

CW3E Atmospheric River Outlook: 20 December 2024

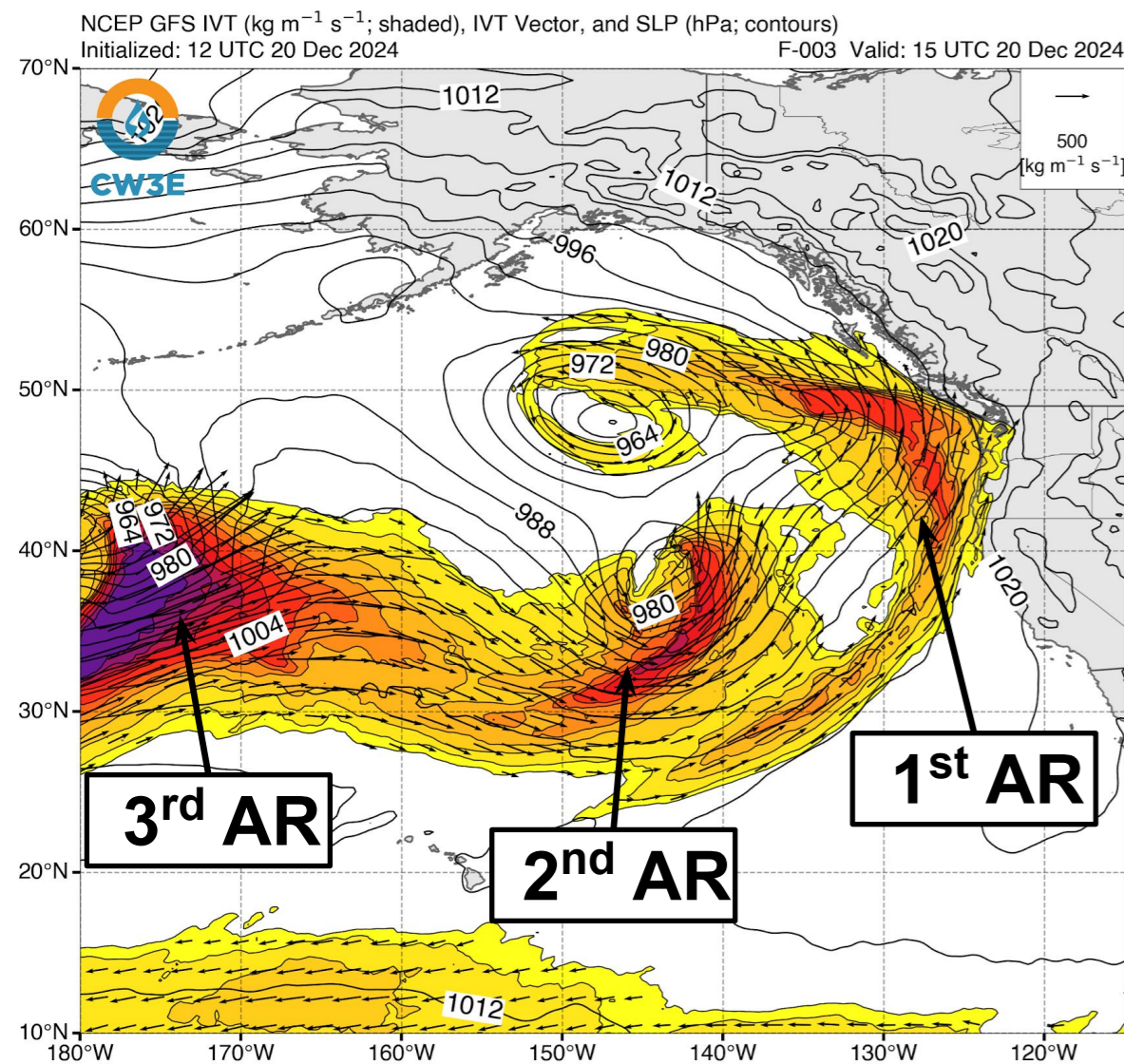
Family of Atmospheric Rivers Forecast to Continue Bringing Heavy Precipitation to US West Coast

- A series of atmospheric rivers (ARs) and low-pressure systems are forecast continue impacting the US West Coast over at least the next seven days.
- The first AR has made landfall today (Fri 20 Dec) with the second AR following shortly behind, making landfall early tomorrow (Sat 21 Dec) over the Pacific Northwest and Northern California coasts. These two ARs are forecast to bring light precipitation impacts to the US West Coast.
- The third and fourth ARs are forecast to make landfall on Sun 22 Dec and Mon 23 Dec. Both ARs are forecast to bring moderate-to-strong AR conditions ($IVT > 500 \text{ kg m}^{-1} \text{ s}^{-1}$) to the Pacific Northwest and Northern California coasts.
- Following a lull in AR conditions, a fifth AR is forecast to make landfall Wed 25 Dec.
- Extended range forecast products indicate wet conditions, potentially driven by continued AR activity, are likely to continue into next weekend.
- The NWS Weather Prediction Center is forecasting 6-14 inches of total precipitation over the Olympic Peninsula and Northern California during the next 7 days.
- ECMWF is forecasting higher precipitation totals across coastal California and Southern Oregon with less across Northern Oregon and Washington over the next 10 days compared to GFS.
- The Weather Prediction Center issued a marginal risk excessive rainfall outlook (Level 1 of 4, 5% chance) for the Northern California and Oregon coasts in association with the fourth AR from 4 AM PST 23-24 Dec.
- Stream levels are forecast to rise throughout Washington, Oregon and California over the next seven days, with numerous gauges in Washington and Oregon reaching bankfull levels as a result of the high freezing levels and heavy rain

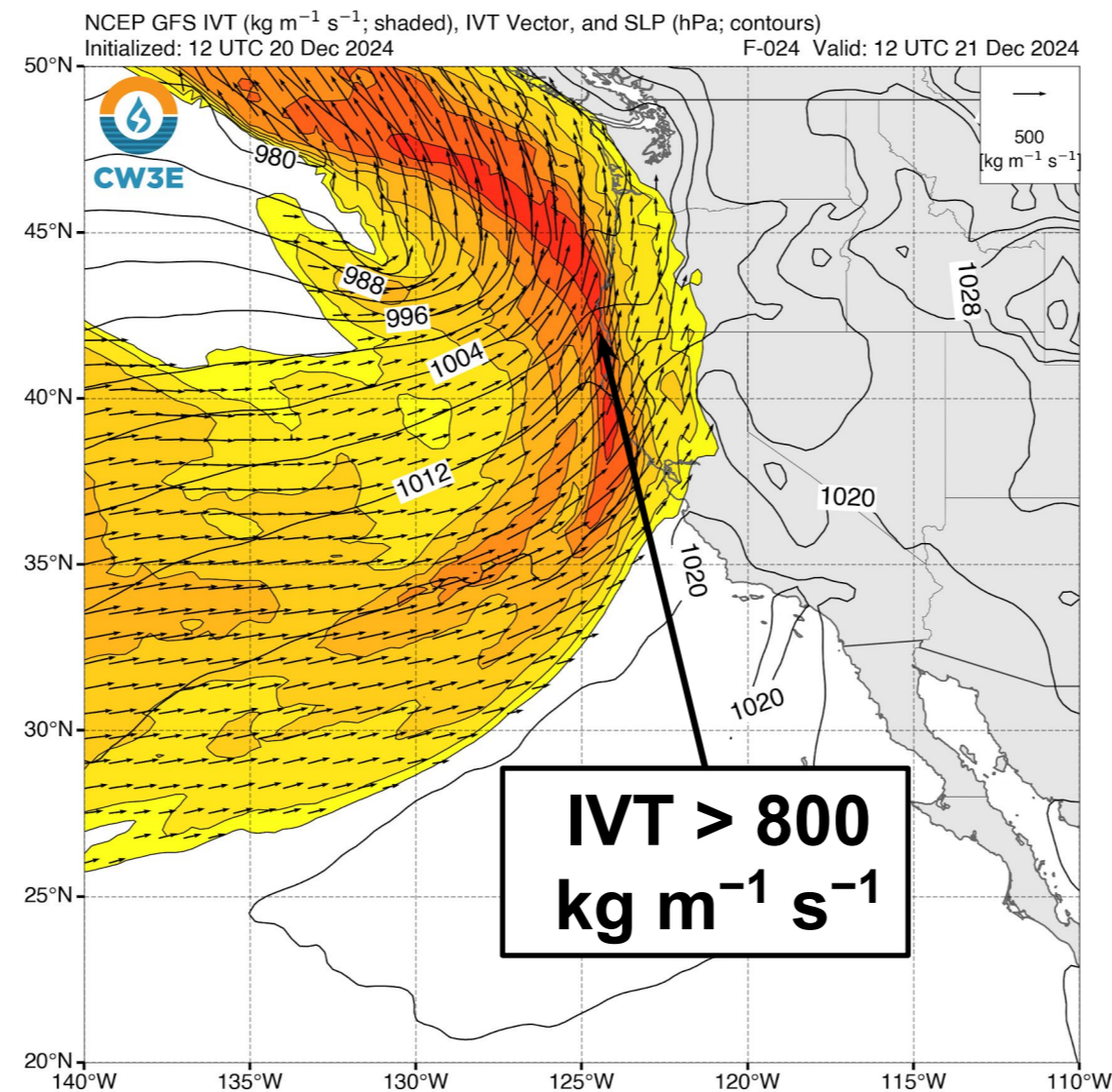
AR Outlook: 20 December 2024

GFS IVT & SLP Forecasts

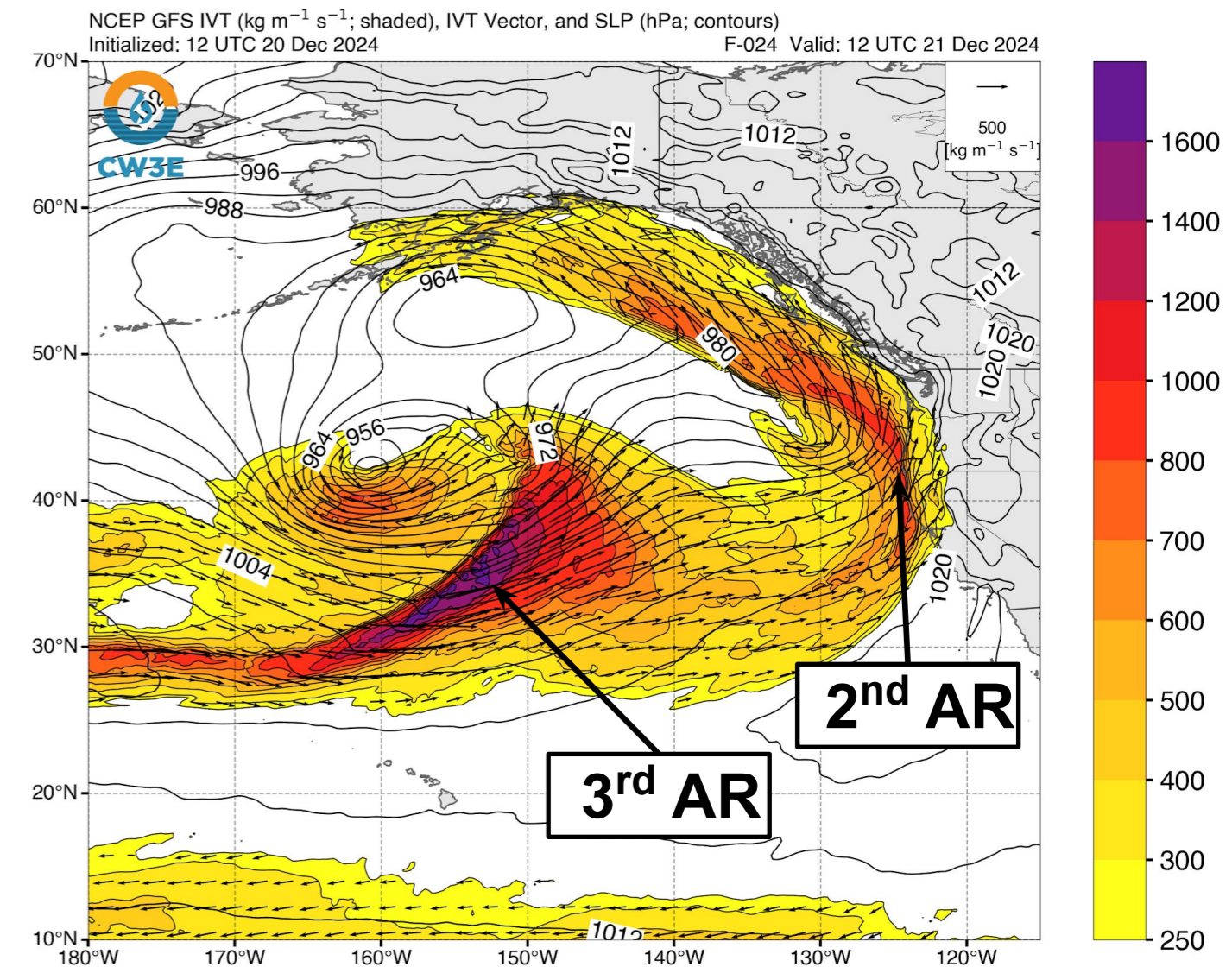
Valid: 7 AM PST 20 Dec (F-003)



Valid: 4 AM PST 21 Dec (F-024)



Valid: 4 AM PST 21 Dec (F-024)

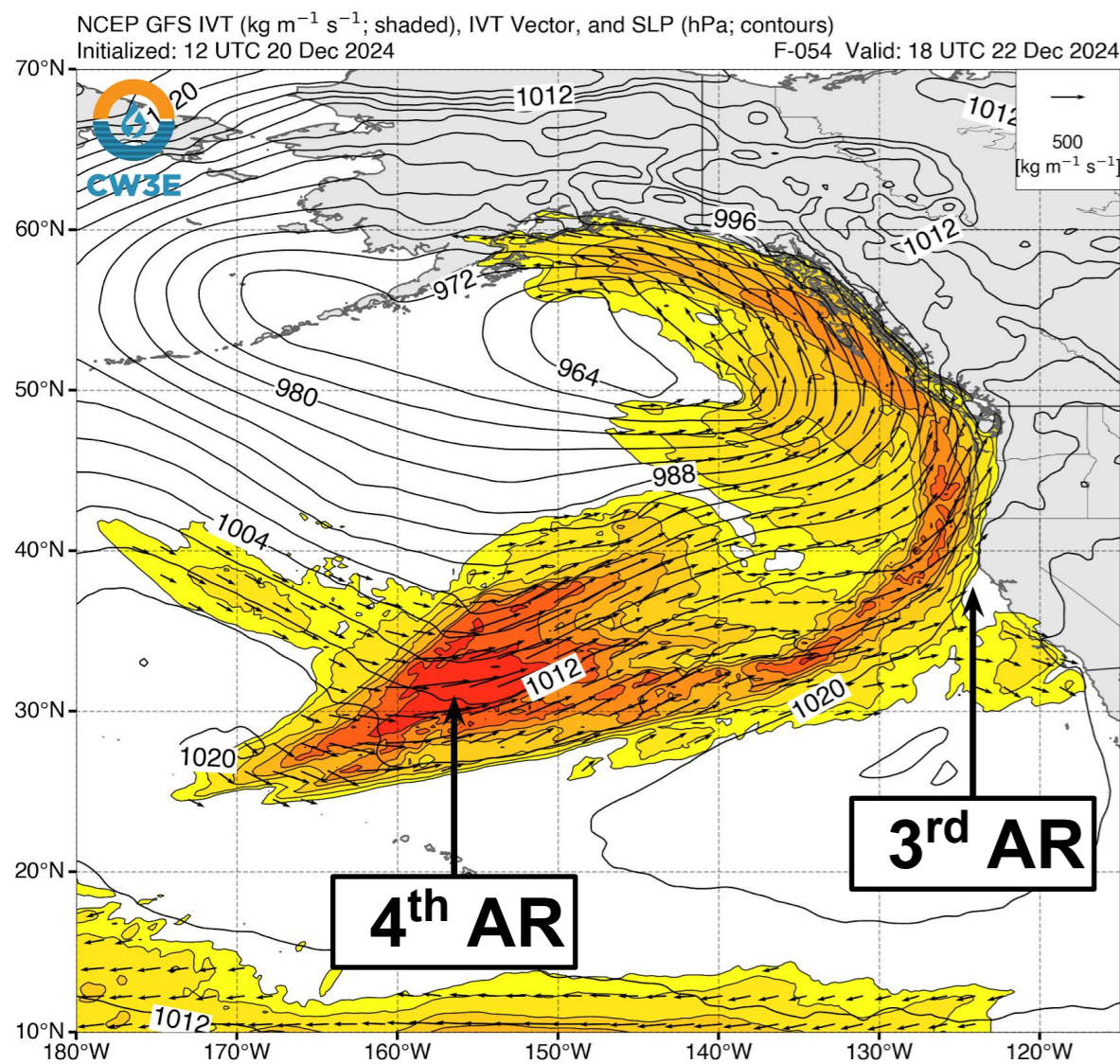


- The first AR has made landfall over the Pacific Northwest today while the second AR is just behind it, forecast to make landfall tomorrow (Sat 21 Dec).
- The core of the second ARs is forecast to dissipate as it moves onshore, but still manages to bring a brief period of moderate-to-strong AR conditions ($IVT \geq 500 \text{ kg m}^{-1} \text{ s}^{-1}$) to coastal Washington and Oregon.
- The third AR continues propagating toward the US West Coast as the second AR make landfall.

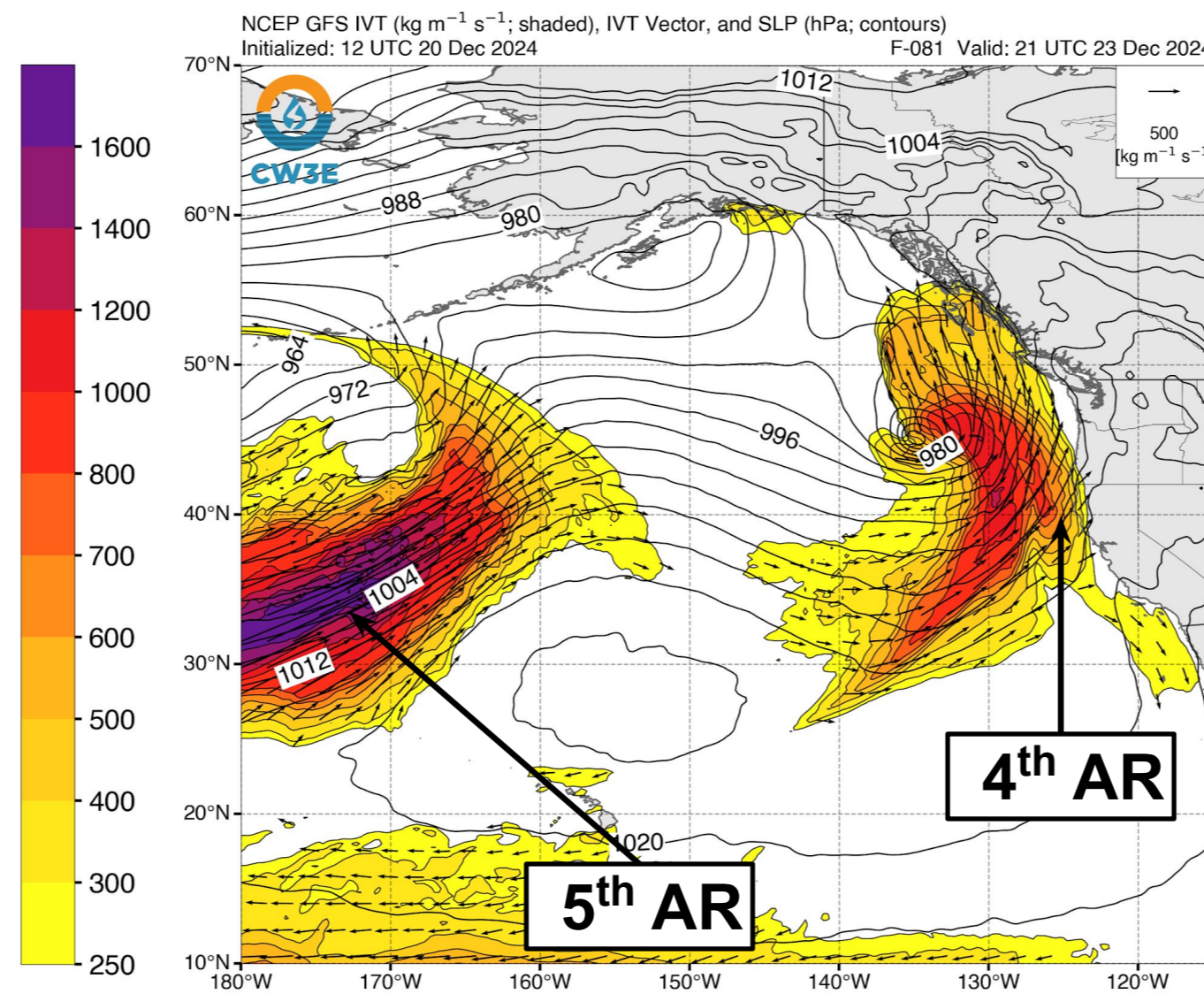
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GFS IVT & SLP Forecasts

