CW3E Atmospheric River Outlook: 10 Jan 2024

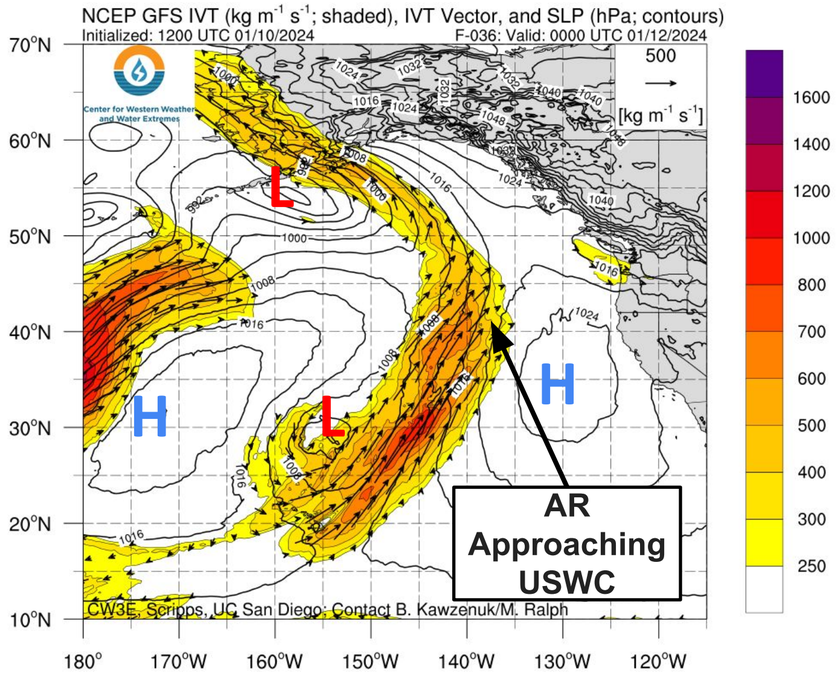
Atmospheric River Will Fuel Winter Weather in Pacific Northwest and Northern California This Weekend

- An atmospheric river (AR) will help drive winter weather set to impact the PNW from Fri 12 Jan through the end of the weekend.
- Model guidance is showing significant uncertainty in AR landfall location, as well as precipitation amounts and precipitation type, especially over the Willamette Basin.
- The GEFS is forecasting the AR to make landfall in and primarily impact the PNW while the ECMWF EPS is forecasting the AR to make landfall in Central/Southern OR and propagate down the CA coast through the weekend.
- The GEFS control run is forecasting AR1 conditions (based on Ralph et al. 2019 AR scale) from Central OR down through Central CA, with the greatest AR conditions (AR2/AR3) near the OR/CA border.
- The ECMWF EPS is also forecasting at least AR1 conditions (based on Ralph et al. 2019 AR scale) from Cen. OR down through Central CA, but the greatest AR conditions (AR2/AR3) are forecast for Northern/Central CA.
- Further uncertainty in how far south into OR an Arctic Air Mass progresses also presents uncertainty in precipitation type in the Willamette Valley.
- Significant snowfall accumulations are expected throughout the Cascades.
- The Weather Prediction Center's (WPC) Winter Storm Severity Index (WSSI) indicates that **major impacts** are expected throughout the Cascades for the period ending 4 AM PT on Sat 13 Jan.

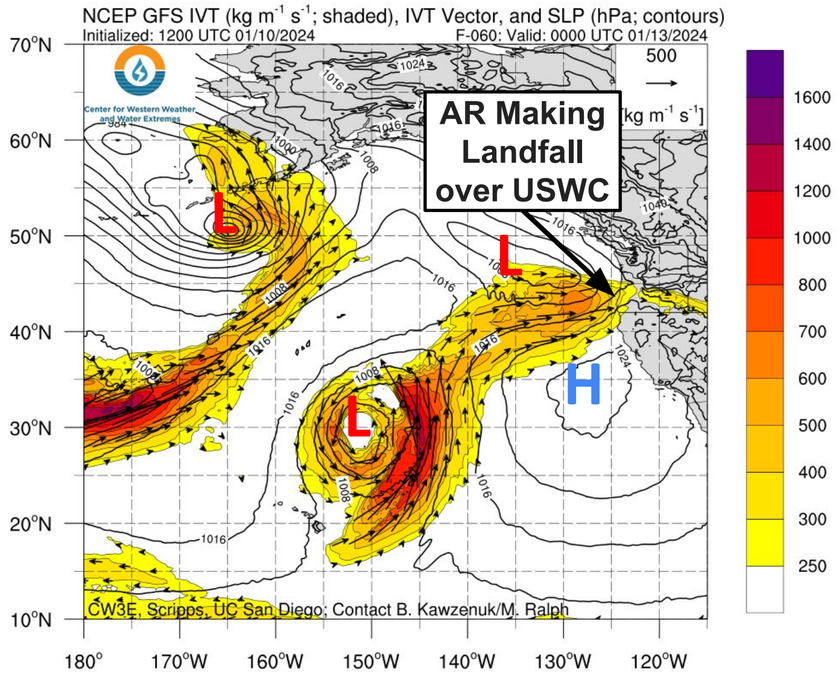
CW3E AR Outlook: 10 Jan 2024

GFS Init 12Z Wed 10 Jan 2024

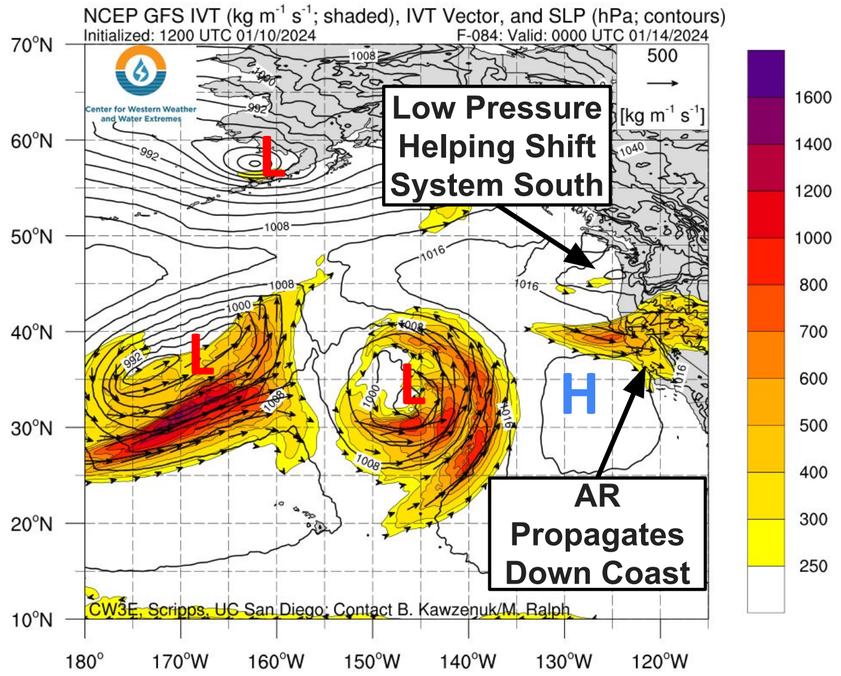
4PM PT Thu 11 Jan 2024



4PM PT Fri 12 Jan 2024



4PM PT Sat 13 Jan 2024



- An atmospheric river (AR) that forms to the north of Hawaii along with a low pressure system is forecast to make landfall into the PNW Fri 12 Jan.
- As the AR is making landfall, a secondary low pressure system progresses toward the USWC from the north.
- The secondary low pressure system helps drive the AR down the West Coast, bringing AR conditions into N. and C. CA.

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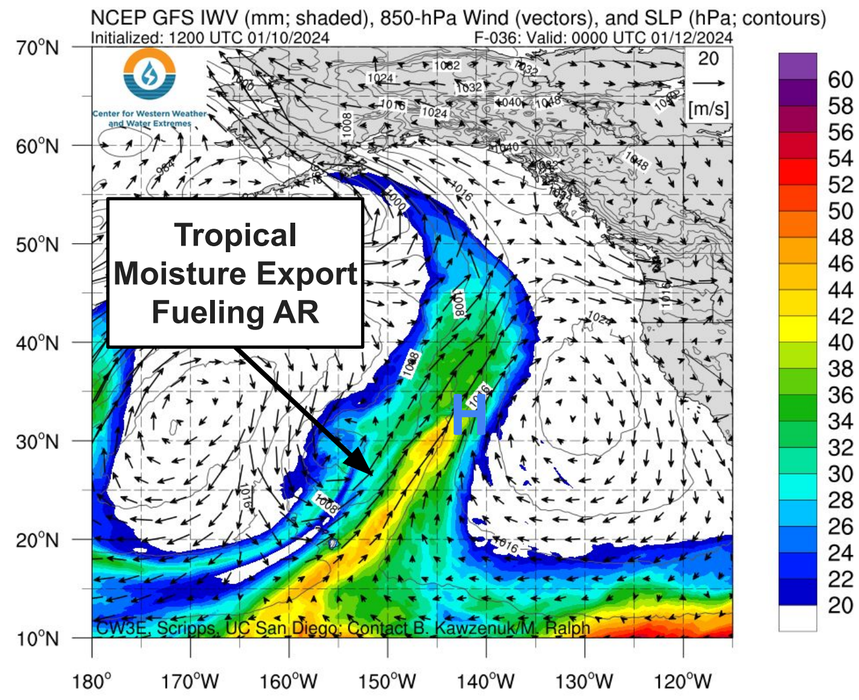
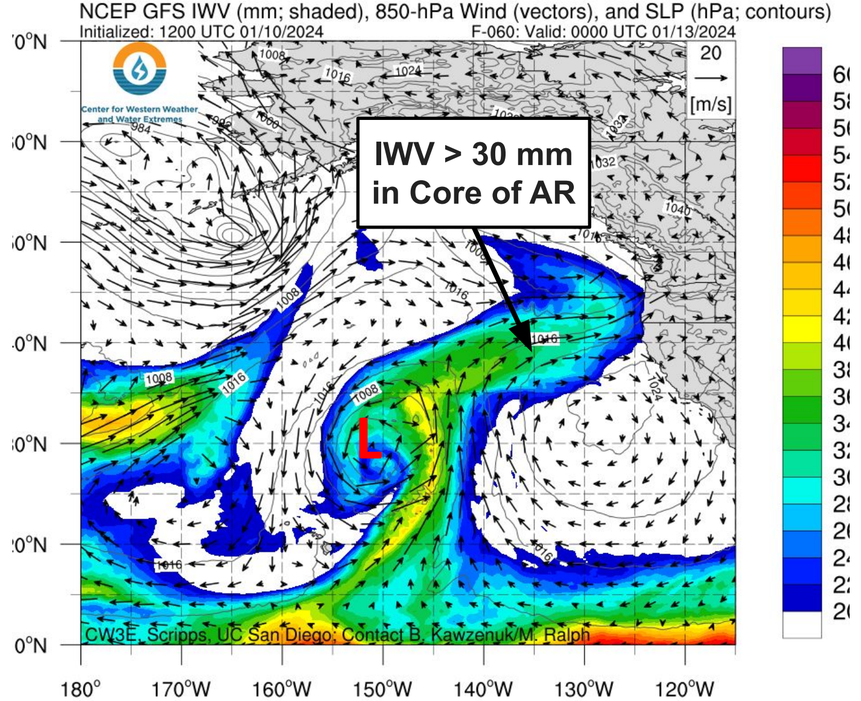


