CW3E Atmospheric River Outlook: 5 Jan 2024

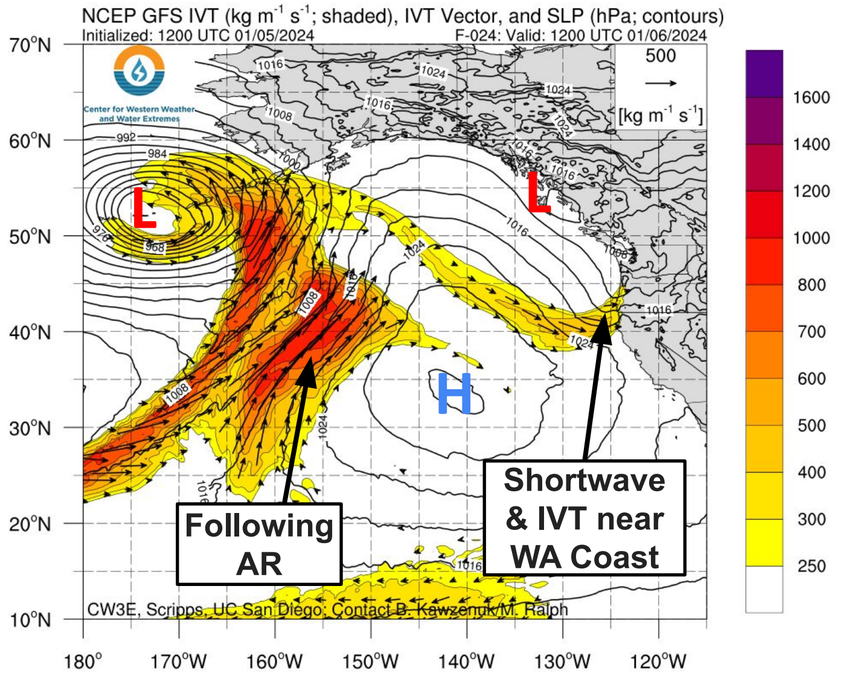
Winter Weather Set to Impact US West Coast this Weekend into Early Next Week

- A series of upper-level shortwave troughs and an atmospheric river (AR) will help drive winter weather set to impact the US West Coast from late Fri 5 Jan through the end of next week.
- The first period of winter weather begins late Fri 5 Jan when the shortwave trough is forecast to form off the PNW coast, deepening and eventually progressing east throughout Sat 6 Jan.
- The second period of winter weather is driven by an AR that is forecast to make landfall as an AR1 to AR2 (based on Ralph et al. 2019 AR scale) into the PNW early Mon 8 Jan.
- A second and third shortwave are forecast to move into the region late Tue 9 Jan and late Thu 11 Jan respectively, continuing the unsettled weather in the region.
- For the 7-day period encompassing both shortwaves and the AR, significant snowfall accumulations are expected in the Cascades and Sierra Nevada ranges.
- The Weather Prediction Center's (WPC) Winter Storm Severity Index (WSSI) indicates that Major Impacts are expected in portions of the Sierra Nevada during the first winter storm period (ending Mon 8 Jan).
- The WPC’s probabilistic WSSI tools indicates greater than 60% chance of moderate impacts with the AR and shortwave trough for the Cascades.
- Given low seasonal snow amounts thus far, these systems will be beneficial for water resources across the region.

