

CW3E Atmospheric River Outlook: 23 December 2024

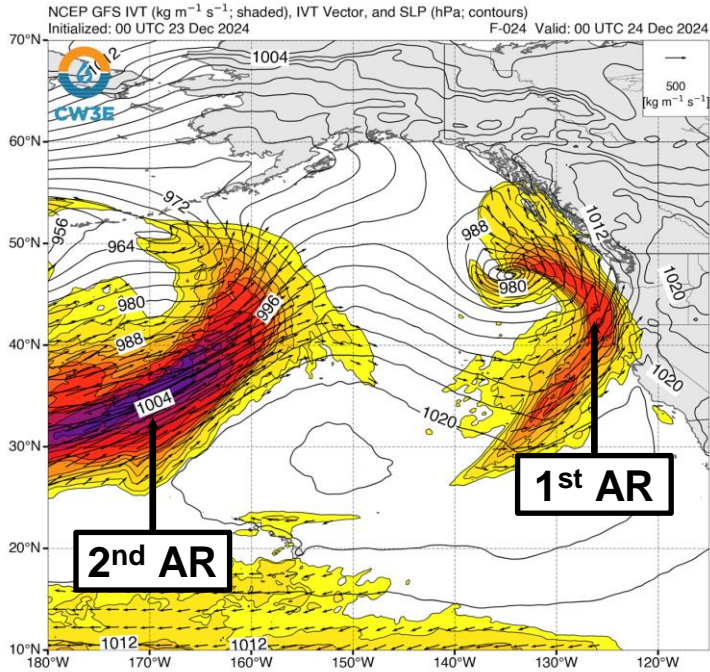
Unsettled Weather Pattern to Continue Over US West Coast Through This Weekend

- A series of atmospheric rivers (ARs) will continue to propagate across the North Pacific and impact the Pacific Northwest and Northern California over the next 7 days.
- The first AR is forecast to make landfall early late today and bring AR 2/AR 3 conditions (based on the Ralph et al. 2019 AR Scale) to coastal Southern Oregon.
- The second and third ARs are forecast to make landfall on Wed 25 Dec and Thu 26 Dec.
- The fourth and potentially most impactful AR is forecast to make landfall on Fri 27 Dec.
- As the fourth AR moves onshore, a mesoscale frontal wave may prolong the AR duration and bring a second pulse of stronger moisture transport to the region. There is considerable uncertainty in the evolution of this AR.
- The NWS Weather Prediction Center is forecasting 7–15 inches of total precipitation over portions of western Washington, western Oregon, and Northern California during the next 7 days.
- Model differences in the forecast evolution of these ARs is driving differences in forecast precipitation. Overall, EPS is forecasting much higher precipitation totals across western Oregon and Northern California during the next 10 days compared to GEFS.
- A marginal risk excessive rainfall outlook (ERO) has been issued for the Southern Oregon and Northern California Coast Ranges, as well as the Northern Sierra Nevada foothills today into early Wed 25 Dec.
- Marginal risk EROs have also been issued for coastal Washington, Oregon, and Northern California for Wed 25 Dec into early Sat 28.
- Numerous stream gages in western Washington, western Oregon, and Northern California are forecast to rise above action/bankfull stage over the next 10 days, with the greatest potential for flooding in southwestern Oregon.

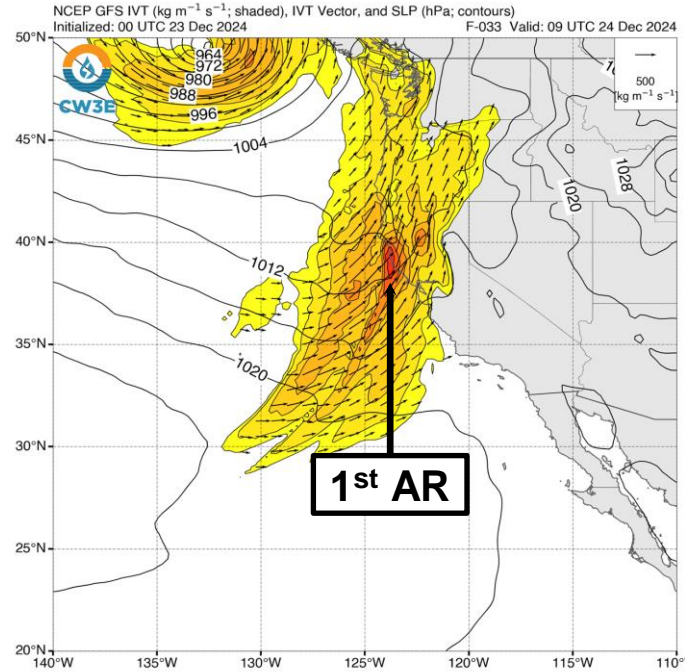
AR Outlook: 23 December 2024

GFS IVT & SLP Forecasts

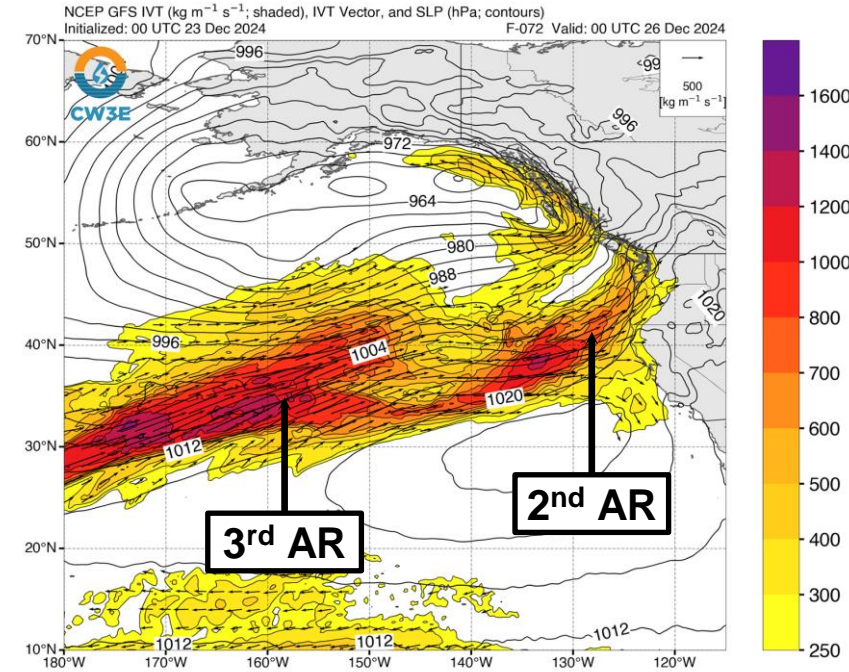
Valid: 4 PM PST 23 Dec (F-024)



Valid: 1 AM PST 24 Dec (F-033)



Valid: 4 PM PST 25 Dec (F-072)

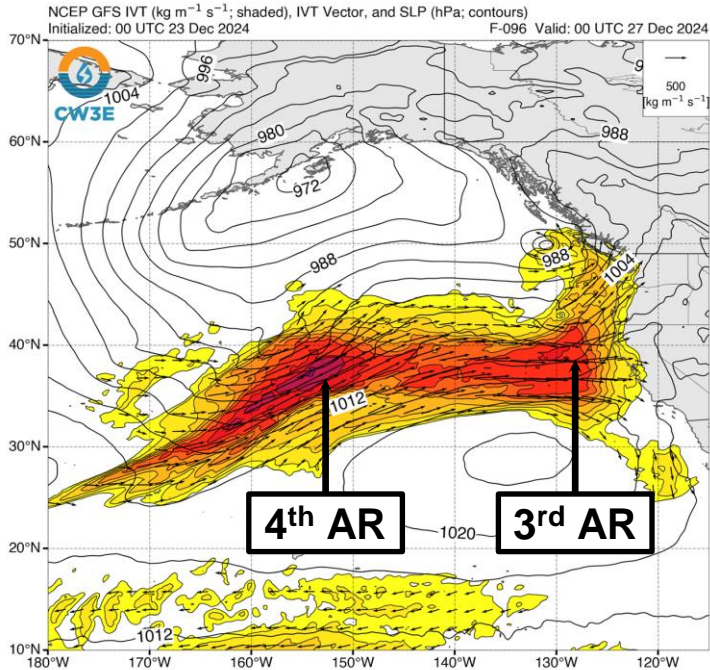


- The first AR is forecast to make landfall late today and bring moderate-to-strong AR conditions ($\text{IVT} \geq 500 \text{ kg m}^{-1} \text{ s}^{-1}$) to coastal Oregon and Northern California.
- As the AR passes through Northern California, south-southwesterly IVT will likely support orographic enhancement of precipitation over portions of the Northern California Coast Ranges, Southern Cascades, and Northern Sierra Nevada.
- The second AR is forecast to make landfall on Wed 25 Dec and bring moderate AR conditions to coastal Washington, Oregon, and Northern California.

