CW3E Atmospheric River Outlook: 16 December 2024

Family of Atmospheric Rivers Forecast to Bring 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 through the end of the week.
- The first AR is forecast to make landfall early tomorrow and bring AR 2/AR 3 conditions (based on the Ralph et al. 2019 AR Scale) and heavy precipitation to coastal Washington and northern Oregon.
- The second and third ARs are forecast to make landfall over British Columbia on Thu 19 Dec and Fri 20 Dec, with limited impacts expected over the US West Coast.
- The fourth and fifth ARs are forecast to make landfall on Sat 21 Dec and Sun 22 Dec and potentially bring moderate-to-strong AR conditions (IVT > 500 kg m^{-1} s^{-1}) and heavy precipitation to western Washington, western Oregon, and Northern California.
- Extended range and subseasonal forecast products suggest that additional AR activity and wet conditions are likely to continue into next week, especially over the Pacific Northwest.
- The NWS Weather Prediction Center is forecasting 10–20 inches of total precipitation over the Olympic Peninsula 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 Washington and Oregon during 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 potential during the first AR.

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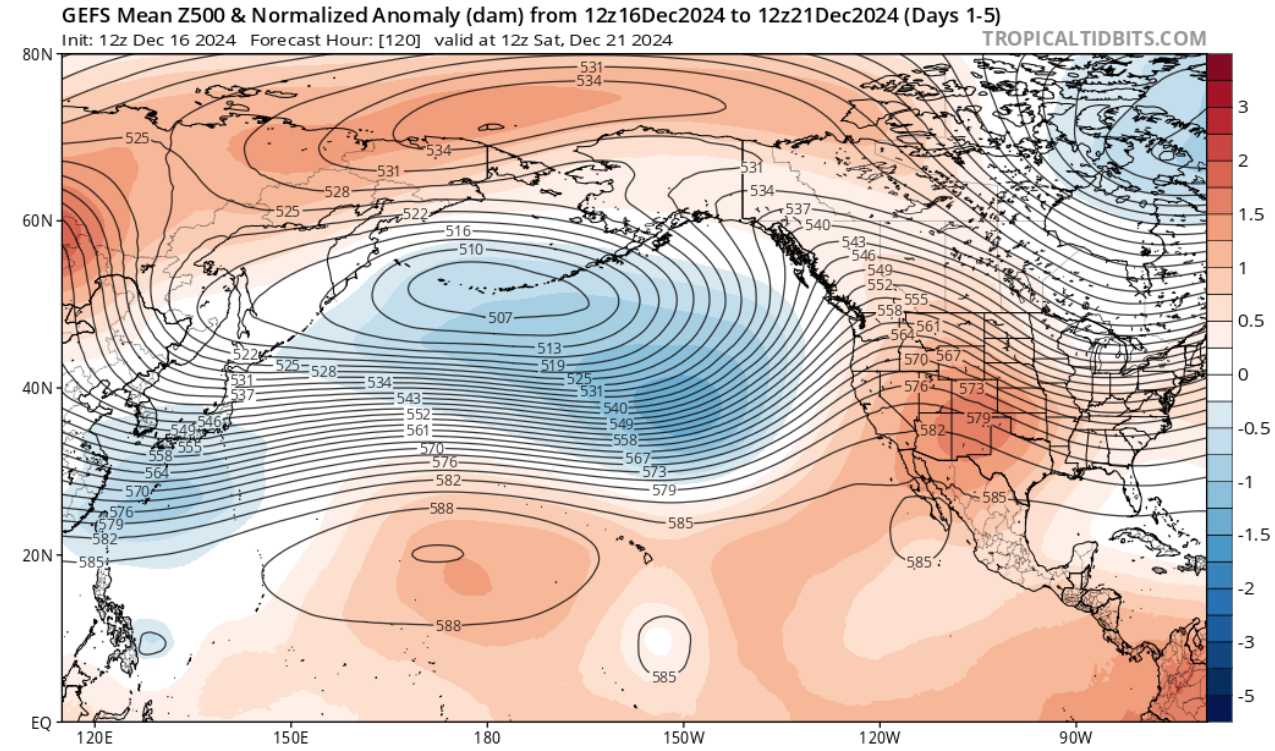
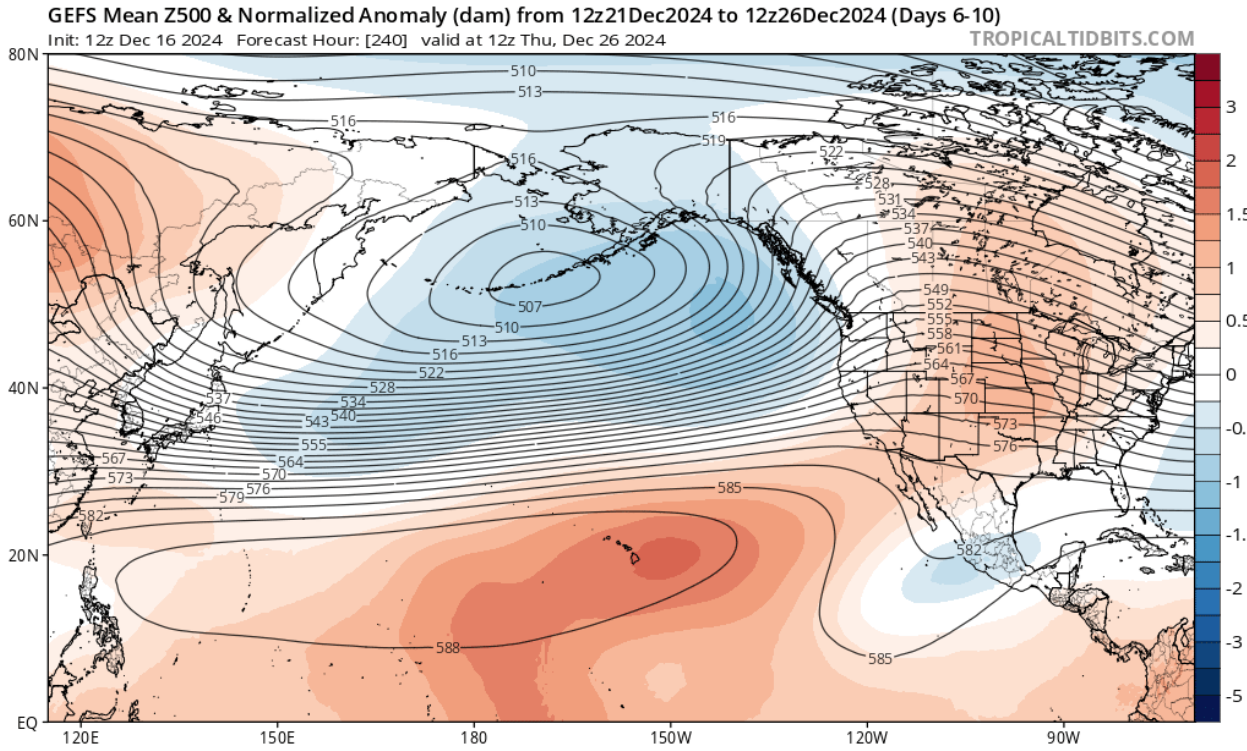
GEFS 5-day Mean 500-hPa Geopotential Height & Normalized Anomalies: Days 1–5 and 6–10





- An eastward expansion of the North Pacific jet and the development of a broad and persistent upper-level trough over the North Pacific will set the stage for an extended period of active weather over the US West Coast.
- Favorable large-scale dynamics will facilitate the development and eastward propagation of a sequence of atmospheric rivers (ARs) and low-pressure systems over the next 10 days.
- Also known as an ”AR family,” ARs making landfall in close succession are often associated with heavy precipitation and flooding over the US West Coast (Fish et al. 2019).

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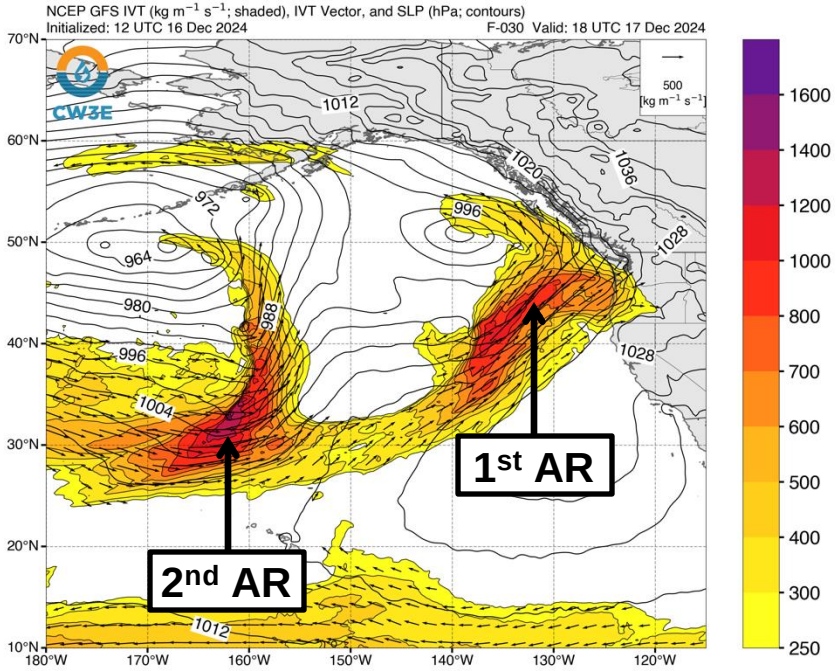
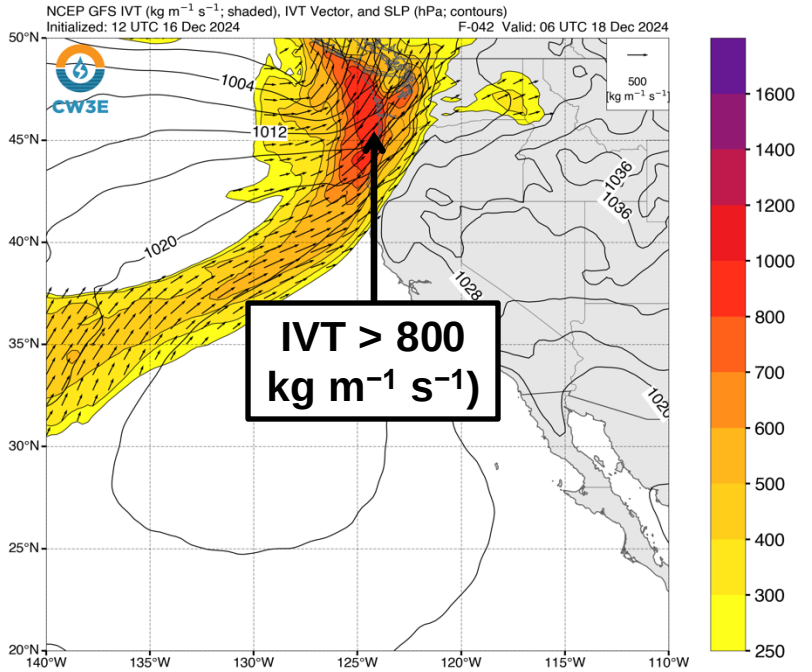
GFS IVT & SLP Forecasts