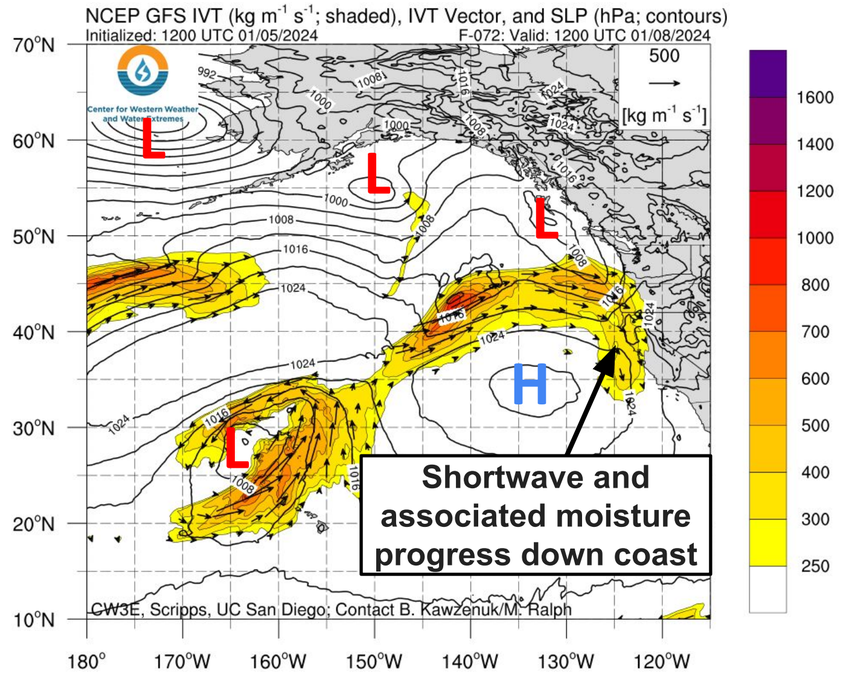
CW3E AR Outlook: 5 Jan 2024

GFS Init 12Z Fri 5 Jan 2024

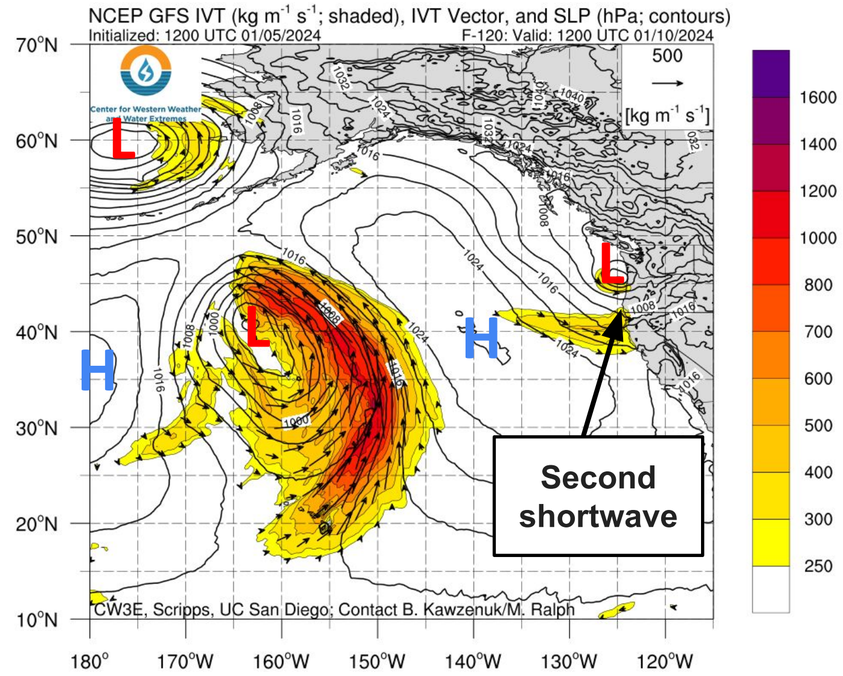
4AM PT Sat 6 Jan 2024



4AM PT Mon 8 Jan 2024



4AM PT Wed 10 Jan 2024

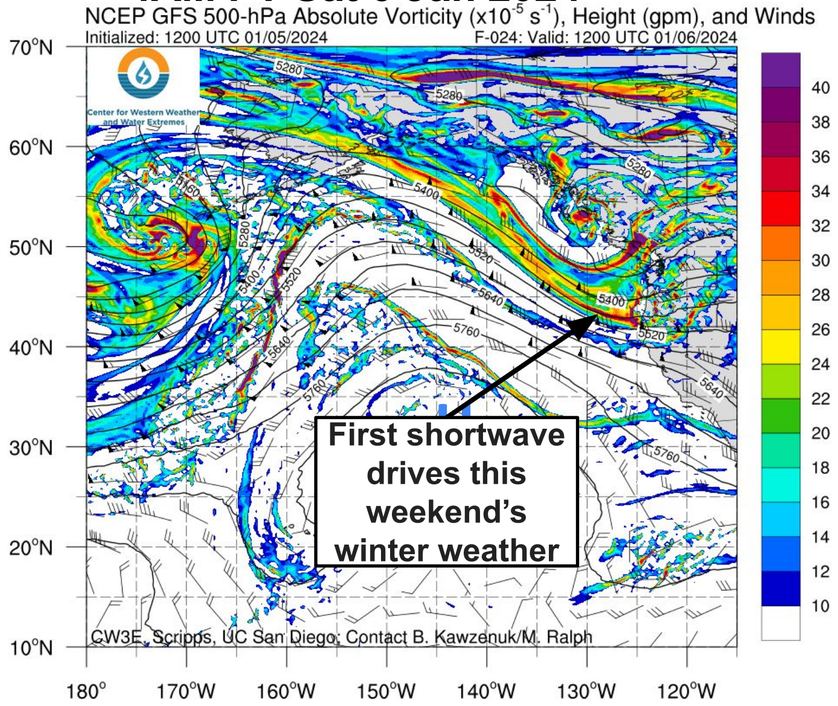


- A shortwave trough forms off the coast of the PNW late Fri 5 Jan, bringing IVT > 250 kg m^{-1} s^{-1} onshore late Fri 5 Jan into early Sat 6 Jan.
- An AR that developed to the north of Hawaii progresses over the ridge, making landfall in the PNW late Sun 7 Jan into early Mon 8 Jan.
- A second shortwave moves into PNW from the north late Tue 9 Jan into early Wed 10 Jan, helping to continue the winter weather in the region.

