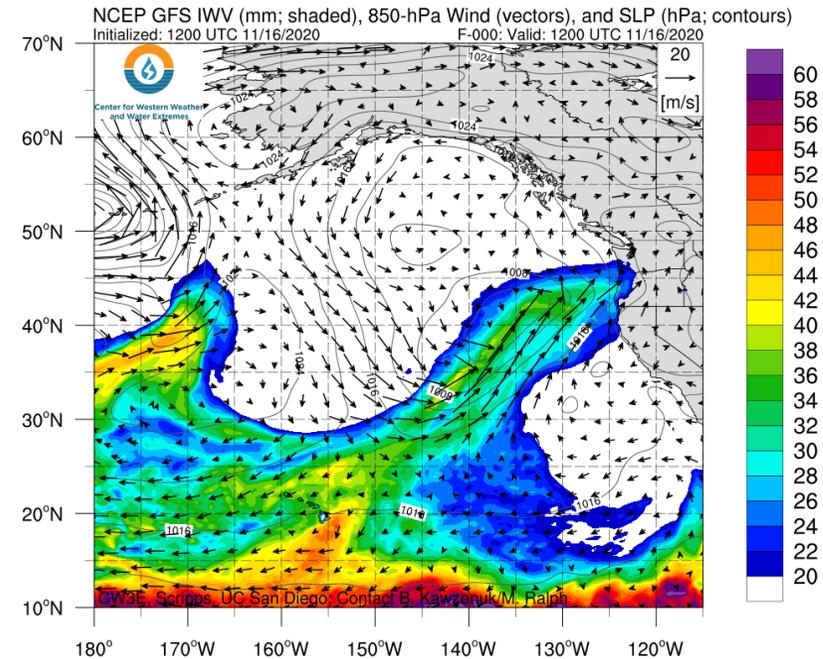
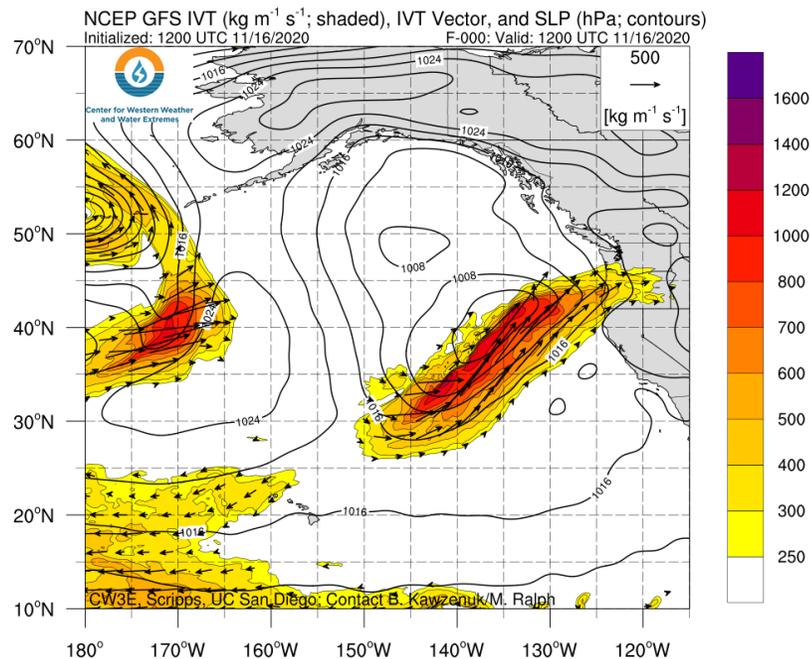


Active pattern is forecast to continue as another atmospheric river makes landfall this evening

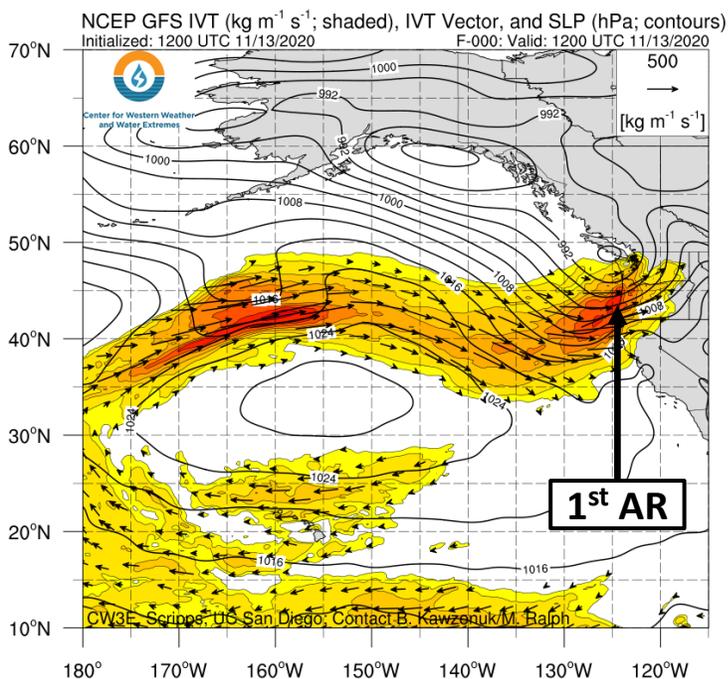
- Multiple landfalling ARs have produced heavy rainfall and snowfall across the northwestern U.S. and Northern California over the past several days
- A cyclone and an associated AR currently located over the Eastern Pacific are forecast to strengthen as they propagate towards the Pacific Northwest and southern British Columbia
- Current forecasts suggest that this AR may bring AR 3–4 conditions (based on the Ralph et al. 2019 AR Scale) to the Pacific Northwest and AR 1–2 conditions to Northern CA
- The WPC is forecasting as much as 3.5 inches of precipitation across numerous coastal and high elevation locations across the PNW and Northern CA
- High wind speeds are forecast to impact coastal locations and high elevations from WA to Northern CA