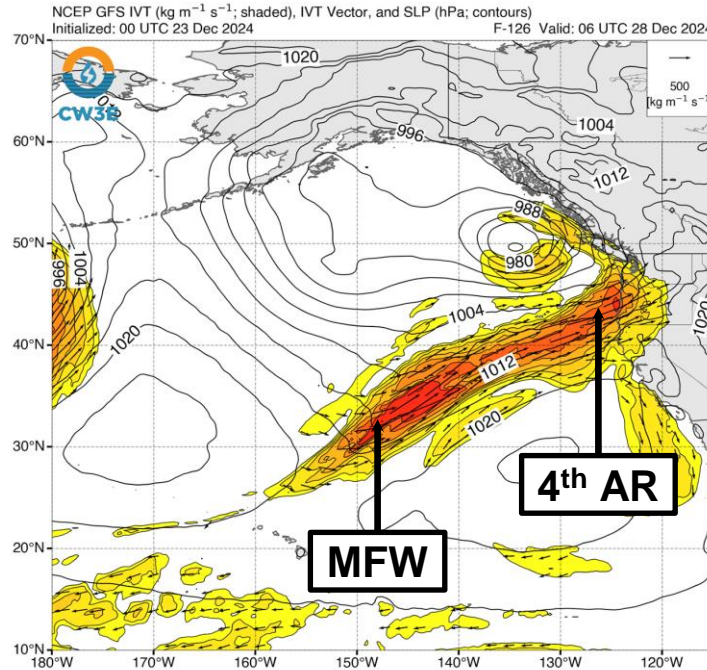
AR Outlook: 23 December 2024

GFS IVT & SLP Forecasts

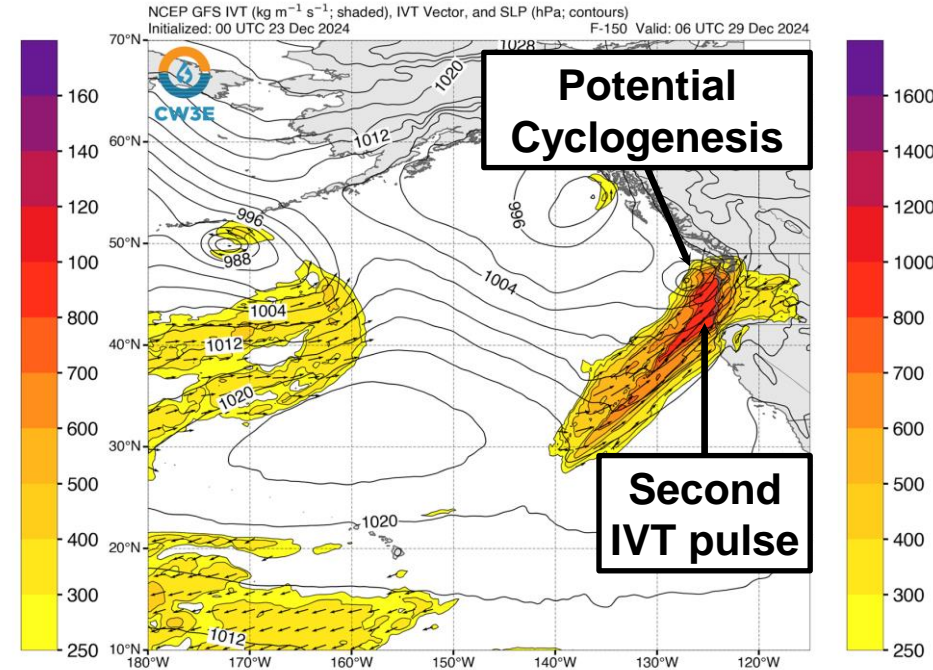
Valid: 4 PM PST 26 Dec (F-096)



Valid: 10 PM PST 27 Dec (F-126)

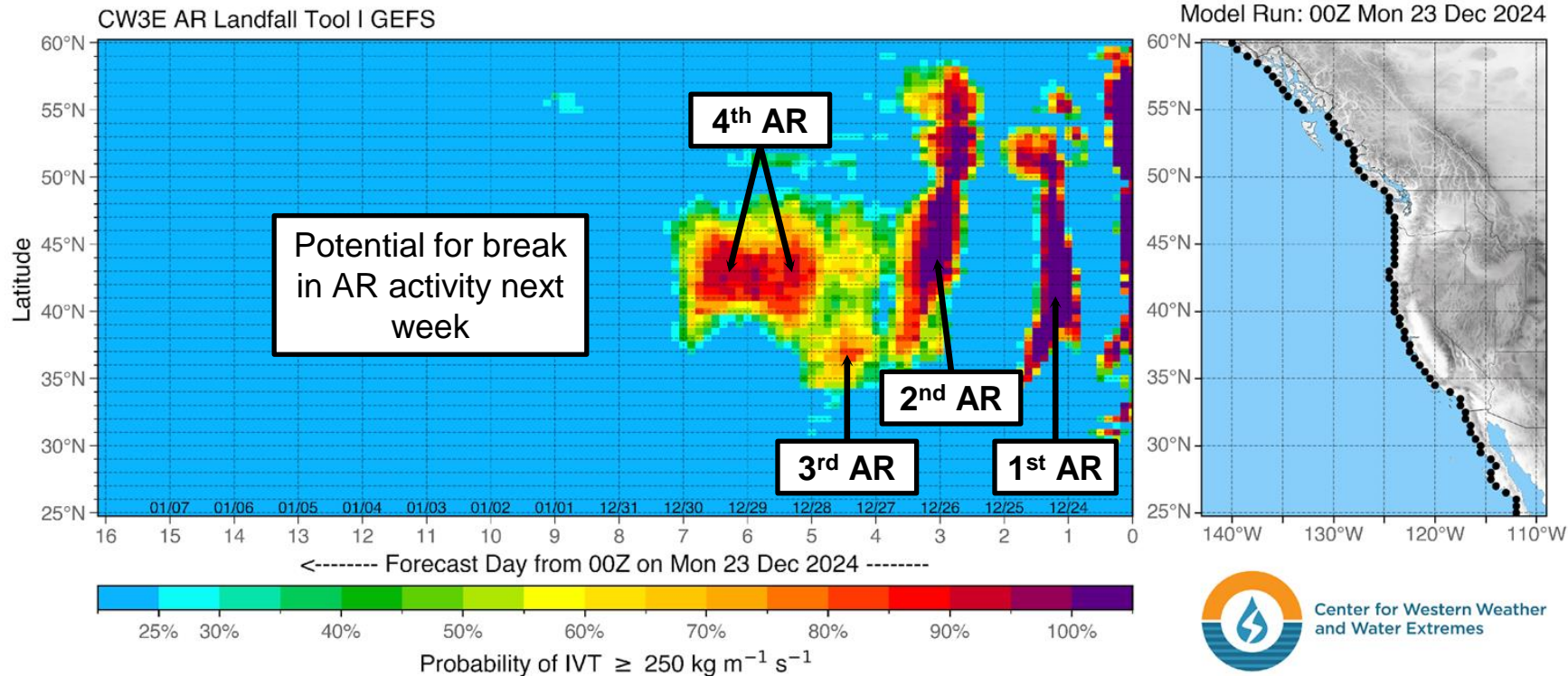


Valid: 10 PM PST 28 Dec (F-150)



- The third AR is forecast to make landfall on Thu 26 Dec, with the strongest moisture transport expected over Northern California.
- While AR conditions ($\text{IVT} \geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$) are also forecast over Central and Southern California during the third AR, the northwesterly IVT direction will not be favorable for precipitation in these areas.
- The fourth AR is forecast to make landfall on Fri 27 Dec and potentially bring strong AR conditions ($\text{IVT} \geq 750 \text{ kg m}^{-1} \text{ s}^{-1}$) to coastal Oregon.
- After the fourth AR moves onshore, a mesoscale frontal wave (MFW) is forecast to develop near the tail of the AR, potentially leading to a cyclogenesis event and a second stronger pulse of moisture transport over the Pacific Northwest.

GEFS Probability of AR Conditions Along Coast

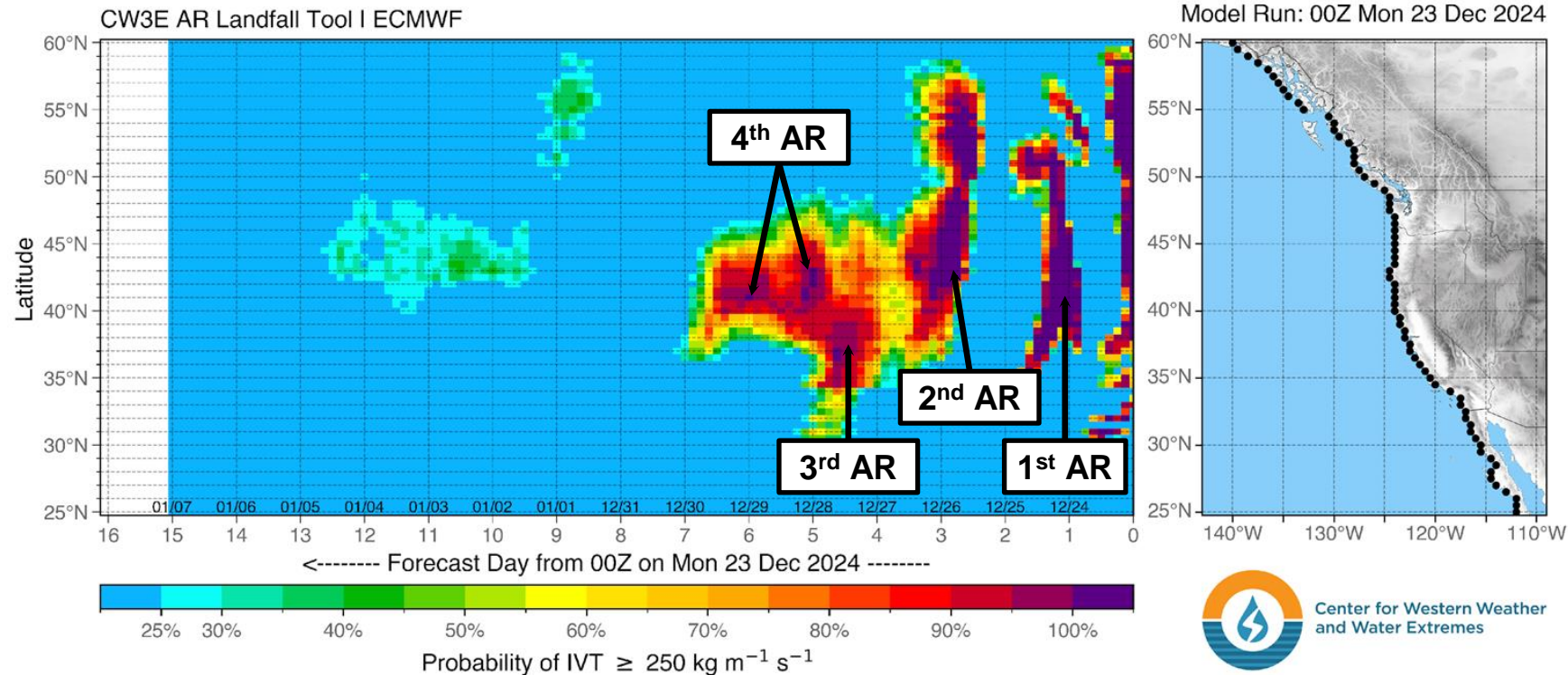


Forecasts support FIRO/CA-AR Program and NSF #2052972 | Intended for research purposes only

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

- The 00Z GEFS is showing very high confidence (near 100% probability) in two periods of AR conditions ($IVT \geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$) along the US West Coast in association with the first and second ARs on 23–24 Dec and 25–26 Dec, respectively.
- GEFS is also showing high confidence (> 80% probability) in a longer period of AR conditions over coastal Oregon and far Northern California on 27–29 Dec association with the fourth AR.
- There is somewhat lower confidence (60–80%) in AR conditions in association with the third AR on 26–27 Dec.

