

CW3E Atmospheric River Outlook: 18 December 2024

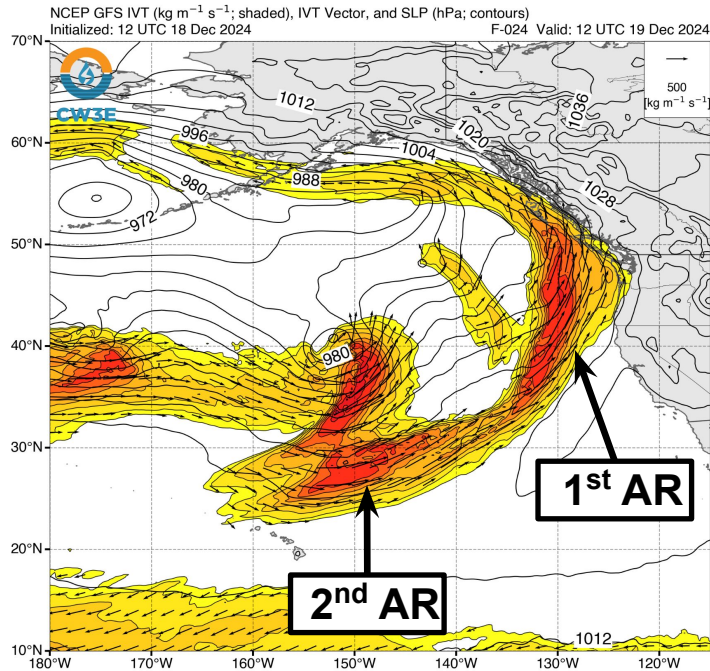
Family of Atmospheric Rivers Forecast to Continue Bringing Heavy Precipitation to US West Coast

- A series of atmospheric rivers (ARs) and low-pressure systems are forecast to develop over the North Pacific and propagate toward the US West Coast over the next 8-10 days.
- The first AR is forecast to make landfall early tomorrow (Thu 19 Dec) and bring AR 1 conditions (based on the Ralph et al. 2019 AR Scale) with limited impacts expected over the US West Coast.
- A second AR is forecast to make landfall over Oregon and Washington on Fri 20 Dec. The core of the AR is expected to stay mostly offshore with a more southerly IVT direction, limiting precipitation impacts.
- The third and fourth ARs are forecast to make landfall on Sat 21 Dec and Sun 22 Dec. However, IVT is expected to approach from a more southerly direction pushing the heavier precipitation towards Vancouver Island.
- A fifth AR could potentially bring strong AR conditions ($IVT > 750 \text{ kg m}^{-1} \text{ s}^{-1}$) to coastal Oregon with moderate AR conditions ($IVT > 500 \text{ kg m}^{-1} \text{ s}^{-1}$) for coastal Northern California to Washington
- Extended range and subseasonal forecast products suggest that additional AR activity and wet conditions are likely to continue into late next week, especially over the Pacific Northwest.
- The NWS Weather Prediction Center is forecasting 8-14 inches of total precipitation over the Olympic Peninsula and Northern California during the next 7 days.
- Uncertainty in the forecast evolution of these ARs and shortwave troughs is driving uncertainty in forecast precipitation. In general, EPS is forecasting higher precipitation totals across coastal California with less across coastal Oregon and Washington over the next 10 days compared to GEFS.
- Numerous stream gages in western Washington and Oregon are forecast to rise above action/bankfull stage over the next 10 days. The combination of high freezing levels and heavy rain will likely increase runoff and flooding.

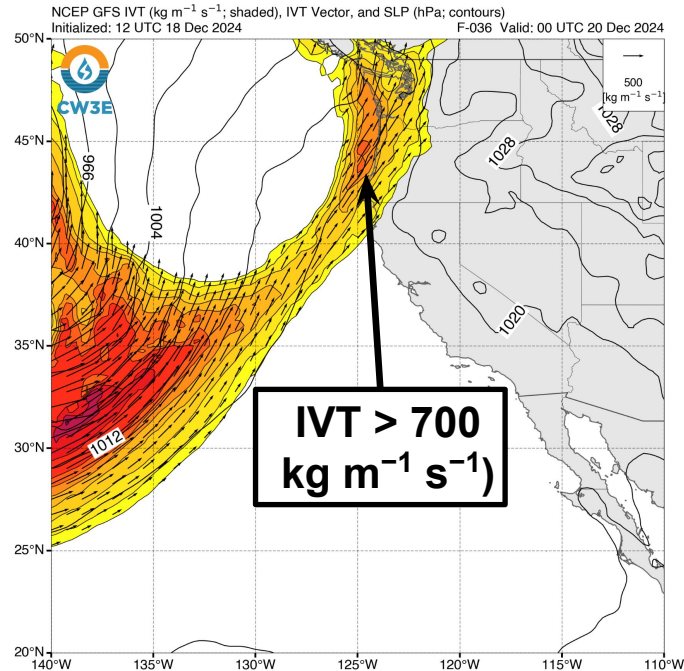
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GFS IVT & SLP Forecasts

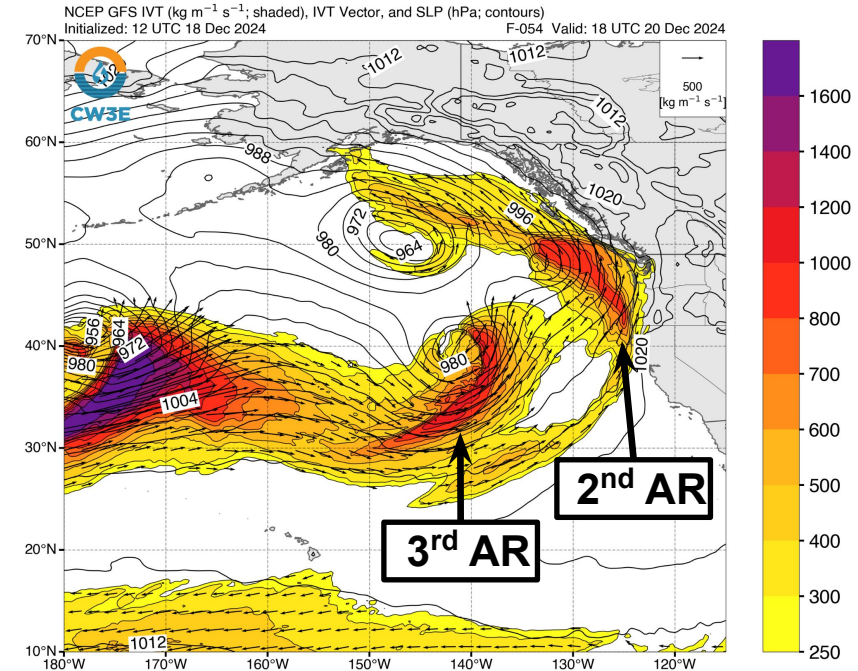
Valid: 4 AM PST 19 Dec (F-024)



Valid: 4 PM PST 19 Dec (F-036)



Valid: 10 AM PST 20 Dec (F-054)

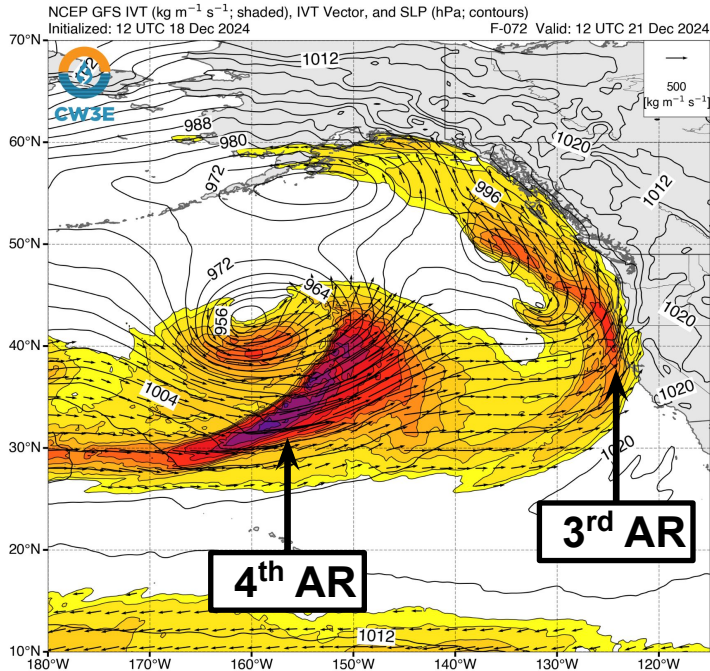


- The first AR is forecast to begin making landfall over Oregon and Washington early tomorrow morning (Thu 19 Dec).
- The core of the AR is forecast to dissipate as it moves onshore, but still manages to bring a brief period of moderate AR conditions ($IVT \geq 500 \text{ kg m}^{-1} \text{ s}^{-1}$) to coastal Oregon.
- Southwesterly IVT during the first AR will likely support orographic enhancement of precipitation over the Olympic Mountains and North Cascades.
- A second AR is forecast to make landfall over Oregon and Washington on Fri 20 Dec. The core of the AR is expected to stay mostly offshore with a more southerly IVT direction, limiting precipitation impacts.