4PM PT Fri 12 Jan 2024



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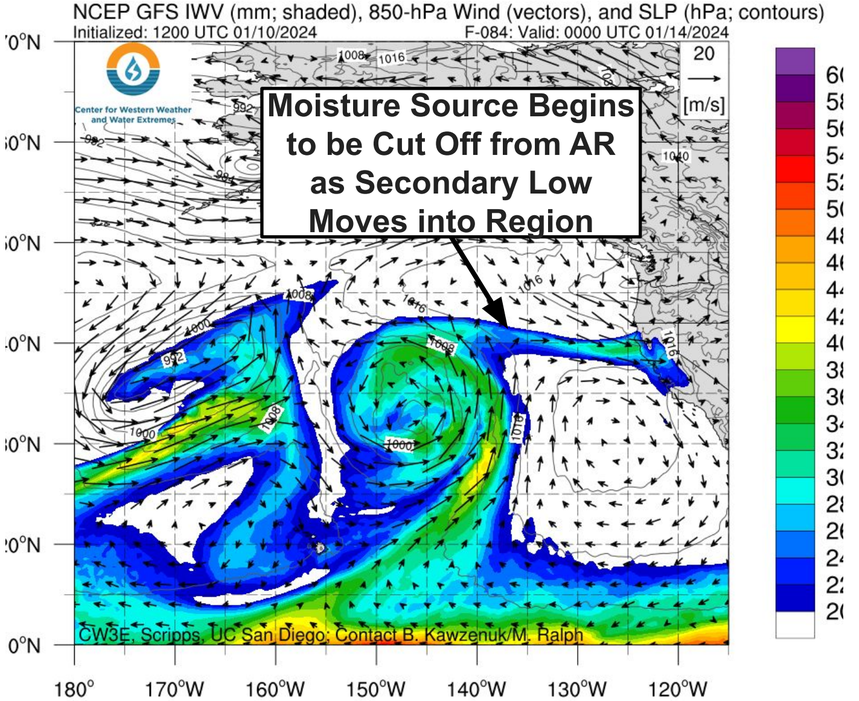
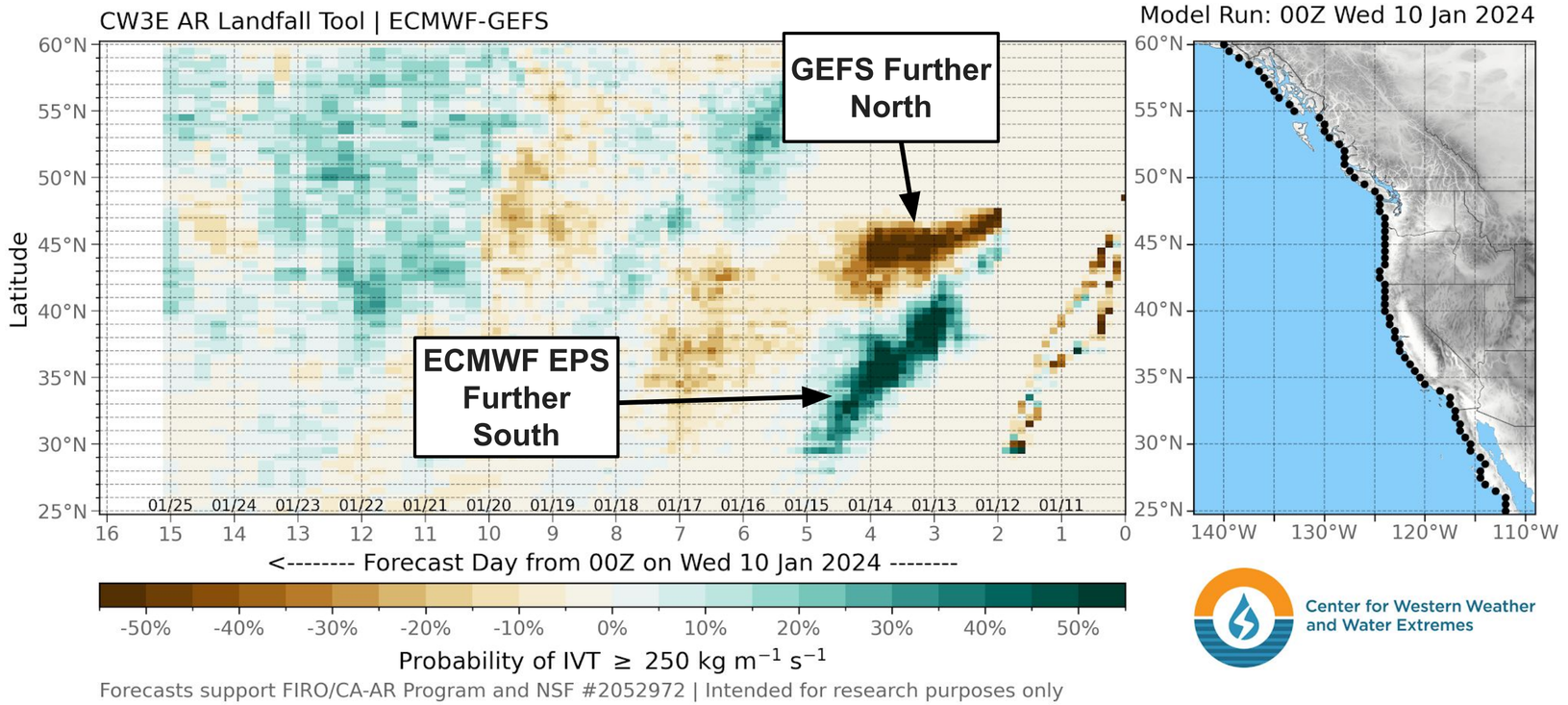
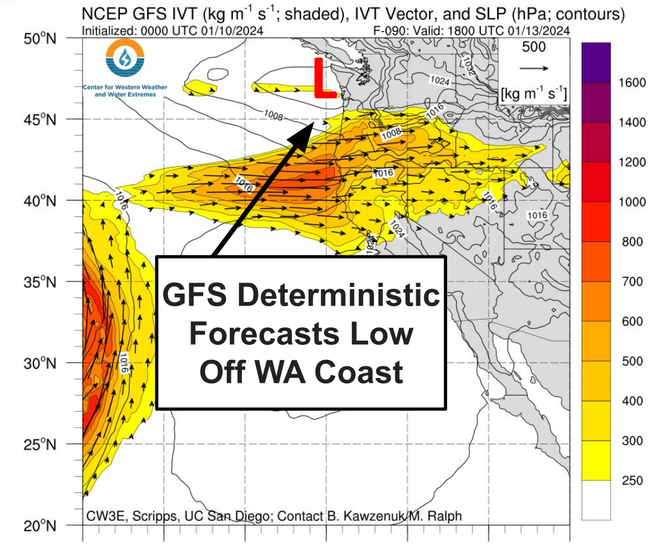
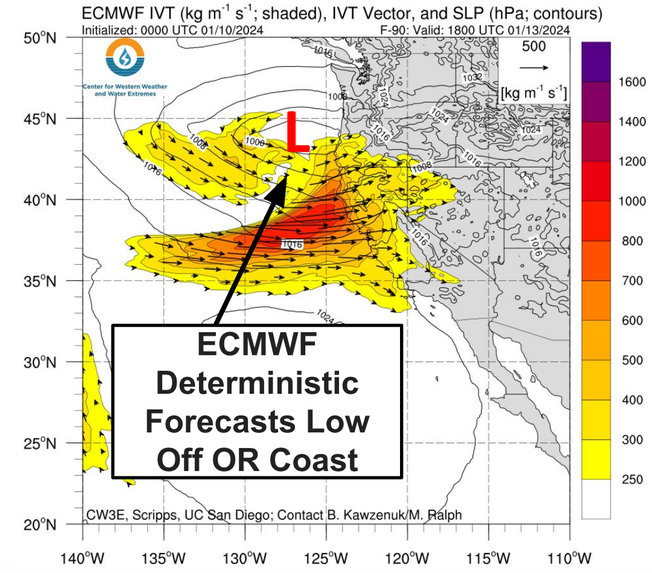


- The incoming AR is supported by a strong tropical moisture export (TME) extending from south of Hawaii.
- IWV > 30 mm is forecast in the core of the AR as it makes landfall over the PNW.
- As the secondary low pressure system moves into the PNW, the AR begins to get cut off from the TME.