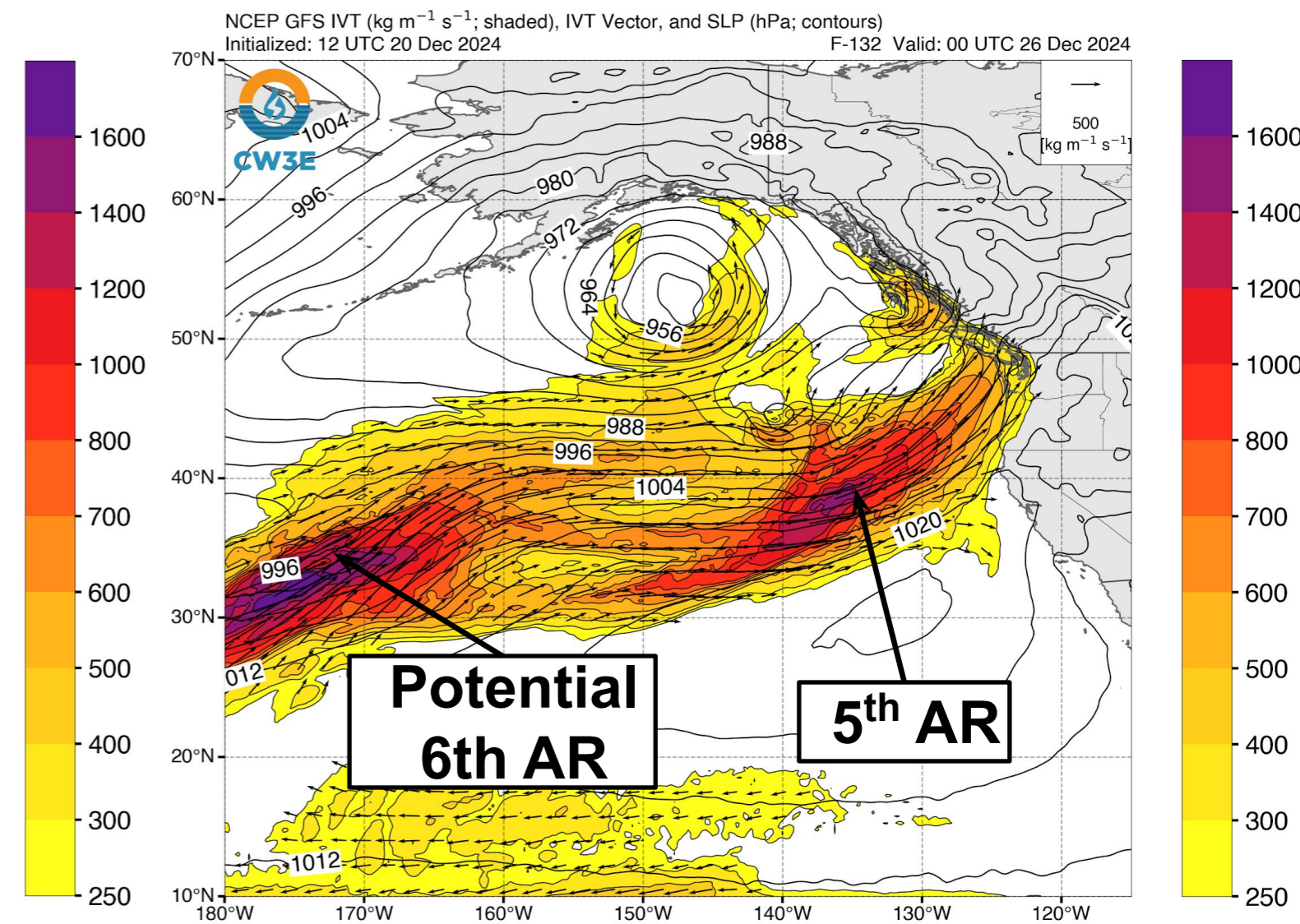
Valid: 10 AM PST 22 Dec (F-54)



Valid: 1 PM PST 23 Dec (F-081)



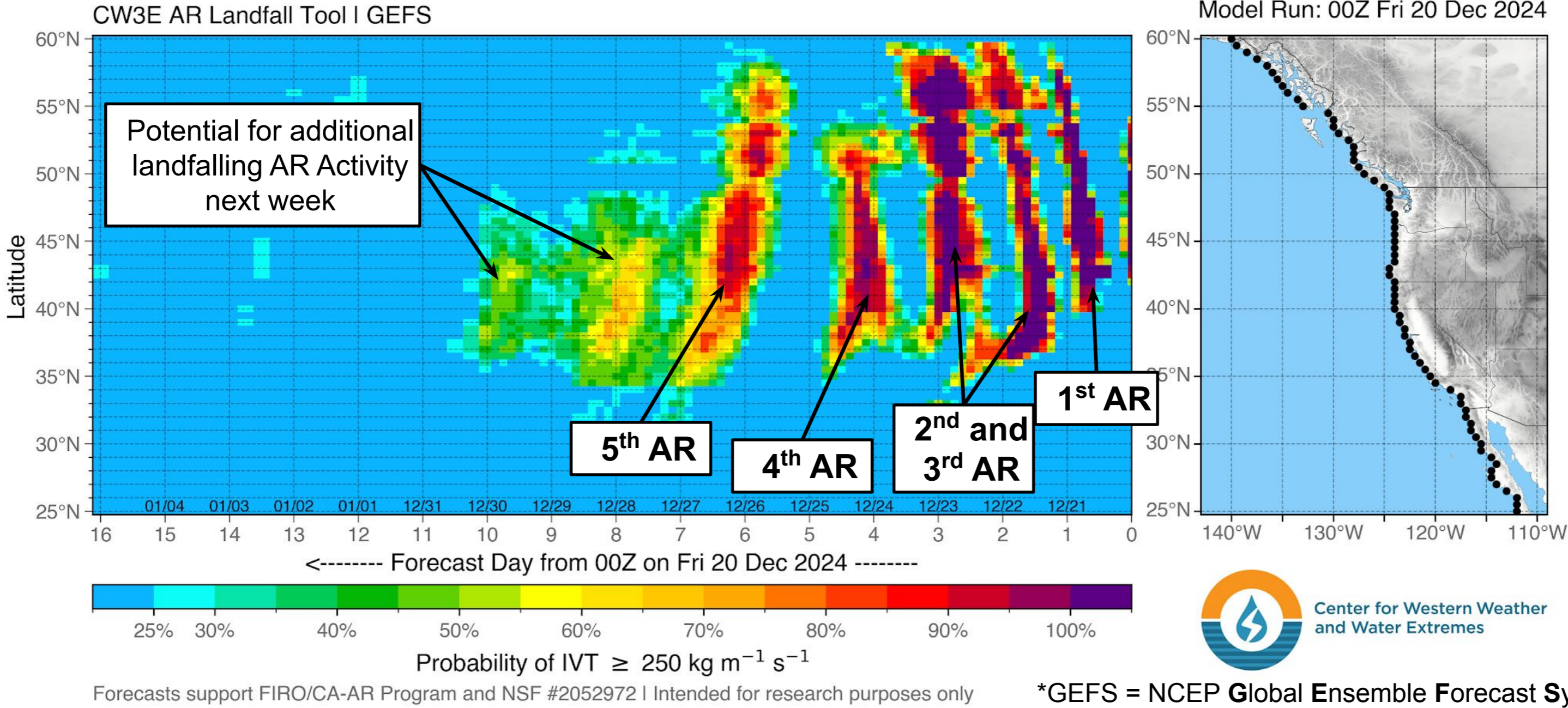
Valid: 4 PM PST 25 Dec (F-132)



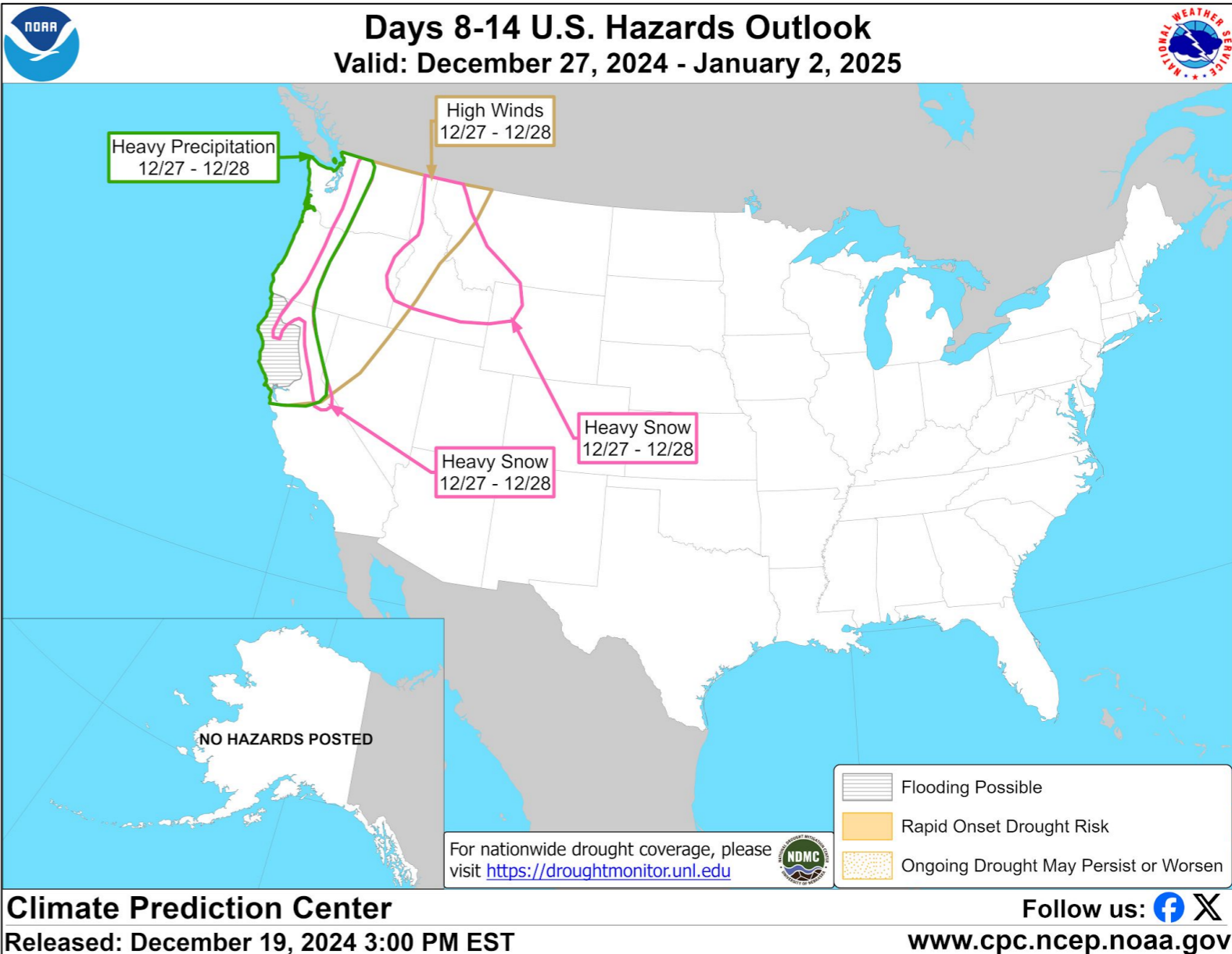
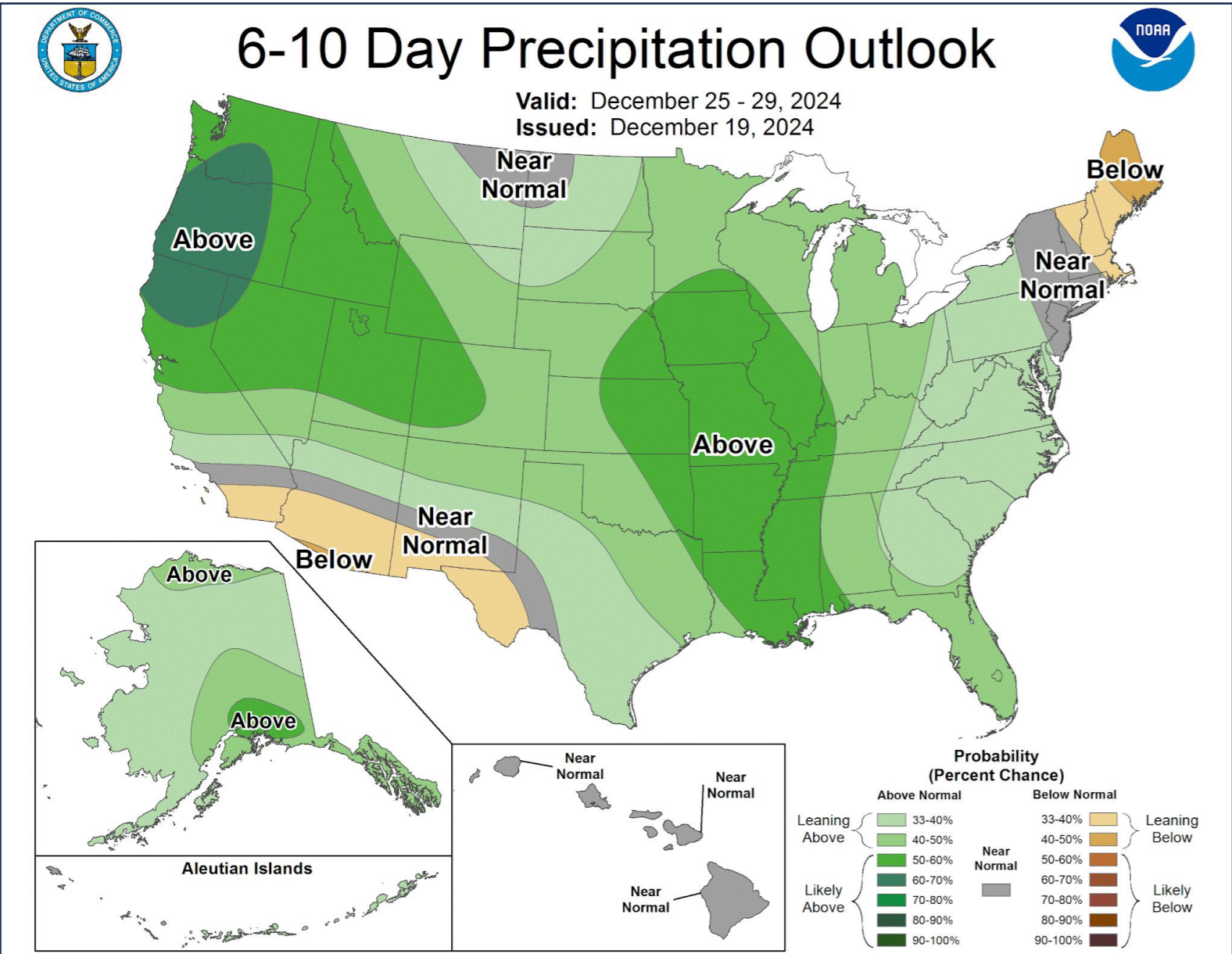
- The core of the third AR weakens substantially prior to making landfall early Sun 22 Dec but is still forecast to bring moderate-to-strong AR conditions to coastal Oregon.
- A fourth AR is forecast to make landfall over the coast shortly following the third AR and is currently forecast to be the strongest AR in this sequence. In some locations, there is not expected to be a break in AR conditions between the third and fourth ARs.
- Following a short lull in AR conditions, a fifth AR is forecast to make landfall on Wed 25 Dec and bring moderate AR conditions to the Pacific Northwest and Northern California coast.
- There is the potential for a sixth AR further out in the forecast that may make landfall along the US West Coast late next week.

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GEFS Probability of AR Conditions Along Coast



- The 00Z GEFS is showing very high confidence (near 100% probability) in a period of AR conditions ($IVT \geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$) over coastal Washington and Northern Oregon on Fri 20 Dec in association with the first AR.
- After the first AR landfall, GEFS continues to show moderate-to-high confidence (> 70% probability) in multiple periods of AR conditions between Central California and Washington into early next week in association with the sequence of ARs propagating across the Northeast Pacific.
- Elevated probabilities of landfalling AR activity persist through the end of next week.



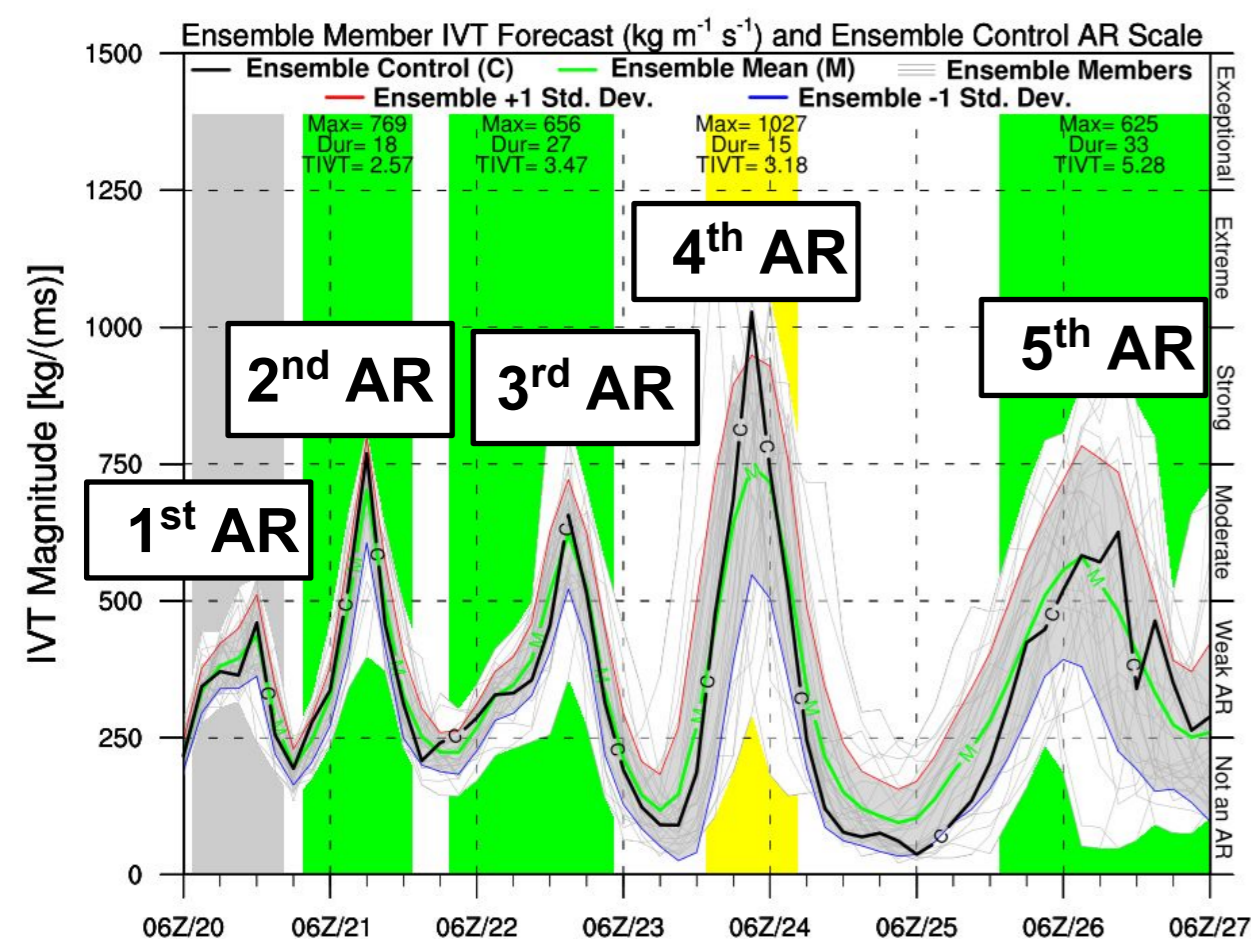
- The potential for AR activity extending wet conditions on the US West Coast is apparent in extended range forecast products issued by the Climate Prediction Center (CPC).
- The CPC’s 6–10 Day outlook is showing > 60% probability of above-normal precipitation in Washington, Oregon and Northern California, with odds tilted toward above-normal precipitation southward into the Los Angeles Basin.
- The CPC’s 8-14 day U.S. Hazards Outlook is highlighting the potential for heavy precipitation from Northern California to the Canada border with flooding possible for Northern California on Dec 27-28. The outlook also highlights the possibility of heavy snow for the Cascades and Sierra Nevada mountain ranges.