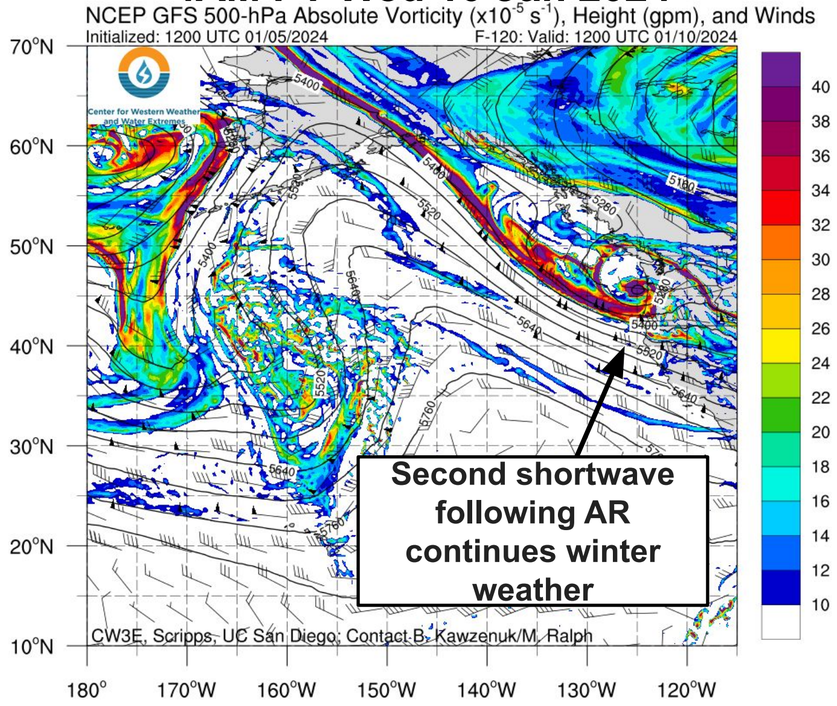
CW3E AR Outlook: 5 Jan 2024

GFS Init 12Z Fri 5 Jan 2024

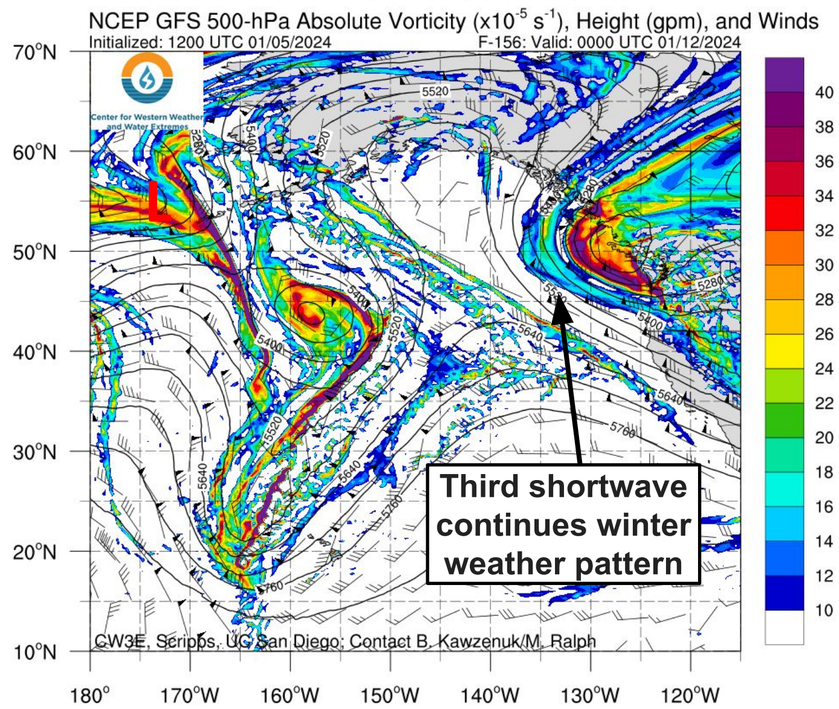
4AM PT Sat 6 Jan 2024



4AM PT Wed 10 Jan 2024

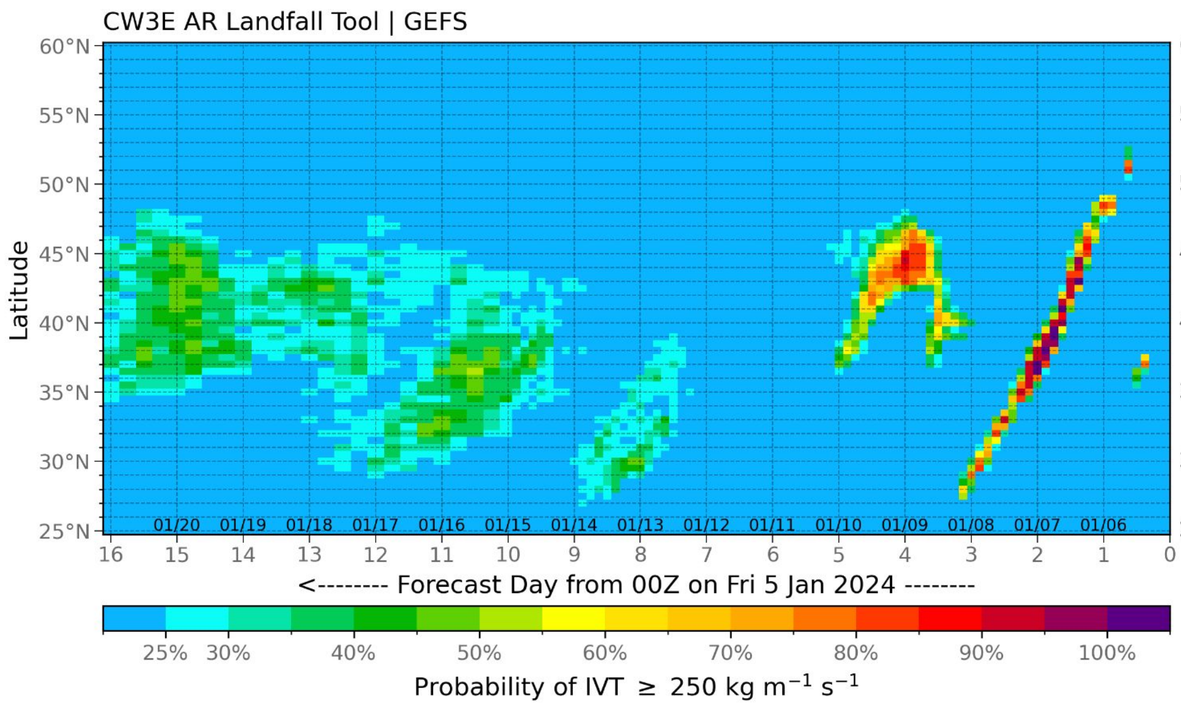


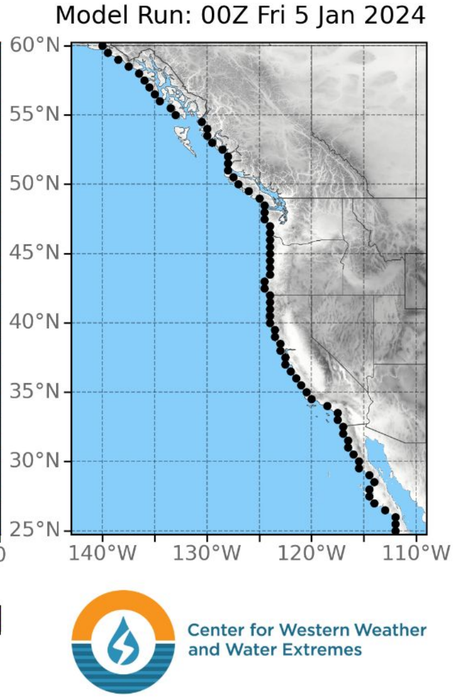
4PM PT Thu 11 Jan 2024

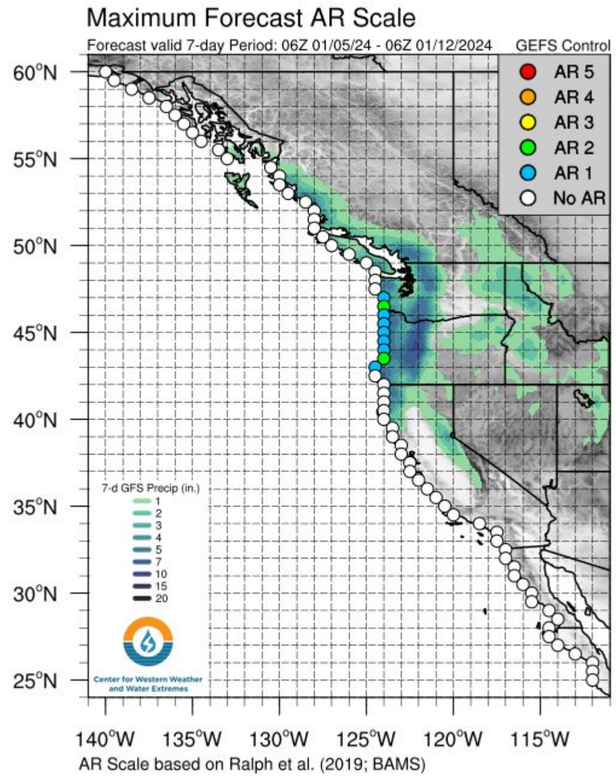


- The series of shortwave troughs are forecast to helps bring precipitation to the USWC.
- The first shortwave is forecast to begin forming and moving onshore in the PNW by early Sat 6 Jan, deepening and moving down the USWC through early Sun 7 Jan.
- The second shortwave trough is forecast to move onshore late Tue 9 Jan through Wed 10 Jan following the dissipation of the AR. This will help continue precipitation in the PNW
- The third potential shortwave trough is forecast move into the region following the passage of the second shortwave trough late Thu 11 Jan

CW3E AR Outlook: 5 Jan 2024



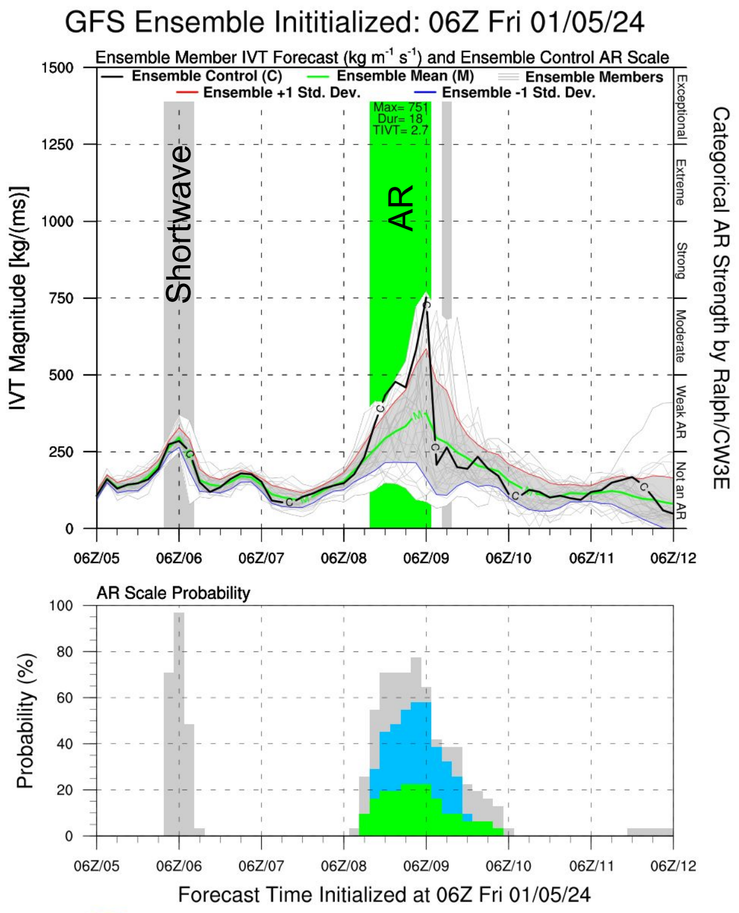


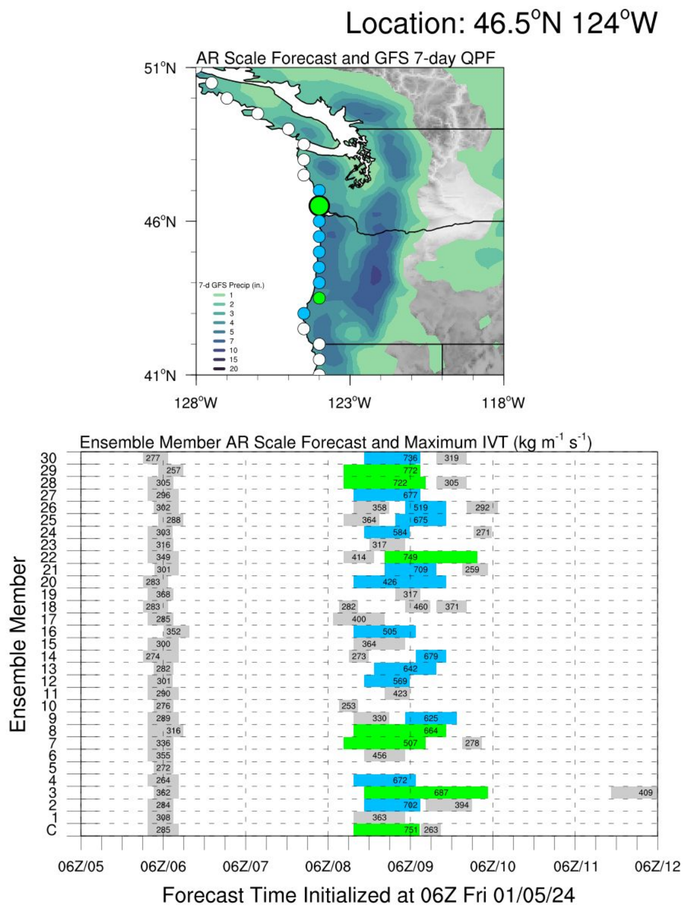


- The GEFS is showing very high confidence (>85%) in IVT > 250 kg m^{-1} s^{-1} moving down the US West Coast from Sat 6 Jan through Mon 8 Jan for a short duration at each location.
- The GEFS is also quite confident (> 70% probability) in a period (beginning late on Mon 8 Jan) of IVT > 250 kg m^{-1} s^{-1} with the second AR making landfall in the PNW
- There is a lower (40-60%) probability of IVT > 250 kg m^{-1} s^{-1} extending into Northern California near the end of the AR.
- The GEFS control is forecasting AR1 to AR2 conditions in coastal OR and WA for this AR.

