

# CW3E Atmospheric River Outlook: 24 Jan 2024

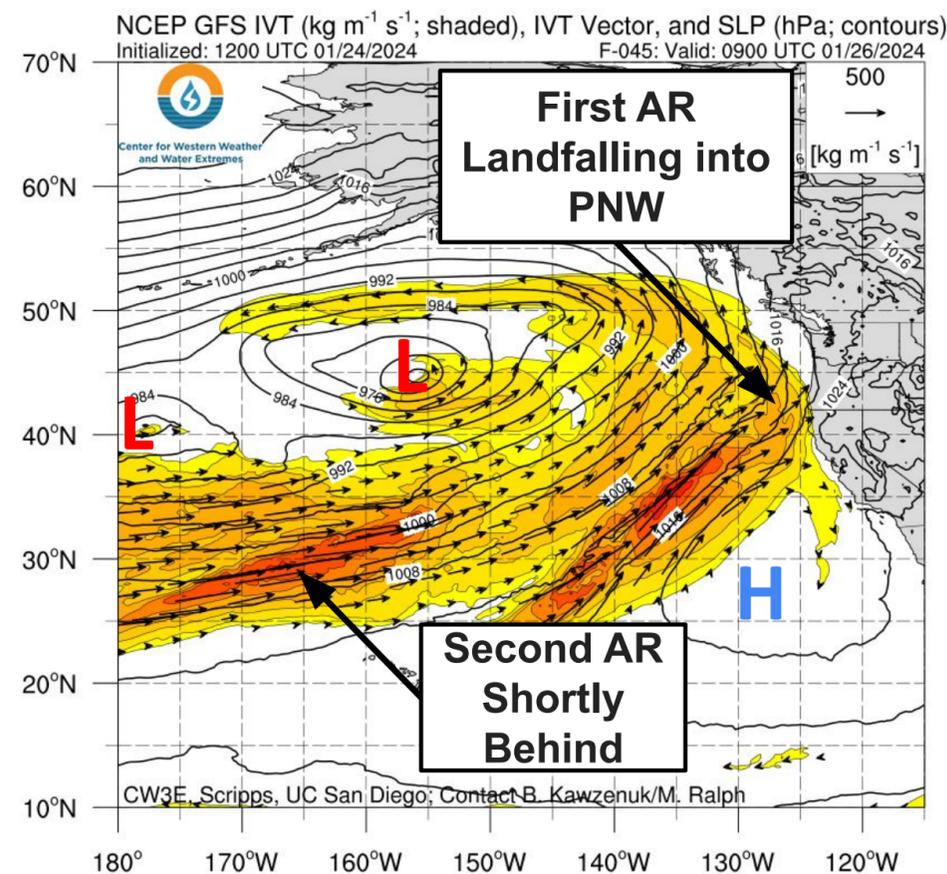
## Active Weather Forecast to Continue into Early February for US West Coast

- An active weather pattern for the US West Coast is forecast to continue through Tue 30 Jan and potentially beyond.
- The **first AR** period begins early Fri 26 Jan as an AR makes landfall into the PNW. This AR kicks off a period of AR conditions in the PNW and Northern California expected to continue through Tue 30 Jan.
- The **second AR** is forecast to make landfall early Sun 28 Jan into the PNW, continuing AR conditions in the region.
- The **third, strongest AR** is forecast to make landfall into British Columbia and the PNW toward the end of this AR period on Tue 30 Jan.
- **All three ARs** are forecast to bring precipitation to the USWC, with the heaviest rainfall expected from the **first and second ARs** over CA/OR border and into the PNW with the **third AR**.
- The WPC Excessive Rainfall Outlook indicates a Marginal Risk (level 1 of 4, or at least 5% chance) for flooding in days 3 through 5 (24-hour periods ending 4 AM PT Sat 27 Jan, Sun 28 Jan and Mon 29 Jan) along the PNW coast and over the Olympic Peninsula.
- The **third AR** is forecast to progress down the USWC and potentially bring impacts to much of the Western US. The Climate Prediction Center (CPC) has already indicated a moderate risk for **heavy precipitation, heavy snow,** and **high winds** for regions in the Western US and possible flooding along the CA coast and in AZ for Jan 31 through Feb 5.

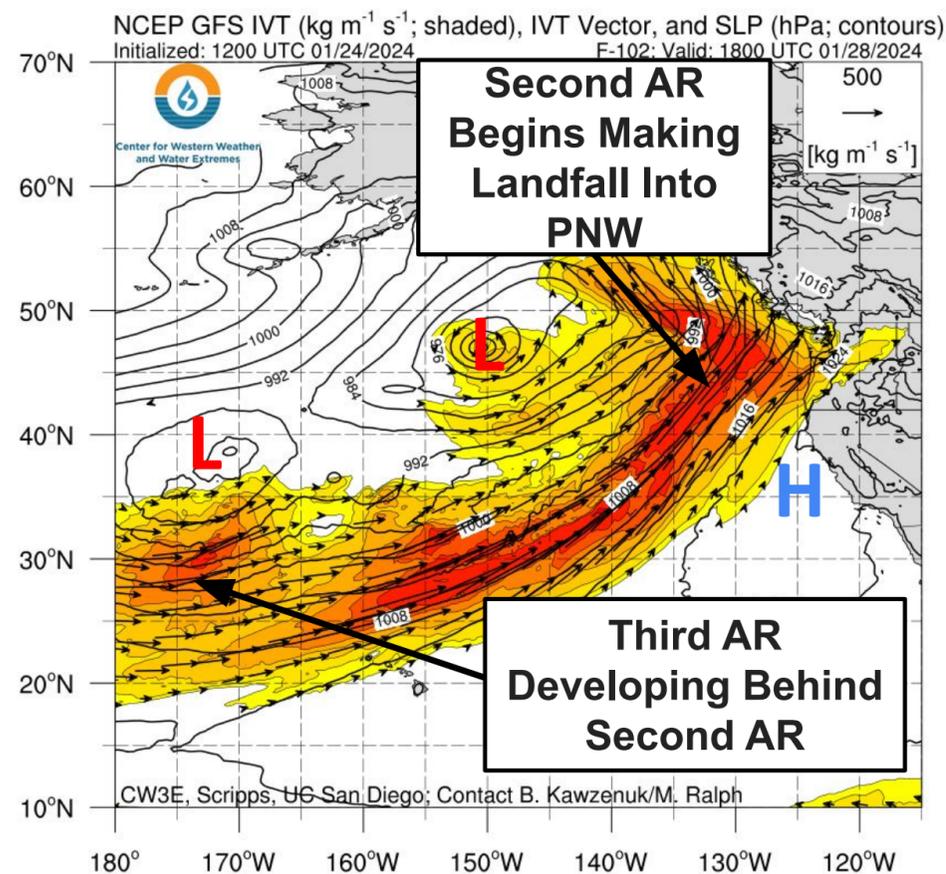
# CW3E AR Outlook: 24 Jan 2024

GFS Init 12Z Wed 24 Jan 2024

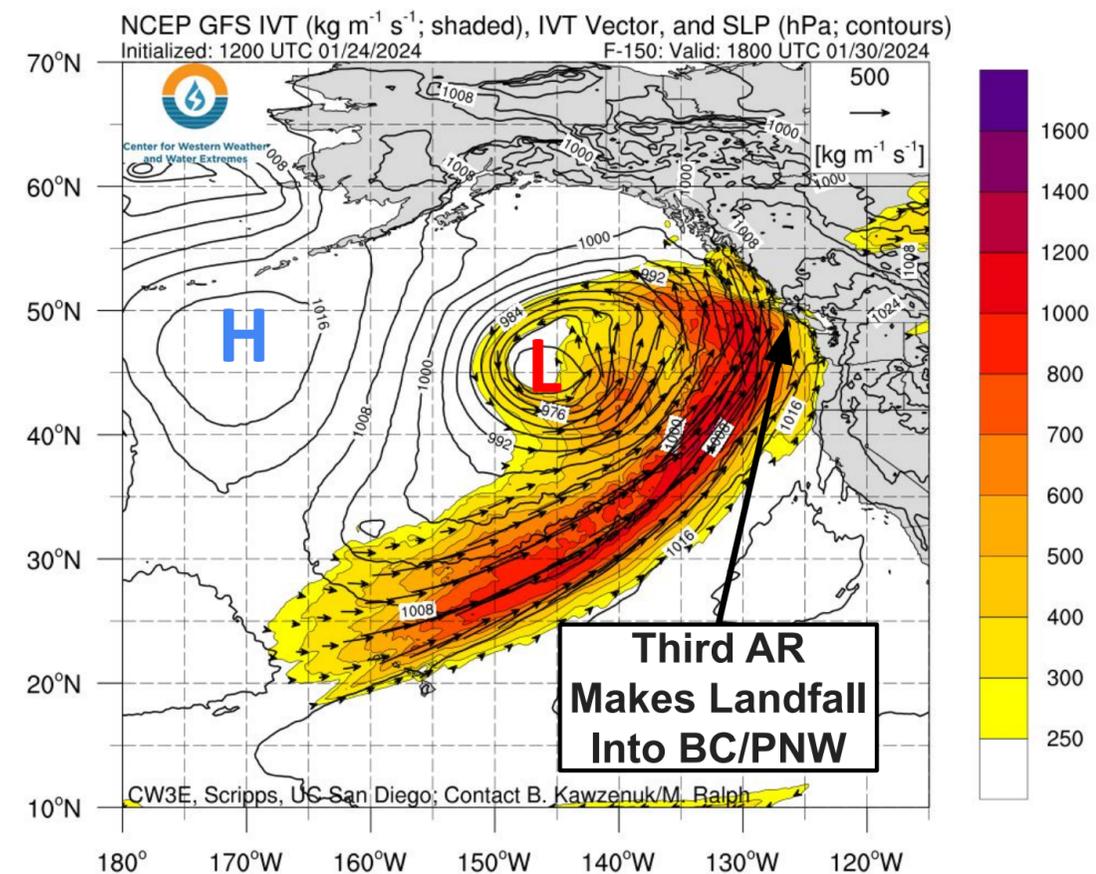
1AM PT Fri 26 Jan 2024



10AM PT Sun 28 Jan 2024



10AM PT Tue 30 Jan 2024

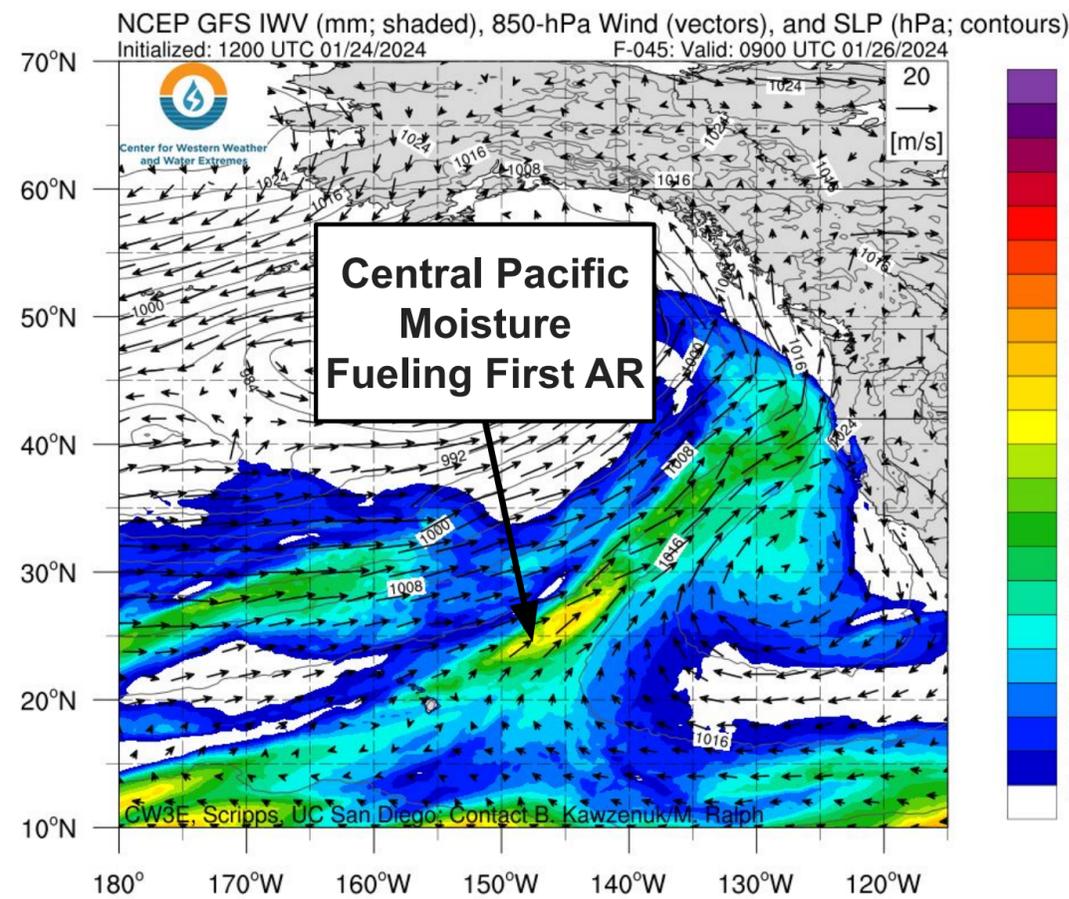


- The first AR is forecast to make landfall early Fri 26 Jan beginning a prolonged period of AR conditions in the PNW and N. CA, as AR conditions are forecast to continue through Tue 30 Jan.
- The second AR and low pressure system are forecast to form in the NE Pacific shortly behind the first AR and propagate toward the USWC through Sat 27 Jan before making landfall in the PNW early Sun 28 Jan.
- Similarly, a third AR develops with a low pressure system behind the second AR, eventually making landfall into BC and the PNW on Tue 30 Jan.
- The third AR is forecast to be stronger than the first two and will likely bring widespread impacts to the Western US into early February.