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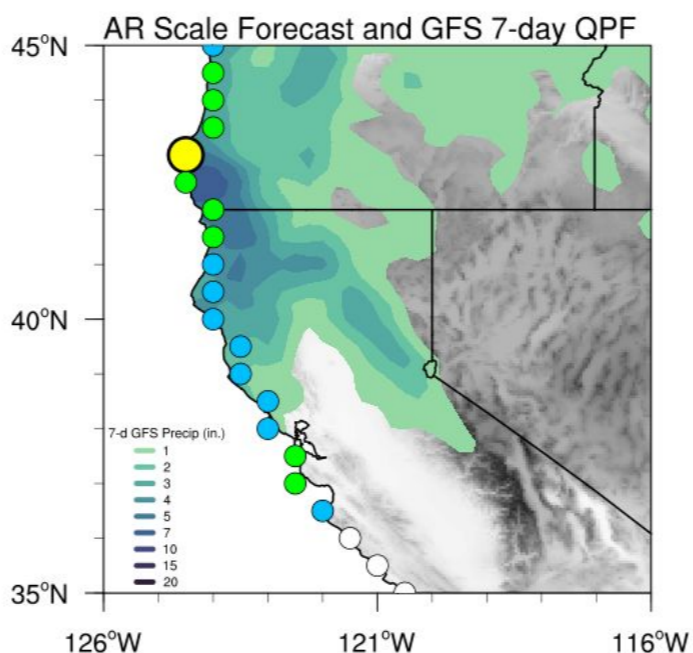
GEFS AR Scale and IVT Forecasts

GFS Ensemble Initialized: 06Z Fri 12/20/24

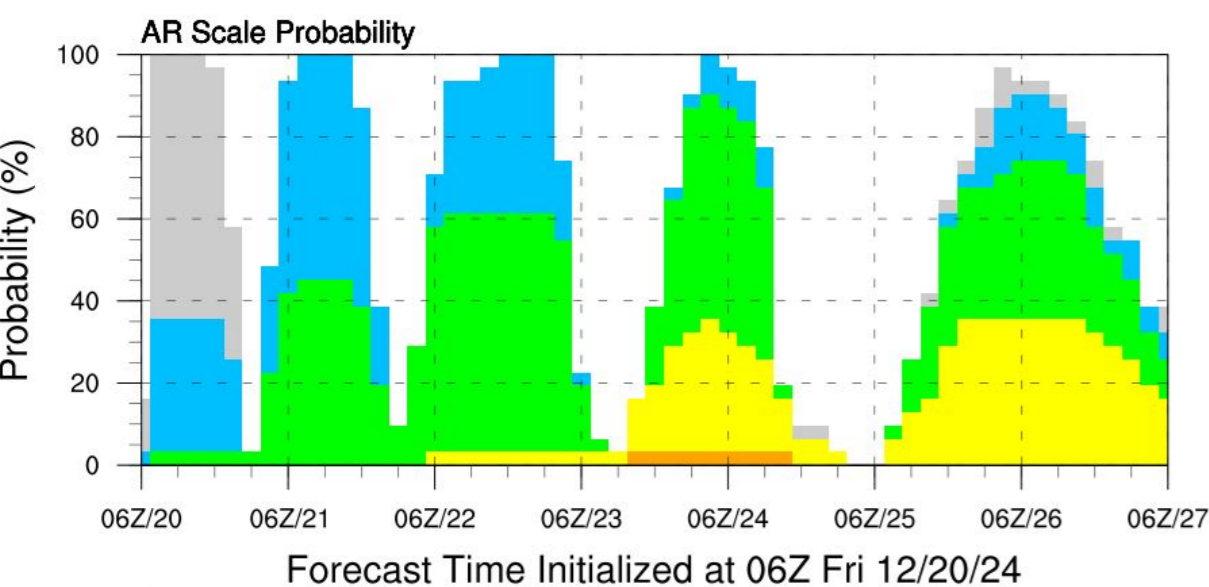
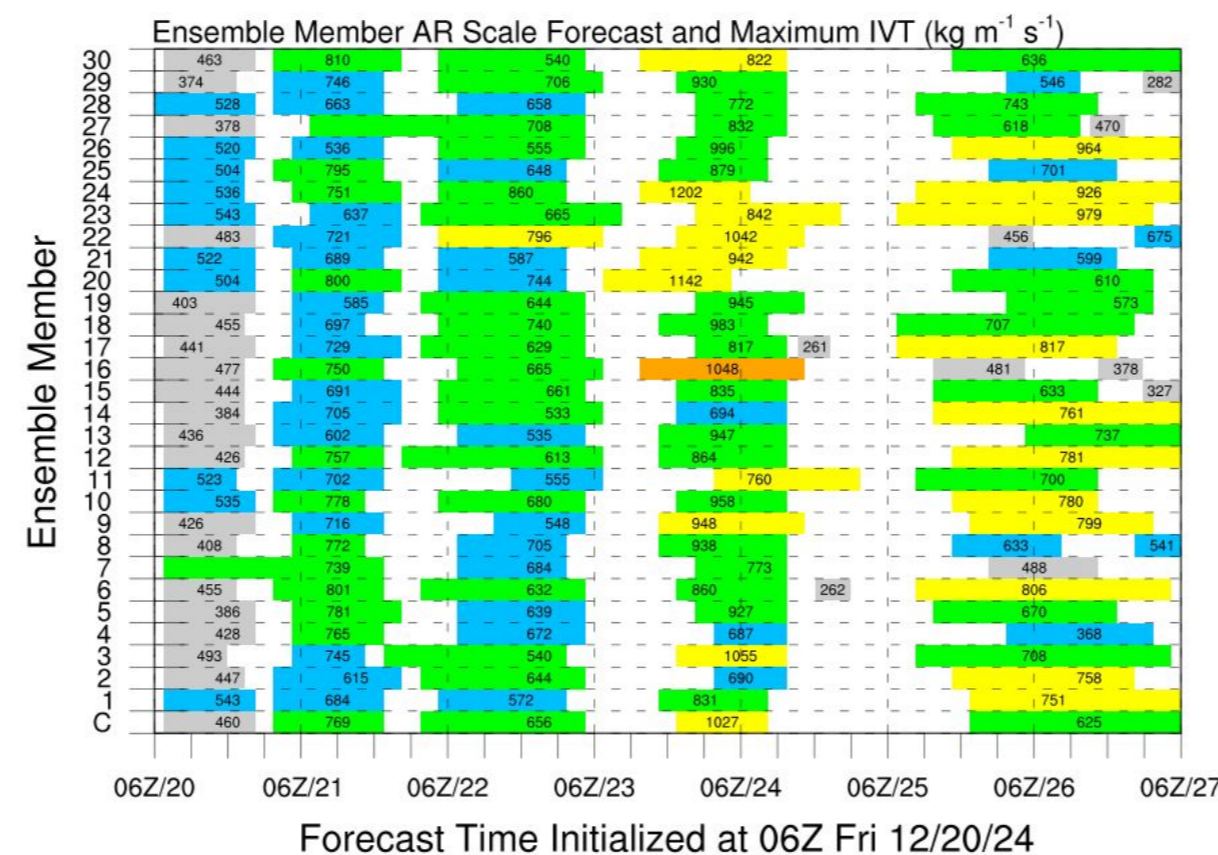
Location: 43°N 124.5°W



Categorical AR Strength by Ralph/CW3E



- The 06Z GEFS control member is forecasting AR 0 conditions (based on the Ralph et al. 2019 AR Scale) over coastal southern Oregon in association with the 1st AR.
- GEFS is showing higher probabilities of AR Scale conditions for each subsequent AR in this sequence, with the control member forecasting AR2-3 conditions for the second through fifth ARs.
- There continues to be much uncertainty in the timing, duration, and magnitude of AR conditions for the 4th and 5th ARs with 33% of ensemble members predicting an AR 3 or greater for either AR.



AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 14 UTC 12/20/2024

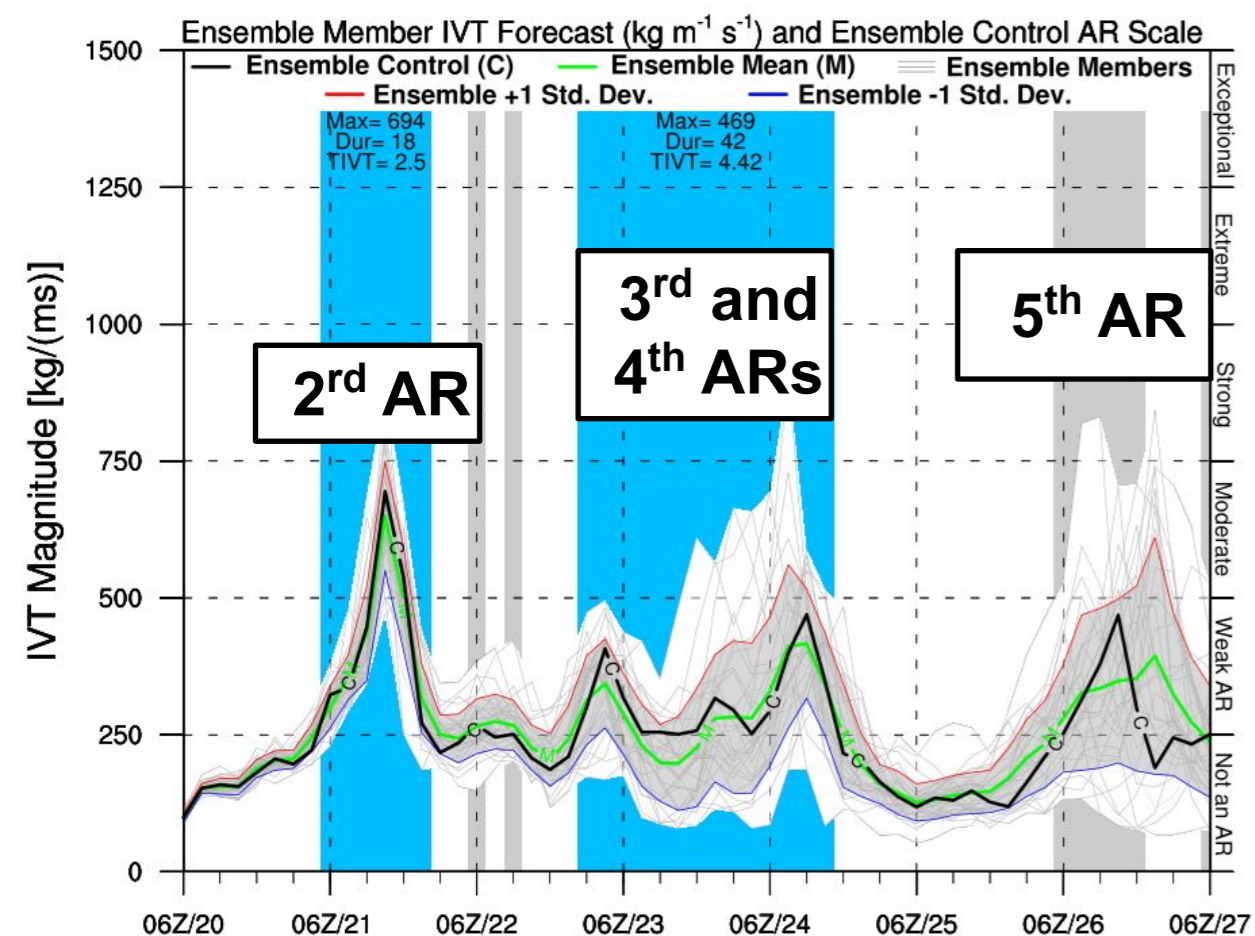
More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

AR Outlook: 20 December 2024

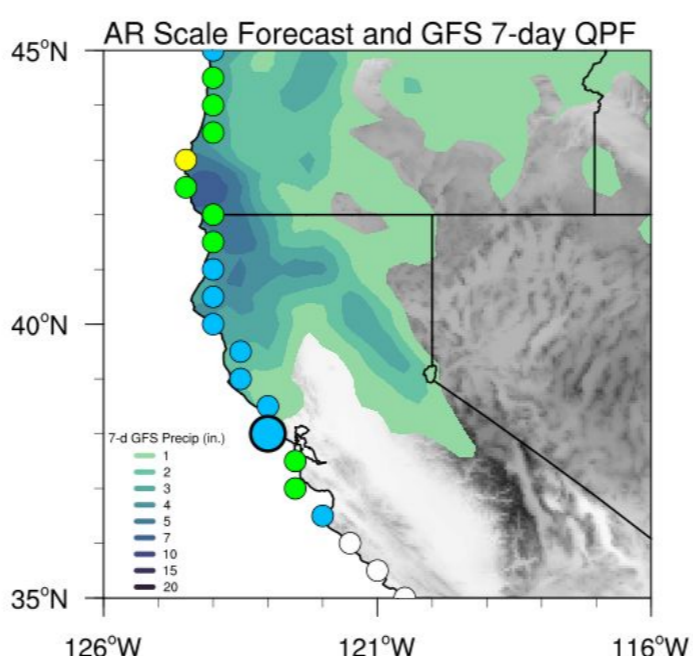
GEFS AR Scale and IVT Forecasts

GFS Ensemble Initialized: 06Z Fri 12/20/24

Location: 38°N 123°W



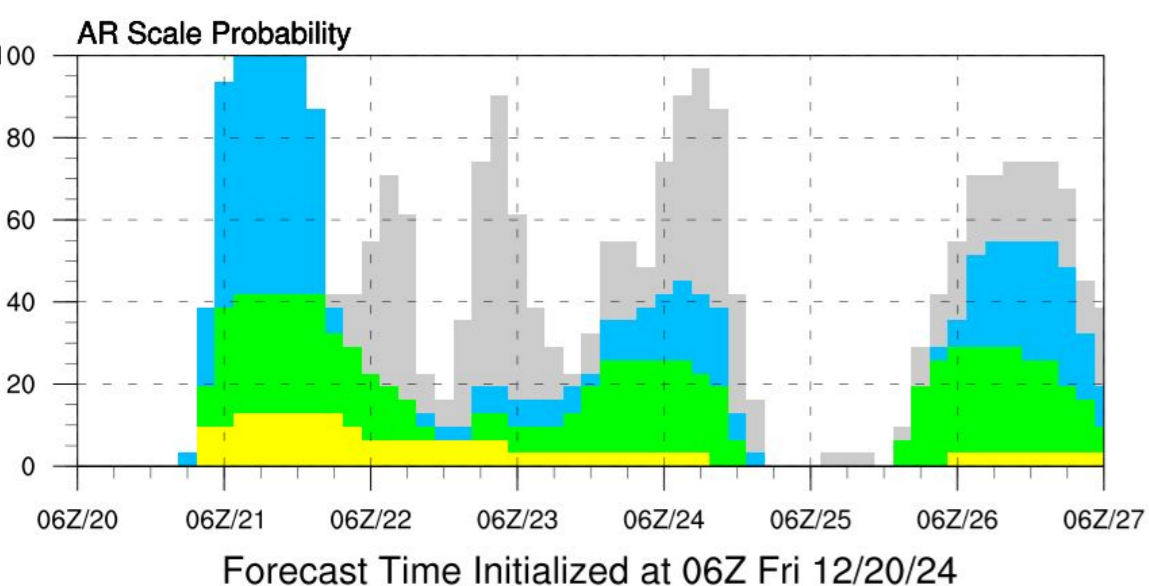
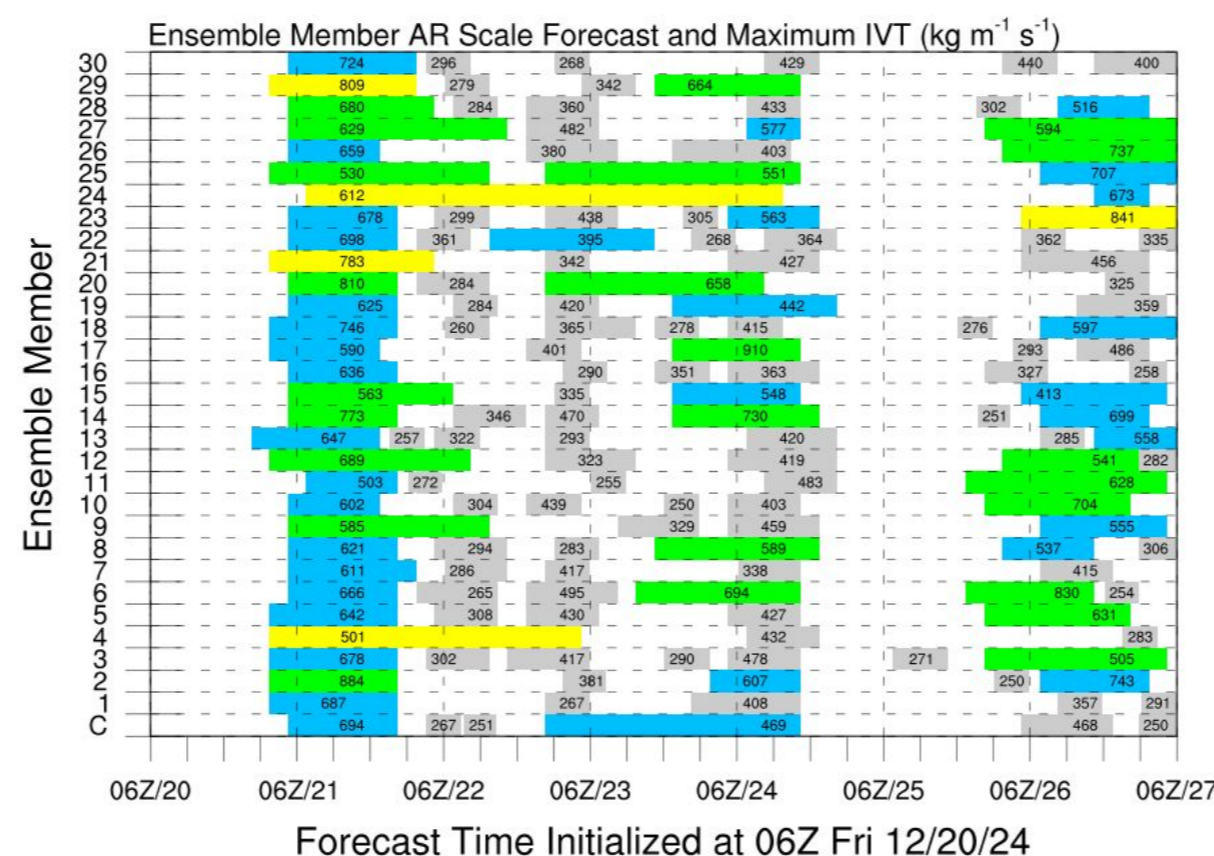
Categorical AR Strength by Ralph/CW3E



- The 06Z GEFS control is forecasting AR 1 to 2 conditions over coastal California from Monterey County to the Oregon border in association with the 2nd AR while combining the 3rd and 4th ARs.

- 13/31 (42%) ensemble members are predicting an AR 2 or AR 3 at 38°N, 123°W (Marin County, CA) for the 2nd AR

- While 13/31 (42%) members are predicting AR 1 or greater conditions for the 3rd and/or 4th AR, there continues to be much uncertainty in the timing, duration, and magnitude of AR conditions mostly due to how close the AR gets to the coast.



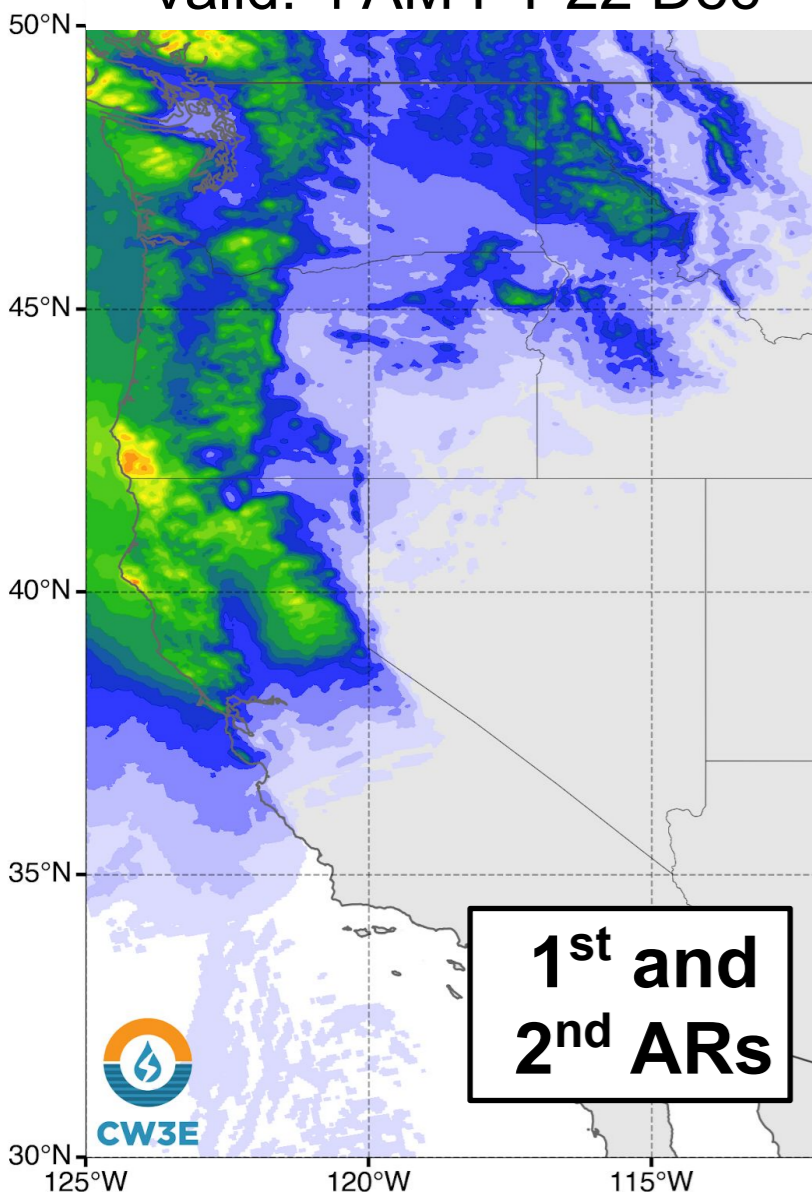
AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 14 UTC 12/20/2024

