

# CW3E Atmospheric River Outlook: 29 November 2022

## Atmospheric River to bring precipitation to the U.S. West Coast

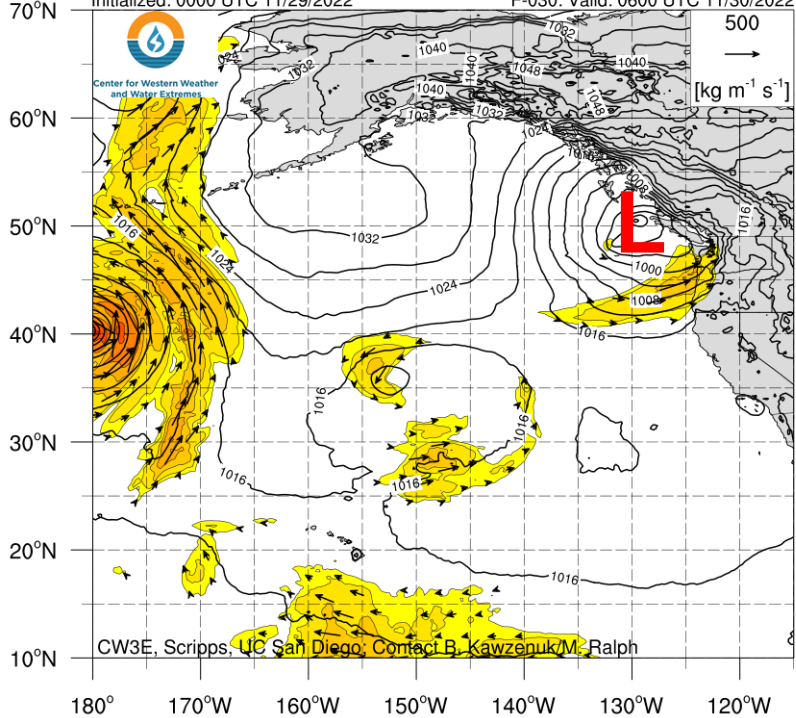
- A strong low-pressure system associated with an upper-level shortwave trough will impact much of the US West Coast today through Thursday, with the development of an atmospheric river over Northern California
- After the initial AR, a second low-pressure system will develop offshore and travel down the coast, bringing another round of precipitation to the region Friday into Sunday.
- There is considerable model disagreement between the GFS and ECMWF, with the ECMWF forecasting more intense AR2 conditions along the coast of California during AR landfall
- The National Weather Service Weather Prediction Center is forecasting up to 7 inches of precipitation for mountainous regions along the border of Oregon and California during this event, with a marginal risk for excessive rainfall along the coast
- Rivers are expected to rise in Southern Oregon and Northern California during this storm, but are not forecast to exceed flood stage as a result of this event
- Cold air associated with the upper-level trough moving into the area will lead to lower freezing levels in the region
- National Weather Service forecast offices across the western U.S. have begun issuing public guidance for this storm, including winter storm watches and warnings in advance of snowfall totals in exceeding 24 inches for some locations at higher elevations

# AR Outlook: 29 November 2022

## GFS IVT and SLP Forecasts

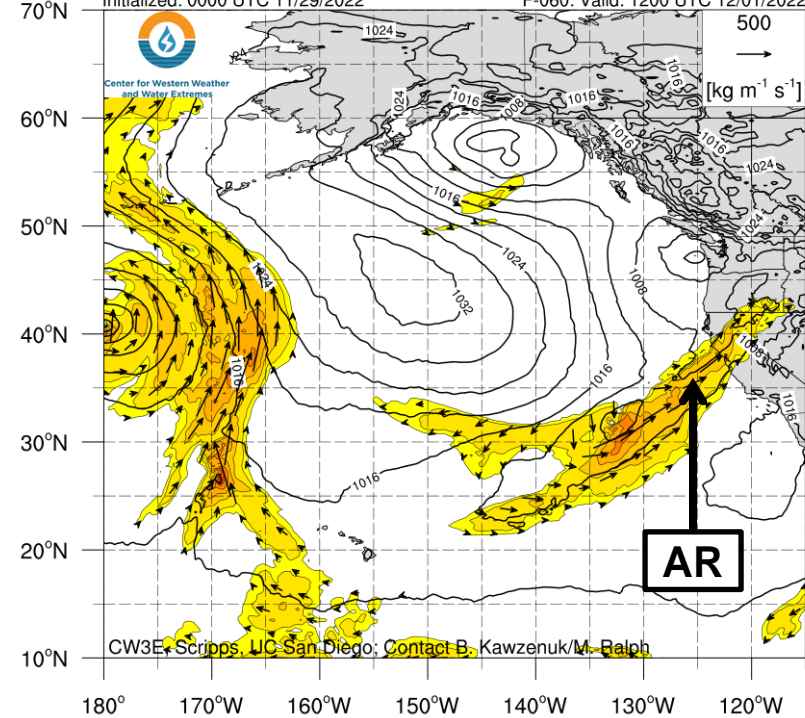
(A) Valid: 10 PM PT 29 Nov (F-30)