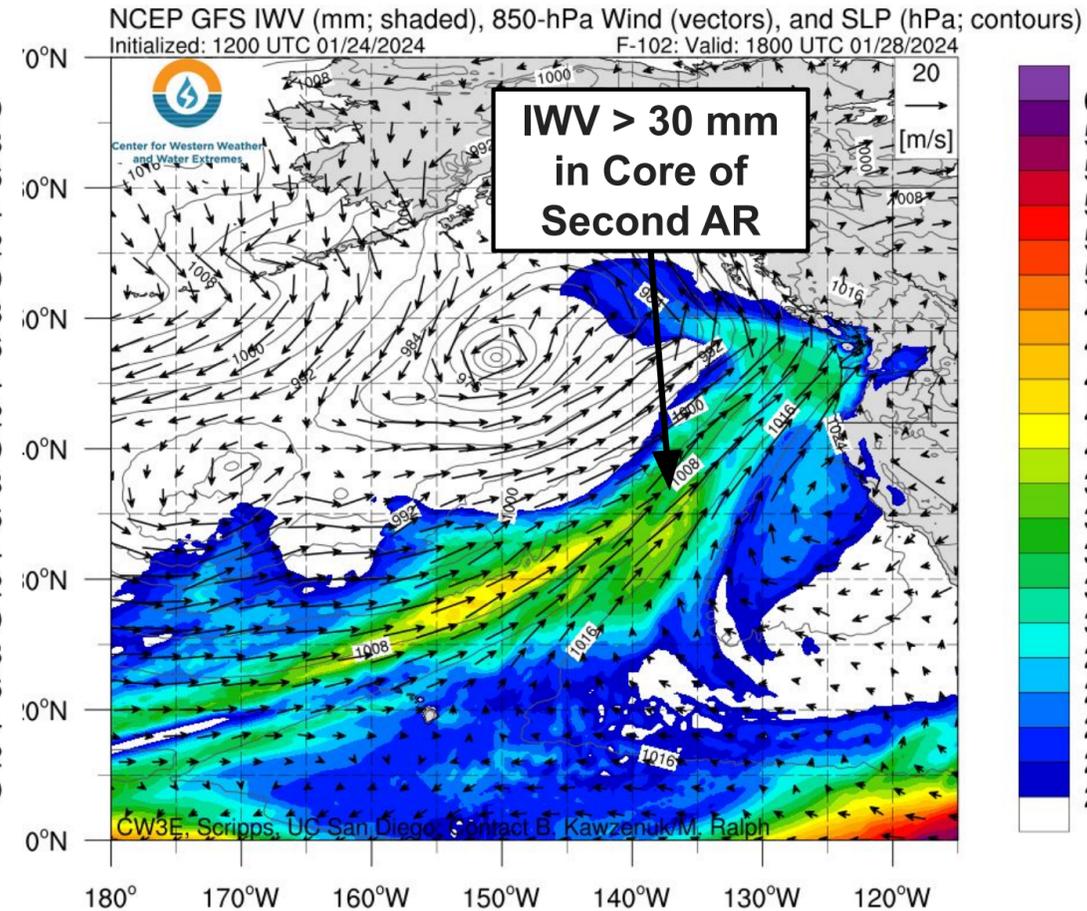
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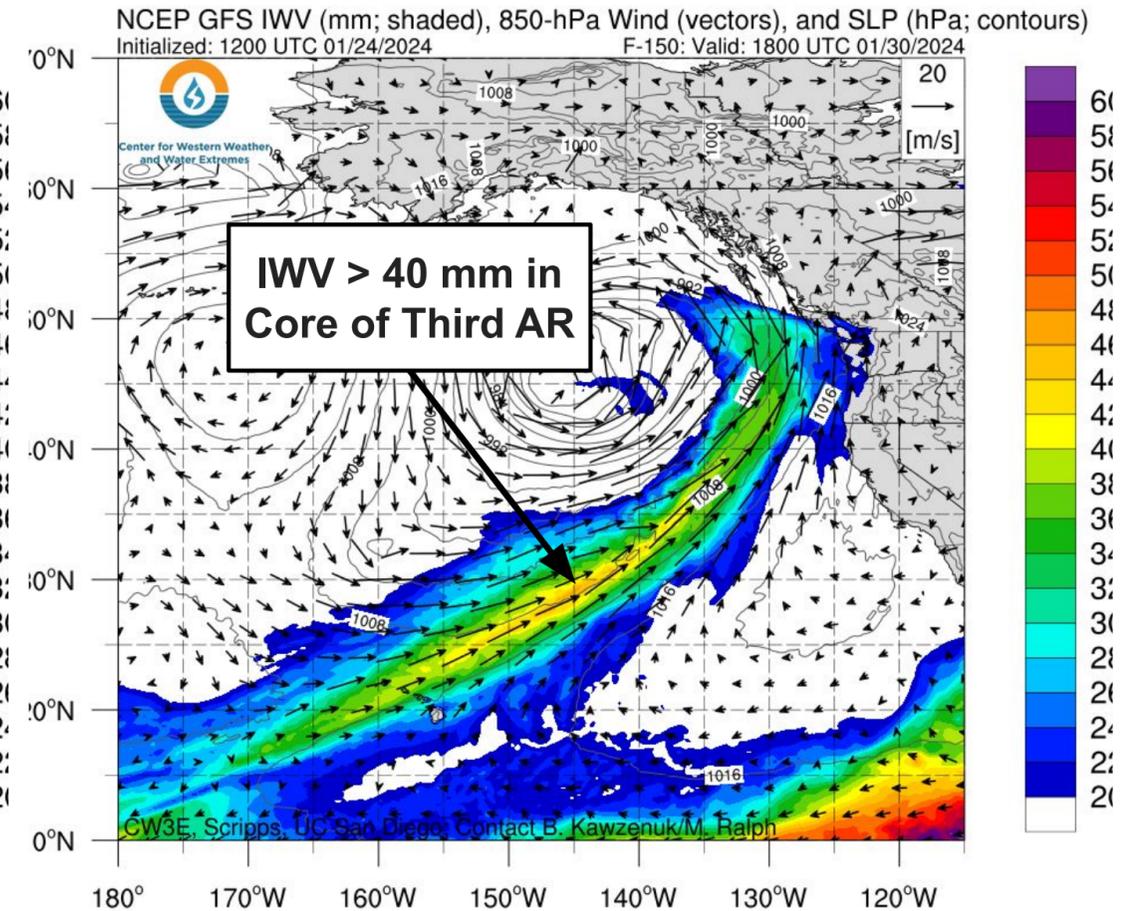
1AM PT Fri 26 Jan 2024



10AM PT Sun 28 Jan 2024



10AM PT Tue 30 Jan 2024



- This sequence of ARs is fueled by tropical moisture out of the Central Pacific.
- The first AR will bring tropical moisture into OR and N. CA at landfall whereas the second and third ARs are forecast to bring higher IWV to the PNW coast.

# CW3E AR Outlook: 24 Jan 2024

## ECMWF EPS 7-day AR Scale and IVT Forecast

ECMWF Ensemble Initialized: 00Z Wed 01/24/24

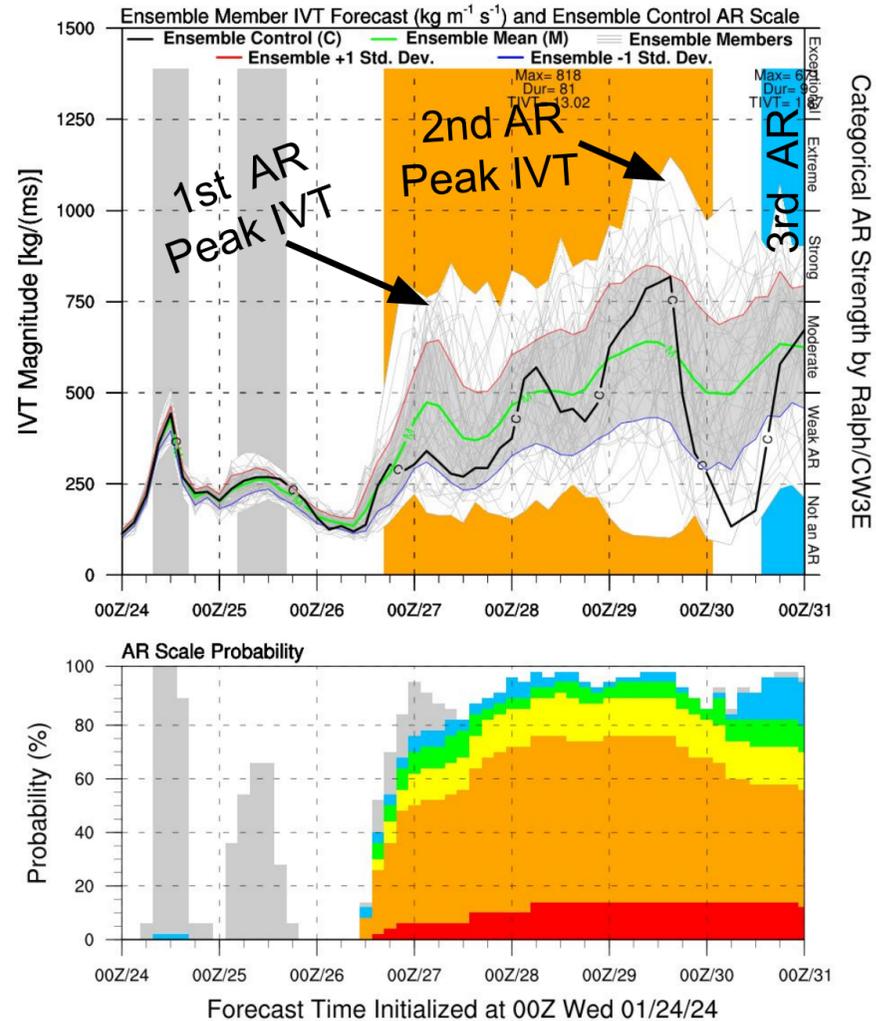
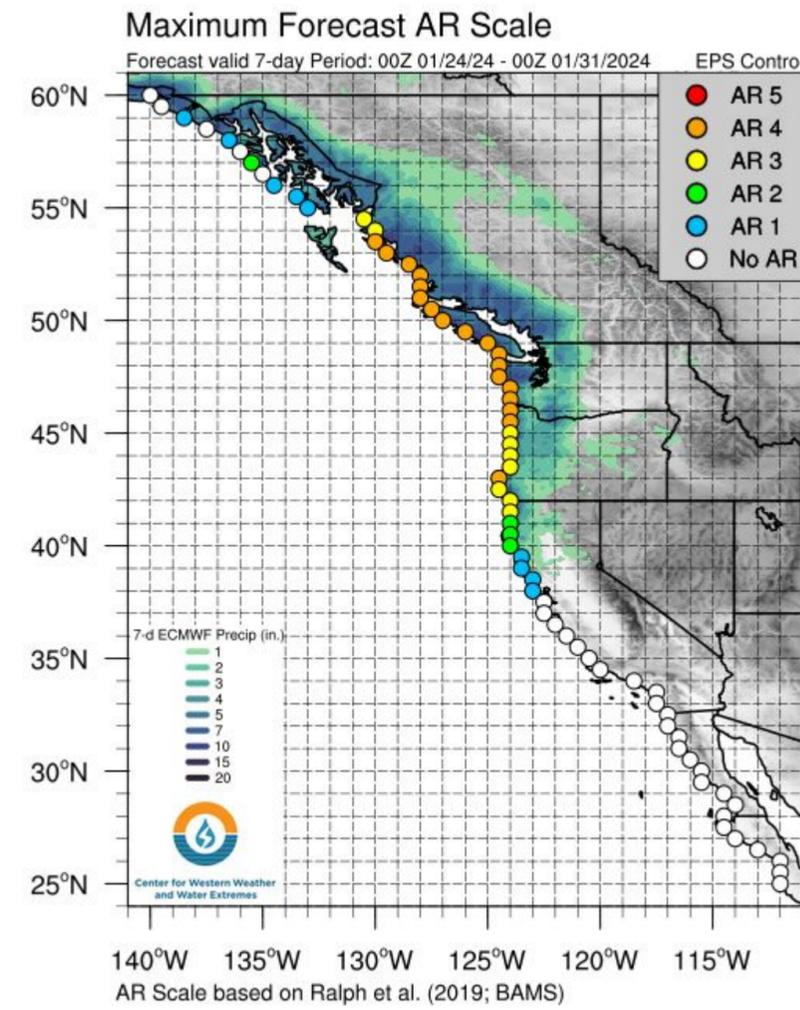
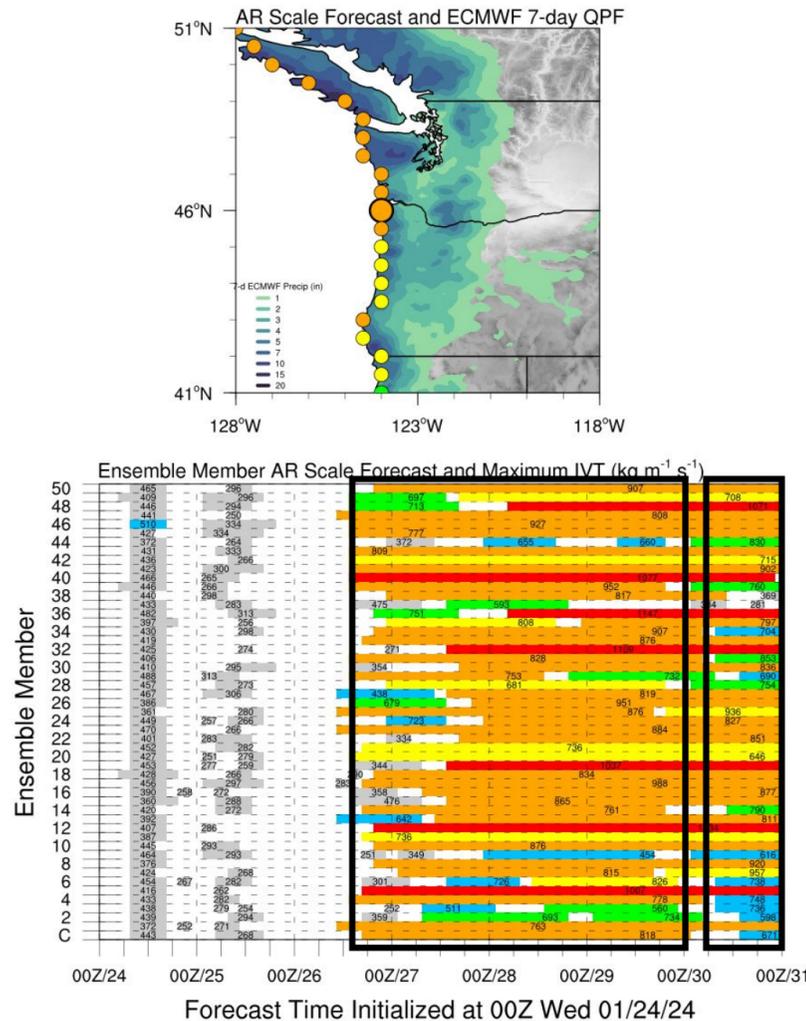


Image created: 15 UTC 01/24/2024

AR 1 AR 2 AR 3 AR 4 AR 5

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

Location: 46°N 124°W



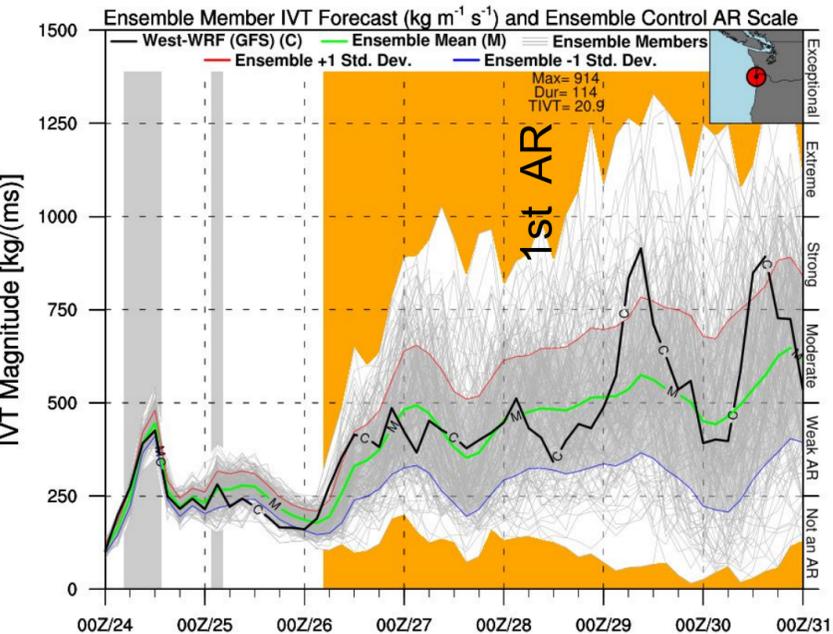
- The ECMWF EPS control member is forecasting multiple ARs for the point at 46° N, 124° W (WA/OR border) during the next 7 days.
- 46/51 (90%) EPS ensemble members are forecasting at least AR3 conditions during the **first, second and third ARs** for Jan 27-30.
- The majority of members forecasting an AR3 or greater are forecasting >72 hours of AR conditions at this point.
- There is uncertainty amongst the members on when or if a break in AR conditions will occur during the second AR and between the second and third ARs.