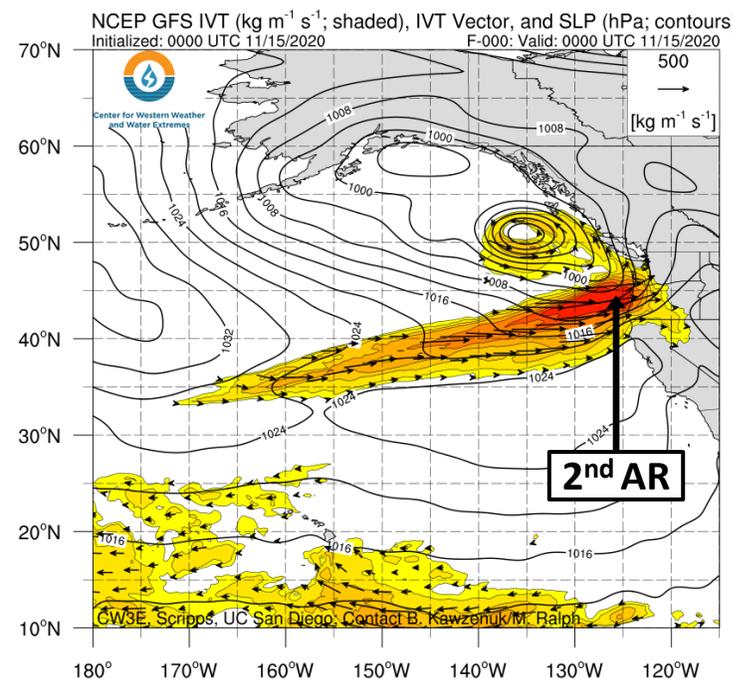
Event Summary: 13–15 Nov 2020

GFS IVT & SLP Analyses

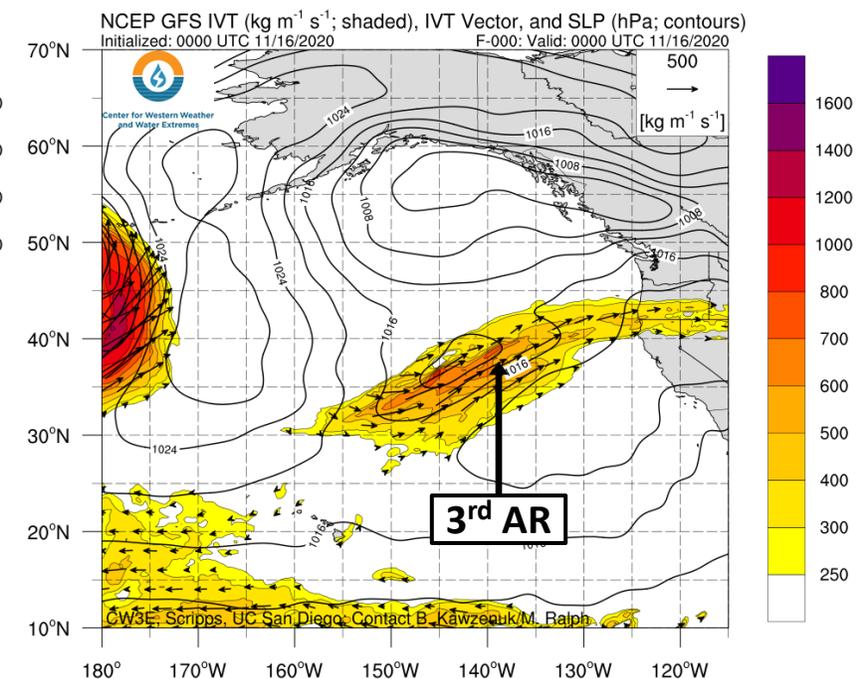
A) Valid: 1200 UTC 13 Nov



B) Valid: 0000 UTC 15 Nov



C) Valid: 0000 UTC 16 Nov

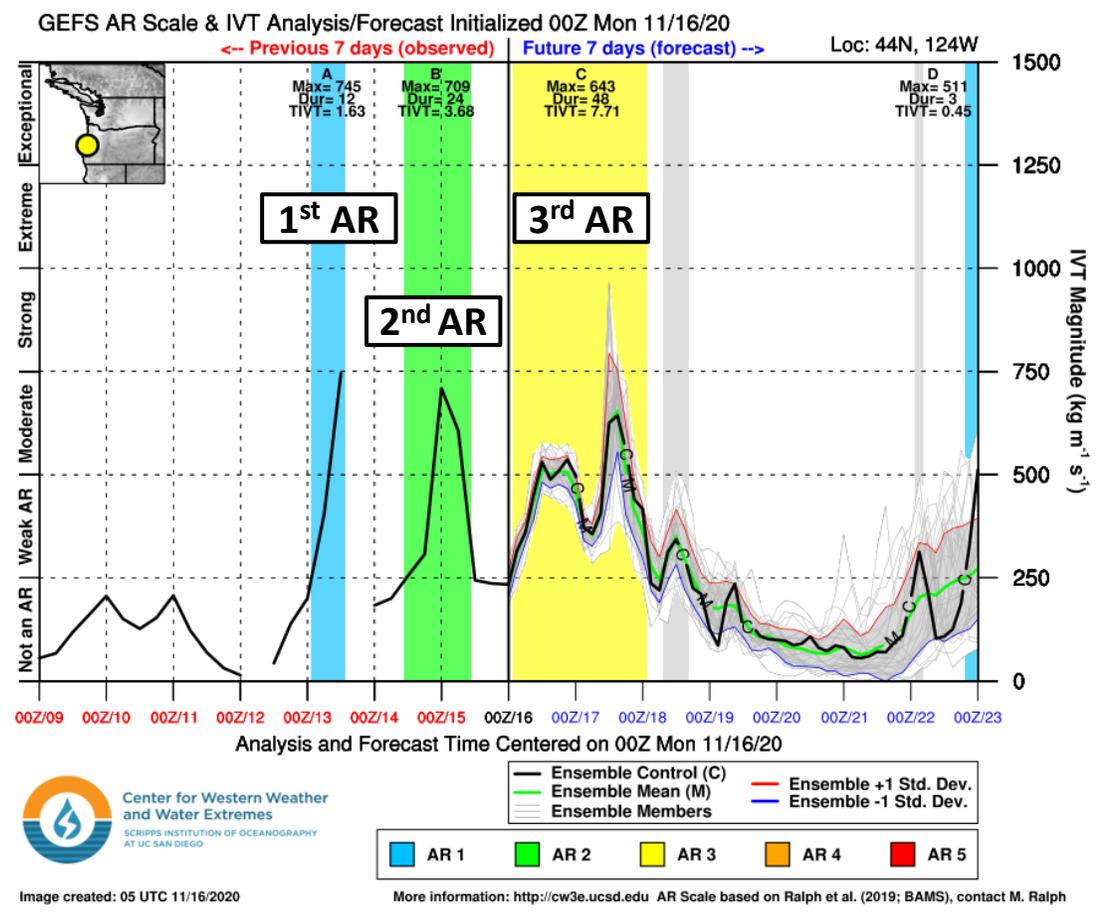
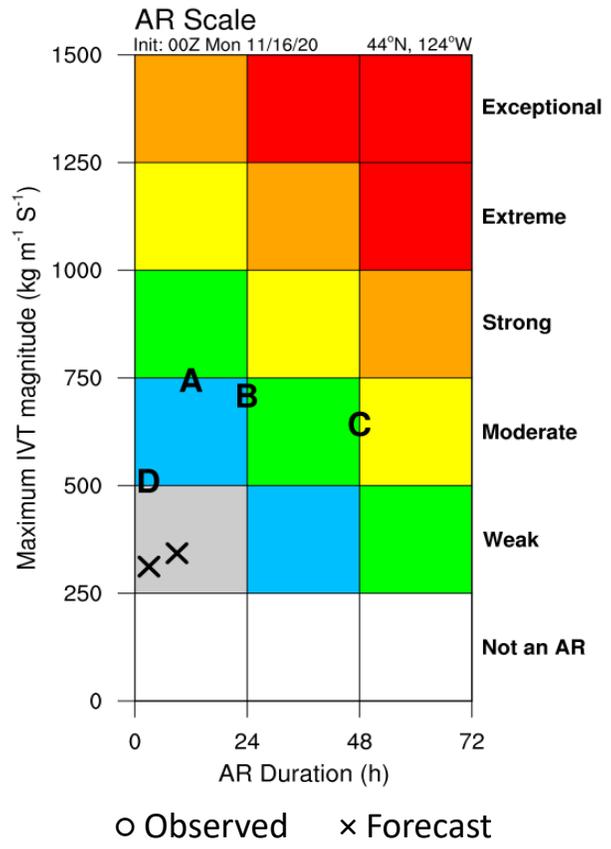
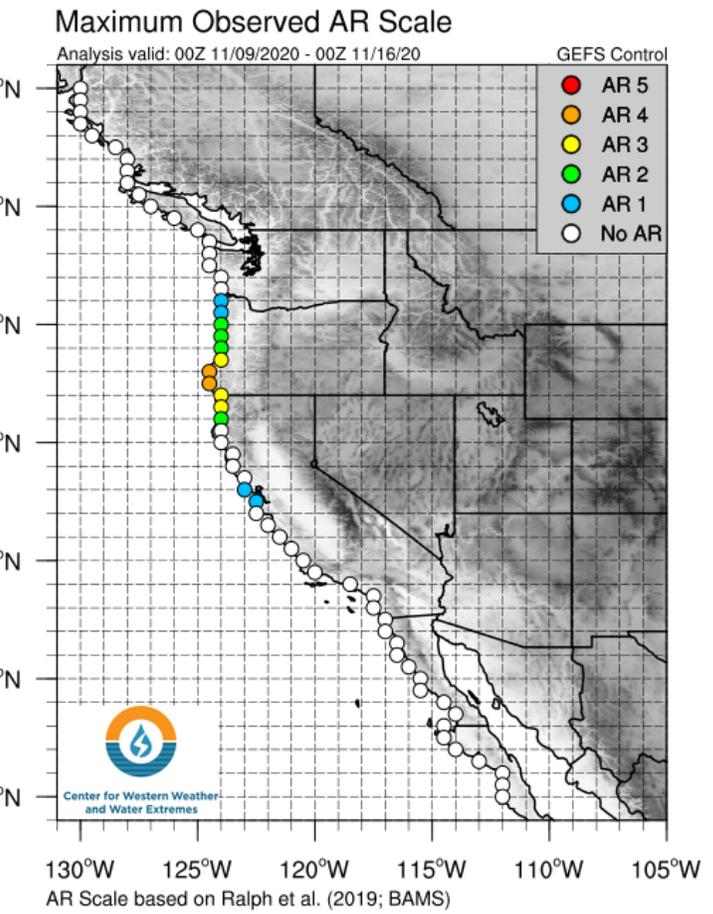


- The first AR (Figure A) made landfall in association with a secondary surface cyclone that formed near Vancouver Island on 13 Nov
- The second AR (Figure B) made landfall in association with a rapidly intensifying surface cyclone over the Northeast Pacific Ocean
- The third and strongest AR (Figure C) is forecast to make landfall in association with a deepening surface cyclone that will move northeastward towards British Columbia over the next few days
- As of 00Z 16 Nov, southern Oregon and Northern California were still experiencing weak AR conditions ($\text{IVT} \geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$) from the remnants of the most recent landfalling AR