NCEP GFS IVT ( $\text{kg m}^{-1} \text{s}^{-1}$ ; shaded), IVT Vector, and SLP (hPa; contours)  
Initialized: 0000 UTC 11/29/2022 F-030: Valid: 0600 UTC 11/30/2022



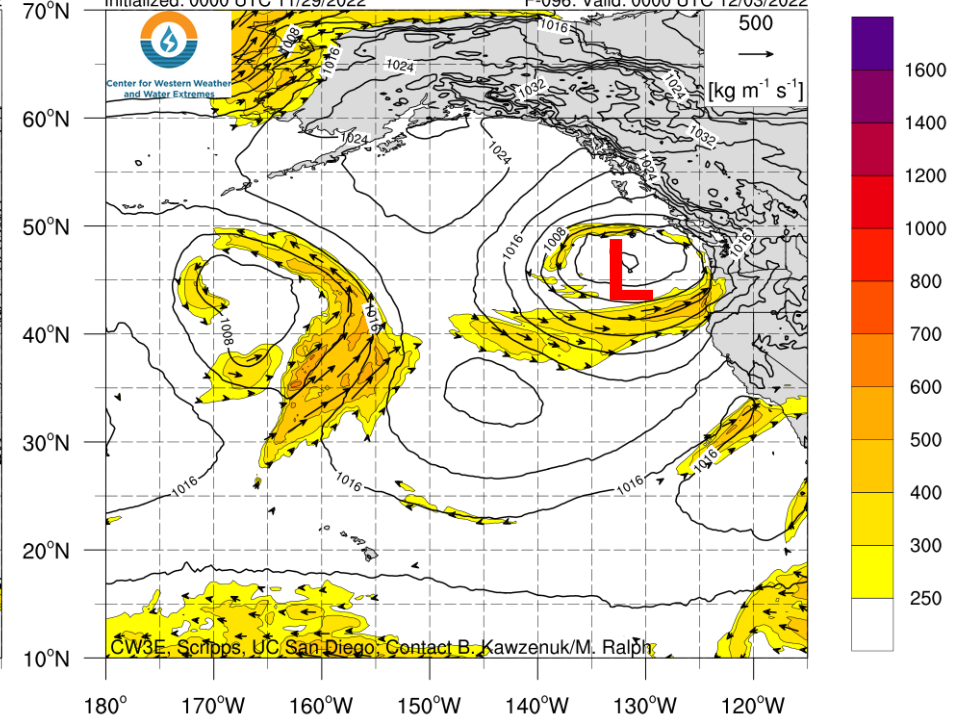
(B) Valid: 4 AM PT 1 Dec (F-60)

NCEP GFS IVT ( $\text{kg m}^{-1} \text{s}^{-1}$ ; shaded), IVT Vector, and SLP (hPa; contours)  
Initialized: 0000 UTC 11/29/2022 F-060: Valid: 1200 UTC 12/01/2022



(C) Valid: 4 PM PT 2 Dec (F-96)

NCEP GFS IVT ( $\text{kg m}^{-1} \text{s}^{-1}$ ; shaded), IVT Vector, and SLP (hPa; contours)  
Initialized: 0000 UTC 11/29/2022 F-096: Valid: 0000 UTC 12/03/2022



