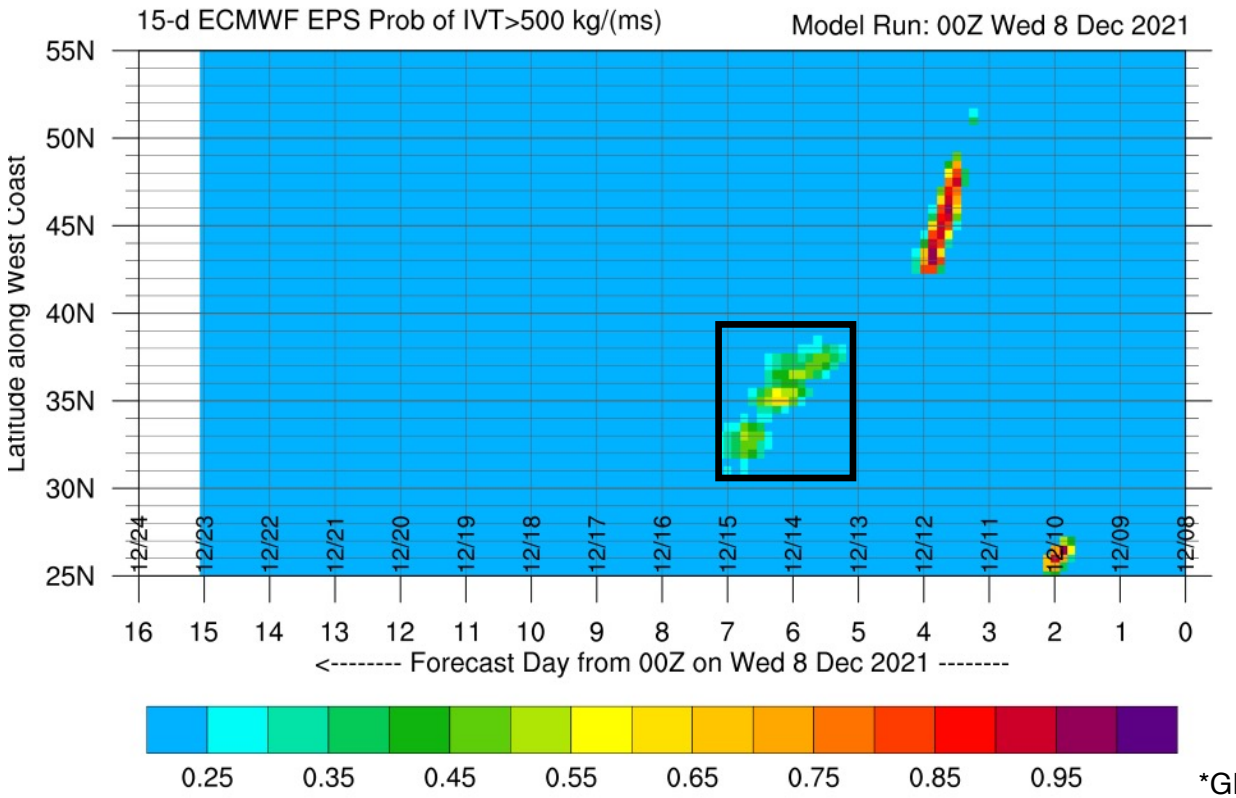
*GEFS = NCEP **G**lobal **E**nsemble **F**orecast **S**ystem (United States)

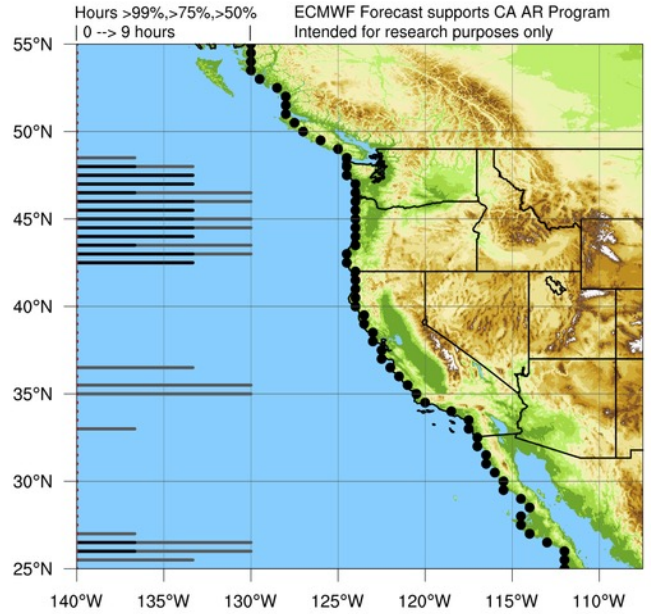
- The 00Z ECMWF EPS is also showing high confidence (> 80% probability) in AR conditions along the California coast on 13–14 Dec
- The ECMWF EPS is more confident in the continuation of AR conditions over Northern California as the second AR begins to interact with the upper-level trough and re-intensify
- Compared to the 00Z GEFS, the 00Z ECMWF EPS is also showing a higher probability of AR conditions extending into Southern California and Baja California on 14 Dec
- The 00Z ECMWF control run is forecasting AR 4 conditions over the San Francisco Bay Area in association with the second AR

