CW3E Atmospheric River Outlook: 16 Oct 2024

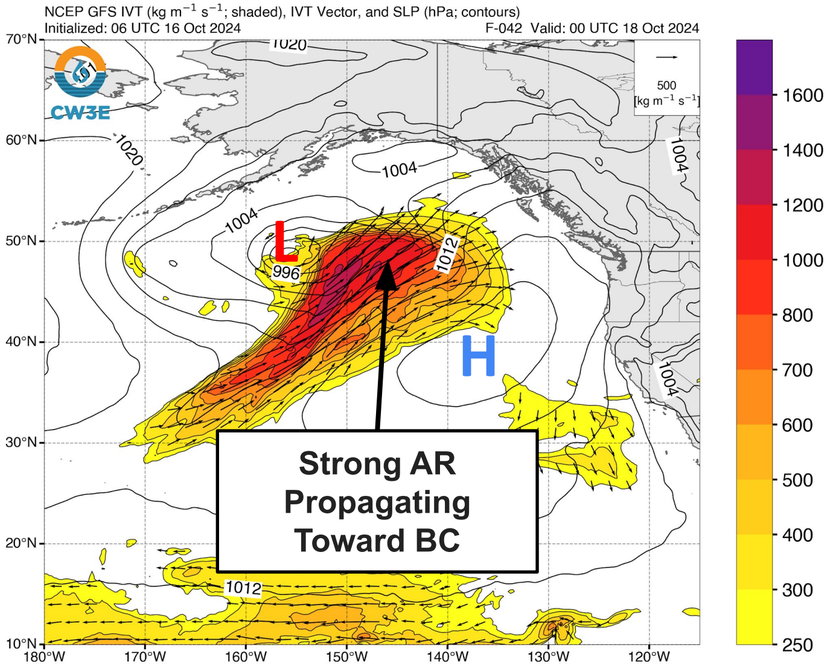
AR to Produce Heavy Rain over Pacific Northwest and British Columbia

- An atmospheric river (AR) and low-pressure system will bring heavy precipitation to the Pacific Northwest and Southwest British Columbia from Fri 18 Oct through at least Sun 20 Oct.
- The AR is forecast to make initial landfall over British Columbia Fri 18 Oct and progress down the coast toward the Pacific Northwest through the weekend.
- The ECMWF and GFS models differ regarding the development of a shortwave trough behind the initial AR. The ECMWF is forecasting a more amplified shortwave, leading to a second pulse of IVT that extends AR conditions over the Pacific Northwest.
- The GEFS control member is forecasting AR2 conditions (based on Ralph et al. 2019 AR scale) over the Pacific Northwest and and BC Coast while the EPS control member is forecasting AR4 conditions along the WA coast and AR3 conditions along the BC coast.
- The NWS Weather Prediction Center (WPC), GFS and ECMWF are all forecasting at least 3-6 inches or precipitation over the Olympic Peninsula, Cascade Mountains and Southwest British Columbia.
- The ECMWF is forecasting greater precipitation over the Olympic Peninsula than the GFS due to the longer duration of AR conditions.
- The British Columbia River Forecast Center (BCRFC) CLEVER discharge and return period forecast has three stations in southwestern British Columbia forecast to exceed a 100-year return period and two stations between 50 and 100 year return period
- Despite the forecasted river rise in Northwestern WA, the Northwest River Forecast Center is currently not forecasting any stations to exceed action stage at this time.

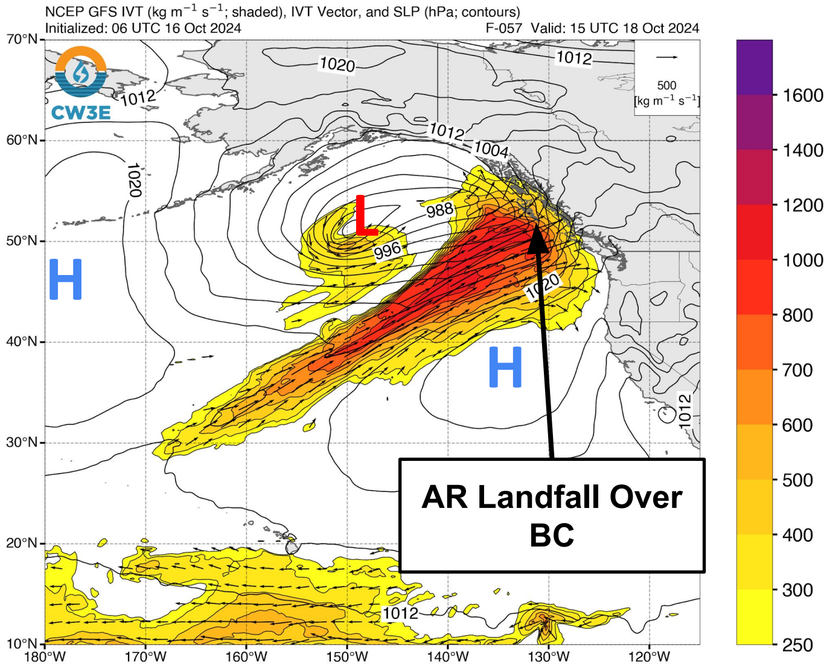
CW3E AR Outlook: 16 Oct 2024

GFS Initialized: 06Z Wed 16 Oct 2024

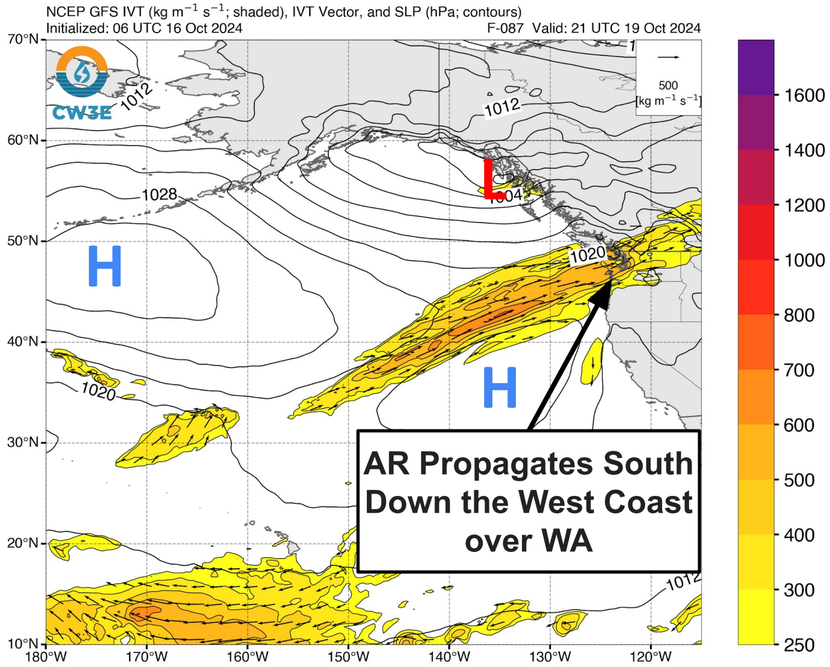
5PM PT Thu 17 Oct 2024



8AM PT Fri 18 Oct 2024



2PM PT Sat 19 Oct 2024

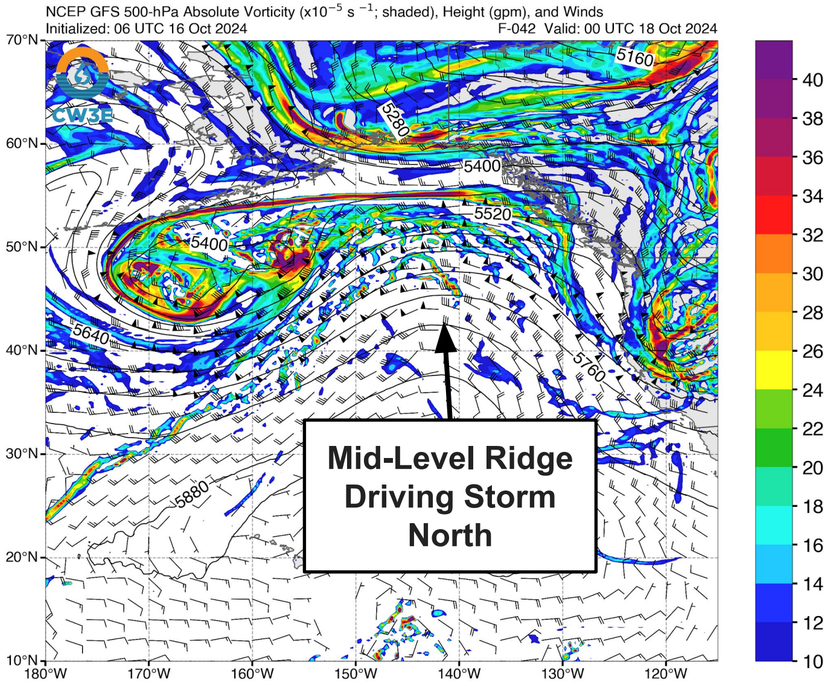


- An atmospheric river (AR) and an associated low-pressure system are forecast to propagate across the NE Pacific and approach British Columbia on Thu 17 Oct into Fri 18 Oct.
- The AR is forecast to make landfall over British Columbia early on Fri 18 Oct and progress down the coast toward the Pacific Northwest through Fri into Sat.