# CW3E AR Outlook: 24 Jan 2024

## West-WRF Ensemble 7-day AR Scale and IVT Forecast

West-WRF Ensemble Initialized: 00Z Wed 01/24/24

Location: 46°N 124°W



Categorical AR Strength by Ralph/CW3E

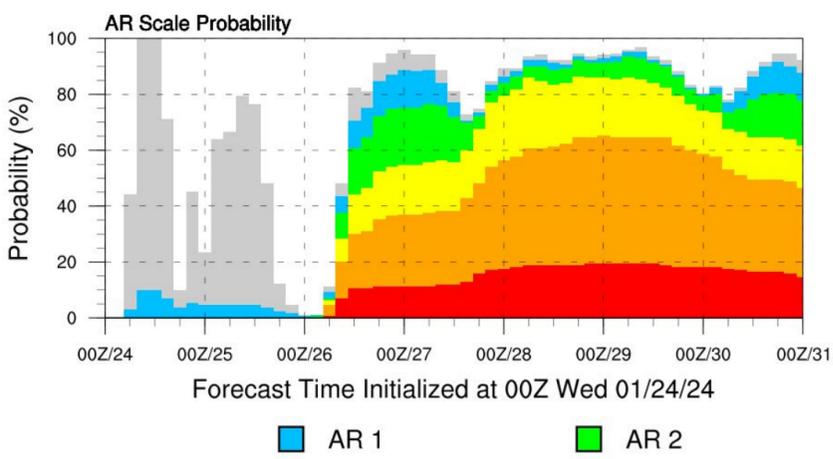
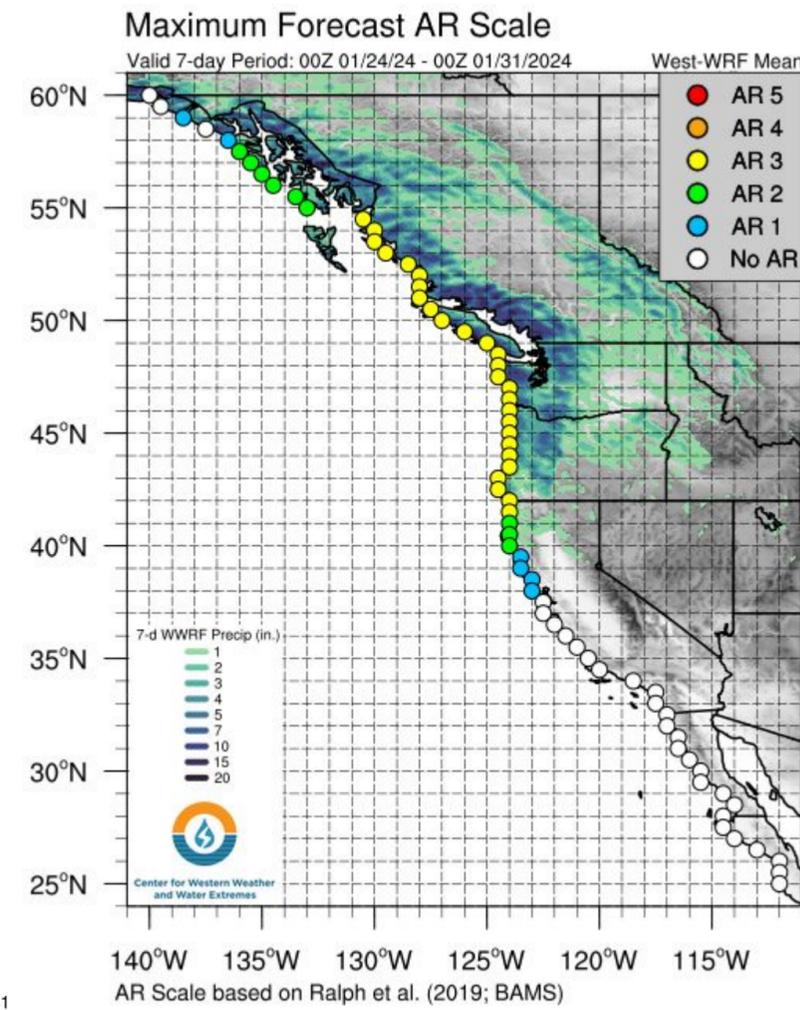
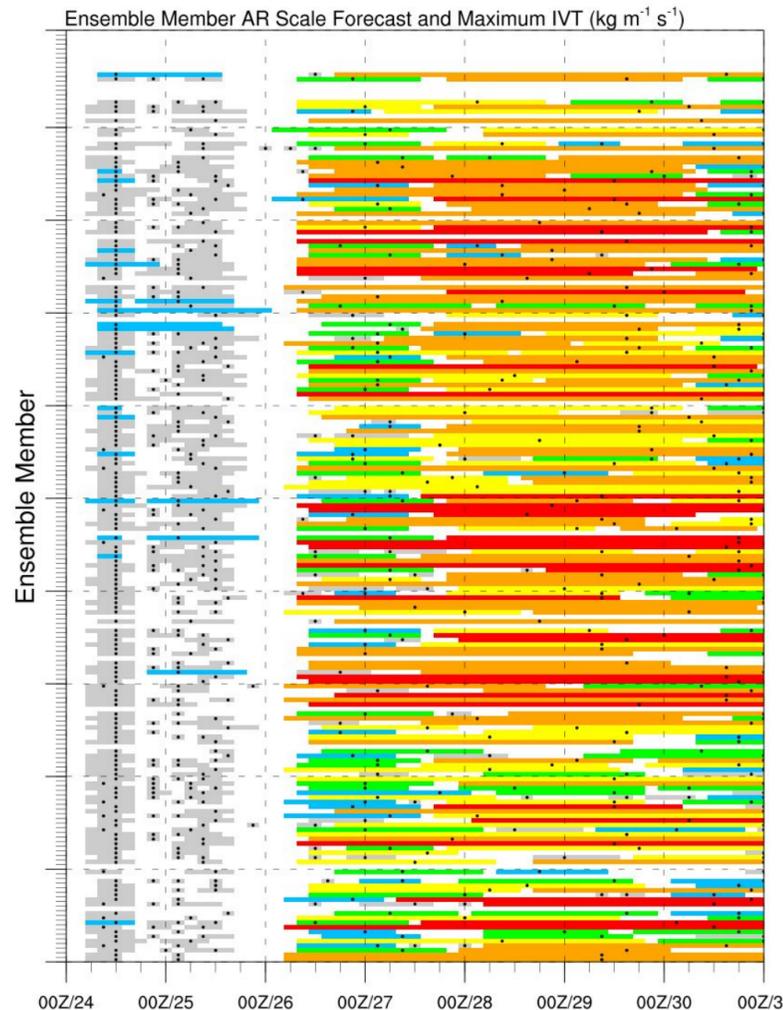
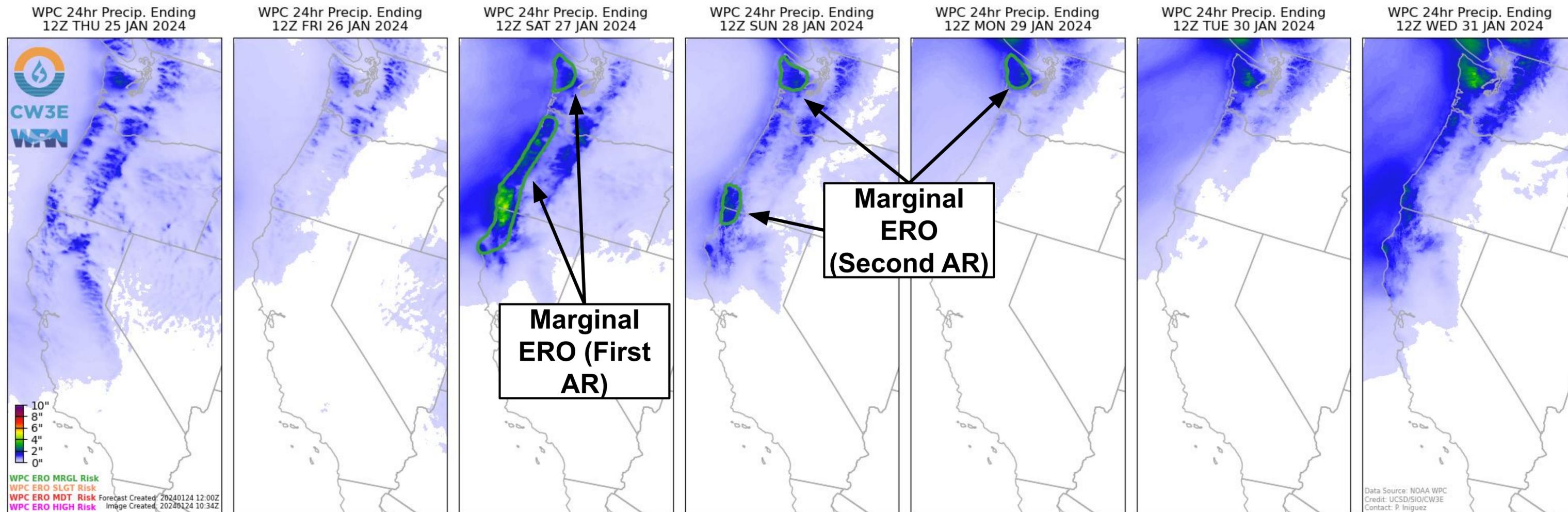


Image created: 14 UTC 01/24/2024

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

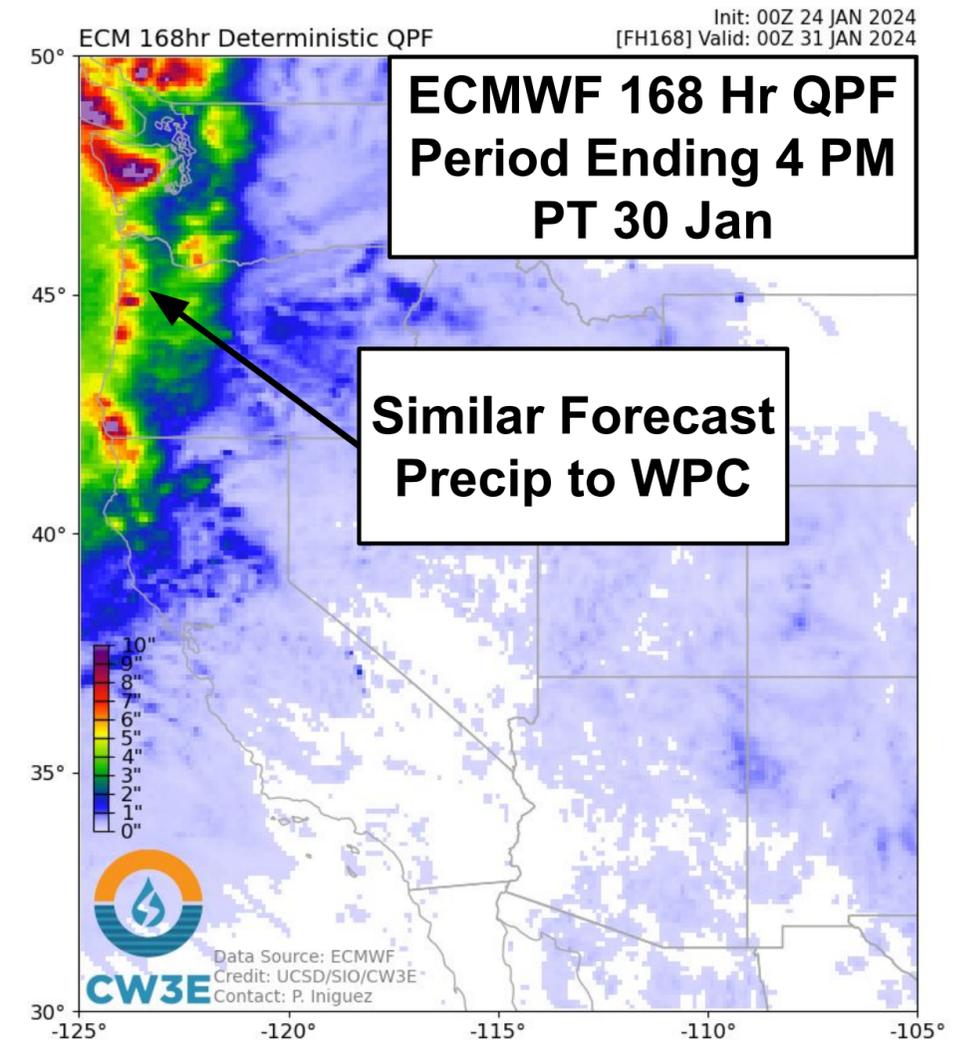
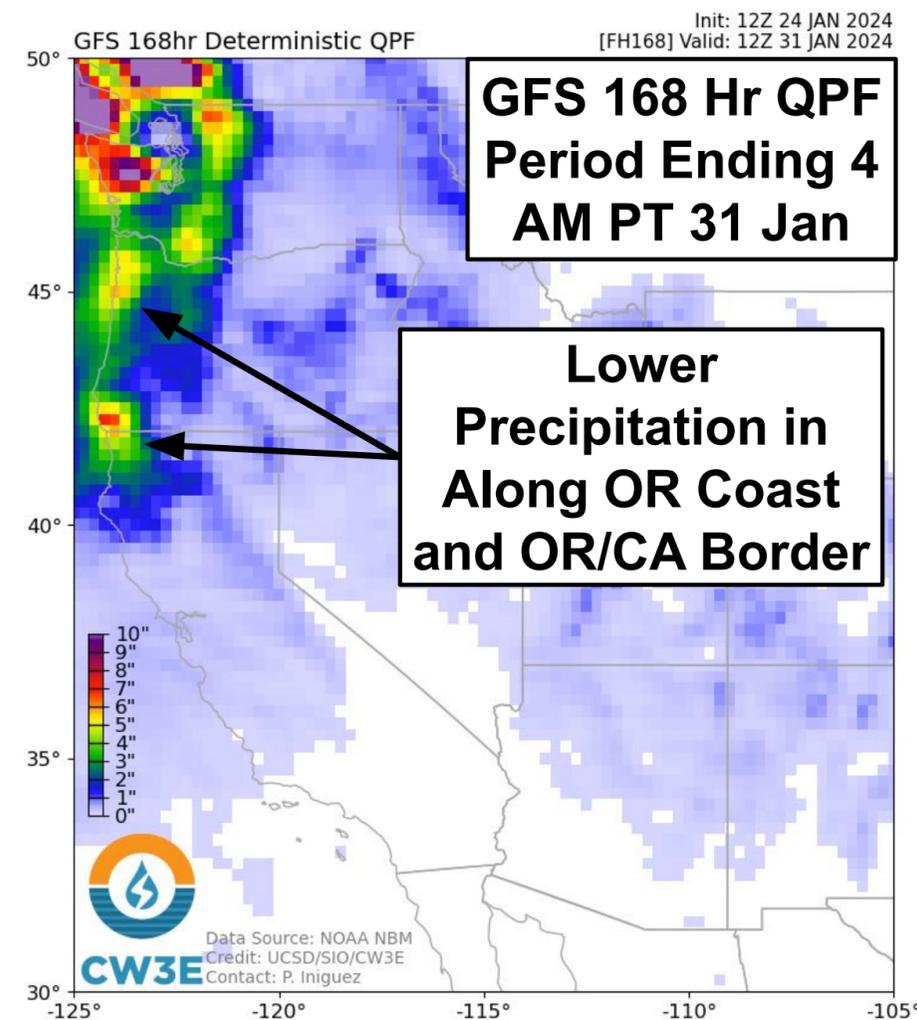
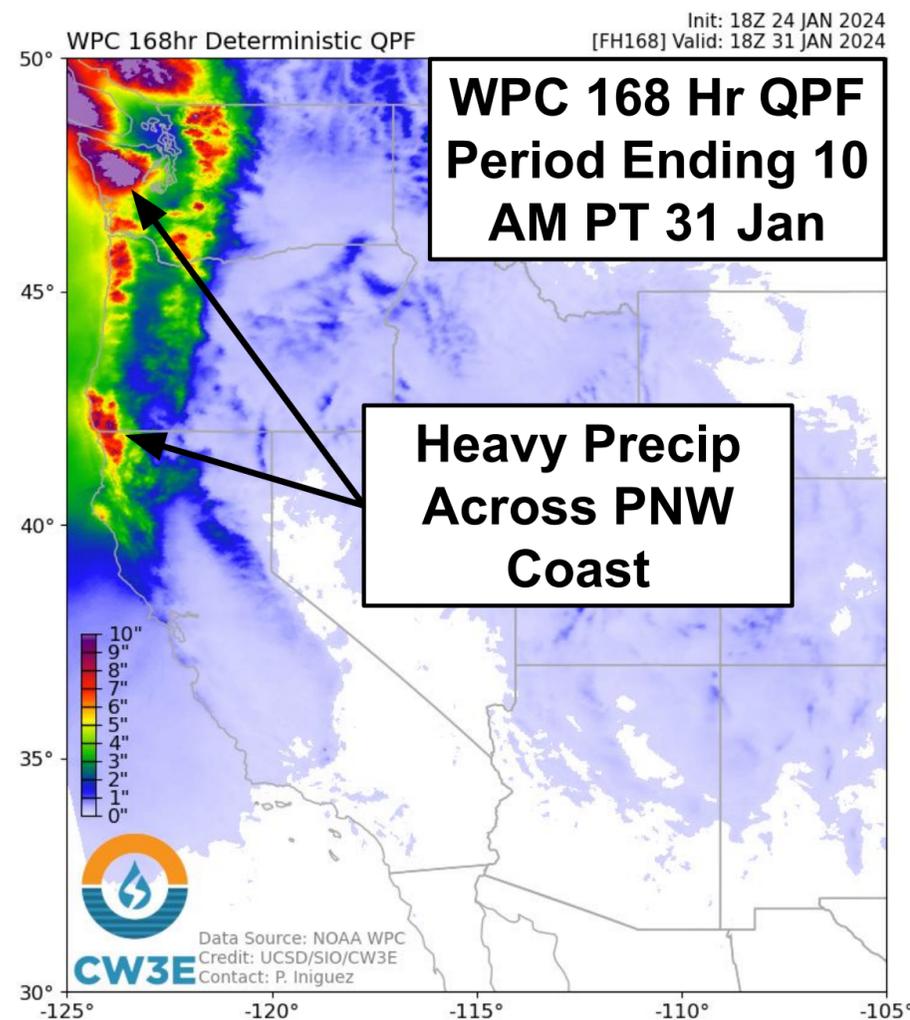
- The West-WRF ensemble control member is forecasting persistent AR conditions for the point at 46° N, 124° W (coastal WA/OR) beginning late 26 Jan and continuing through 30 Jan
- The maximum AR forecast for the West-WRF ensemble mean indicates AR3 conditions from Southern AK through Northern CA.
- There is uncertainty amongst the members as to when or if there will be a break in AR conditions for WA/OR coasts during the **second AR** and between the **second** and **third ARs**.
- More than 60% of ensemble members are forecasting an AR4 or AR5 at this location

# CW3E AR Outlook: 24 Jan 2024



- The NWS WPC is forecasting the heaviest precipitation in the PNW and along the CA/OR border for the **second** and **third** AR (5 day period from 4 AM PT 26 Jan to 4 AM PT 31 Jan).
- Marginal Risks (level 1 of 4, or at least 5% chance) for flooding have been issued for the Olympic Peninsula for the 24-hour periods ending at 4 AM PT on Jan 27-29, along the WA/OR coasts for the period ending on 27 Jan and along the CA/OR border for the periods ending on Jan 27 and 28.