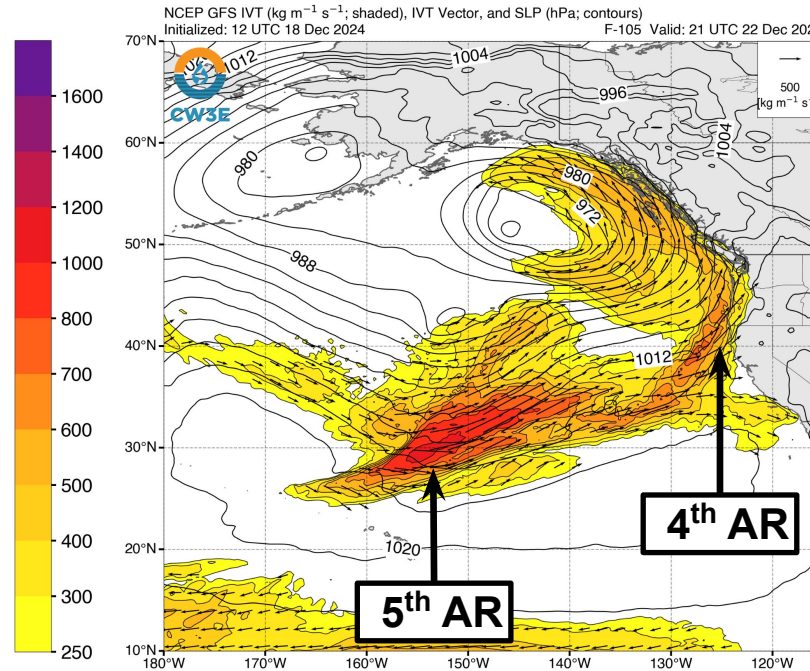
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GFS IVT & SLP Forecasts

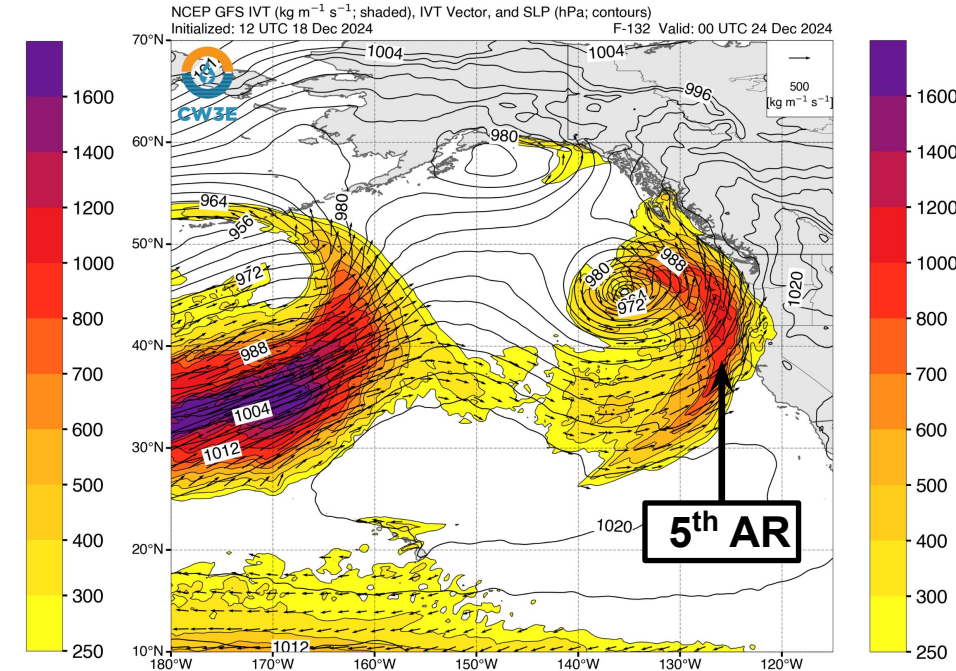
Valid: 4 AM PST 21 Dec (F-72)



Valid: 1 PM PST 22 Dec (F-105)

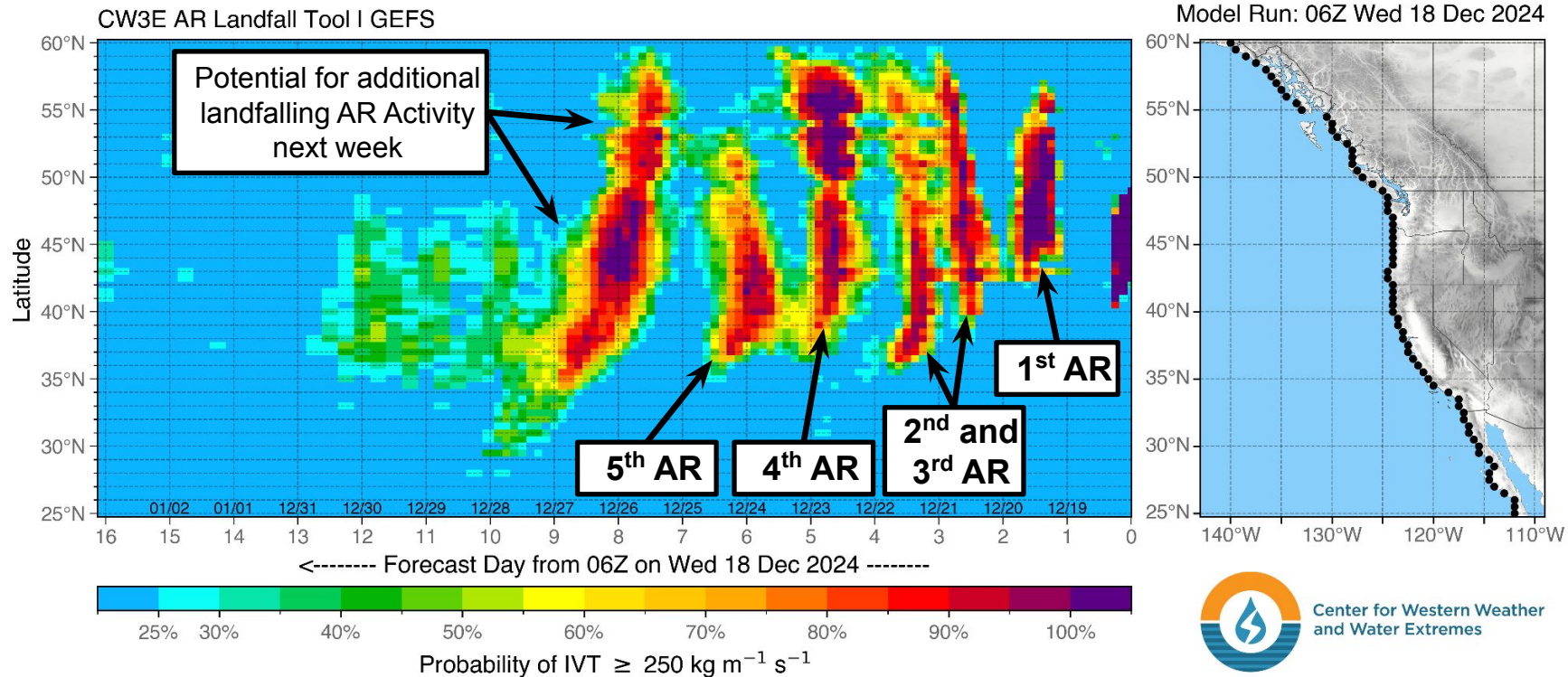


Valid: 4 PM PST 23 Dec (F-132)



- The core of the third AR is forecast to make landfall near the Northern California/Oregon border on the morning of Sat 21 Dec and bring heavy precipitation to Northern California.
- The third AR splits as it moves onshore pushing the highest precipitation totals towards Vancouver Island in British Columbia.
- The fourth AR is forecast to make landfall on Sun 22 Dec and bring moderate AR conditions ($\text{IVT} > 500 \text{ kg m}^{-1} \text{ s}^{-1}$) to coastal Washington, Oregon, and Northern California.
- The fifth AR is forecast to be the strongest with landfall on Mon 23 Dec and bring moderate-to-strong AR conditions ($\text{IVT} > 500 \text{ kg m}^{-1} \text{ s}^{-1}$) to coastal Washington, Oregon, and Northern California.