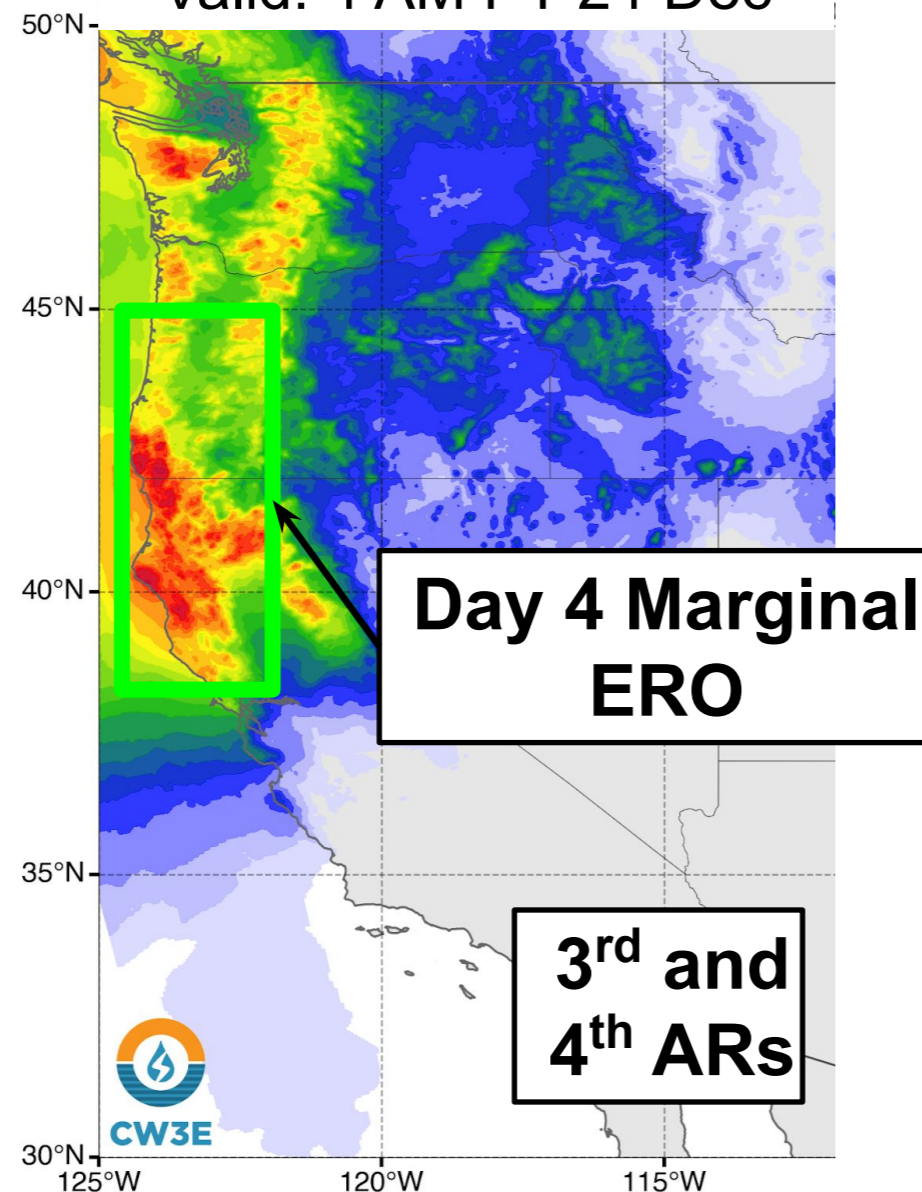
More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

Precipitation Forecasts

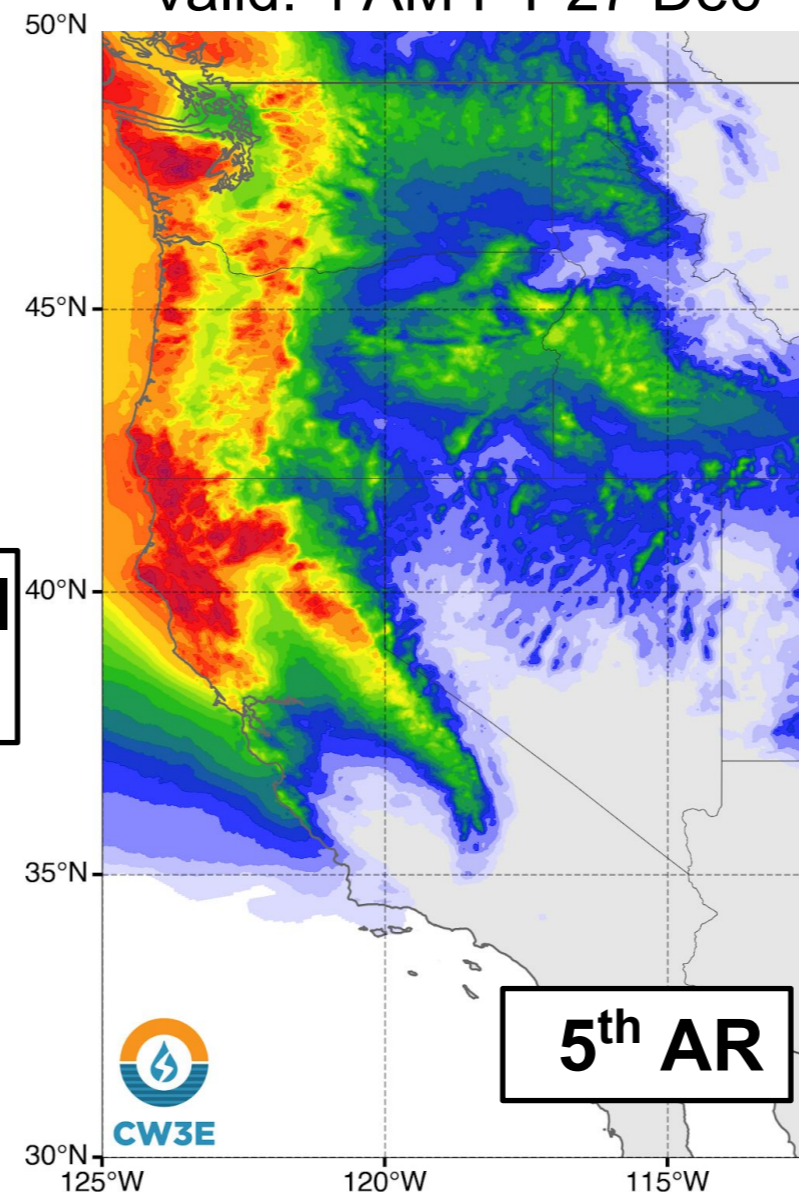
WPC 48-h QPF
Valid: 4 AM PT 22 Dec



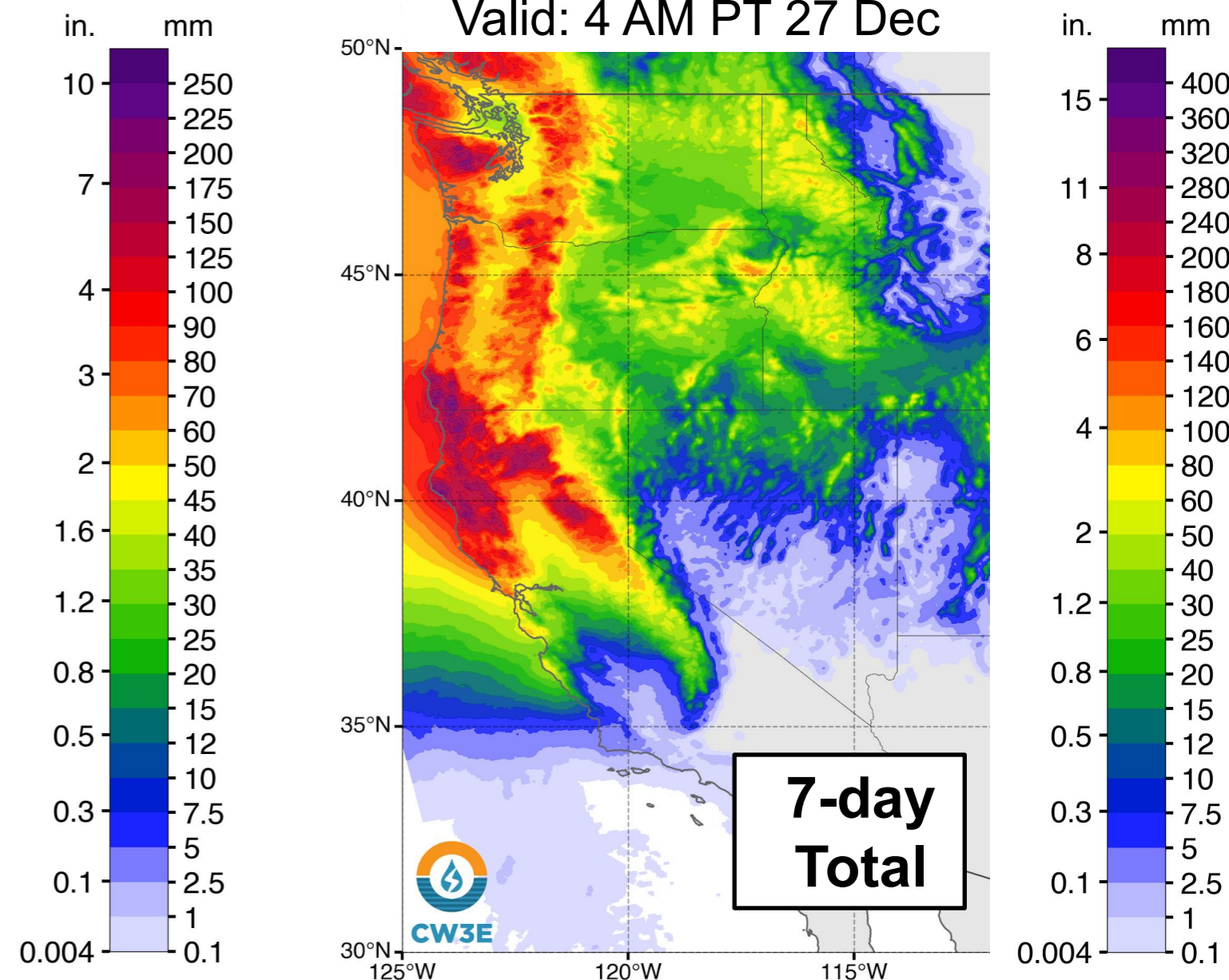
WPC 48-h QPF
Valid: 4 AM PT 24 Dec



WPC 48-h QPF
Valid: 4 AM PT 27 Dec



WPC 168-h QPF
Valid: 4 AM PT 27 Dec

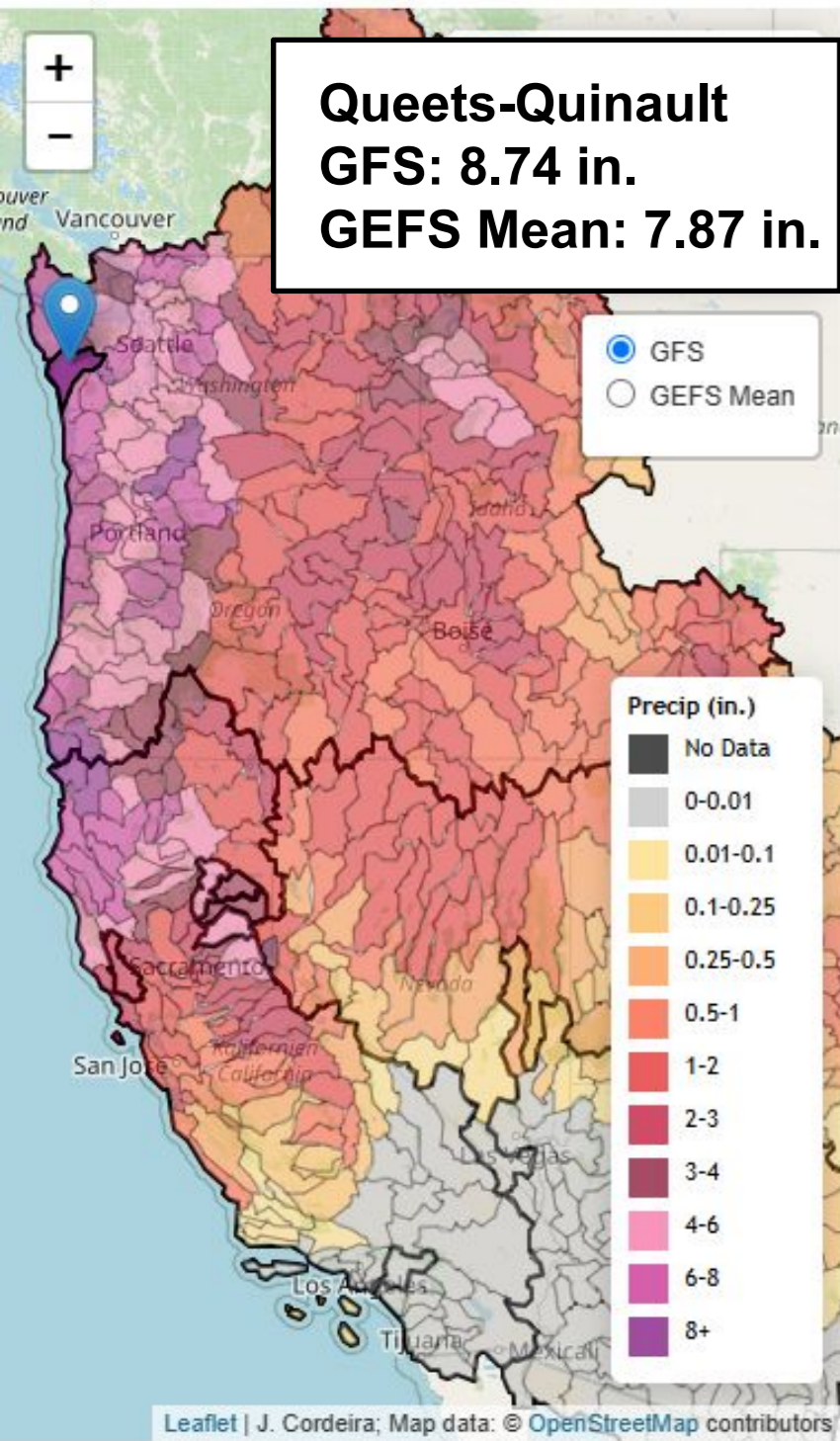


- The first and second ARs are forecast to produce light precipitation with up to 2 inches possible over the Oregon Coast Ranges.
- The third and fourth ARs are forecast to produce 2-4 inches of precipitation over the Olympic Peninsula, Southern Oregon, Northern California Coast Ranges, and Northern Sierra Nevada. WPC issued a marginal Excessive Rainfall Outlook along the Oregon and Northern California coast with the fourth AR.
- The fifth and potentially strongest AR is forecast to produce 4-6+ inches of precipitation over the Washington to Northern California Coasts, Northern Sierra Nevada and Cascades.
- During the next 7 days, the Weather Prediction Center (WPC) is forecasting 6-14 inches of total precipitation over the previously mentioned regions.

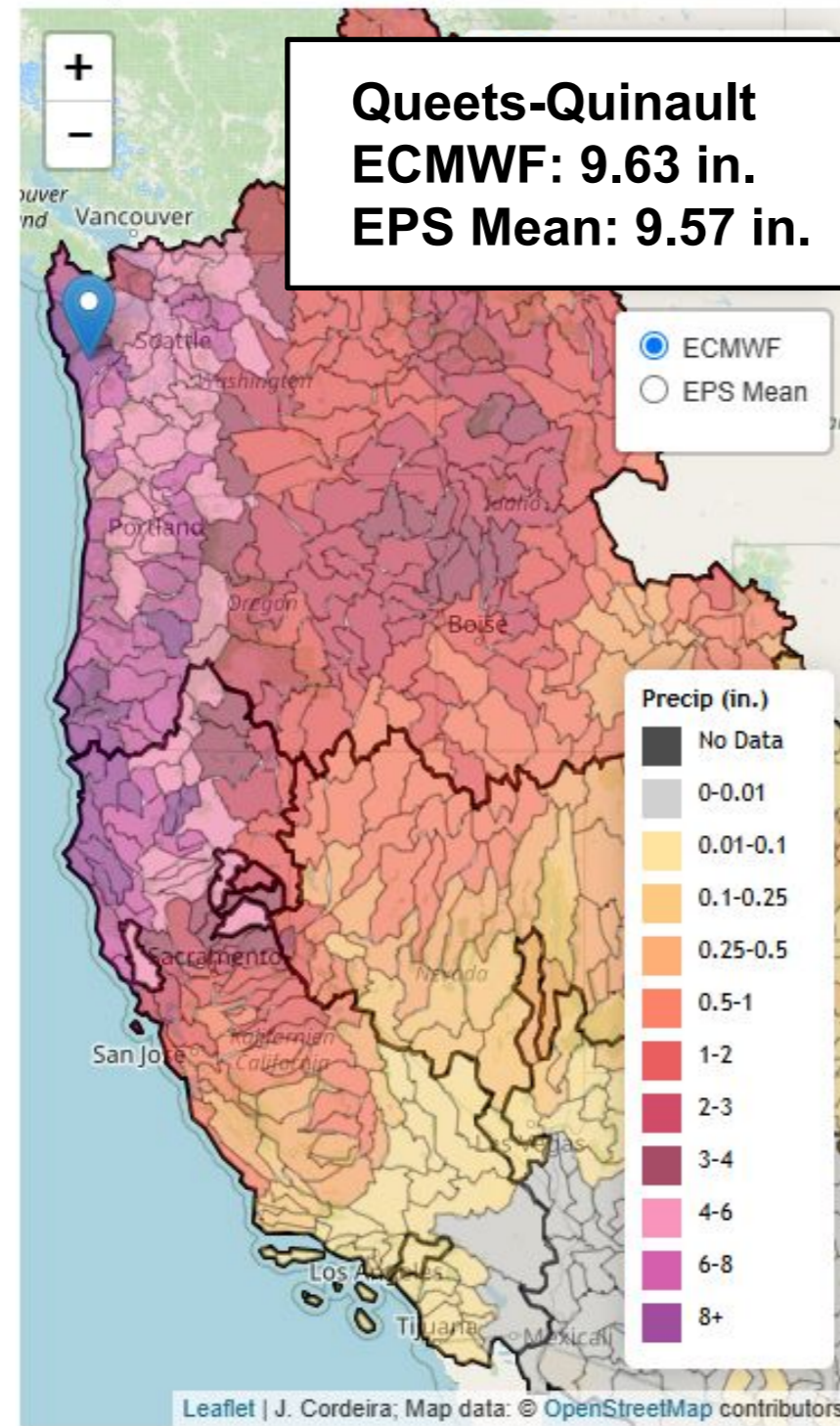
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Watershed Precipitation Forecasts