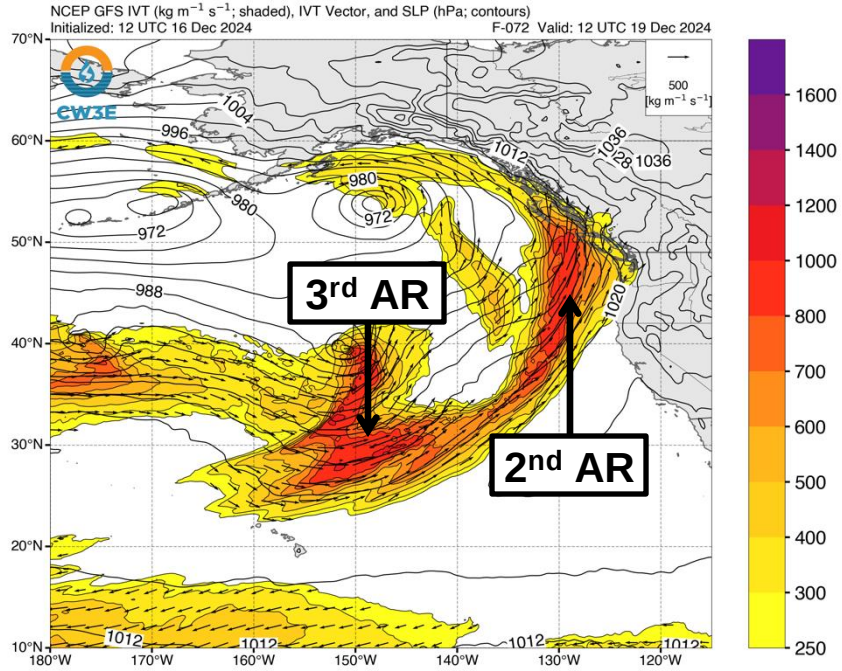
Valid: 10 AM PST 17 Dec (F-030)



Valid: 10 PM PST 17 Dec (F-042)



Valid: 4 AM PST 19 Dec (F-072)



- The first AR is forecast to make landfall over Oregon and Washington tomorrow morning (17 Dec).
- The core of the AR is forecast to move onshore tomorrow night, bringing a brief period of strong AR conditions (IVT ≥ 750 kg m^{-1} s^{-1}) to coastal Washington and Oregon.
- Southwesterly IVT during the second AR will likely support orographic enhancement of precipitation over the Olympic Mountains and North Cascades.
- A second AR is forecast to make landfall over British Columbia early Thu 19 Dec and eventually move eastward into western Washington before rapidly weakening.

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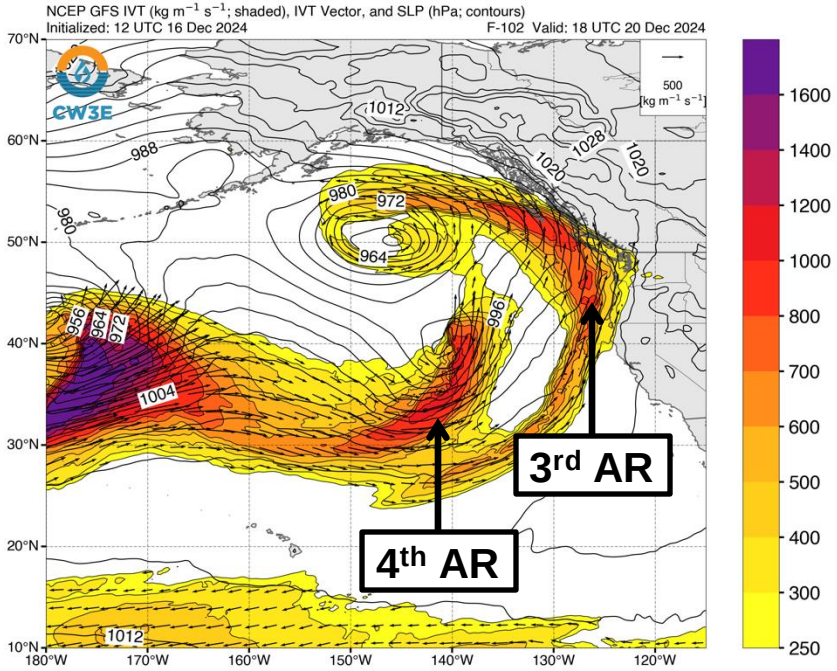
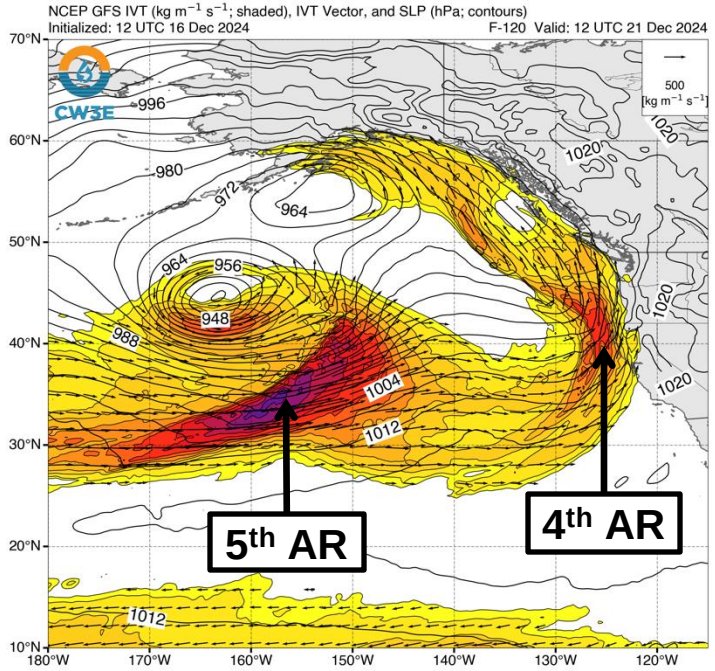
GFS IVT & SLP Forecasts

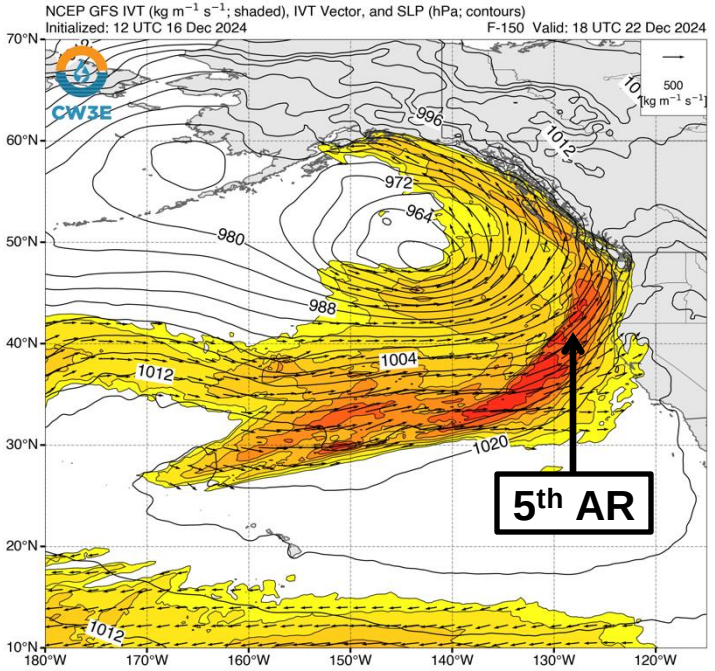
Valid: 10 AM PST 20 Dec (F-102)



Valid: 4 AM PST 21 Dec (F-120)



Valid: 10 AM PST 22 Dec (F-150)



- The third AR is forecast to follow a similar trajectory as the second AR and make landfall on Fri 20 Dec.
- Precipitation associated with the second and third ARs will likely be limited outside of the Olympic Peninsula due to the strongest IVT remaining offshore and a more southerly IVT direction.
- The fourth and fifth ARs are forecast to make landfall early on Sat 21 Dec and Sun 22 Dec, respectively, and bring moderate-to-strong AR conditions (IVT > 500 kg m^{-1} s^{-1}) to coastal Washington, Oregon, and Northern California.