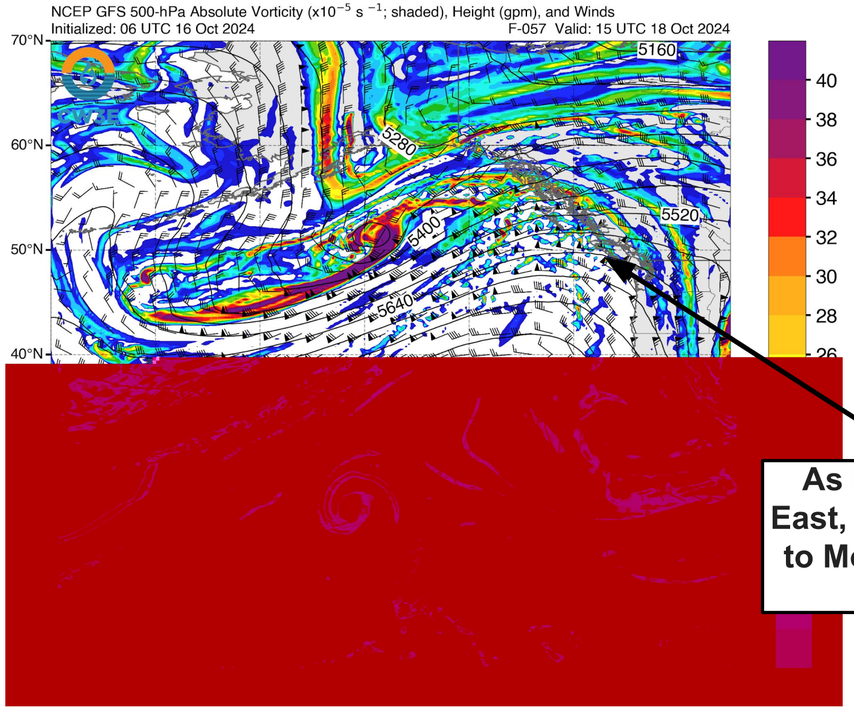
CW3E AR Outlook: 16 Oct 2024

GFS Init: 06Z Wed 16 Oct 2024

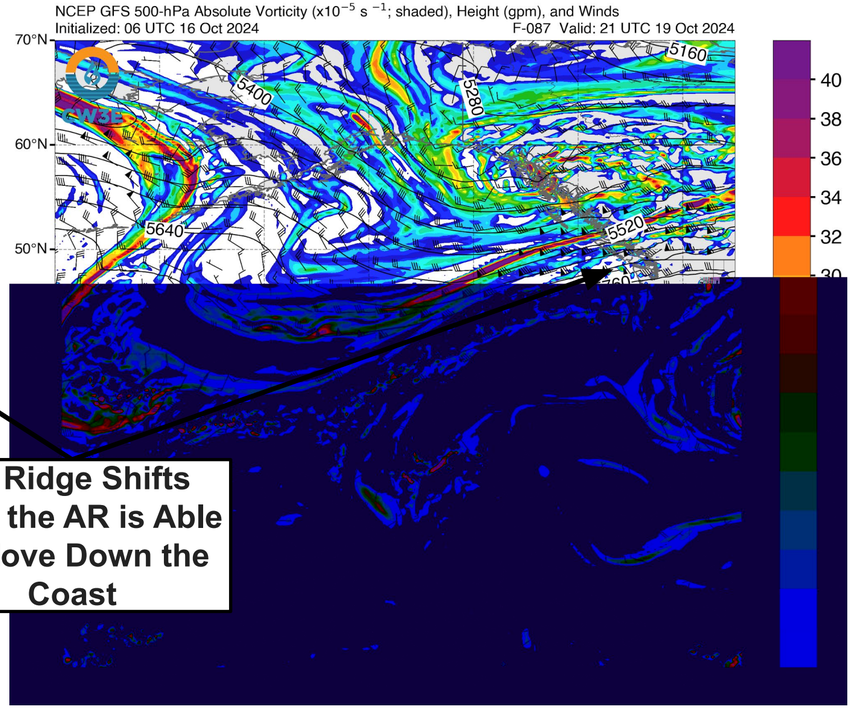
5PM PT Thu 17 Oct 2024



8AM PT Fri 18 Oct 2024



2PM PT Sat 19 Oct 2024

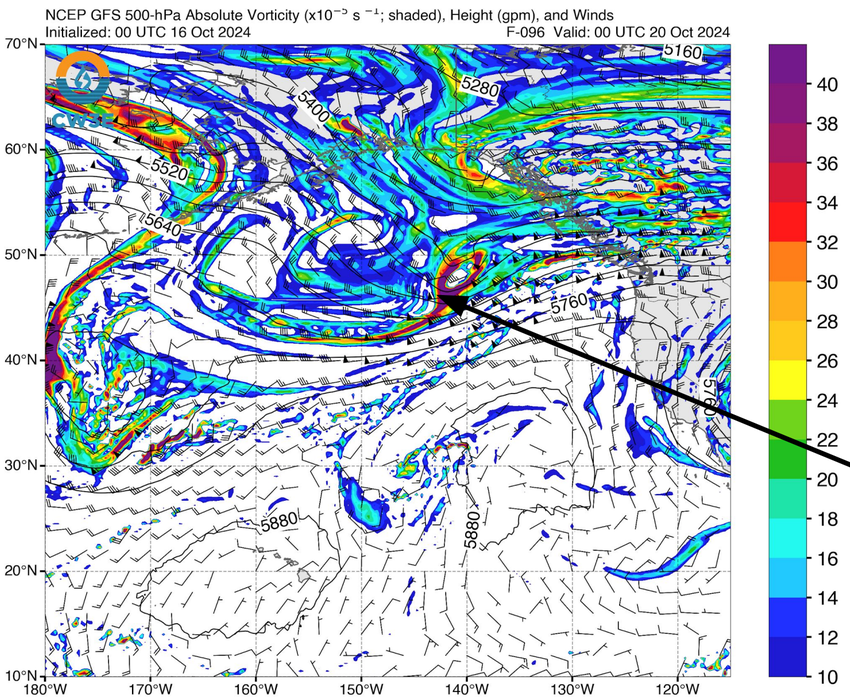


- The atmospheric river propagates toward the North American west coast with the leading edge of a trough developing in the Northeast Pacific.
- The positive tilt of the trough axis and relatively zonal flow present ingredients for a possible long duration AR event, however the GFS currently does not generate it as such.