CW3E AR Outlook: 10 Jan 2024



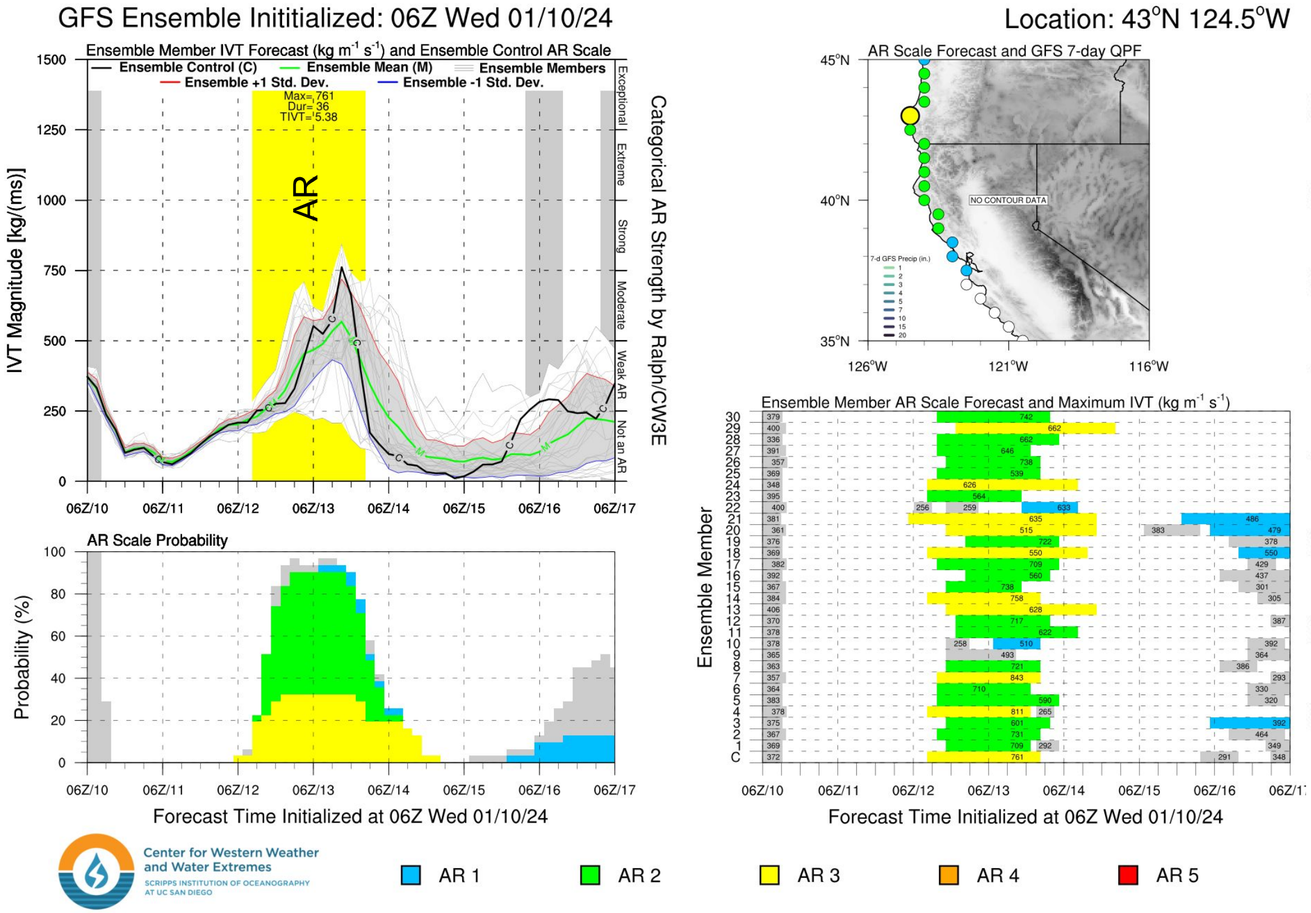


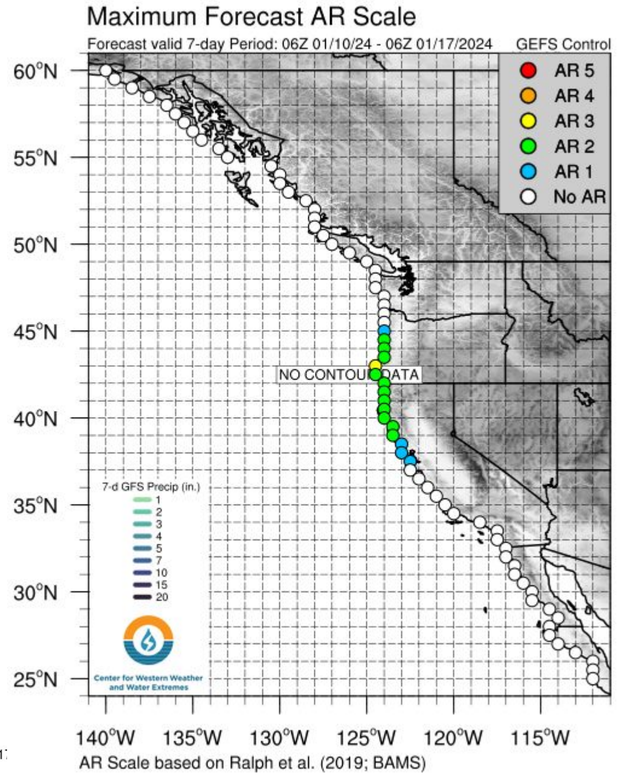


- The GEFS and ECMWF EPS are showing uncertainty in the forecasted landfall location and progression of the incoming AR.
- The GEFS is currently forecasting the AR to make landfall in OR and remain north of the Bay Area.
- The ECMWF EPS is forecasting AR landfall in C. OR and propagate down the CA coast through the duration of the event.
- The GFS and ECMWF deterministic models highlight the uncertainty, where the GFS is forecasting the secondary low pressure system further north than the ECMWF.

