

# CW3E Event Summary: 3–5 November 2022

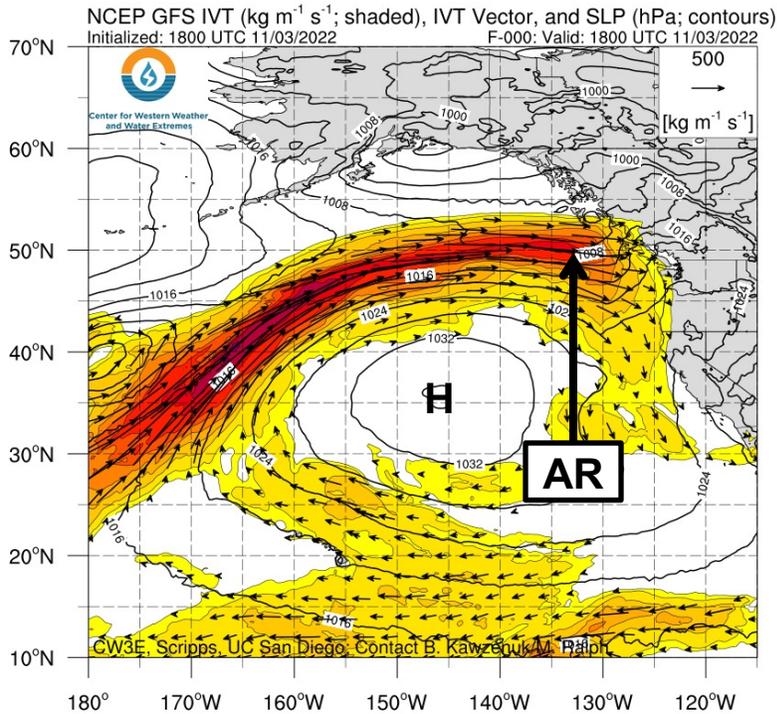
## Strong Atmospheric River Brings Heavy Precipitation to Northwestern US

- A strong atmospheric river (AR) made landfall over the Pacific Northwest on 3 Nov
- AR 3 conditions (based on the Ralph et al. 2019 AR Scale) were observed in coastal Washington and northern coastal Oregon, while AR 1/AR 2 conditions were observed in southern coastal Oregon and coastal Northern California
- AR 2/AR 3 conditions were also observed east of the Cascades due to significant inland penetration of the AR
- This AR produced at least 5–10 inches of precipitation over portions of western Washington and northwestern Oregon, as well as 2–5 inches of precipitation in parts of the interior northwestern US
- At least 1–3 feet of snow fell in the higher terrain of the Washington Cascades, the Blue Mountains, and the Northern Rockies
- Heavy rainfall on 4 Nov caused riverine flooding on the western side of the Washington Cascades, with multiple rivers exceeding moderate flood stage
- Strong winds on 4 Nov downed trees and power lines, resulting in numerous power outages in northwestern Washington
- This AR was sampled by the 53<sup>rd</sup> Weather Reconnaissance Squadron as the first mission of the 2023 AR Recon season, with data from 23 dropsondes assimilated into the 00Z 5 Nov GFS model run

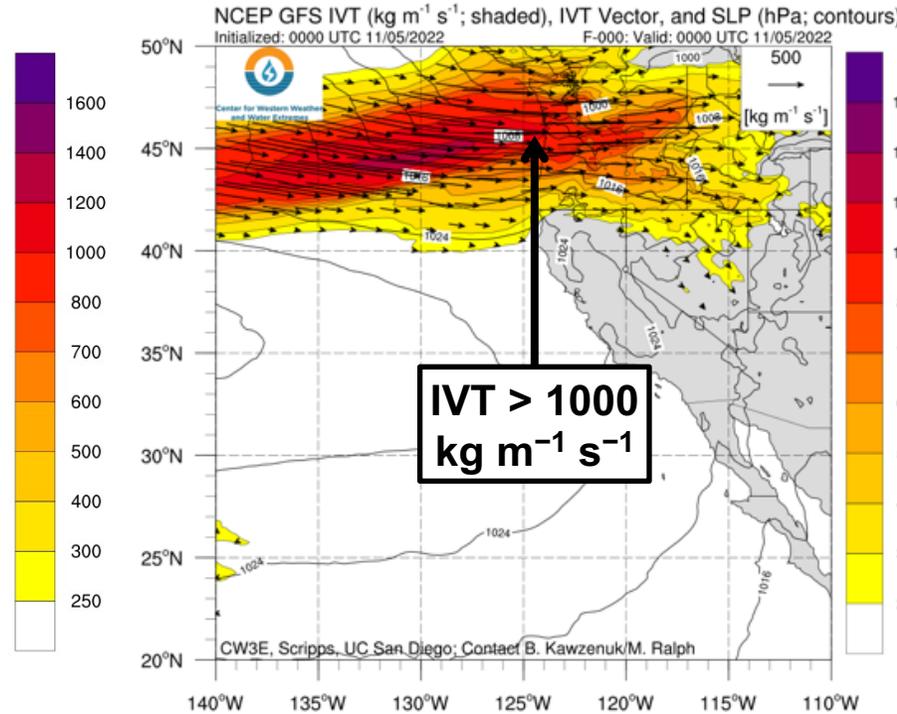
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## GFS IVT Analyses of the AR