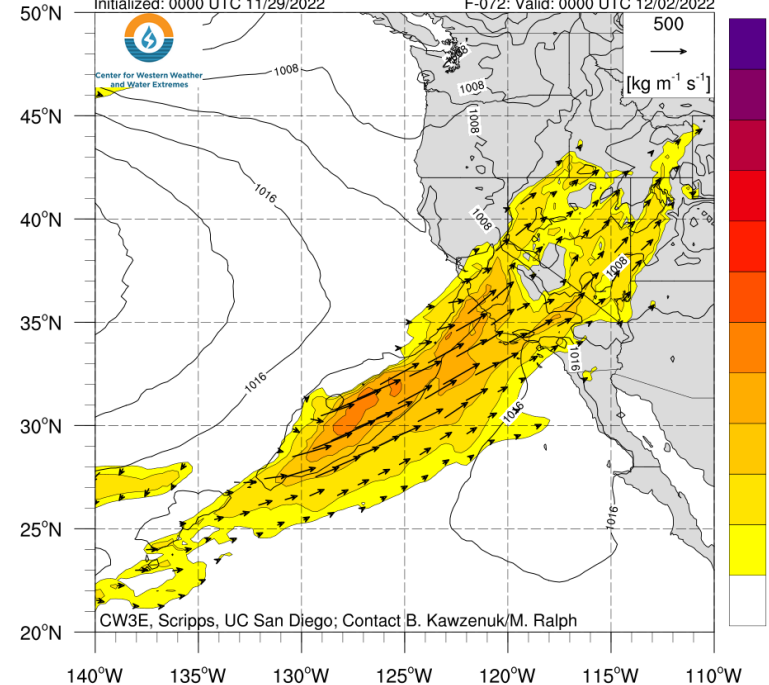
- A strong low-pressure system (L) associated with an upper-level shortwave trough will impact much of the US West Coast today through Thursday (Figure A)
- As time progresses, the upper-level trough is forecast to interact with a region of subtropical moisture, leading to the development of an AR over Northern California (Figure B)
- While the AR begins to dissipate over Southern California, a second low-pressure system is forecast to enter the region on Friday, bringing another round of precipitation (Figure C)

# AR Outlook: 29 November 2022

## Model IVT Comparison: Valid 4 PM PT 1 Dec

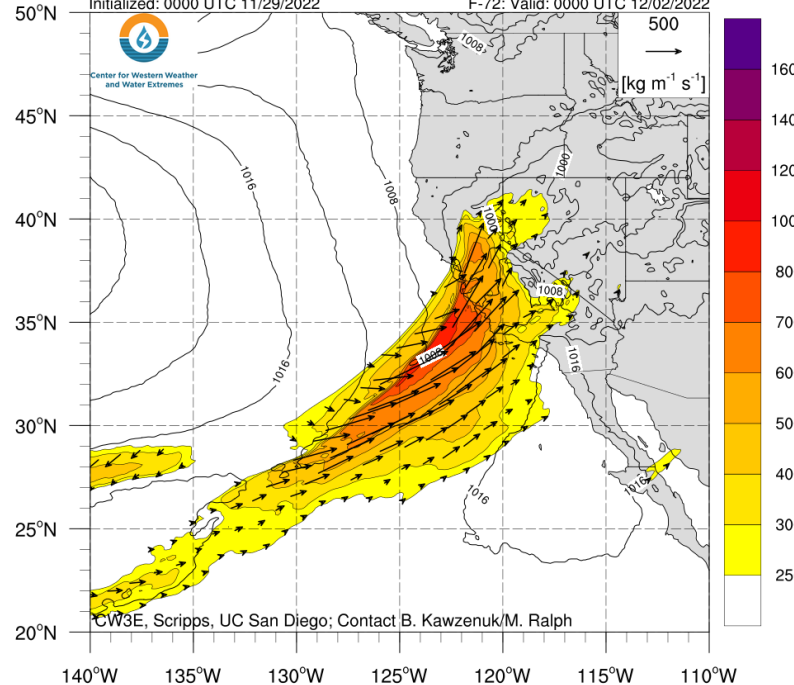
### GFS

NCEP GFS IVT ( $\text{kg m}^{-1} \text{s}^{-1}$ ; shaded), IVT Vector, and SLP (hPa; contours)  
Initialized: 0000 UTC 11/29/2022 F-072: Valid: 0000 UTC 12/02/2022