CW3E AR Outlook: 10 Jan 2024

GEFS 7-day AR Scale and IVT Forecast

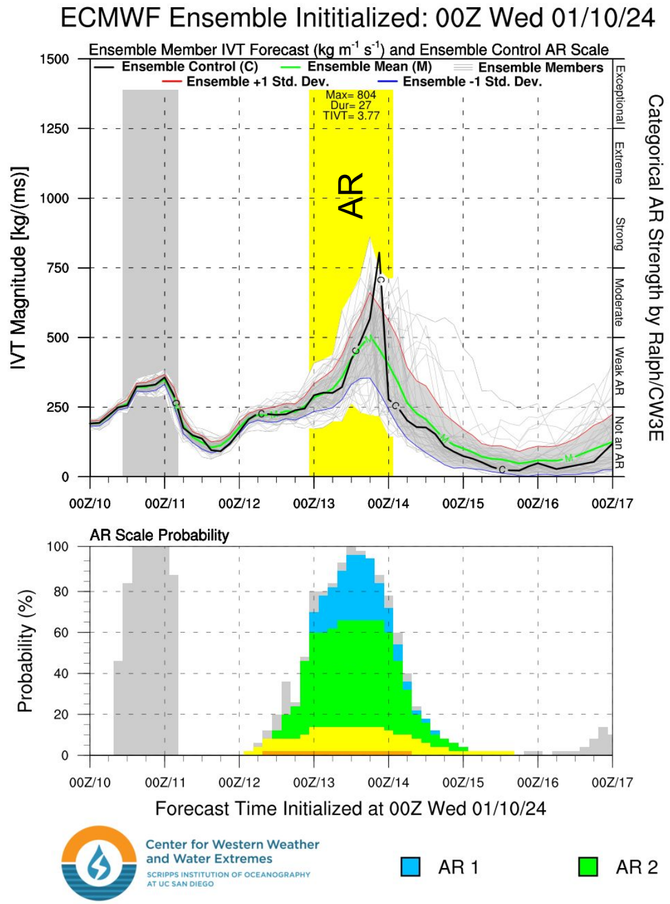


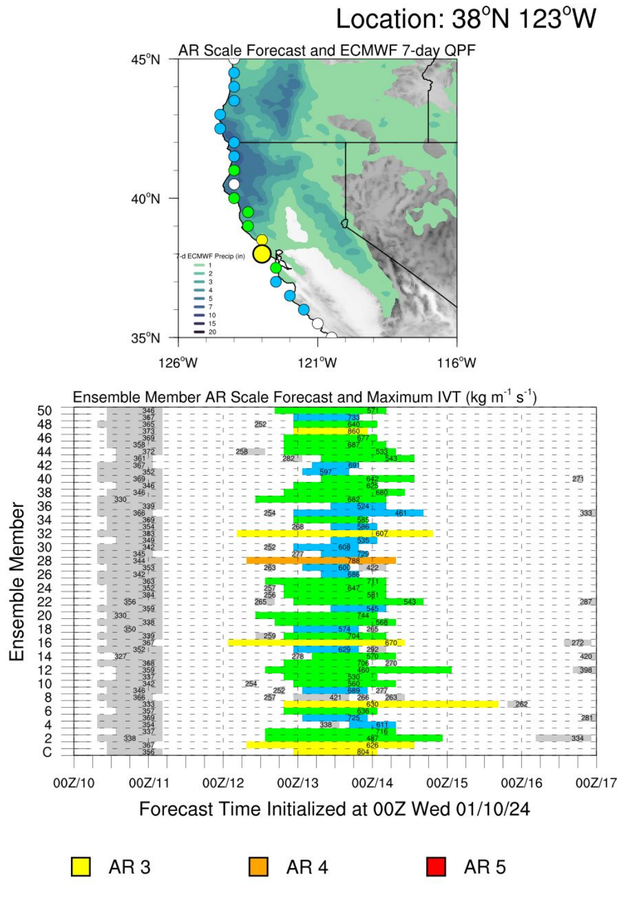


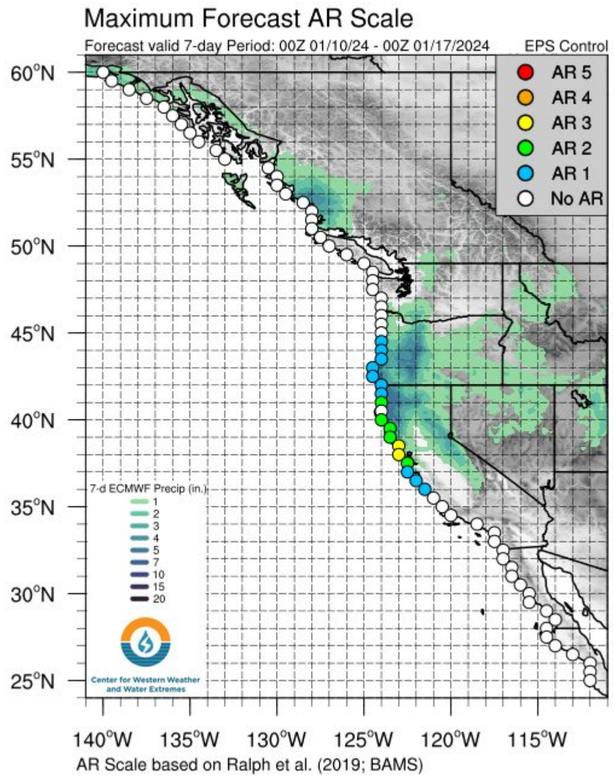
- The GEFS control member is forecasting an AR on Fri 12 Jan through Sat 13 Jan for the point at 43⁰ N, 124.5⁰ W (coastal S.OR).
- 28/31 (90%) GEFS ensemble members are forecasting at least AR2 conditions during the AR on 12-13 Jan.
- 10/31 (32%) of the members (including the control) are forecasting at least AR3 conditions.
- The GEFS is forecasting at least AR1 conditions from C. OR down through C. CA, with the greatest AR conditions near the OR/CA border.

CW3E AR Outlook: 10 Jan 2024

ECMWF EPS 7-day AR Scale and IVT Forecast







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

AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 09 UTC 01/10/2024

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

- The ECMWF EPS control member is forecasting an AR on Sat 13 Jan for the point at 38⁰ N, 123⁰ W (near Point Reyes, CA).
- 50/51 (98%) GEFS ensemble members are forecasting at least AR1 conditions.
- 33/51 (65%) of the members (including the control) are forecasting at least AR2 conditions.
- The EPS is also forecasting at least AR1 conditions from C. OR down through C. CA, but the greatest AR conditions are forecast for N./C. CA.

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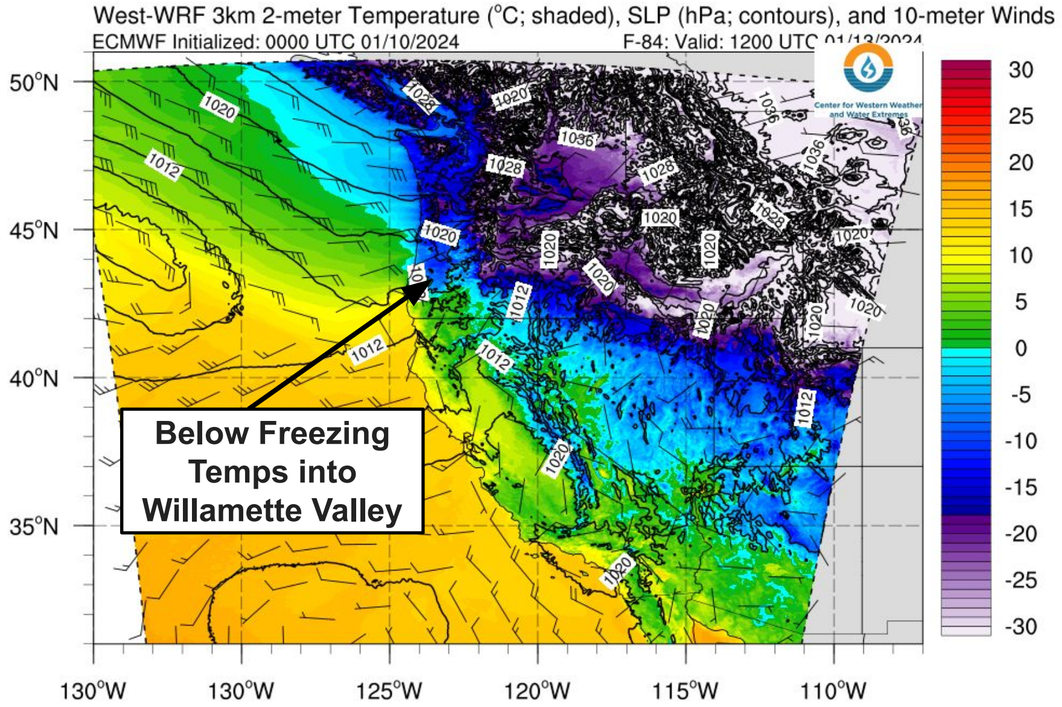
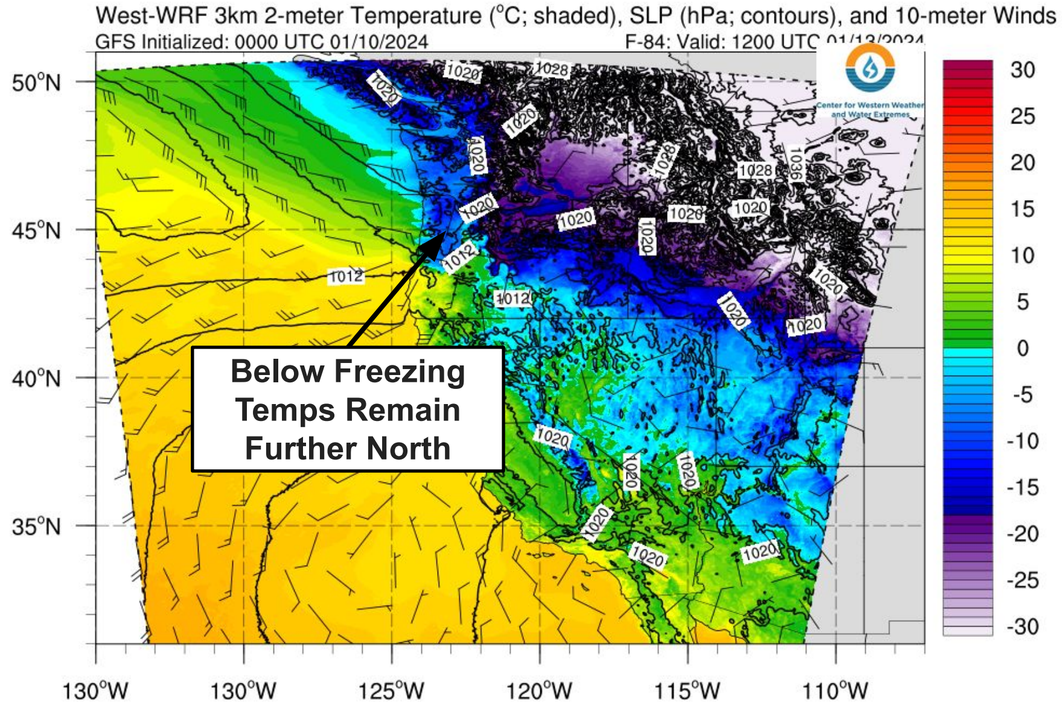
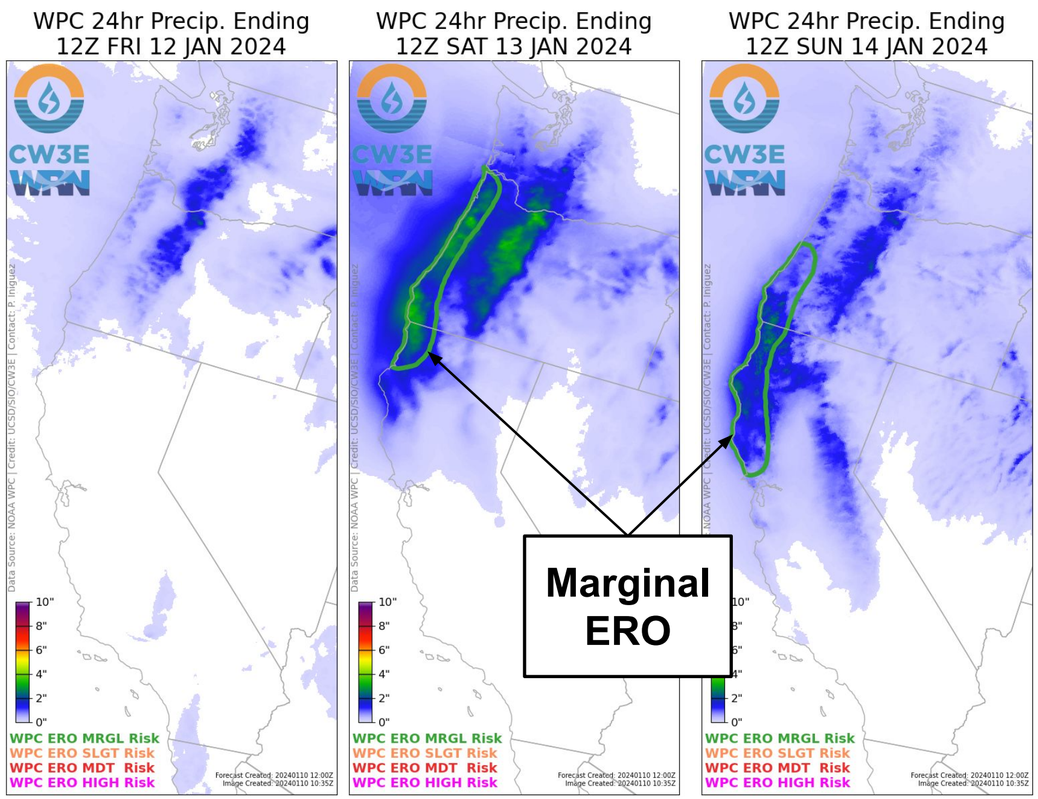
West-WRF Temperature Forecast Uncertainty