EPS Probability of AR Conditions Along Coast

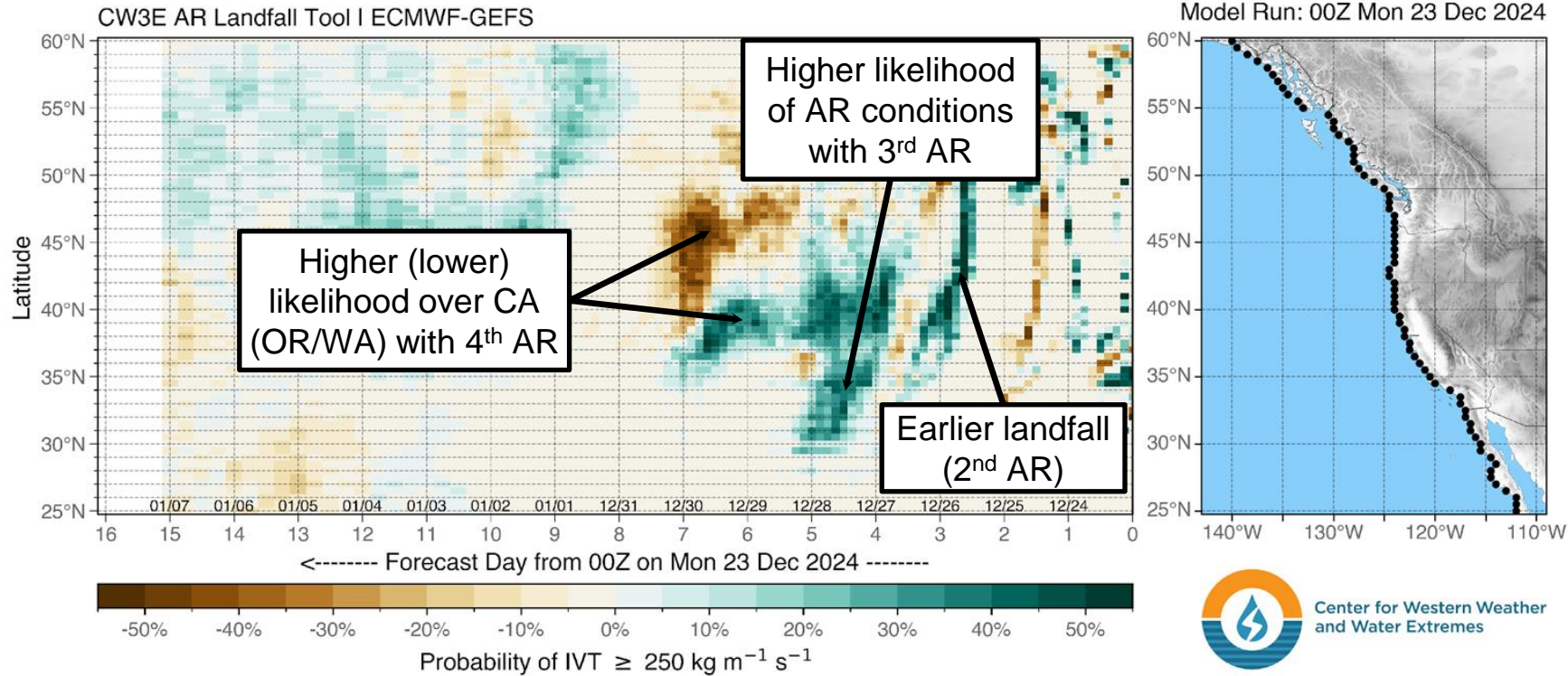


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*EPS = ECMWF Ensemble Prediction System (European)

- Similar to GEFS, the EPS is showing very high confidence (near 100% probability) AR conditions along the US West Coast on 23–24 Dec and 25–26 Dec in association with the first and second ARs.
- The EPS is also showing high confidence (> 90% probability) in AR conditions over Northern and Central California on 27 Dec and Oregon and Northern California on 27–29 Dec in association with the third and fourth ARs.

EPS Minus GEFS Probability of AR Conditions Along Coast



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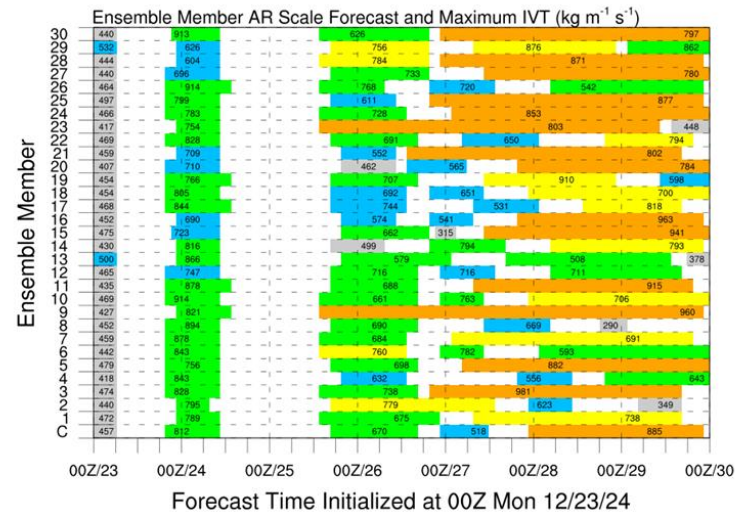
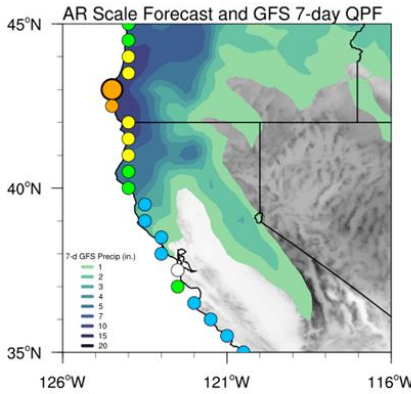
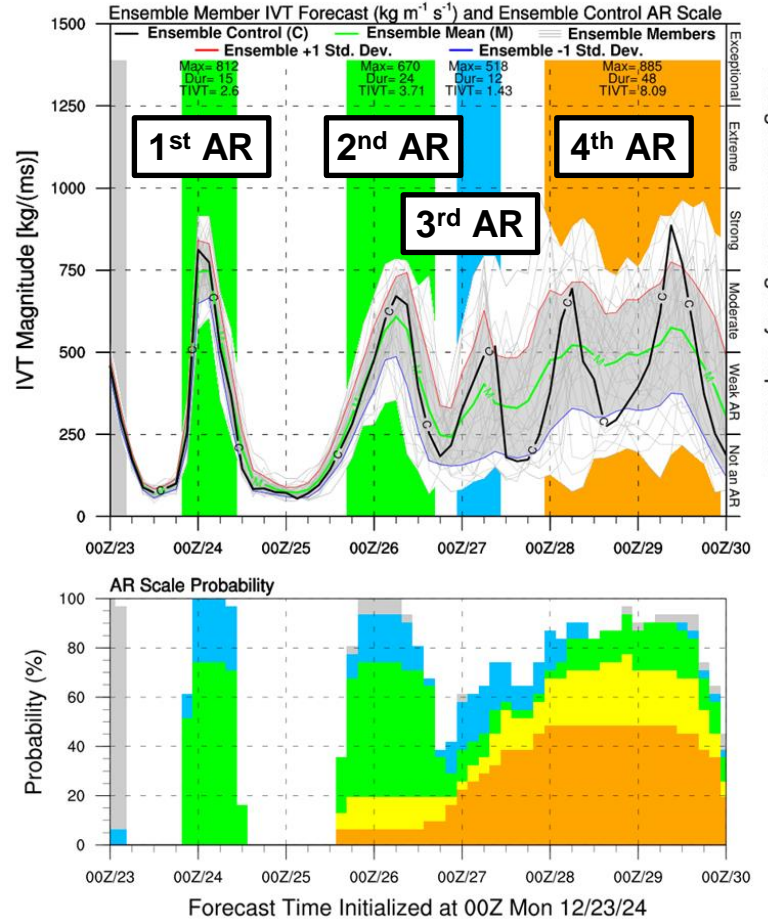
- Compared to GEFS, EPS is showing a slightly earlier AR landfall in association with the second AR and a higher likelihood of landfalling AR conditions over California in association with the third AR.
- EPS is also favoring a more southerly AR trajectory as the fourth AR re-intensifies on 28–29 Dec, with higher probabilities of AR conditions over California and lower probabilities of AR conditions over Oregon and Washington.