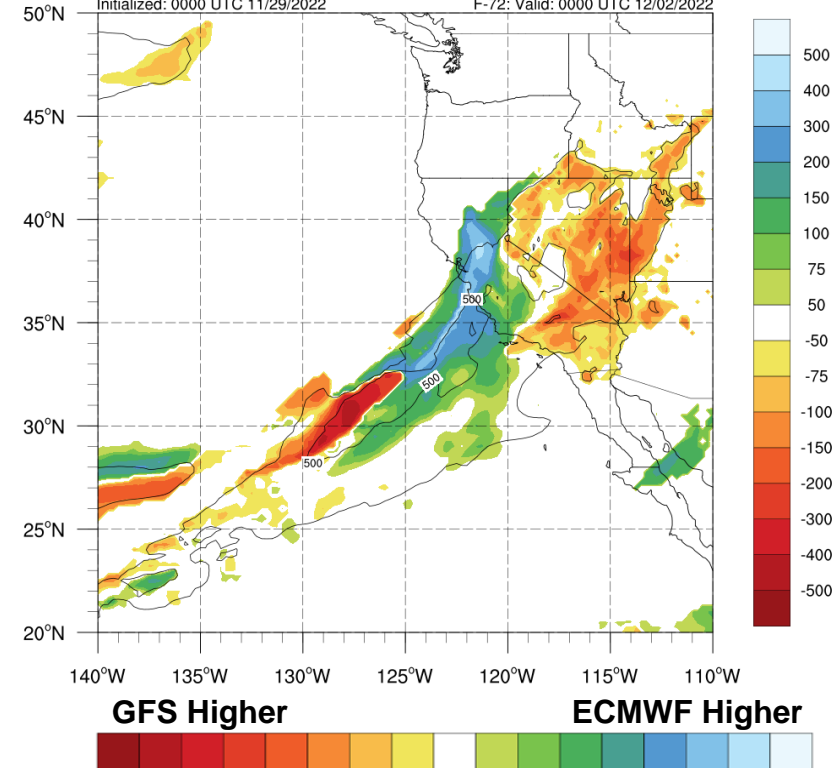
### ECMWF

ECMWF IVT ( $\text{kg m}^{-1} \text{s}^{-1}$ ; shaded), IVT Vector, and SLP (hPa; contours)  
Initialized: 0000 UTC 11/29/2022 F-72: Valid: 0000 UTC 12/02/2022



### Difference (ECMWF - GFS)

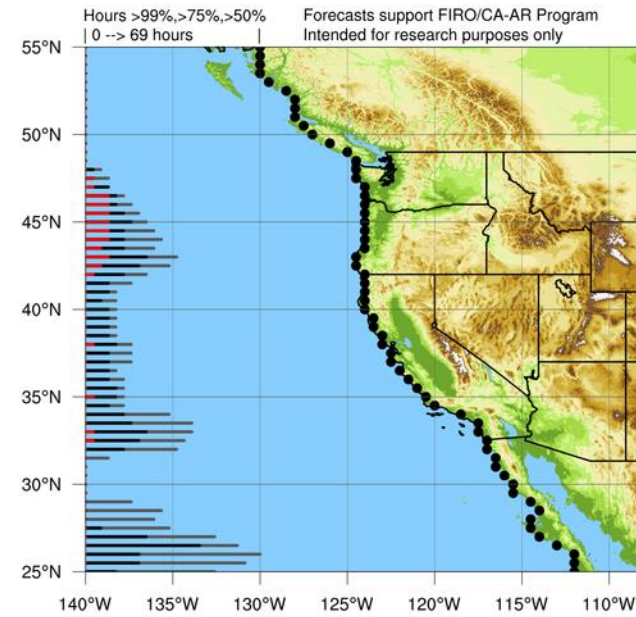
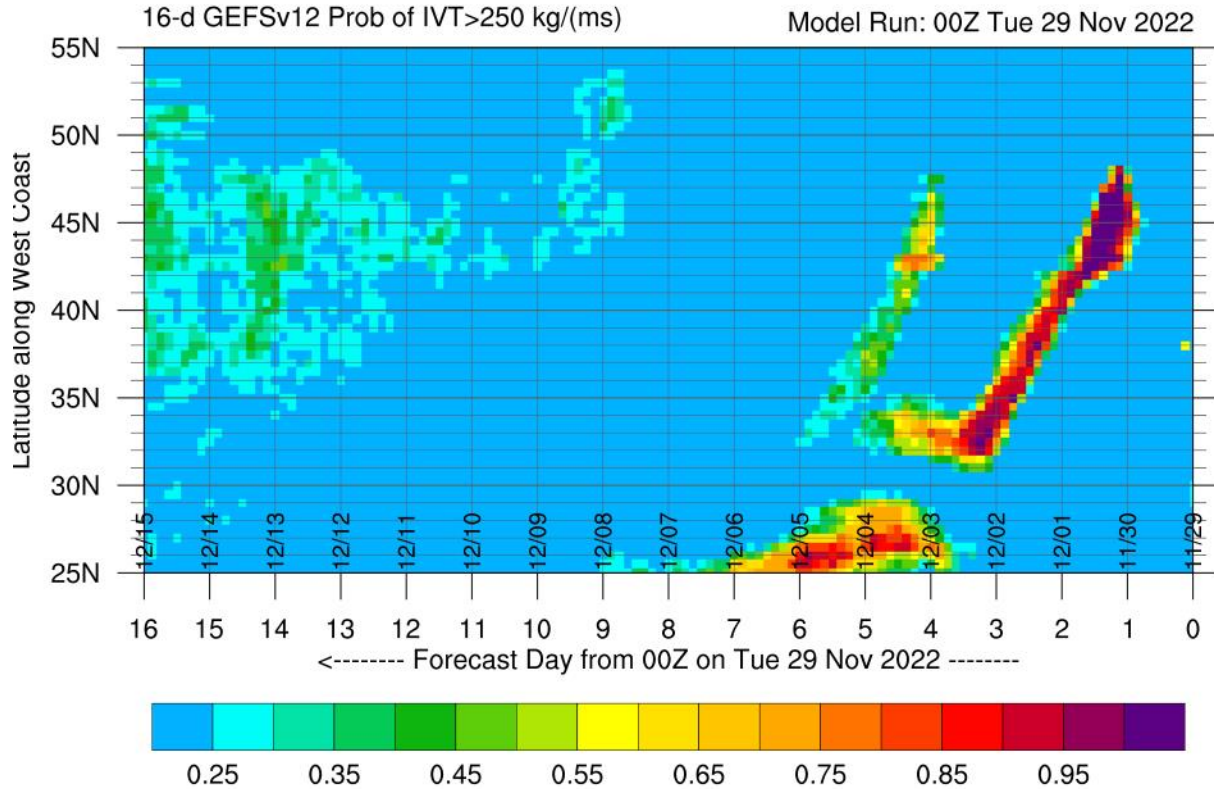
ECMWF IVT - GFS IVT ( $\text{kg m}^{-1} \text{s}^{-1}$ ; shaded), and GFS IVT ( $\text{kg m}^{-1} \text{s}^{-1}$ ; contours)  
Initialized: 0000 UTC 11/29/2022 F-72: Valid: 0000 UTC 12/02/2022