Atmospheric River Outlook: 8 Dec 2021

For California DWR's AR Program

Probability of Moderate AR Conditions Along Coast





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PLYMOUTH STATE METEOROLOGY

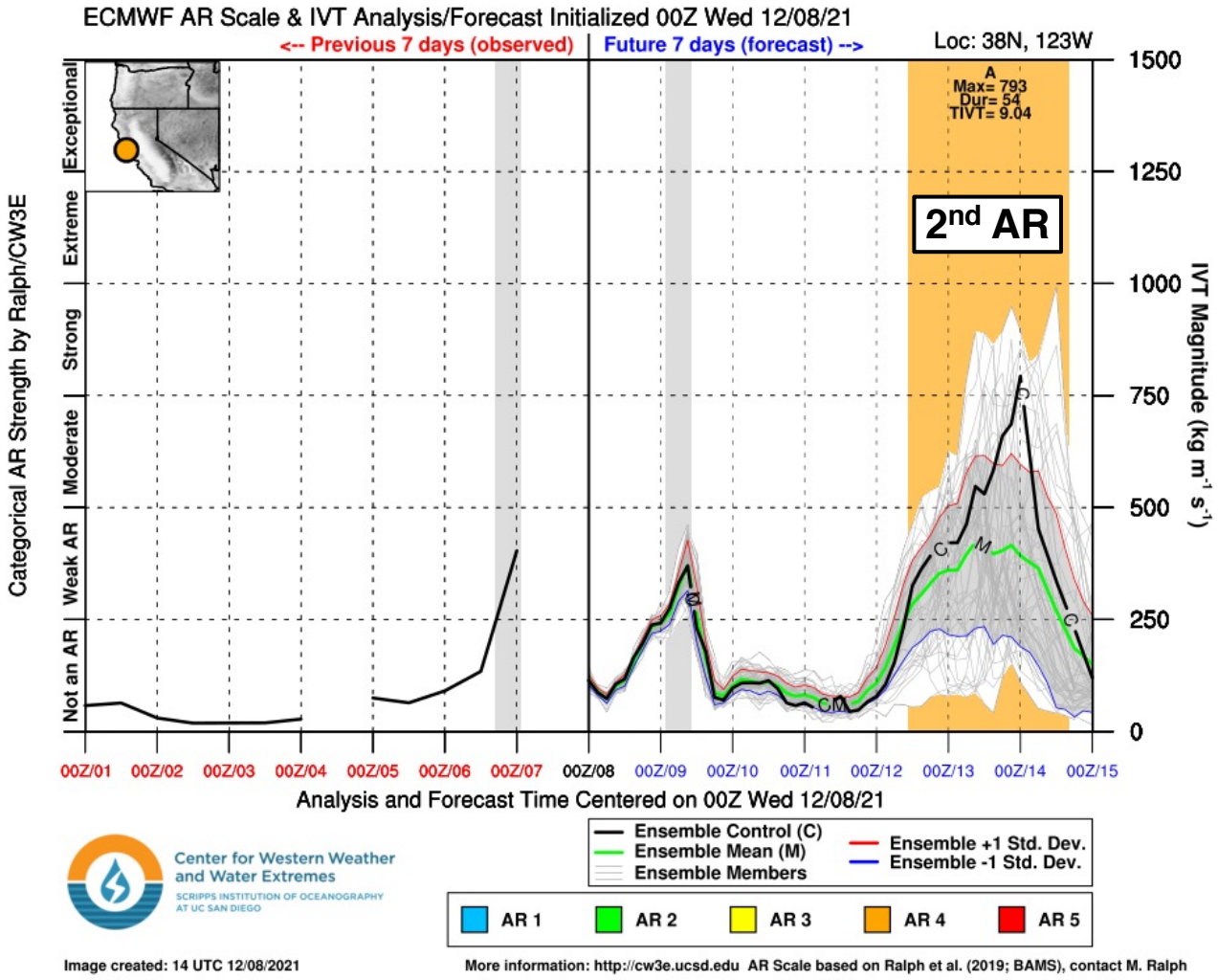
*GEFS = NCEP **G**lobal **E**nsemble **F**orecast **S**ystem (United States)

- The 00Z ECMWF is showing an elevated probability (40–60%) of moderate AR conditions (IVT > 500 kg m^{-1} s^{-1}) over coastal California on 13–14 Dec
- The 00Z GEFS is showing much lower probabilities of moderate AR conditions over coastal California during the second AR