AR Outlook: 23 December 2024

GEFS AR Scale and IVT Forecasts

GFS Ensemble Initialized: 00Z Mon 12/23/24

Location: 43°N 124.5°W



- The 00Z GEFS control is forecasting AR 2 conditions (based on the Ralph et al. 2019 AR Scale) over coastal Southern Oregon in association with the first and second ARs.
- Nearly 75% of ensemble members are predicting an AR 2 or greater at 43°N, 124.5°W for both ARs.
- While there is greater uncertainty in the timing, duration, and magnitude of AR conditions during the subsequent ARs, nearly 50% of ensemble members are forecasting an AR 4 in association with the fourth AR.
- The GEFS control also clearly illustrates the two distinct pulses of IVT during the fourth AR.



AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 05 UTC 12/23/2024

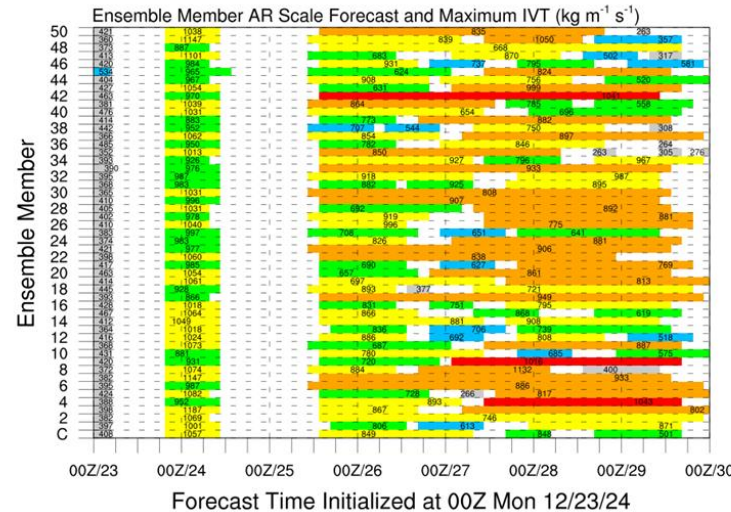
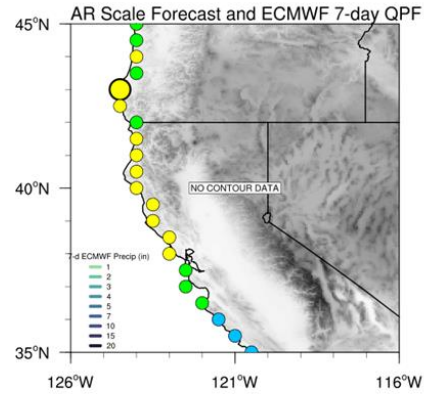
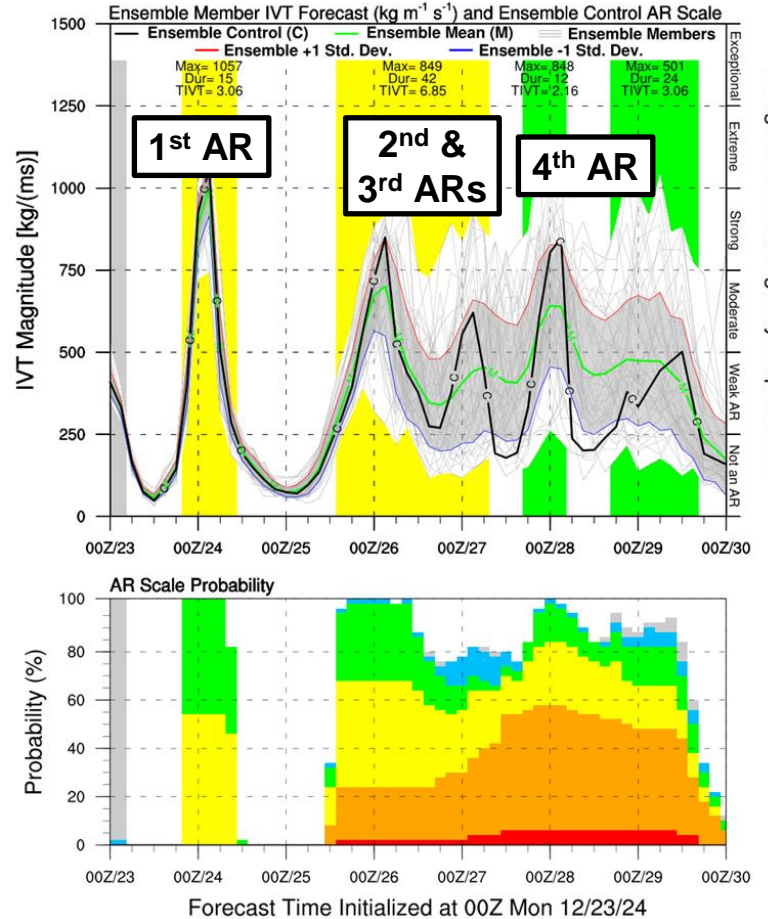
More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

AR Outlook: 23 December 2024

EPS AR Scale and IVT Forecasts

ECMWF Ensemble Initialized: 00Z Mon 12/23/24

Location: 43°N 124.5°W



- The 00Z EPS control is forecasting AR 3 conditions over coastal Southern Oregon in association with the first AR.
- The EPS control is also forecasting an AR 3 in association with the second and third ARs due to the lack of a break in AR conditions between the two ARs.
- More than 50% of EPS members are forecasting an AR 3 or greater at 43°N, 124.5°W for the first AR.
- While the EPS control member is showing a distinct break in AR conditions between the two IVT pulses during the fourth AR, a majority of ensemble members are forecasting a longer period continuous AR conditions (and therefore, an AR 4).

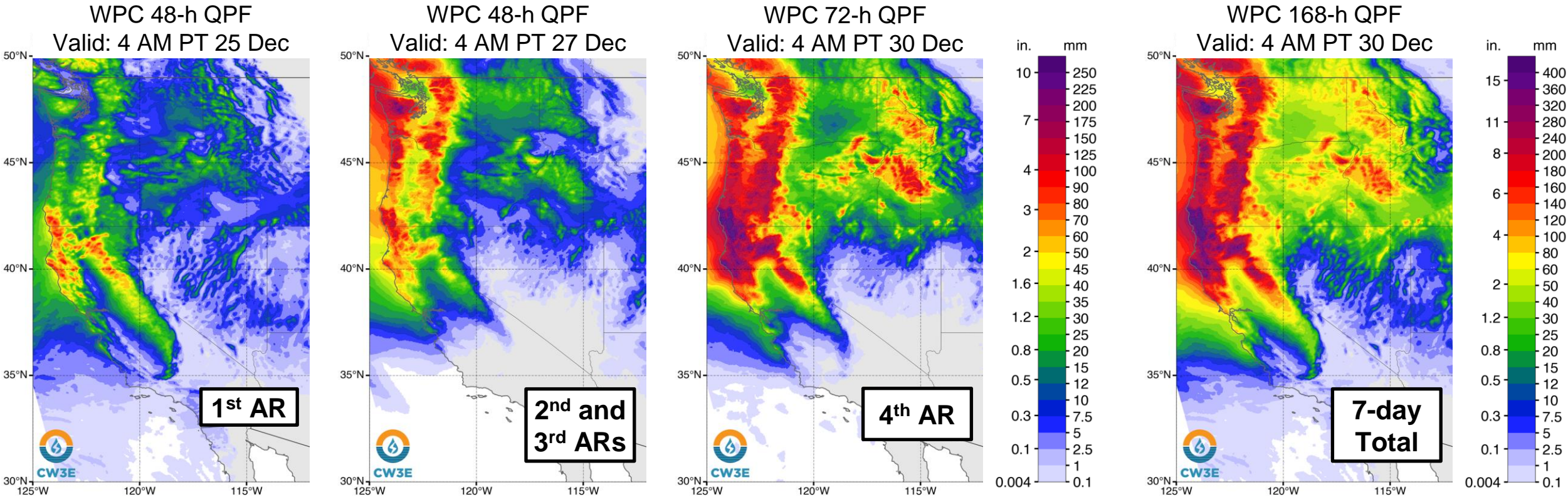


AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 09 UTC 12/23/2024

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

Precipitation Forecasts

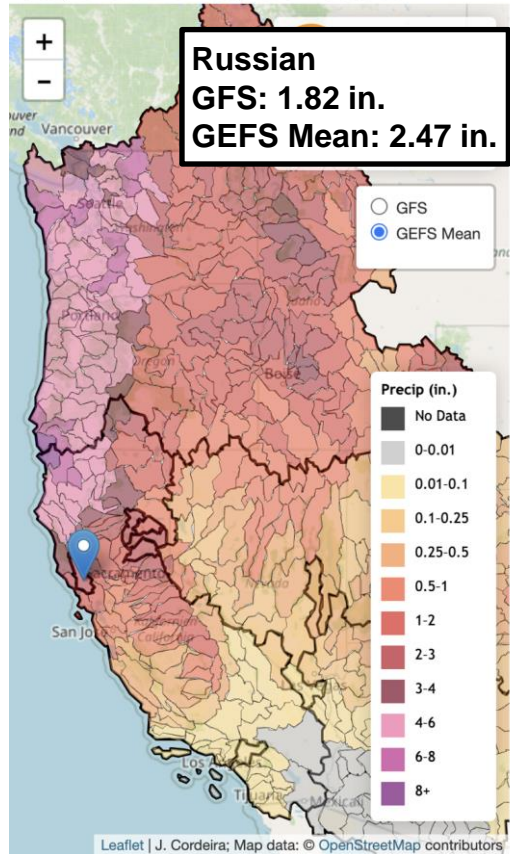


- The first AR is forecast to produce 2–4 inches of precipitation over the Southern Oregon and Northern California Coast Ranges, Southern Cascades, and Northern Sierra Nevada.
- The second and third ARs are forecast to produce at least 3–7 inches of precipitation over the Coast Ranges and Cascades in Washington, Oregon, and Northern California, with higher amounts possible in the Olympic Mountains.
- The fourth AR is forecast to produce 5–10 inches of precipitation in the same areas, with the heaviest amounts near the Oregon/California border.
- During the next 7 days, the Weather Prediction Center (WPC) is forecasting 7–15 inches of total precipitation over the Pacific Coast Ranges, Cascades, and Northern Sierra Nevada.