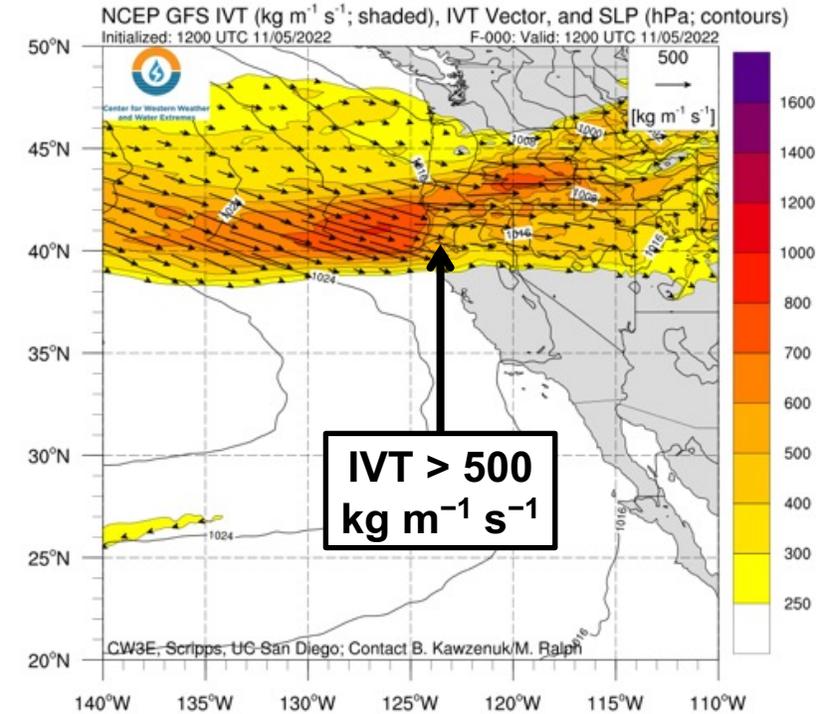
(A) Valid: 11 AM PT 3 Nov



(B) Valid: 5 PM PT 4 Nov



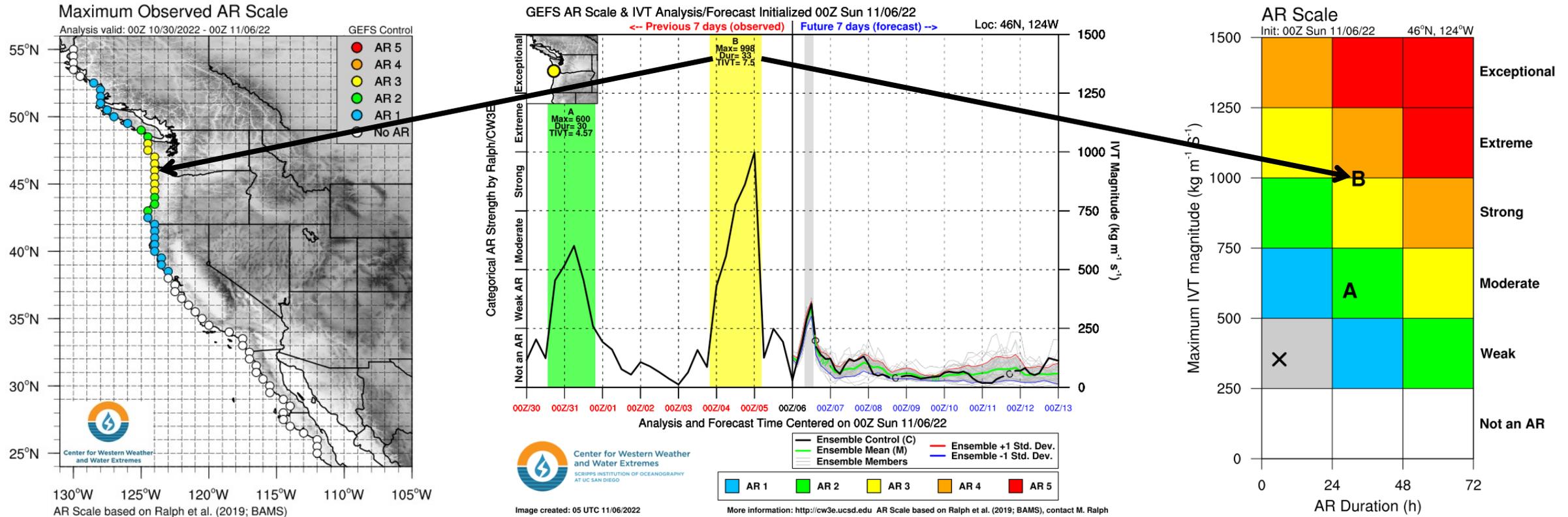
(C) Valid: 5 AM PT 5 Nov



- This AR made landfall over Washington and Oregon on 3 Nov on the poleward side of surface high pressure (Figure A)
- The strongest moisture transport occurred around 00Z 5 Nov (5 PM PT 4 Nov), with IVT values approaching  $1000 \text{ kg m}^{-1} \text{s}^{-1}$  near the WA/OR border (Figure B)