Event Summary: 13–15 Nov 2020

GEFS IVT & AR Scale Analyses

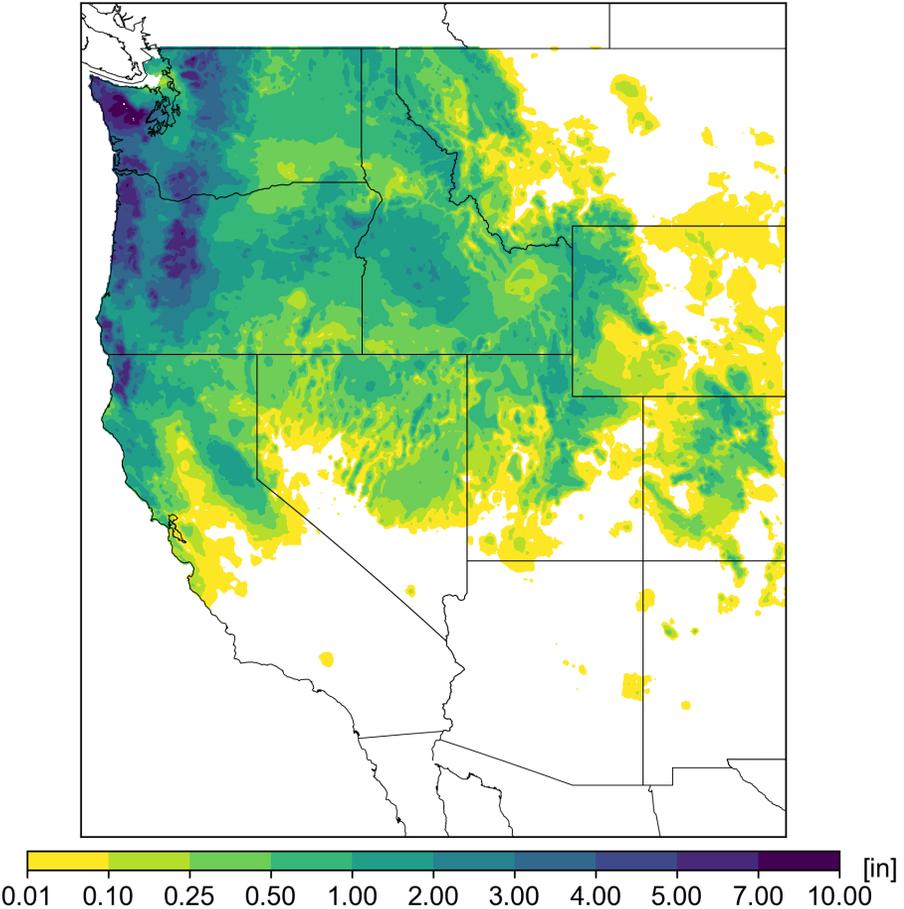
*GEFS = NCEP Global Ensemble Forecast System



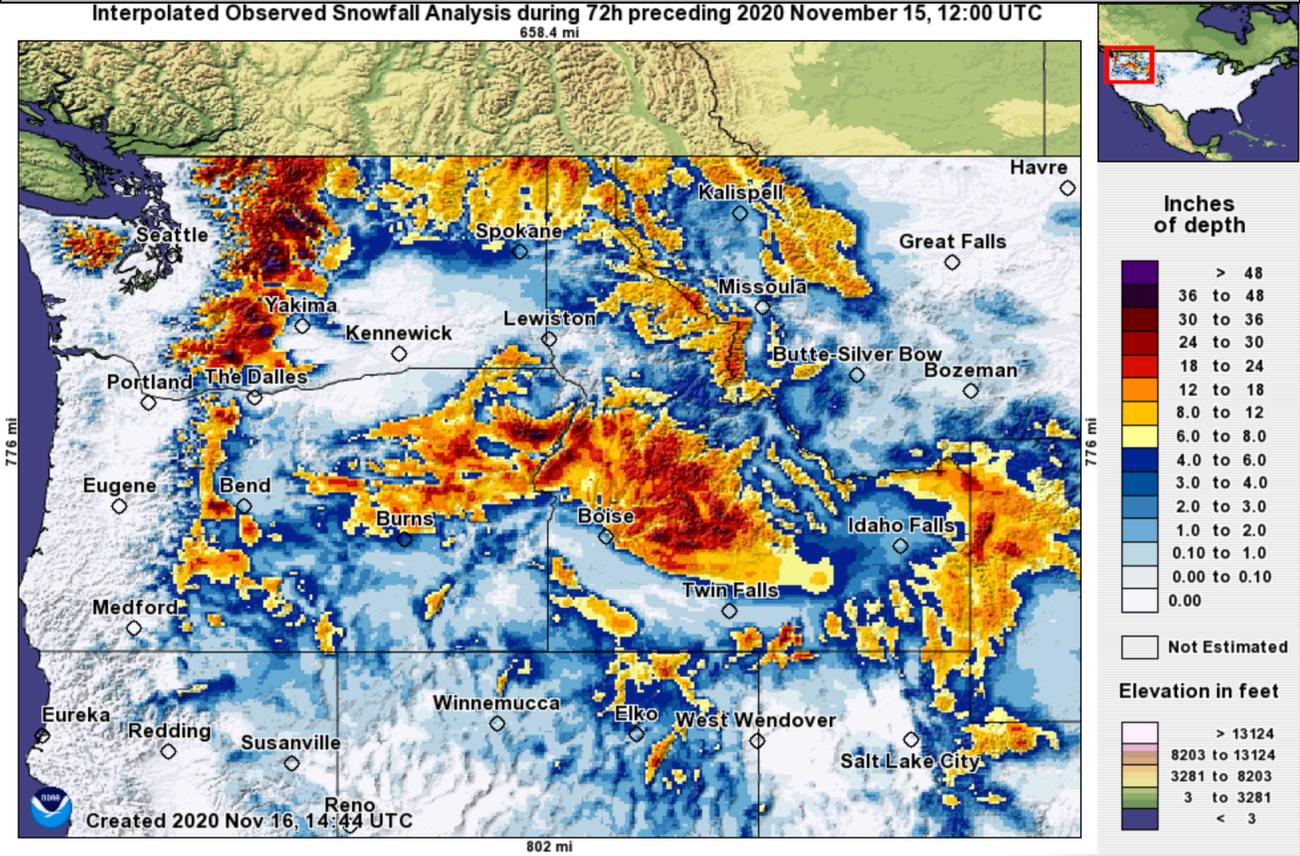
- Multiple ARs have made landfall over the Pacific Northwest and Northern California over the past several days
- Another stronger AR is expected to impact the Western U.S. during the next few days
- Some locations in southwestern Oregon and extreme northwestern California will likely experience AR3/AR 4 conditions in association with next landfalling AR due to persistently high values of IVT ($\geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$) leftover from the previous landfalling AR

Event Summary: 13–15 Nov 2020

PRISM 72-h QPE Valid: 1200 UTC 15 Nov 2020



NOHRSC 72-h Interpolated Snowfall: Valid 1200 UTC 15 Nov



Source: NOAA/NWS NOHRSC, <https://www.nohrsc.noaa.gov/>

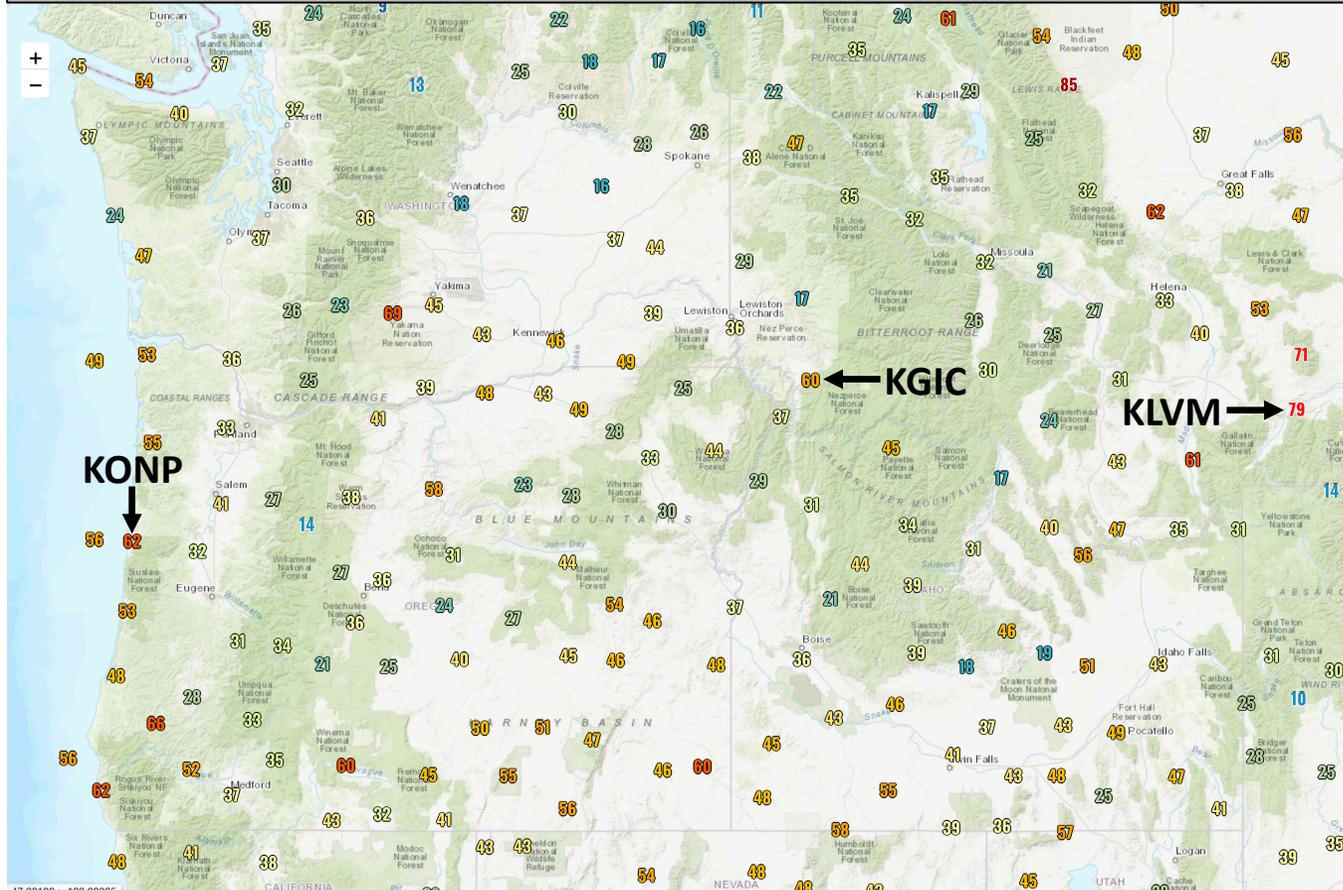
- The heaviest precipitation (3–7 inches, locally higher amounts in the Olympic Mountains) has fallen over the Cascade Mountains and Pacific Coast Ranges
- Lighter precipitation (0.5–2 inches) fell over the higher terrain in Northern California and the Intermountain West
- An estimated 1–3 feet of snow fell over the highest elevations of the Cascades during the 72-hour period ending 1200 UTC (4 AM) 15 Nov
- Inland penetration of these ARs also produced significant snowfall (> 12 inches) over portions of the interior northwestern U.S.