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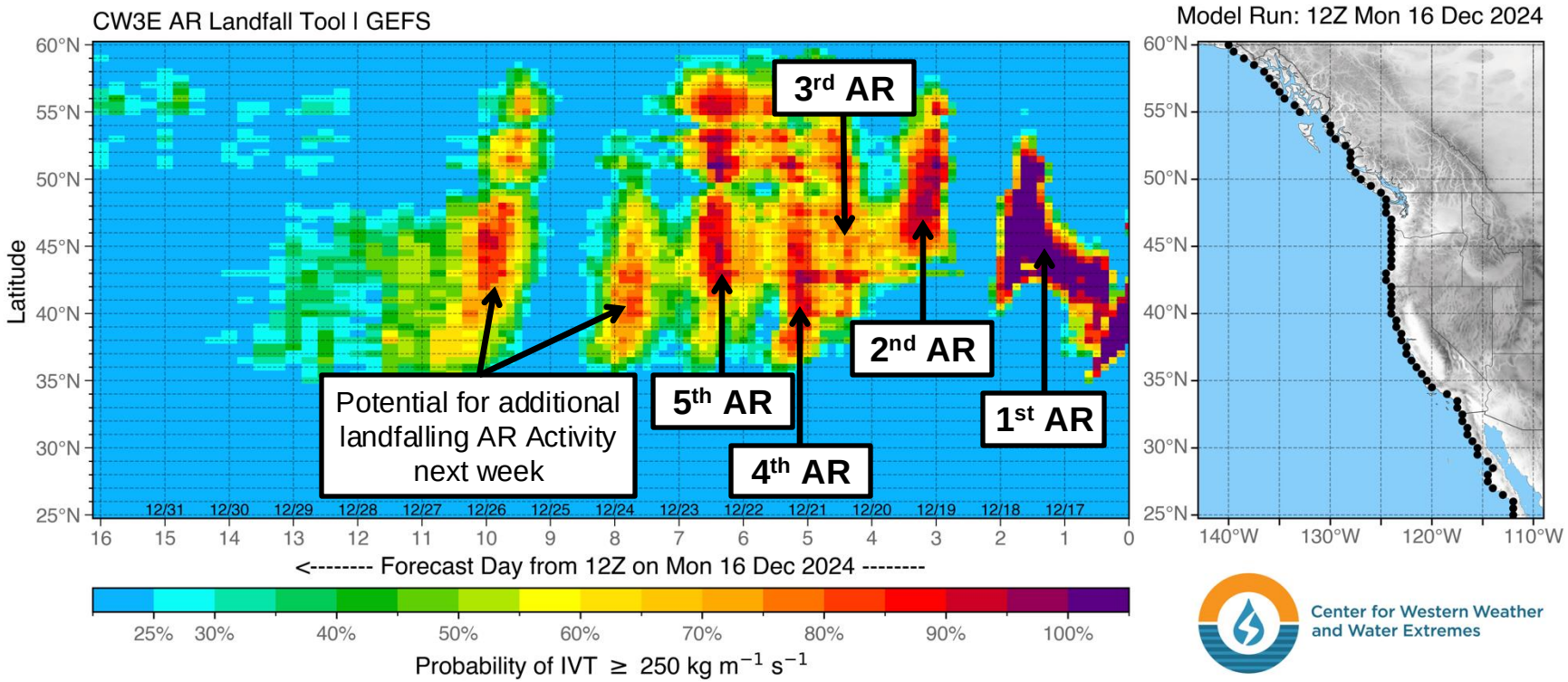
GEFS Probability of AR Conditions Along Coast



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

- The 12Z GEFS is showing very high confidence (near 100% probability) in a period of AR conditions (IVT ≥ 250 kg m^{-1} s^{-1}) over coastal Washington and Oregon on 17–18 Dec in association with the first AR.
- After the first AR landfall, GEFS is also showing moderate-to-high confidence (> 70% probability) in multiple episodes of AR conditions between Northern 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 into the middle of next week.

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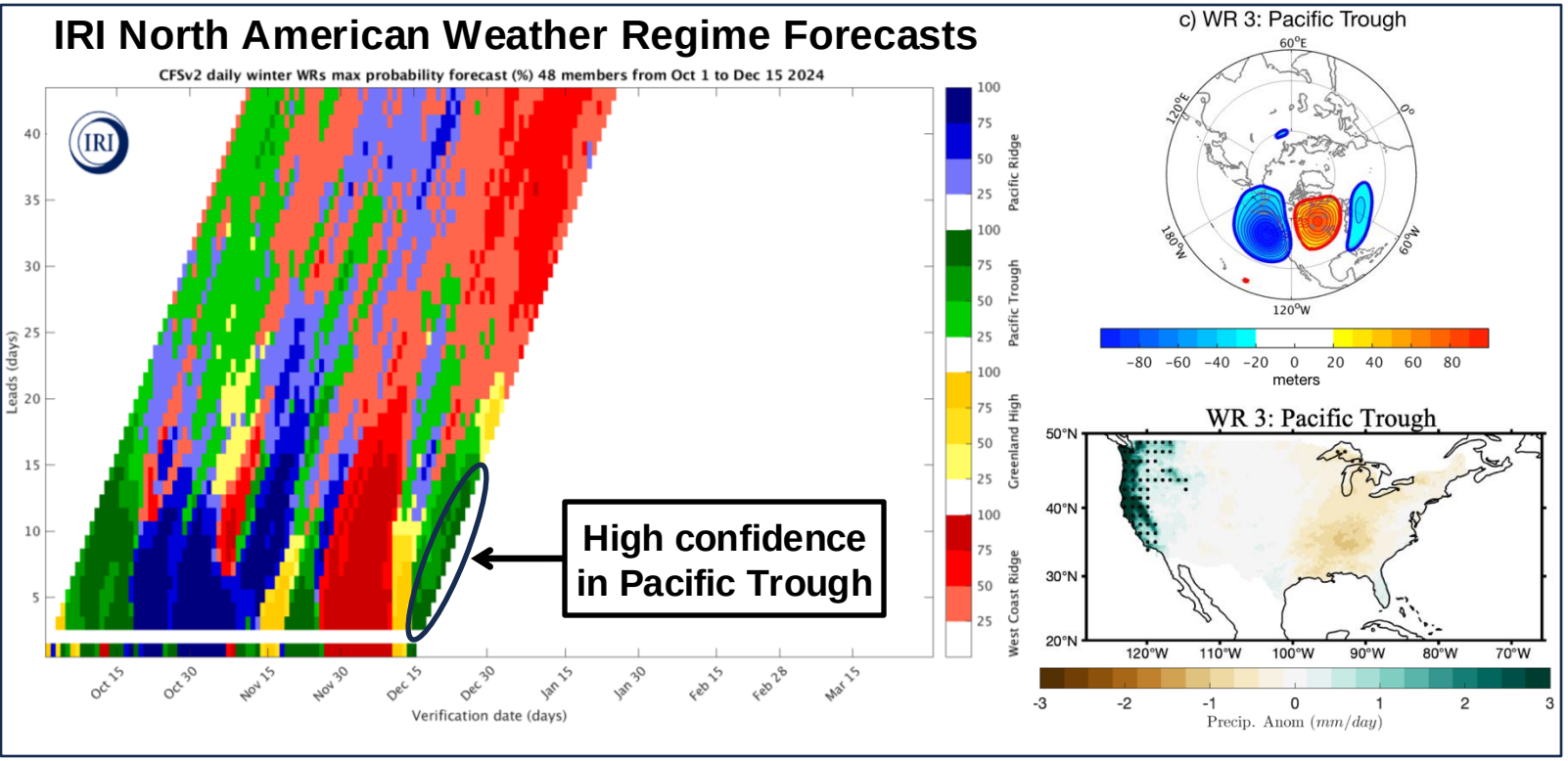

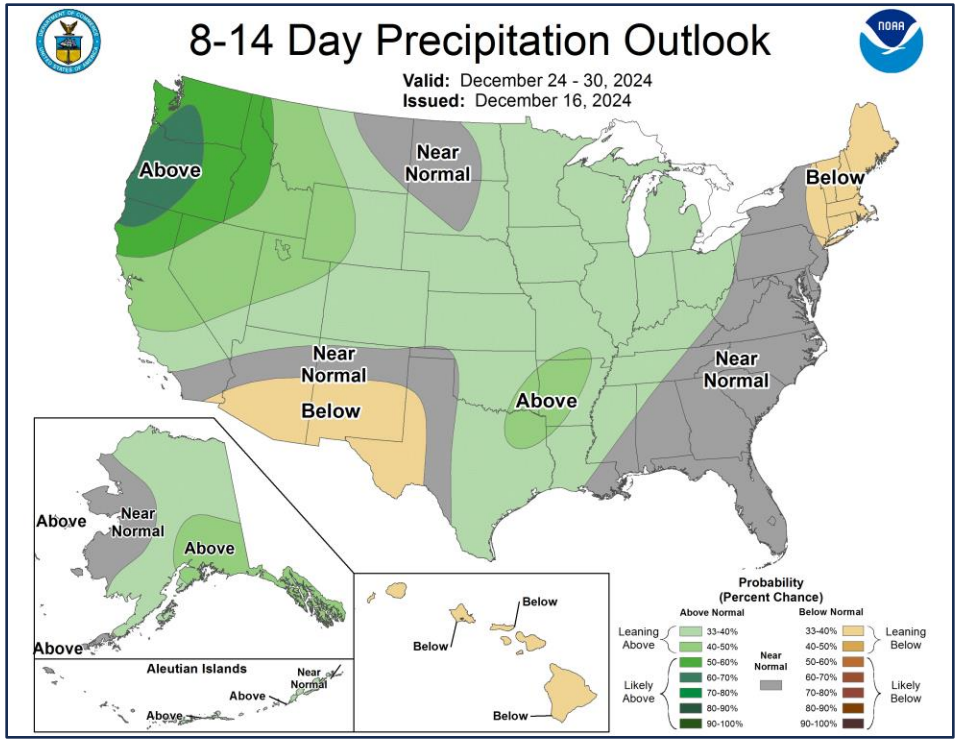

- Extended range and subseasonal products from other institutions are also indicating an elevated likelihood of wet conditions continuing into next week.
- The IRI North American Weather Regime forecasts are showing high confidence (> 75% ensemble agreement) in the Pacific Trough regime over the next 10 days. This regime is associated with above-normal precipitation over the entire US West Coast.
- The Climate Prediction Center's 8–14 Day outlook is showing > 50% probability of above-normal precipitation in Washington, Oregon, and Northern California, with odds tilted toward above-normal precipitation in Central California.