- As time progressed, the AR continued to move southward, bringing a brief period of moderate AR conditions ( $500 \text{ kg m}^{-1} \text{s}^{-1}$ ) to Northern California (Figure C)
- This event was also characterized by significant inland penetration of the AR over the interior northwestern US (Figures B and C)

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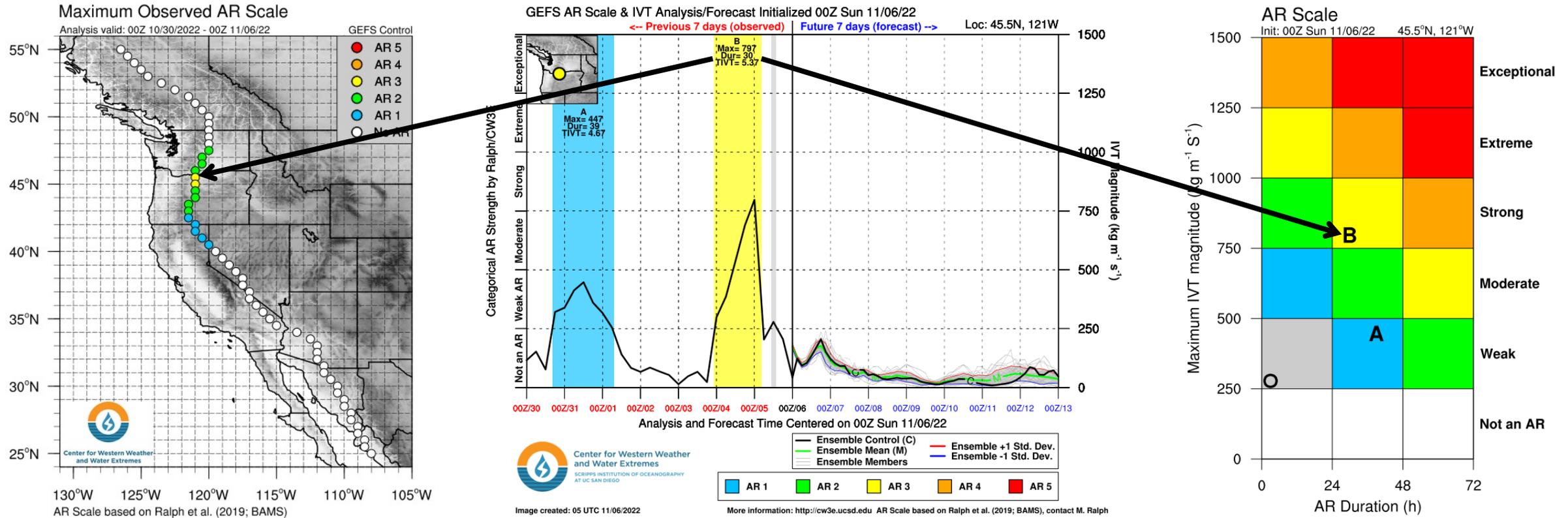
## GEFS Control AR Scale (Coastal)