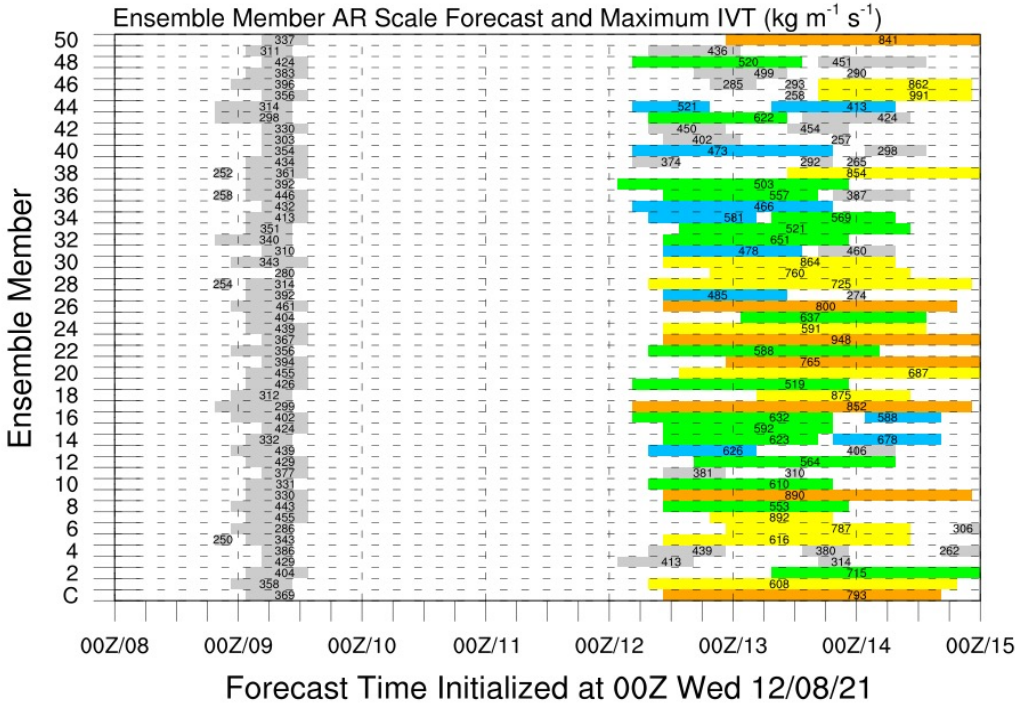
Atmospheric River Outlook: 8 Dec 2021

For California DWR's AR Program

ECMWF EPS AR Scale and IVT Forecasts



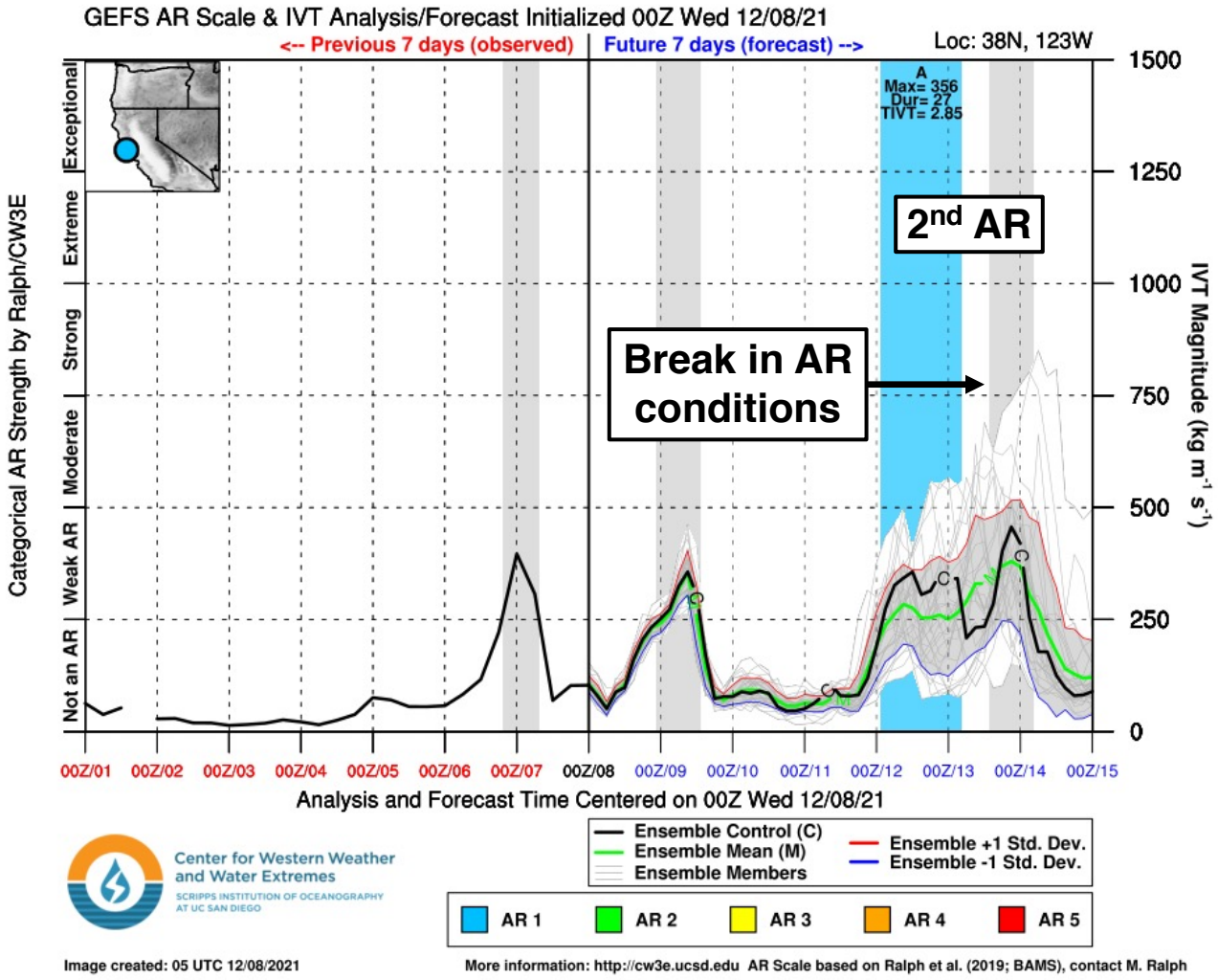
- The 00Z ECMWF EPS control run is forecasting an AR 4 at 38°N, 123°W (near Point Reyes, CA) in association with the second AR
- There is large uncertainty in the timing, duration, and magnitude of AR conditions, with 7/51 ensemble members predicting an AR 4, 13 predicting an AR 3, 17 predicting an AR 2, and 6 predicting an AR 1