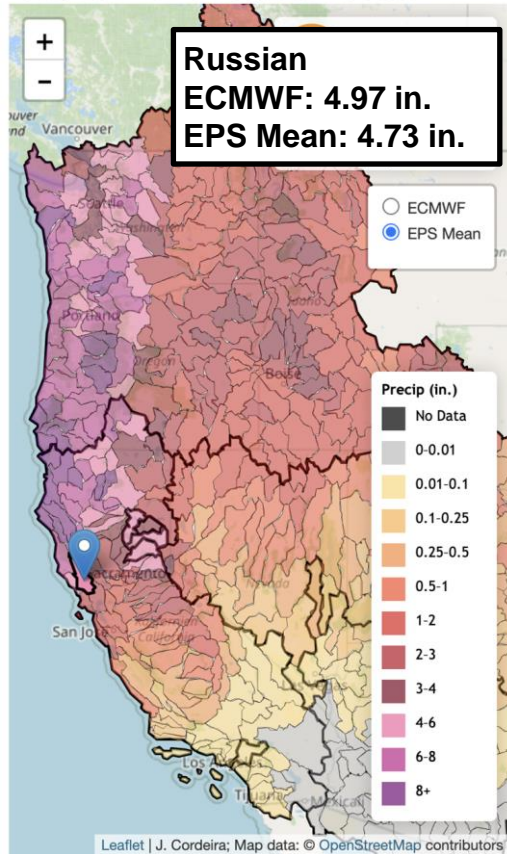
AR Outlook: 23 December 2024

Watershed Precipitation Forecasts

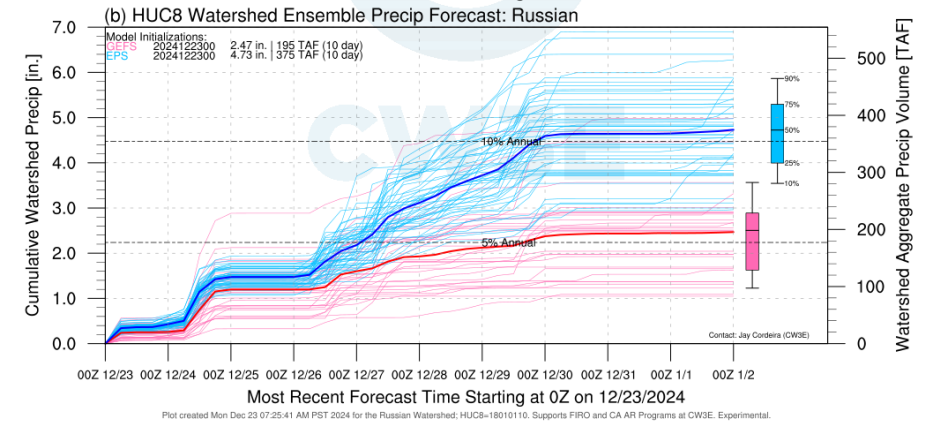
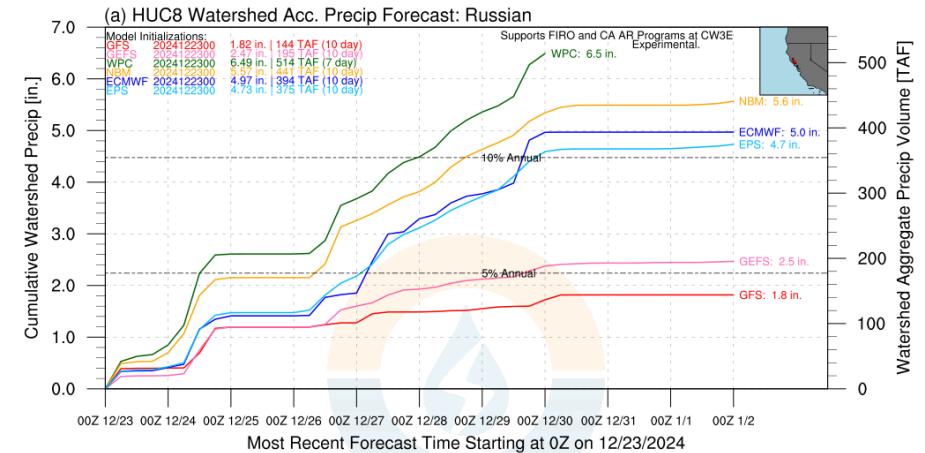
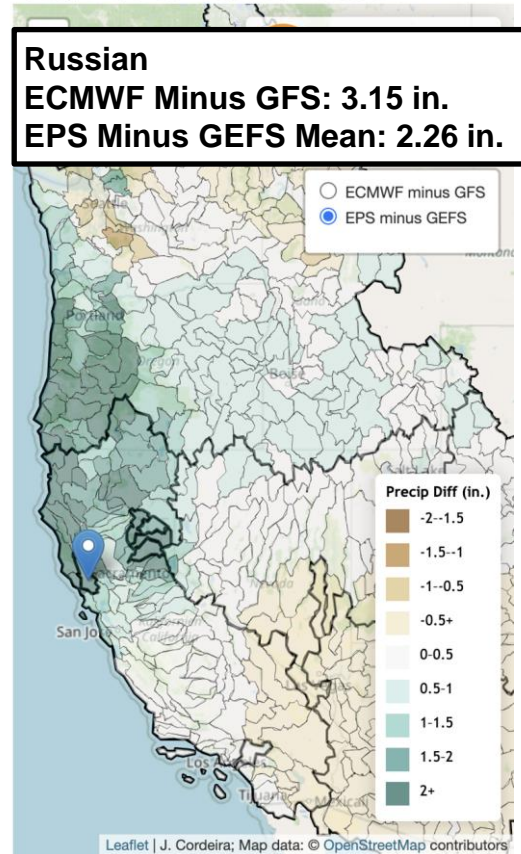
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast

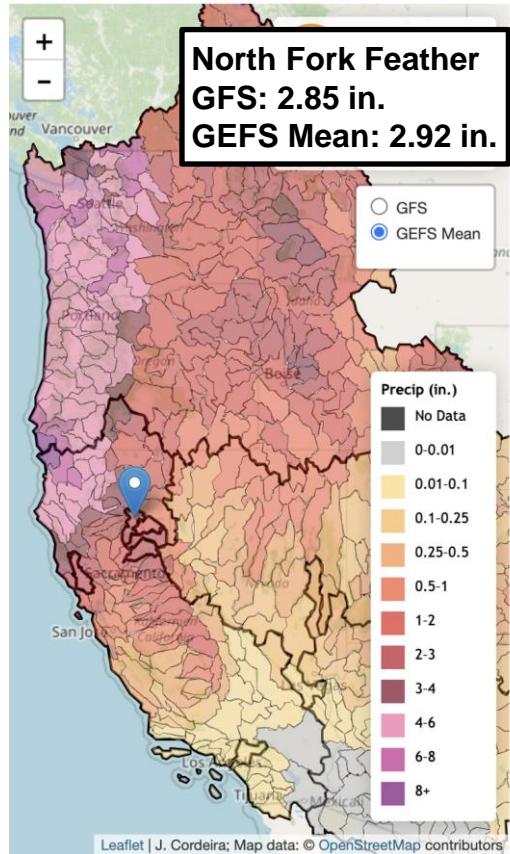


- Model differences in the evolution of the third and fourth ARs are contributing to large differences in forecast precipitation over the next 10 days.
- Overall, the 00Z EPS is forecasting much higher precipitation totals over western Oregon and Northern California compared to the 00Z GEFS.
- In the Russian River watershed, ~75% of EPS members and <10% of GEFS members are forecasting 4+ inches of mean areal precipitation.
- More than 50% of EPS members are forecasting the Russian River watershed to receive at least 10% of its normal annual precipitation during the next 10 days.