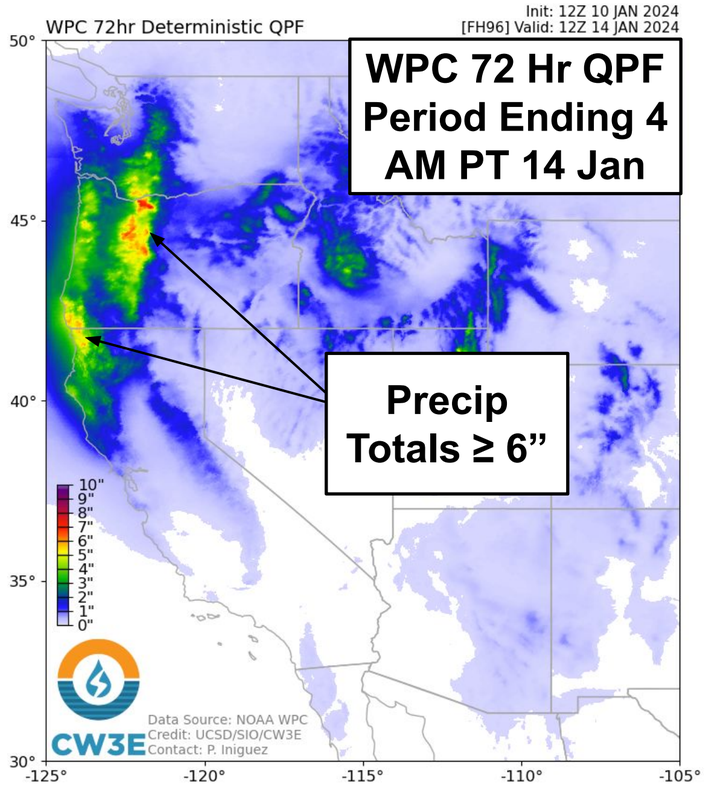




- The West-WRF initialized with the ECMWF (left) and GFS (right) highlights another forecast uncertainty with this event.
- The West-WRF initialized with the ECMWF is forecasting below freezing temperatures to reach down into the Willamette Valley in OR whereas the West-WRF with GFS is forecasting these below freezing temperatures to stay further to the north.
- Uncertainty in the Arctic air intrusion is leading to further uncertainty in precipitation type forecasts for OR.

CW3E AR Outlook: 10 Jan 2024

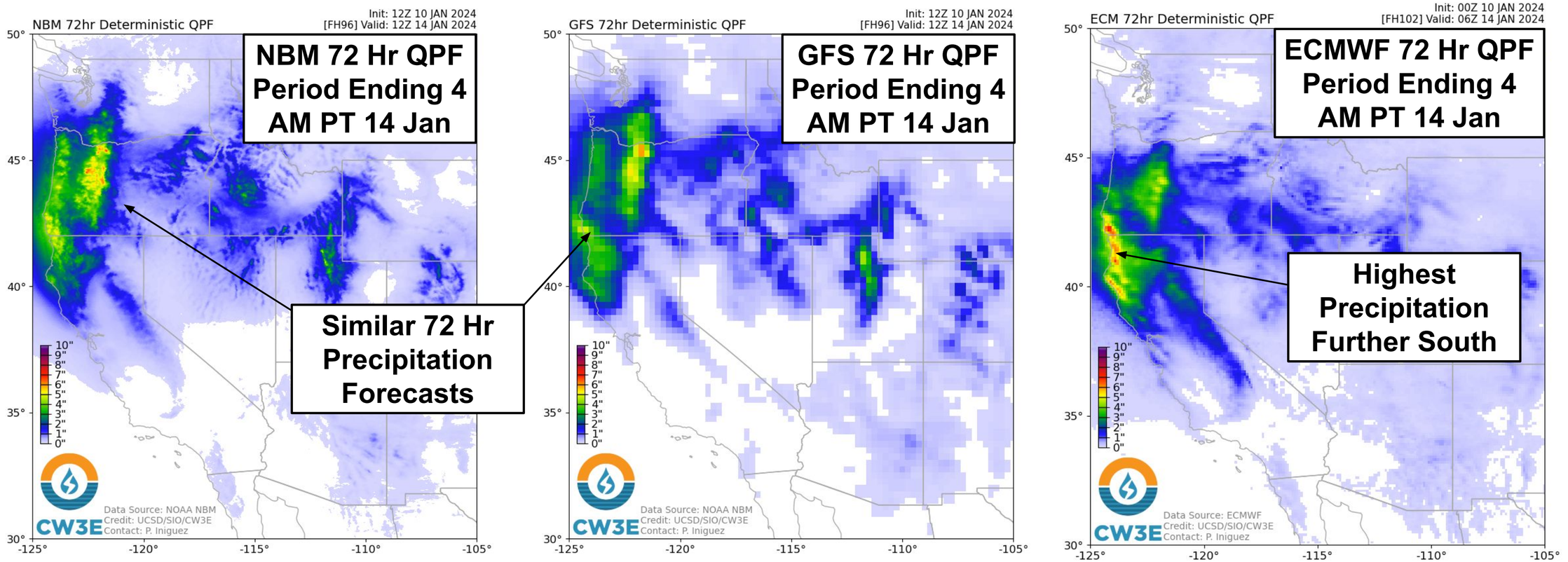




- The NWS WPC 3-day precipitation totals for the period ending at 4 AM PT Sun 14 Jan are the highest for regions along the OR/CA border and the S. Cascades, where greater than 6” is forecast to fall during the period.

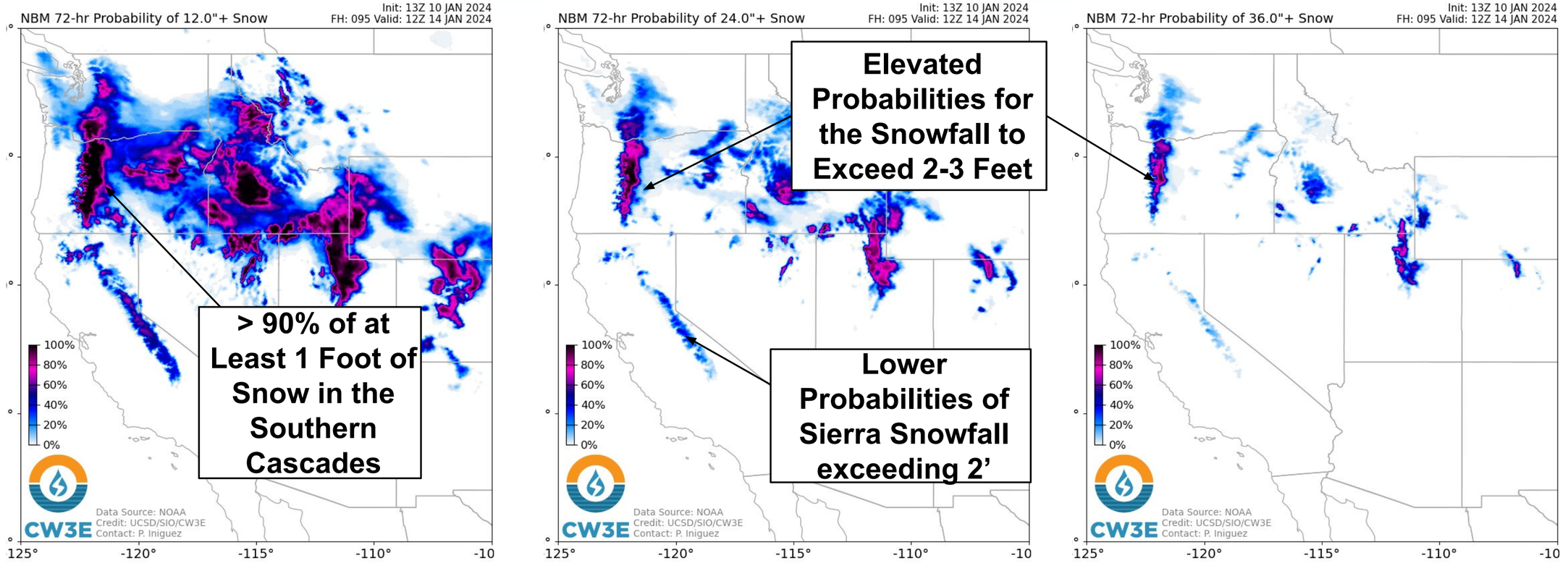
- The WPC Excessive Rainfall Outlook indicates a Marginal Risk (level 1 of 4, or at least 5% chance) for flooding to occur across the OR/ N.CA coast for the 24-hour periods ending at 4 AM PT on Sat 13 Jan and Sun 14 Jan.