- This AR produced AR 3 conditions (based on the Ralph et al. 2019 AR Scale) in coastal Washington and northern coastal Oregon
- AR 1/AR 2 conditions were observed in southern coastal Oregon and coastal Northern California
- Clatsop County, OR, nearly experienced an AR 4, with a maximum IVT value of  $998 \text{ kg m}^{-1} \text{ s}^{-1}$  at 00Z 5 Nov (5 PM PT 4 Nov)

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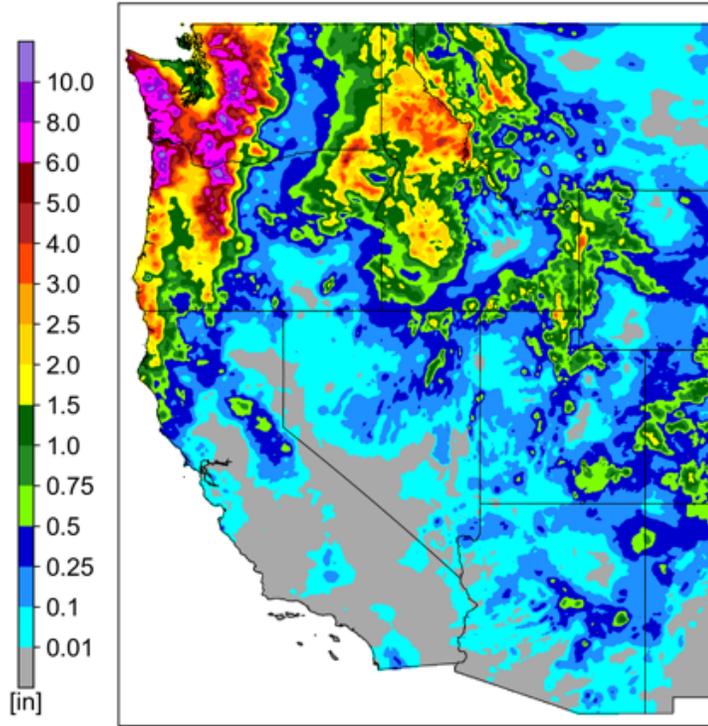
## GEFS Control AR Scale (Inland)



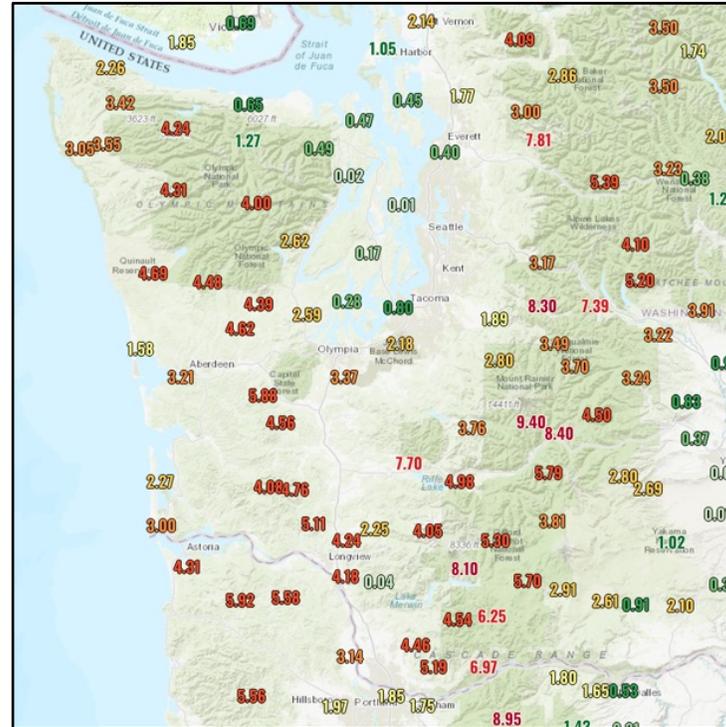
- Significant inland penetration of this AR resulted in AR 2/AR 3 conditions east of the Cascades in south-central Washington and central Oregon
- A maximum IVT value of  $797 \text{ kg m}^{-1} \text{ s}^{-1}$  was observed at  $45.5^\circ\text{N}$ ,  $121^\circ\text{W}$  (near The Dalles, OR) at 00Z 5 Nov (5 PM PT 4 Nov)