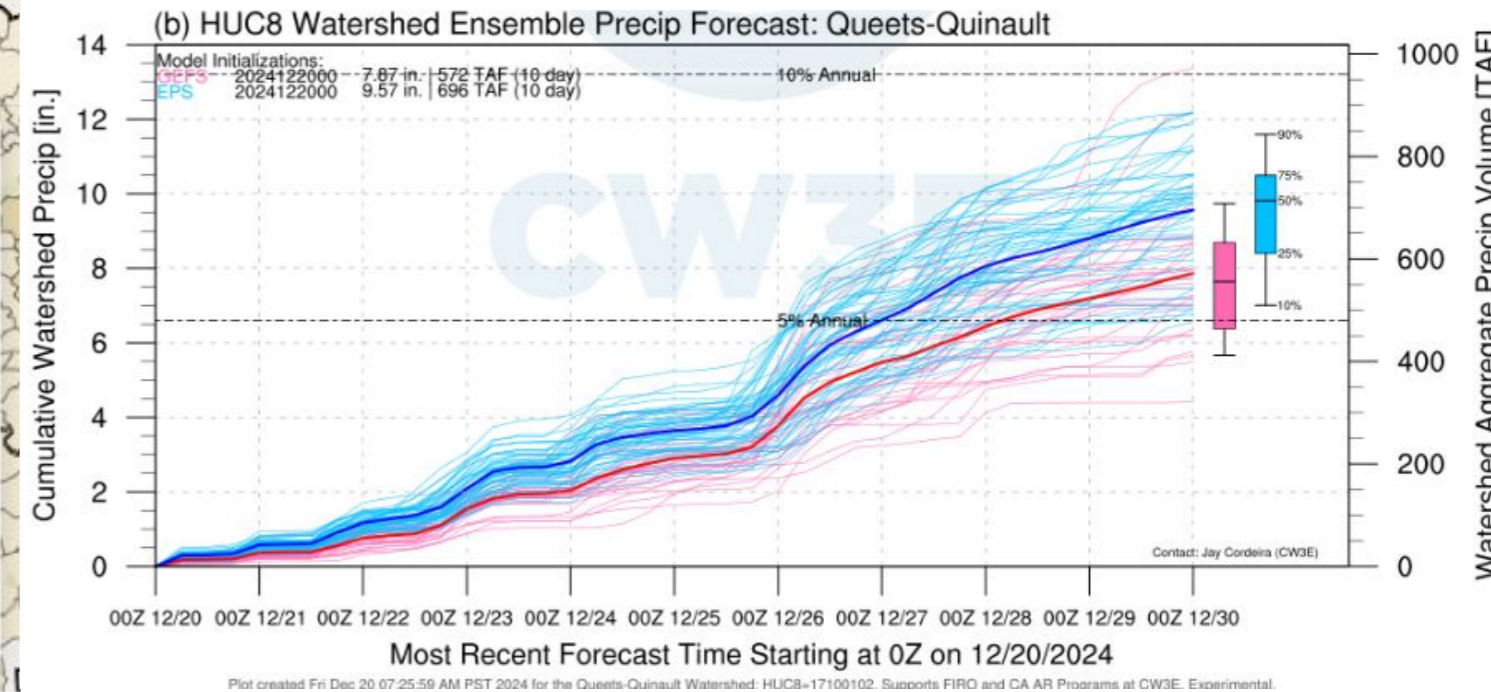
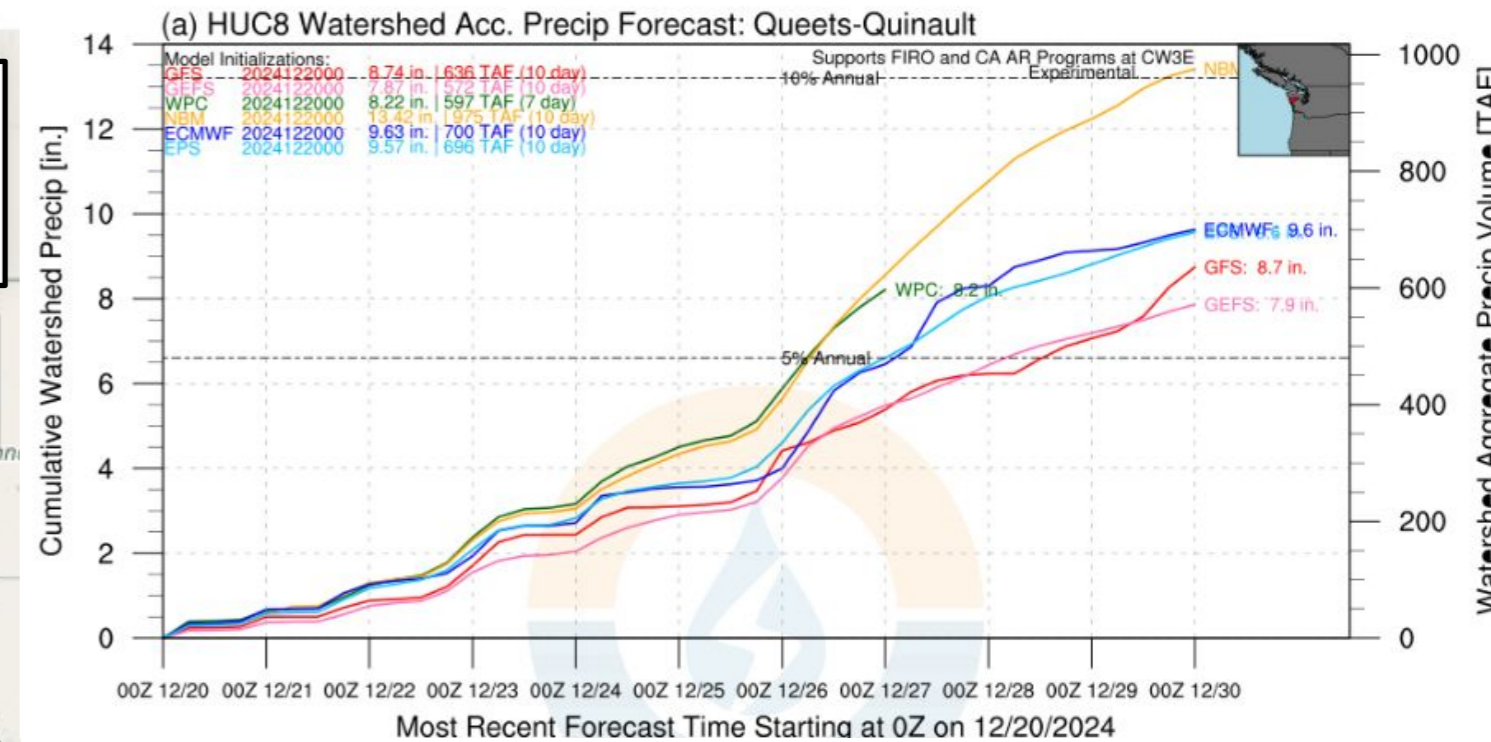
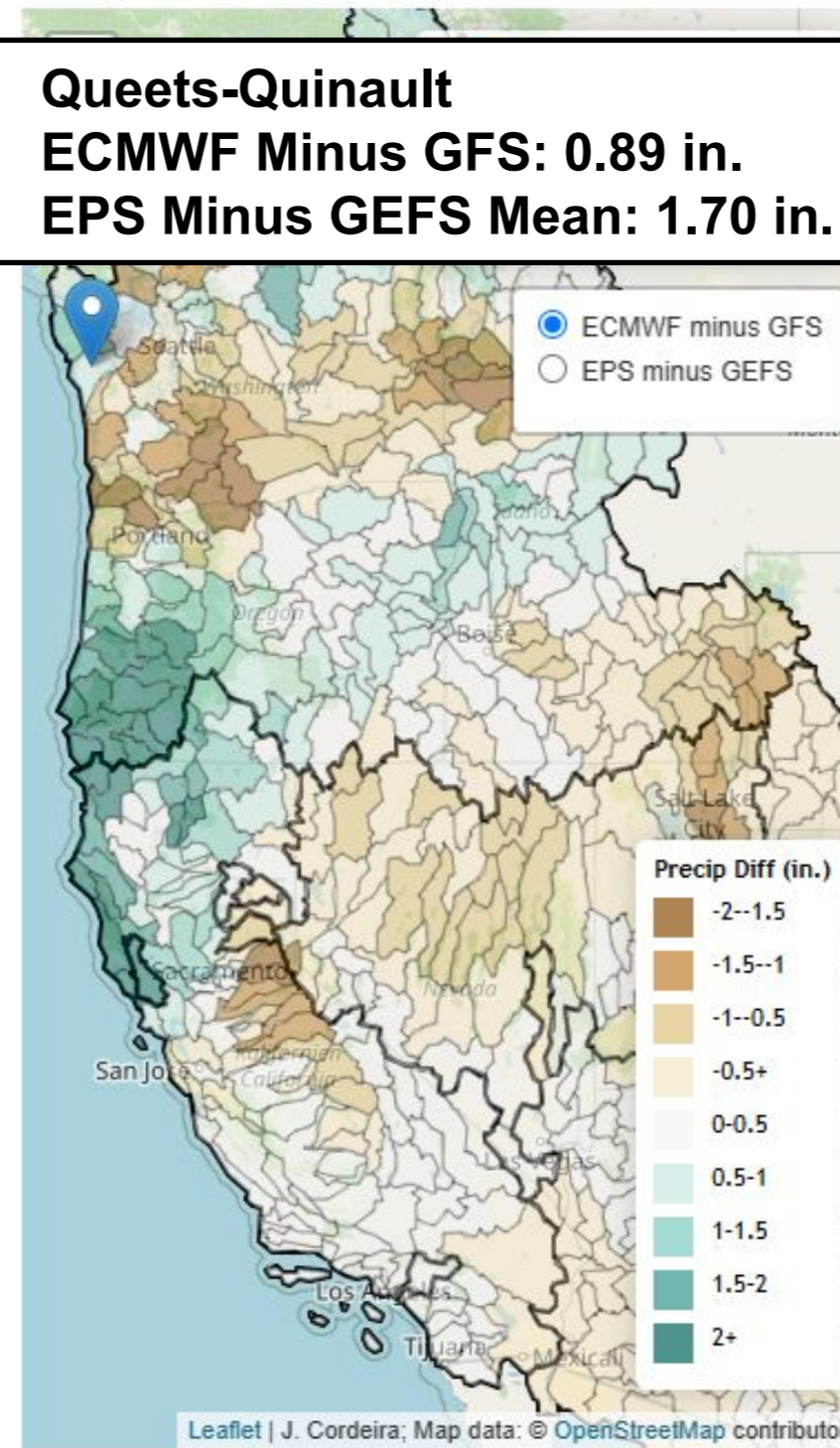
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast

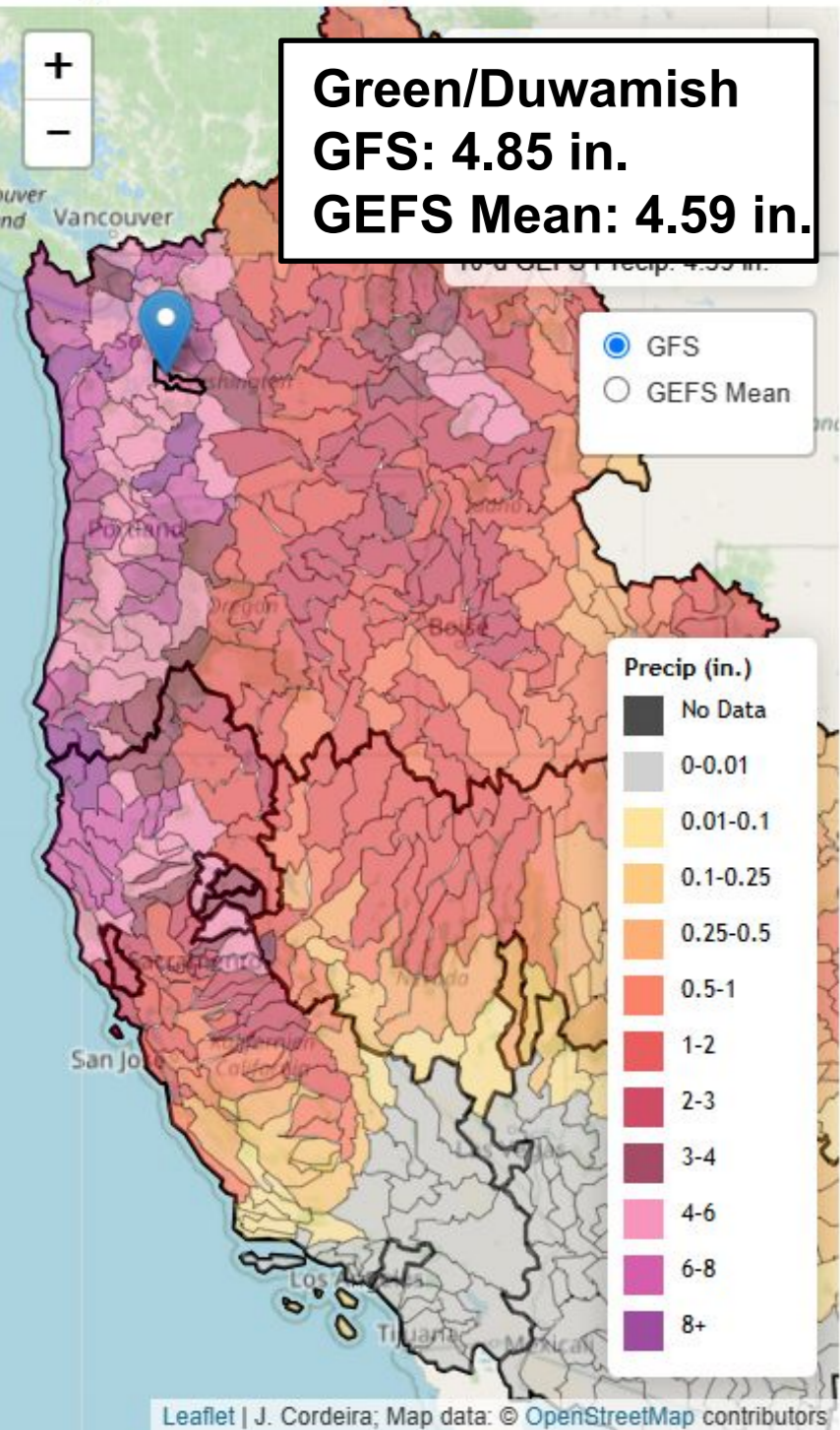


- Uncertainty in forecast evolution of these ARs is contributing to uncertainty in precipitation forecasts over the US West Coast.
- Overall, the 00Z GFS is forecasting higher precipitation totals over Washington, Northern Oregon and Sierra Nevada and less throughout Northern California and Southern Oregon during the next 10 days as compared to the 00Z ECMWF.
- In the Queets-Quinault, nearly 50% of EPS members are forecasting 10+ inches of mean areal precipitation while less than 10% of GFS members are forecasting 10+ inches.

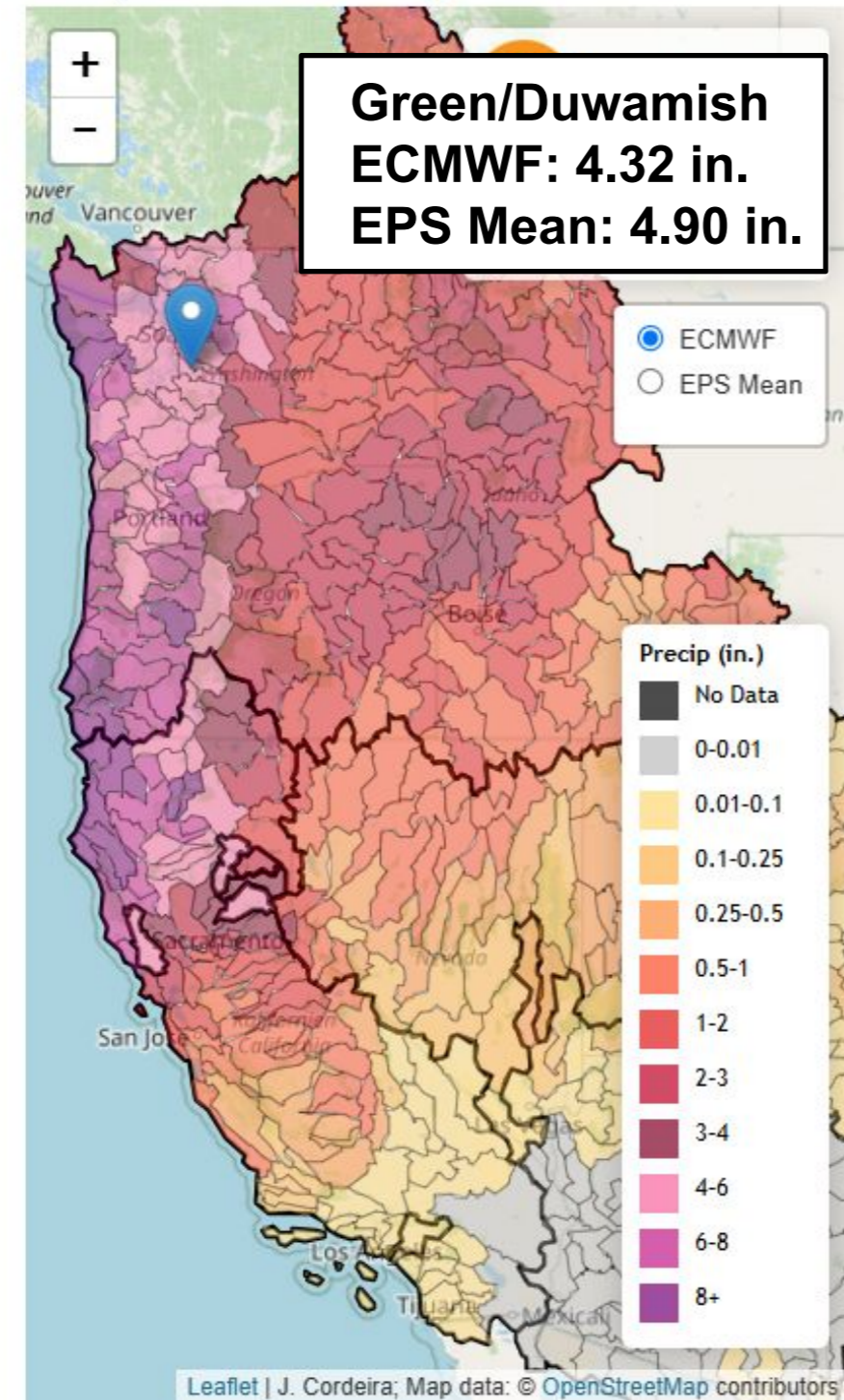
AR Outlook: 20 December 2024

Watershed Precipitation Forecasts

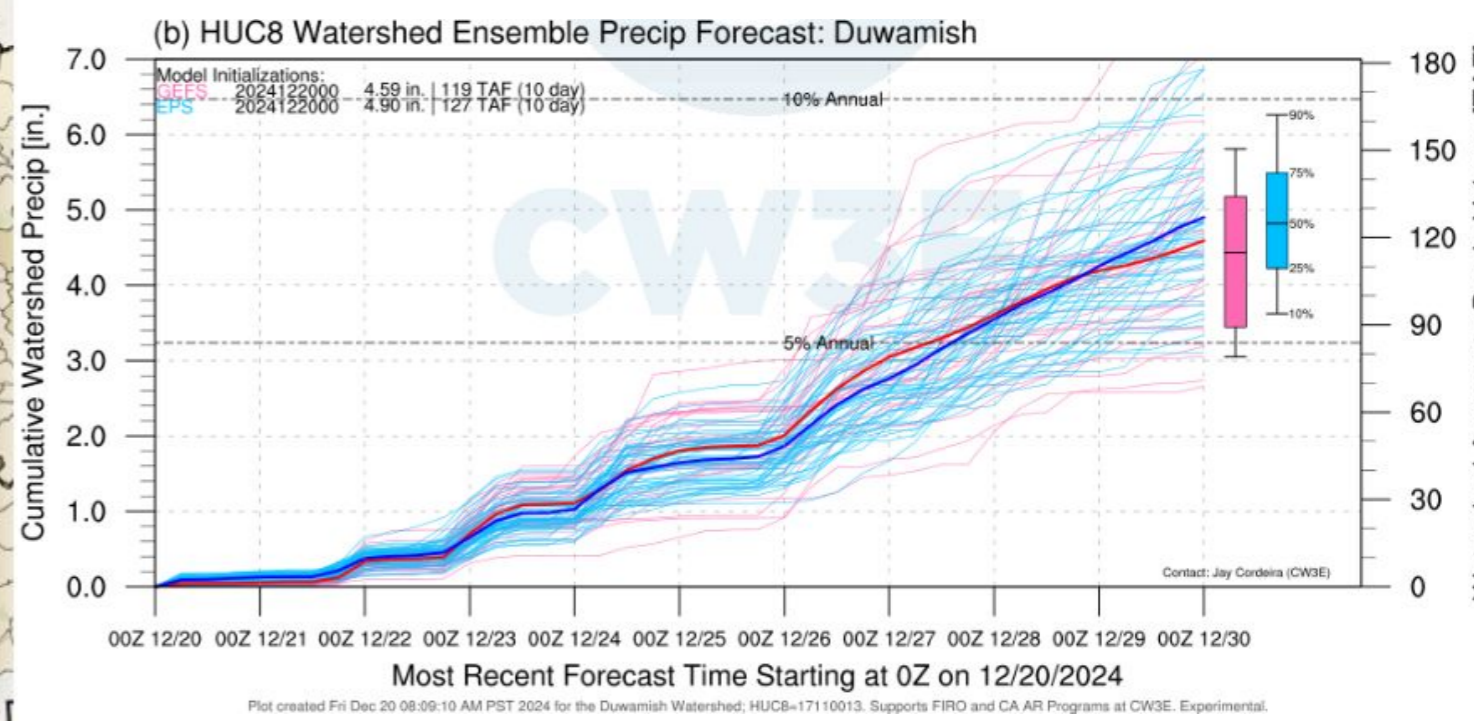
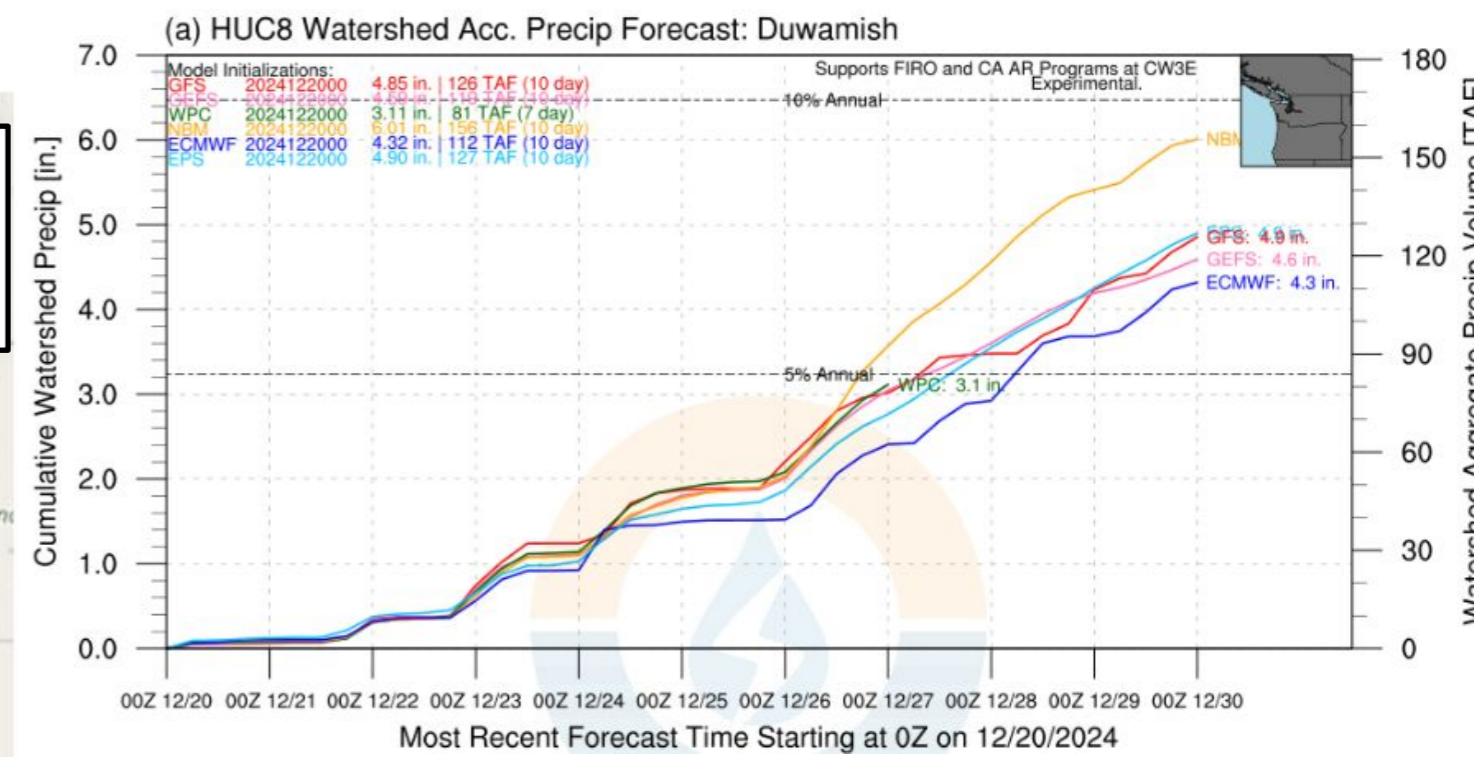
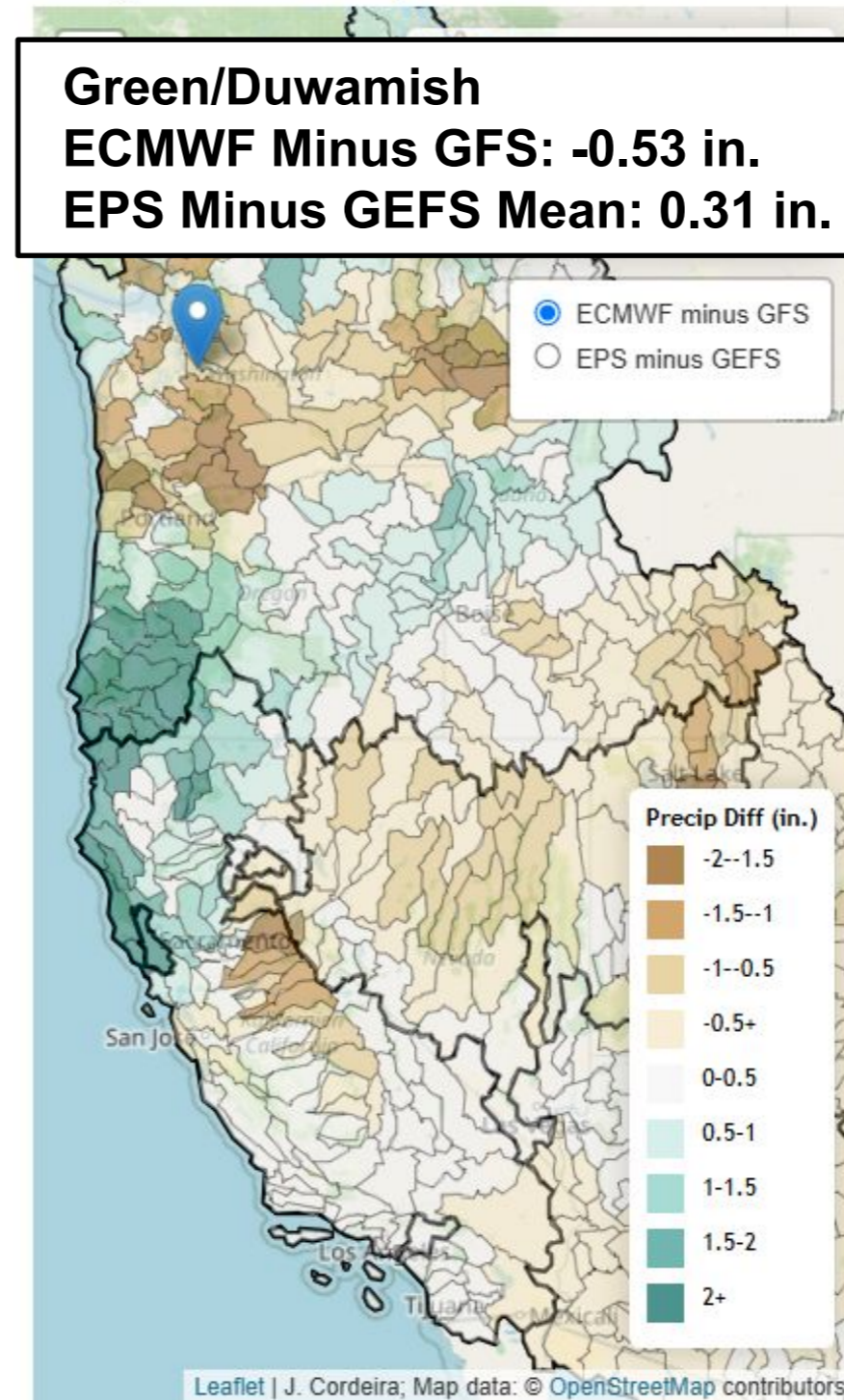
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EPF Precipitation Forecast