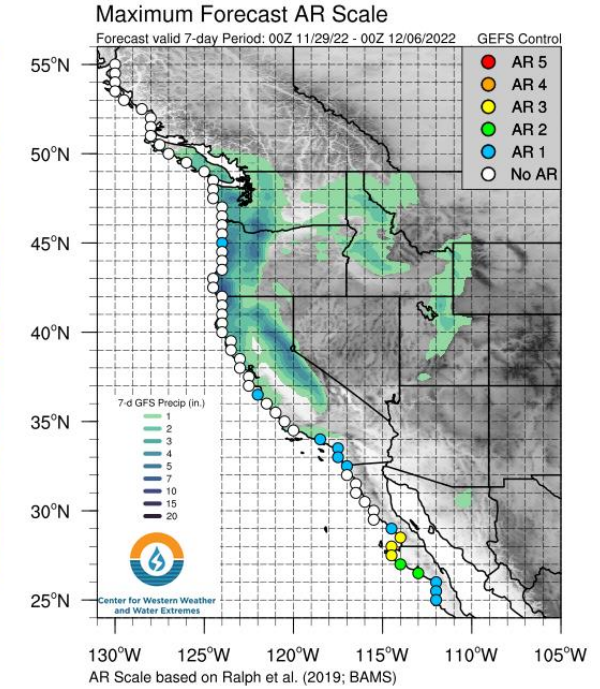
- The 00Z deterministic GFS and ECMWF models are showing large differences in the forecast intensity and orientation of the AR over California on 1 Dec
- Compared to the GFS, the ECMWF is forecasting much higher IVT values over coastal California and the Sacramento Valley
- In addition, the orientation of the moisture transport is more southerly in the ECMWF model
- These differences are contributing to differences in forecast precipitation, especially over Northern California