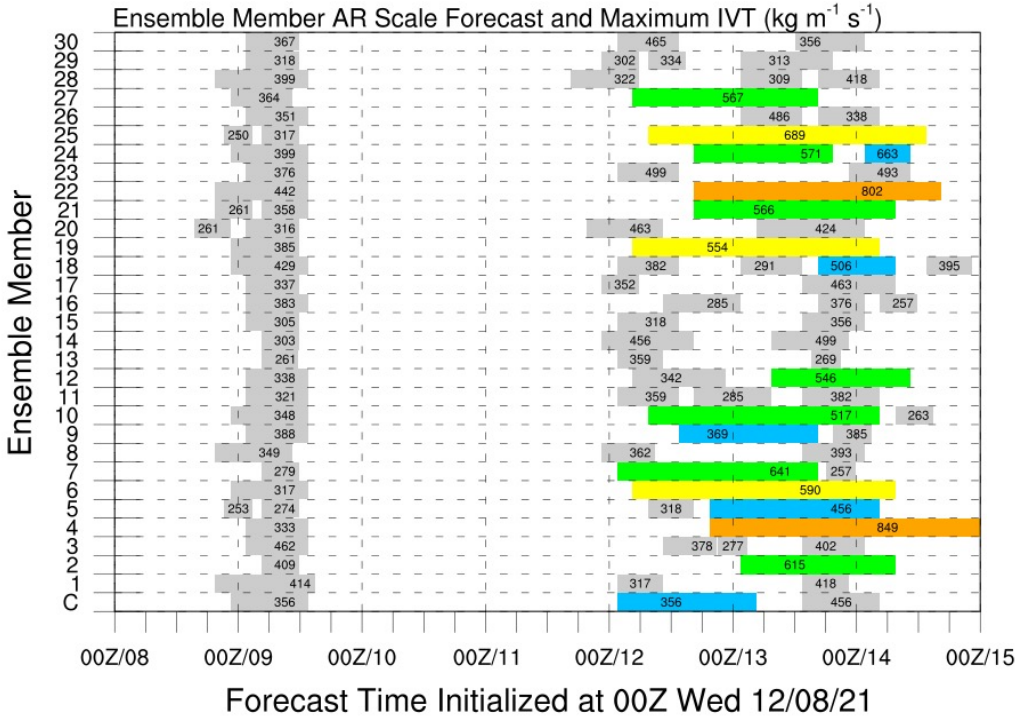
Atmospheric River Outlook: 8 Dec 2021

For California DWR's AR Program

GEFS AR Scale and IVT Forecasts



- The 00Z GEFS control run is only forecasting an AR 1 at this location
- Unlike the ECMWF control run, the GEFS control run is predicting a break in AR conditions as the second AR re-intensifies
- Similar to the ECMWF ensemble, GEFS is showing large forecast uncertainty in the timing, duration, and magnitude of the second AR