Event Summary: 13–15 Nov 2020

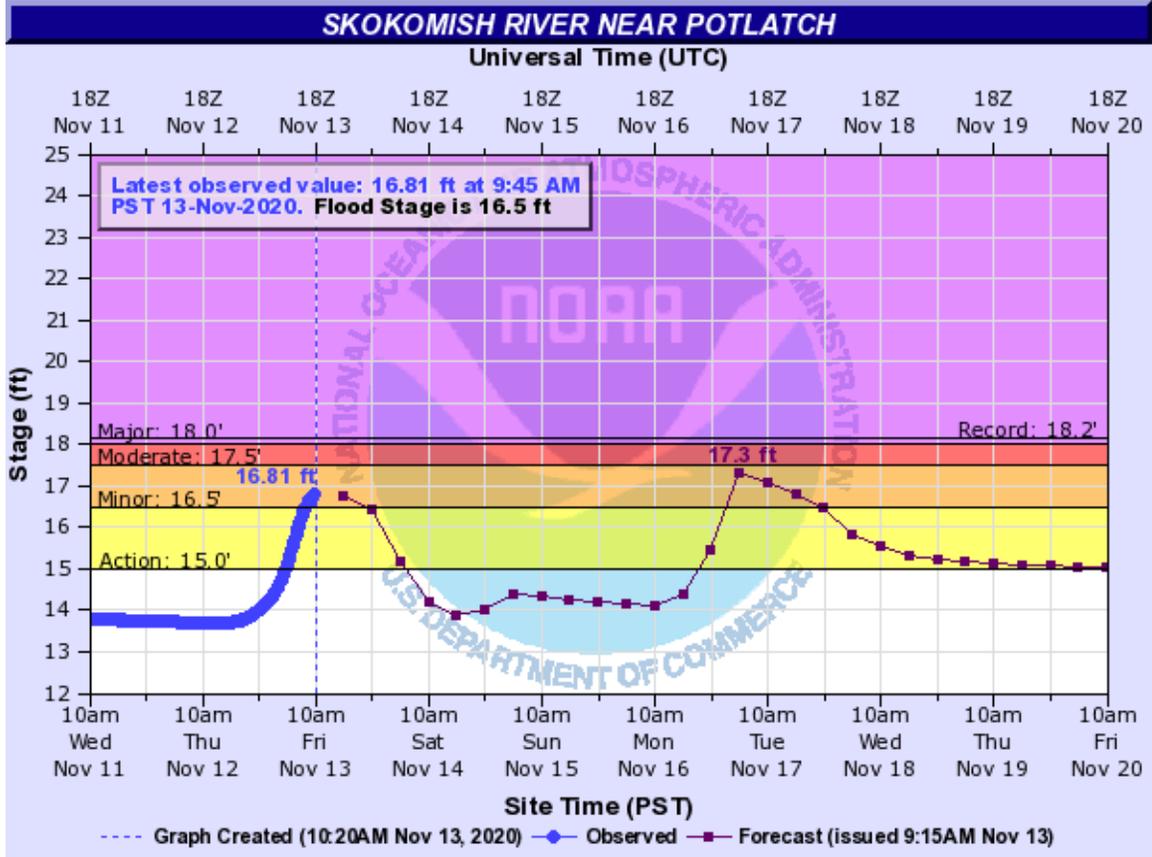


Center for Western Weather and Water Extremes
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Daily Maximum Wind Gust: Valid 0000–2359 UTC 13 Nov



Source: NOAA/NWS Western Region Headquarters, <https://www.wrh.noaa.gov/>



SRPW1(plotting HGIRG) "Gage 0" Datum: 10.67' | Observations courtesy of U.S. Geological Survey

Source: NWS Seattle <https://www.weather.gov/sew/>

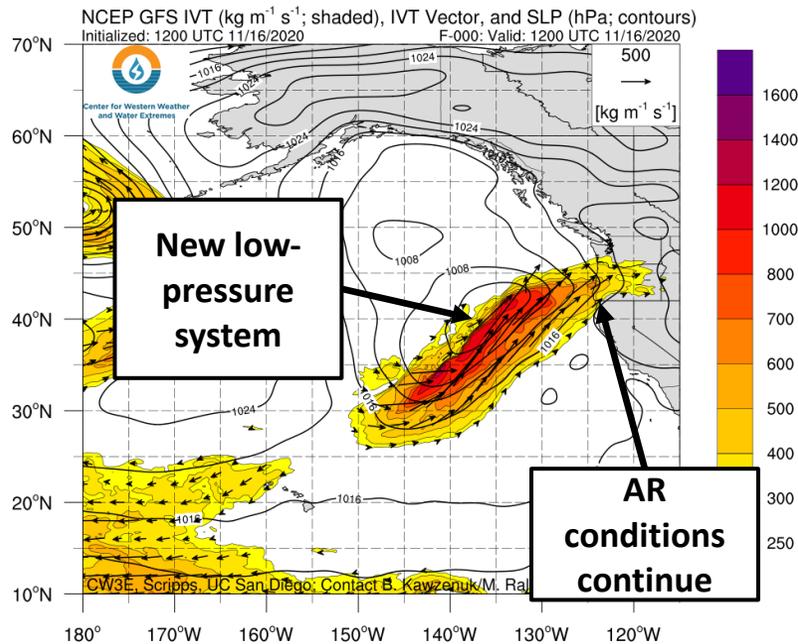
- The first storm produced strong wind gusts (> 50 mph) throughout the northwestern U.S., resulting in sporadic tree damage and power outages in western Oregon
- Notable wind gusts: Livingston, MT (KLVM): 79 mph; Newport, OR (KONGP): 62 mph; Grangeville, ID (KGIC): 60 mph
- Although there were no reports of flooding, the Skokomish River (near Potlatch, WA) reached minor flood stage (16.5') on 13 Nov