# CW3E AR Outlook: 29 November 2022

## Probability of AR Conditions Along Coast (GEFS)



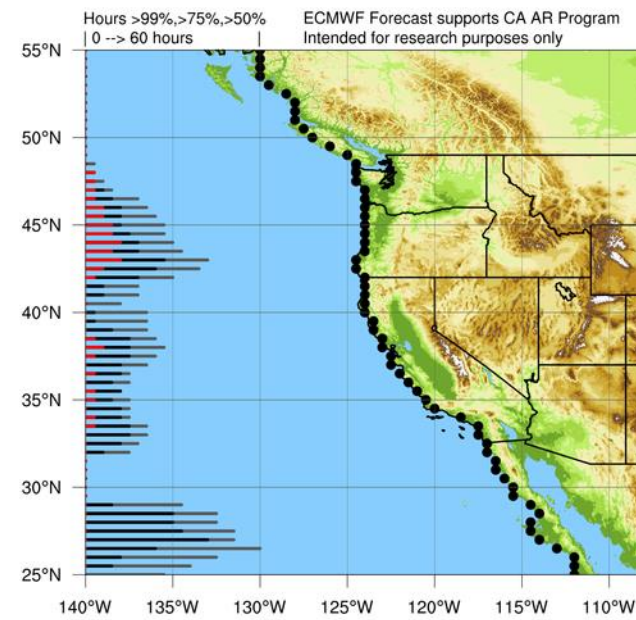
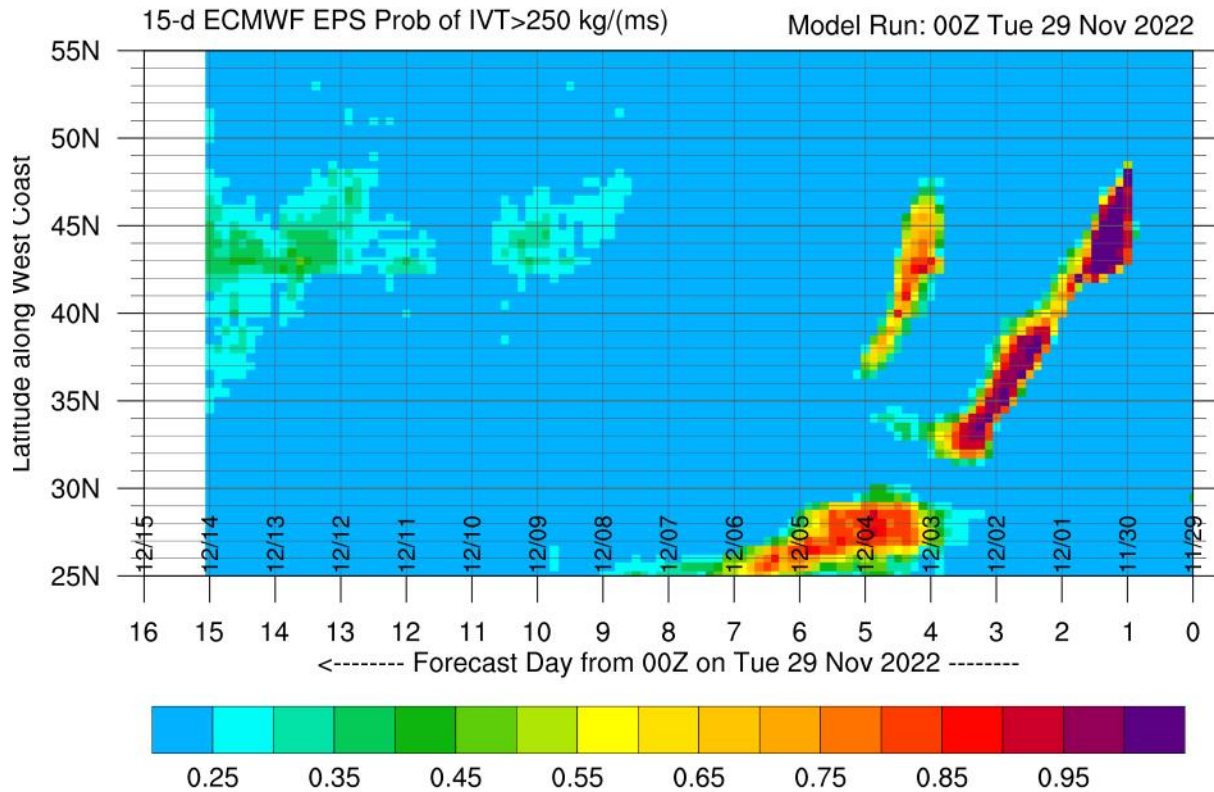
## AR Scale