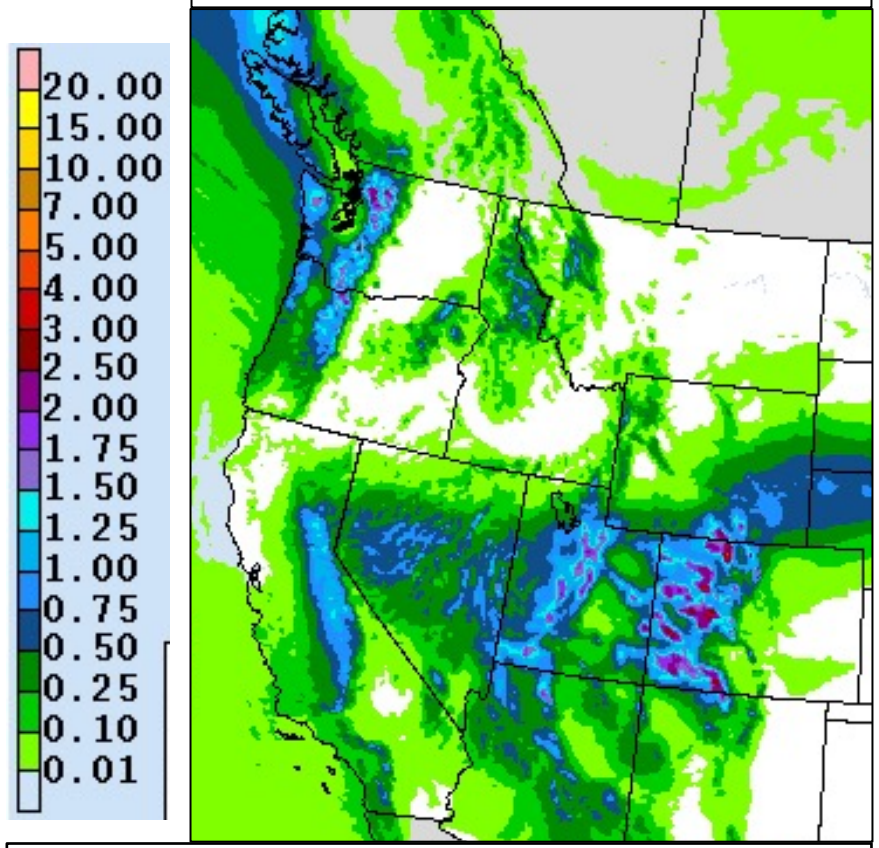
Atmospheric River Outlook: 8 Dec 2021

AMBASSADOR™ WRN WEATHER-READY NATION

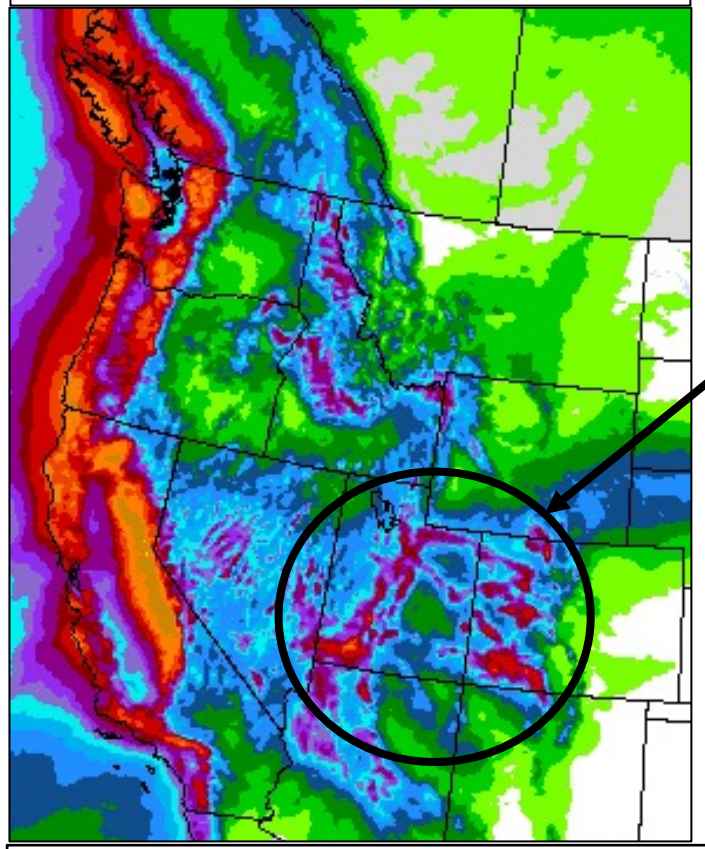
For California DWR's AR Program

NOAA Weather Prediction Center Precipitation Forecasts

Days 1–2 QPF
Valid: 00Z 9-11 December



Days 1-7 QPF
Valid: 00Z 9-16 December



The inland penetration of the two ARs is forecast to bring precipitation to the Intermountain West as well

Several high-elevation locations in Southern Utah, Western Colorado and far Northern Arizona are forecast to receive more than 3 inches of precipitation during the next 7 days

Lower elevations in California are forecast to receive more than 1.5 inches of precipitation over the next week

The WPC is forecasting the first AR to bring 0.75–1.5 in. to the Sierra Nevada and ~0.5 inches to the mountains of Southern California today and tomorrow

The second and stronger AR is forecast to bring substantially more precipitation, with a majority of the Sierra Nevada forecast to receive > 7 inches of precipitation over the next week