CW3E AR Outlook: 5 Jan 2024

GEFS 7-day AR Scale and IVT





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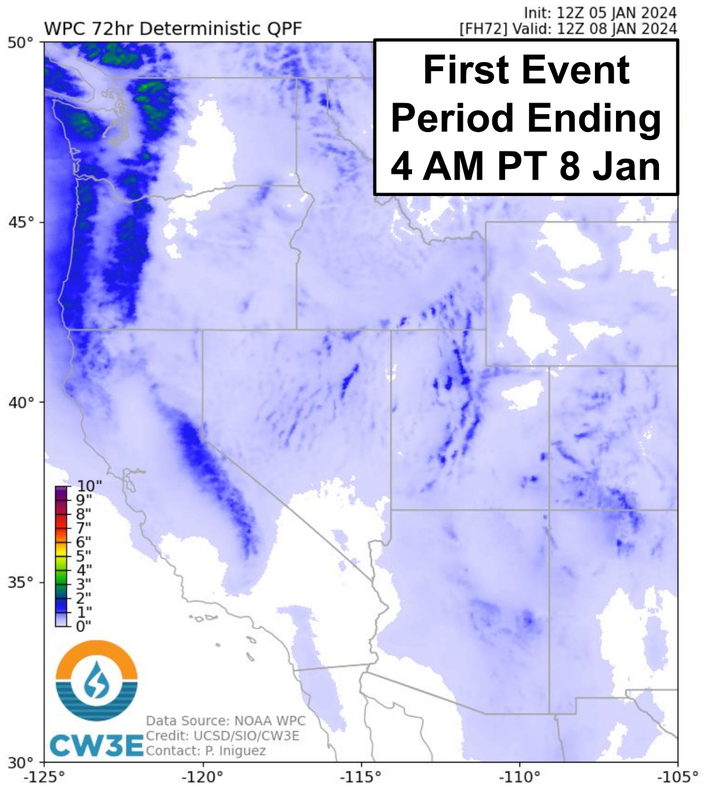
AR 1 AR 2 AR 3 AR 4 AR 5

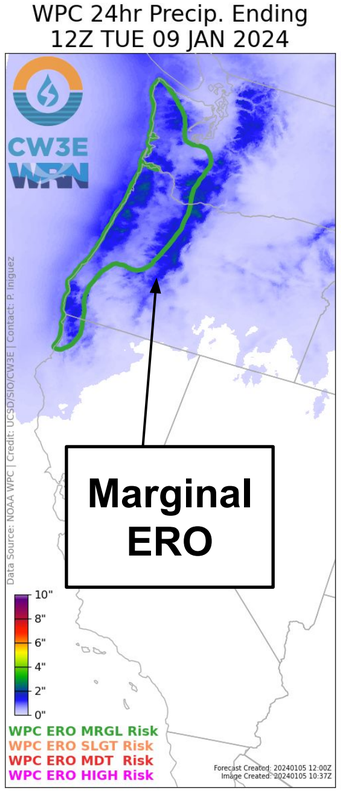
Image created: 12 UTC 01/05/2024

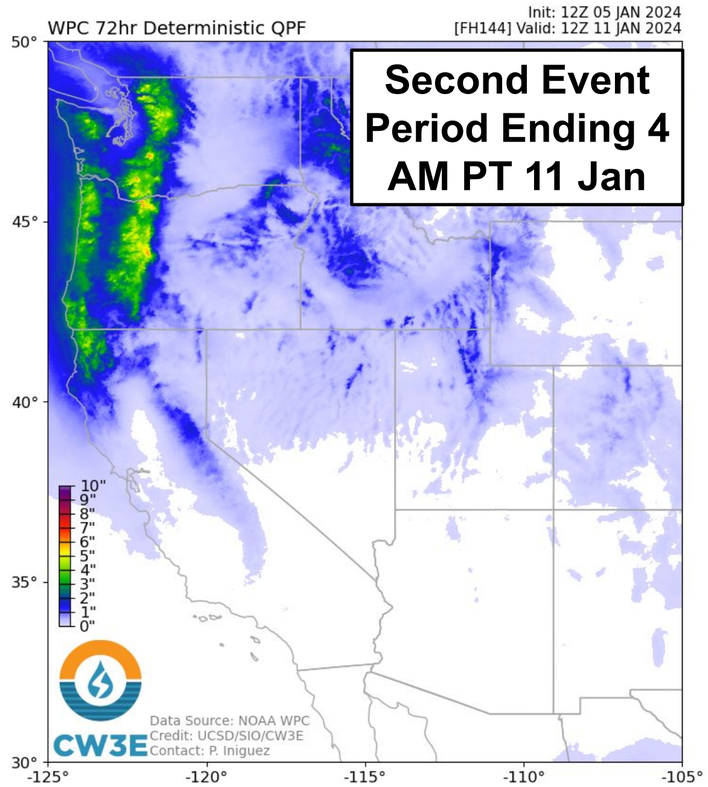
More information: http://cw3e.ucsd.edu AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

- The GEFS control member is forecasting an AR on Mon 8 Jan through Tue 9 Jan for the point at 46.5^0 N, 124^0 W (coastal WA/OR border).
- 21/31 (68%) GEFS ensemble members are forecasting at least AR1 conditions during the AR on 8-9 Jan.
- 7/31 (23%) of the members (including the control) are forecasting at least AR2 conditions.
- There is uncertainty in the duration and timing of AR conditions amongst GEFS members.

CW3E AR Outlook: 5 Jan 2024





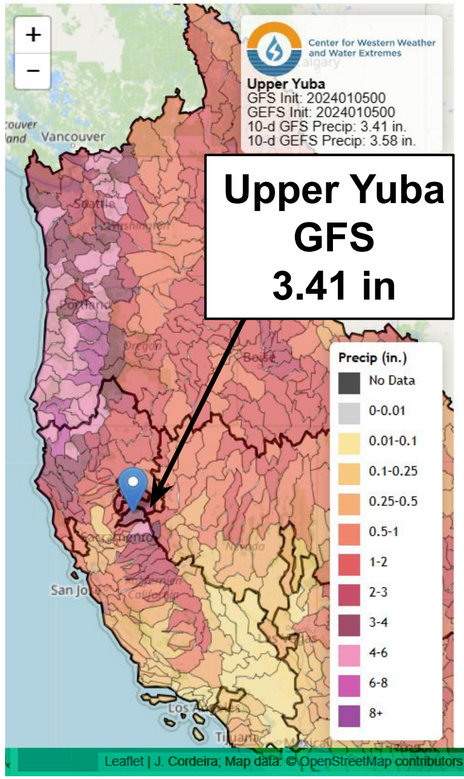


- The NWS WPC 3-day precipitation totals for the periods ending at 4 AM PT Sun 8 Jan and 4 AM PT Thu 11 Jan are the highest for regions along the OR, WA and N. CA coasts and into the Cascades and N. Sierras.
- The 3-day precipitation totals are forecast to exceed 1” for the peak regions for the period ending at 4 AM PT Mon 8 Jan. Heavier precip is expected during the second 3-day period with totals forecast to exceed 3” along the WA/OR/N.CA coasts and Cascades.
- The WPC Excessive Rainfall Outlook indicates a Marginal Risk (level 1 of 4, or at least 5% chance) for flooding to occur across for WA/OR/ N.CA coast and foothills of the Cascades for the 24-hour periods ending at 4 AM PT on 9 Jan.