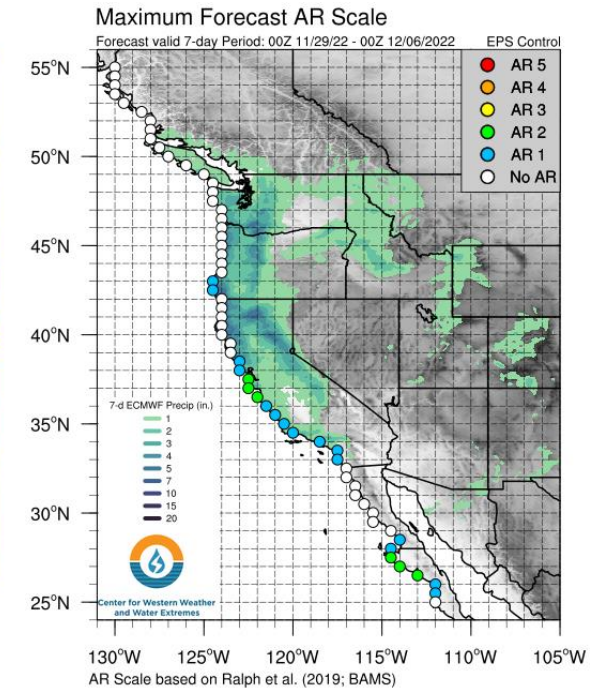
- The 00Z GEFS is showing high confidence (> 95%) in a period of AR conditions (IVT > 250 kg m<sup>-1</sup> s<sup>-1</sup>) along the coast of Oregon into Northern California on 30 November in association with the initial low-pressure system
- Model confidence is slightly lower (75-85%) along the coast of Central and Southern California between 1–2 December at the AR develops and makes landfall
- Although many coastal locations will experience IVT > 250 kg m<sup>-1</sup> s<sup>-1</sup>, many GEFS members do not meet the 24-hour duration criteria of the Ralph et al. (2019) AR Scale to classify as an AR

# CW3E AR Outlook: 29 November 2022

## Probability of AR Conditions Along Coast (ECMWF EPS)



## AR Scale

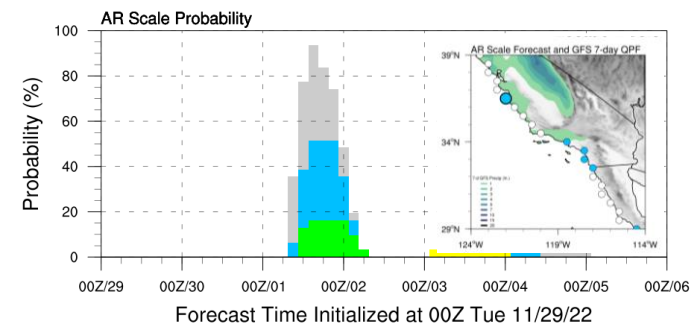
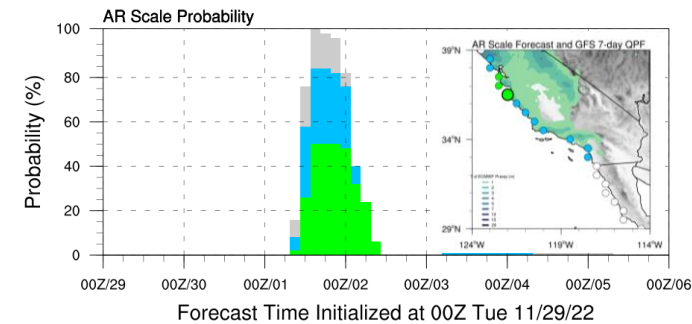
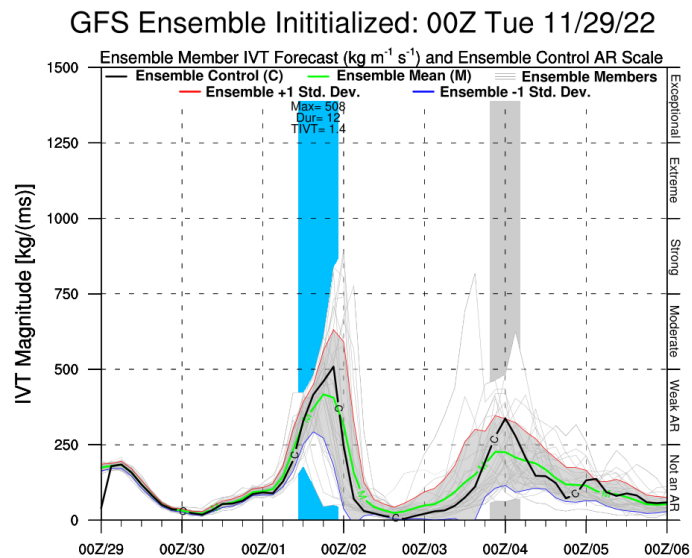
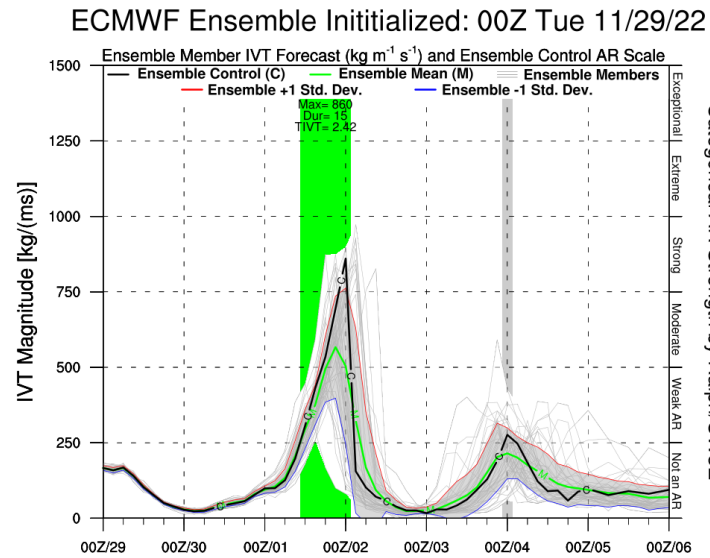