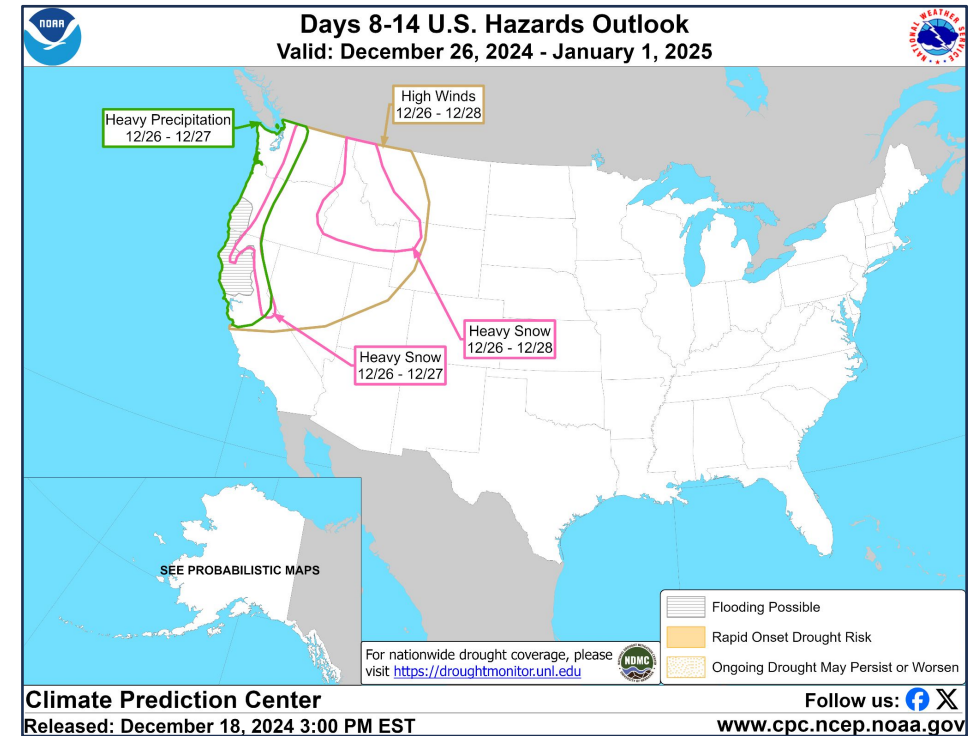
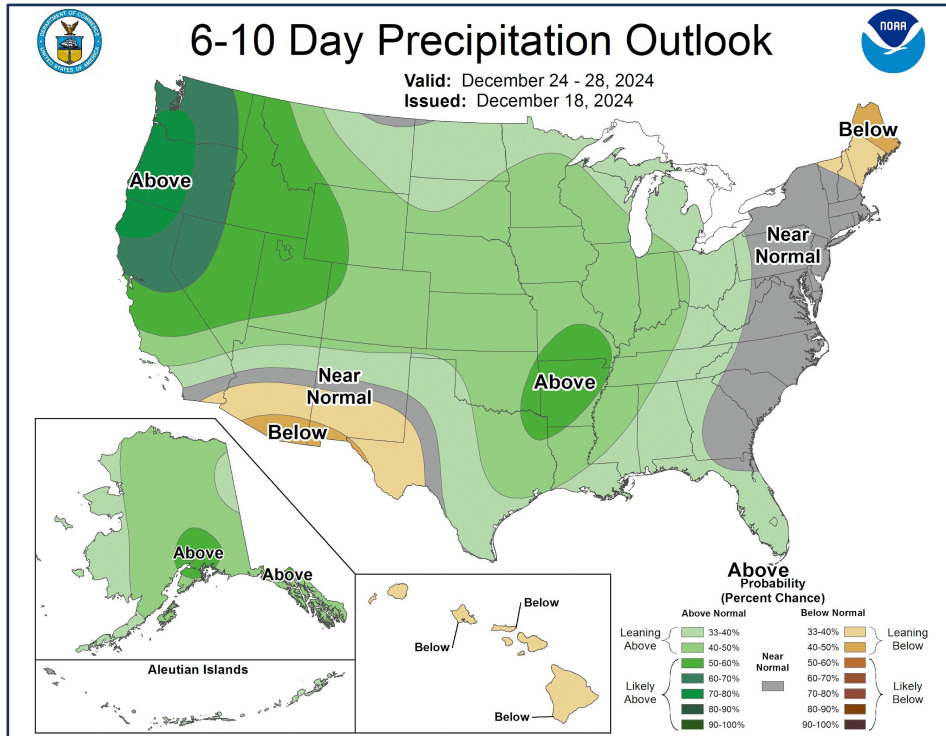
GEFS Probability of AR Conditions Along Coast



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

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

- The 06Z 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 Thu 19 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 through the end of this 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.



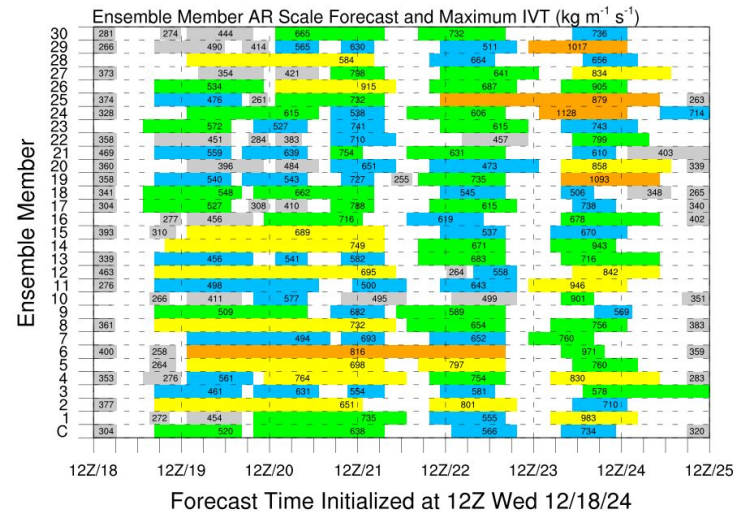
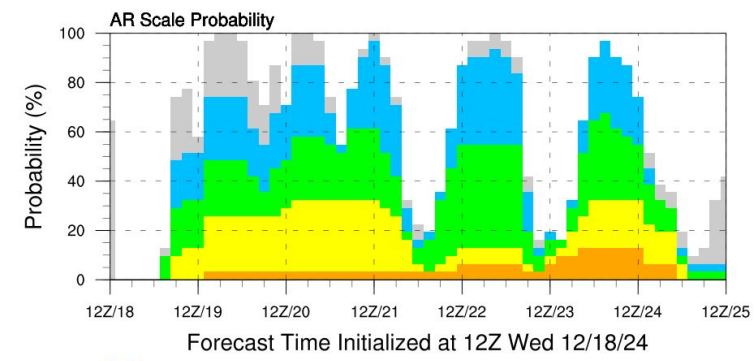
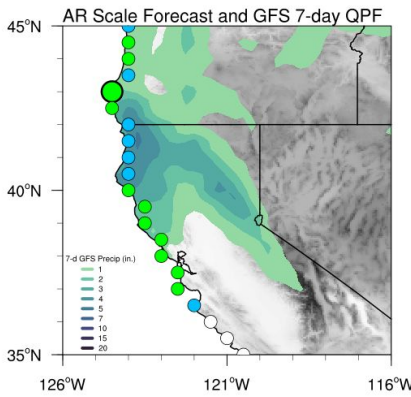
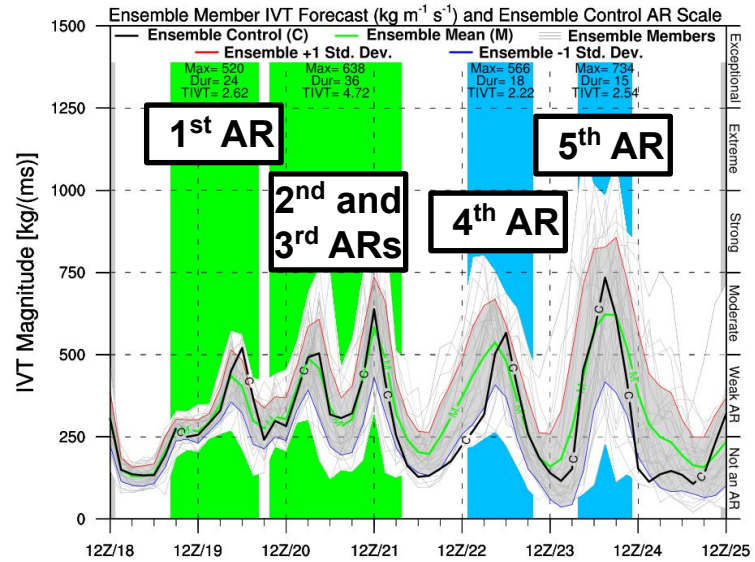
- The Climate Prediction Center’s 6–10 Day outlook is showing > 70% probability of above-normal precipitation in Washington, Oregon and Northern California, with odds tilted toward above-normal precipitation southward into the Los Angeles Basin.
- The Climate Prediction Center’s 8-14 day U.S. Hazards Outlook is highlighting the potential for heavy precipitation from Northern California to the Canada border with flooding possible for Northern California and Southern Oregon. 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: 12Z Wed 12/18/24

Location: 43°N 124.5°W



- The 12Z GEFS control is forecasting AR 1-2 conditions (based on the Ralph et al. 2019 AR Scale) over coastal southern Oregon in association with the 1st AR while combining the 2nd and 3rd ARs.
- While 9/31 (29%) of ensemble members are predicting an AR 3 or greater at 43°N, 124.5°W (Coos County, OR) for the 2nd and 3rd ARs, there is still uncertainty in the timing, duration, and magnitude, with maximum forecast IVT ranging from 500 to 816 $\text{kg m}^{-1} \text{s}^{-1}$.
- There continues to be much uncertainty in the timing, duration, and magnitude of AR conditions for the 4th and 5th ARs with > 50% of ensemble members predicting an AR 2 or greater



AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 18 UTC 12/18/2024

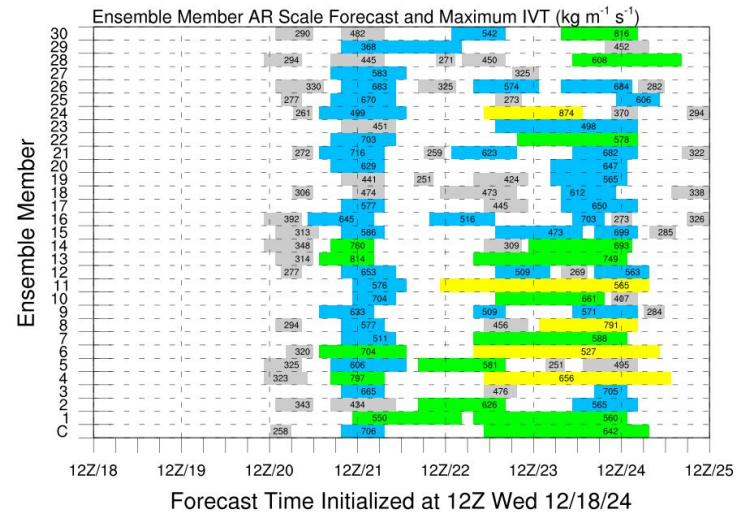
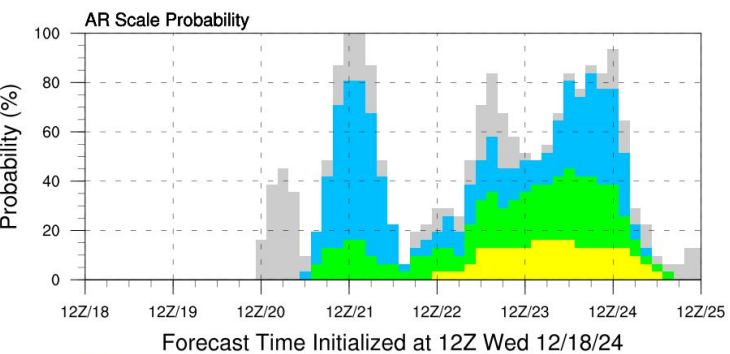
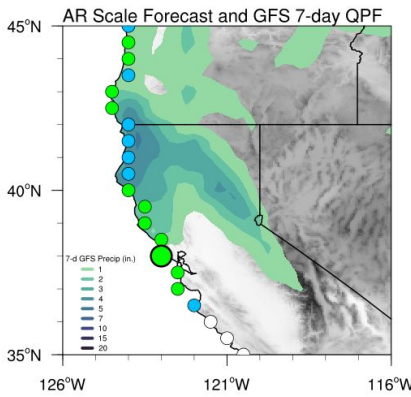
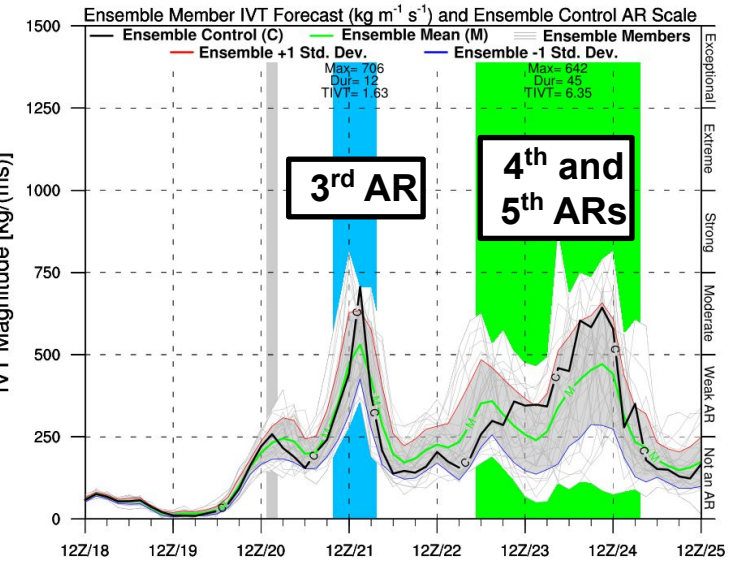
More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

AR Outlook: 18 December 2024

GEFS AR Scale and IVT Forecasts

GFS Ensemble Initialized: 12Z Wed 12/18/24

Location: 38°N 123°W



- The 12Z GEFS control is forecasting AR 1 conditions over coastal California from Monterey County to the Oregon border in association with the 3rd AR while combining the 4th and 5th ARs.
- 25/31 (81%) ensemble members are predicting an AR 1 or AR 2 at 38°N, 123°W (Marin County, CA) for the 3rd AR
- While 16/31 (52%) members are predicting AR 2 or greater conditions for the 4th and/or 5th 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.

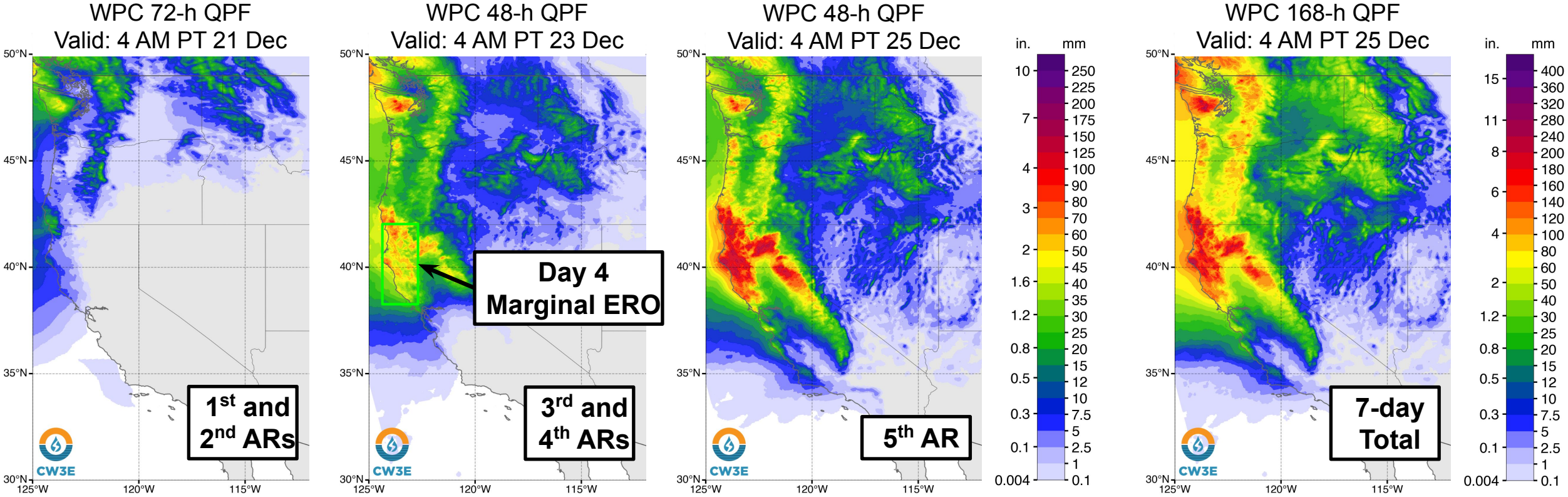


AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 18 UTC 12/18/2024

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

Precipitation Forecasts

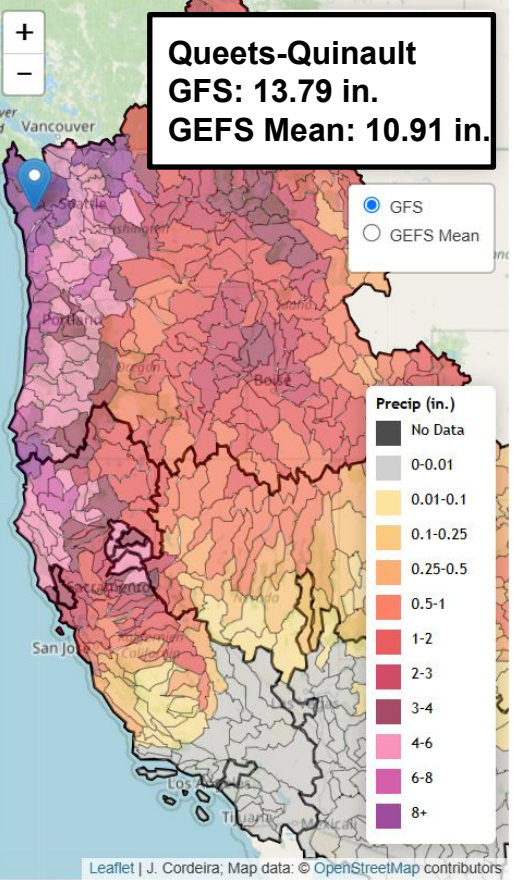


- The first and second ARs are forecast to produce light precipitation with up to 2 inches possible in the Olympic Mountains due to the strongest moisture transport remaining mostly offshore and the primarily southerly IVT direction.
- The third and fourth ARs are forecast to produce 2-4 inches of precipitation over the Olympic Peninsula, Southern Oregon, Northern California Coast Ranges, and Northern Sierra Nevada. WPC issued a marginal Excessive Rainfall Outlook along the Northern California coast with the third AR.
- The fifth and potentially strongest AR is forecast to produce 4-6+ inches of precipitation over the Southern Cascades, Southern Oregon, Northern California Coast Ranges, and Northern Sierra Nevada.
- During the next 7 days, the Weather Prediction Center (WPC) is forecasting 8-14 inches of total precipitation over the previously mentioned regions.