## Observed Precipitation

NCEP Stage IV 72-h QPE  
Valid: 4 AM PT 6 Nov

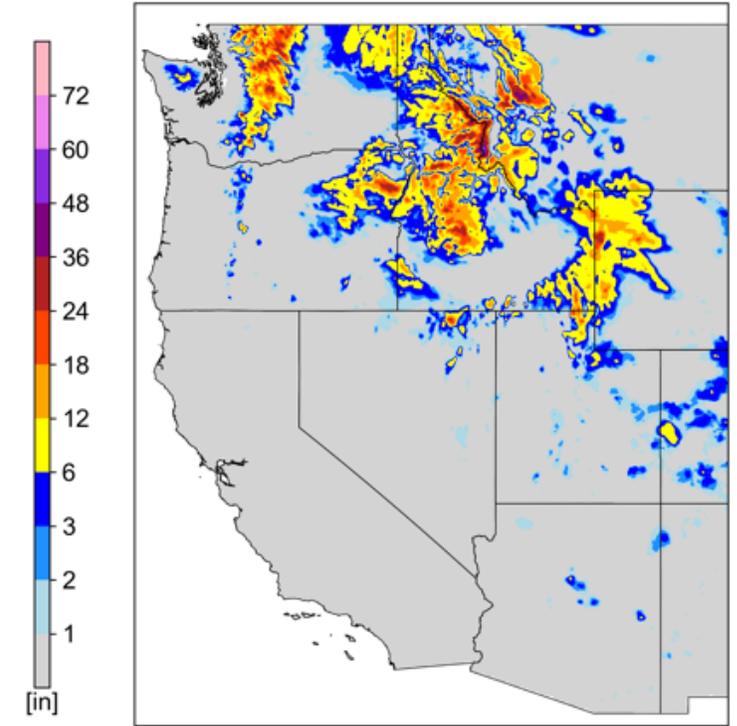


Observed 24-h Precip: Valid 12 AM PT 5 Nov



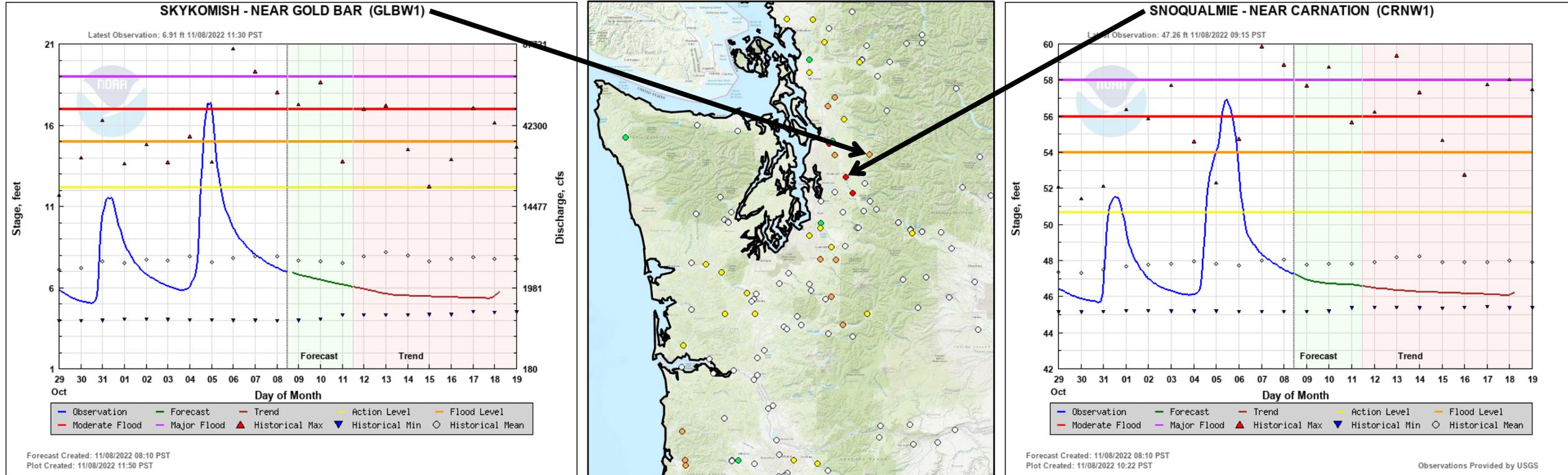
Source: NOAA/NWS Western Region

NOHRSC 48-h Snowfall Analysis  
Valid: 5 PM PT 5 Nov



- This AR produced at least 5–10 inches of precipitation over portions of western Washington and northwestern Oregon, with the highest amounts (> 10 inches locally) in the Olympic Mountains, Cascades, and Oregon Coast Ranges
- Inland penetration of the AR also brought 2–5 inches of precipitation to portions of the interior northwestern US
- The heaviest precipitation fell on 4 Nov, with several stations in the Cascades reporting > 7 inches in a 24-hour period