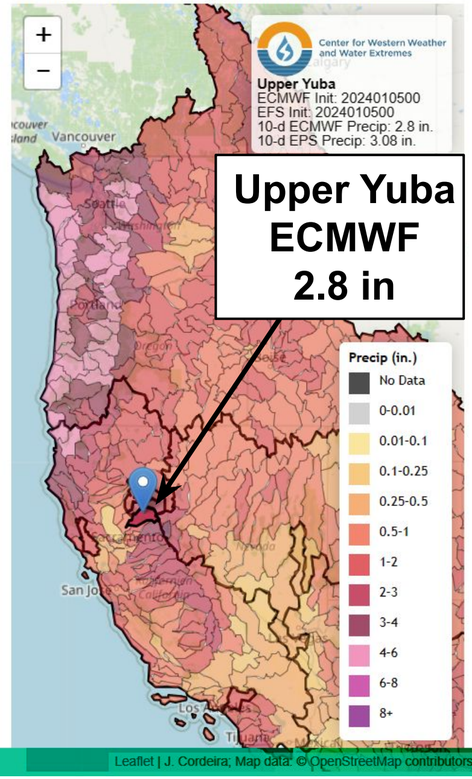
CW3E AR Outlook: 5 Jan 2024

10-day Watershed Precipitation Forecasts (Initialized 00Z 27 Dec)

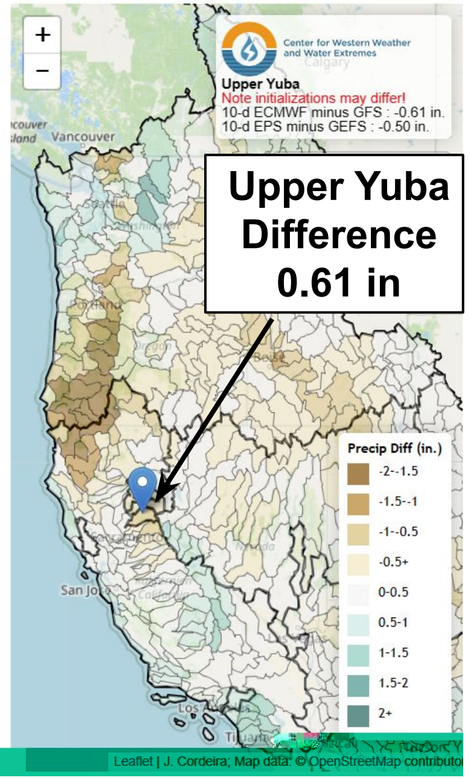
10-day GFS/GEFS Precipitation Forecasts

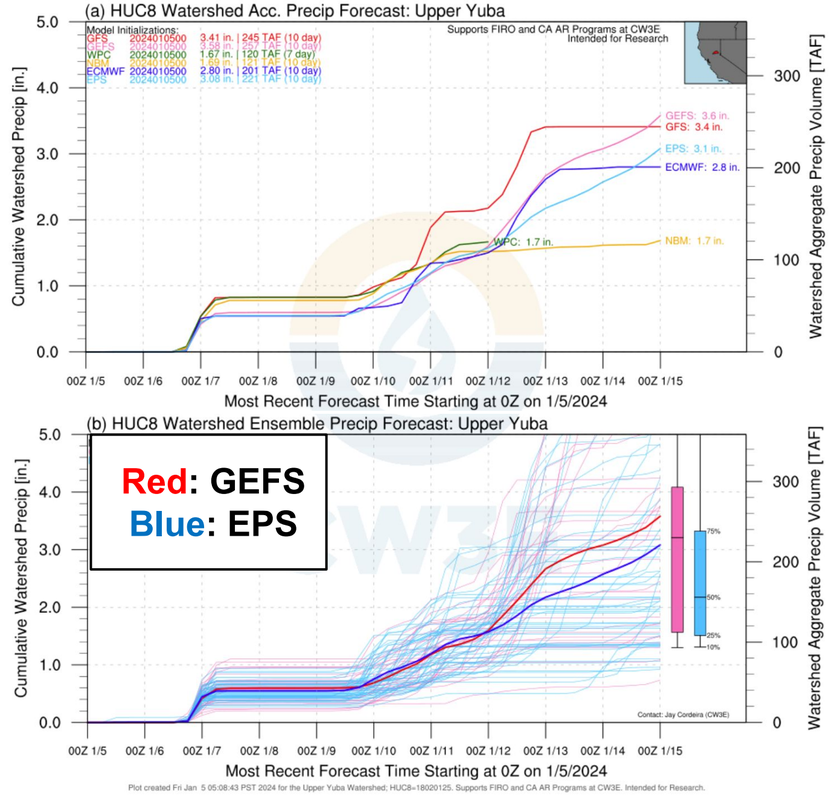


10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast





- The 00Z ECMWF and 00Z GFS are forecasting similar 10-day watershed precipitation totals in the Sierras and WA. Primary forecast differences are in the Southern Cascades and along the OR/CA border, where the GFS is forecasting 1.5” to 2” greater 10-day precipitation.
- The 00Z GFS is forecasting 3.41” of mean areal precipitation in the Upper Yuba watershed over the next 10 days, while the 00Z ECMWF is forecasting 2.8” over the same watershed. Both ensembles’ members show large uncertainty in the 10-day totals.