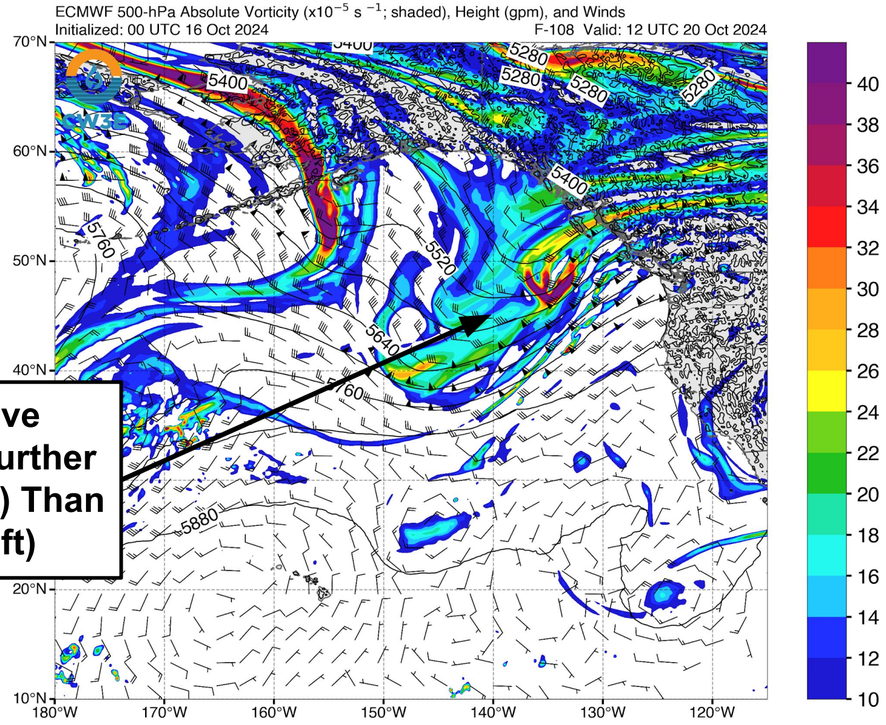
CW3E AR Outlook: 16 Oct 2024

Model Comparison; Valid 11 PM PT Sat Oct 19

00Z 16 Oct GFS 500-hPa



00Z 16 Oct ECMWF 500-hPa



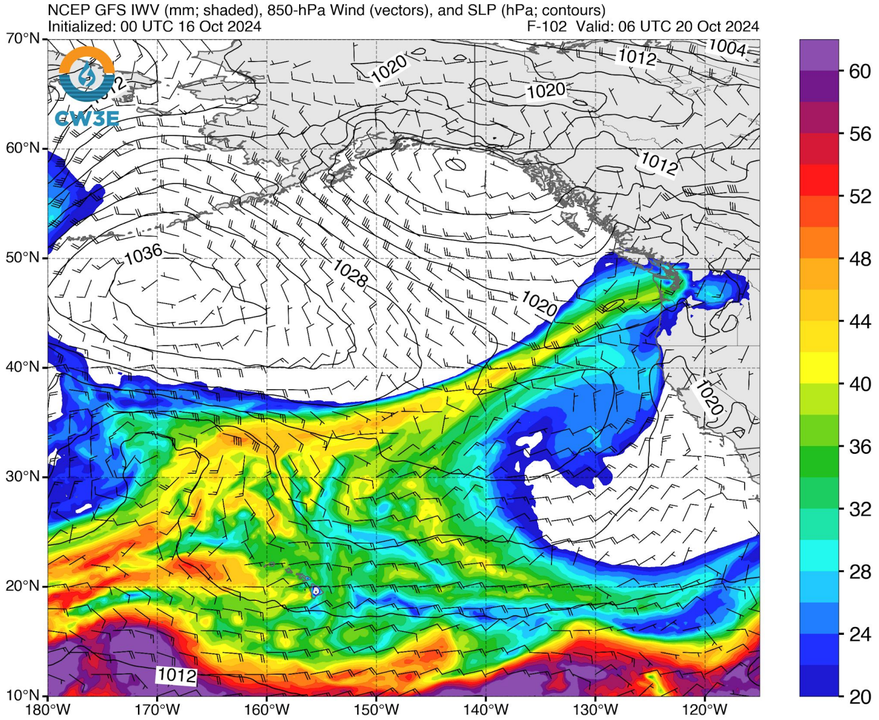
Shortwave Develops Further in EC (Right) Than GFS (Left)

- The 00Z ECMWF (*right*) forecasts a more amplified mid-level shortwave to develop on the northern side of the AR than the GFS (*left)*.

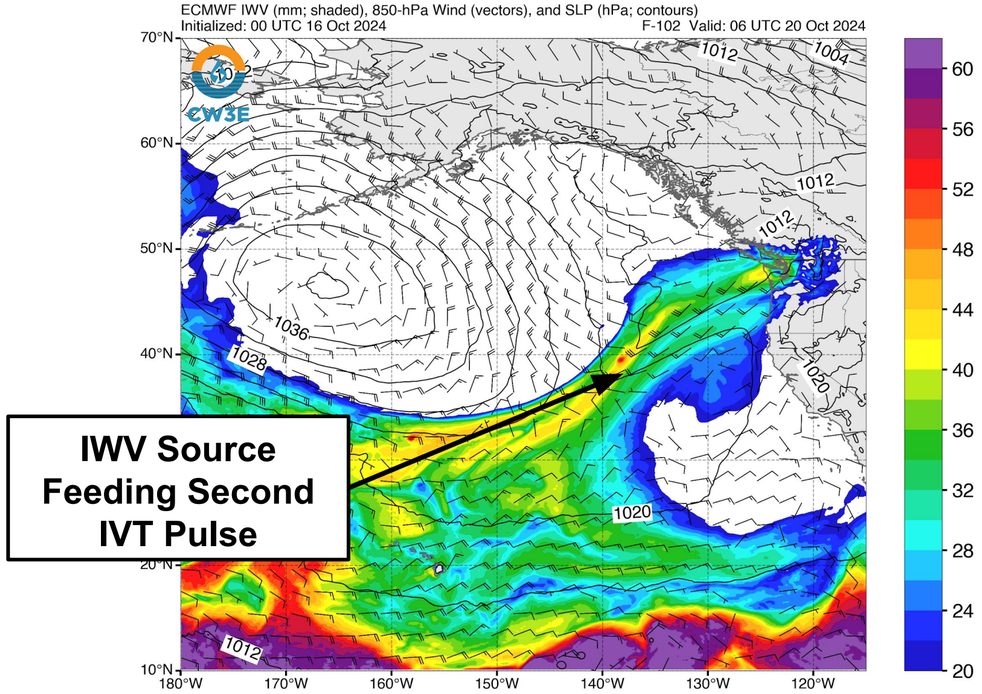
CW3E AR Outlook: 16 Oct 2024

Model Comparison; Valid 11 PM PT Sat Oct 19

00Z 16 Oct GFS IWV



00Z 16 Oct ECMWF IWV

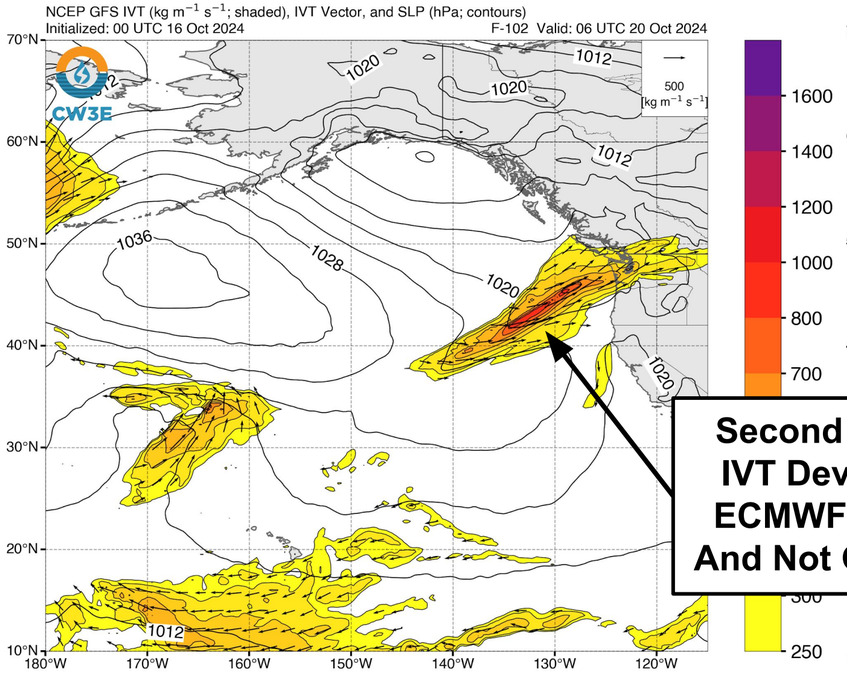


- As a result, the ECMWF (*right*) forecasts the AR to tap into more moisture on the back end of the system than the GFS (*left*)