10-day Difference Precipitation Forecast

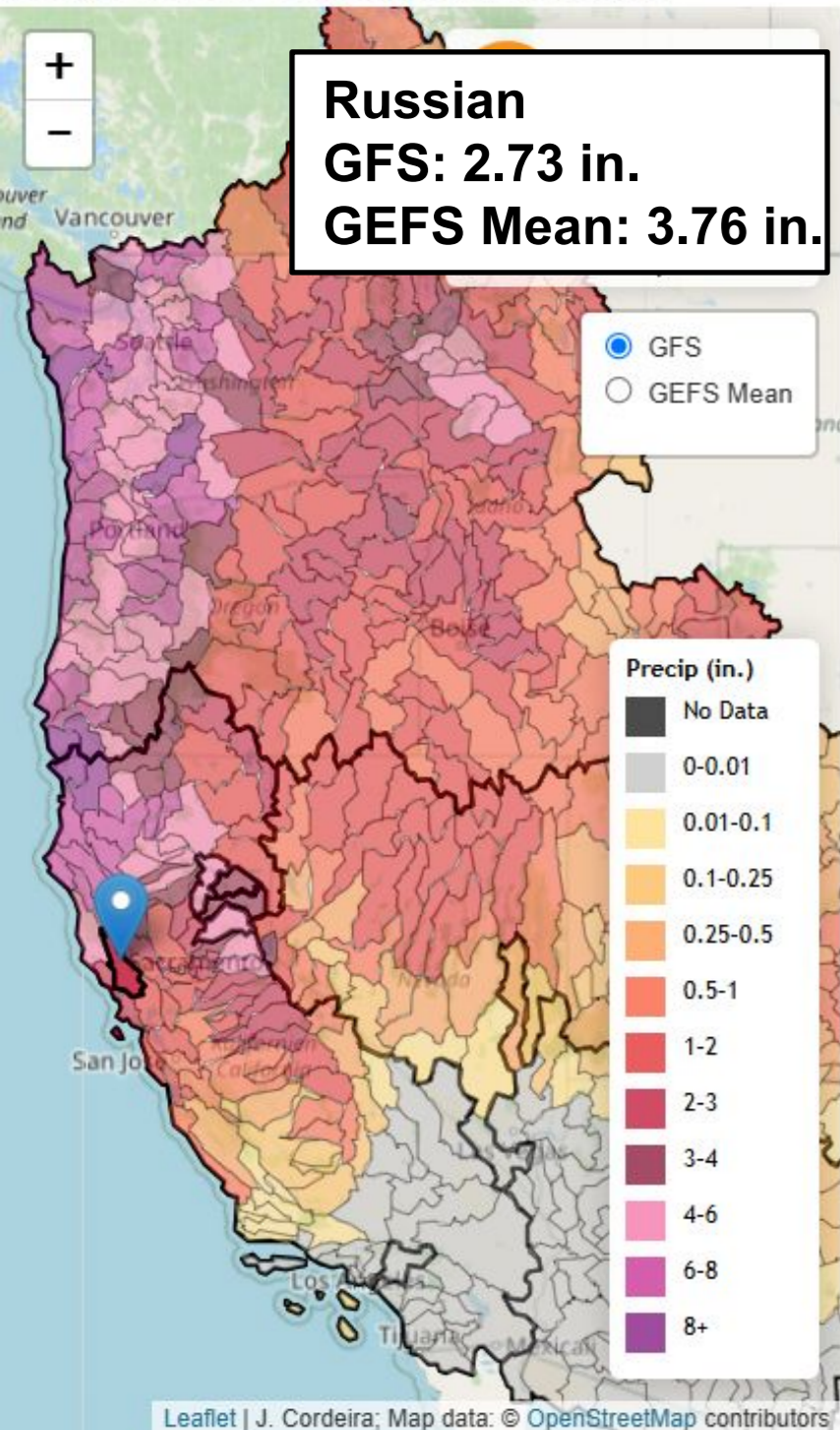


- GFS is forecasting higher precipitation amounts in the Green/Duwamish watershed over the next 10 days than the ECMWF, while the EPS is forecasting greater precipitation than the GEFS.
- The GEFS and EPS both have large ensemble spread, with some members forecasting >7 inches and some <3 inches.

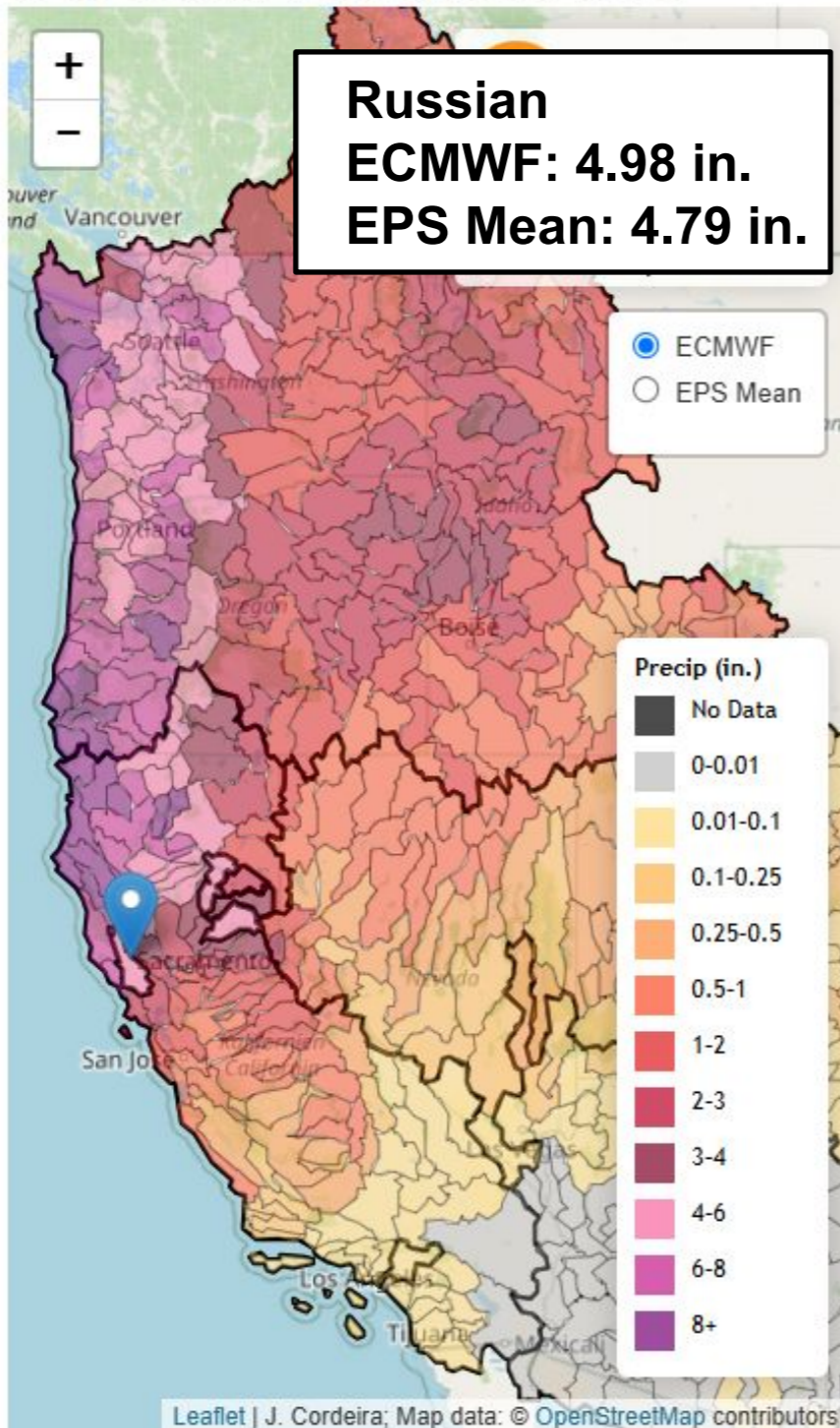
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Watershed Precipitation Forecasts

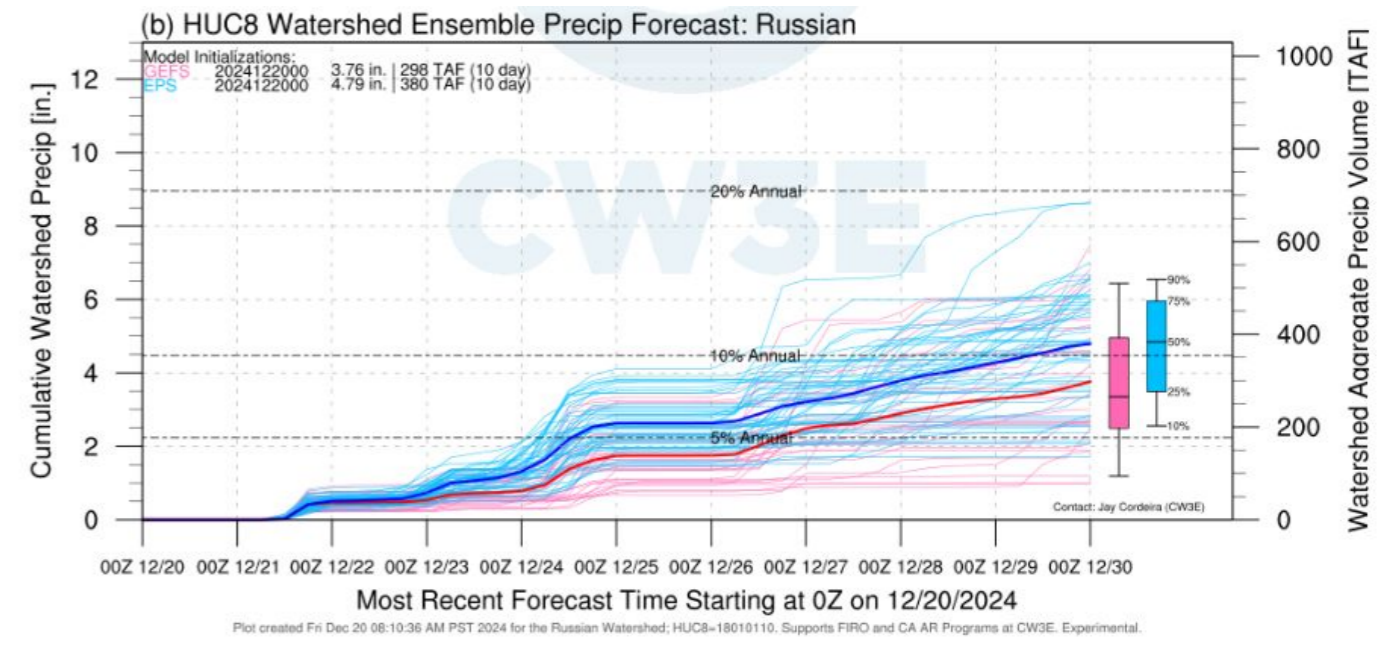
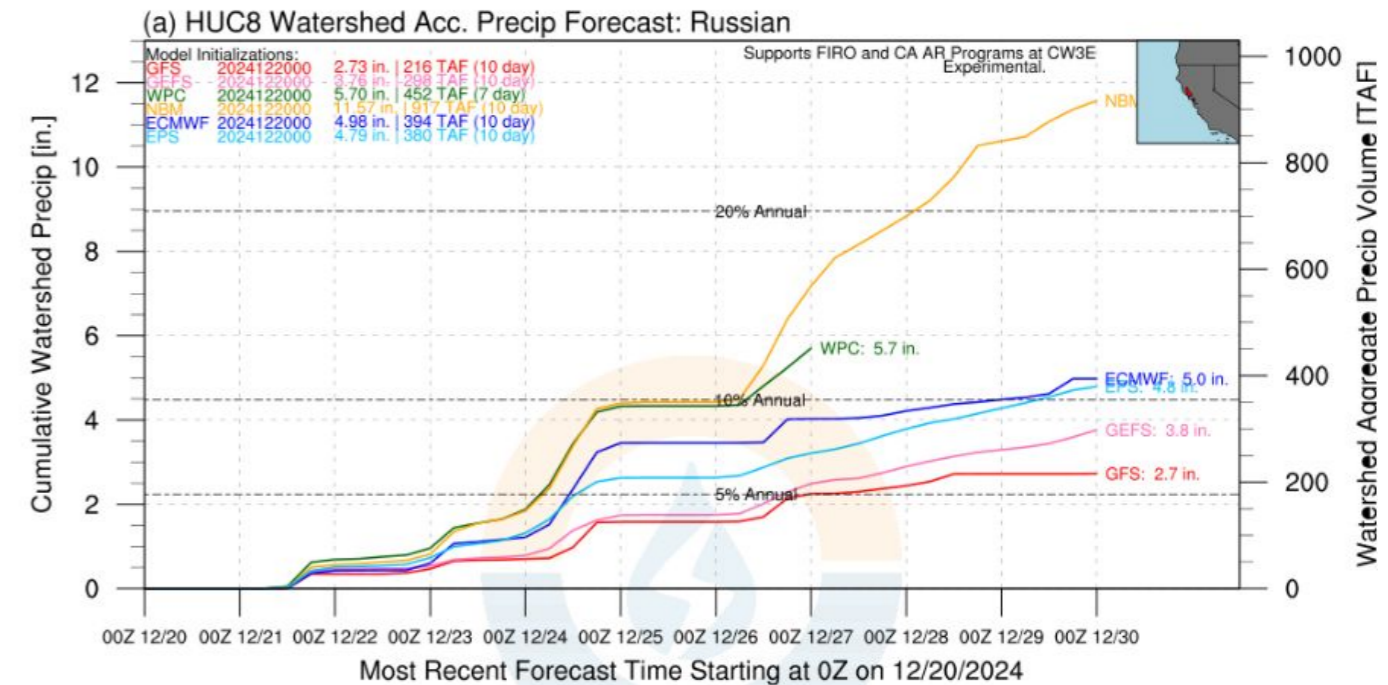
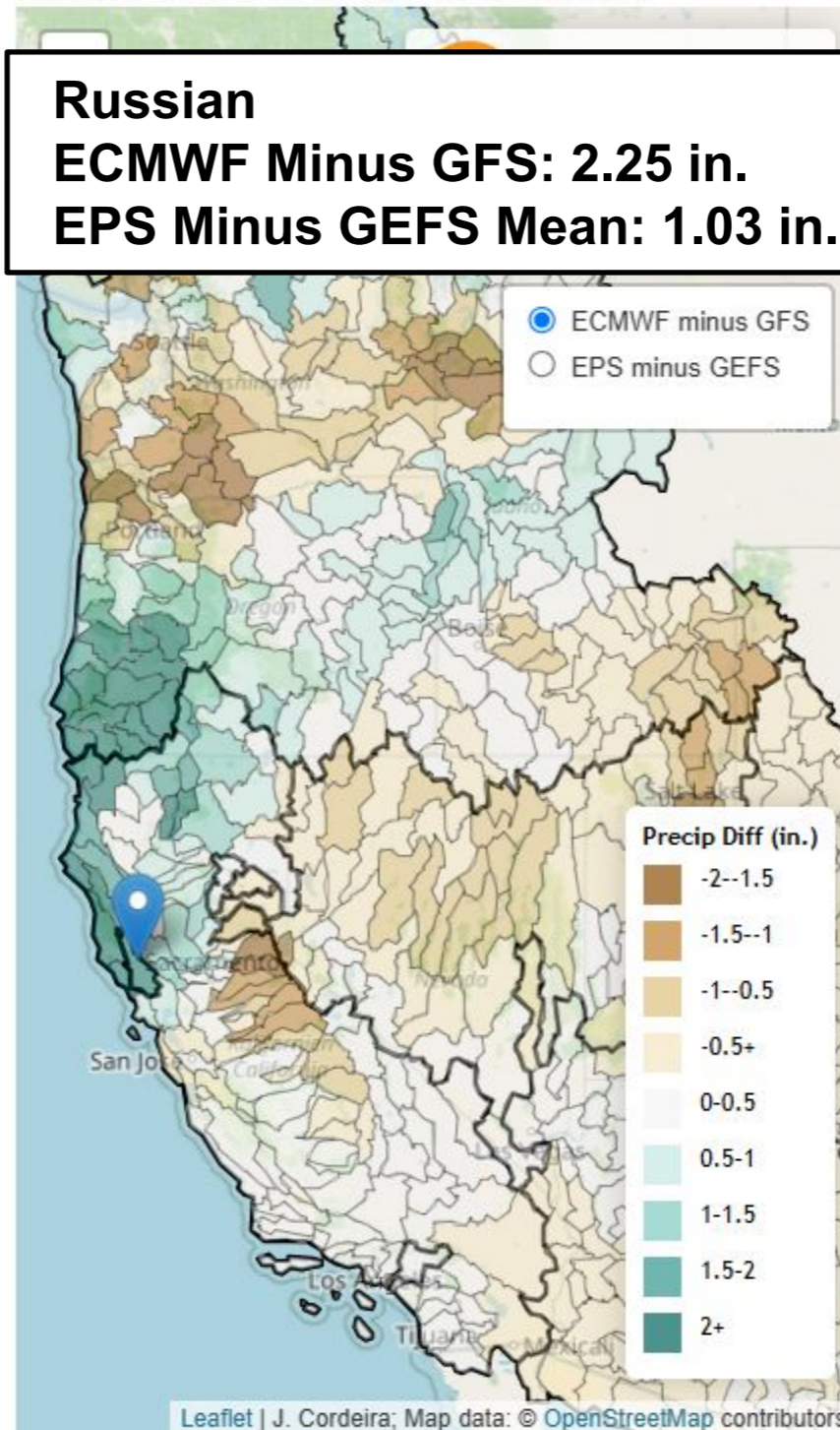
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EFS Precipitation Forecast