AR Outlook: 16 Nov 2020

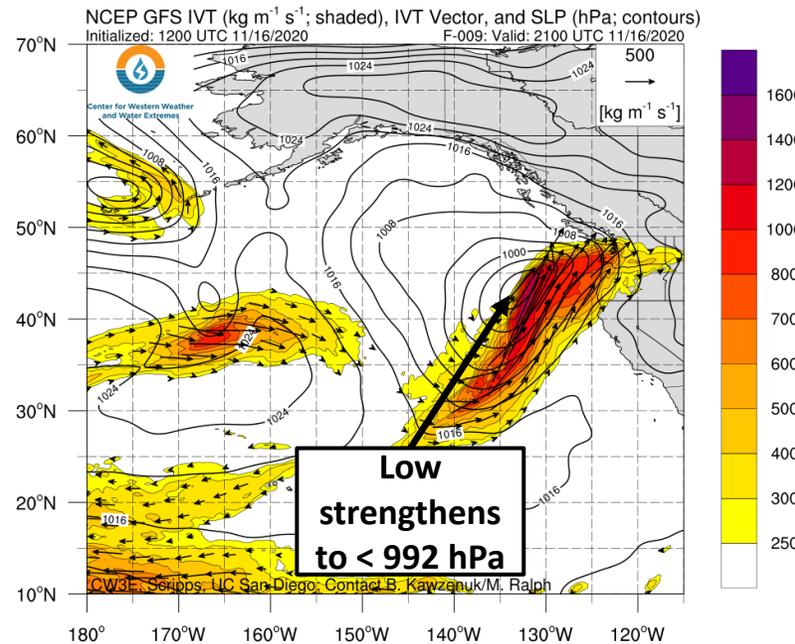
For California DWR's AR Program

GFS IVT & SLP Forecasts

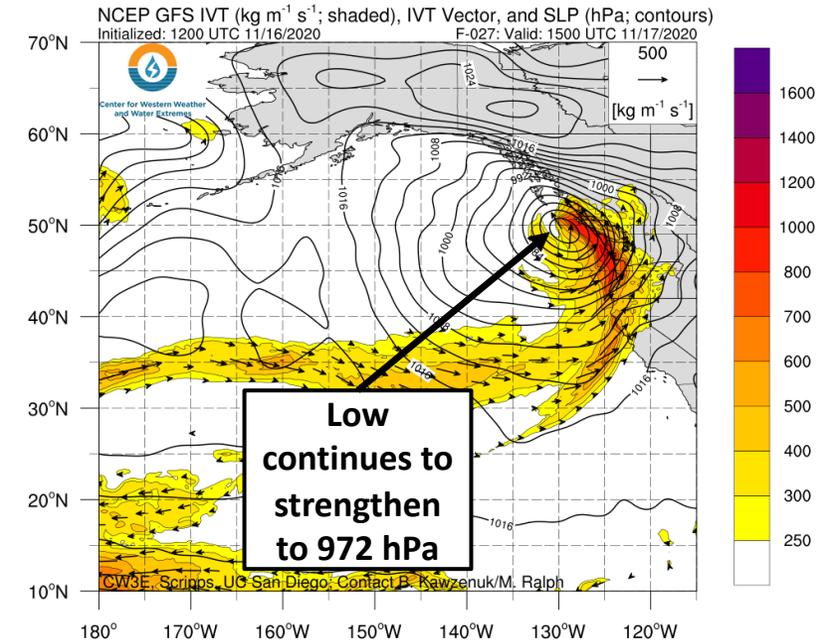
A) Valid: 1200 UTC 16 Nov (F-00)



B) Valid: 2100 UTC 16 Nov (F-09)



C) Valid: 1500 UTC 17 Nov (F-27)



At ~12 UTC on 16 Nov., the cyclone associated with the next AR continues to form over the Eastern Pacific as AR conditions continue to impact Oregon

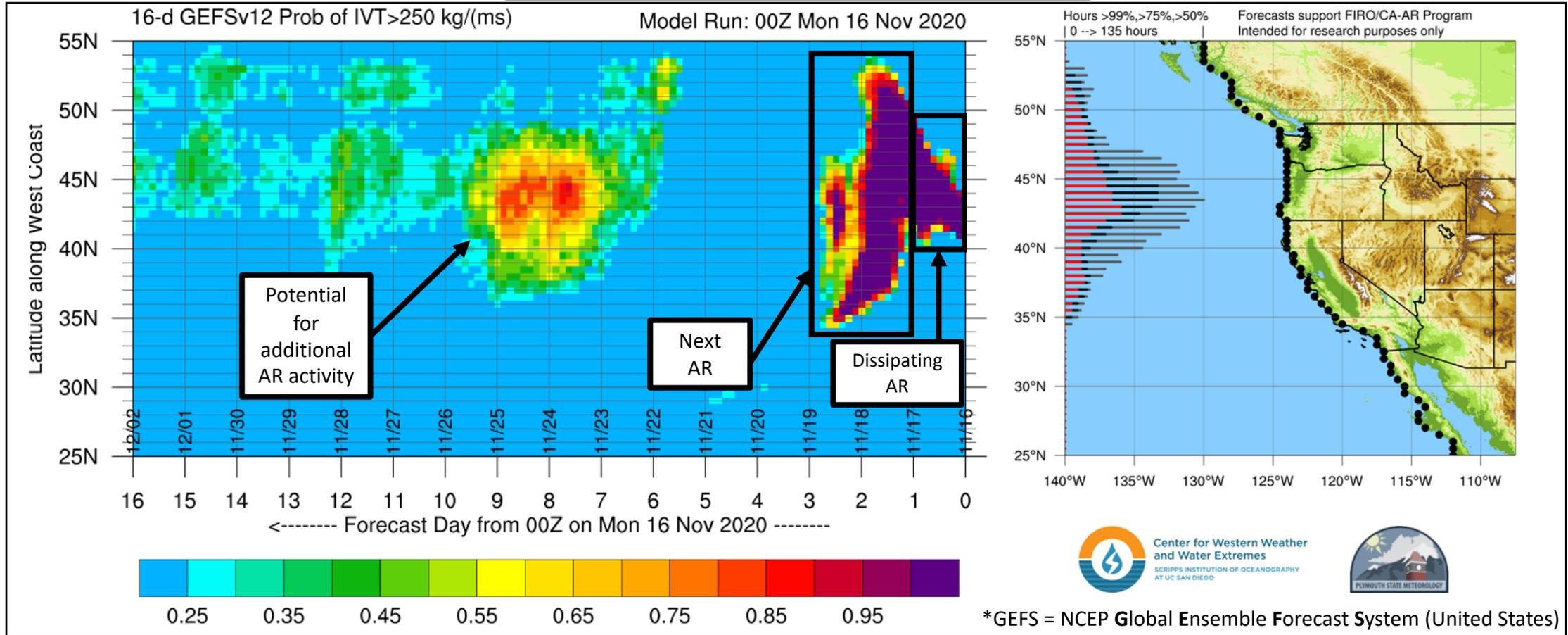
9 hours later, the cyclone is forecast to strengthen to 992 hPa as the AR also strengthens and begins to move onshore

The cyclone is forecast to continue to strengthen as it moves close shore at ~15 UTC 17 Nov, increasing the potential for strong winds over the PNW and Northern CA

AR Outlook: 16 Nov 2020

For California DWR's AR Program

Probability of AR Conditions Along Coast

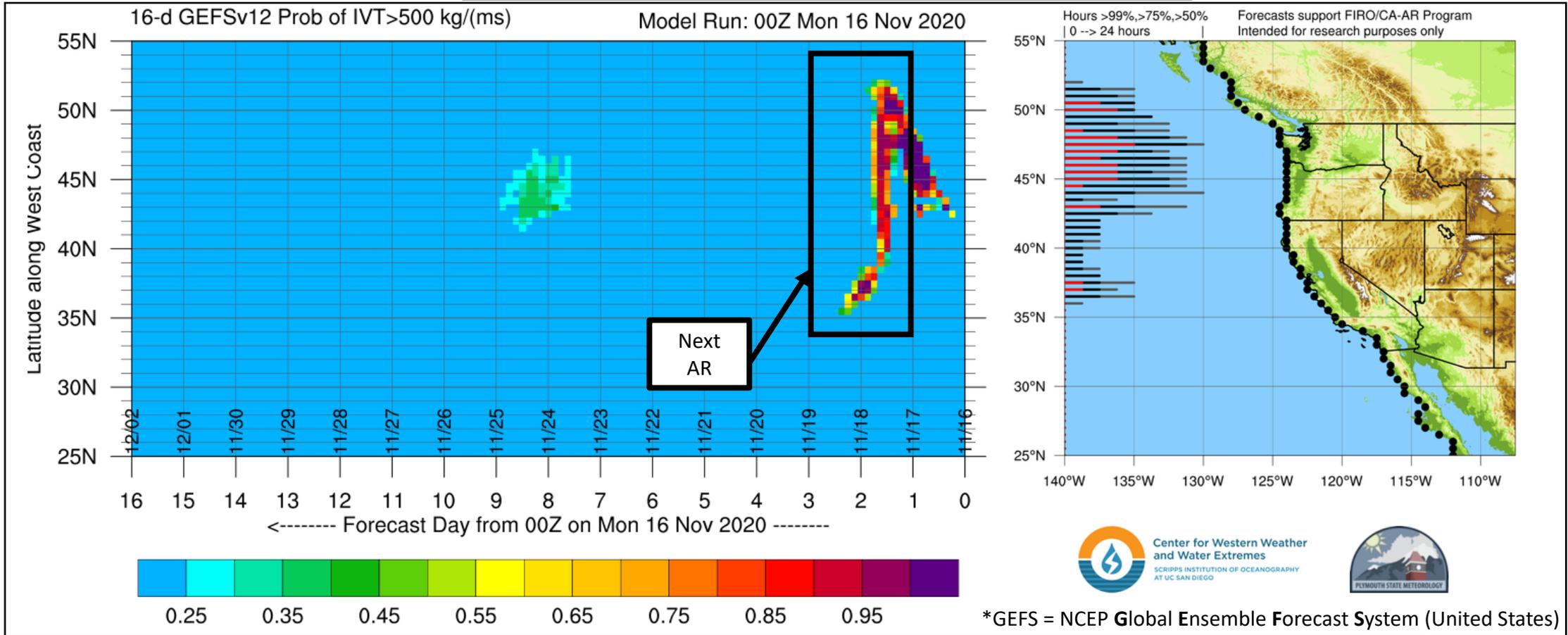


- The GEFS ensembles are currently in good agreement that AR conditions ($IVT > 250 \text{ kg m}^{-1} \text{ s}^{-1}$) associated with the next landfalling AR will last 12–24 hours over Washington, Oregon, and Northern California
- Since the next AR is forming and strengthening over the Eastern Pacific while the current AR is dissipating over southern Oregon, there is a high probability that AR conditions do not end between events, resulting in an extended duration of AR conditions
- The GEFS is also highlighting a period of potential AR activity between days 7 and 10, but ensemble agreement is currently low