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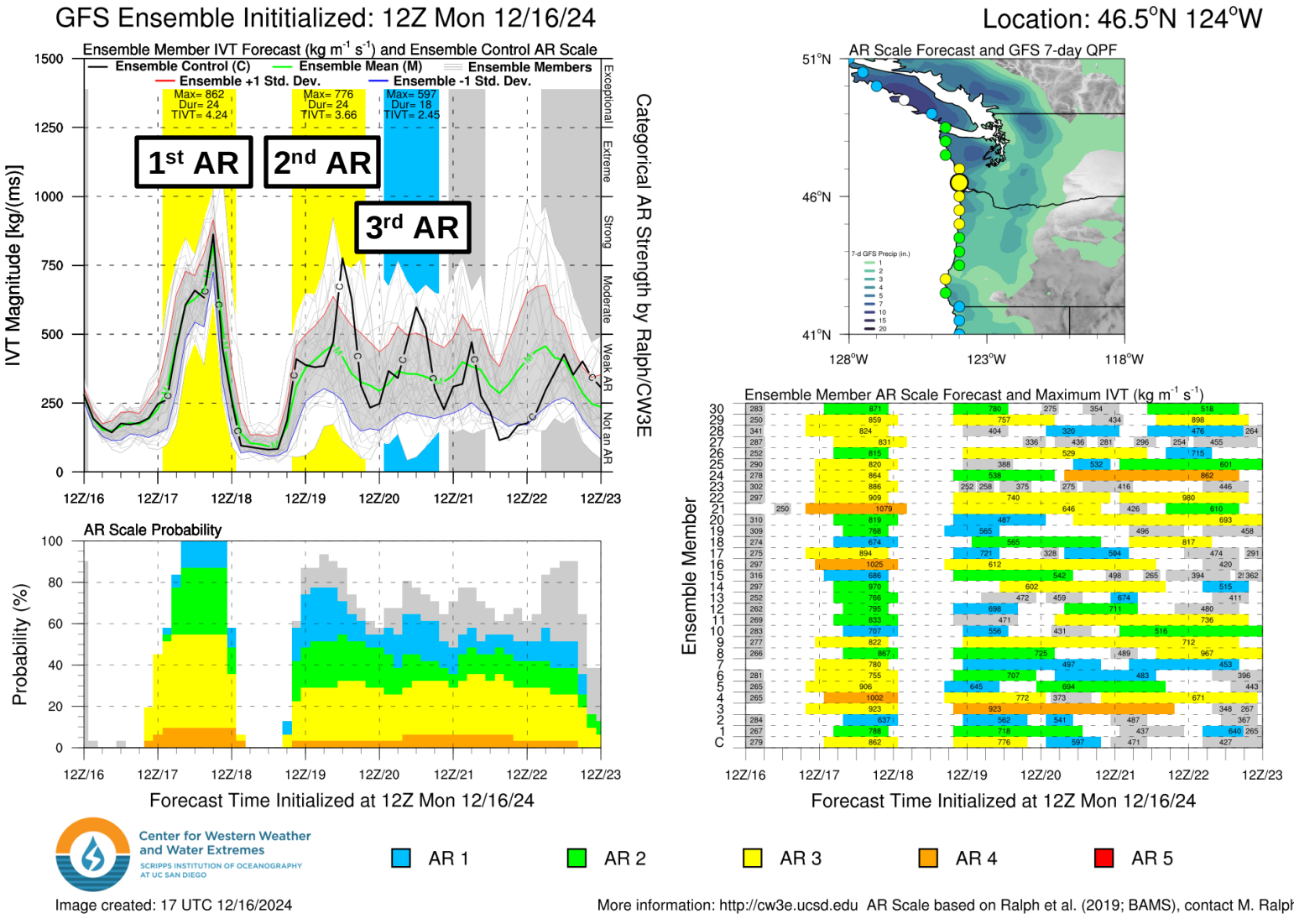
GEFS AR Scale and IVT Forecasts



- The 00Z GEFS control is forecasting AR 2–3 conditions (based on the Ralph et al. 2019 AR Scale) over coastal Washington and northern Oregon in association with the first and second ARs.
- While > 50% of ensemble members are predicting an AR 3 or greater at 46.5°N, 124°W (Pacific County, WA), there is still some uncertainty in the timing, duration, and magnitude of the first AR, with maximum forecast IVT ranging from 637 to 1079 kg m^{-1} s^{-1}.
- There is even greater uncertainty in the timing, duration, and magnitude of AR conditions during the subsequent ARs, with several ensemble members showing no break in AR conditions between the second and third ARs.

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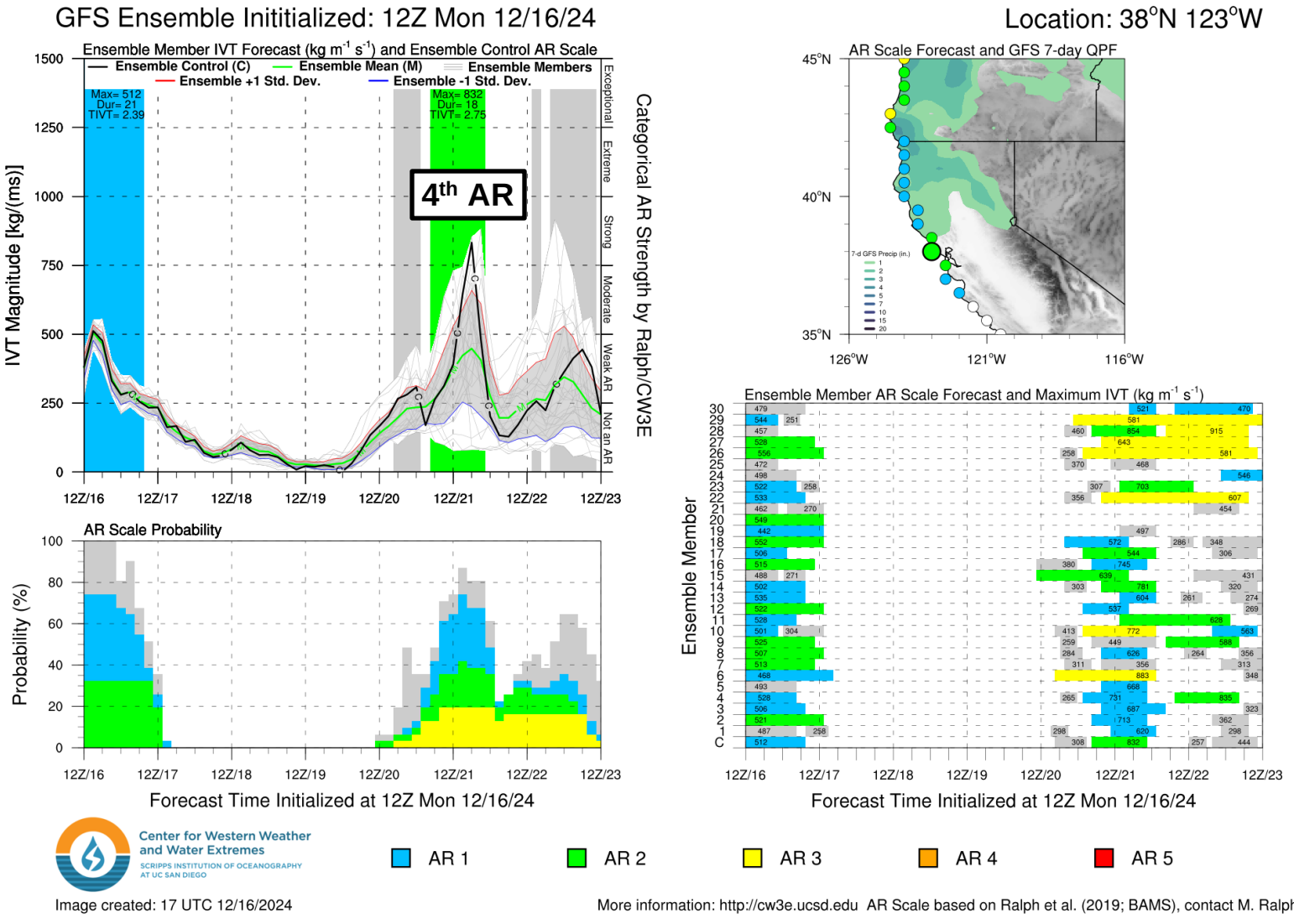
GEFS AR Scale and IVT Forecasts



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

Image created: 17 UTC 12/16/2024

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

- The 00Z GEFS control is forecasting AR 1–2 conditions over coastal California from Monterey County to the Oregon border in association with the fourth AR.
- There is considerable uncertainty in the timing, magnitude, and duration of the fourth AR.
- 13/31 (42%) ensemble members are predicting an AR 2 or an AR 3 at 38°N, 123°W (Marin County, CA), and 7/31 (23%) members are predicting less than an AR 1.