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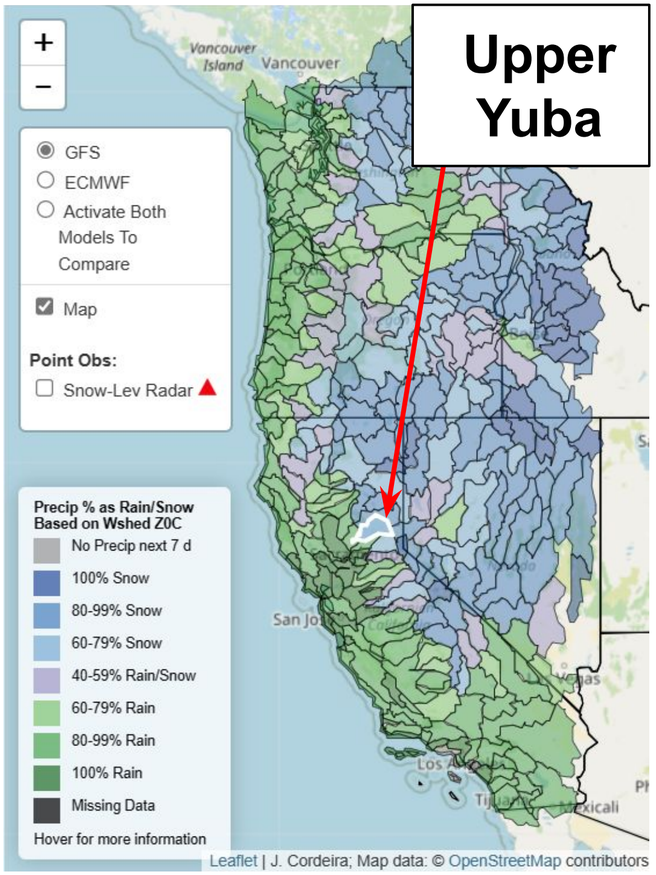
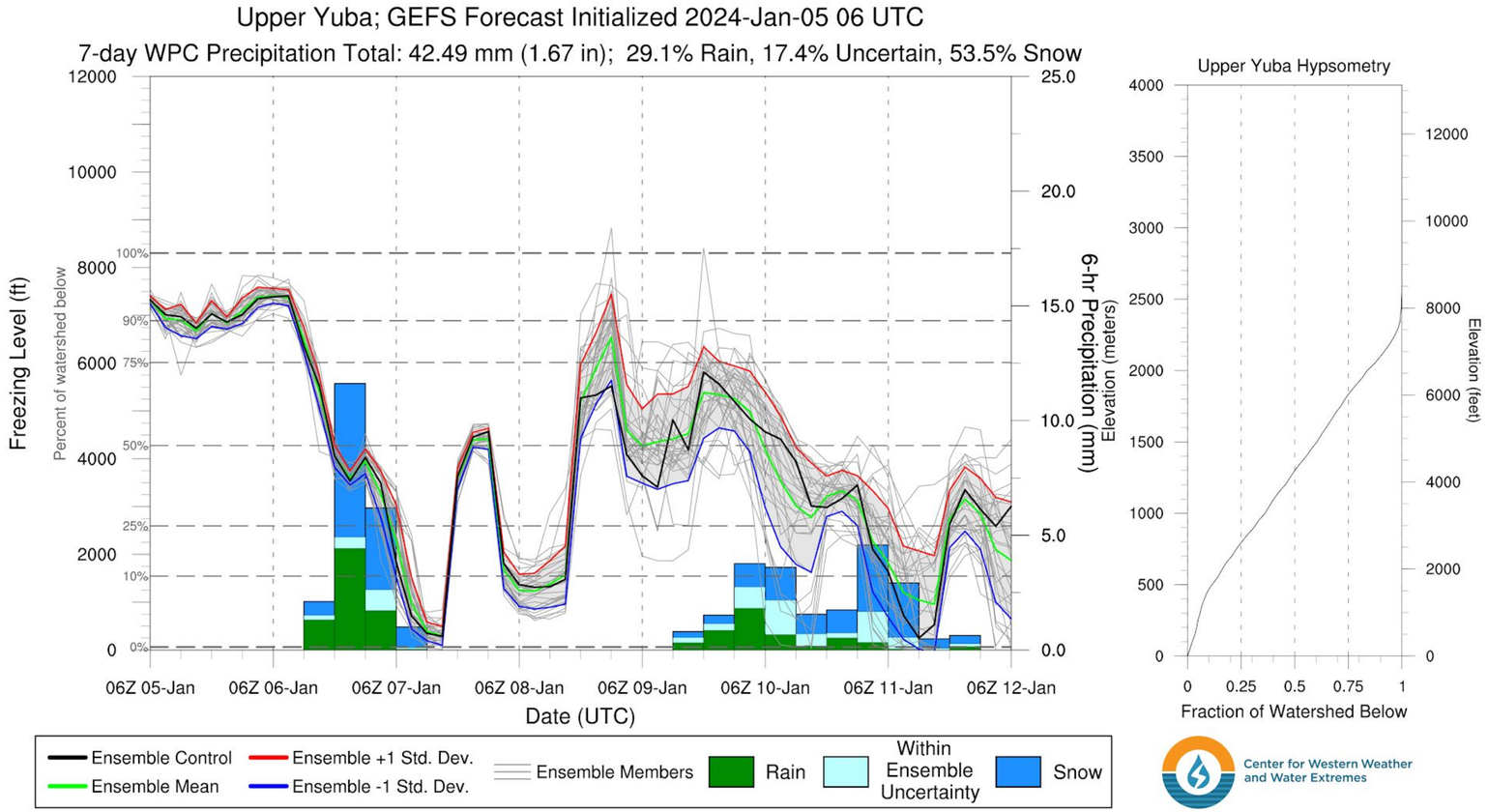
Freezing Level Forecast





- The Freezing level is forecast to fall from ~6000 ft above MSL to ~0 ft above MSL during the first event, rise during the break in conditions, then fall from ~5000 - 7000 ft to around 0 ft again during the second event
- The CW3E watershed freezing level tool is forecasting 53.5%+ of the precipitation in the Upper Yuba watershed to fall as snow

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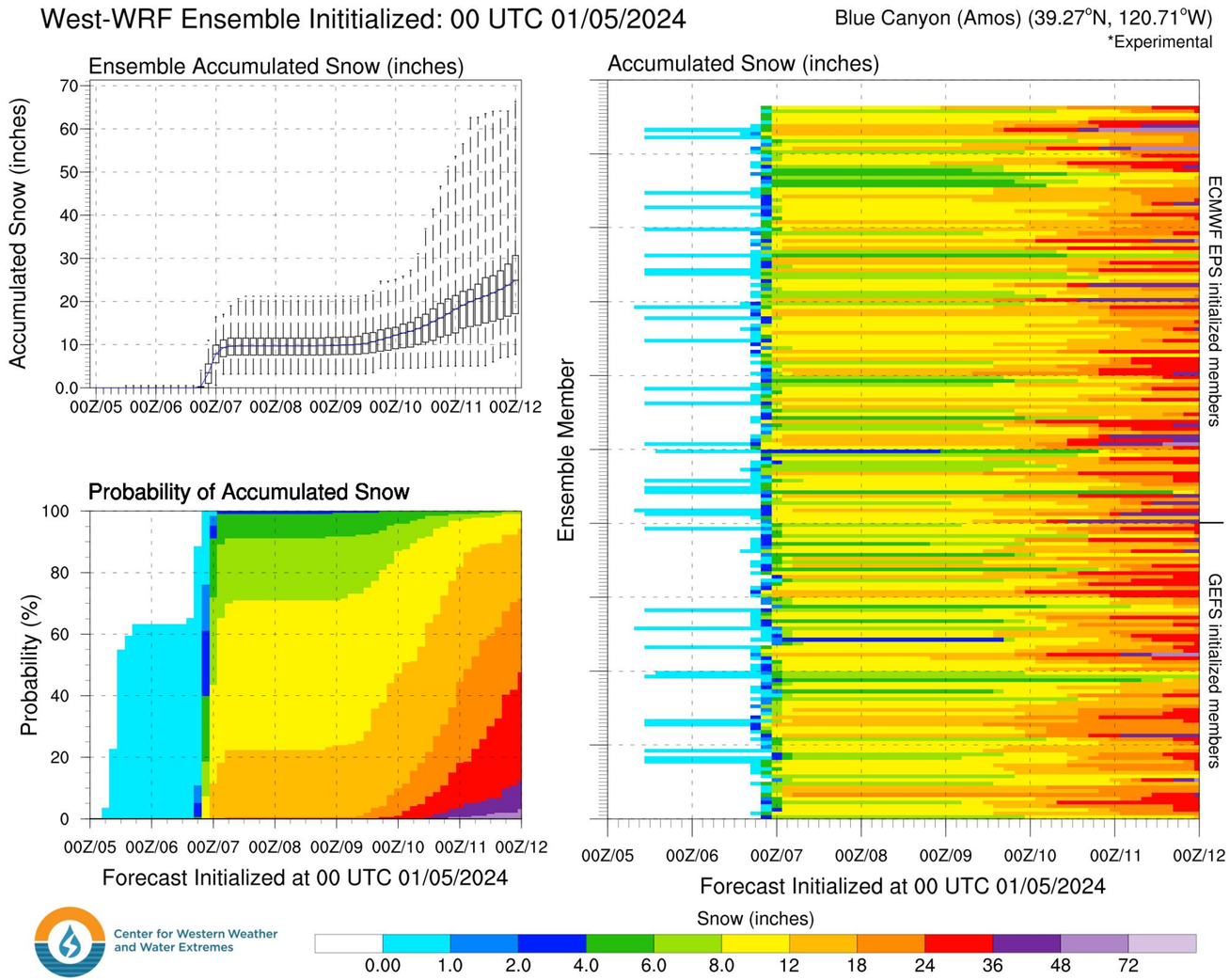
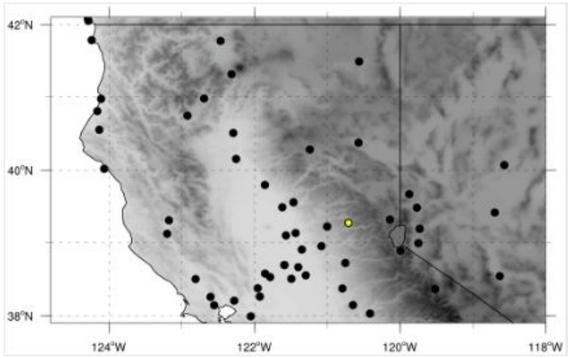
West-WRF Ensemble Meteogram





- 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 >70% chance of 18”+ of accumulated snowfall in the next 7-days
- Every member that ran is forecasting at least 8” of accumulated snow, with several members forecasting totals greater than 36”