AR Outlook: 16 Nov 2020

For California DWR's AR Program

Probability of Moderate AR Conditions Along Coast



- The GEFS is also suggesting a high probability (> 80% of ensembles) of moderate AR conditions ($IVT > 500 \text{ kg m}^{-1} \text{ s}^{-1}$) within the next AR from southern British Columbia to the San Francisco Bay Area for 6+ hours

AR Outlook: 16 Nov 2020

For California DWR's AR Program



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GEFS AR Scale & IVT Analysis/Forecast Initialized 06Z Mon 11/16/20

<-- Previous 7 days (observed) Future 7 days (forecast) --> Loc: 42.5N, 124.5W

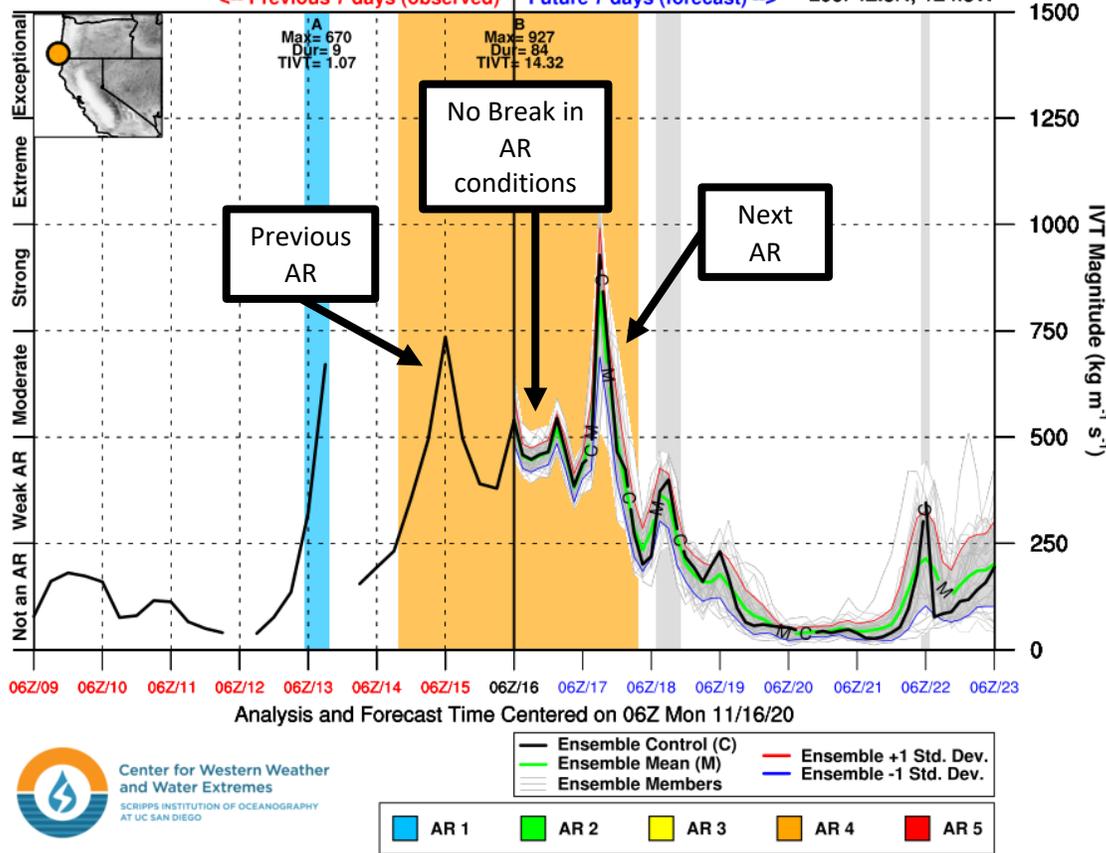


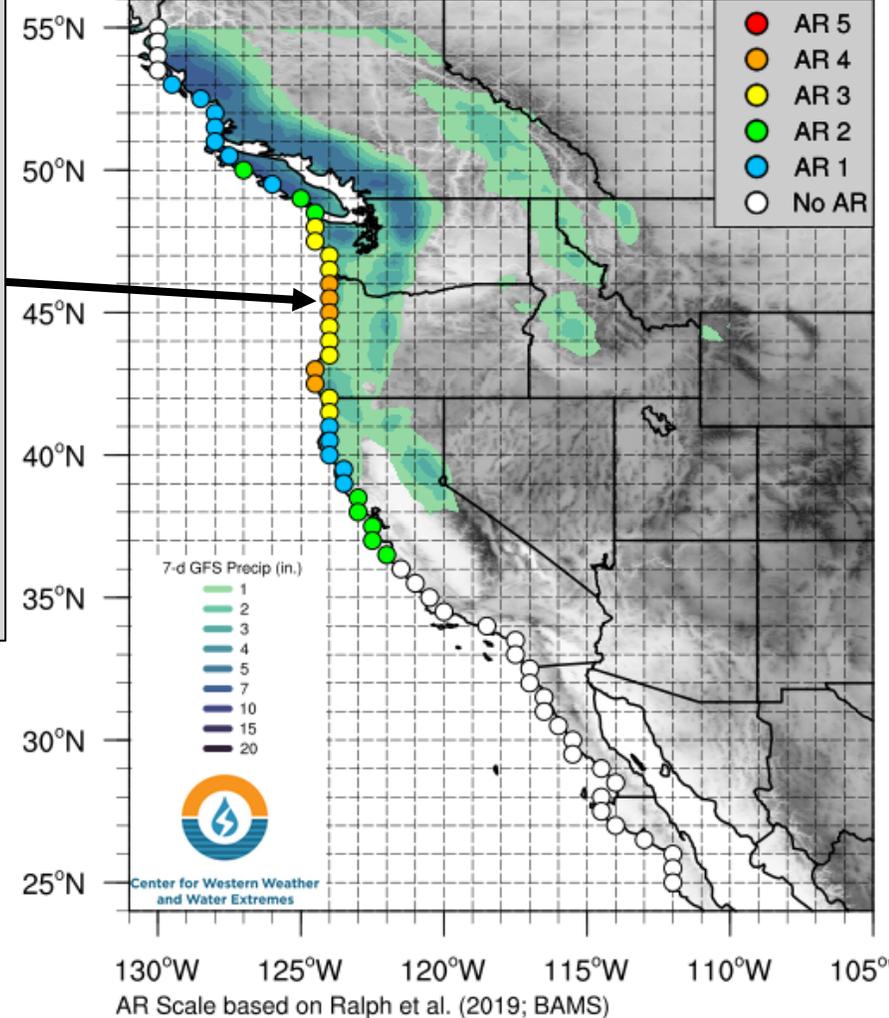
Image created: 12 UTC 11/16/2020

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

- The next AR is forecast to bring AR 3–4 conditions to most of the Pacific Northwest and AR 1–3 conditions to Northern California
- The AR 4 conditions that are forecast to impact northern Oregon are from the next AR and not the extension of AR conditions between the previous and next AR (As discussed to the left)

Maximum Forecast AR Scale

Forecast valid 7-day Period: 06Z 11/16/20 - 06Z 11/23/2020 GEFS Control



AR Scale based on Ralph et al. (2019; BAMS)

- Since AR conditions are not forecast to end between the current AR impacting southern Oregon and the AR that is forecast to make landfall this evening, the two ARs are forecast to result in a total duration of 84 hours
- The extended duration between the two ARs and maximum IVT magnitude of 927 kg m⁻¹ s⁻¹ produced by the next AR is forecast to result in AR 4 conditions over southern Oregon (Ralph et al. 2019)