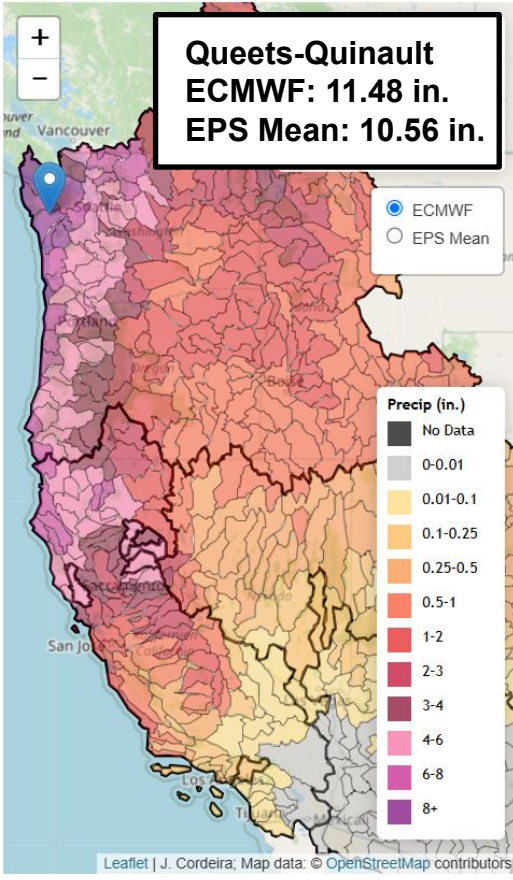
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Watershed Precipitation Forecasts

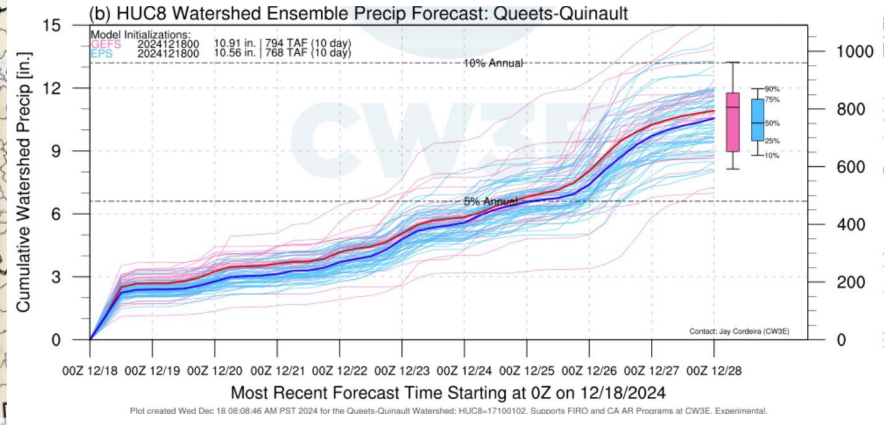
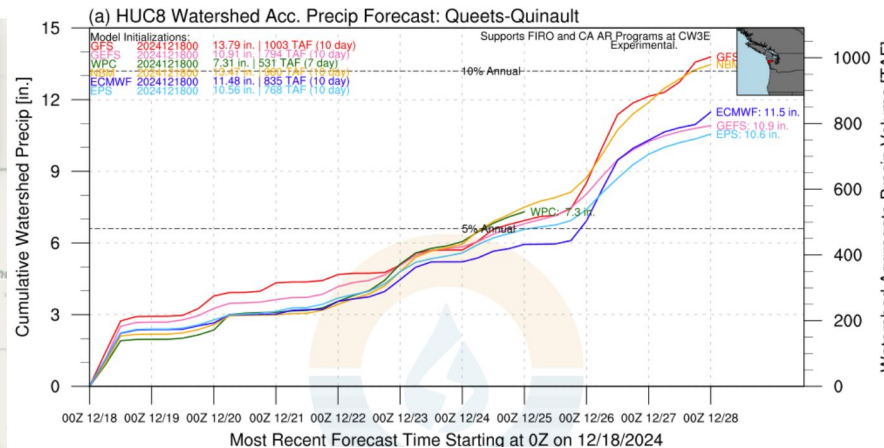
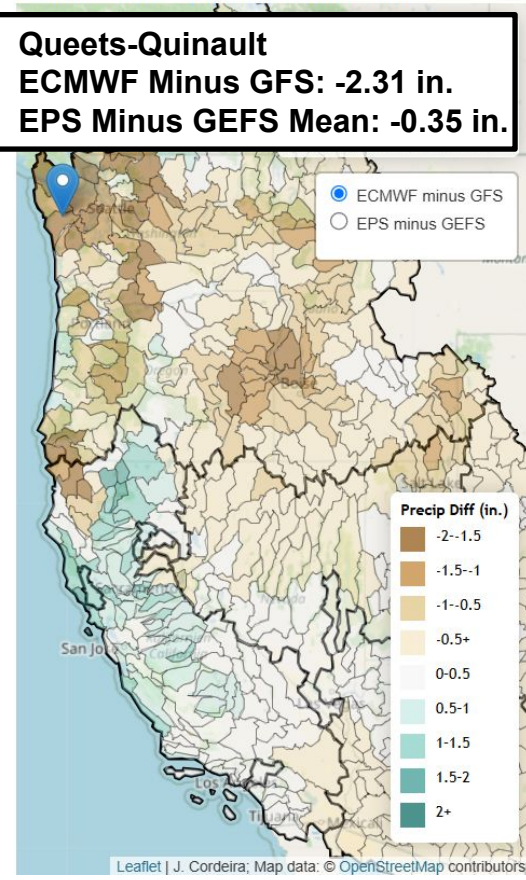
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/GEFS Precipitation Forecast



10-day Difference Precipitation Forecast

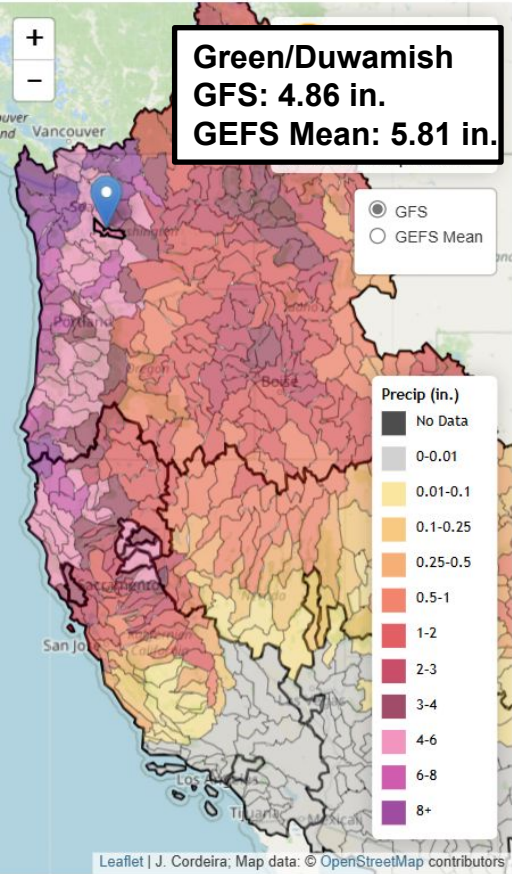


- Uncertainty in forecast evolution of these ARs is contributing to uncertainty in precipitation forecasts over the US West Coast.
- Overall, the 00Z GFS is forecasting higher precipitation totals over Washington and Oregon and less throughout California during the next 10 days as compared to the 00Z ECMWF.
- In the Queets-Quinault, >50% of EPS and GEFS members are forecasting 10+ inches of mean areal precipitation.
- There is also slightly larger spread among the GEFS members, with an interquartile range of ~3 inches (versus ~2 inches in the EPS).

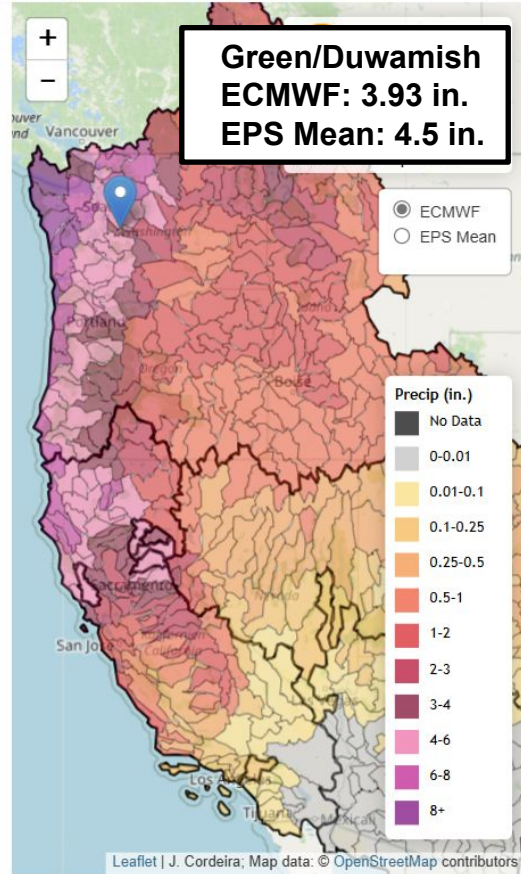
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Watershed Precipitation Forecasts