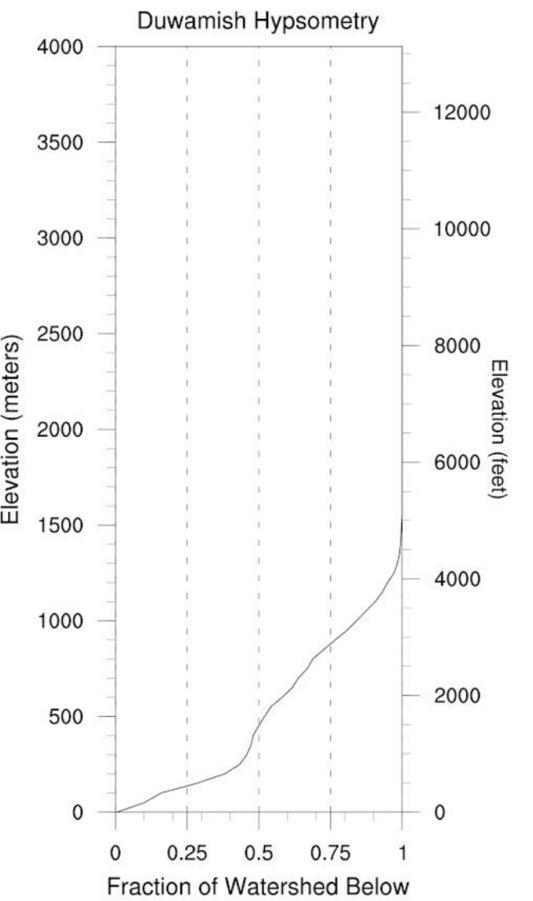
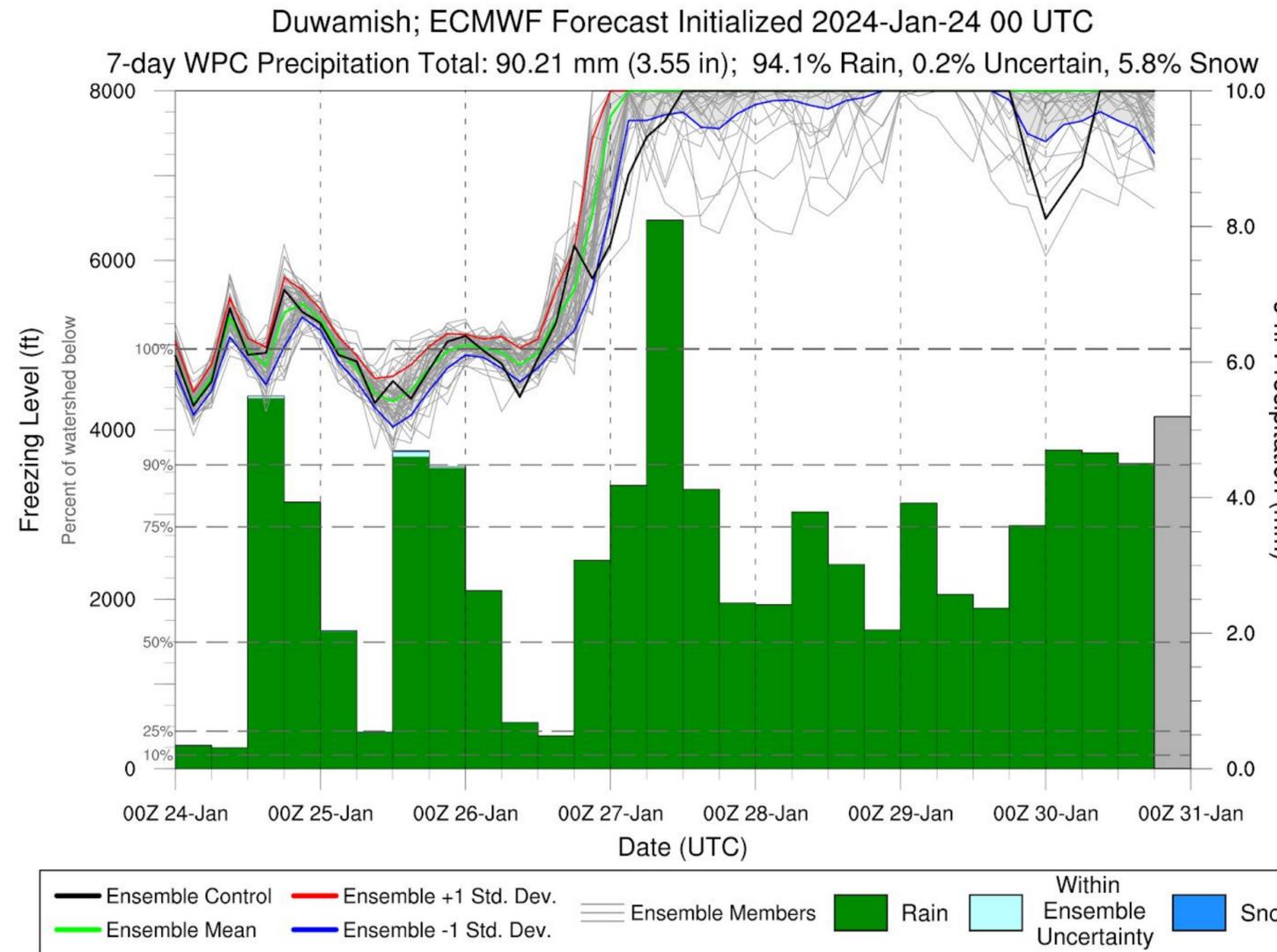
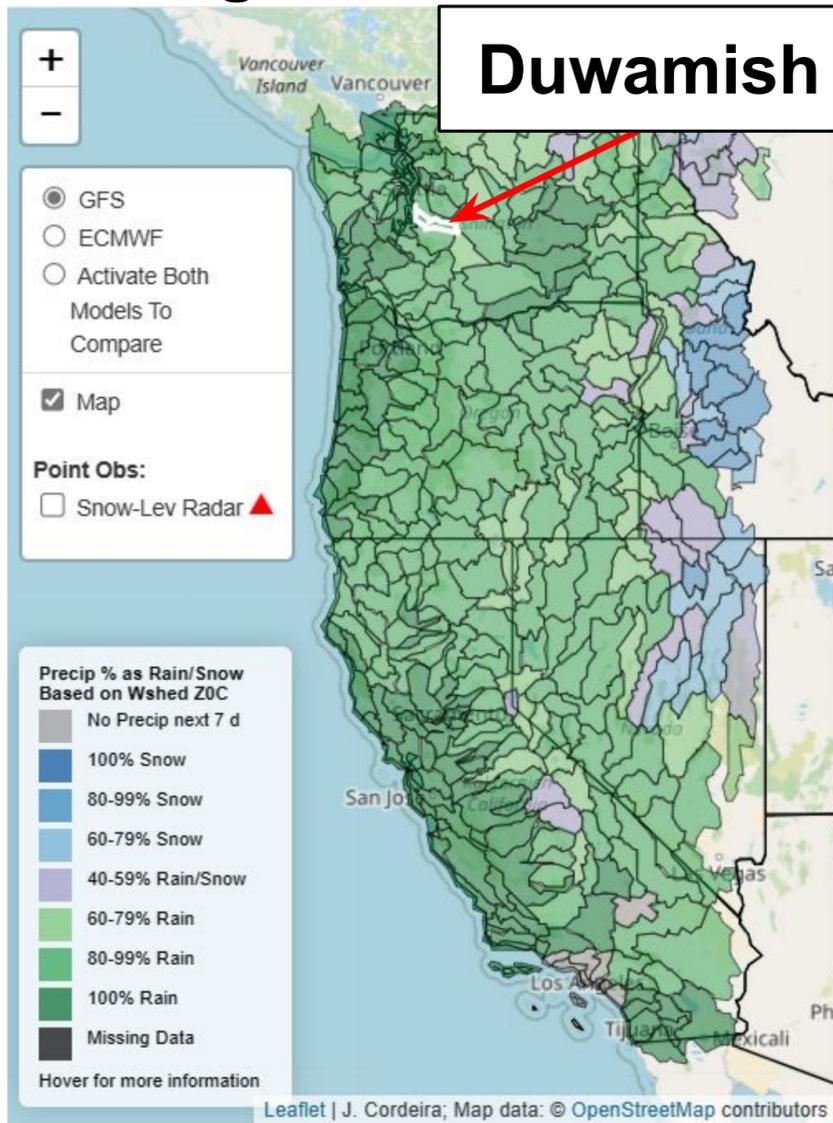
# CW3E AR Outlook: 24 Jan 2024



- WPC, GFS and ECMWF are forecasting the highest 7-day precipitation totals over the Olympic Peninsula, WA Cascades and along the CA/OR border.
- The most noticeable difference in the GFS compared to the WPC and ECMWF is lower forecasted precipitation along the OR coast and in the OR Cascades.

# CW3E AR Outlook: 24 Jan 2024

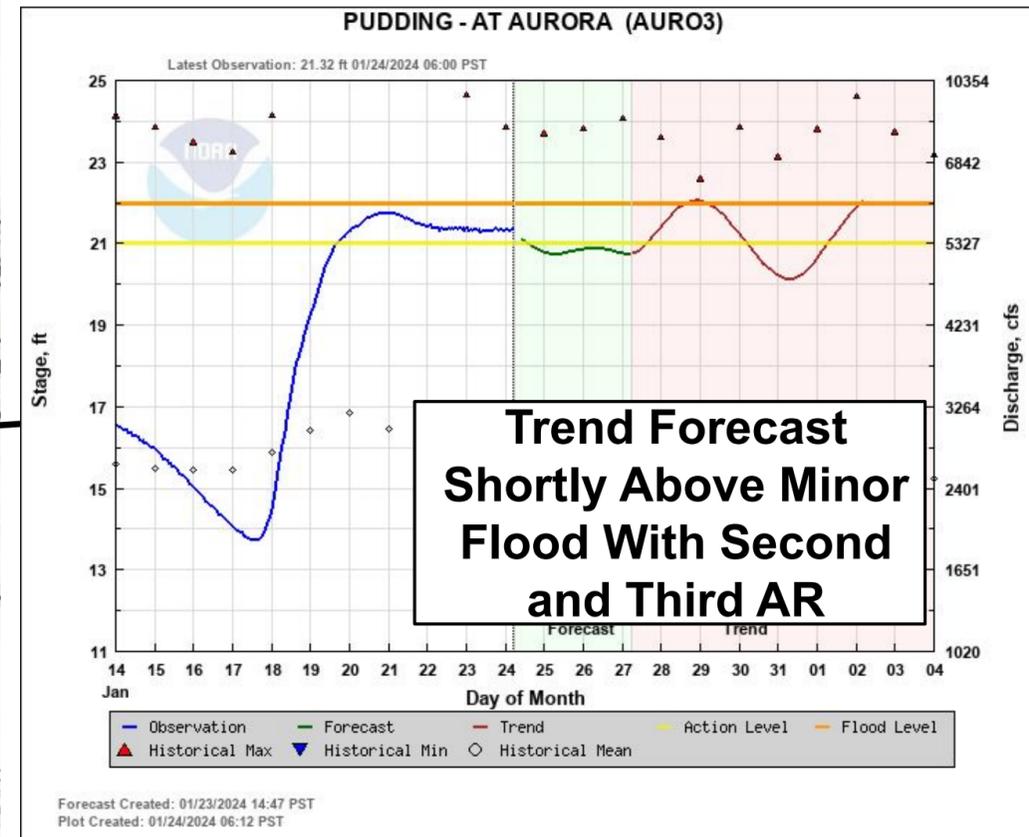
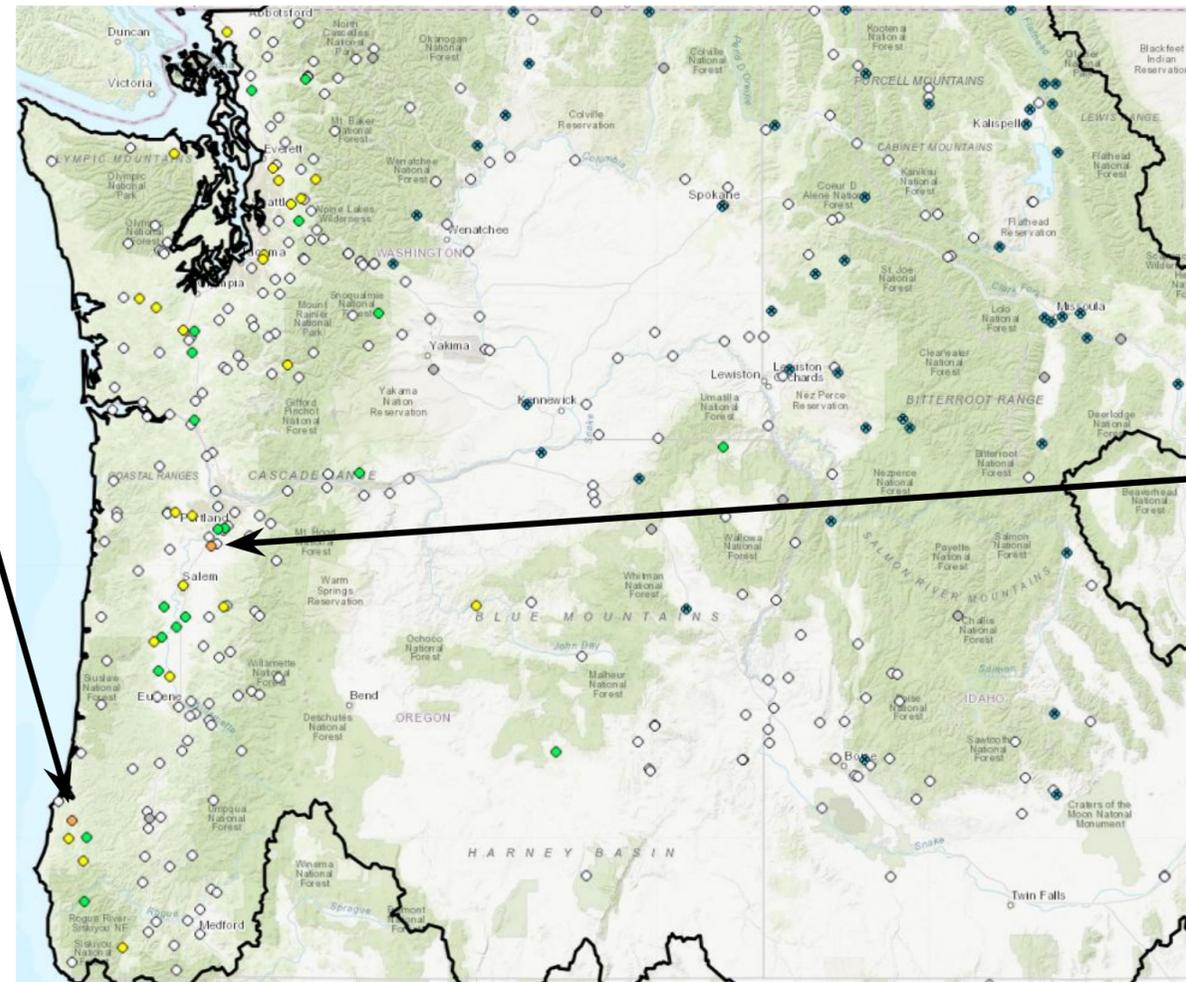
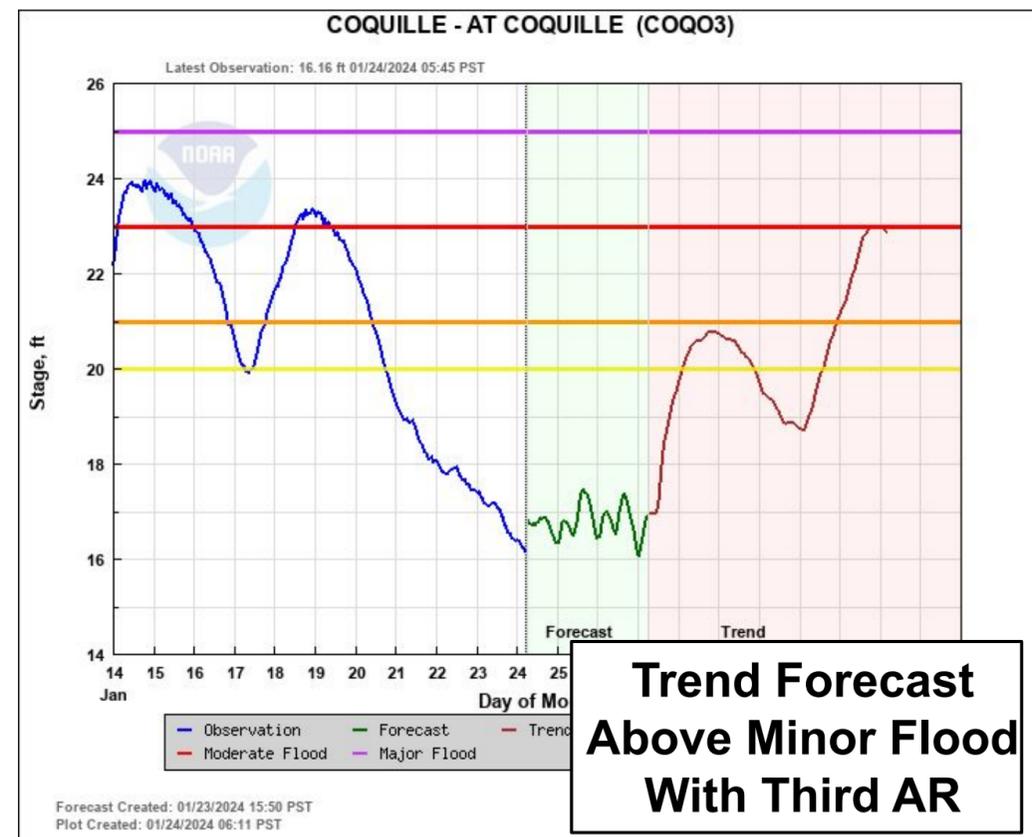
## Freezing Level Forecast



- The freezing level is forecast to remain above ~5000 ft mean sea level (MSL) for the duration of the **first** AR before rising to above ~8000 ft above MSL in the Duwamish watershed.
- The CW3E watershed freezing level tool is forecasting >90% of the precipitation in the Duwamish to fall as rain over the next 7 days.