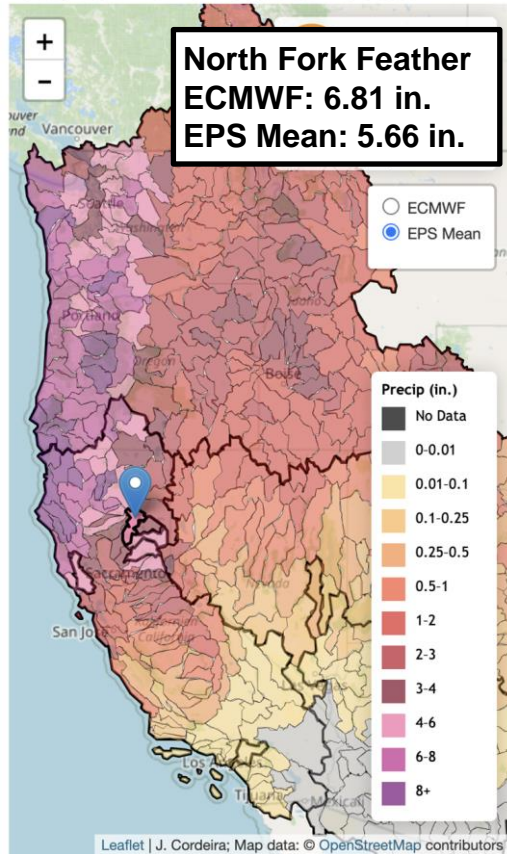
AR Outlook: 23 December 2024

Watershed Precipitation Forecasts

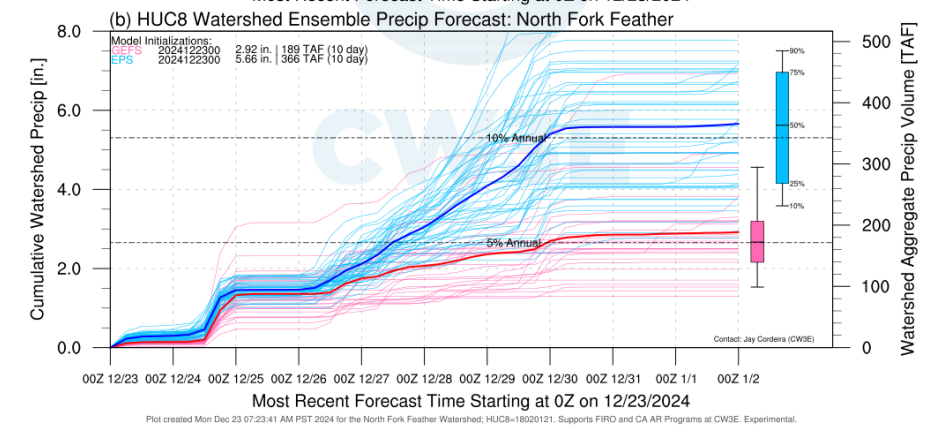
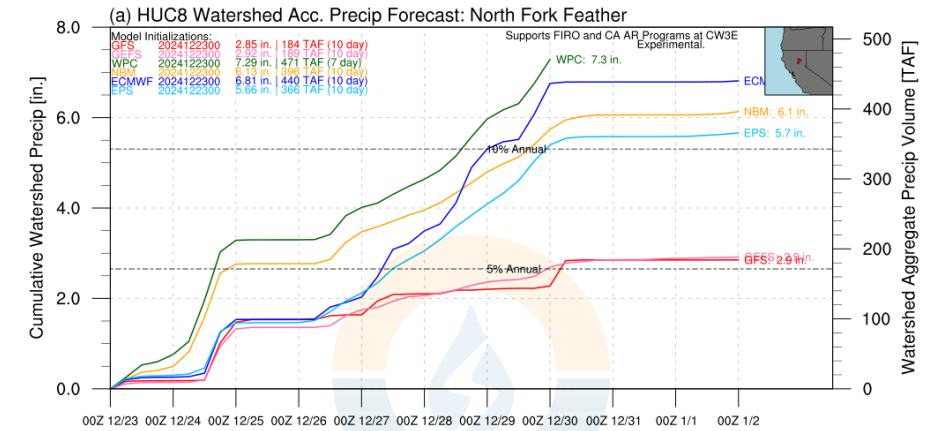
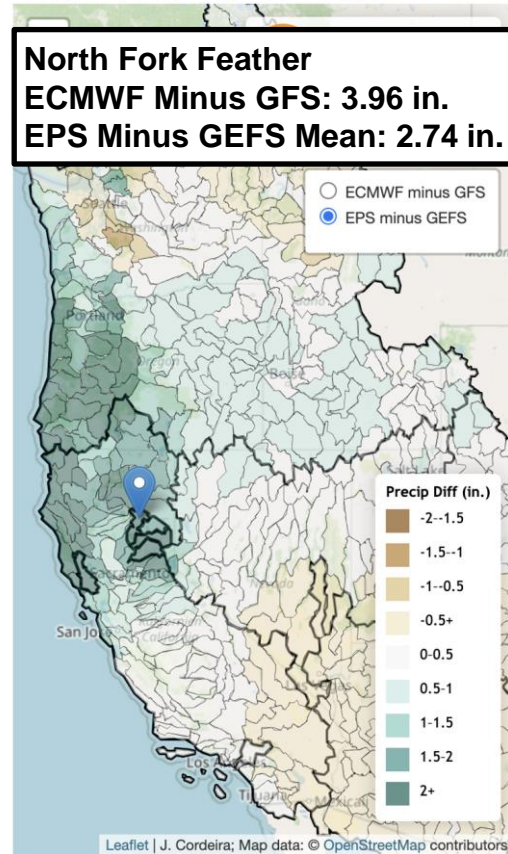
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast



- In the North Fork Feather watershed, ~75% of EPS members and <25% of GFS members are forecasting 4+ inches of mean areal precipitation over the next 10 days.
- There is also much larger spread among the EPS members, with an interquartile range of ~3 inches (versus ~1 inch in GFS).
- More than 50% of EPS members are forecasting the North Fork Feather watershed to receive at least 10% of its normal annual precipitation during the next 10 days.

WPC Excessive Rainfall Outlook

Day 1
Valid: 4 AM PT 24 Dec



Day 2
Valid: 4 AM PT 25 Dec



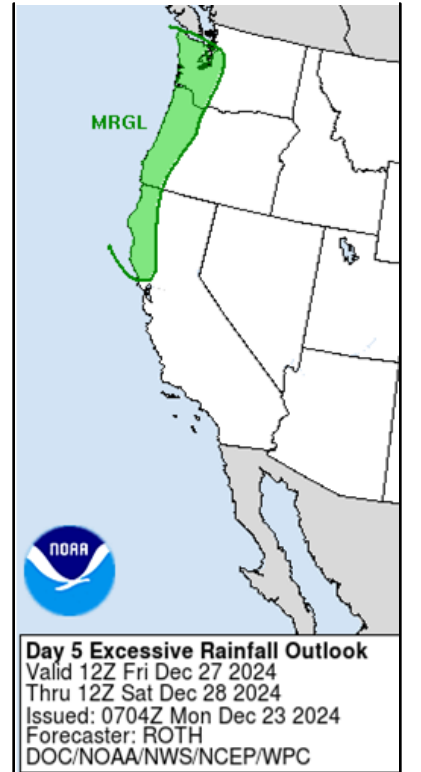
Day 3
Valid: 4 AM PT 26 Dec



Day 4
Valid: 4 AM PT 27 Dec

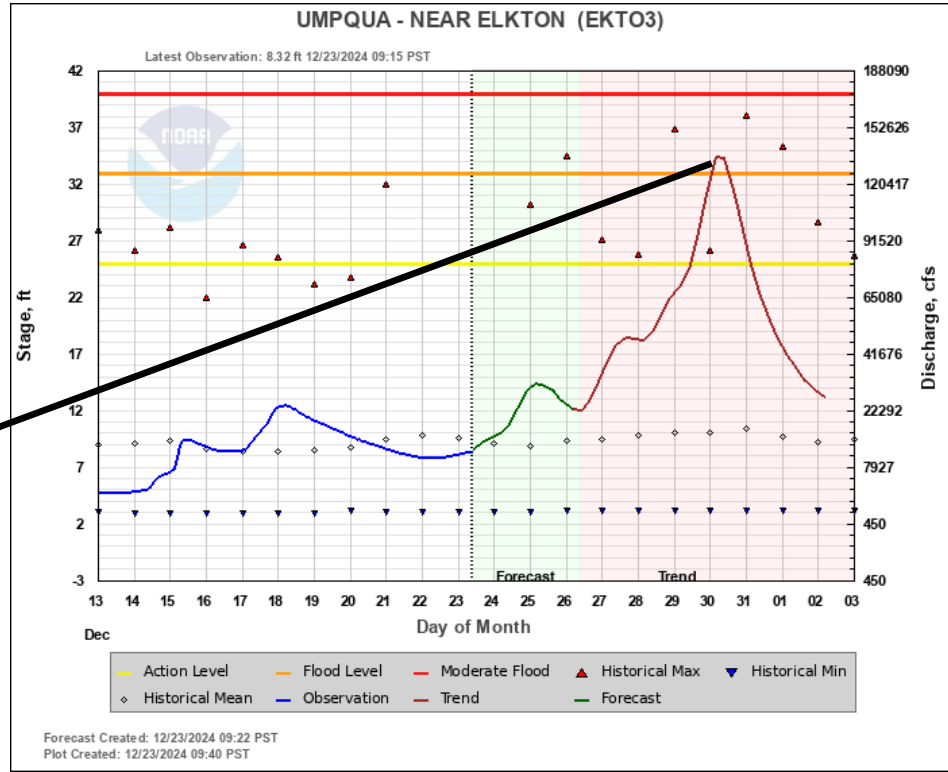
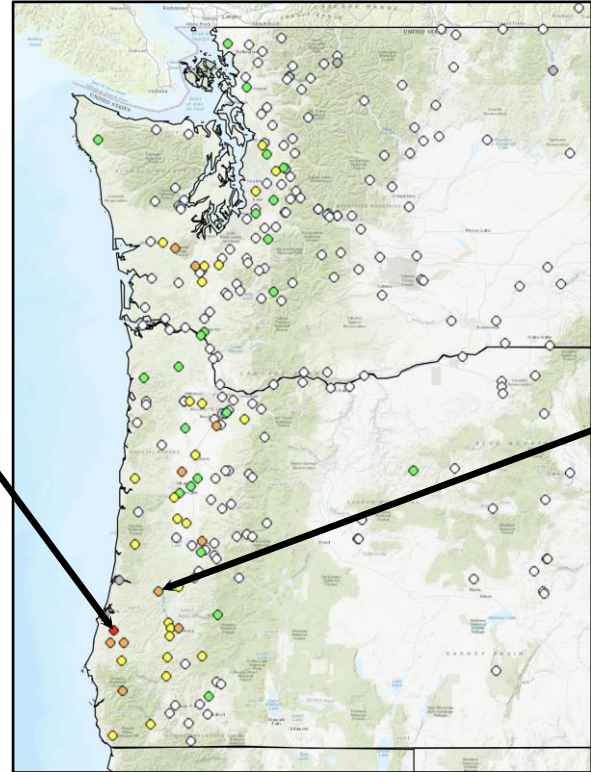
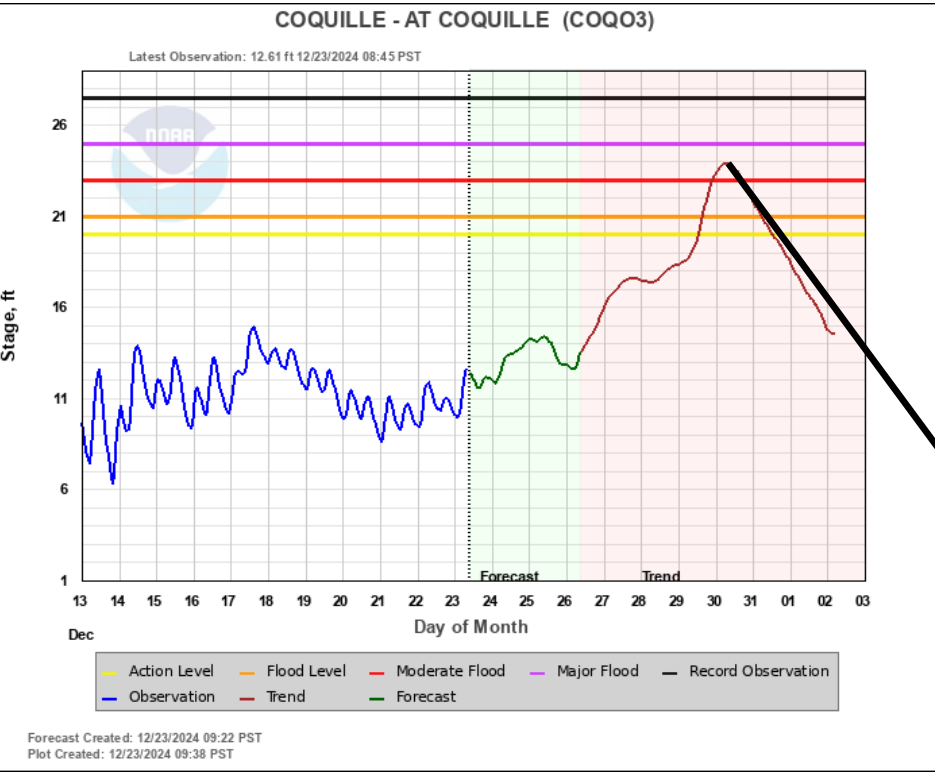