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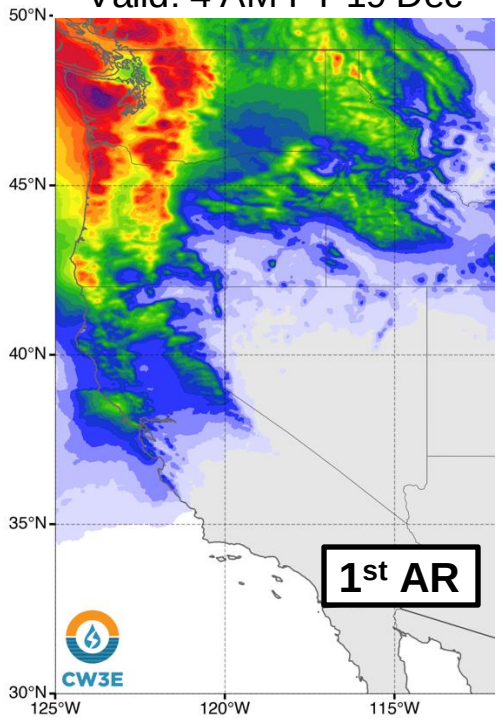
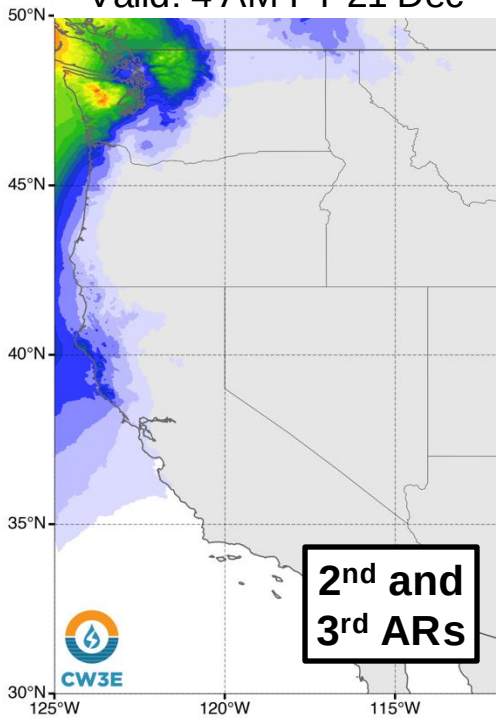
Precipitation Forecasts

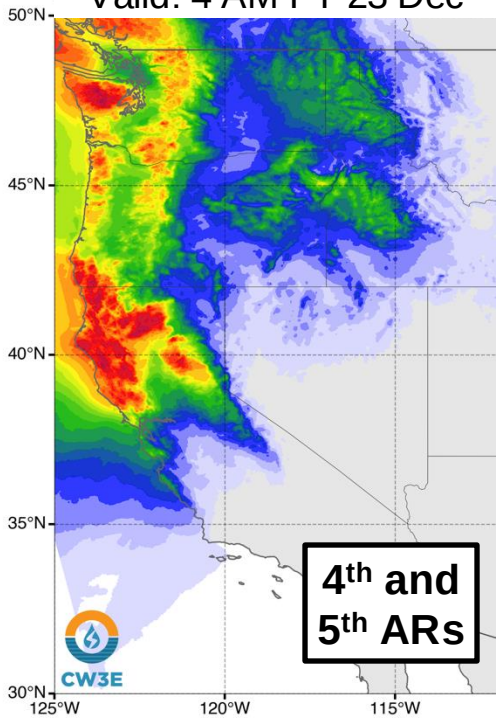
WPC 72-h QPF
Valid: 4 AM PT 19 Dec

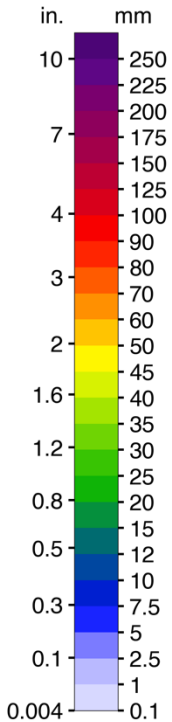


WPC 48-h QPF
Valid: 4 AM PT 21 Dec

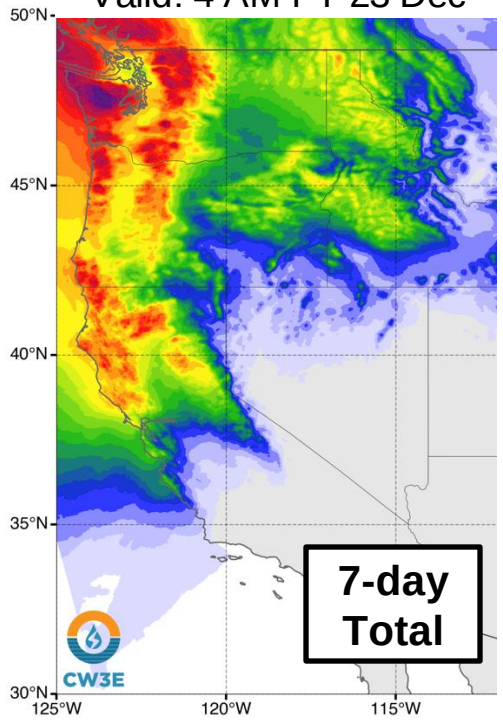


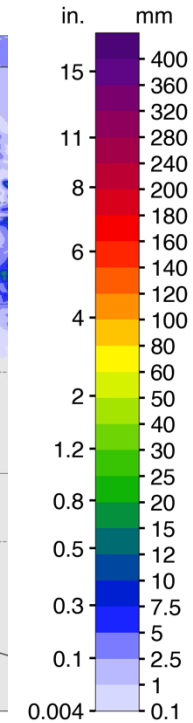
WPC 48-h QPF
Valid: 4 AM PT 23 Dec





WPC 168-h QPF
Valid: 4 AM PT 23 Dec





- The first AR is forecast to produce at least 3–7 inches of precipitation over the Coast Ranges and Cascades in Washington and northern Oregon, with 10+ inches possible in the Olympic Mountains.
- The second and third ARs are only forecast to produce 1–3 inches of precipitation over the Olympic Peninsula and North Cascades due to the strongest moisture transport remaining mostly offshore and the primarily southerly IVT direction.
- The fourth and fifth ARs are forecast to produce 3–5 inches of precipitation over the Olympic Peninsula, Southern Oregon and Northern California Coast Ranges, Southern Cascades, and Northern Sierra Nevada.
- During the next 7 days, the Weather Prediction Center (WPC) is forecasting 10–20 inches of total precipitation over the Olympic Peninsula.

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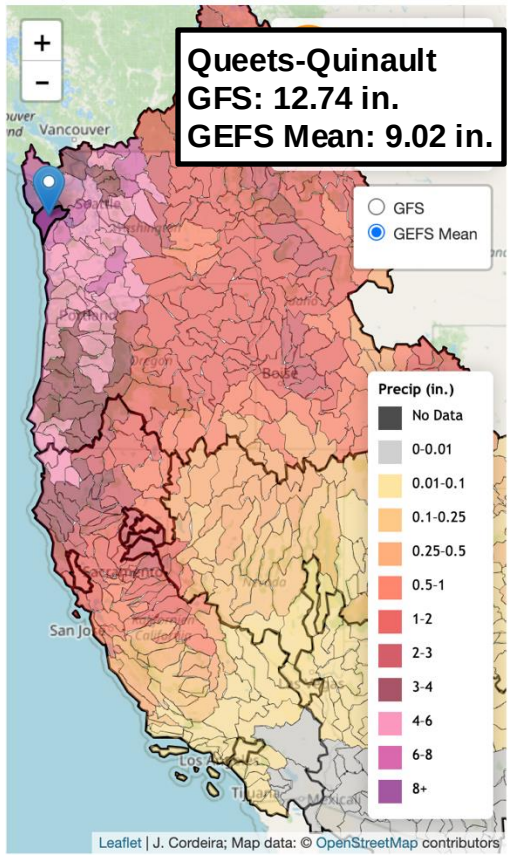
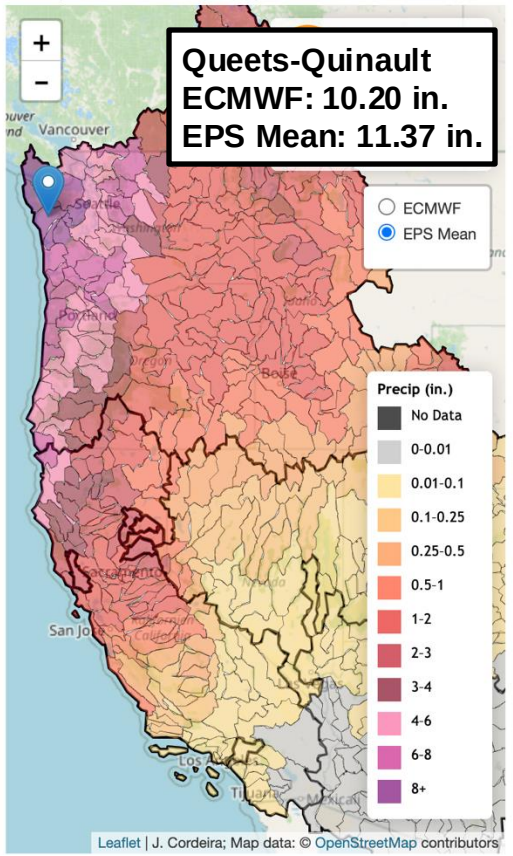
Watershed Precipitation Forecasts