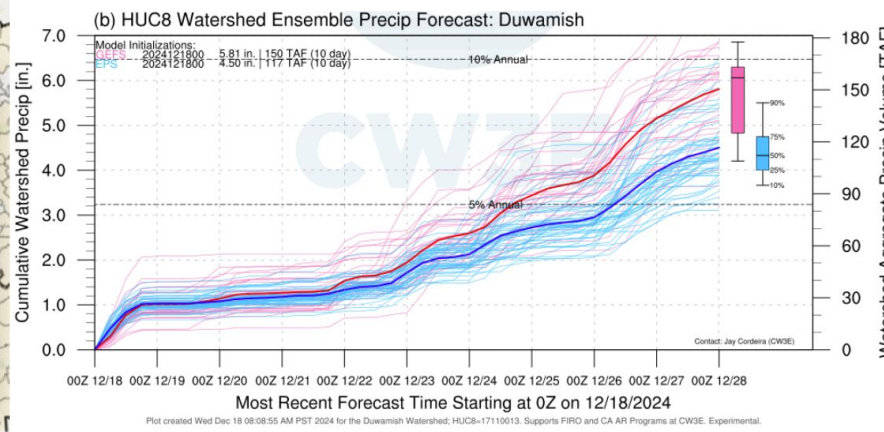
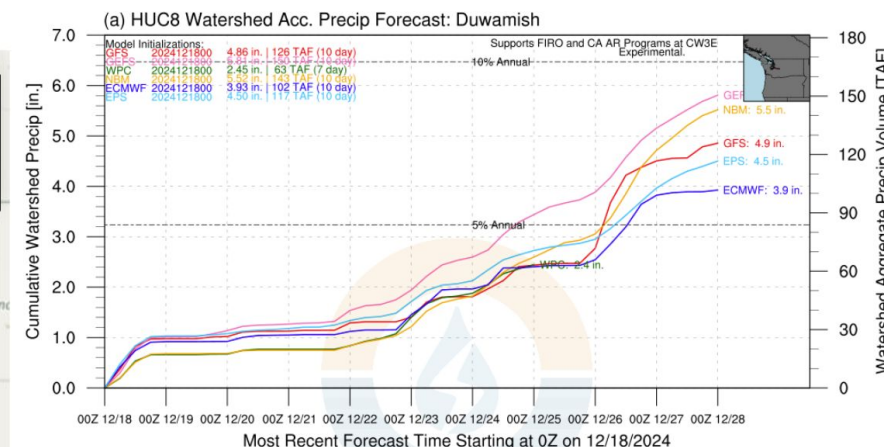
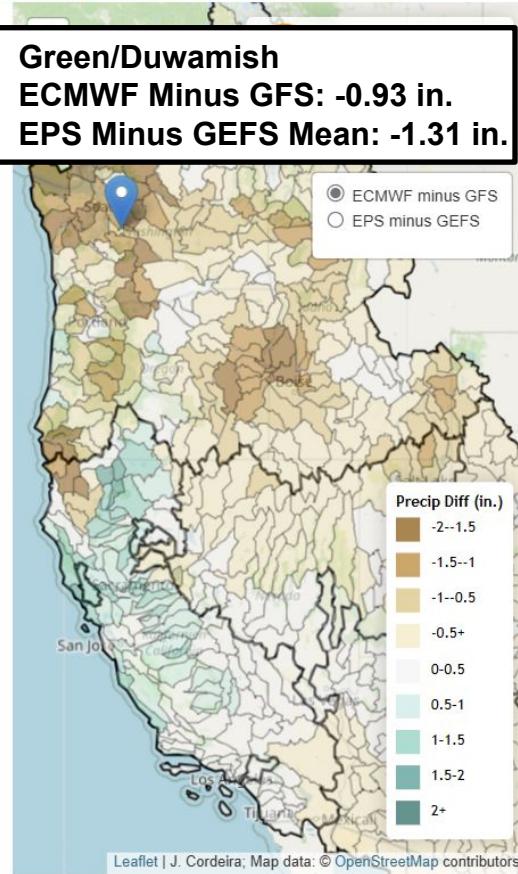
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EPS Precipitation Forecast



10-day Difference Precipitation Forecast

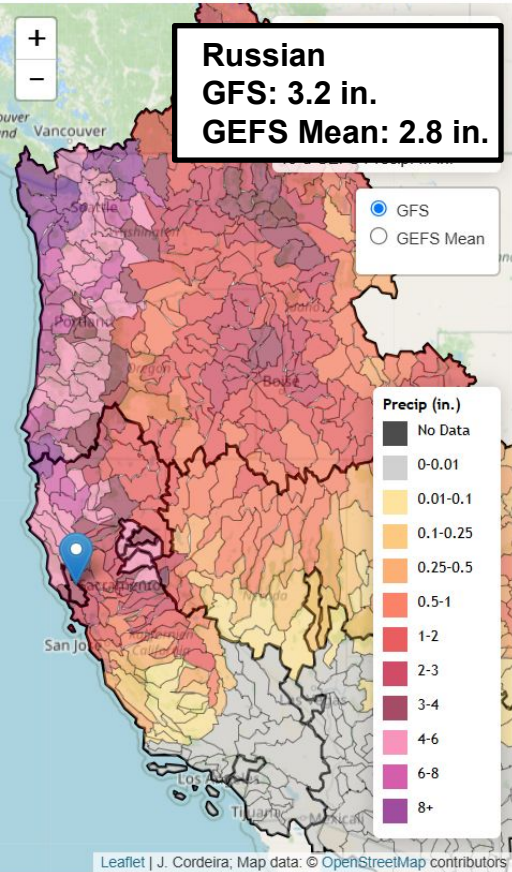


- GFS is forecasting higher precipitation amounts in the Green/Duwamish watershed over the next 10 days than the ECMWF.
- GEFS lower quartile (25th percentile; 4.8 in.) is greater than EPS upper quartile (75th percentile; 4.6 in.), indicating a much wetter scenario for the Green/Duwamish in the GEFS.
- GEFS ensemble spread is much larger than the EPS, with some members forecasting >7 in. and some <4 in..

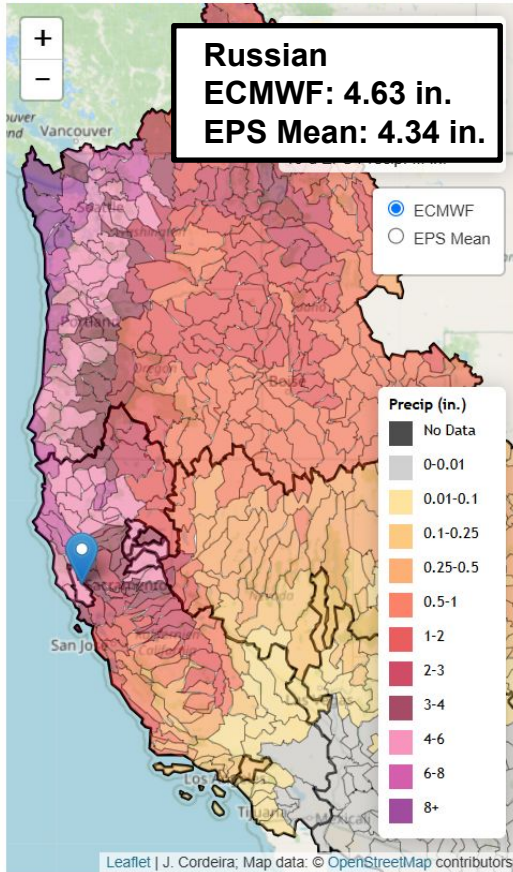
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Watershed Precipitation Forecasts

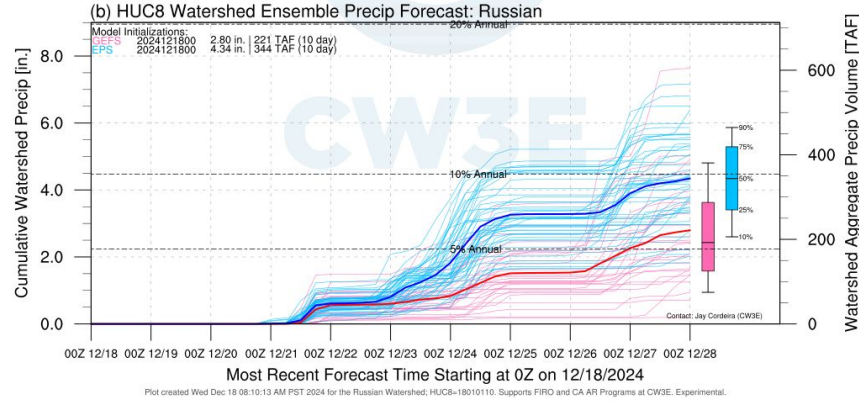
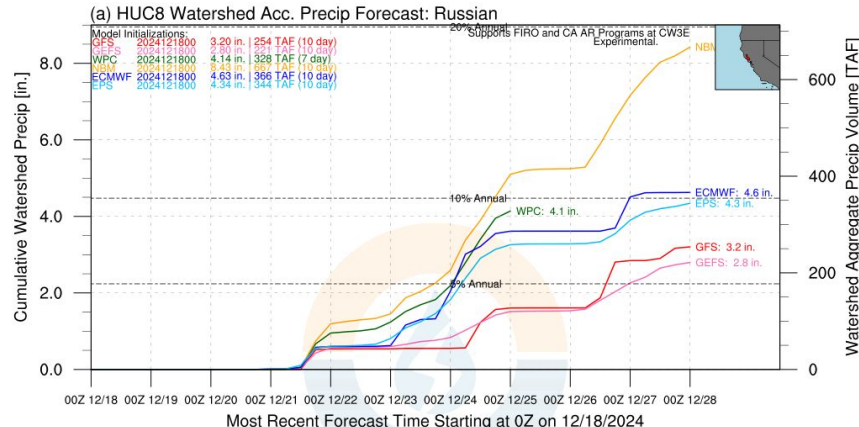
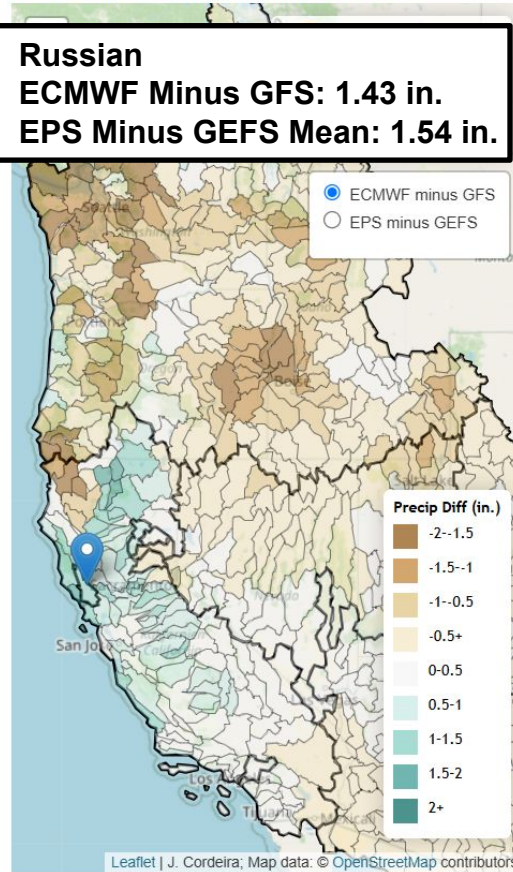
10-day GFS/GEFS Precipitation Forecasts