CW3E AR Outlook: 10 Jan 2024



- The GFS 72-hr precipitation forecast is further to the North, with the highest precipitation totals in the S. Cascades and along the OR/CA border, while the ECMWF is further south, with the highest precipitation totals along the OR/CA border and along the N.CA coast.
- The NBM shows a blend between the models with precipitation along the coast from OR through N. CA and in the S. Cascades with lower peak values in the locations the GFS and ECMWF are highlighting the highest possible totals.

CW3E AR Outlook: 10 Jan 2024



- For the 72-hour period ending at 4 AM PT Sun 14 Jan, the NBM is showing very high probabilities (> 90%) that the S. Cascades receive at least 12" of snowfall.
- In the NBM's most recent forecast the S. Cascades also have high probabilities of snowfall totals exceeding 2'-3', with portions of the Cascades around a 90% chance to receive 3'+.
- There are medium probabilities (>60%) of snowfall in the Sierras exceeding 1', with lower probabilities (>20%) of snowfall exceeding 2'.

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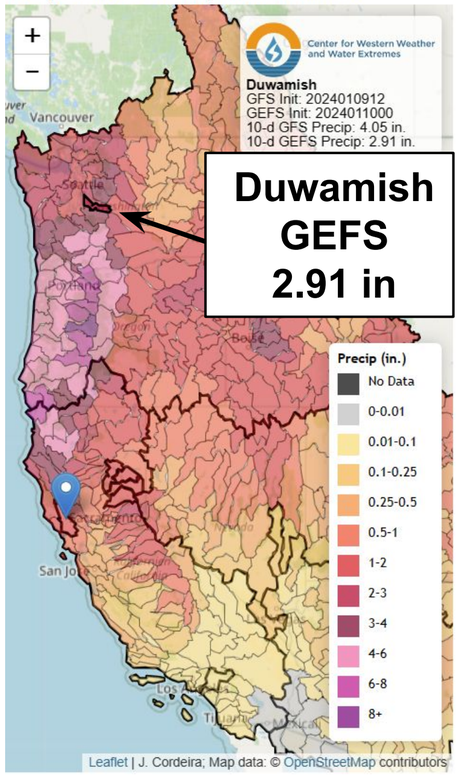
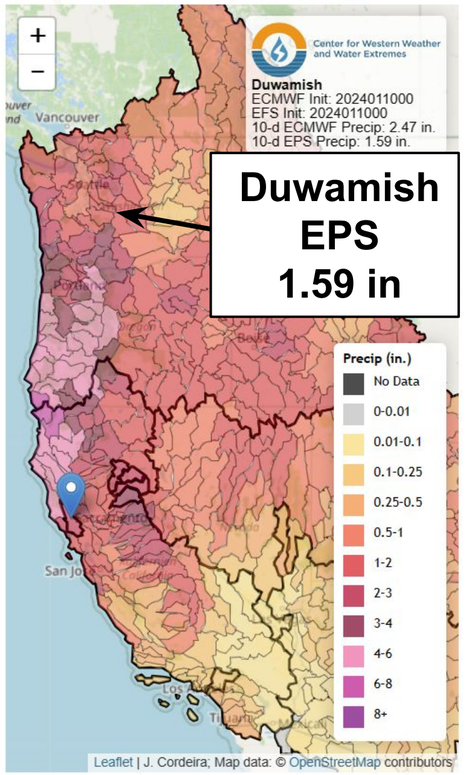
10-day Watershed Precipitation Forecasts (Initialized 00Z 10 Jan)

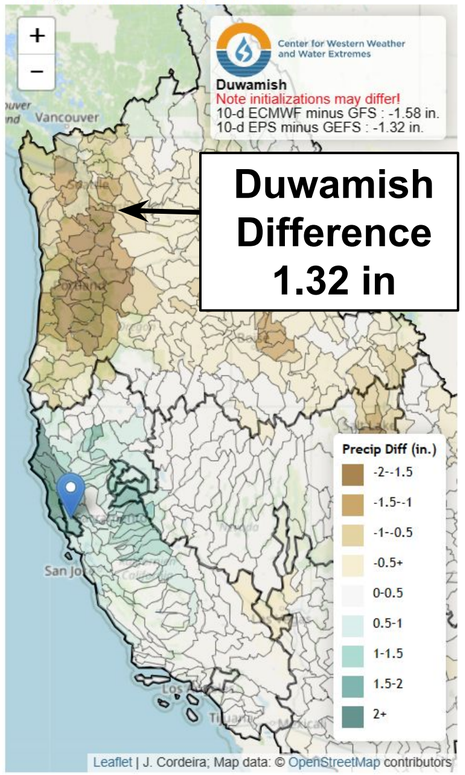
10-day GFS/GEFS Precipitation Forecasts

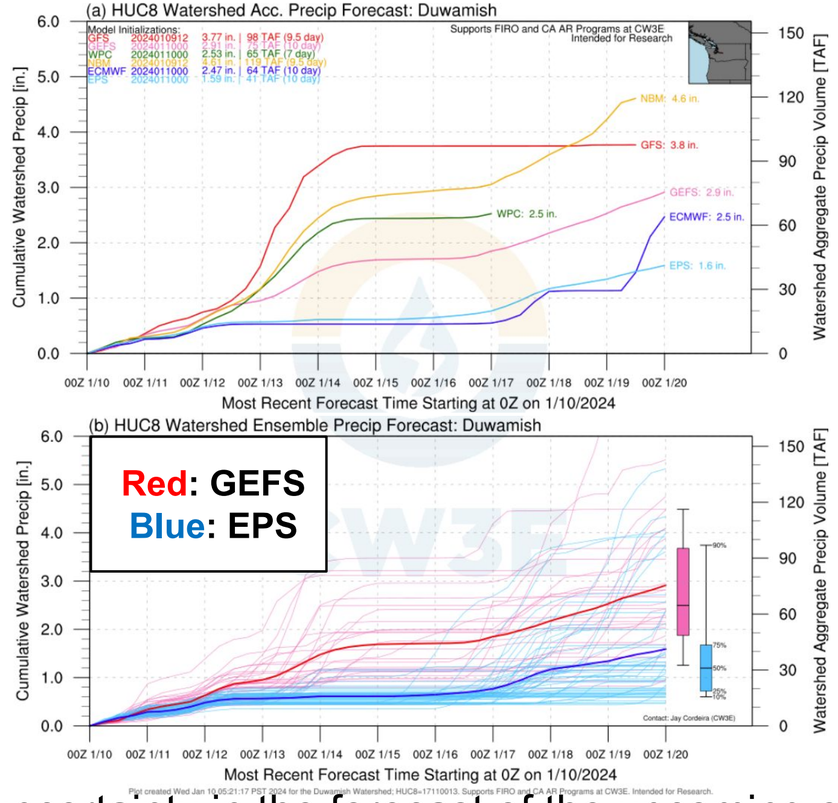


10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast





- The 00Z EPS and 00Z GEFS 10-day watershed precipitation totals highlight the uncertainty in the forecast of the upcoming event.
- 00Z GEFS mean 10-day totals are at least 1” greater than the 00Z EPS mean in WA and OR whereas the 00Z ECMWF is at least 1” greater in N. CA and the Sierras.
- The 00Z GEFS is forecasting 2.91” of mean areal precipitation in the Duwamish watershed over the next 10 days, while the 00Z EPS is forecasting 1.59” over the same watershed. The GEFS is showing more uncertainty in precipitation totals than the EPS.