Day 5
Valid: 4 AM PT 28 Dec



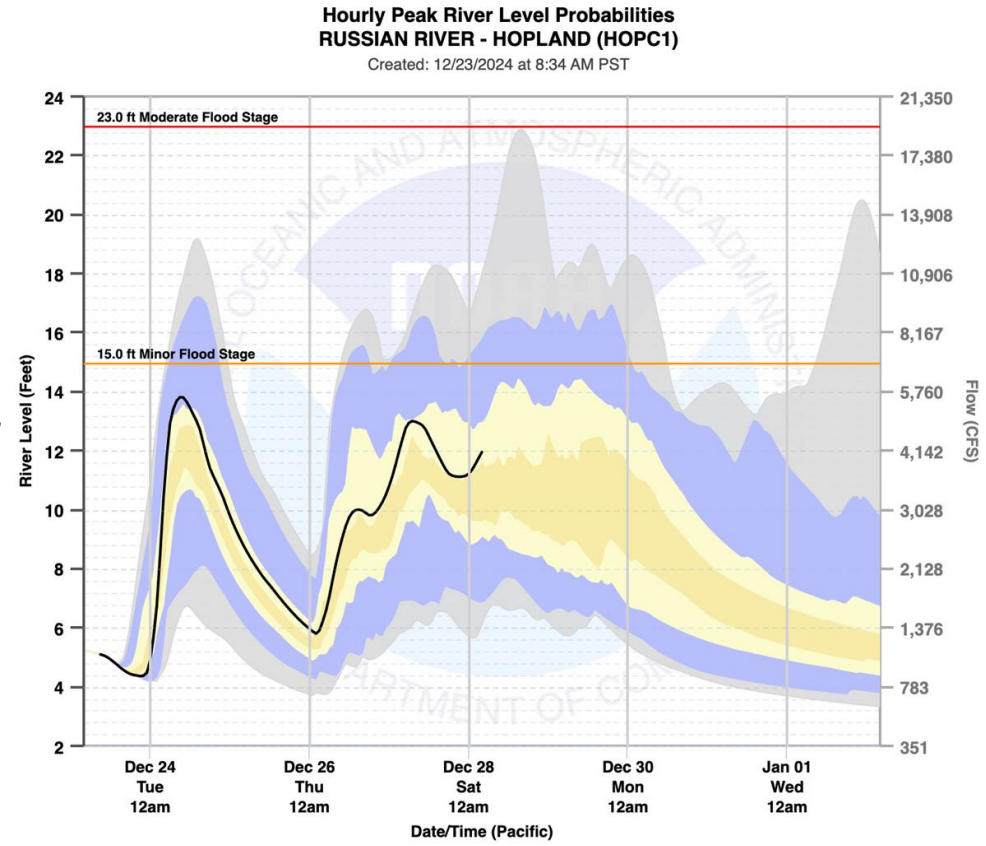
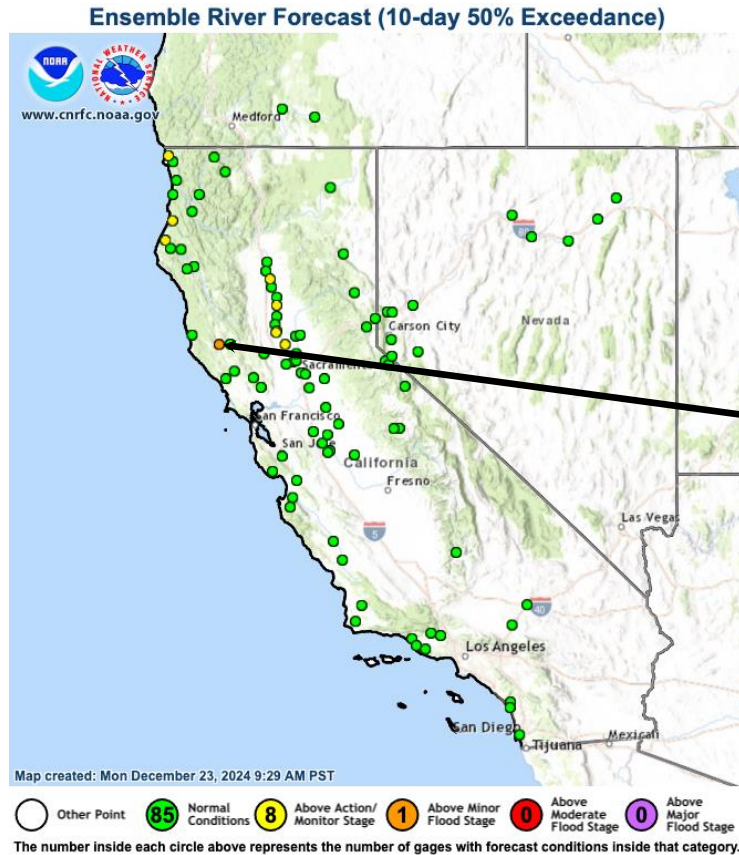
- The WPC has issued a marginal risk excessive rainfall outlook (ERO) for the Southern Oregon and Northern California Coast Ranges, as well as the Northern Sierra Nevada Foothills today into Wed 25 Dec due to rainfall from the first AR.
- The WPC has also issued marginal risk EROs across coastal Washington, Oregon, and Northern California Wed 25 Dec into Sat 28 Dec due to heavy rainfall from subsequent landfalling ARs.

Hydrologic Forecasts: NWRFC



- The Northwest River Forecast Center (NWRFC) is forecasting numerous stream gages in western Oregon and Washington to rise above action/bankfull levels over the next 10 days due to heavy rainfall from these ARs.
- Ten gages are forecast to exceed minor flood stage, and one gage is forecast to exceed moderate flood stage.
- The Coquille River at Coquille, OR, is forecast to crest above moderate flood stage on Mon 30 Dec.
- The Umpqua River near Elkton, OR, is forecast to rise more than 25 feet over the next 10 days and crest above minor flood stage on 30 Dec.

Hydrologic Forecasts: CNRFC



Chance of River Level Exceedance (Feet)