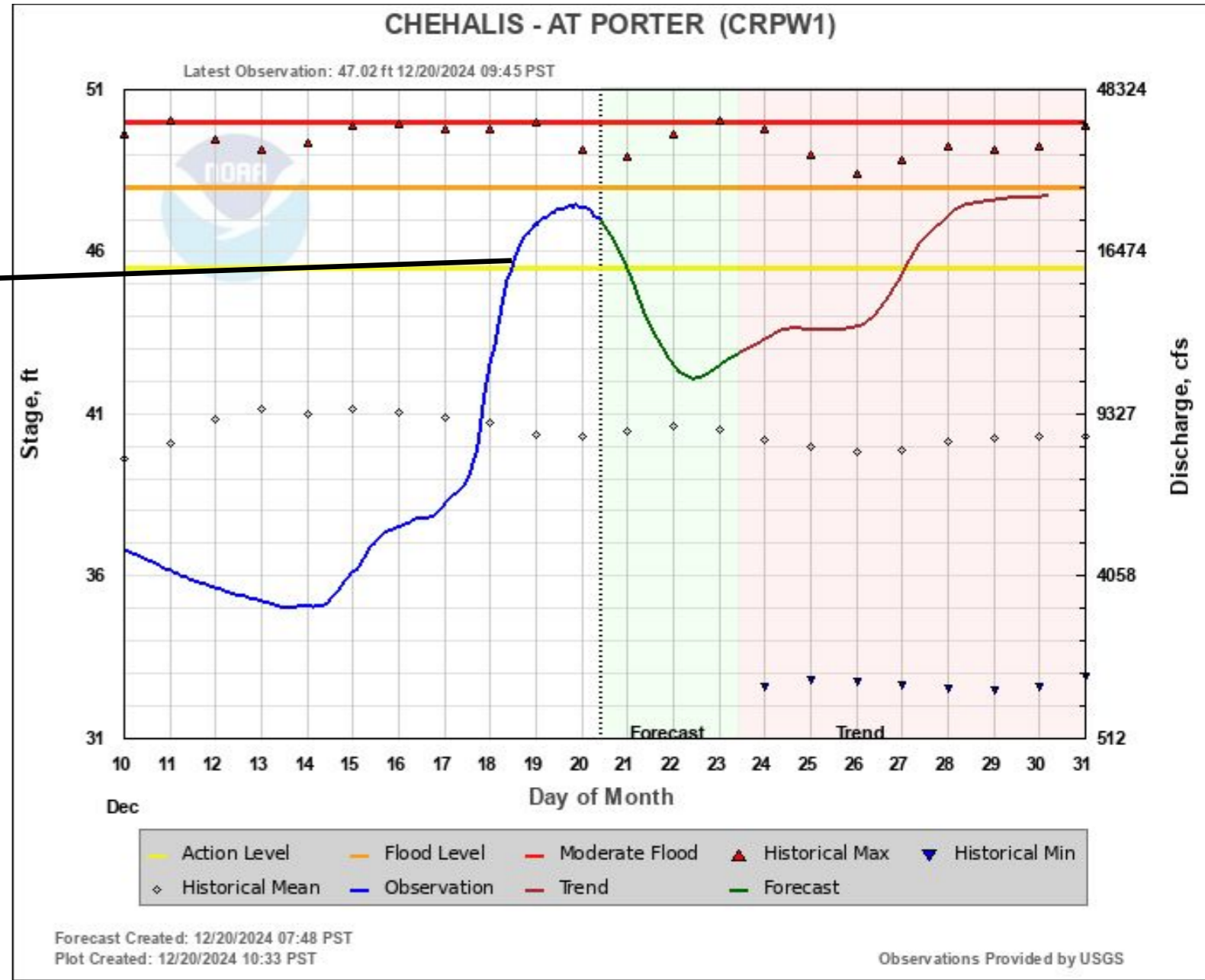
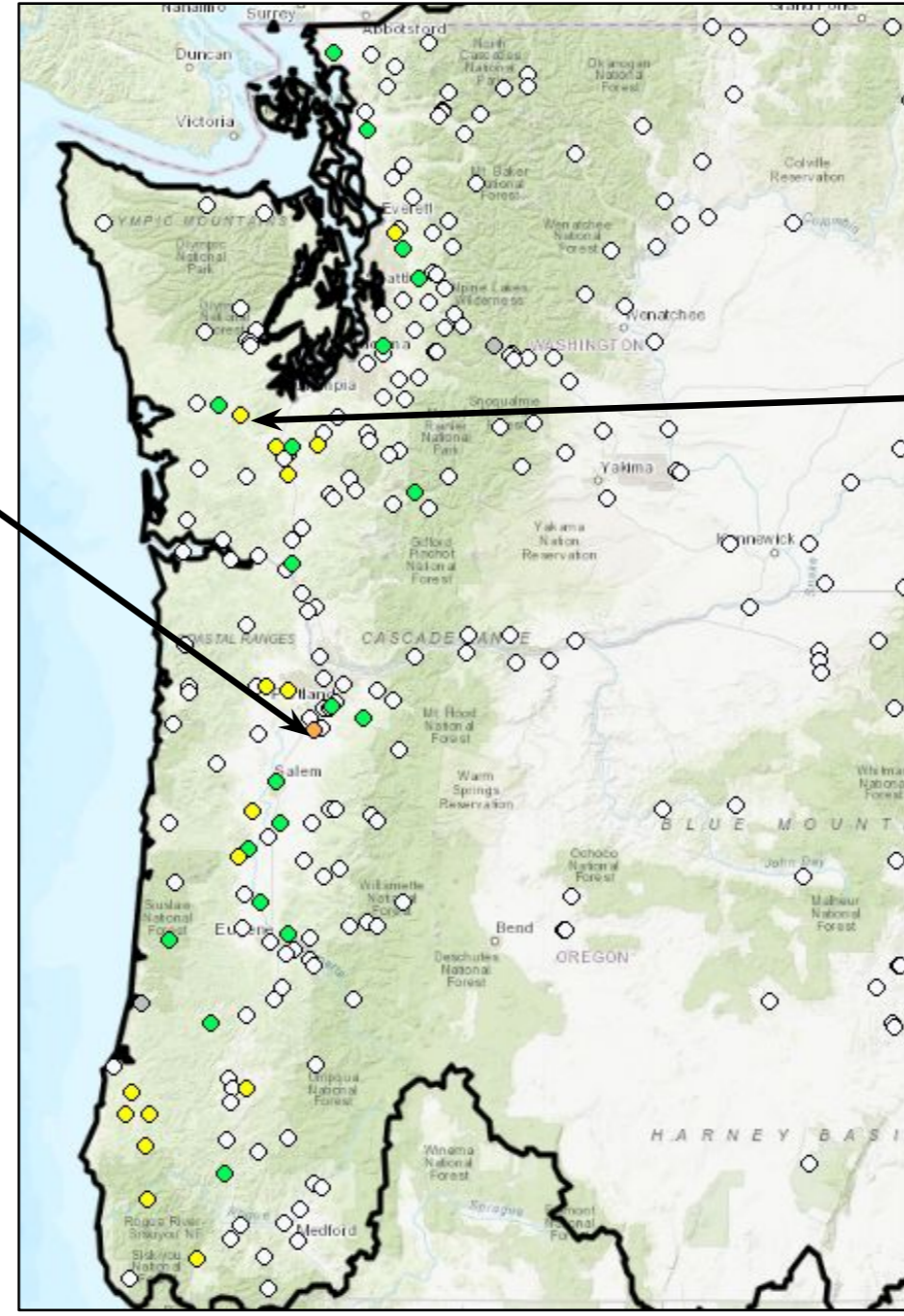
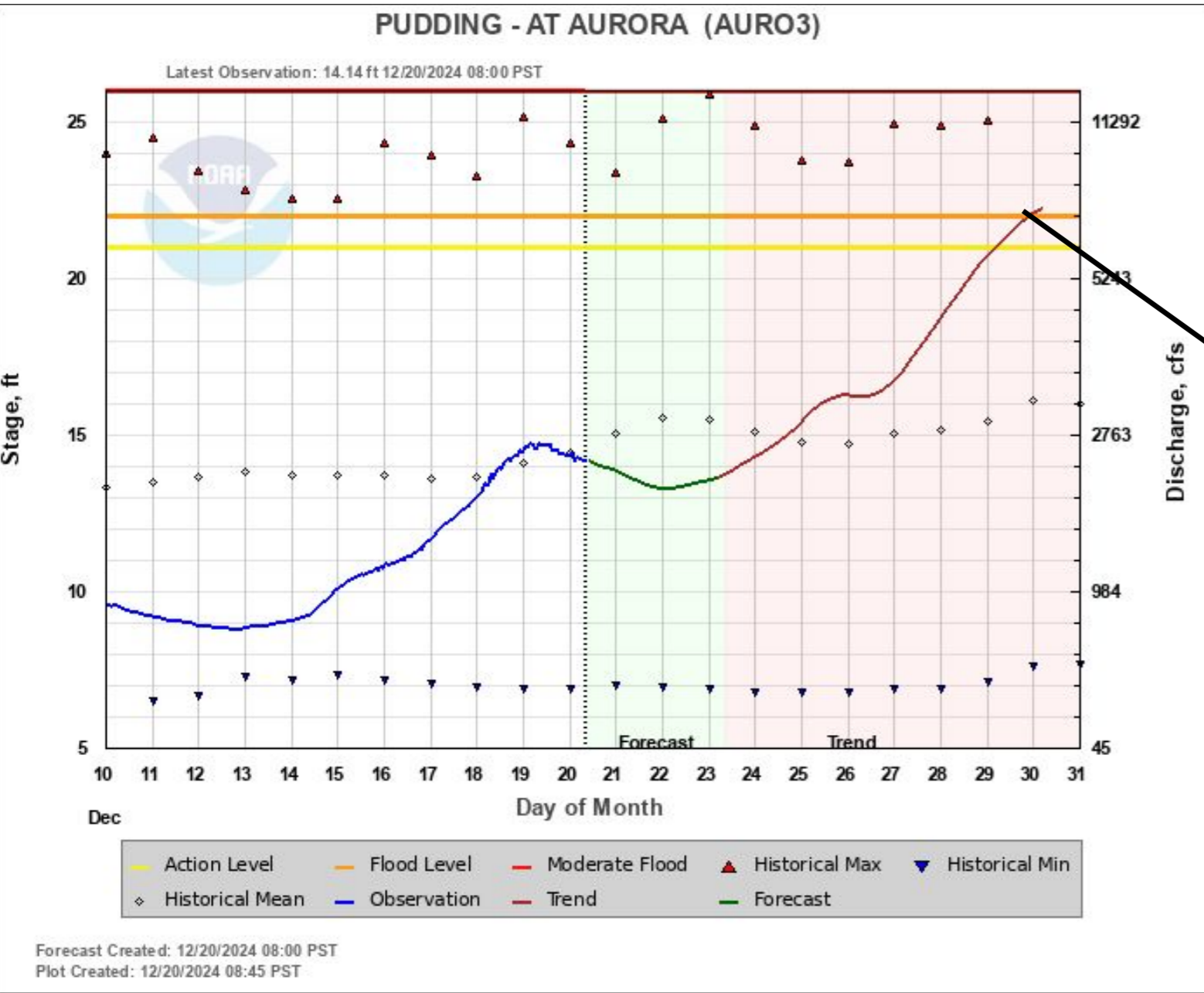
10-day Difference Precipitation Forecast



- The ECMWF and EPS are forecasting more precipitation in the Russian River watershed over the next 10 days than the GFS and GEFS.
- ~50% of EPS members and only ~25% of GEFS members are forecasting 5+ inches of mean areal precipitation.
- The National Blend of Models is forecasting 11.57 in. of total precipitation over the next 10 days which is far above 20% of annual precipitation for the watershed.

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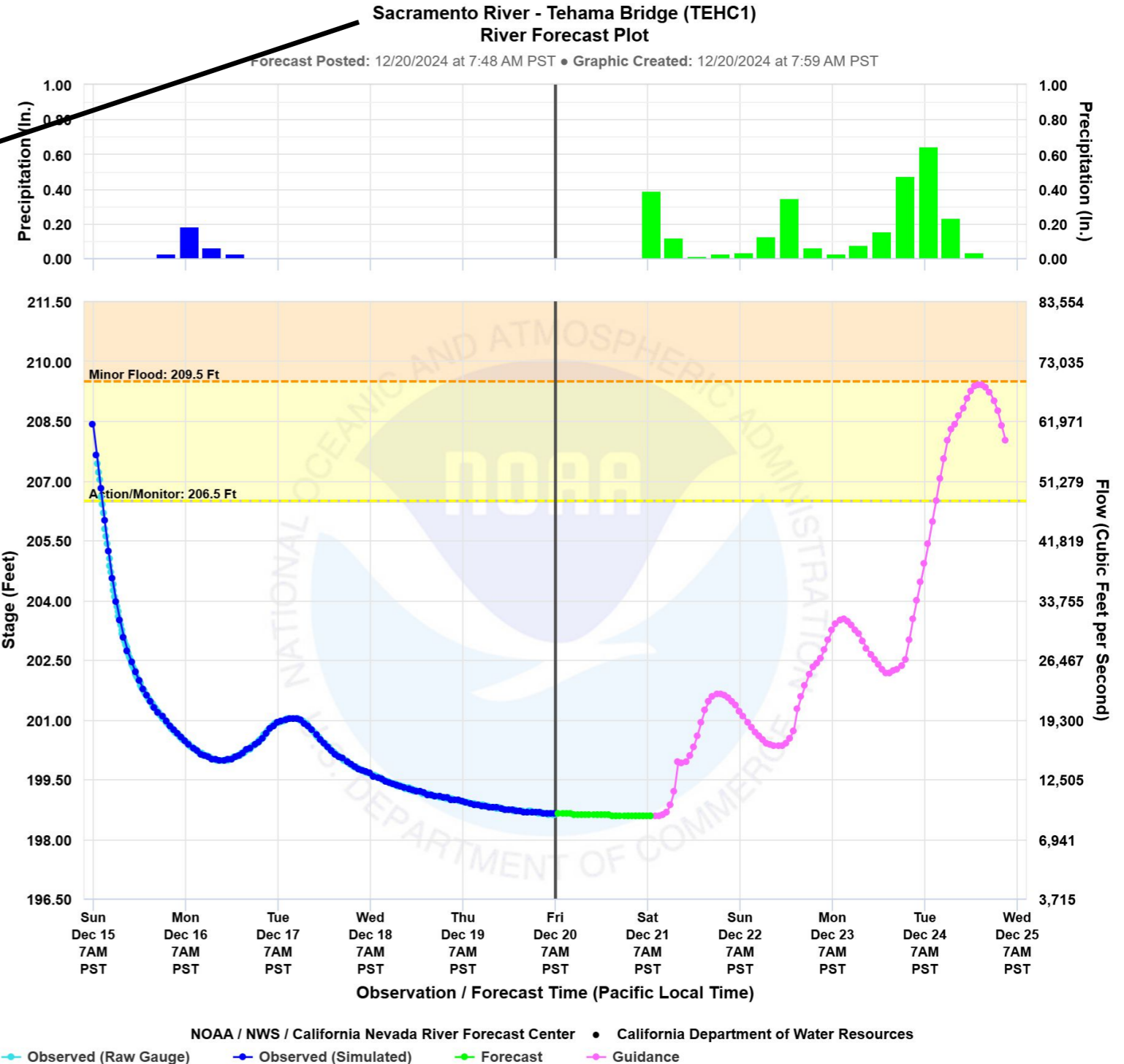
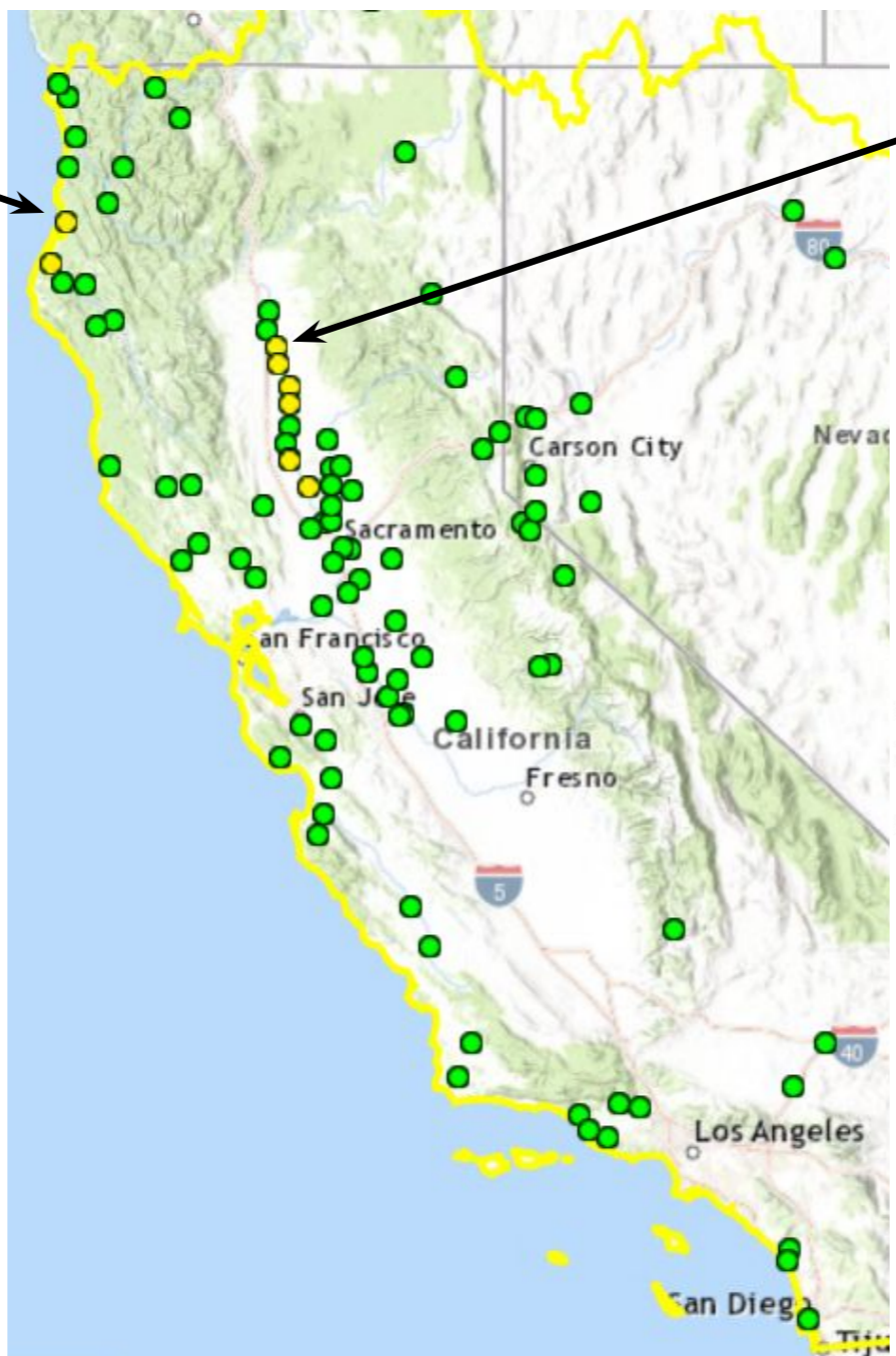
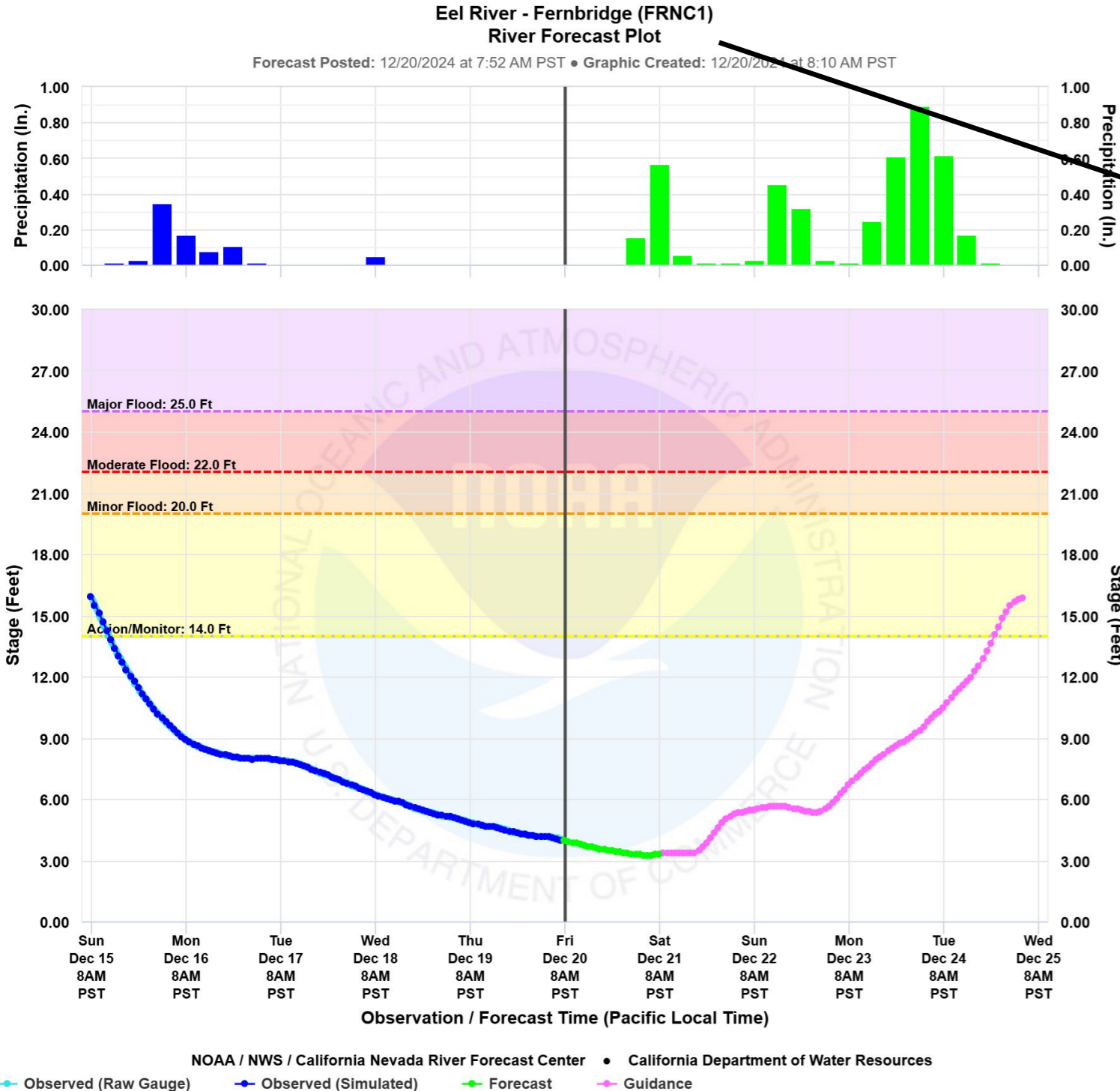
Hydrologic Forecasts: Pacific Northwest