# CW3E AR Outlook: 24 Jan 2024

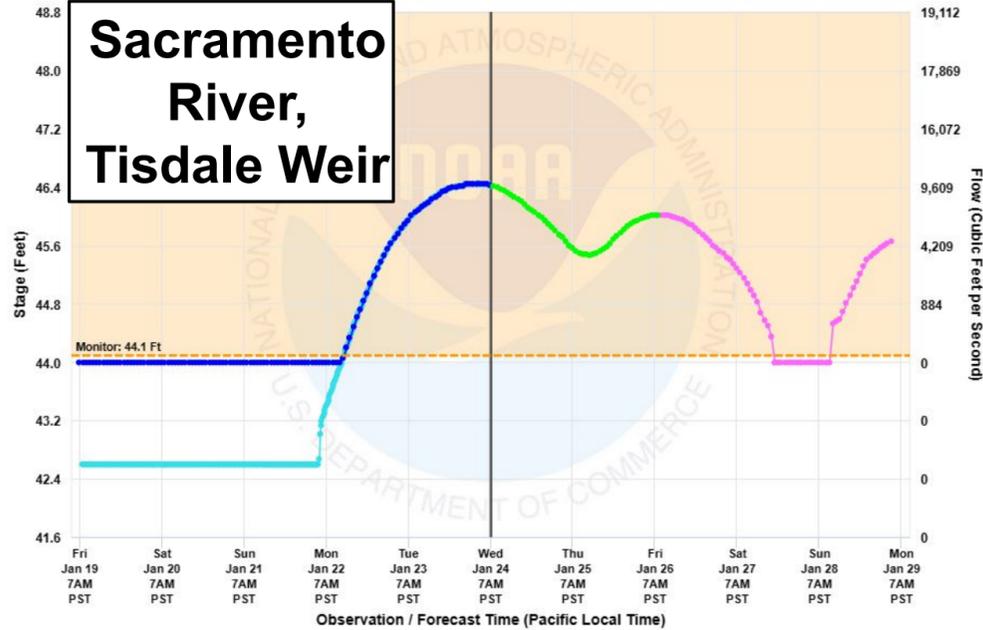
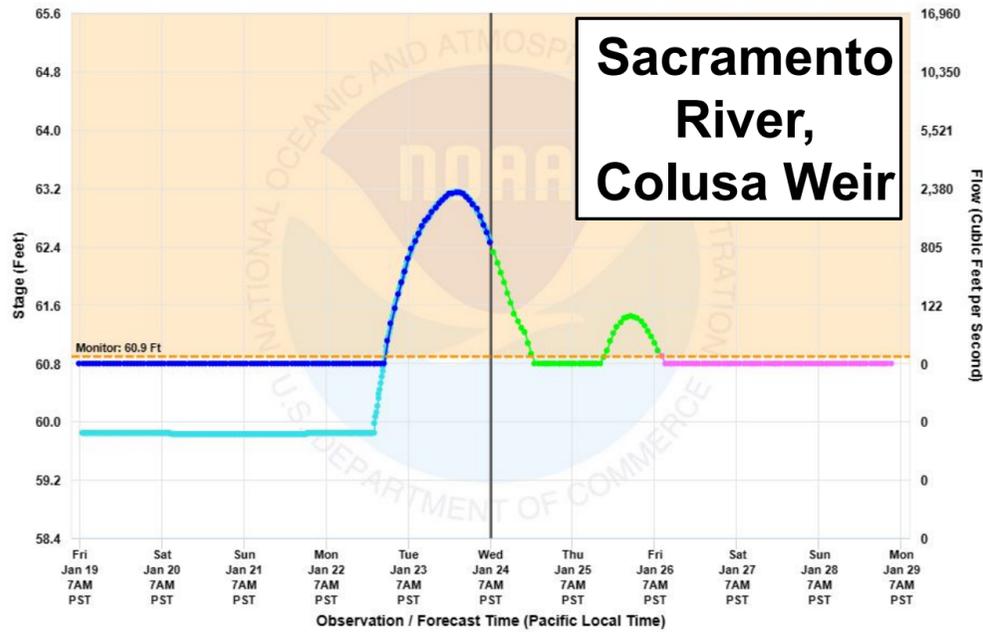
## NWS NWRFC River Stage Forecast



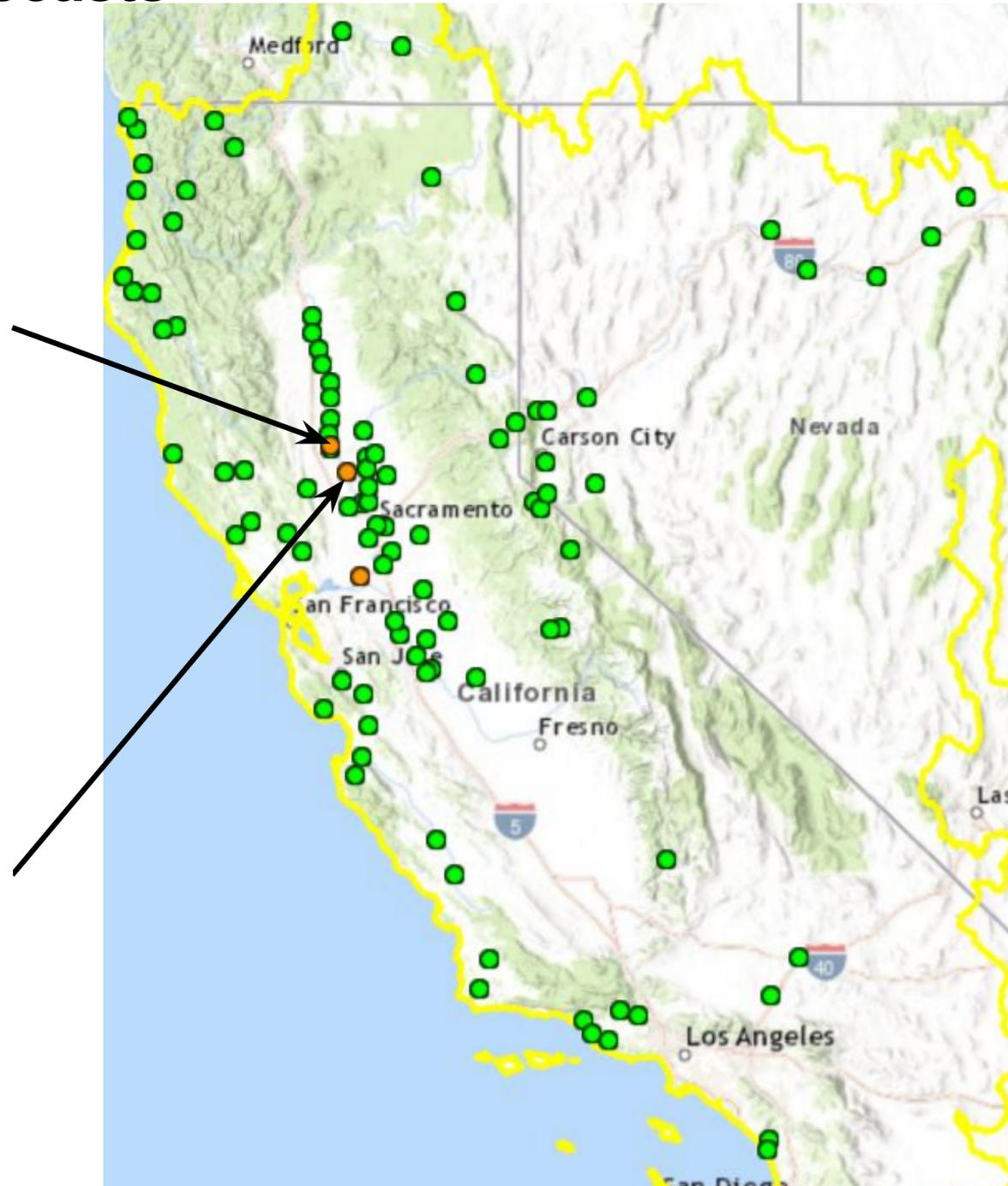
- Rivers across the Pacific Northwest are forecast to steadily rise as a result of the heavy precipitation associated with the **second** and **third** ARs.
- The NWRFC is currently forecasting 19 stream gages to reach bankfull stage and two stream gages to exceed minor flood stage (Coquille River at Coquille on left and Pudding River at Aurora on right), primarily along the WA and OR coasts.
- The station at Coquille has a chance to reach the moderate flood stage during the **third** AR.

# CW3E AR Outlook: 24 Jan 2024

## NWS CNRFC River Stage Forecasts



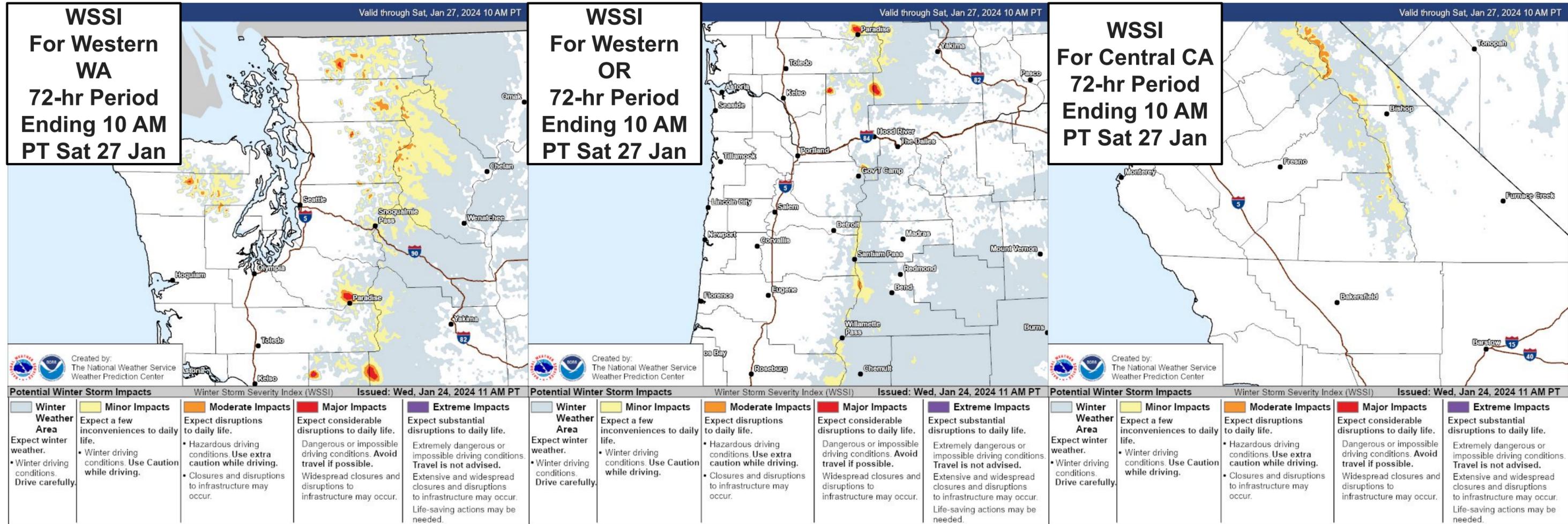
NOAA / NWS / California Nevada River Forecast Center • California Department of Water Resources  
 — Observed (Raw Gauge) — Observed (Simulated) — Forecast — Guidance



- River stages in CA are forecast to rise as a result of the precipitation associated with the first and early portions of the second AR.
- However, the currently forecasted rises in river stage does not approach monitor stage for the majority of CNRFC stream gages.
- CNRFC is currently forecasting 3 gages to exceed monitor stage, all within the Sacramento Valley.
- The Colusa Weir (top left) reached monitor stage late Mon Jan 22 and is forecast to stay above until late Wed Jan 24 with another rise late Thu Jan 25, while the Tisdale Weir (bottom left) will remain above Monitor Stage until late Sat Jan 27.