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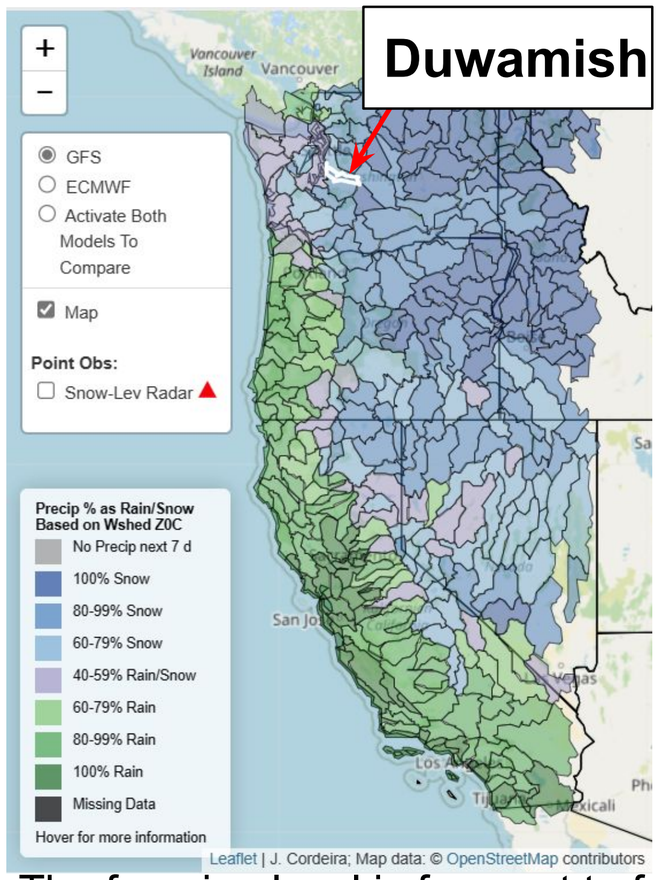
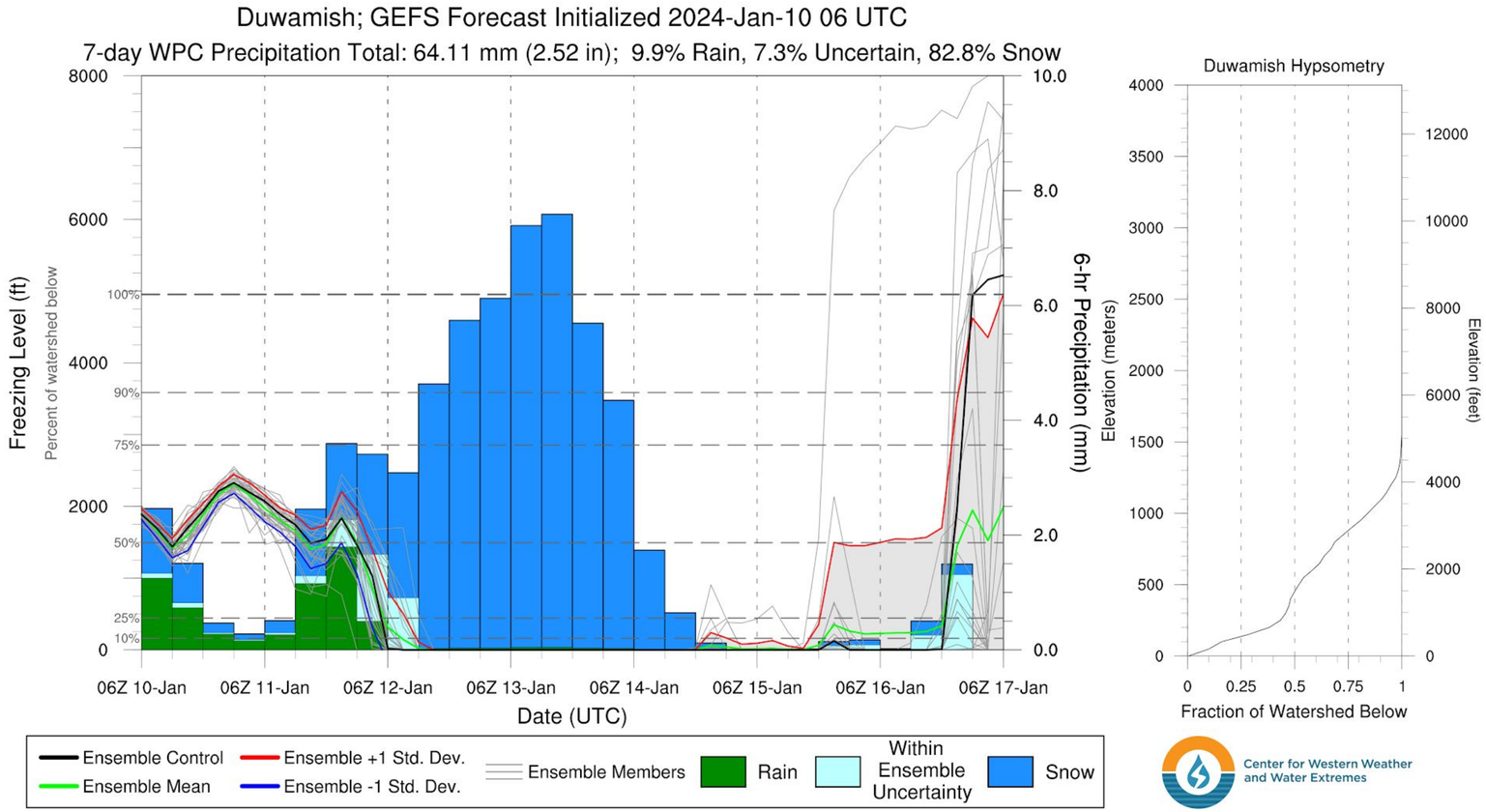
Freezing Level Forecast





- The freezing level is forecast to fall from ~2000 ft above mean sea level (MSL) to near sea level during the AR in the Duwamish watershed.
- The CW3E watershed freezing level tool is forecasting >80% of the precipitation in the Duwamish to fall as snow over the next 7 days.

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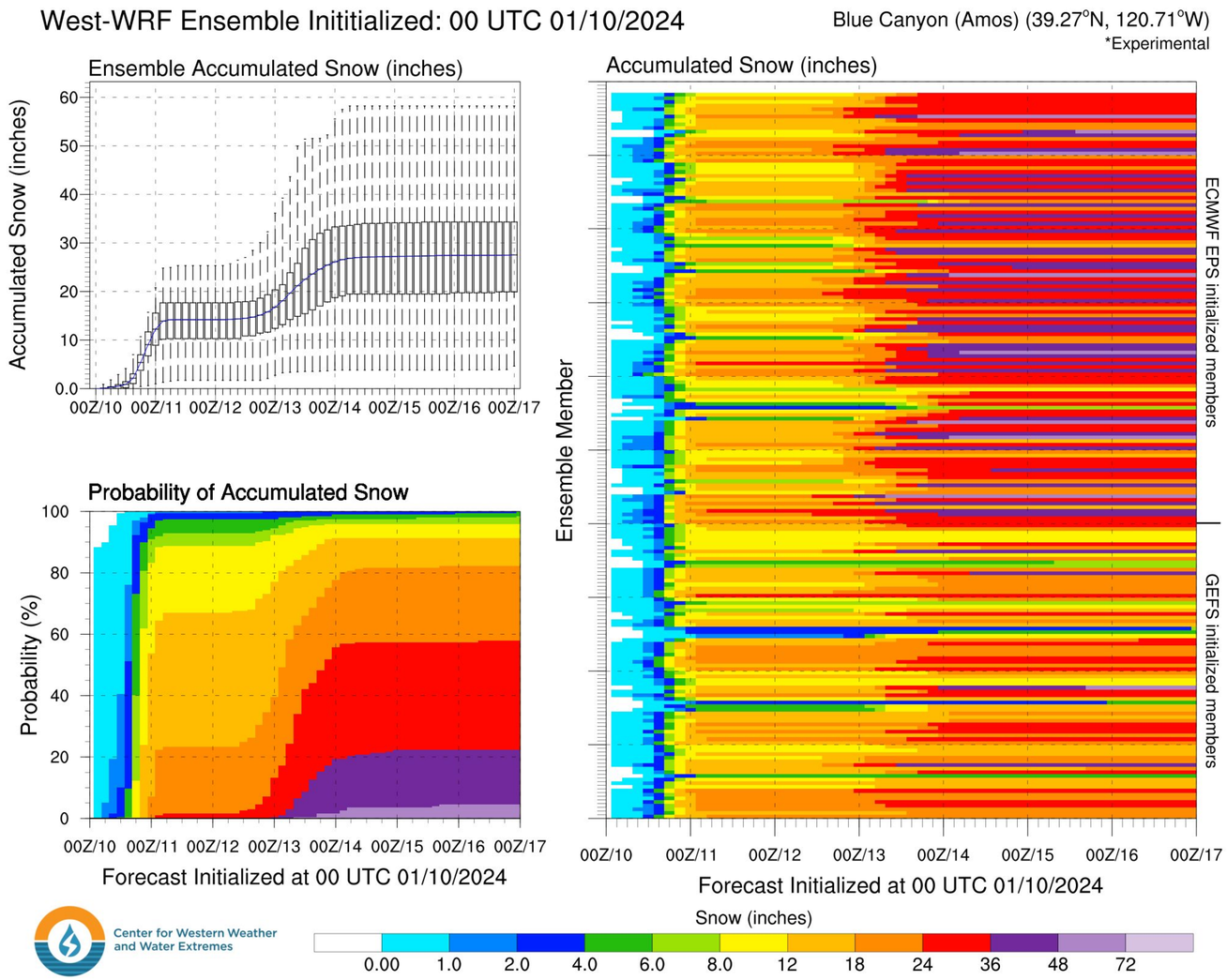
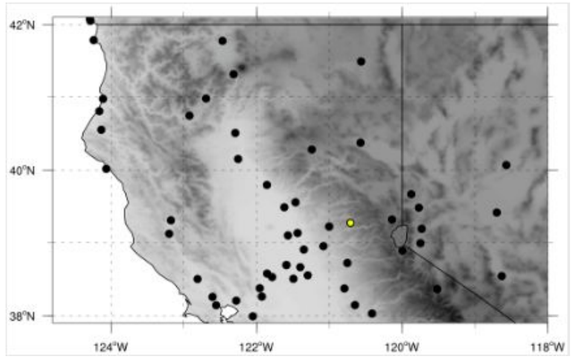
West-WRF Ensemble Meteogram





- The West-WRF ensemble produces meteograms showing accumulated precipitation at select locations across the West Coast.
- For this location at Blue Canyon in the Sierras, the West-WRF ensemble members are forecasting a >60% chance of 18”+ of accumulated snowfall in the next 7 days.
- All but 8 members are forecasting greater than 8” of accumulated snow, with many members forecasting totals greater than 36”.
- The ensemble spread for the snowfall totals is substantial with this event, indicating uncertainty amongst the ensemble members.