- The NWS Northwest River Forecast Center is forecasting 16 stream gages in western Oregon and Washington to rise above action/bankfull levels with 1 gages forecast above minor flood level flood level over the next 10 days.
- While many gages saw large stream level rises as a result of the recent AR activity, several gages across the region are forecast to see large rises in stream levels due the potential for continued AR activity through late next week (ex. Pudding at Aurora, left)

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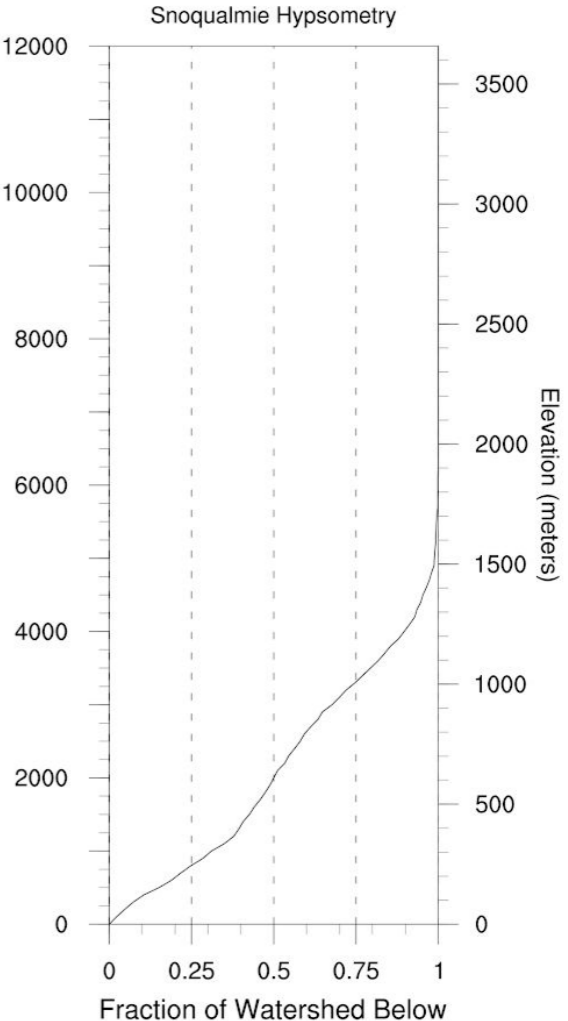
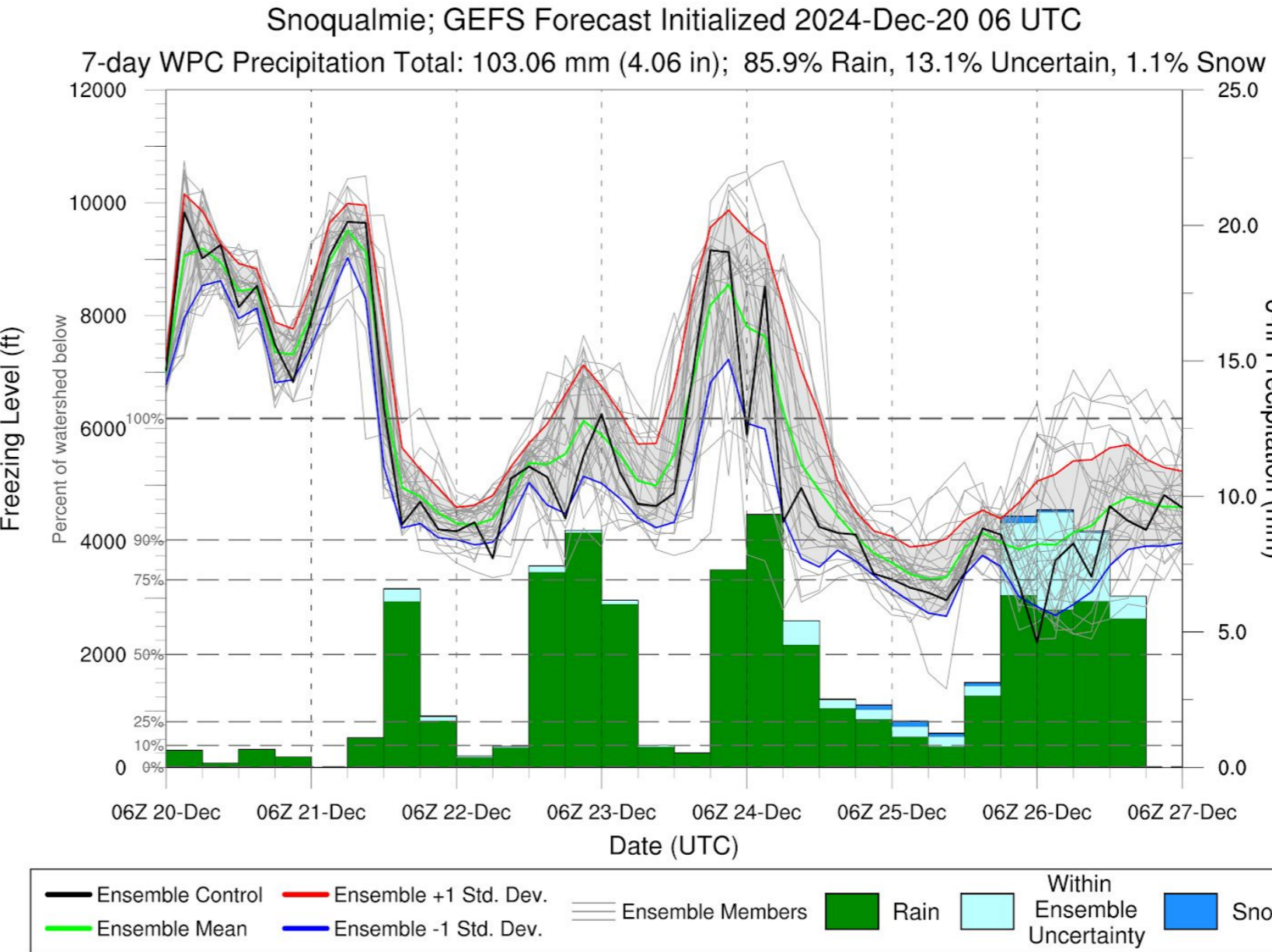
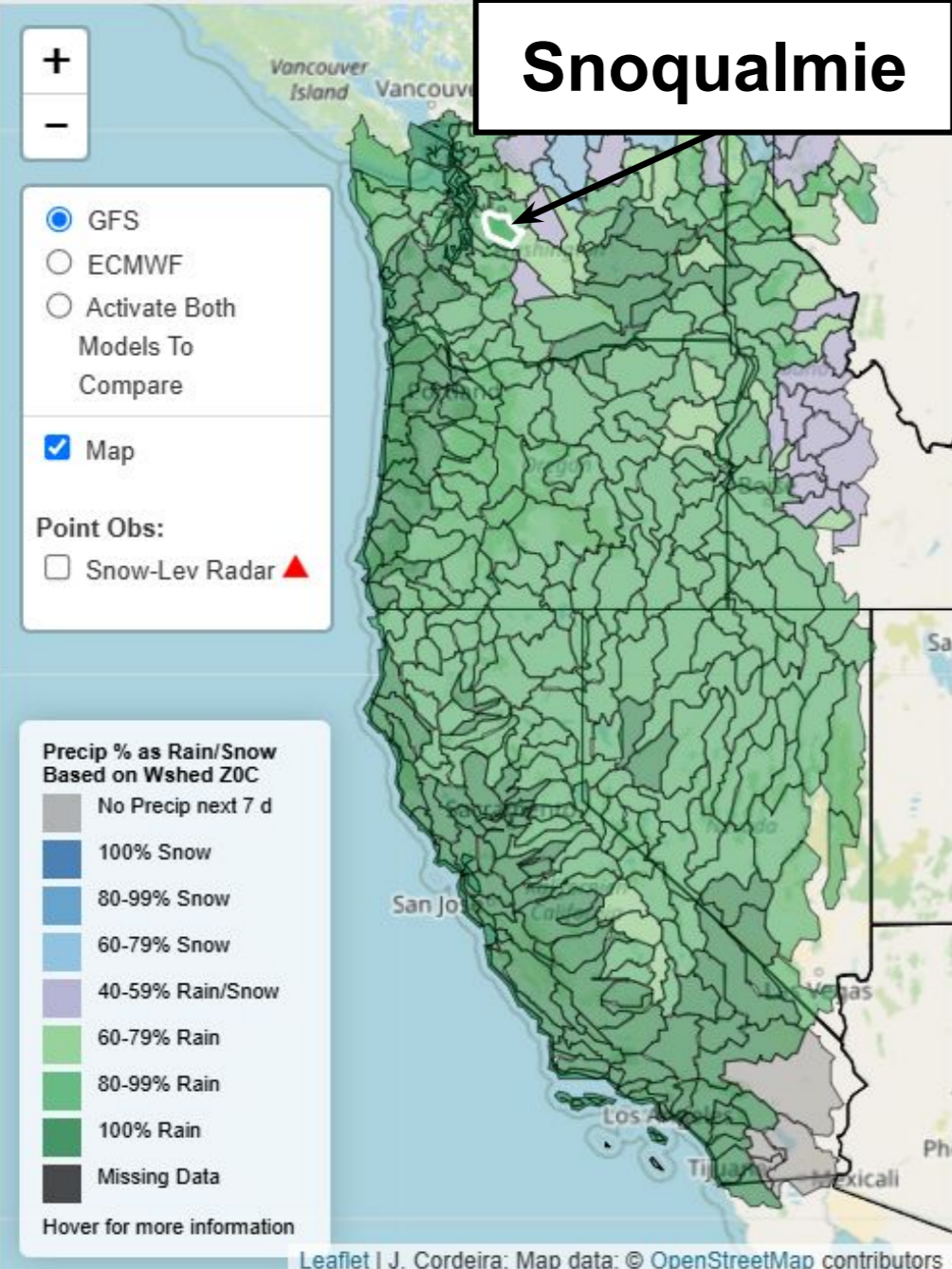
Hydrologic Forecasts: California



- The NWS California-Nevada River Forecast Center has forecast 9 stream gages over Northern California to rise above action/bankfull levels over the next 5 days.
- The Eel River at Fernbridge (left) and Sacramento River at Tehama Bridge (right) are both forecast to exceed action/monitor stage early in the day on Wed 25 Dec with the fourth AR.

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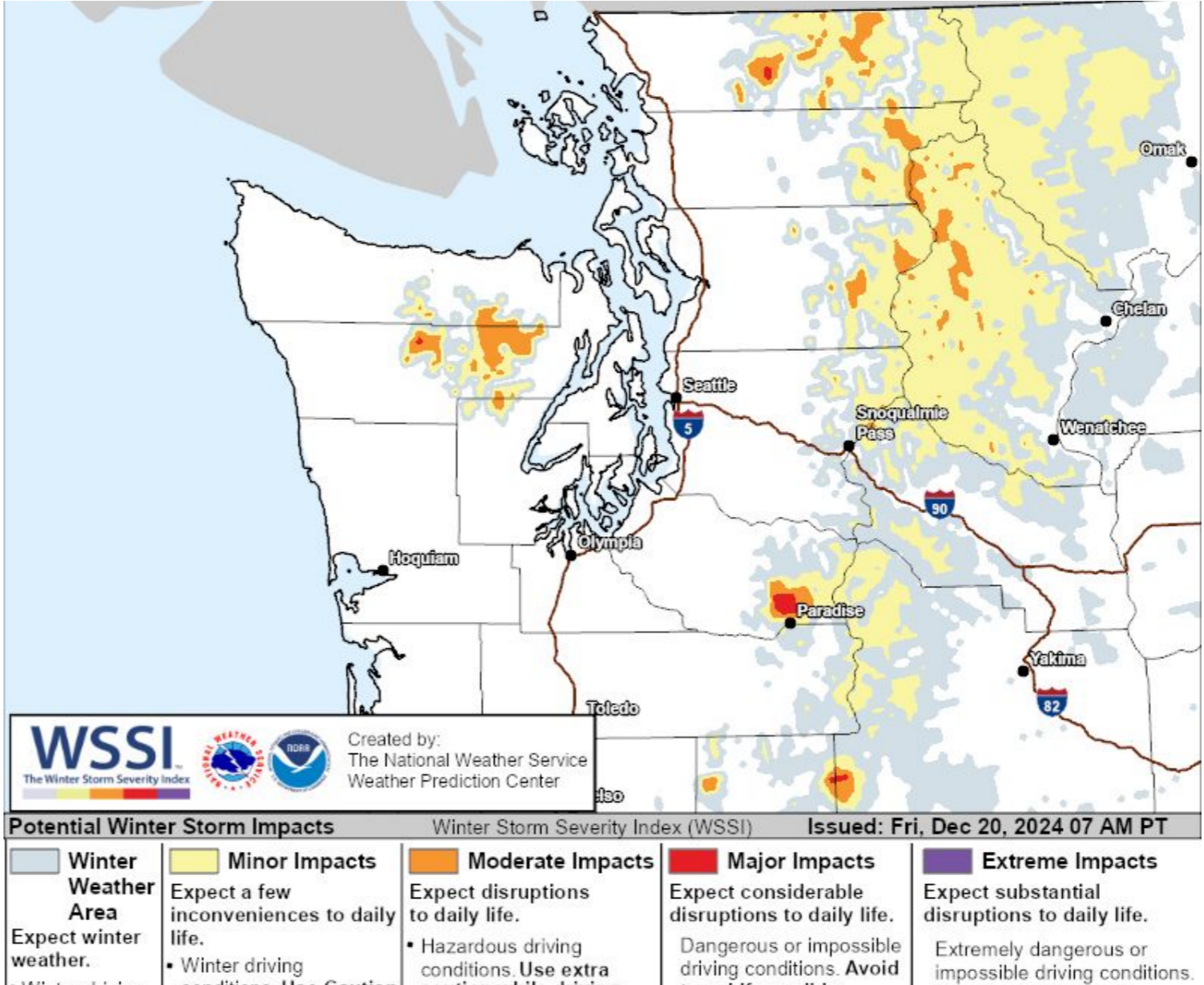
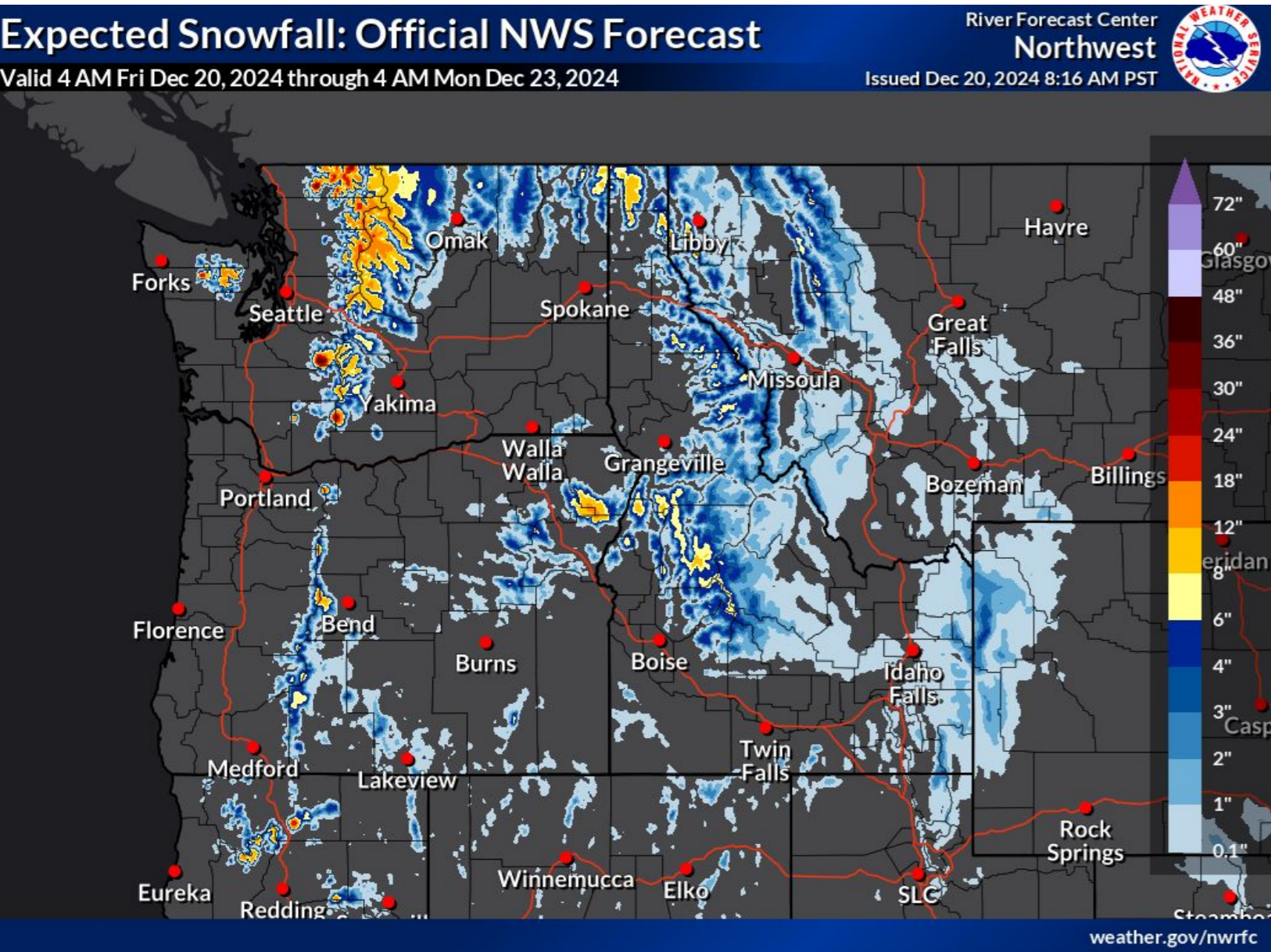
Watershed Freezing Level Forecasts



- Freezing levels are forecast to remain high across the US West Coast over the next seven days.
- The freezing levels over the Snoqualmie are expected to fall rapidly from around 10,000 to 4,000 feet following the second AR on Sun 22 Dec. Freezing levels are also forecast to quickly rise to around 10,000 feet with the fourth AR on Tue 24 Dec.
- Freezing levels fall back to around 4,000 feet for the remainder of the period following the fourth AR.
- The greatest uncertainty in freezing level and precipitation type is during the fifth AR.. However, for the majority of the period rain is projected to be the dominant precipitation type.

AR Outlook: 20 December 2024

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.

- Snowfall accumulations of 6–18 inches are forecast above 7,000 feet in the Washington Cascades over the next three days, with the highest peaks forecast to receive greater than 30 inches.
- WPC’s Winter Storm Severity Index (WSSI) is showing minor-to-moderate winter storm impacts across much of these regions, with major impacts expected over Mt Rainier.