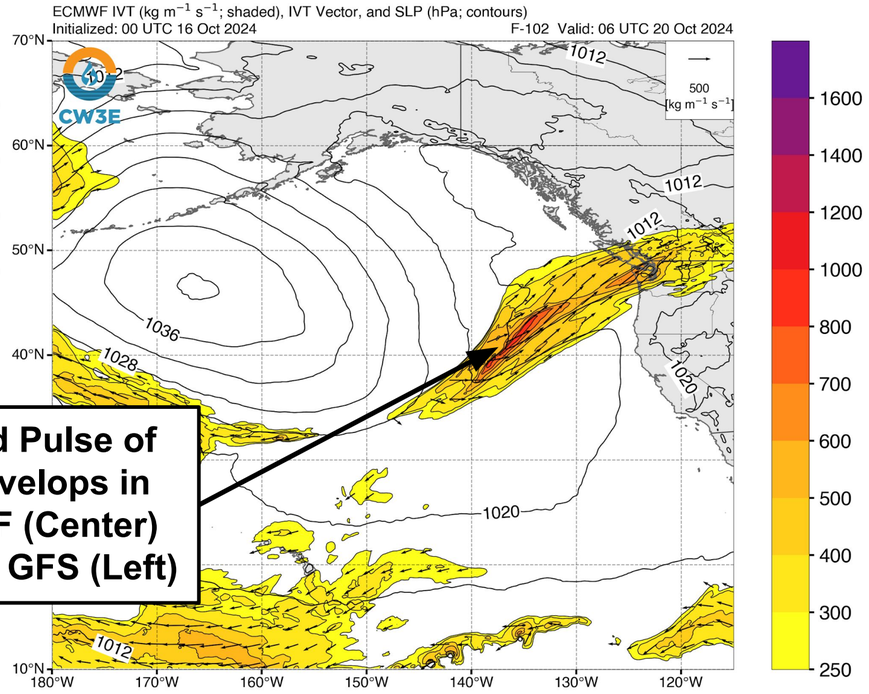
CW3E AR Outlook: 16 Oct 2024

Model Comparison; Valid 11 PM PT Sat Oct 19

00Z 16 Oct GFS IVT

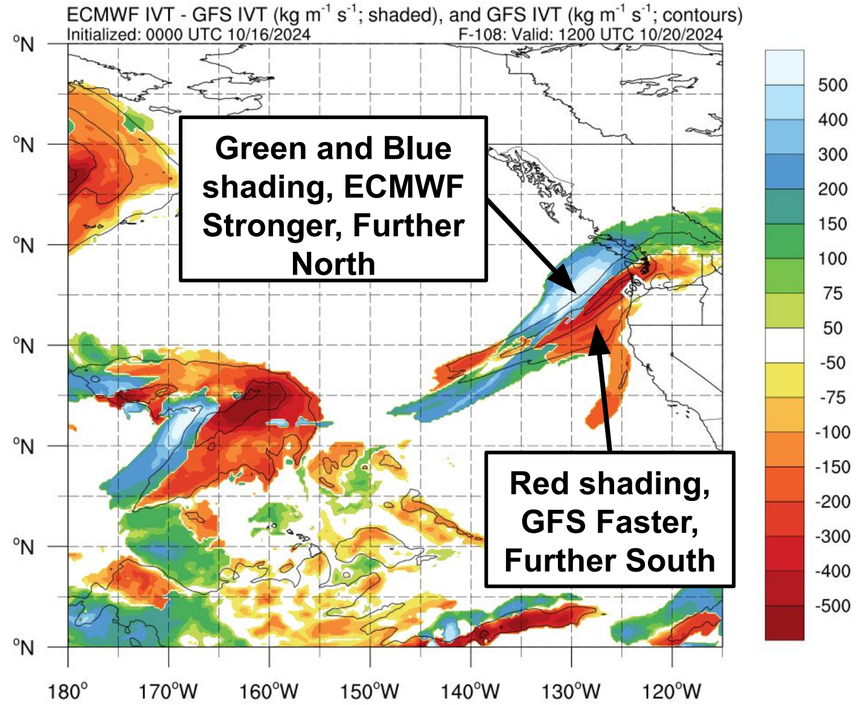


00Z 16 Oct ECMWF IVT



Second Pulse of IVT Develops in ECMWF (Center) And Not GFS (Left)

ECMWF IVT minus GFS IVT

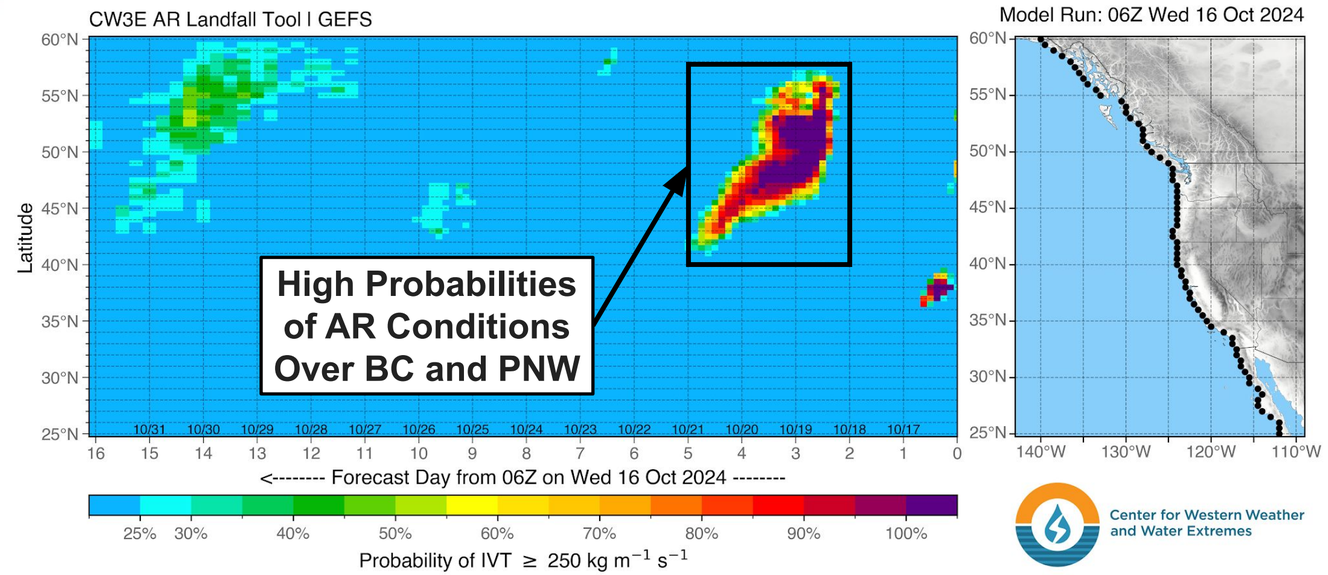


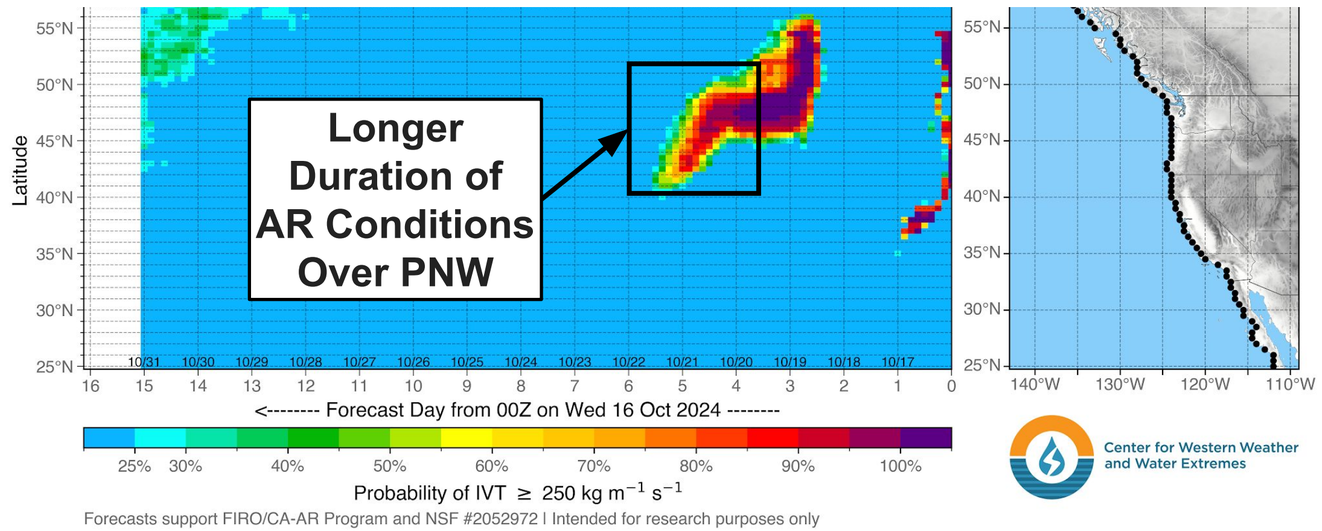
Green and Blue shading, ECMWF Stronger, Further North