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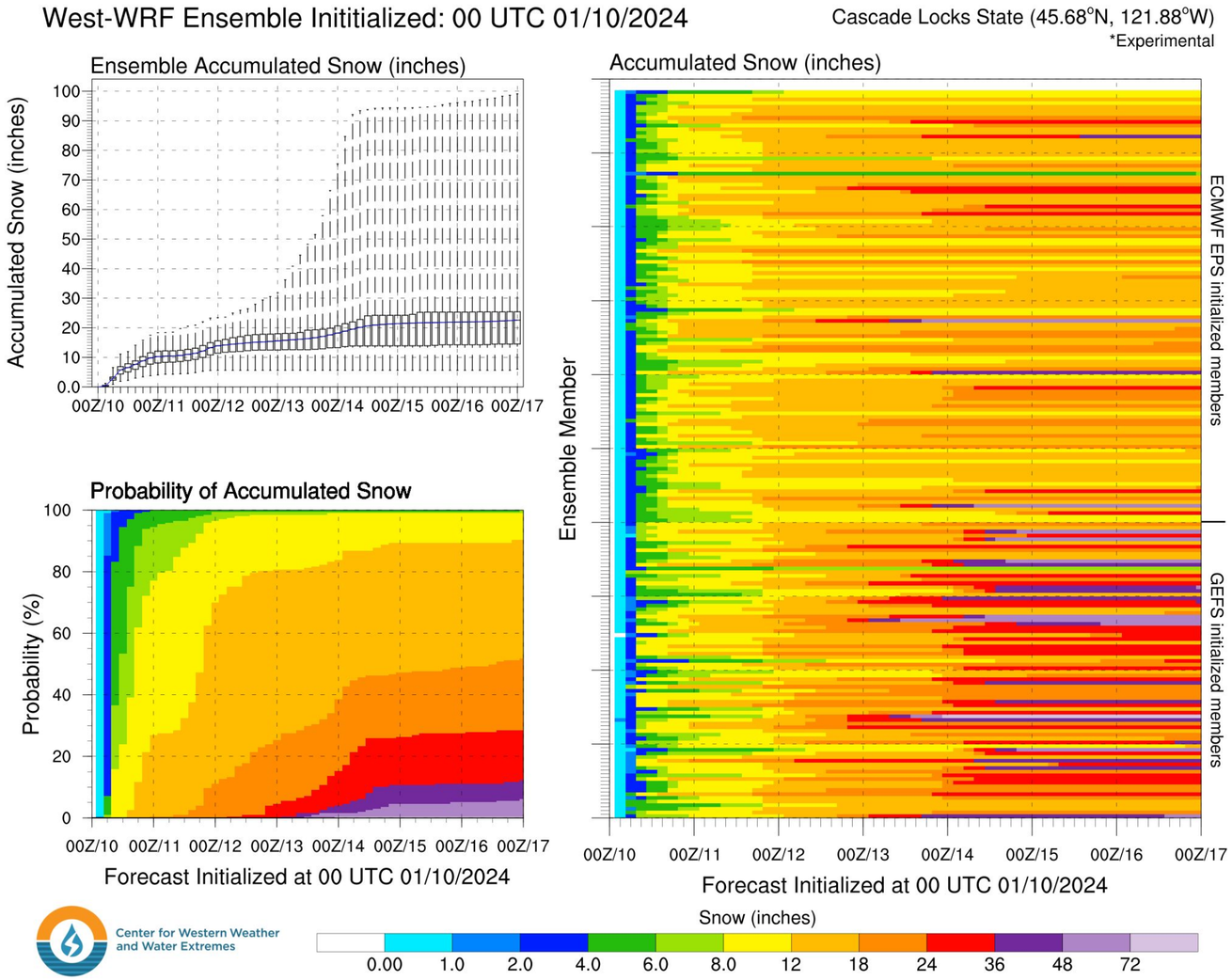
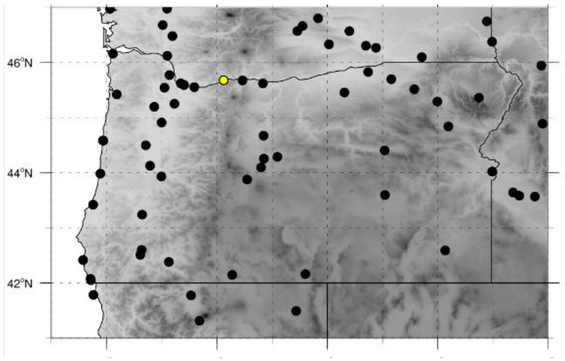
West-WRF Ensemble Meteogram





- For this location at Cascade Locks State Airport along the WA/OR border, the West-WRF ensemble members are forecasting a ~80% chance of 12”+ of accumulated snowfall in the next 7 days.
- Every member but two are forecasting at least 8” of accumulated snow, with several members forecasting totals greater than 36” for this station as well.
- The ensemble spread for this location is also quite large, highlighting the uncertainty throughout the west coast for this event.

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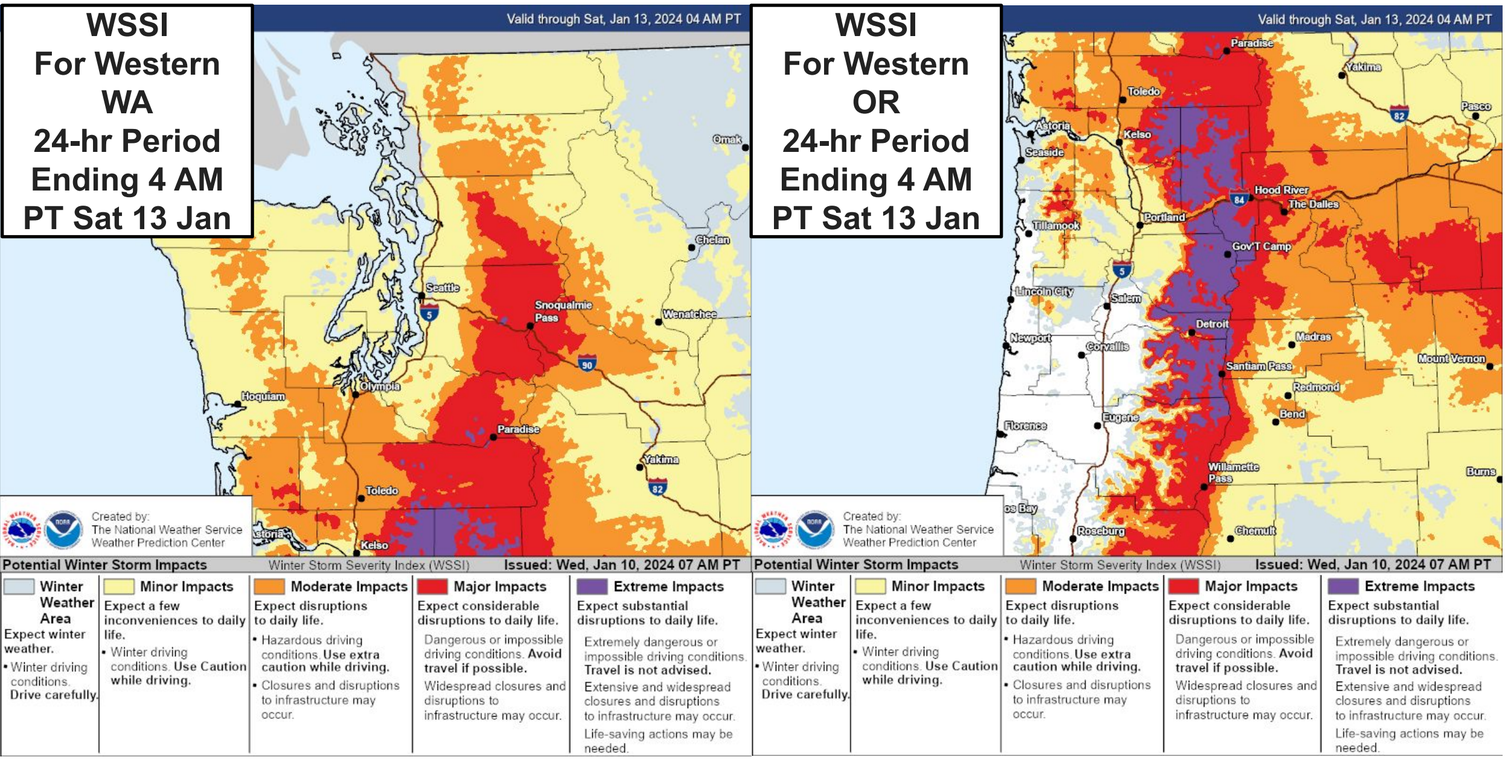
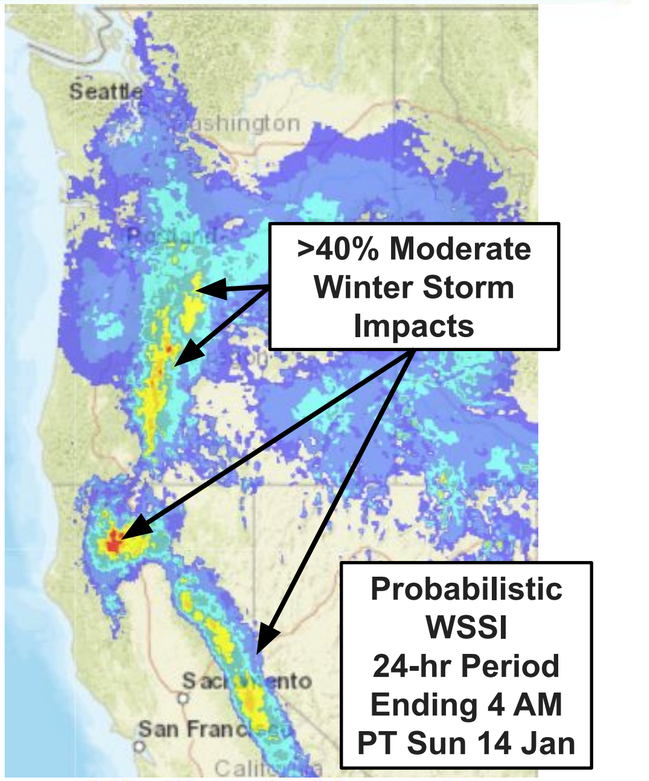
WPC Winter Storm Severity Index (WSSI) and Probabilistic WSSI

WSSI For Western WA 24-hr Period Ending 4 AM PT Sat 13 Jan



WSSI For Western OR 24-hr Period Ending 4 AM PT Sat 13 Jan



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 13 Jan highlights likelihood for **major impacts** throughout the Cascades with substantial regions of extreme impacts.
- The probabilistic WSSI is forecasting greater than 40% chance for moderate winter storm impacts along the S. Cascades and Sierras for the period ending 4 AM PT Sun 14 Jan and along the Southern Cascades for the period ending 4 AM PT Sun 14 Jan.