Atmospheric River Outlook: 8 Dec 2021

AMBASSADOR™ WRN WEATHER-READY NATION

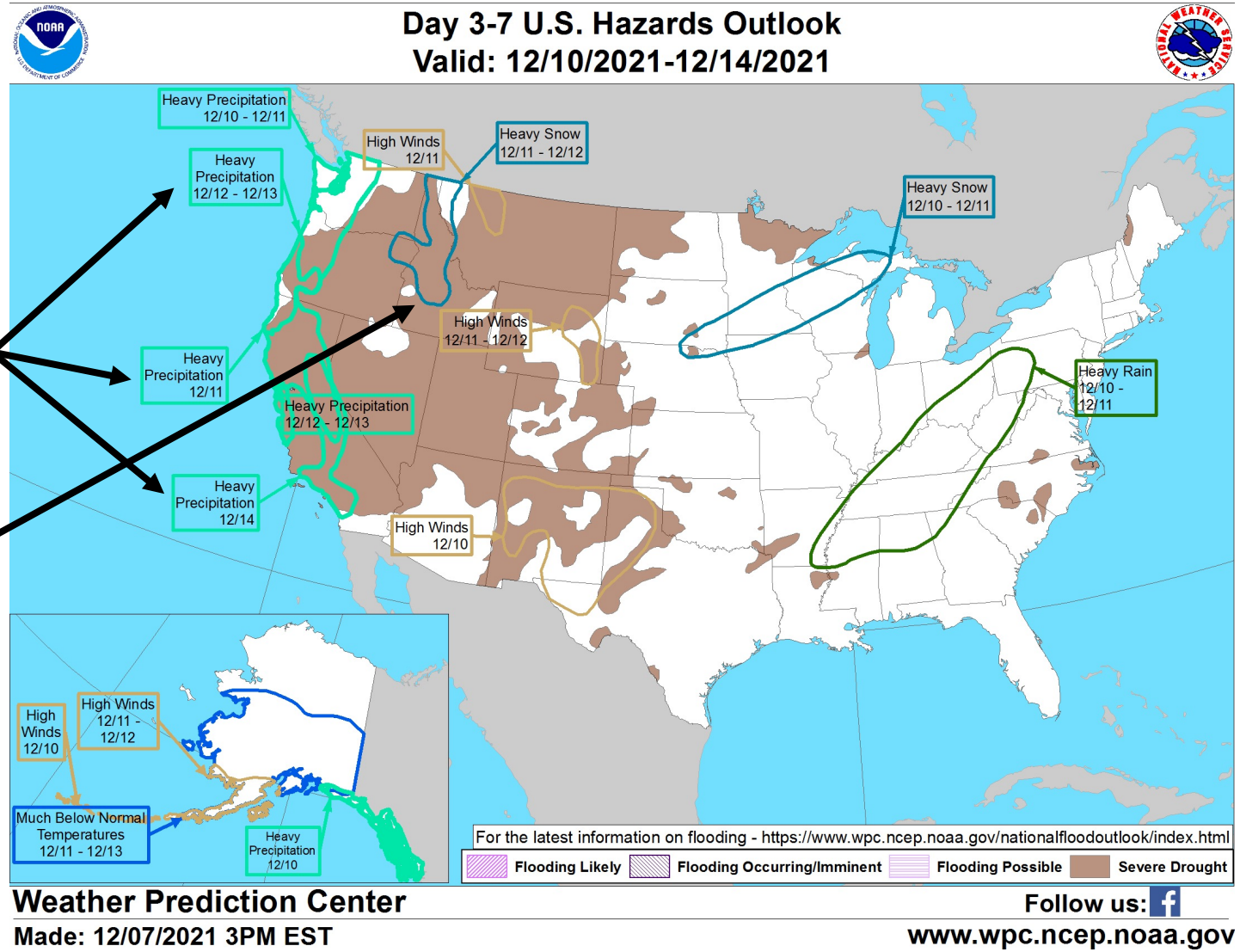
For California DWR's AR Program

The Weather Prediction Center has identified numerous potential hazards in the day 3-7 outlook

Heavy precipitation has been highlighted as a potential hazard across a majority of the US West Coast from 12/10 (Pacific Northwest) to 12/14 (Southern California)

Heavy snow has also been identified as a potential hazard over North-Central Idaho and far western Montana

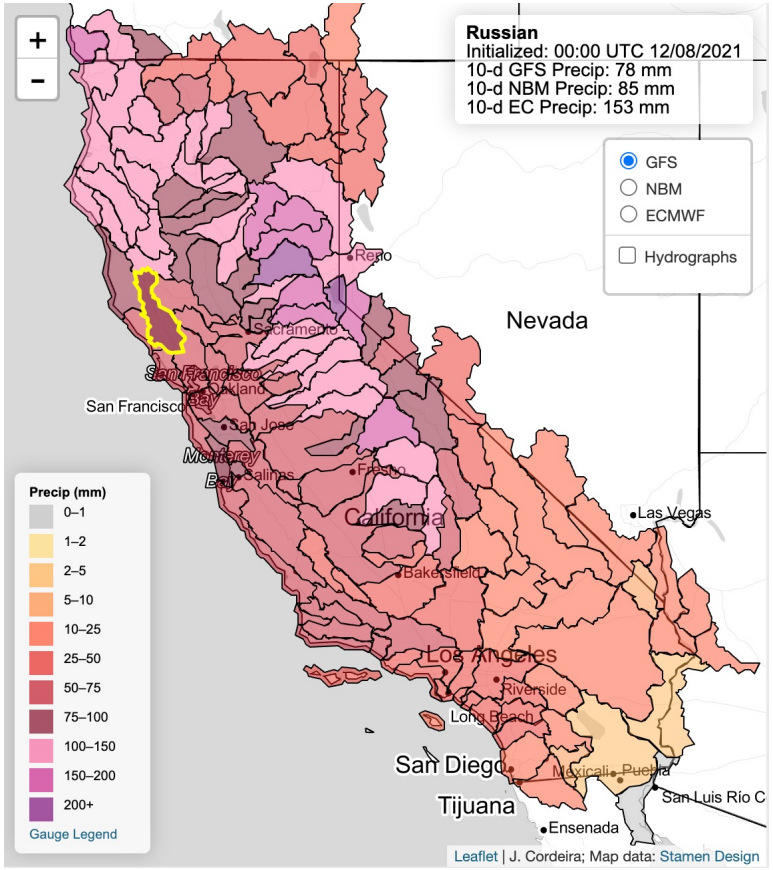
Visit weather.gov for up to date and point specific forecasts, watches, and warnings in the U.S. or Canada as the forecast evolves