# CW3E AR Outlook: 24 Jan 2024

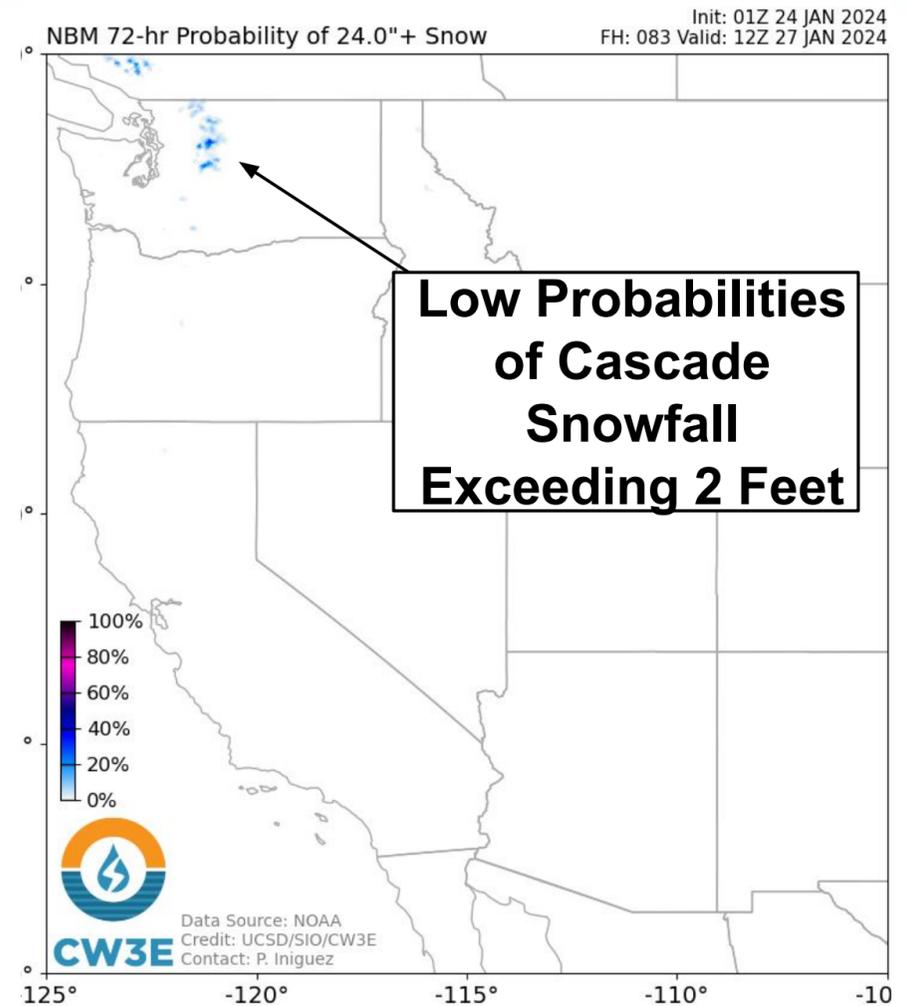
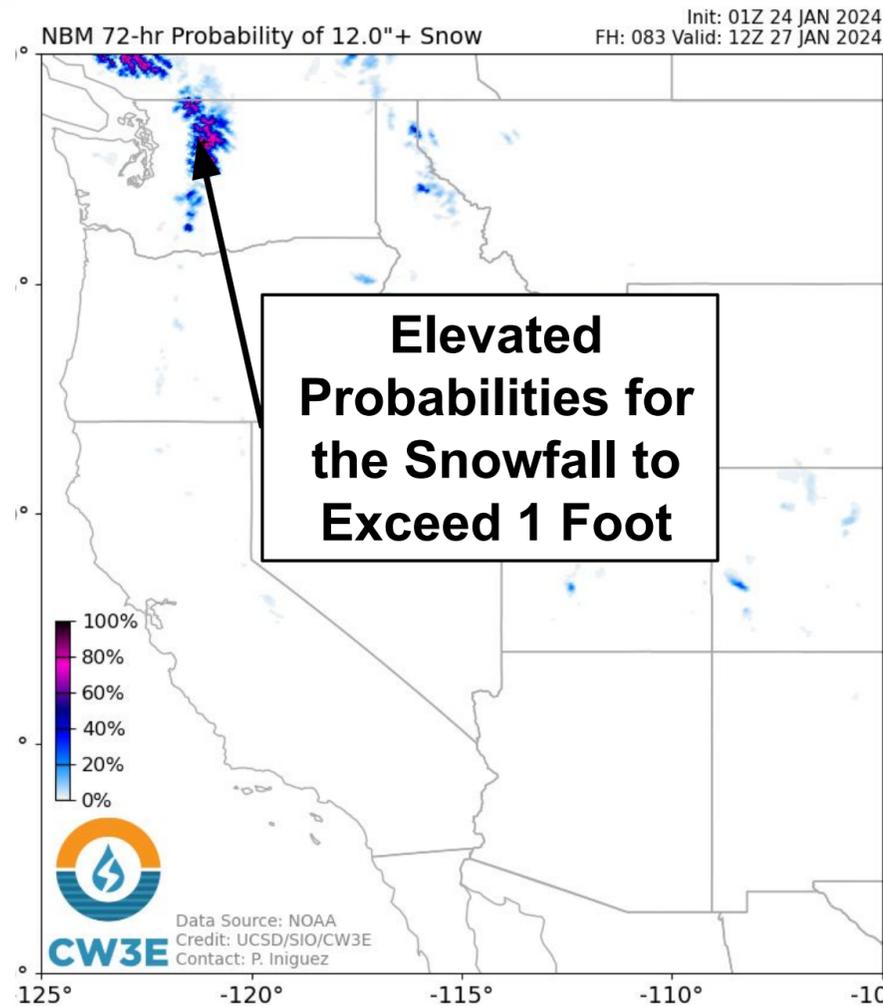
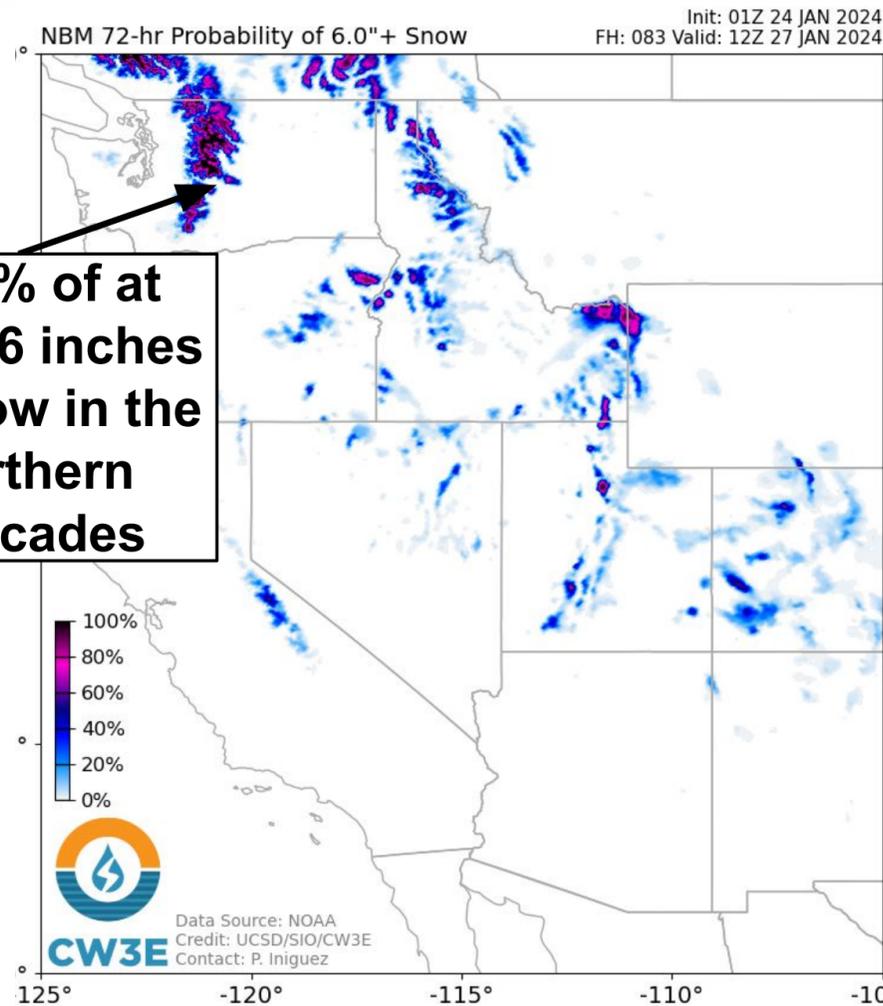
## WPC Winter Storm Severity Index (WSSI)



Source: WPC; <https://www.wpc.ncep.noaa.gov/wwd/wssi/wssi.php>

- WPC WSSI for the 3-day period ending at 4 AM PT Sat 27 Jan highlights likelihood for **minor impacts** for parts of the Cascades, Sierra Nevada and over the Olympic Peninsula with the **first AR**.
- For the same time period there are isolated regions of **moderate and major impacts** along the mountains.

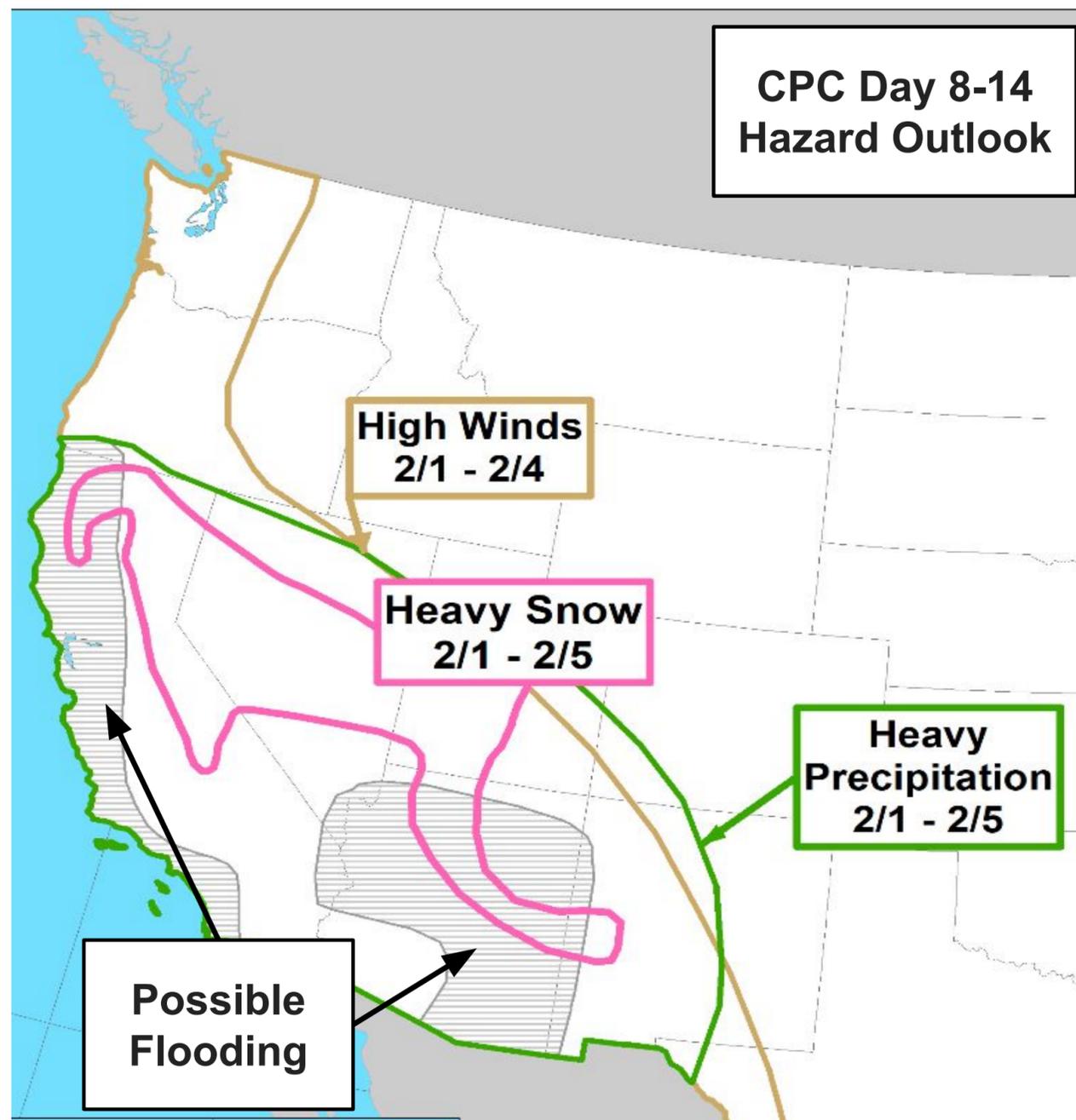
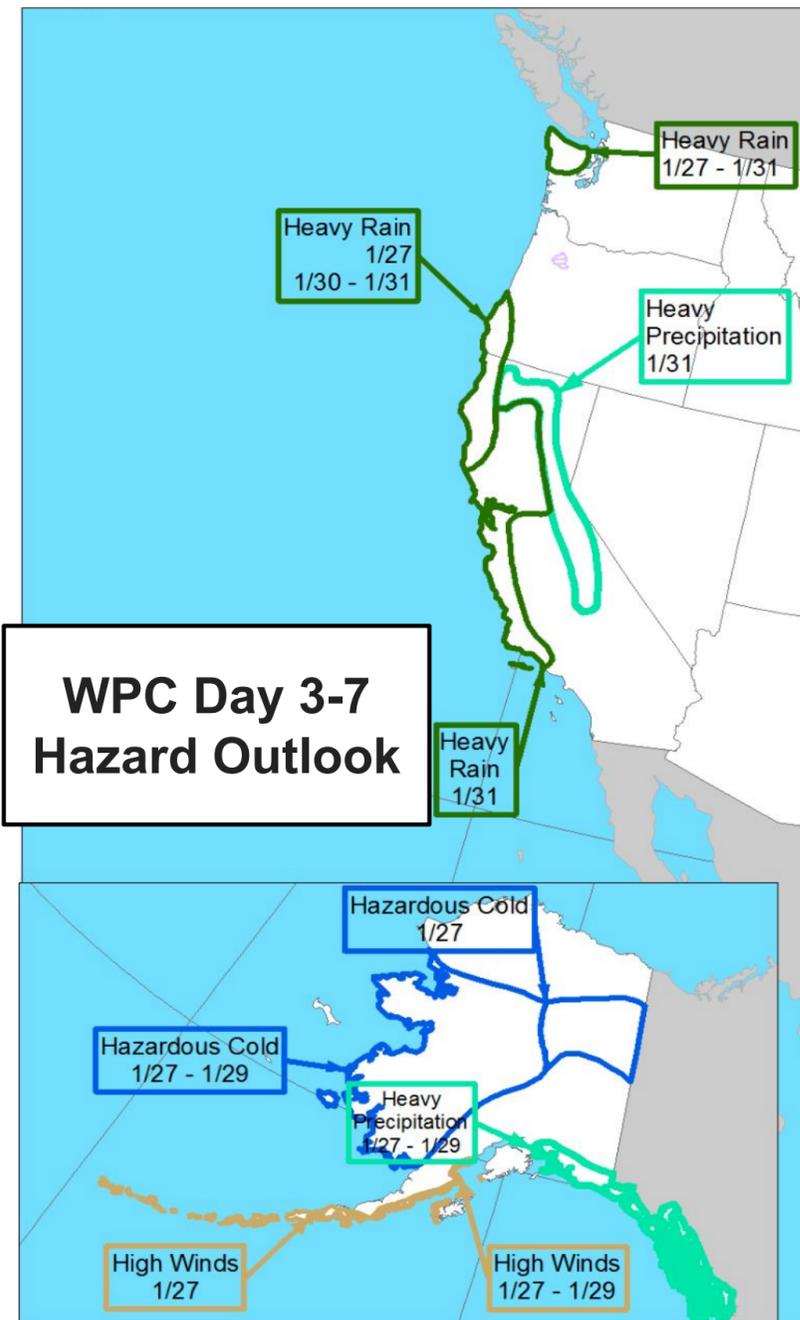
# CW3E AR Outlook: 24 Jan 2024



- For the 72-hour period ending at 4 AM PT Sat 27 Jan, the National Blend of Models (NBM) is showing very high probabilities (>90%) that the WA Cascades receive at least 6 inches of snowfall.
- In the NBM's most recent forecast the WA Cascades also have high probabilities (>70%) of smaller regions of snowfall totals exceeding 1 foot, with low probabilities to receive 2+ feet.

# CW3E AR Outlook: 24 Jan 2024

## WPC Day 3-7 Hazard Outlook and CPC Day 8-14 Hazard Outlook



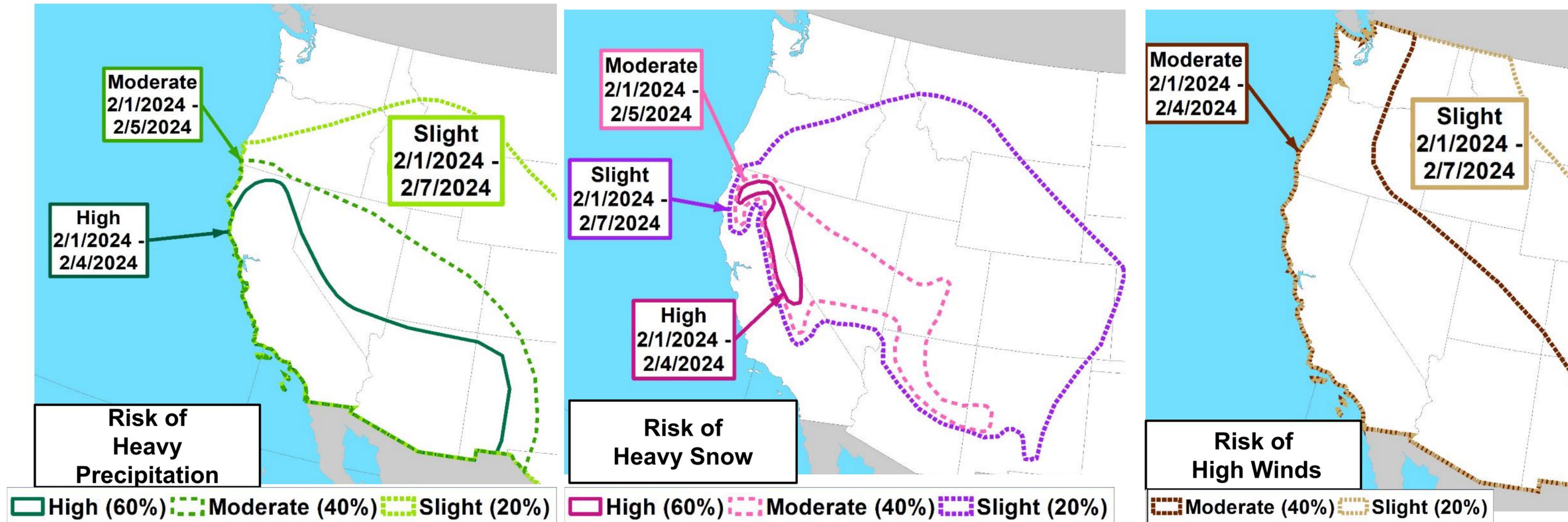
- WPC's Day 3-7 Hazard Outlook is highlighting risks of **heavy rain** over the Olympic Peninsula (Jan 27 to 31), along the OR/CA border (Jan 27, Jan 30-31) and along the C. CA coast and in the Sacramento Valley (Jan 31) and **heavy precipitation** in the Sierra Nevada and Coast Ranges (Jan 31) during the **second and third AR**.
- Looking further into the forecast, the CPC's Day 8-14 Outlook highlights regions of moderate risk of **heavy precipitation**, **heavy snow** and **high winds** as well as regions of possible flooding.
- The most recent outlook shows risks of **heavy precipitation** for all of CA and AZ and portions of OR/NV/UT/CO/NM, **heavy snow** for mountainous regions of CA/NV/UT/AZ/NM, **high winds** for the USWC and inland WA/OR/CA/NV, and **possible flooding** along the CA coast and in AZ.

Source: WPC; [https://www.wpc.ncep.noaa.gov/threats/final/hazards\\_d3\\_7\\_contours.png](https://www.wpc.ncep.noaa.gov/threats/final/hazards_d3_7_contours.png)

<https://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>

# CW3E AR Outlook: 24 Jan 2024

## Climate Prediction Center 8-14 Day Hazard Outlooks



- The Day 8-14 outlooks have a **high risk of heavy precipitation** for CA, SW NV and much of AZ, **high risk of heavy snow** in the Sierra Nevada and Coast Ranges, and a **moderate risk of high winds** along the USWC and inland WA/OR/CA/NV for 1 to 4 Feb.