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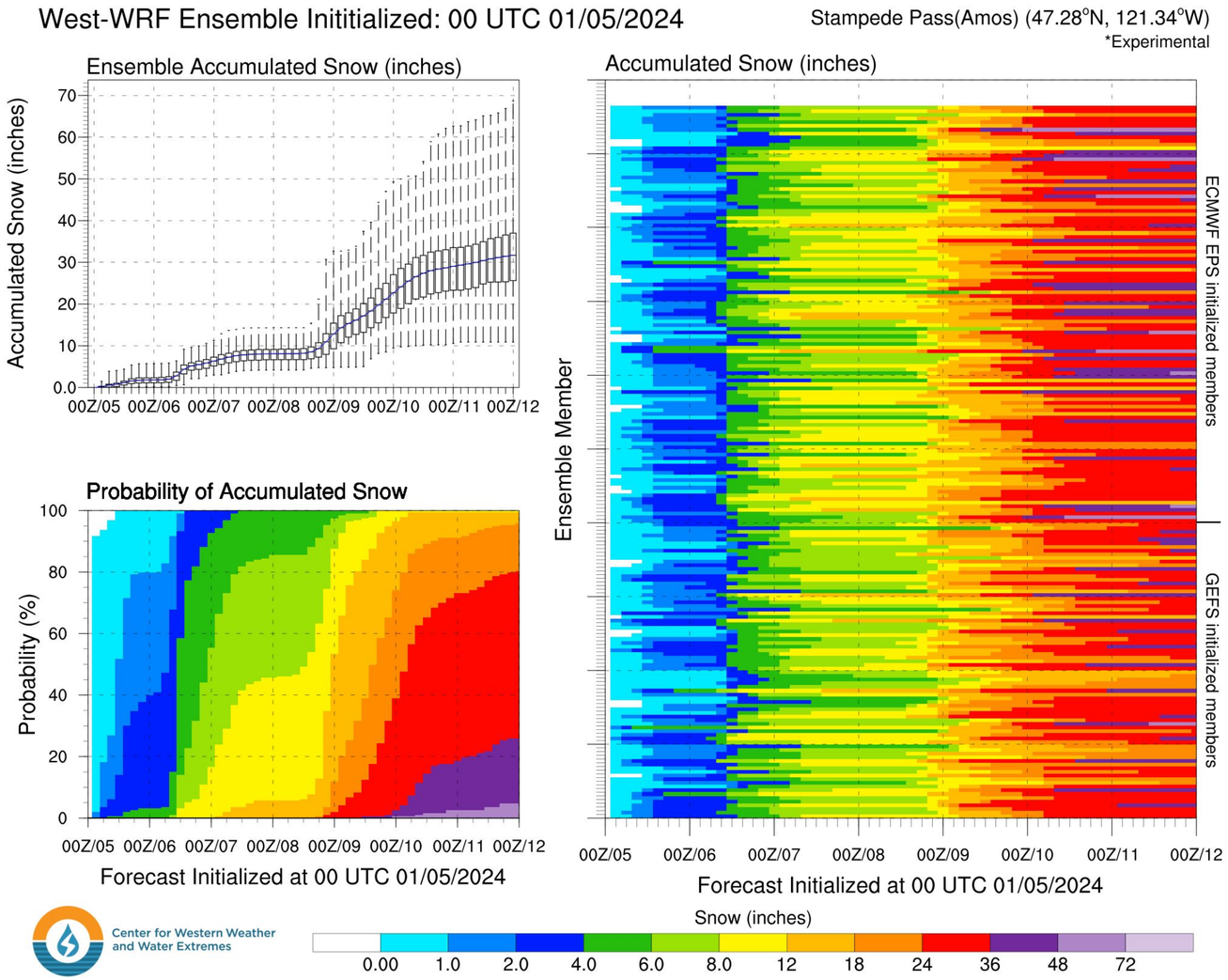
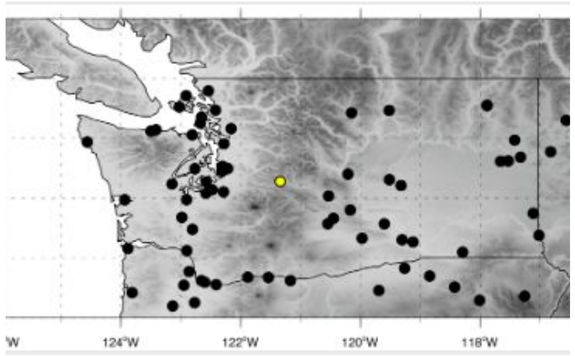
West-WRF Ensemble Meteogram





- For this location at Stampede Pass in the WA Cascades, the West-WRF ensemble members are forecasting a >80% chance of 18”+ of accumulated snowfall in the next 7-days
- Every member but one are forecasting at least 12” of accumulated snow, with several members forecasting totals greater than 36” for this station as well

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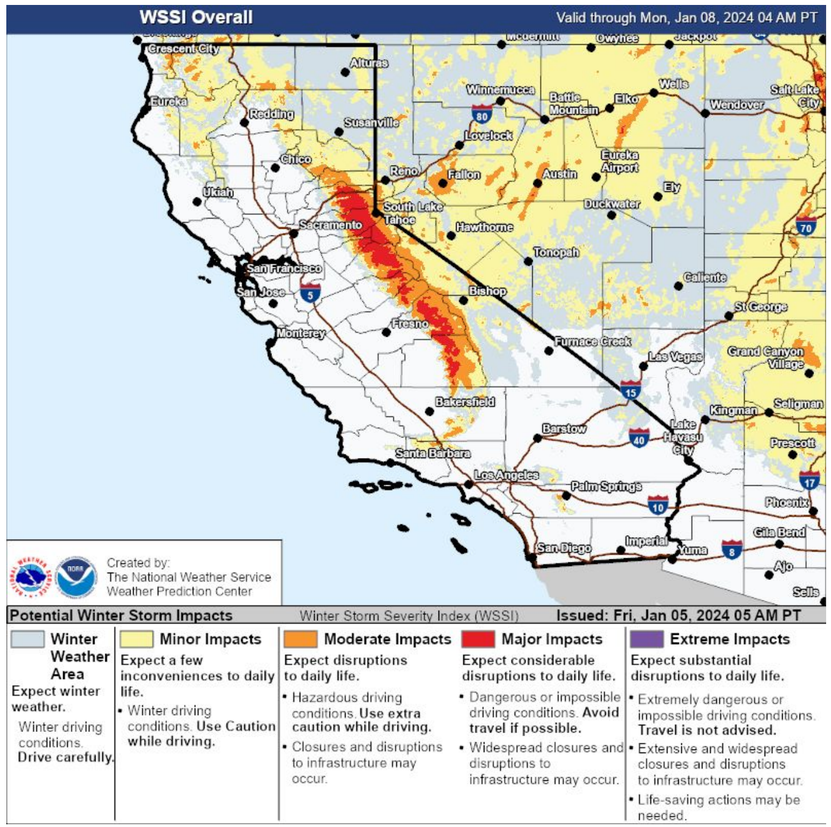
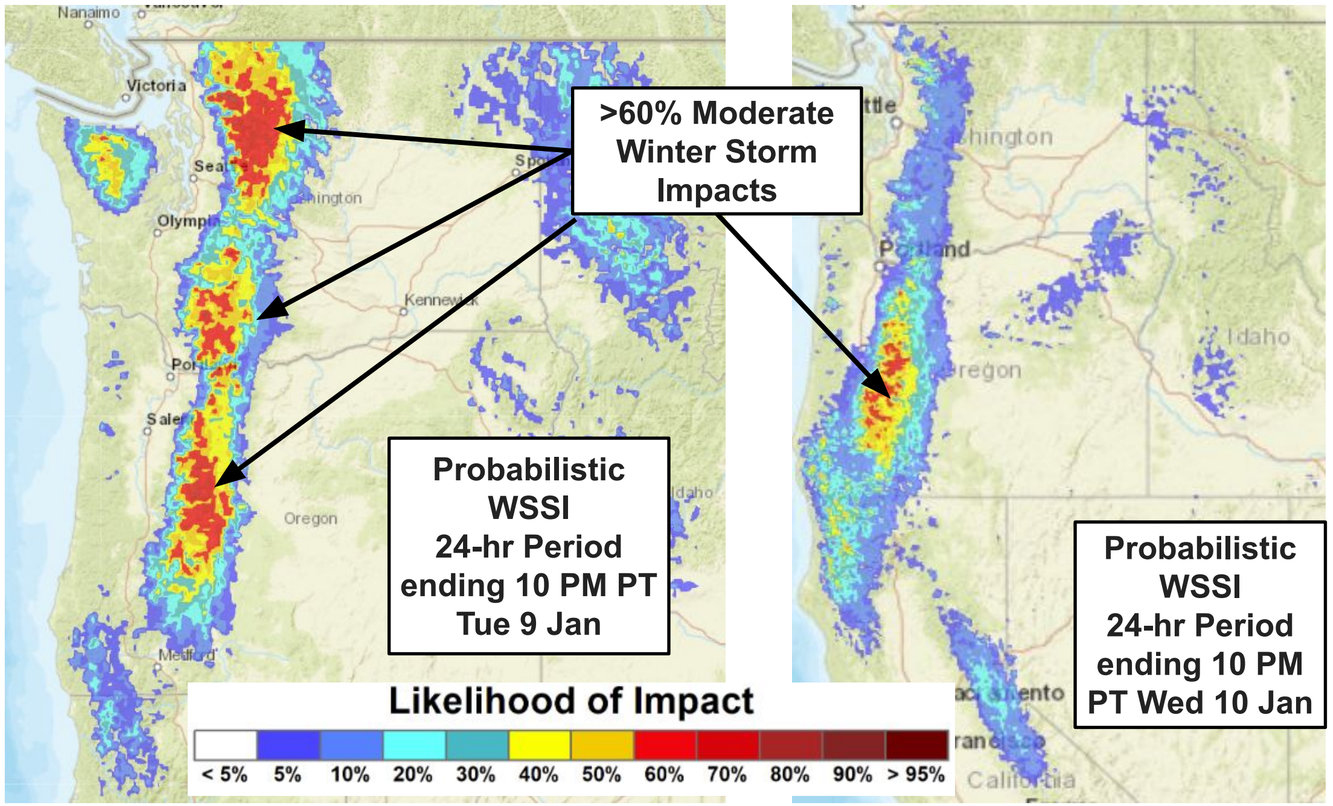
WPC Winter Storm Severity Index (WSSI) and Probabilistic WSSI