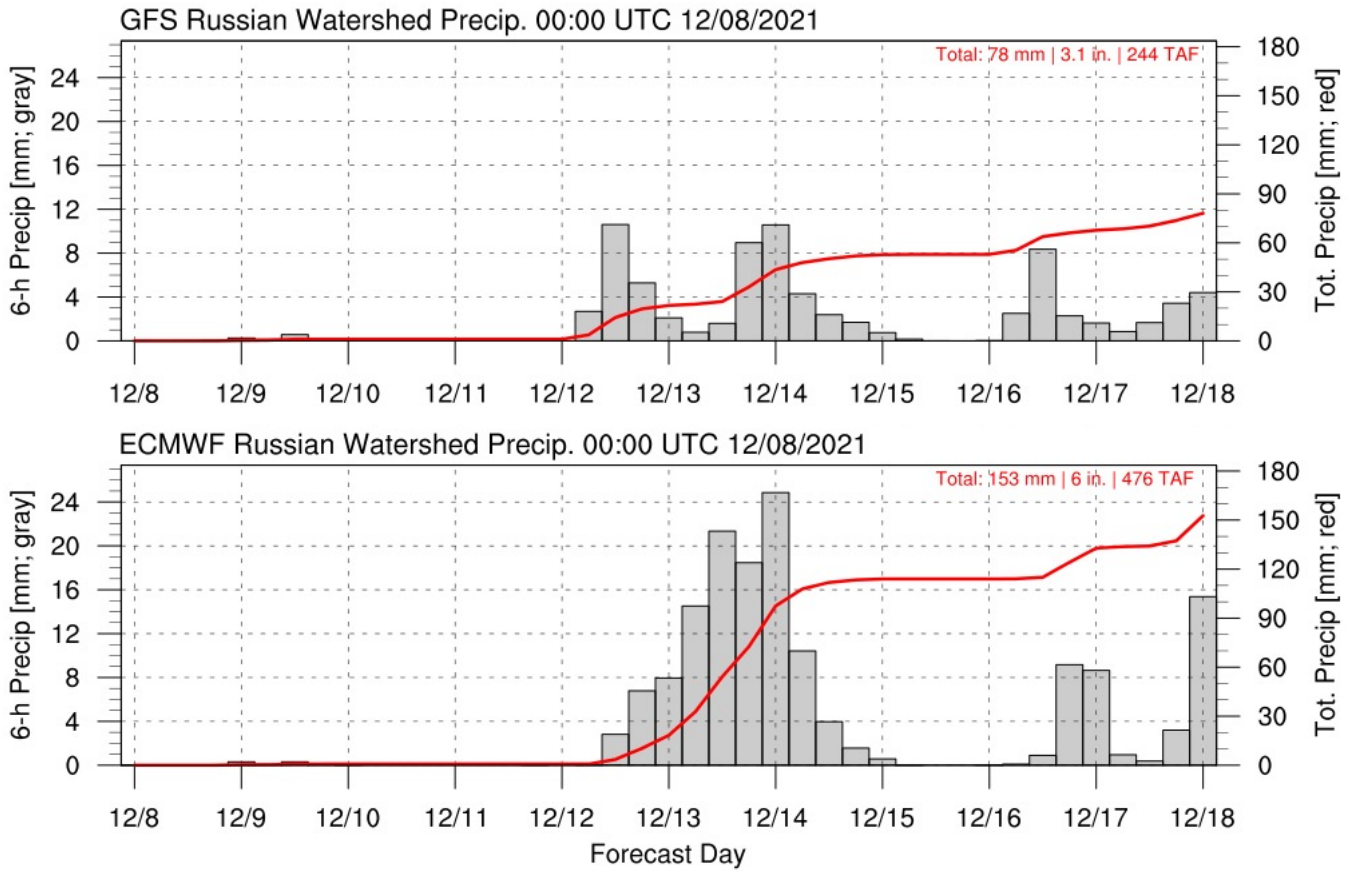


Atmospheric River Outlook: 8 Dec 2021

For California DWR's AR Program

10-day Watershed Precipitation Forecasts: Russian River Watershed



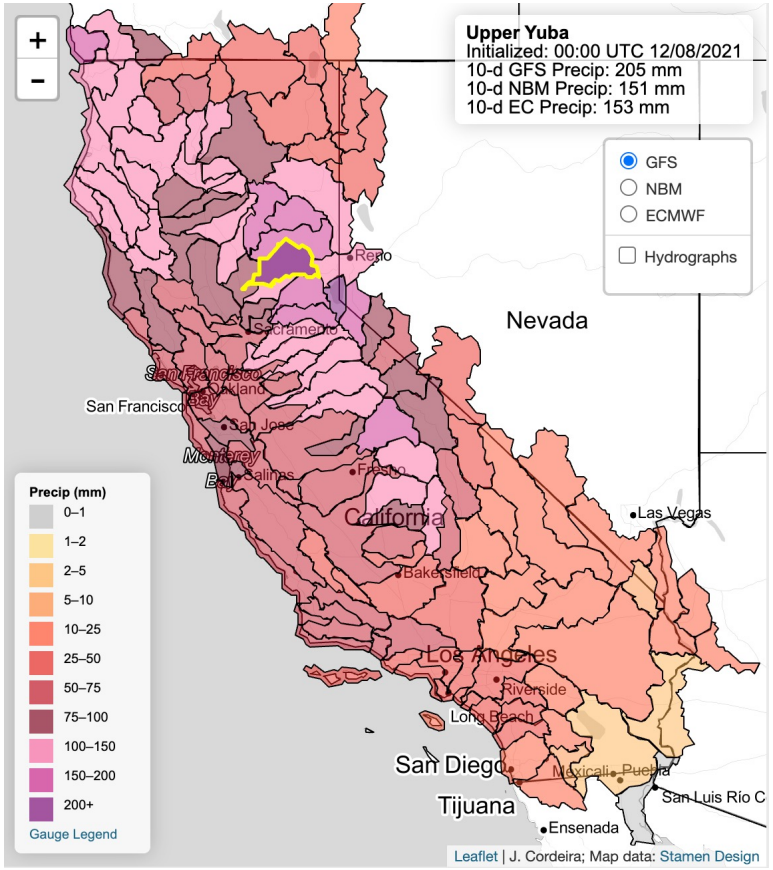


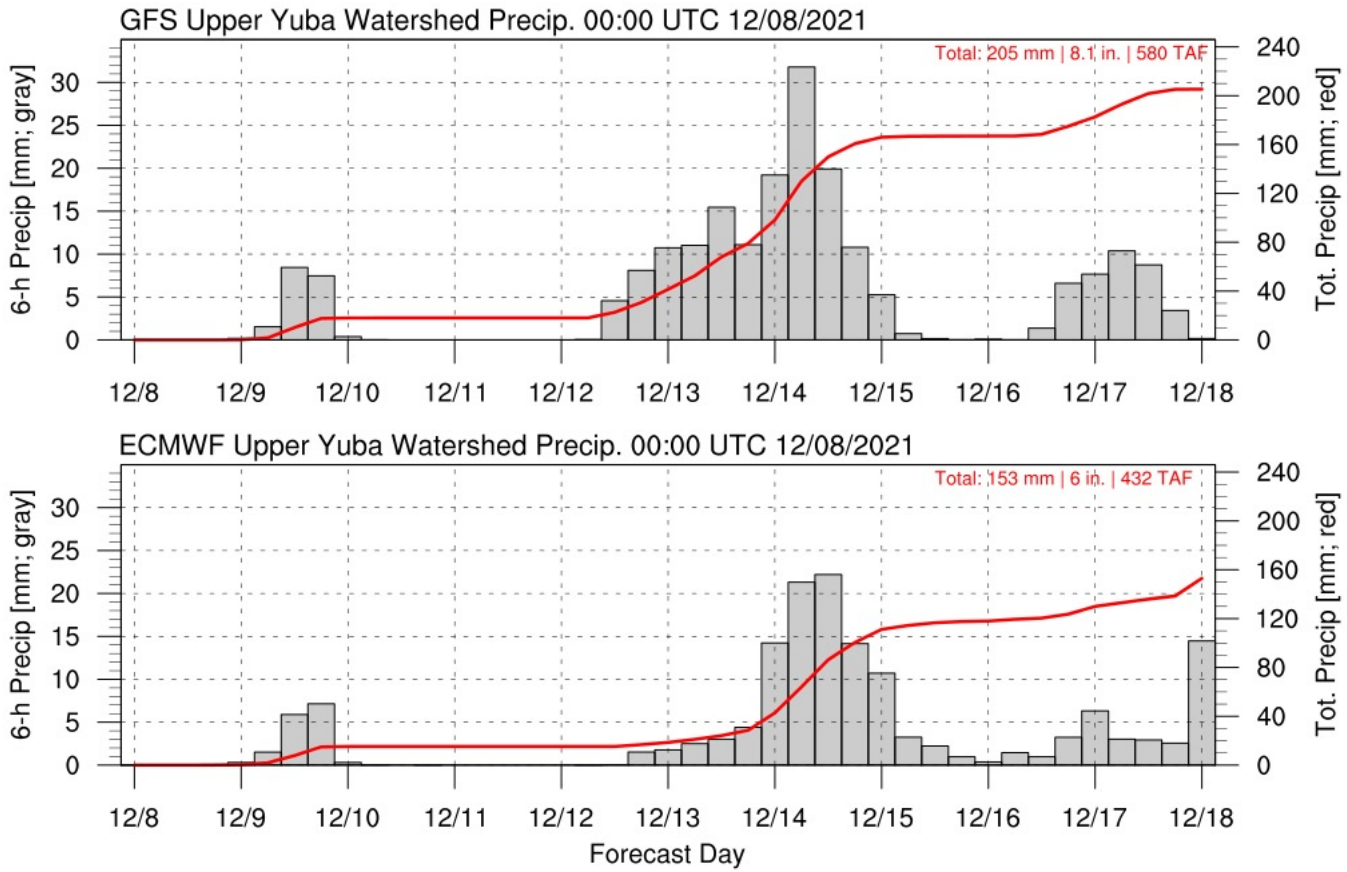
- The 00Z ECMWF model is forecasting significantly higher precipitation amounts (mean areal precip = 6.0 inches) than the 00Z GFS model (mean areal precip = 3.1 inches) in the Russian River watershed during the next 10 days
- In particular, the ECMWF model is forecasting higher rainfall intensities during the AR event on 13 Dec

Atmospheric River Outlook: 8 Dec 2021

For California DWR's AR Program

10-day Watershed Precipitation Forecasts: Upper Yuba Watershed





- The 00Z GFS and ECMWF are forecasting 8.1 inches (580 TAF) and 6.0 inches (432 TAF) of mean areal precipitation, respectively, in the Upper Yuba watershed over the next 10 days