- Daily precipitation records were set at Astoria, OR (4.07 in), Olympia, WA (3.33 in), Hoquiam, WA (2.99 in), and Quillayuate, WA (2.74 in) on 4 Nov
- At least 1–3 feet of snow fell in the higher terrain of the Washington Cascades, the Blue Mountains, and the Northern Rockies

## Impacts

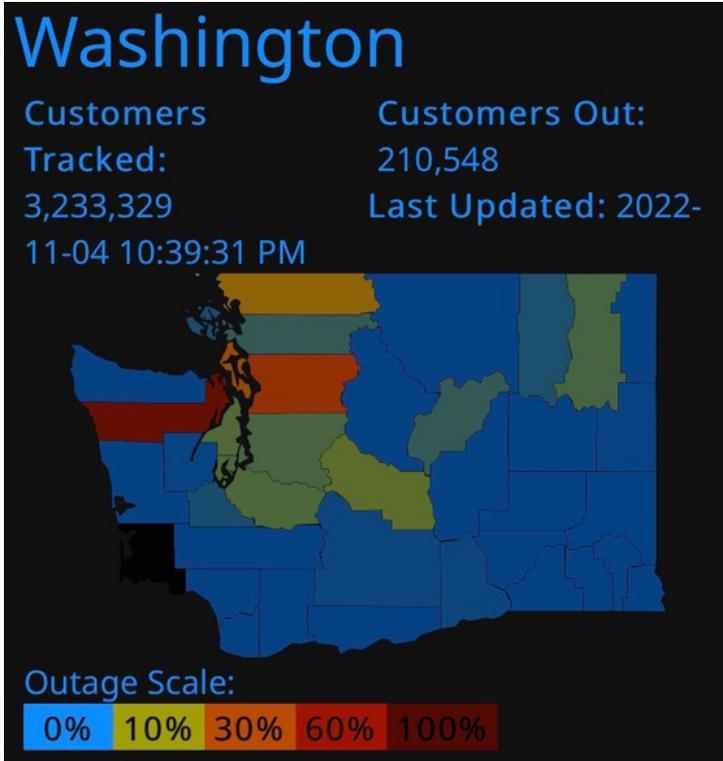


Source: NOAA/NWS Northwest River Forecast Center

- Heavy precipitation on 4 Nov caused riverine flooding on the western side of the Washington Cascades
- The Skykomish River (near Gold Bar) and the Snoqualmie River (near Carnation) both exceeded moderate flood stage
- The Skykomish River (near Gold Bar) rose more than 11 feet in 24 hours, reaching a peak stage of 17.41 feet
- The Snoqualmie River (near Carnation) reached a peak stage of 56.9 feet