- WPC WSSI for the 3-day period ending at Mon 8 Jan highlights likelihood for moderate impacts throughout the Sierras with substantial regions of major impacts.
- The probabilistic WSSI is forecasts greater than 60% chance for moderate winter storm impacts along the Cascades for the period ending 10 PM PT Tue 9 Jan and along the Southern Cascades for the period ending 10 PM PT Wed 10 Jan

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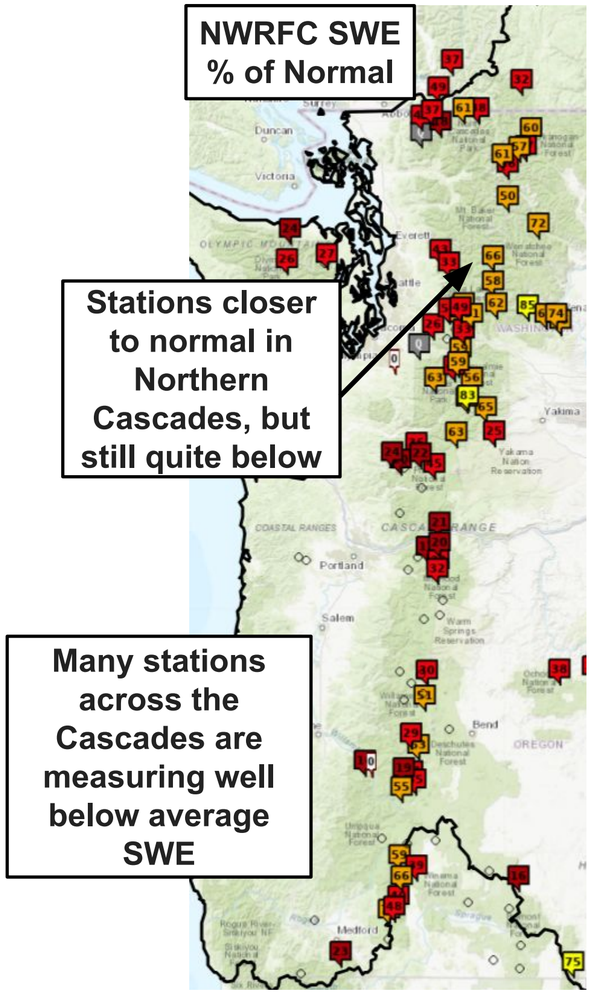
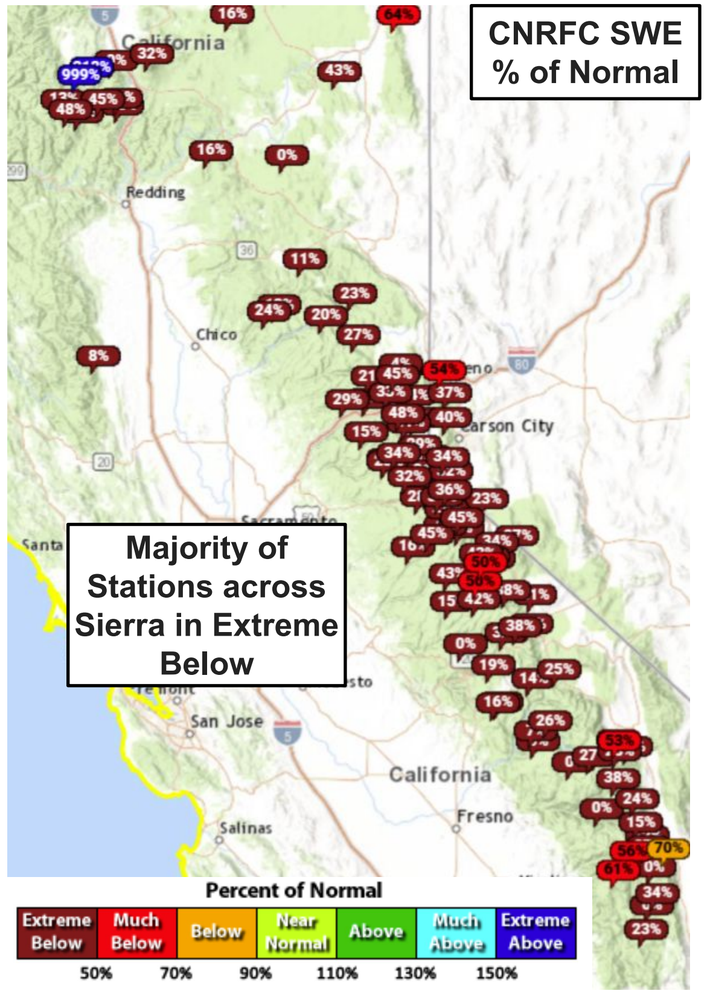
NWRFC and CNRFC Snow Water Equivalent (SWE) Percent of Normal (as of 5 Jan 2024)



Source: NWRFC; https://www.nwrfc.noaa.gov/snow/index.html?version=20201207v1



Source: CNRFC; https://www.cnrfc.noaa.gov/?product=zeroSWEavg&zoom=7&lat=38.386&lng=-118.982

- The majority of stations measuring and reporting SWE in the Cascades and Sierras are well below normal
- All but seven of the stations in the Sierras reporting data to the CNRFC are in the '**Extreme Below**' category, indicating that they have received less than 50% of their normal SWE
- Similarly, many of the stations across the Cascades reporting to the NWRFC are around or below 50% percent of normal
- Given low seasonal snow amounts thus far, these systems will be beneficial for water resources across the region.