10-day ECMWF/EFS Precipitation Forecast



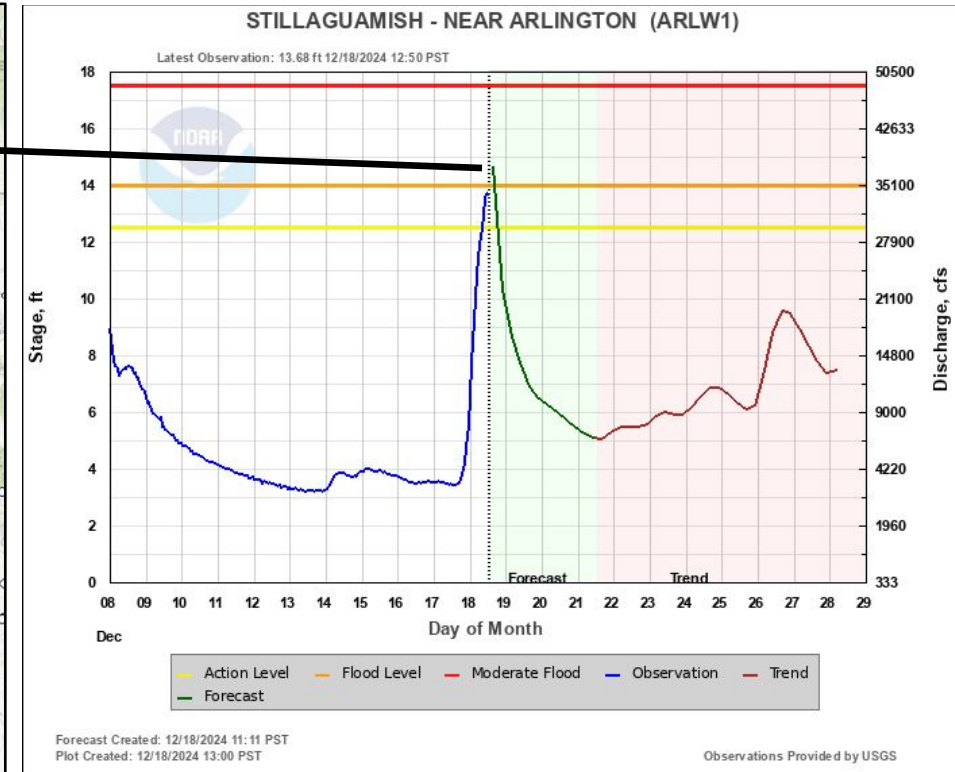
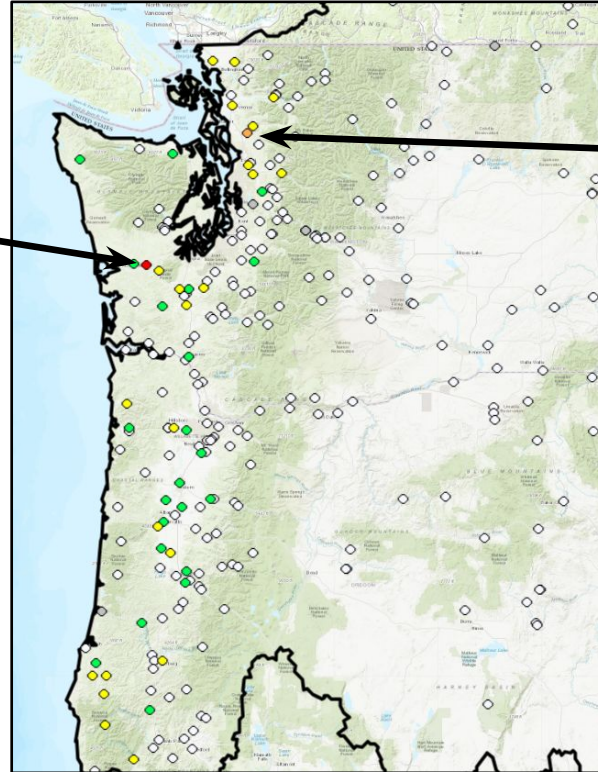
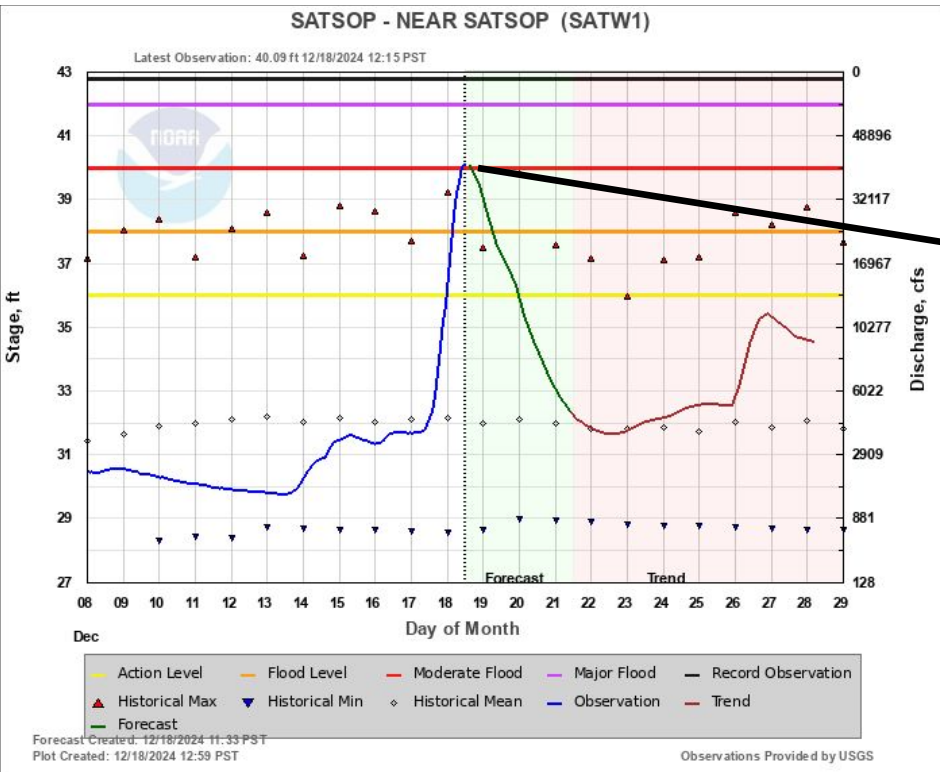
10-day Difference Precipitation Forecast



- GFS is forecasting less precipitation amounts in the Russian River watershed over the next 10 days than the EPS.
- EPS is indicating a wetter scenario of the Russian River watershed since the EPS lower quartile and the GEFS upper quartile are both ~ 3.5 in.
- The National Blend of Models is forecasting 8.43 in. of total precipitation over the next 10 days which is almost 20% of annual precipitation for the watershed.