AR Outlook: 16 Nov 2020

For California DWR's AR Program



Center for Western Weather and Water Extremes

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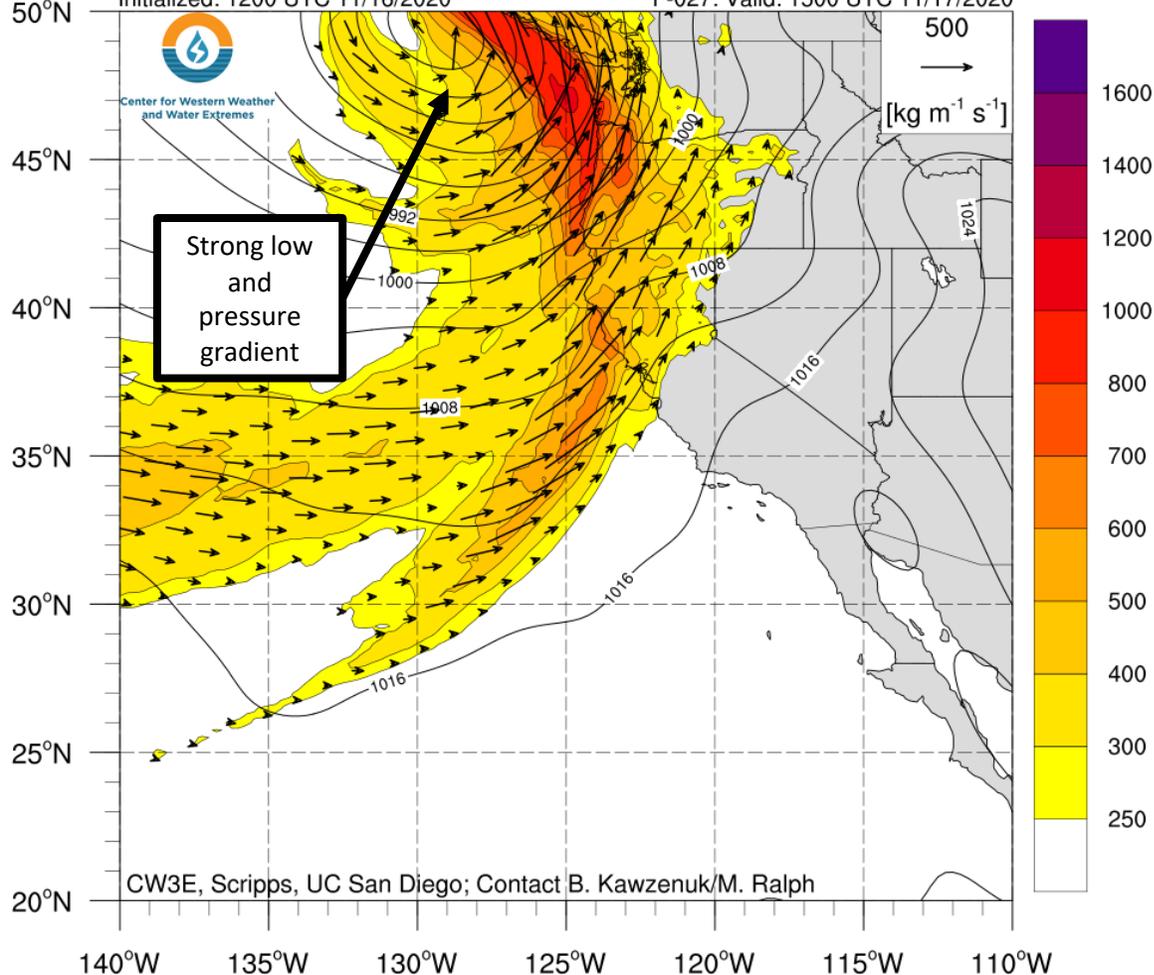
GFS SLP and IVT

Valid: 1500 UTC 17 Nov (F-27)

NCEP GFS IVT ($\text{kg m}^{-1} \text{s}^{-1}$; shaded), IVT Vector, and SLP (hPa; contours)

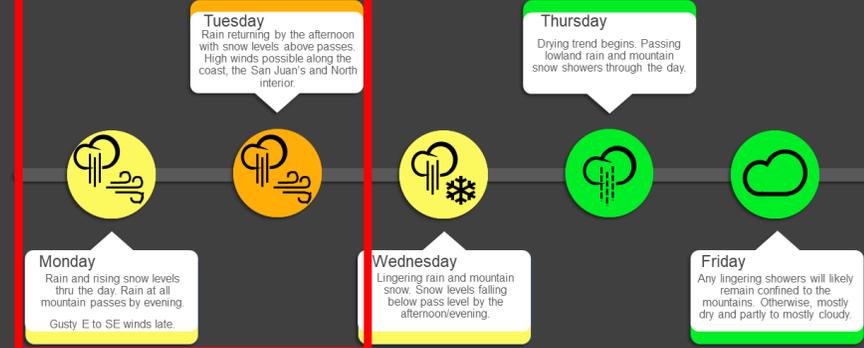
Initialized: 1200 UTC 11/16/2020

F-027: Valid: 1500 UTC 11/17/2020



- The strong cyclone is forecast to move onshore over southern British Columbia and the Pacific Northwest bringing the potential for strong winds to numerous coastal locations
- The National Weather Service Eureka Forecast Office is forecasting wind gusts of 35–55 mph from the coast to the high elevations of the Coast Range in Humboldt and Del Norte Counties
- Numerous high wind and gale warnings have been issued across the PNW and N. CA

Week Outlook for Western Washington



NATIONAL WEATHER SERVICE | Seattle | Issued November 15, 2020

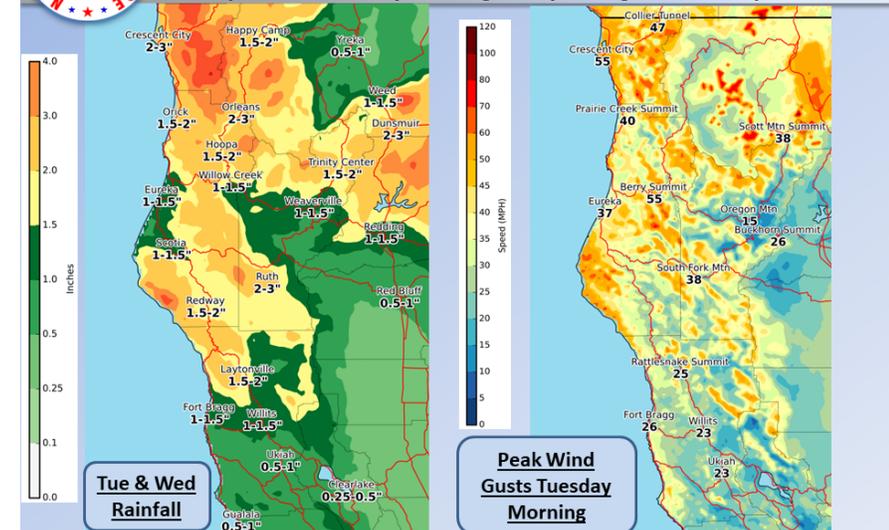
IMPACT LEVEL: Minor Moderate Severe Extreme



Next Round of Rain and Wind

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NWS Eureka

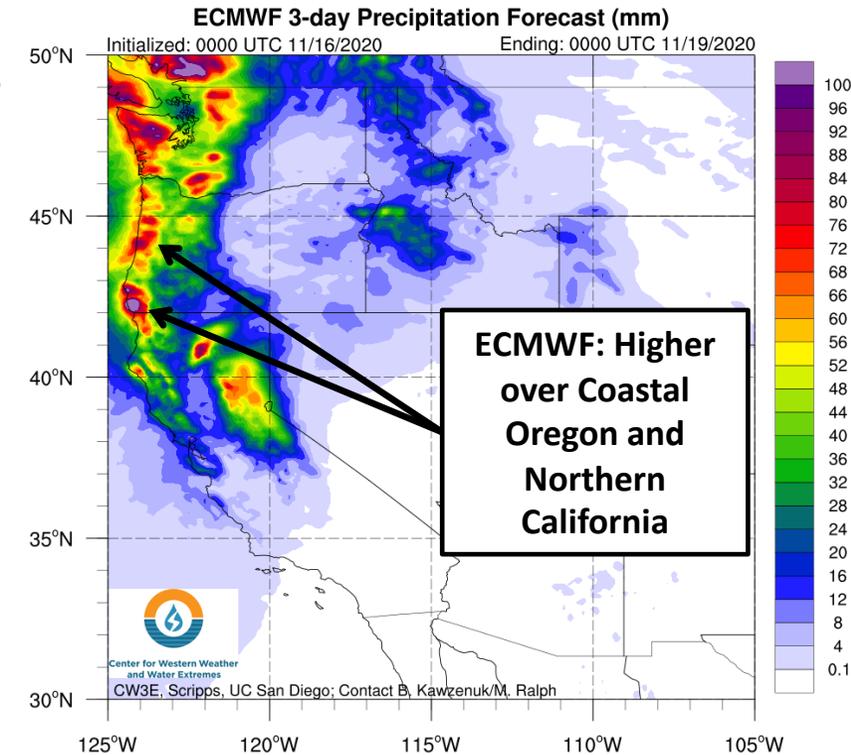
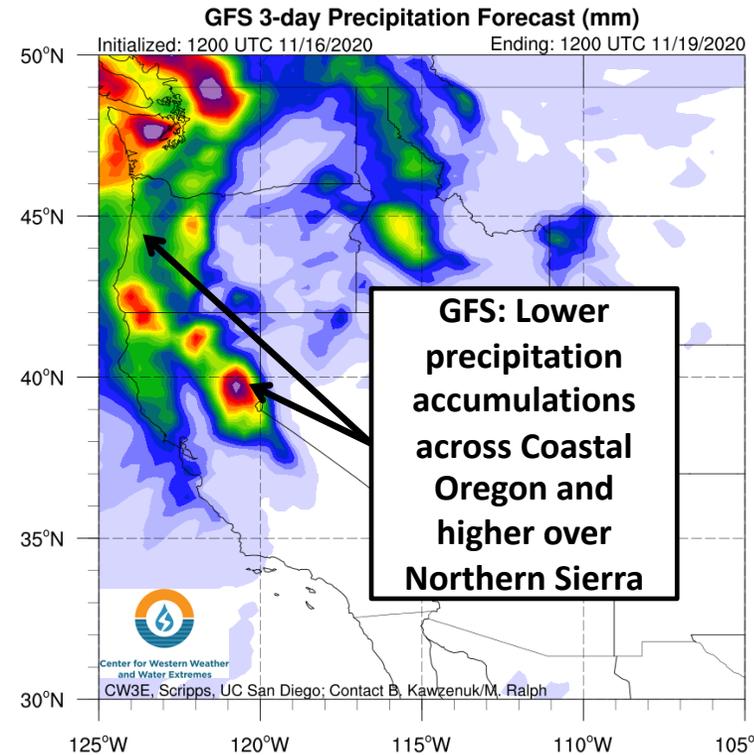
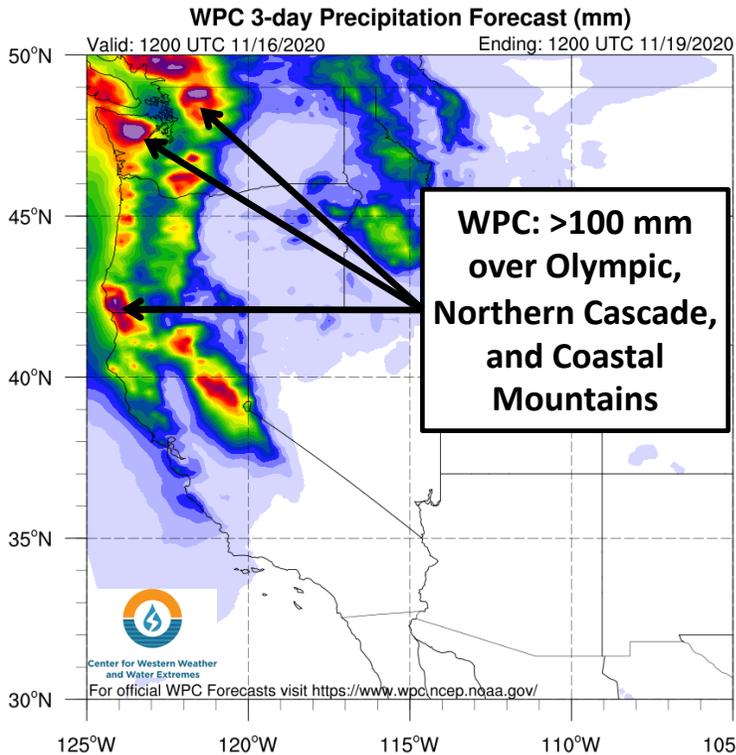
Winds peak late Tuesday Morning; Rainy through Wednesday