Red shading, GFS Faster, Further South

- The more amplified shortwave and its interaction with the AR moisture plume in the ECMWF model fuel a second pulse of IVT that extends the duration of AR conditions over the Pacific Northwest.(*right*)

CW3E AR Outlook: 16 Oct 2024

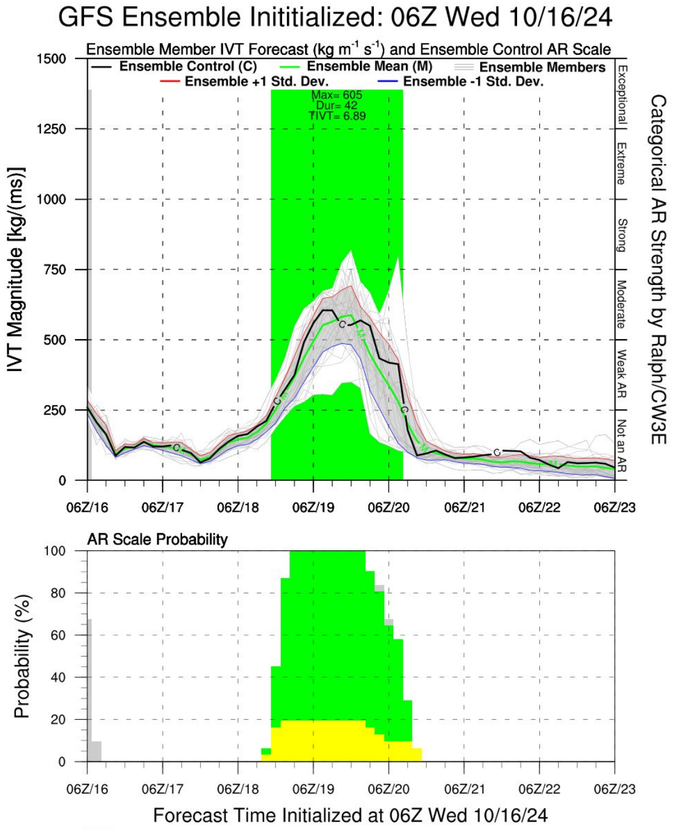


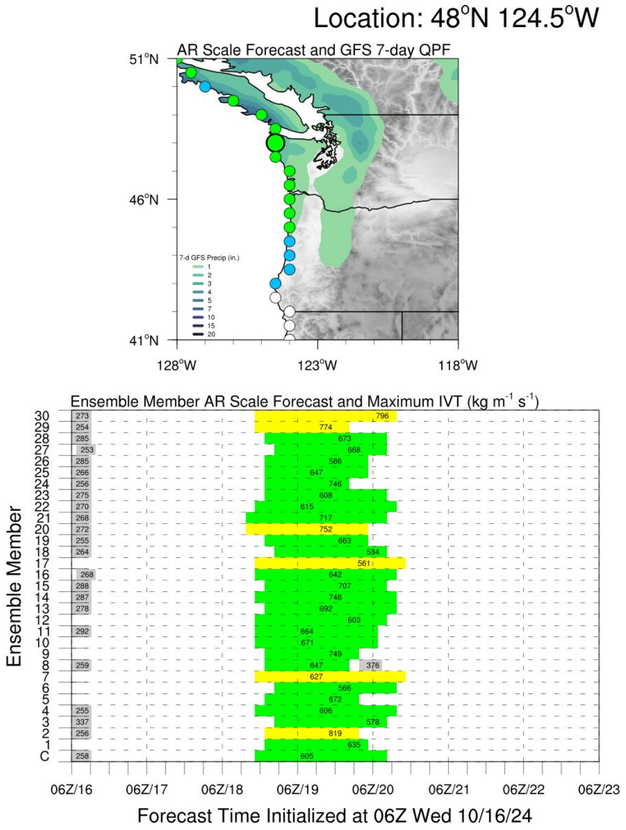


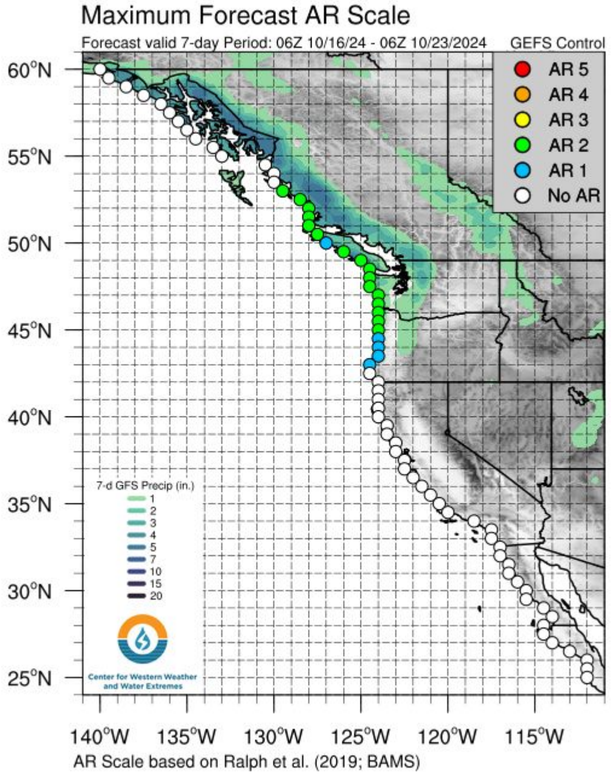
- Both the GEFS (top) and EPS (bottom) are showing very high confidence (>95%) in AR conditions (IVT > 250 kg m^{-1} s^{-1}) over British Columbia starting Fri 18 Oct and propagating down the coast through Mon 21 Oct.
- The EPS is showing high confidence in long duration (> 48 hours) of AR conditions over WA from Sat 19 Oct through lat Sun 20 Oct before the propagation south into OR.

CW3E AR Outlook: 16 Oct 2024

GEFS 7-day AR Scale and IVT Forecast







- The GEFS control member is forecasting AR2 conditions at 48° N, 124.5° W (Northern Olympic Peninsula) for ~18Z Fri 18 Oct through ~12Z Sun 20 Oct.
- 6/31 (~19%) GEFS ensemble members are forecasting AR3 conditions during the upcoming AR.