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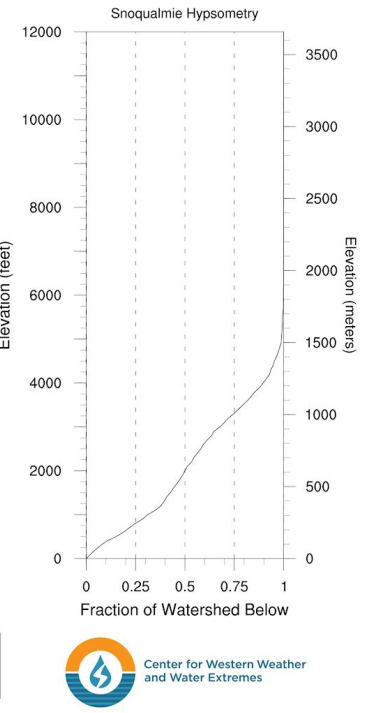
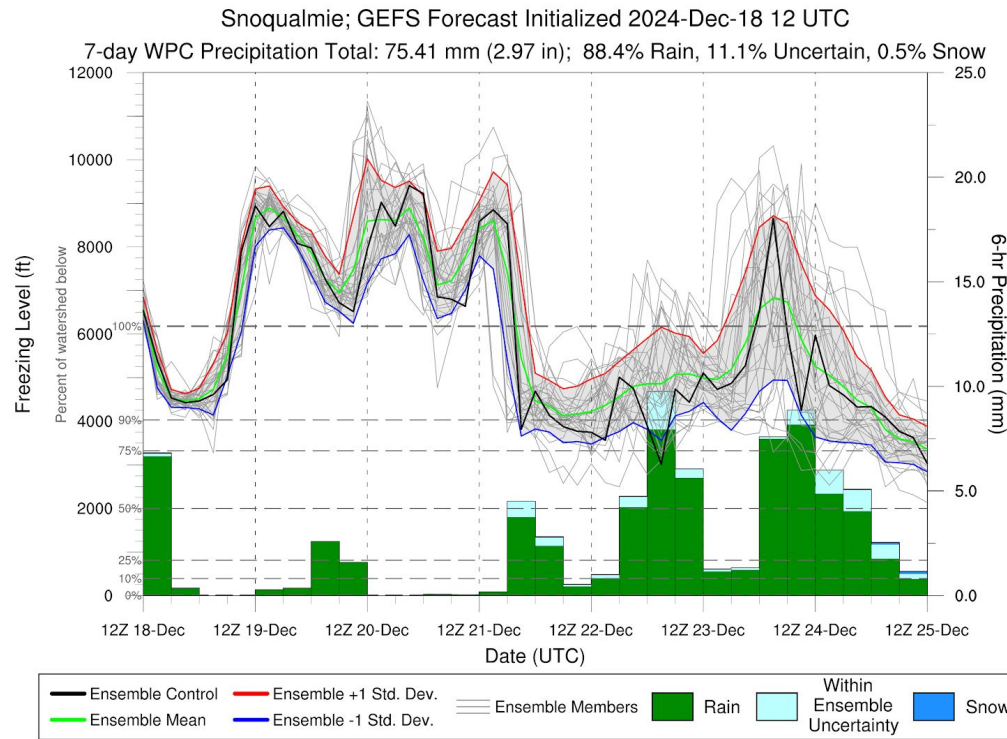
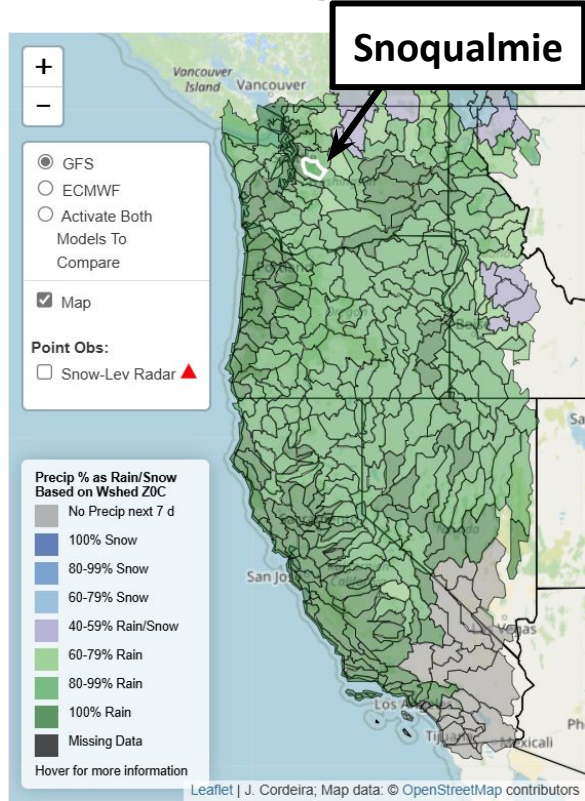
Hydrologic Forecasts



- The Northwest River Forecast Center is forecasting 27 stream gages in western Oregon and Washington to rise above action/bankfull levels with 1 above minor flood level and 1 above moderate flood level over the next 10 days.
- Most of the stream gages above action/bankfull levels are due to the recent AR activity over the region.
- High streamflow and flooding may be possible next week due to additional precipitation from subsequent landfalling ARs.

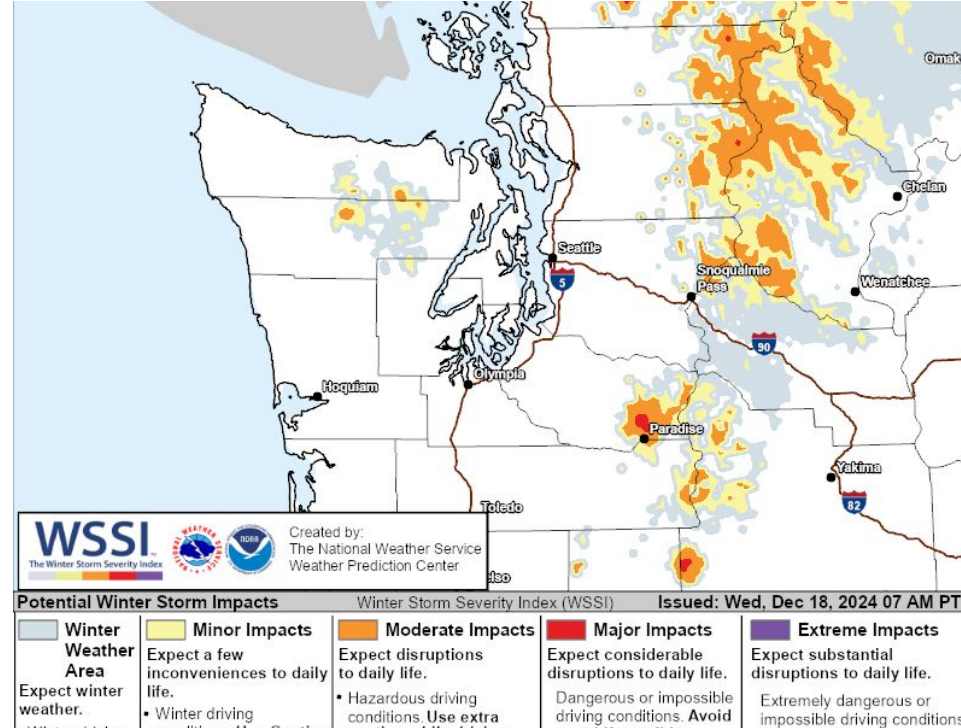
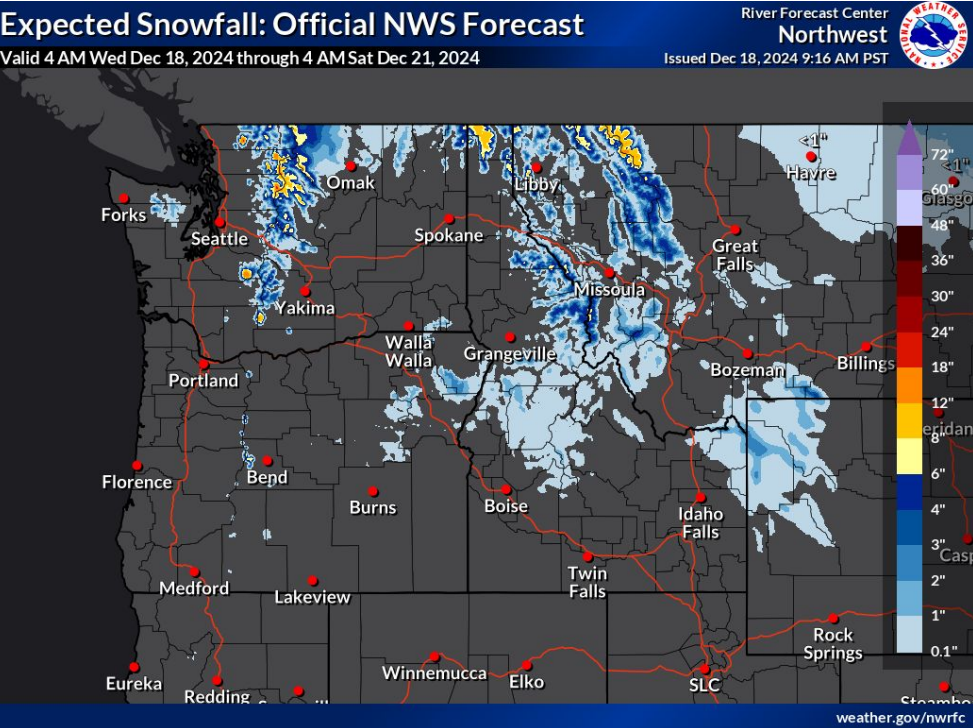
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Watershed Freezing Level Forecasts



- Freezing levels over the Pacific Northwest are expected to rise rapidly on Thu 19 Dec ahead of the first AR and remain high before dropping to around 4,000 feet late Sat 21 Dec ahead of the 4th AR.
- Freezing levels may quickly rise during the 5th AR on Tue 24 Dec but fall rapidly after the storm moves through.
- Despite the drop in freezing levels after the third AR, precipitation over the Snoqualmie watershed is expected to fall as mostly rain.

Winter Weather Hazards



Potential Winter Storm Impacts	
Winter Weather Area	<p>Winter Weather Area Expect Winter Weather. • Winter driving conditions. Drive carefully.</p>
Minor Impacts	<p>Minor Impacts Expect a few inconveniences to daily life. • Winter driving conditions. Use caution while driving.</p>
Moderate Impacts	<p>Moderate Impacts Expect disruptions to daily life. • Hazardous driving conditions. Use extra caution while driving. • Closures and disruptions to infrastructure may occur.</p>
Major Impacts	<p>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.</p>
Extreme Impacts	<p>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.</p>

- Snowfall accumulations of 6–18 inches are forecast above 7,000 feet in the Washington Cascades in the next three days.
- Moderate-to-major winter storm impacts are expected in these areas.