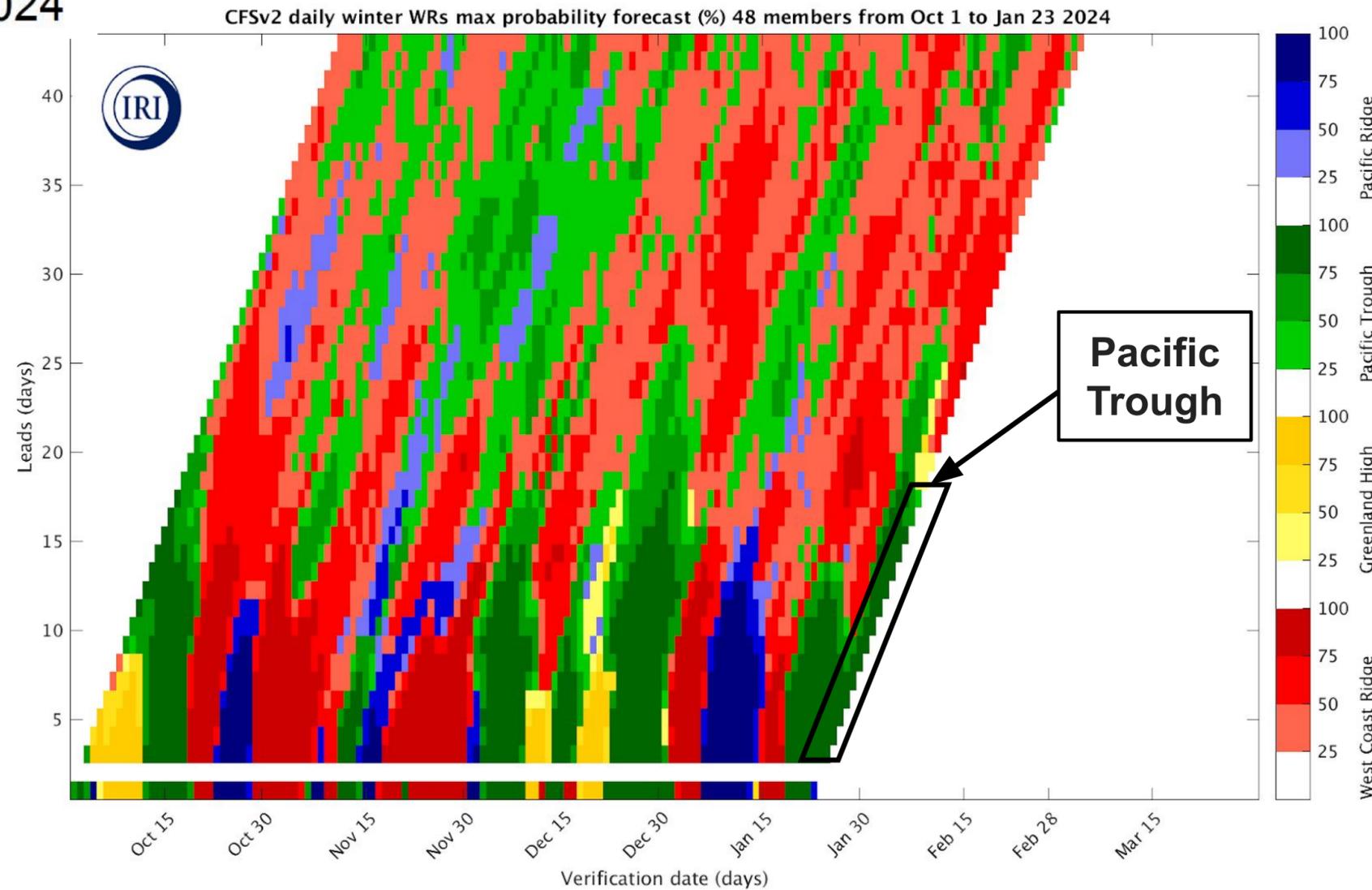
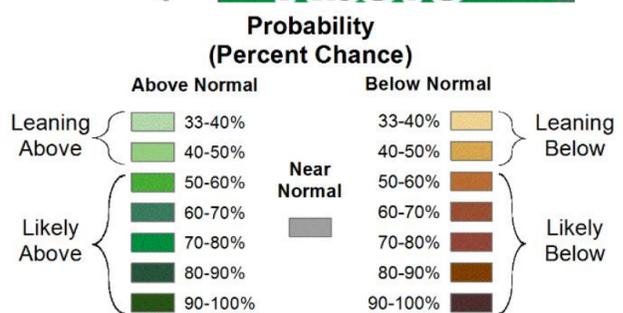
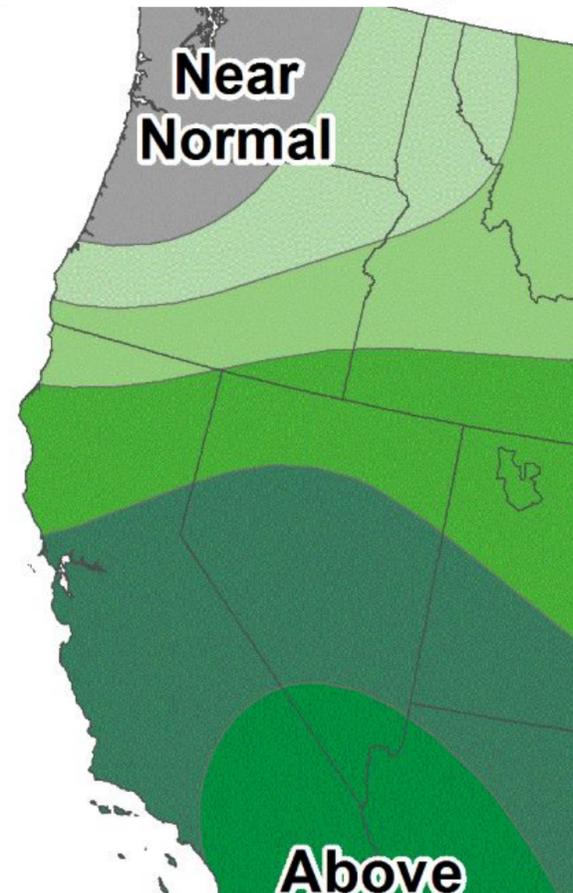
<https://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>

# CW3E AR Outlook: 24 Jan 2024

## CPC Day 8-14 Precipitation Outlook and IRI Regime Forecast

Valid: February 1 - 7, 2024

Issued: January 24, 2024



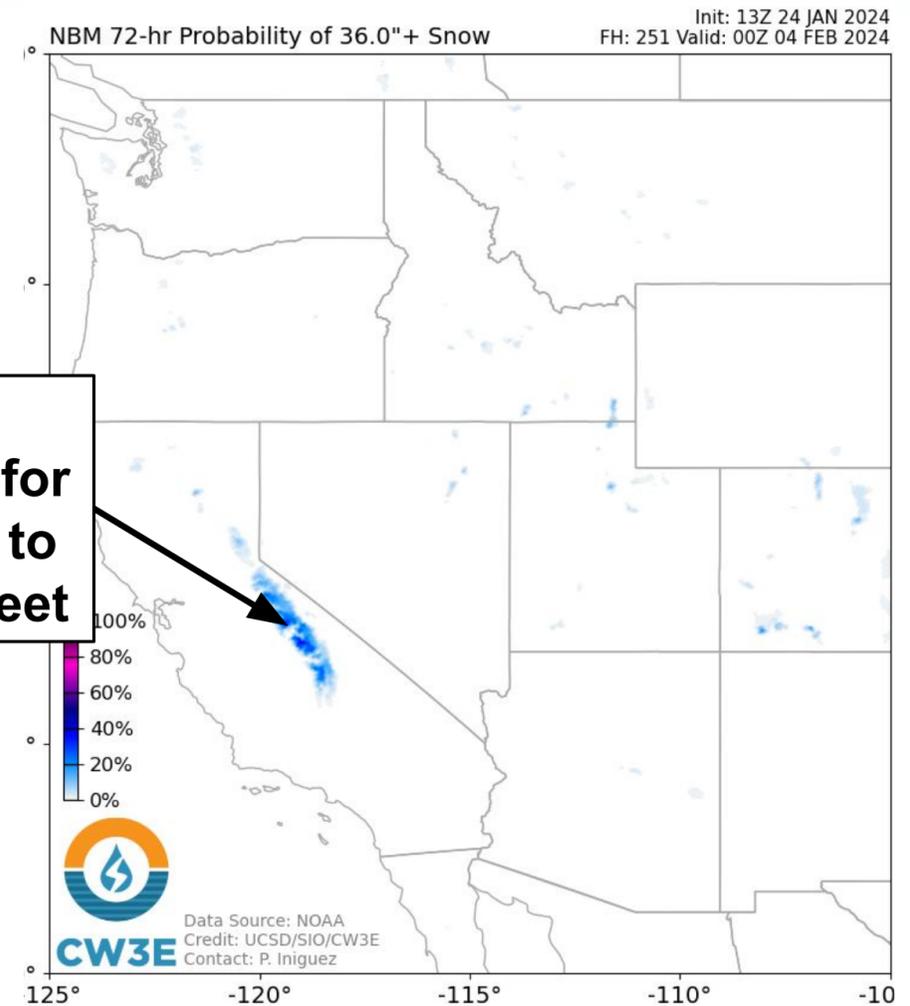
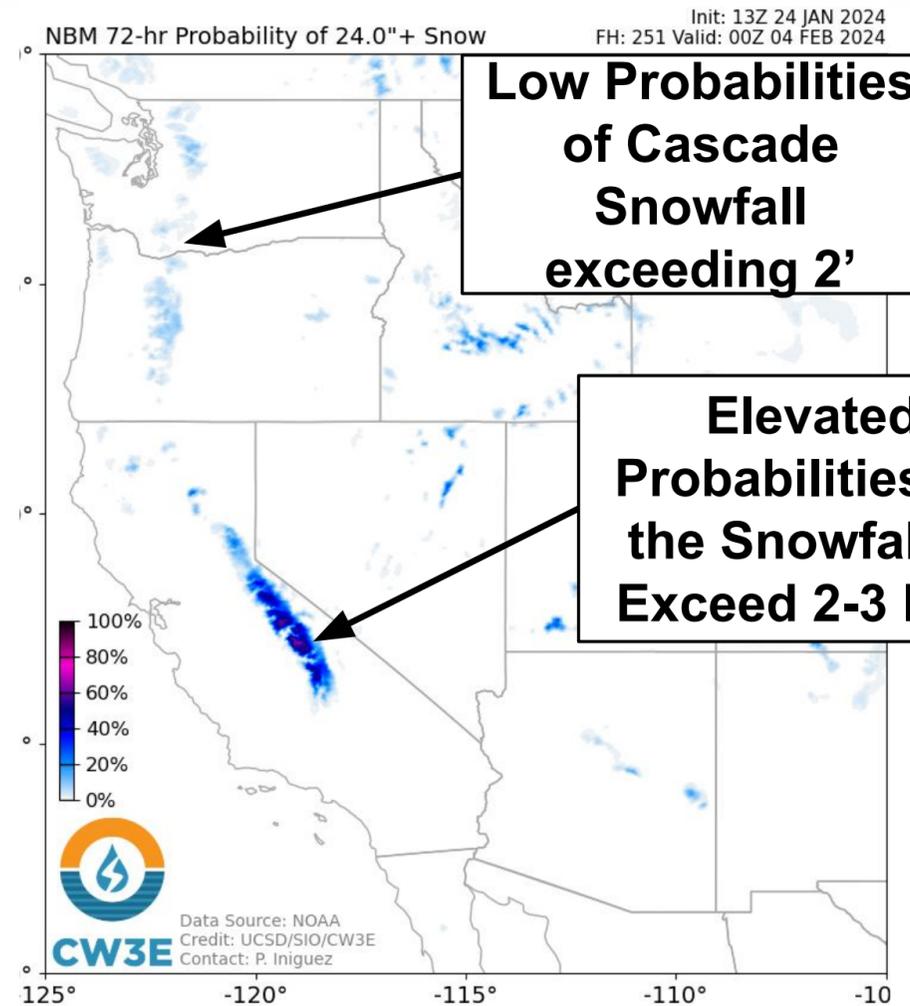
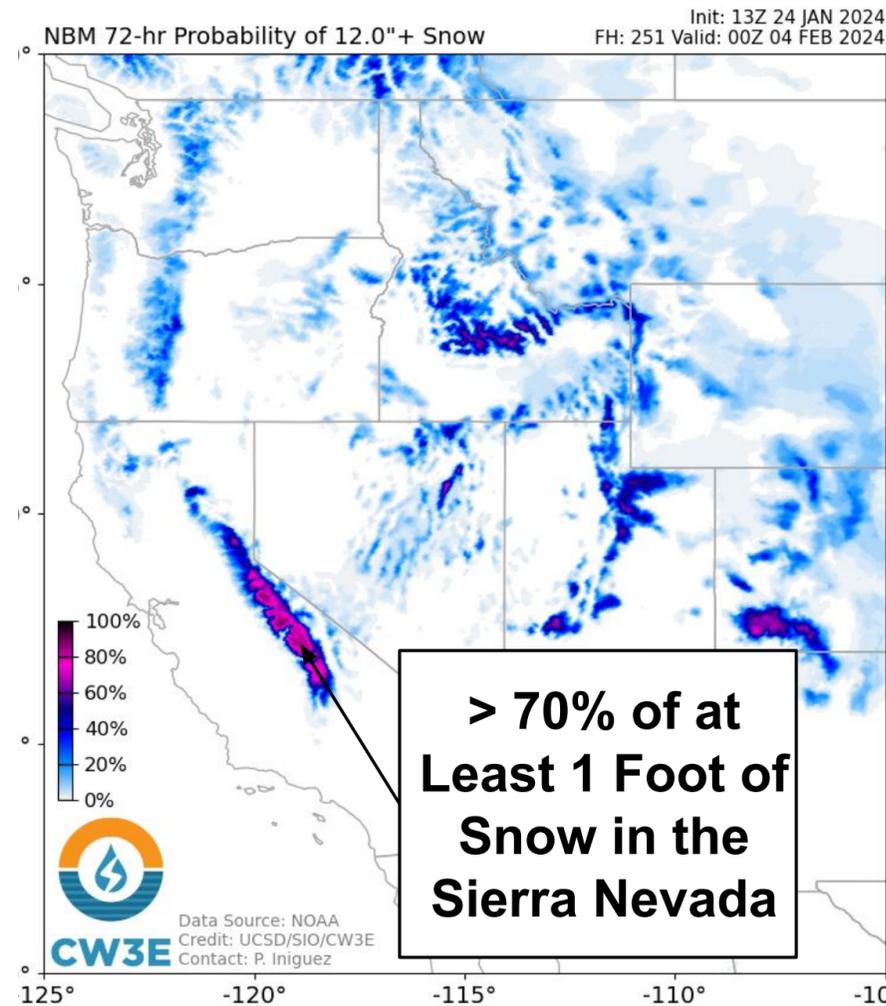
IRI: <https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs>

CPC: <https://www.cpc.ncep.noaa.gov/products/predictions/814day/814prcp.new.gif>

- The CPC's Day 8-14 Precipitation Outlook is showing high probabilities (70-80%) of **above normal** precipitation for much of CA and AZ and portions of NV.