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

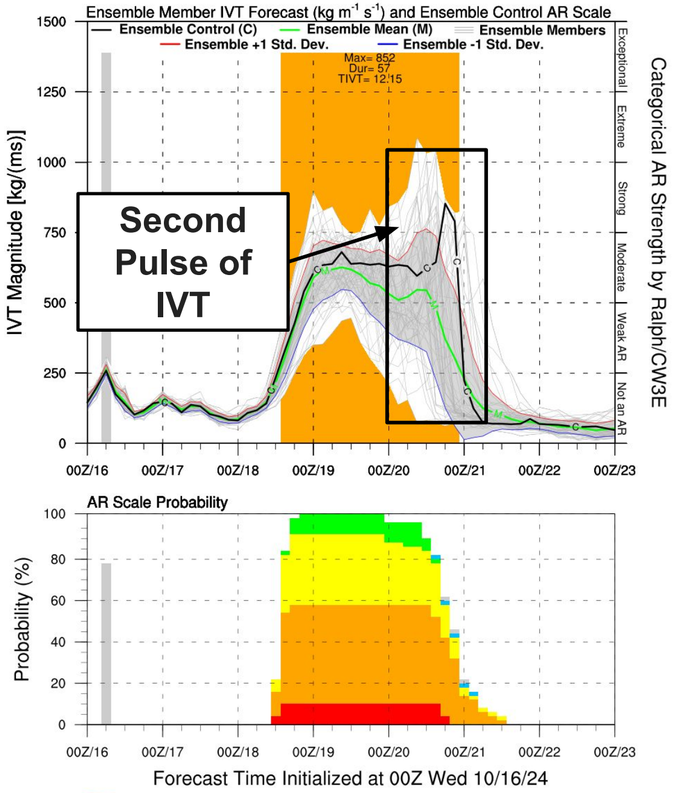
Image created: 11 UTC 10/16/2024

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

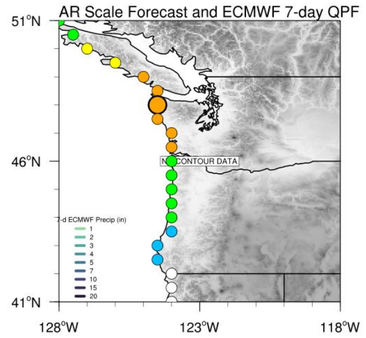
CW3E AR Outlook: 16 Oct 2024

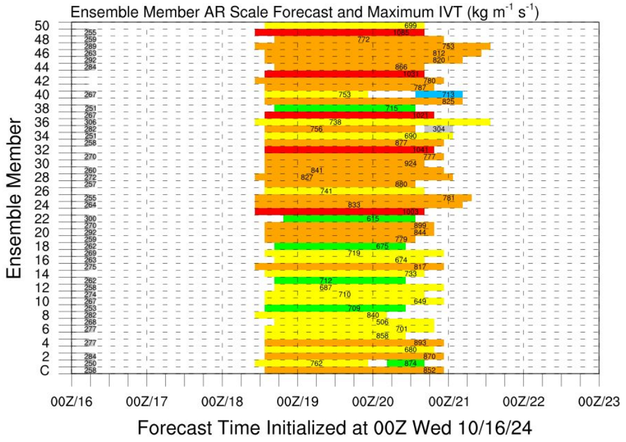
EPS 7-day AR Scale and IVT Forecast

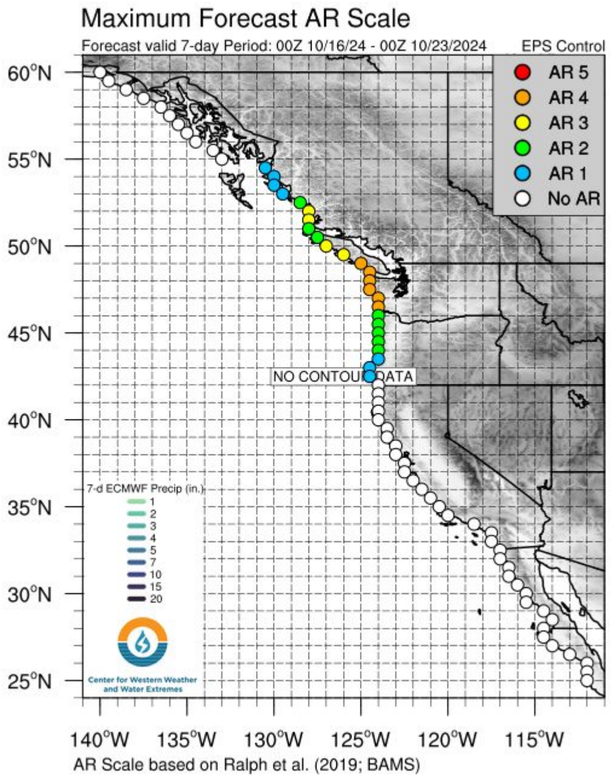
ECMWF Ensemble Inititialized: 00Z Wed 10/16/24



Location: 48°N 124.5°W







- The EPS control member is forecasting AR4 conditions at 48° N, 124.5° W (Northern Olympic Peninsula) for ~12Z Fri 18 Oct through ~00Z Mon 21 Oct.
- 29/51 (57%) EPS ensemble members are forecasting at least AR4 conditions during the upcoming AR.
- The high probability of AR4 conditions is due a large number of EPS members forecasting the second pulse of IVT, which extends the duration of AR conditions in the region
- There is some uncertainty amongst EPS ensemble members in the duration of AR conditions and timing of maximum IVT at this location.

Center for Western Weather and Water Extremes
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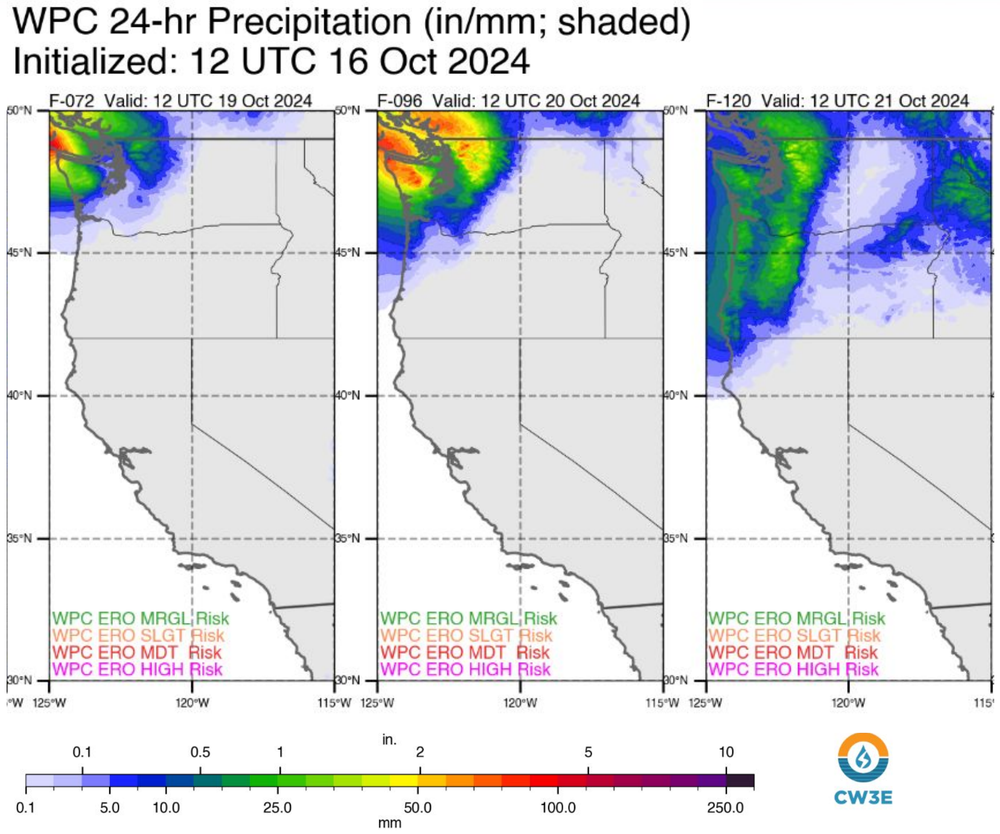
AR 1 AR 2 AR 3 AR 4 AR 5