Forecast Period: 12/23/2024 4 am - 01/02/2025 4 am

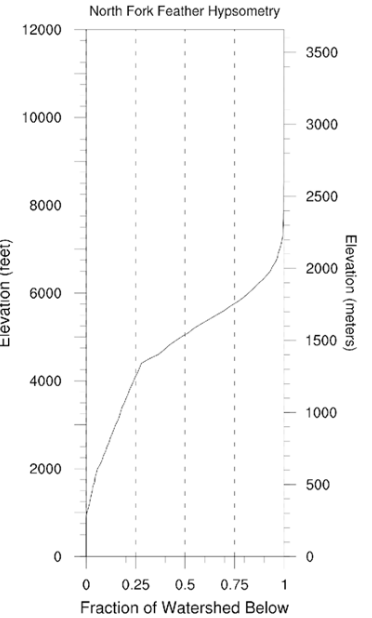
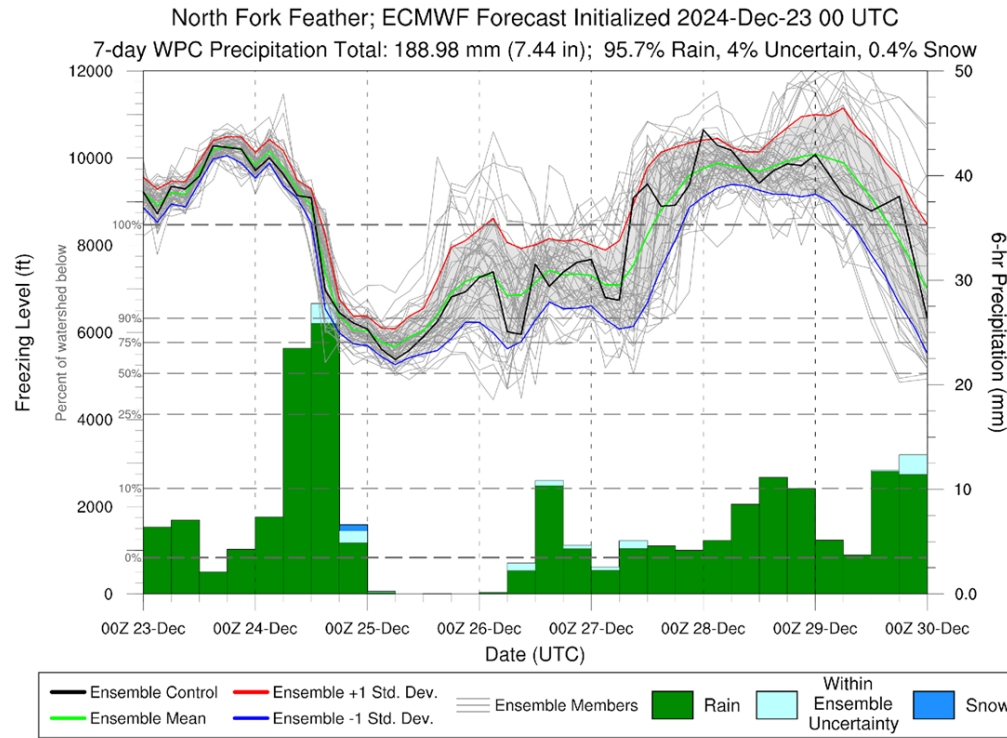
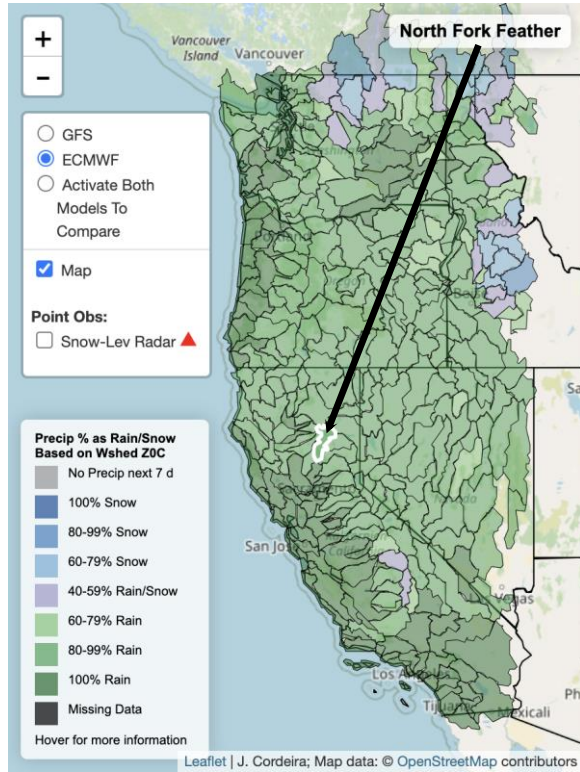
Max	22.88
5%	19.19
10%	18.63
25%	16.80
50%	15.67
75%	13.21
90%	11.41
95%	10.75
Min	8.58

Minor Flood 15.0 ft 55%

- Ensemble forecasts from the California–Nevada River Forecast Center are indicating $\geq 50\%$ likelihood that one stream gage will exceed flood stage and another eight gages will exceed action/monitor stage in California over the next 10 days.
- CNRFC is showing a 55% probability that the Russian River at Hopland will exceed flood stage, most likely between 26 Dec and 30 Dec.

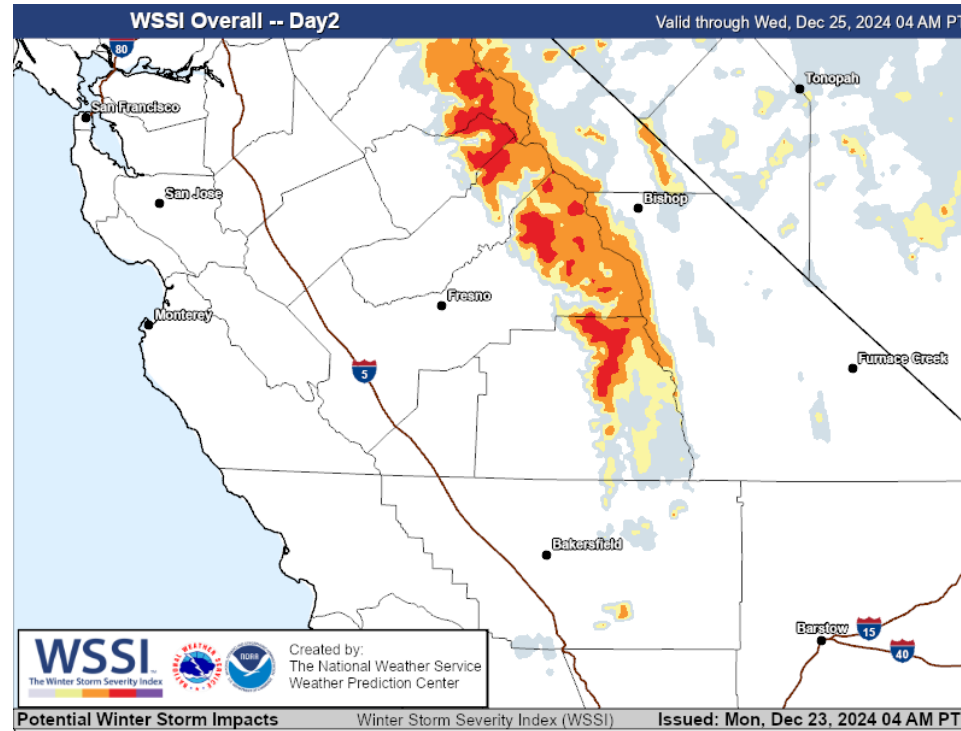
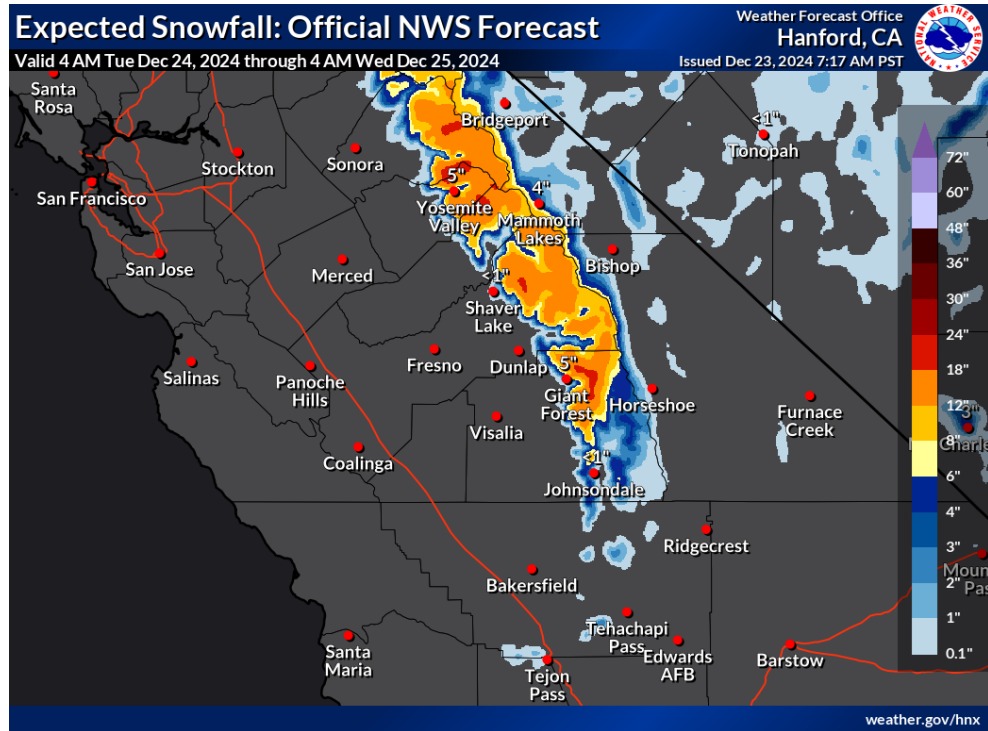
AR Outlook: 23 December 2024

Watershed Freezing Level Forecasts



- The 00Z EPS is forecasting the freezing level in the North Fork Feather watershed to remain above 9,000 feet through this evening and then drop rapidly to ~6,000 feet following the first AR landfall.
- Freezing levels are expected to remain above 6,000 feet for the remainder of the period of landfalling AR activity.
- High freezing levels will result in nearly all the precipitation falling as rain and therefore increase the runoff and flood potential during the first AR.

Winter Weather Hazards



Potential Winter Storm Impacts	
Winter Weather Area	Expect Winter Weather. • Winter driving conditions. Drive carefully.
Minor Impacts	Expect a few inconveniences to daily life. • Winter driving conditions. Use caution while driving.
Moderate Impacts	Expect disruptions to daily life. • Hazardous driving conditions. Use extra caution while driving. • Closures and disruptions to infrastructure may occur.
Major Impacts	Expect considerable disruptions to daily life. • Dangerous or impossible driving conditions. Avoid travel if possible. • Widespread closures and disruptions to infrastructure may occur.
Extreme Impacts	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.

- The first AR is forecast to produce 8–16 inches of snow above 6,000 feet in the Central and Southern Sierra Nevada.
- Moderate-to-major winter storm impacts are expected in these areas based on the NWS Winter Storm Severity Index (WSSI).