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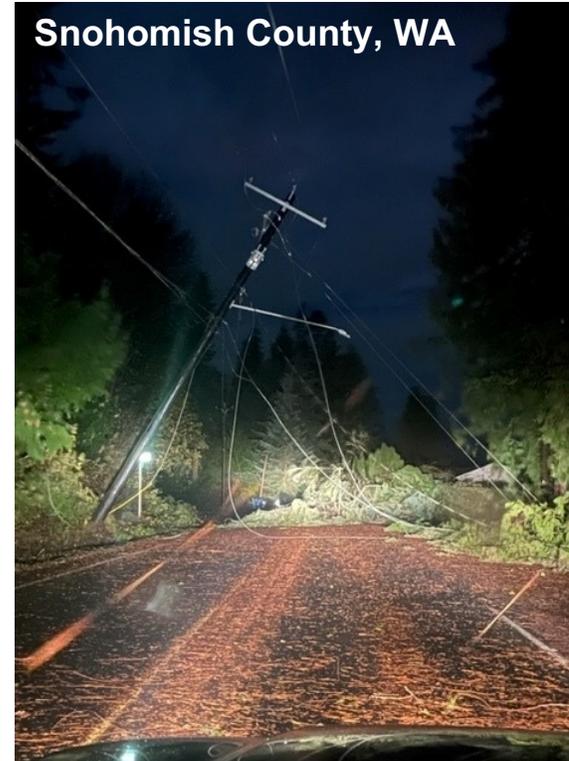
## Impacts



Source: Washington Emergency Management Division and PowerOutage.us



Source: Washington State DOT



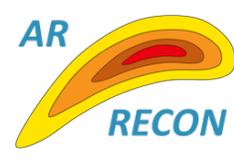
Source: Snohomish County PUD



Source: Washington State DOT

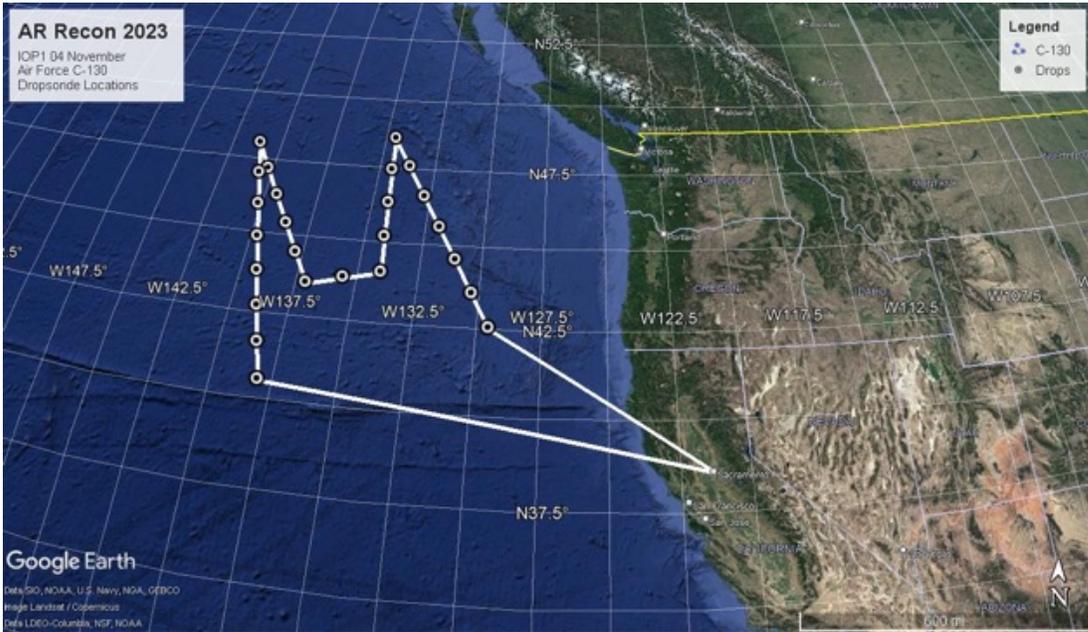
- Strong winds downed trees and power lines, resulting in numerous power outages in northwestern Washington
- More than 200,000 customers were without power at one point during the evening of 4 Nov, with Jefferson and Snohomish Counties hit the hardest
- SR 410 was closed near Greenwater, WA, for more than 24 hours due to a slide that covered the roadway