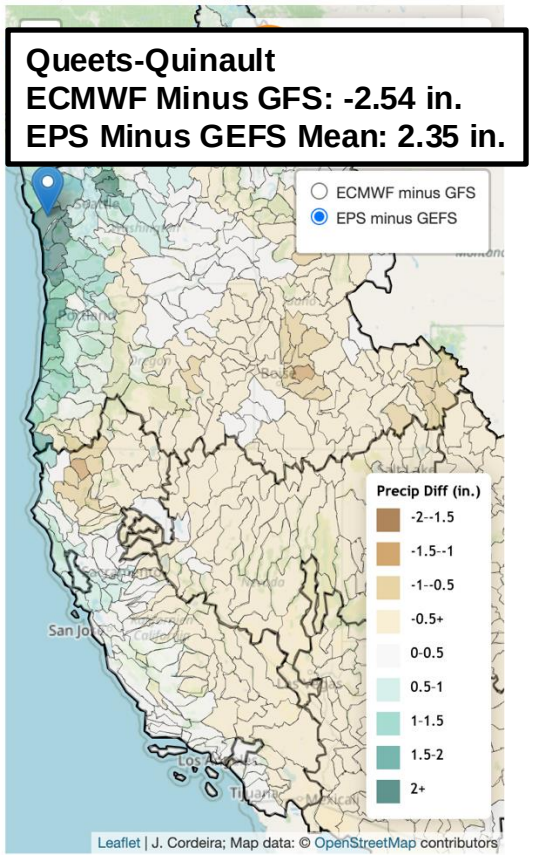
10-day GFS/GEFS Precipitation Forecasts

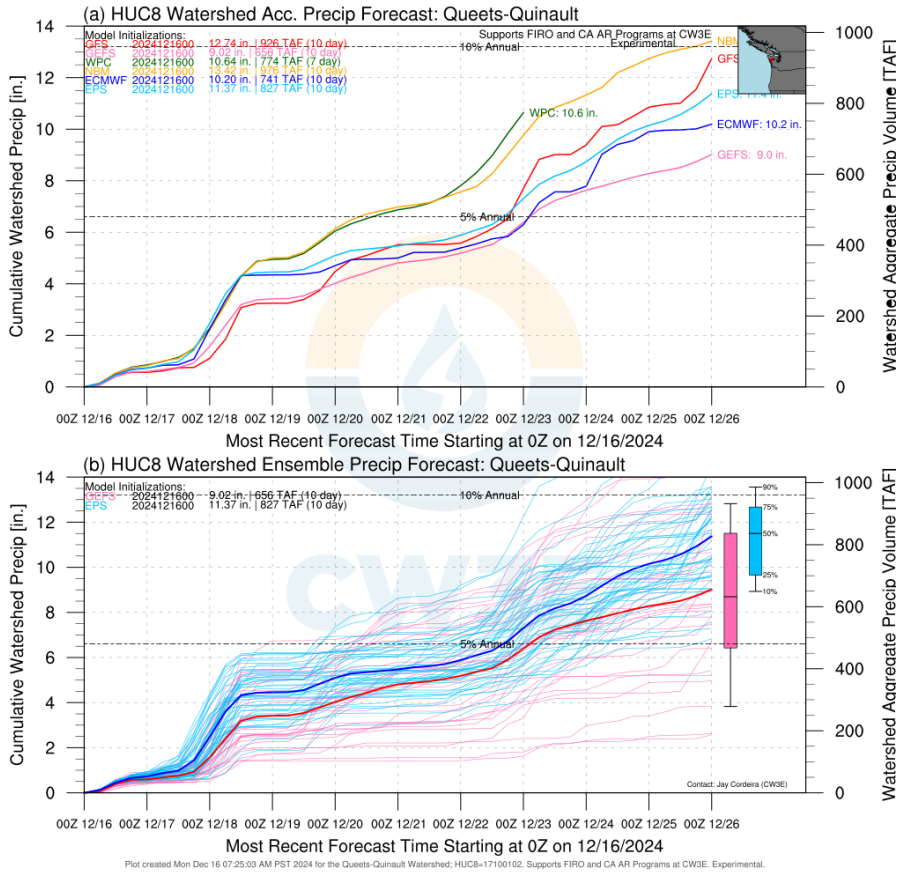


10-day ECMWF/EFS Precipitation Forecast



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 EPS is forecasting higher precipitation totals over coastal Washington and Oregon during the next 10 days compared to the 00Z GEFS.
- In the Queets-Quinault, ~50% of EPS and ~25% of GEFS members are forecasting 11+ inches of mean areal precipitation.
- There is also much larger spread among the GEFS members, with an interquartile range of ~5 inches (versus ~3 inches in the EPS).

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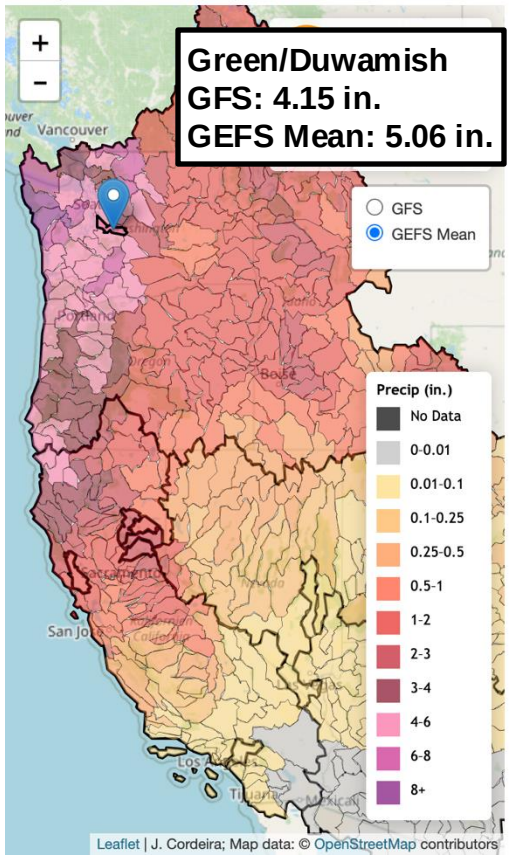
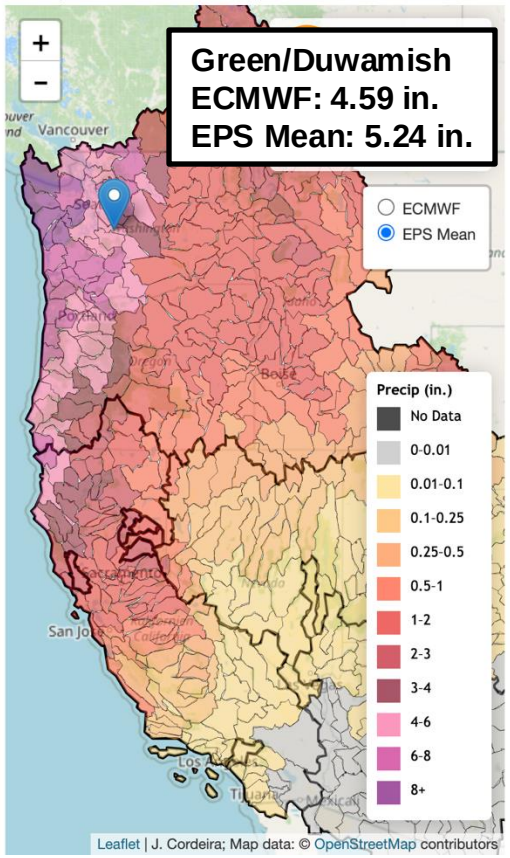
Watershed Precipitation Forecasts