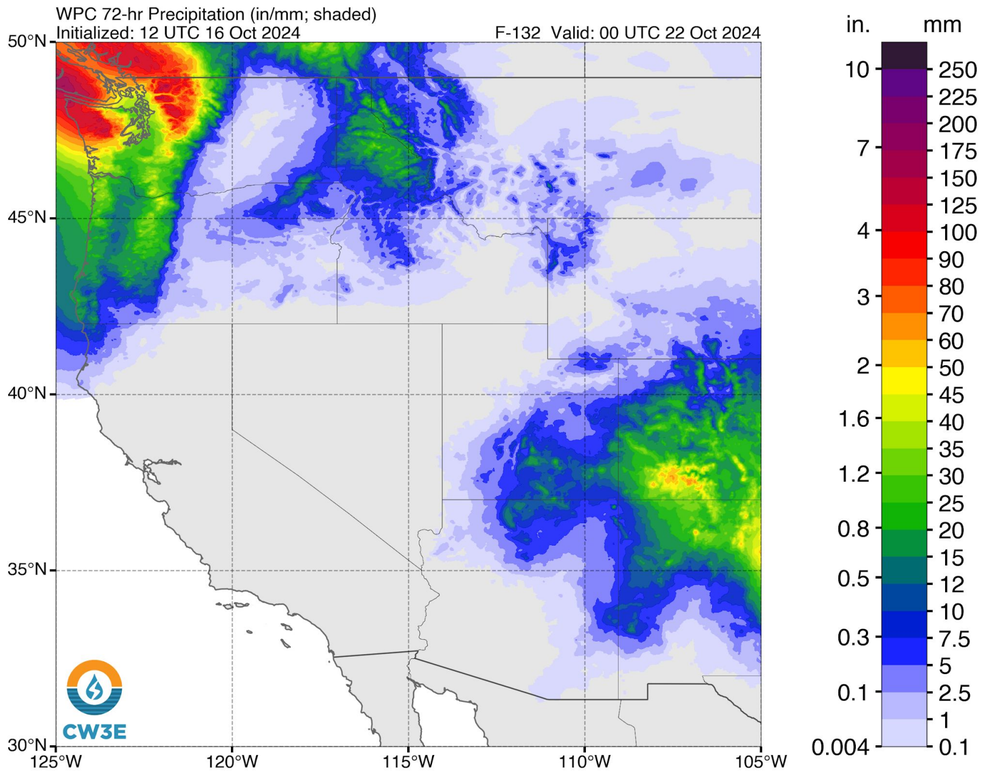
Image created: 09 UTC 10/16/2024

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

CW3E AR Outlook: 16 Oct 2024

*Excessive Rain Outlook (ERO)



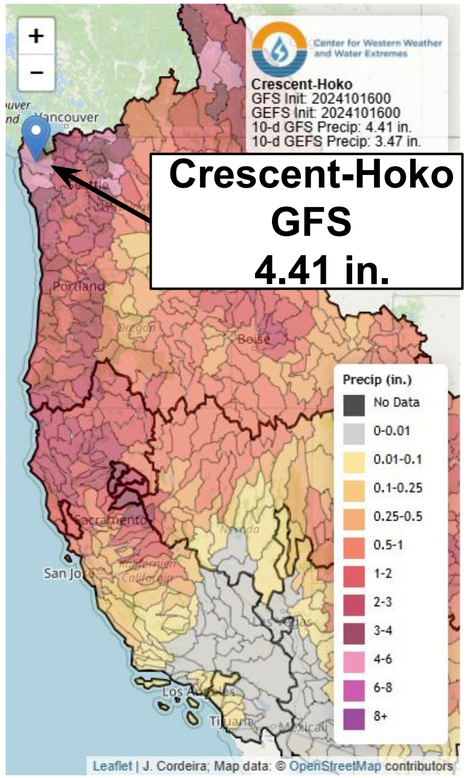


- The highest precipitation totals are expected over the Olympic Peninsula and the Cascades, with the heaviest precipitation expected to fall on day two of the event (5 AM PDT 19 to 20 Oct)
- The WPC is forecasting 3-6 inches of total precipitation in these areas for the three day period ending 5 PM PDT Mon 21 Oct.

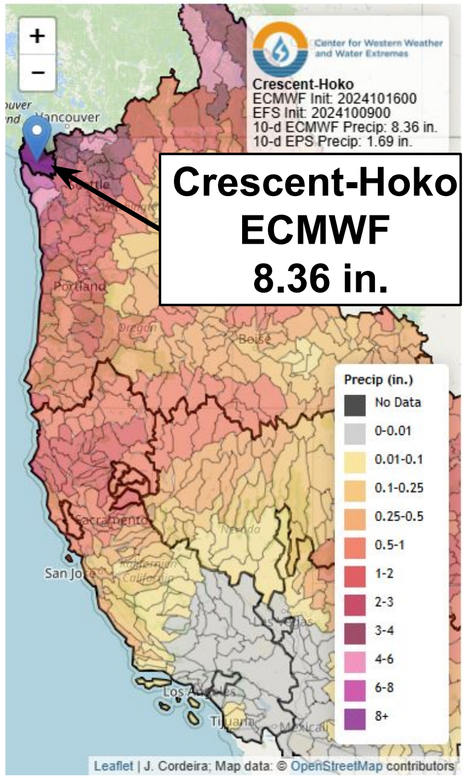
CW3E AR Outlook: 16 Oct 2024

10-day Watershed Precipitation Forecasts (Initialized 00Z 16 Oct)