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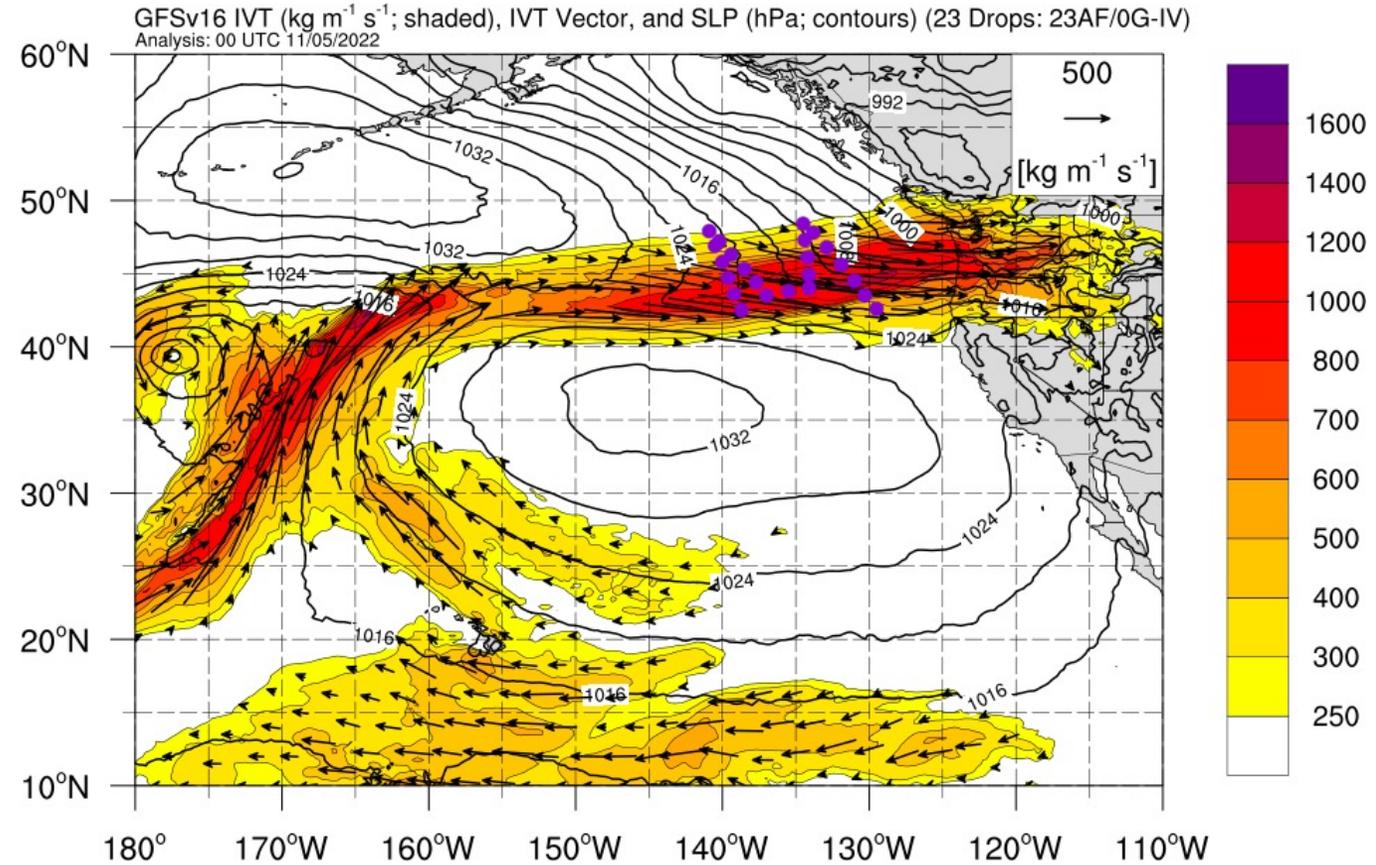


Research And Operations Partnership

- The first mission of CW3E's 2023 Atmospheric River Reconnaissance program sampled this AR on 4 Nov
- The 53<sup>rd</sup> Weather Reconnaissance Squadron flew one C-130 from Mather Air Force Base in California
- During this flight, the crew deployed 25 dropsondes, 23 (24) of which were assimilated into the 00Z 5 Nov GFS (ECMWF) model



## IOP1: 00Z 5 Nov



● Dropsonde points