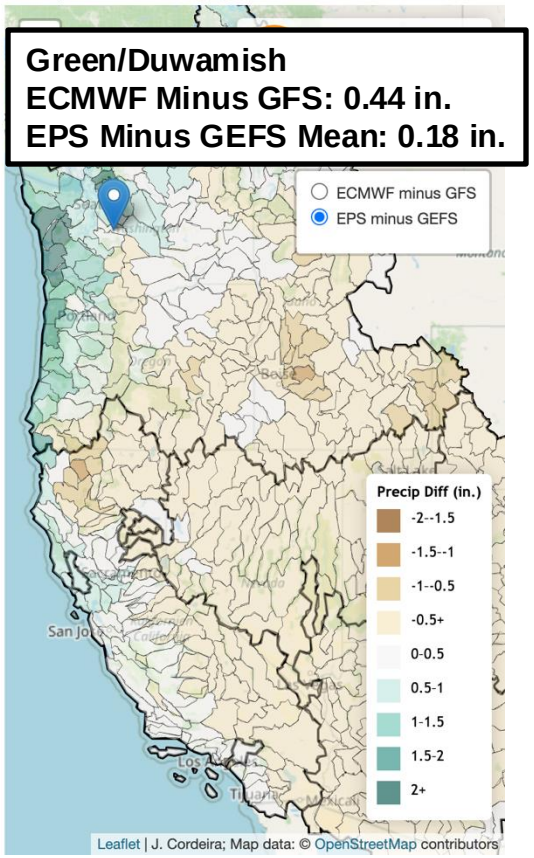
10-day GFS/GEFS Precipitation Forecasts

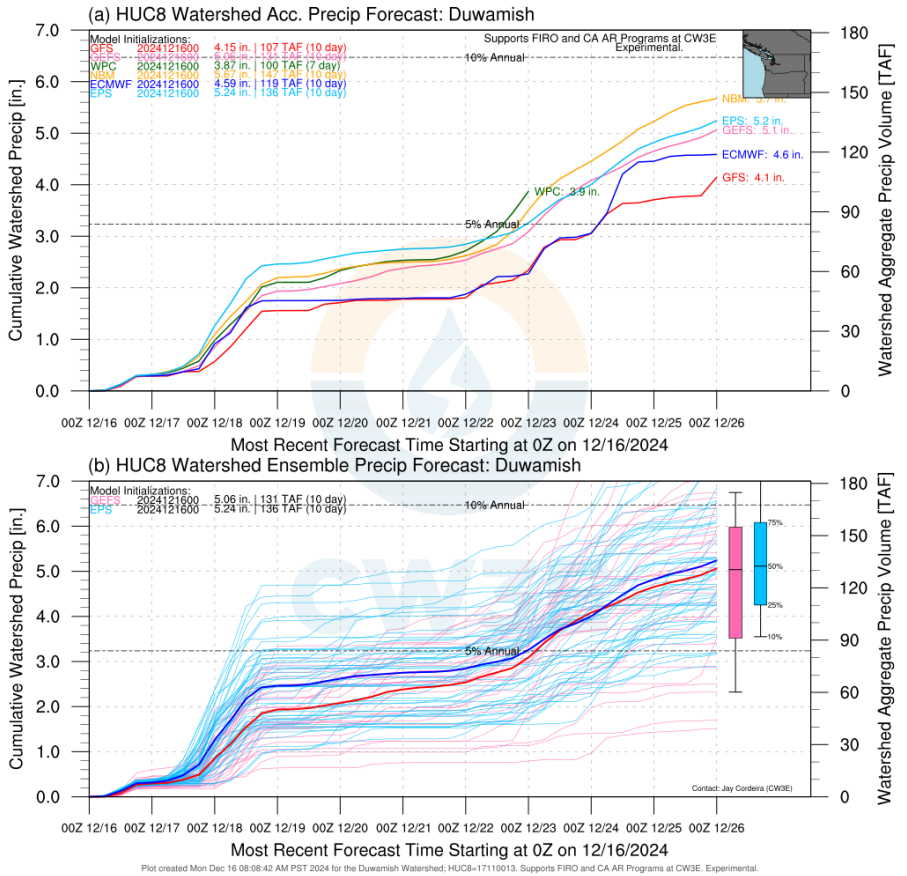


10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast





- GEFS and EPS are forecasting similar precipitation amounts in the Green/Duwamish watershed over the next 10 days.
- ~50% of GEFS and EPS members are forecasting 5+ inches of mean areal precipitation in the Green/Duwamish.
- Ensemble spread is quite large, with several EPS members forecasting > 7 inches of total precipitation and several GEFS members forecasting < 3 inches.

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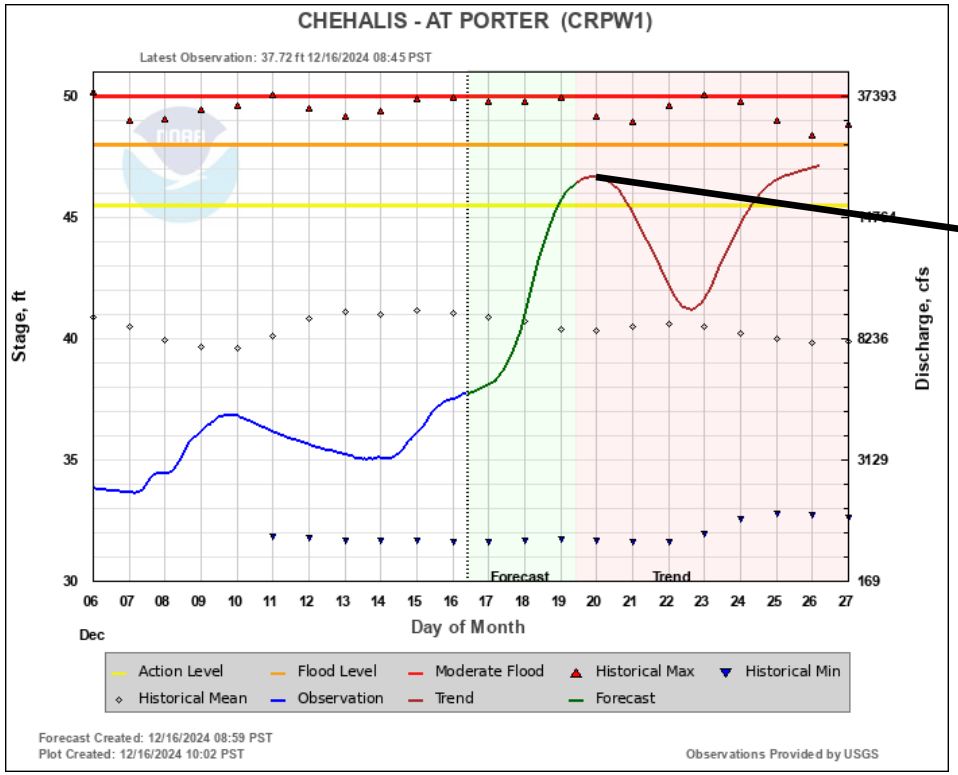
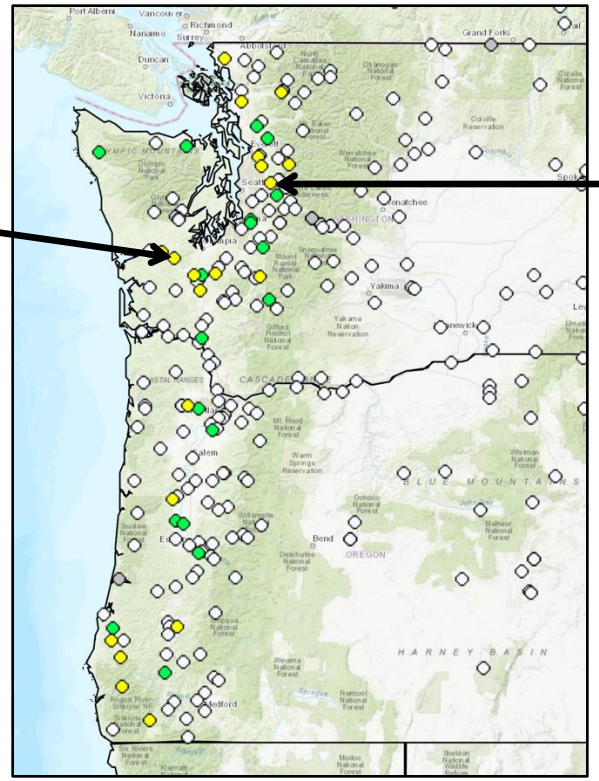
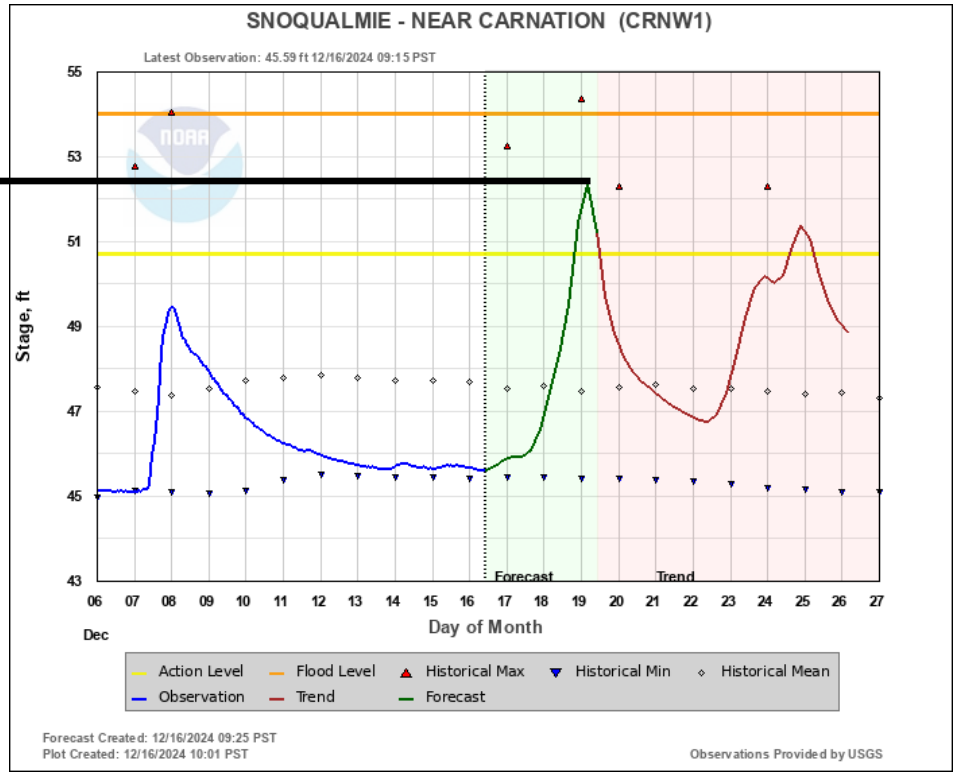
Hydrologic Forecasts







- The Northwest River Forecast Center is forecasting 20 stream gages in western Oregon and Washington to rise above action/bankfull levels over the next 10 days.
- Flooding resulting from heavy rainfall during the first AR is most likely to occur in western Washington and northwestern Oregon Wed 18 Dec into Thu 19 Dec.
- Another round of high streamflow and flooding is possible next week in due to additional precipitation from subsequent landfalling ARs.