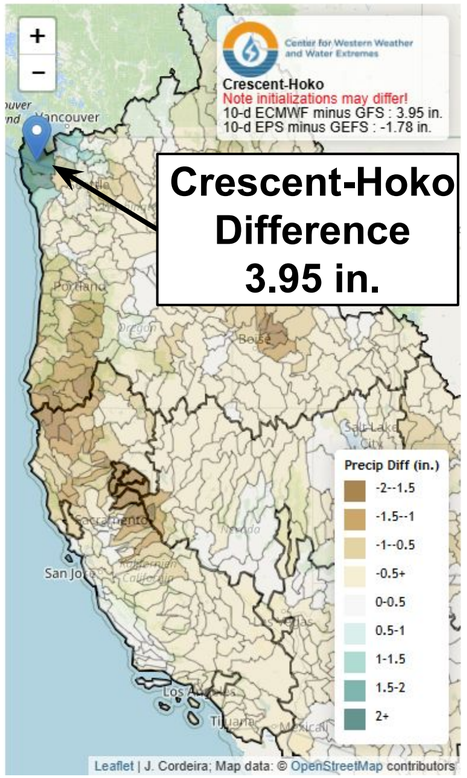
10-day GFS/GEFS Precipitation Forecasts

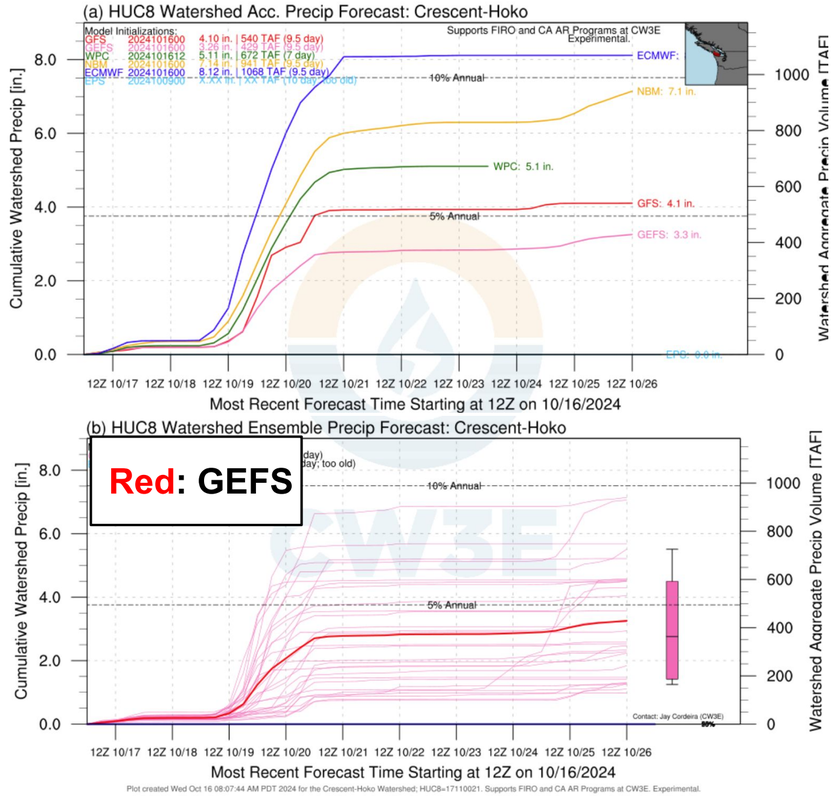


10-day ECMWF/EFS Precipitation Forecast



10-day Difference Precipitation Forecast

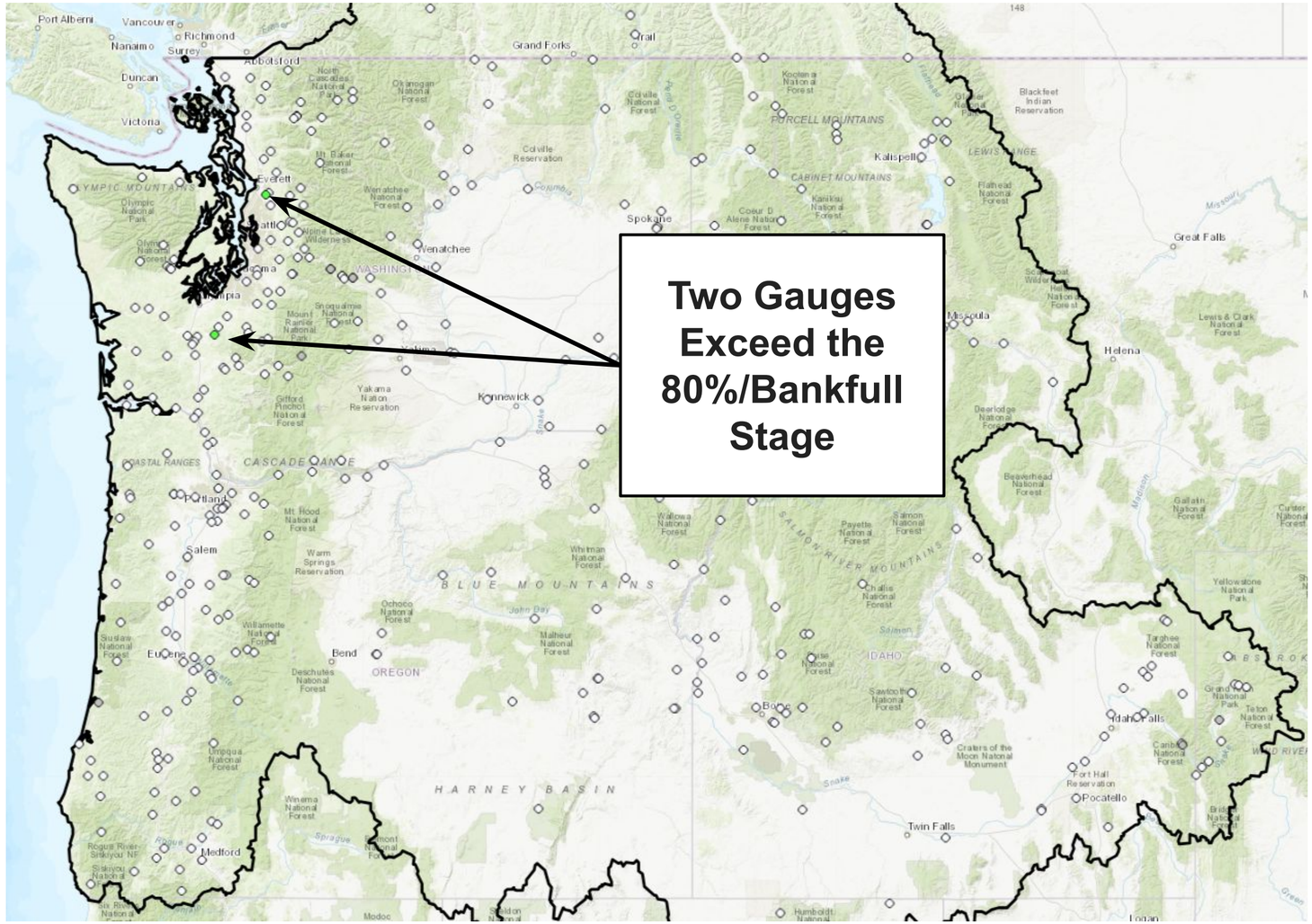




- The 00Z ECMWF is forecasting much higher precipitation totals over the Olympic Peninsula watersheds than the 00Z GFS during the next 10 days, but slightly lower precipitation totals over the North Cascades.
- The 00Z ECMWF is forecasting 8.12 inches of precipitation over the Crescent-Hoko over the next ten days, which would represent greater than 10% of the normal annual precipitation in the watershed.
- There is large spread in QPF amongst the GEFS members currently indicating uncertainty in AR conditions and intensity of the event

CW3E AR Outlook: 16 Oct 2024

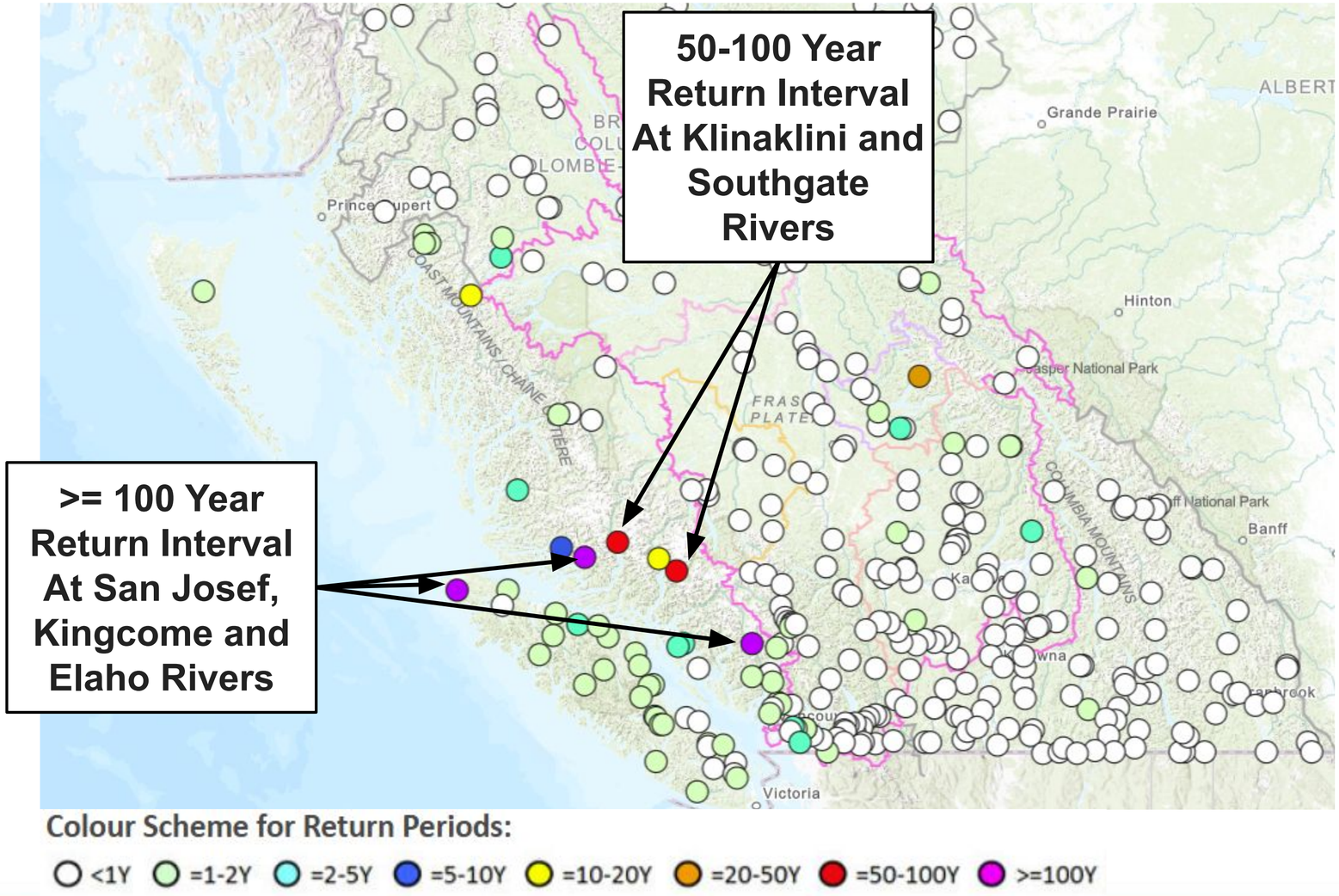
NWS NWRFC River Stage Forecasts



- While river levels are forecast to rise in western WA as a result of the precipitation, flooding is currently not forecast to occur by the NWRFC
- Two gauges, one at Skookumchuck Reservoir and one tidal gauge near Snohomish, are the only gauges forecast to exceed the 80%/bankfull stage

CW3E AR Outlook: 16 Oct 2024

British Columbia River Forecast Center CLEVER Model Discharge and Return Period Forecasts



- Greater riverine responses are forecast in British Columbia as a result of the incoming AR
- In Southwestern BC, two British Columbia River Forecast Center stations are currently forecast to reach a 50-100 year Return Interval and three are forecast to exceed a 100 year return interval.