AR Outlook: 16 Nov 2020

For California DWR's AR Program

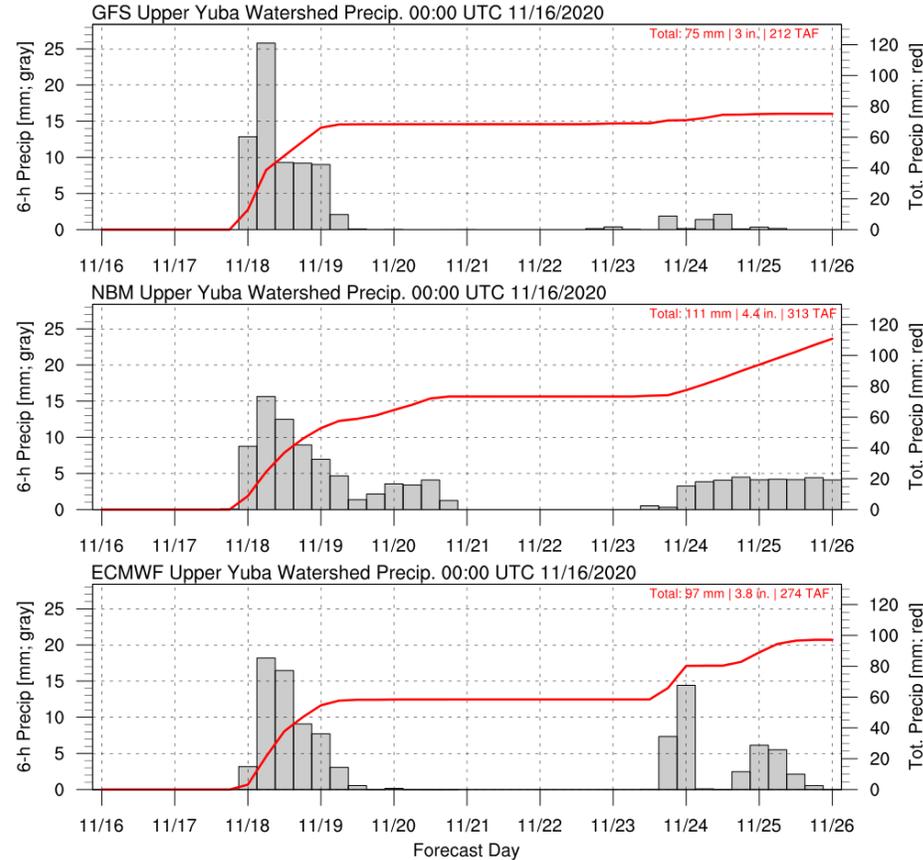
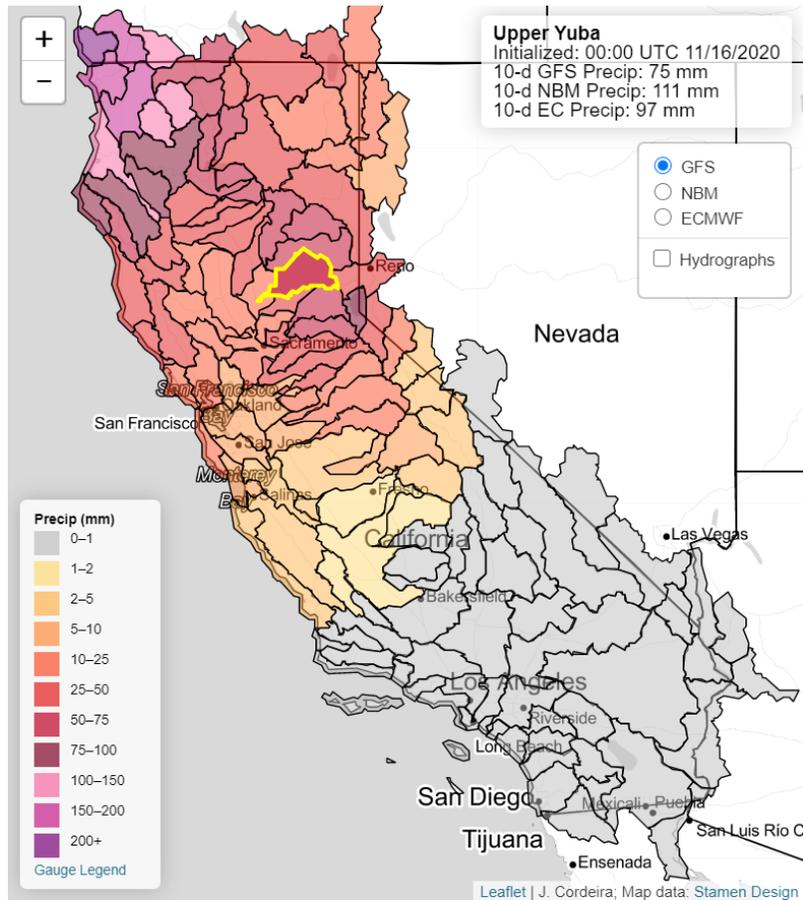
3-day QPF: Valid 0000 UTC 05-12 October



- *WPC = NOAA Weather Prediction Center
- *GFS = NCEP Global Forecast System (United States)
- *ECMWF = European Center for Medium-Range Weather Forecasts (Europe)

- The WPC and ECMWF are currently predicting >3.5 in. of precip. over the Olympic Peninsula and the Coastal Range of S. OR and N. CA
- The WPC and GFS are both predicting >3.5 inches over the Cascade Mountains in N. WA
- The GFS is currently drier than the WPC and ECMWF over much of Coastal Oregon and is wetter over the Northern Sierra Nevada
- The ECMWF is suggesting lower precipitation accumulations than the WPC and GFS over the Cascades in Northern Washington

10-day Watershed Precipitation Forecasts



*GFS = NCEP Global Forecast System (United States)

*NBM = National Blend of Models (Blend of NWS and non-NWS models)

*ECMWF = European Center for Medium-Range Weather Forecasts (Europe)

- The GFS and ECMWF forecast models are predicting 3.0 and 3.8 inches of watershed average precipitation over the Upper Yuba watershed in Northern California during the next 10 day period.
- The NBM is currently suggesting slightly higher precipitation accumulations of 4.4 inches of watershed average precipitation