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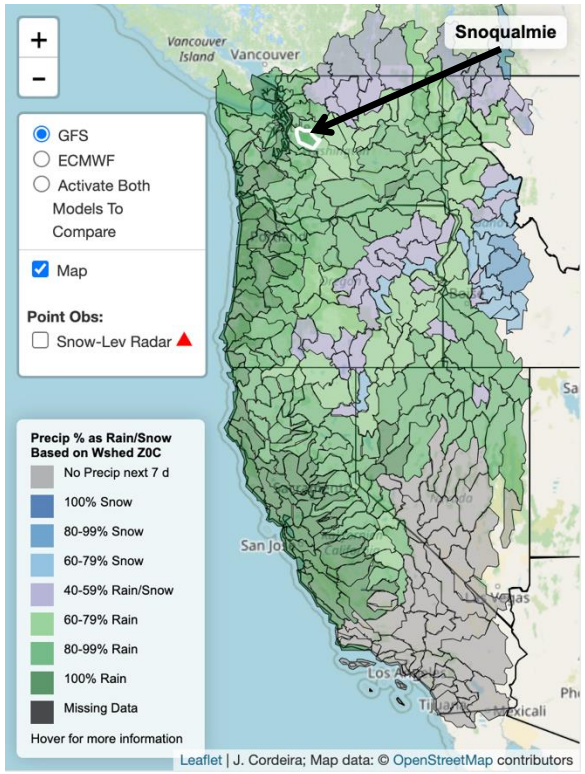
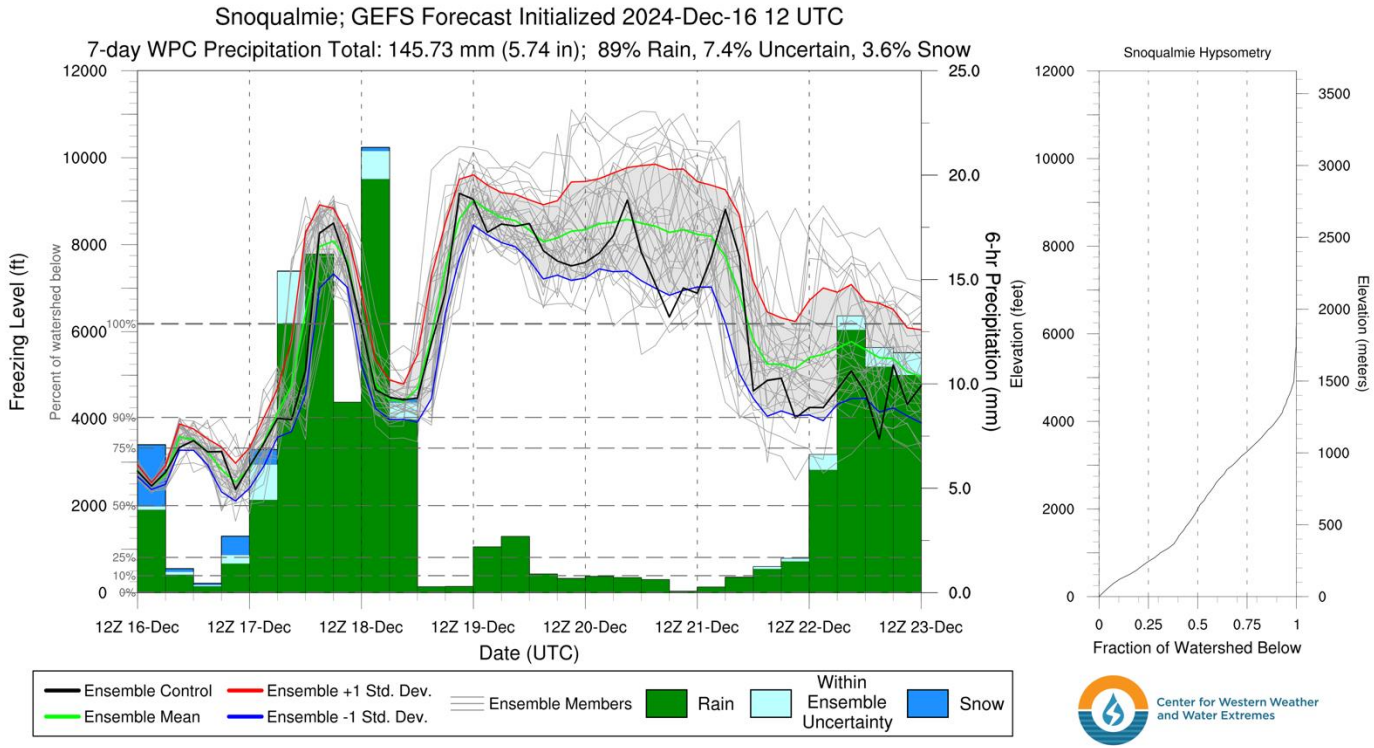
Watershed Freezing Level Forecasts





- Freezing levels over the Pacific Northwest are expected to rapidly rise after the first AR makes landfall.
- The 12Z GEFS is forecasting the freezing level in the Snoqualmie watershed to rise from below 3,000 feet early tomorrow morning to above 7,000 feet by tomorrow evening.
- High freezing levels will result in a significant portion of the precipitation falling as rain and therefore increase the runoff and flood potential during the first AR.

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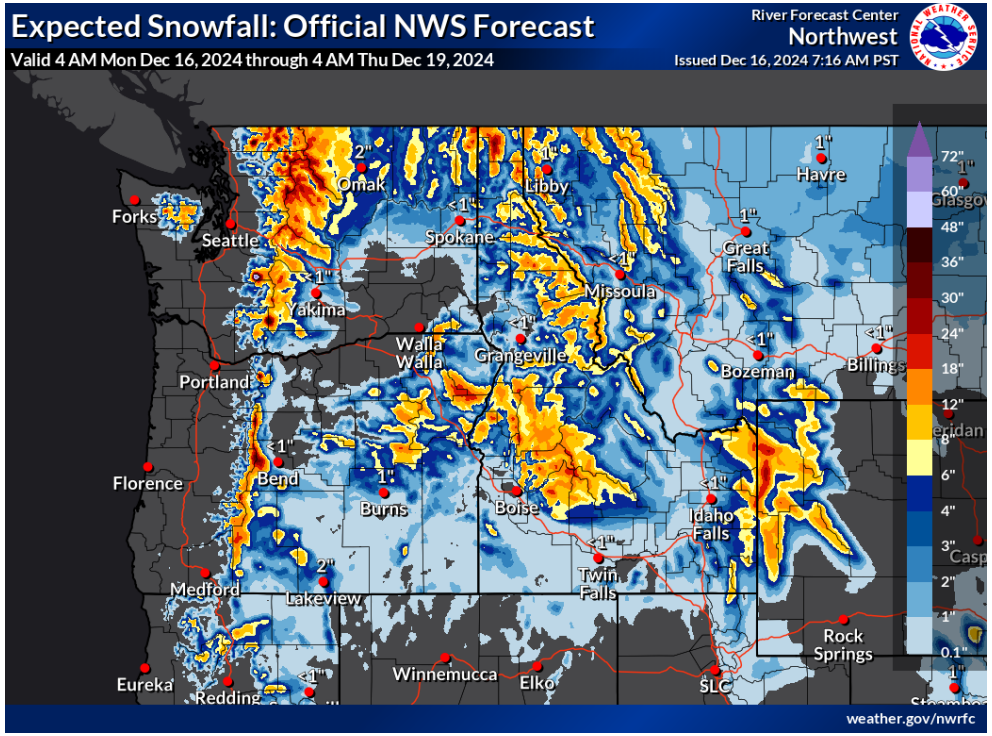
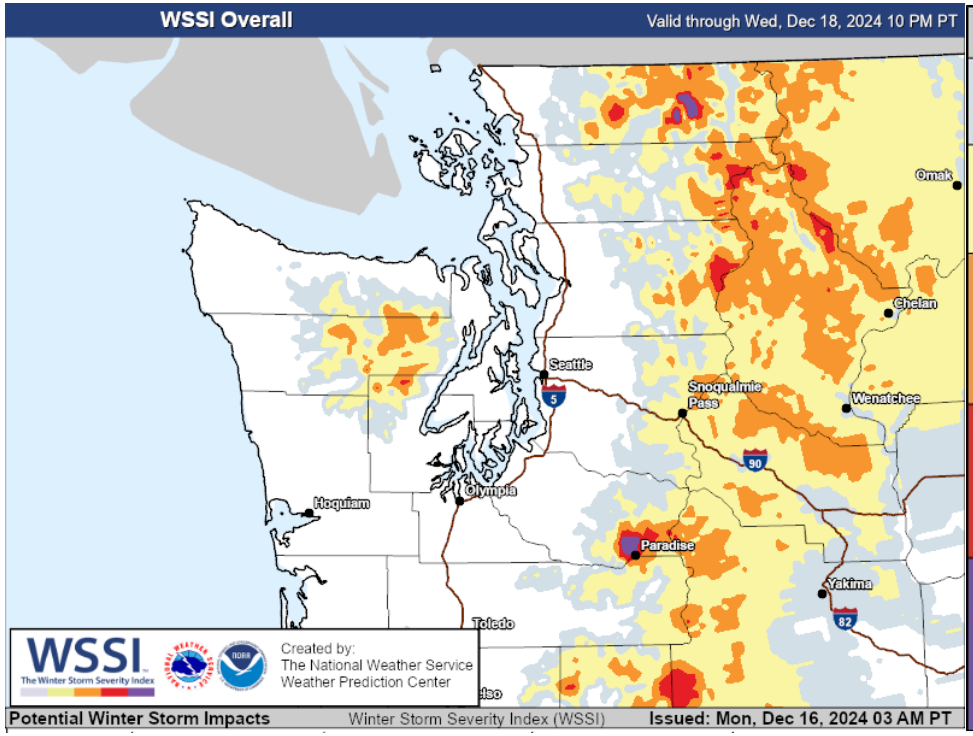
Winter Weather Hazards





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.

- Significant snowfall accumulations (12–30 inches) are forecast above 7,000 feet in the Washington and Oregon Cascades.
- Moderate-to-major winter storm impacts are expected in these areas.