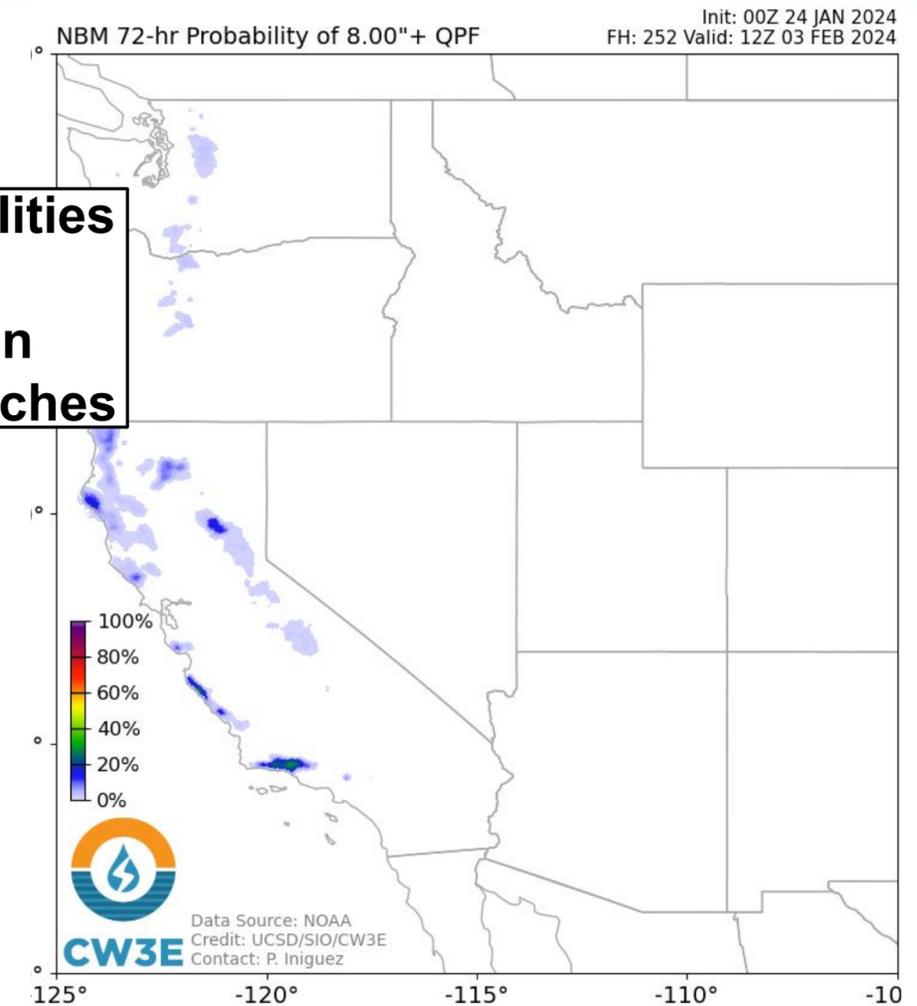
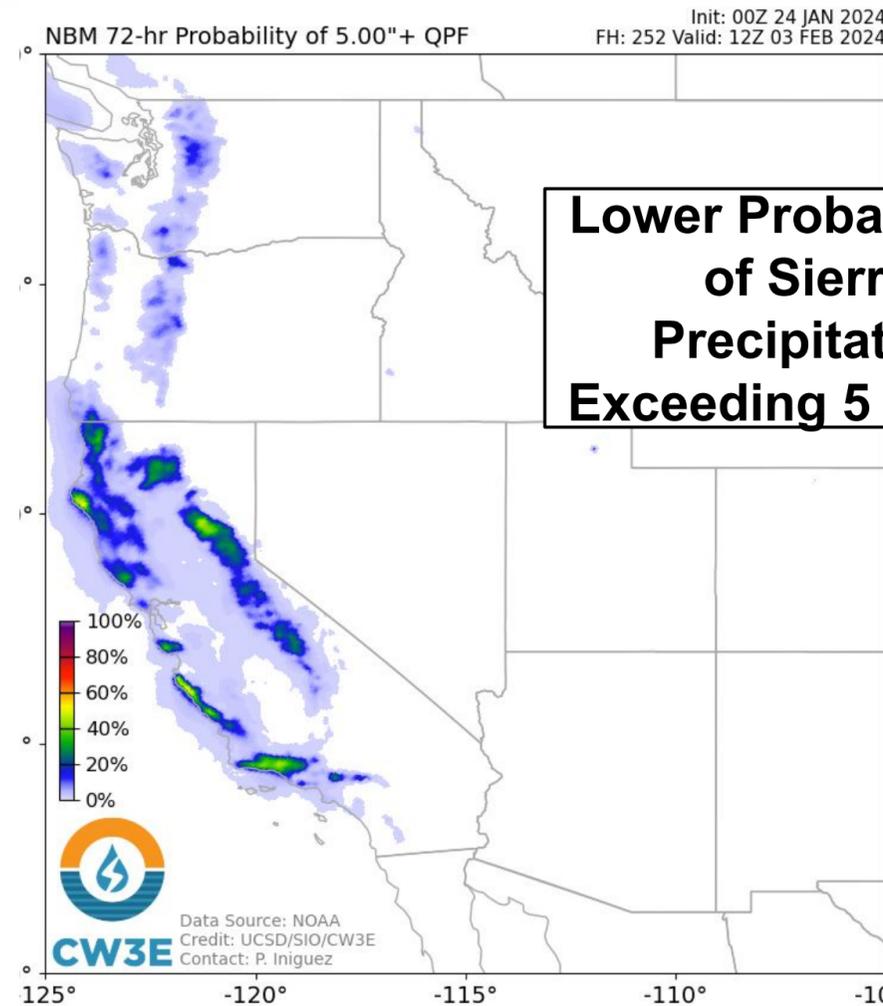
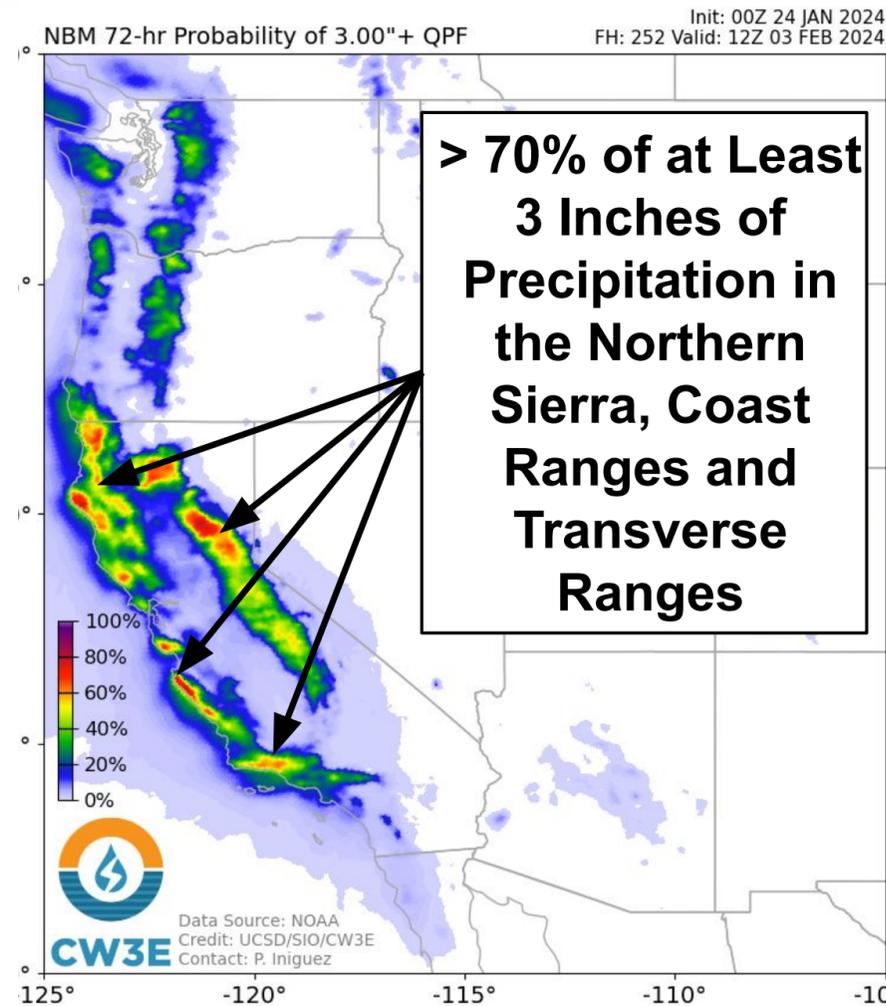
- The IRI Regime Forecast is highlighting a continuation of the **Pacific Trough** Regime through early-mid February. This regime indicates a **greater likelihood** for **wet conditions** for the USWC.

# CW3E AR Outlook: 24 Jan 2024



- For the 72-hour period ending at 4 AM PT Sat 3 Feb, the NBM is showing high probabilities (>70%) that the Sierra Nevada receives at least 12" of snowfall during the **third AR**.
- The NBM is showing moderate probabilities (40-70%) of snowfall exceeding 2 ft and low probabilities (<40%) of snowfall exceeding 3 ft in the Sierra Nevada
- There are low probabilities (>30%) of snowfall in the Cascades exceeding 1', with low probabilities (>10%) of snowfall exceeding 2'.

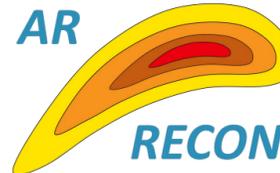
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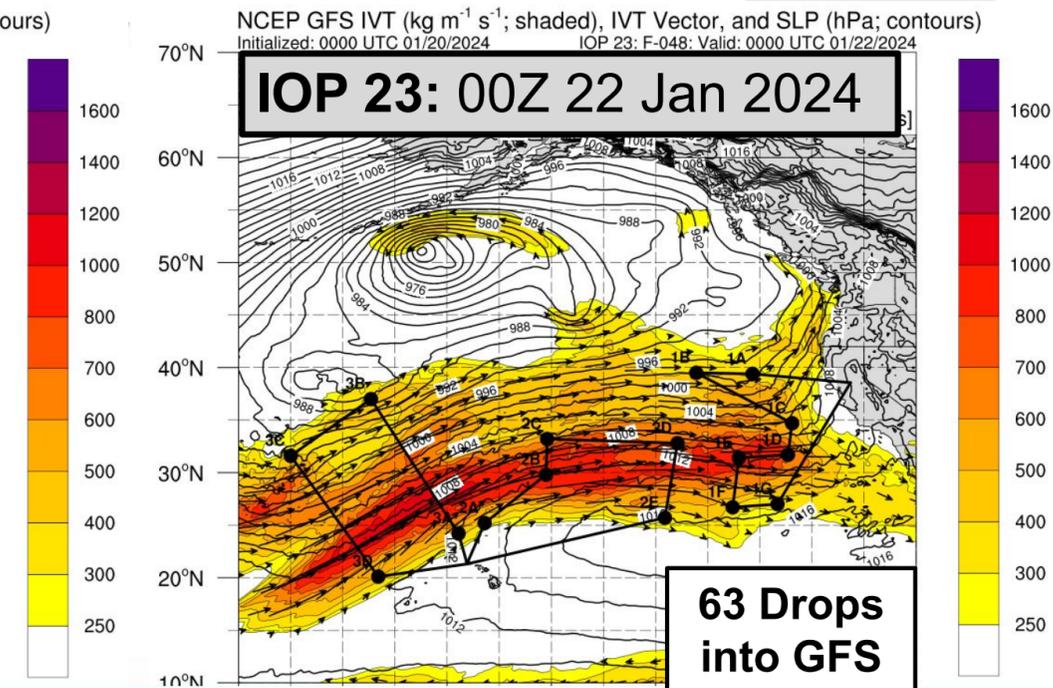
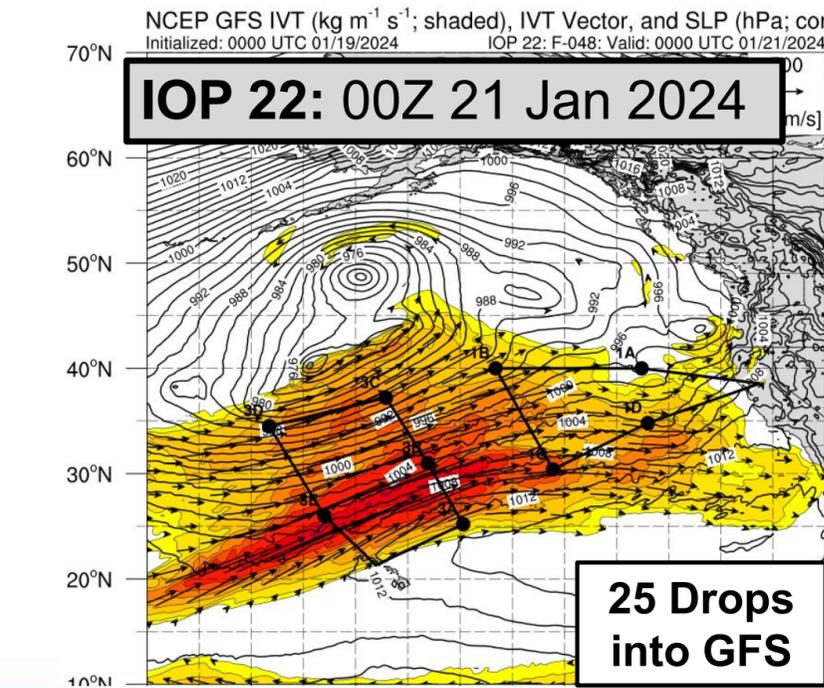
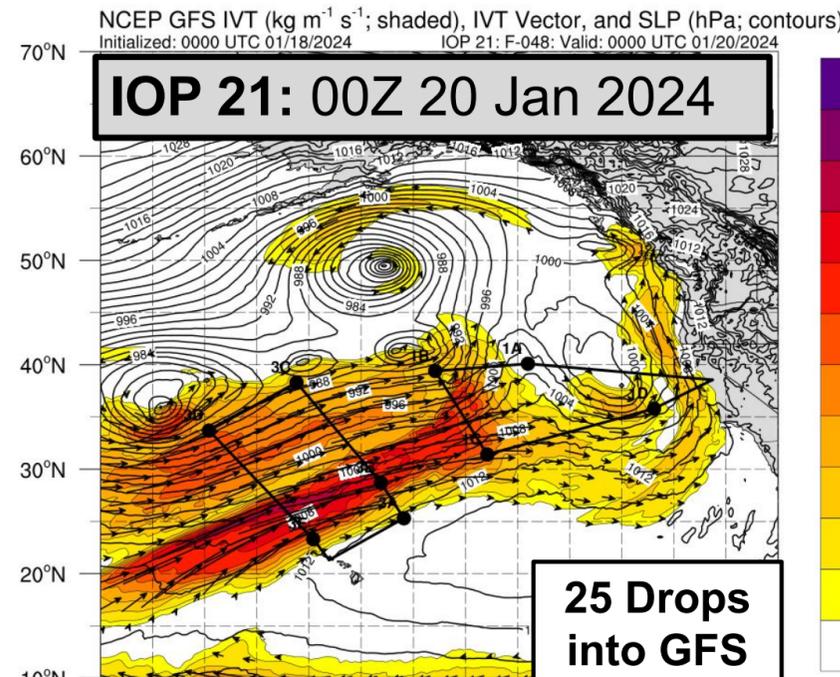
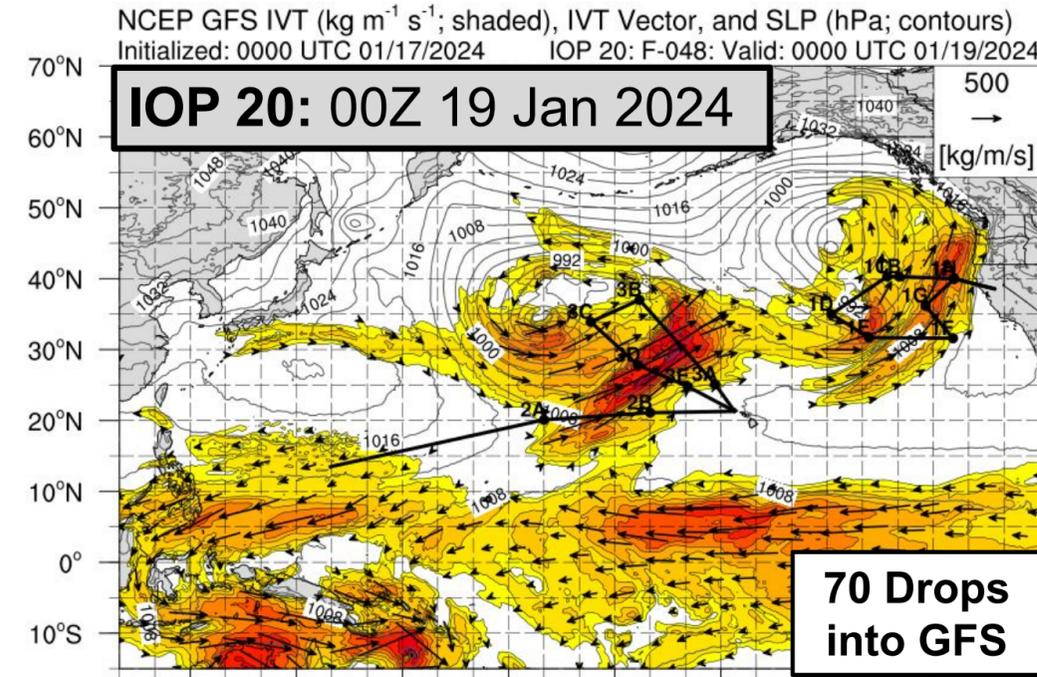
- For the 72-hour period ending at 4 AM PT Sat 3 Feb, the NBM is showing high probabilities (> 70%) that the Sierra Nevada, Coast Ranges and Transverse Ranges receive at least 3" of Precipitation.
- The NBM is also showing low-to-moderate probabilities (20-50%) of 72-h precipitation exceeding 5" during the third AR.
- There are also low probabilities (>20%) of precipitation exceeding 3" in the Cascades and along the WA/OR coast.

# CW3E AR Outlook: 24 Jan 2024

## Current AR Recon Flight Sequence



Research And Operations Partnership



- CW3E's Atmospheric River Reconnaissance (AR Recon) field campaign continues in WY 2024, with the most recent sequence of flights focusing on the approaching systems.
- There were three flights planned for each Intensive Observation Period (IOP); out of Mather Air Force Base in CA (AF C-130), Honolulu, HI (NOAA G-IV) and Guam (AF C-130).
- The Guam C-130 traveled to Hawaii and began making flights from Honolulu during this sequence.
- The flight sequence has allowed for sampling of each AR that was forecast to impact the USWC.
- Additional flights have been planned in this sequence to continue sampling the series of ARs as they progress through the Northeast Pacific.