- The 00Z ECMWF EPS is showing high confidence (> 95%) in a period of AR conditions (IVT > 250 kg m<sup>-1</sup> s<sup>-1</sup>) along coastal Oregon on 30 November, with a secondary region of high confidence over California between 1–2 December
- The maximum AR Scale forecast shows a broad area of coastal California with AR1 conditions forecast and localized locations of AR2 conditions in central California

# CW3E AR Outlook: 29 November 2022

## AR Scale and IVT Forecast: ECMWF Ensemble vs GFS Ensemble

- The 00 Z ECMWF EPS control run is forecasting an AR 2 at 36.5N 122.0 W (Monterrey, CA) in association with this AR
- 42/51 (82%) **ECMWF ensemble** members are forecasting at least AR 1 conditions, with 25/51 (49%) forecasting an AR 2
- 16/31 (52%) **GEFS ensemble** members are forecasting at least AR 1 conditions, with 5/31 (16%) forecasting an AR 2
- The ECMWF ensemble is forecasting a longer, more intense period of AR conditions compared to the GFS ensemble
- Uncertainty in the forecast for this event within each ensemble is shown by the large spread in IVT magnitude during the later portions of the AR



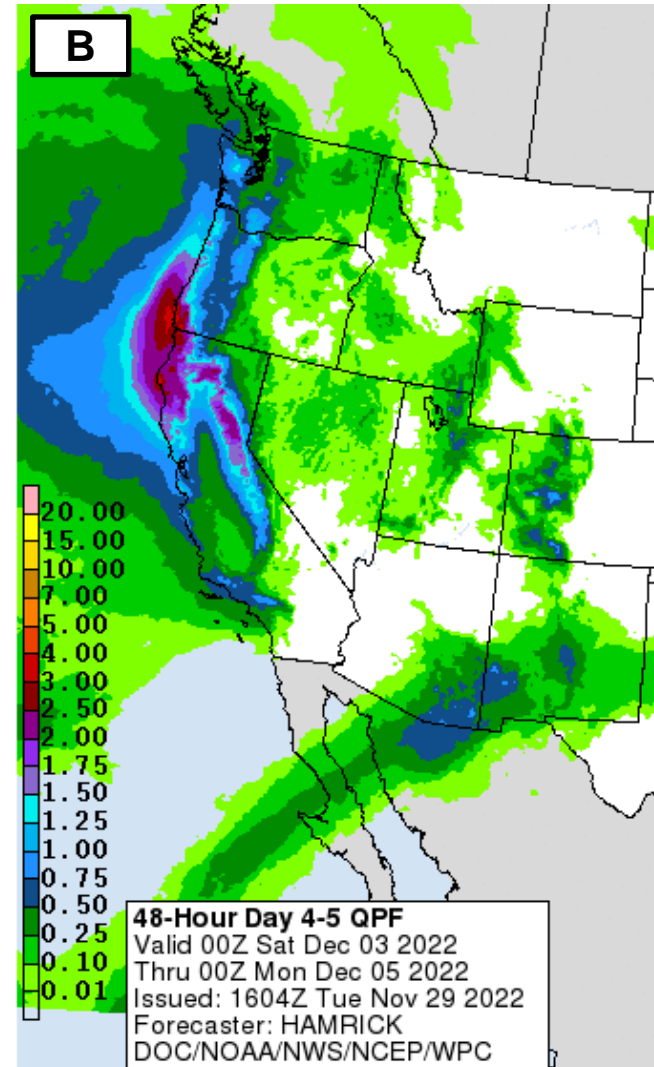
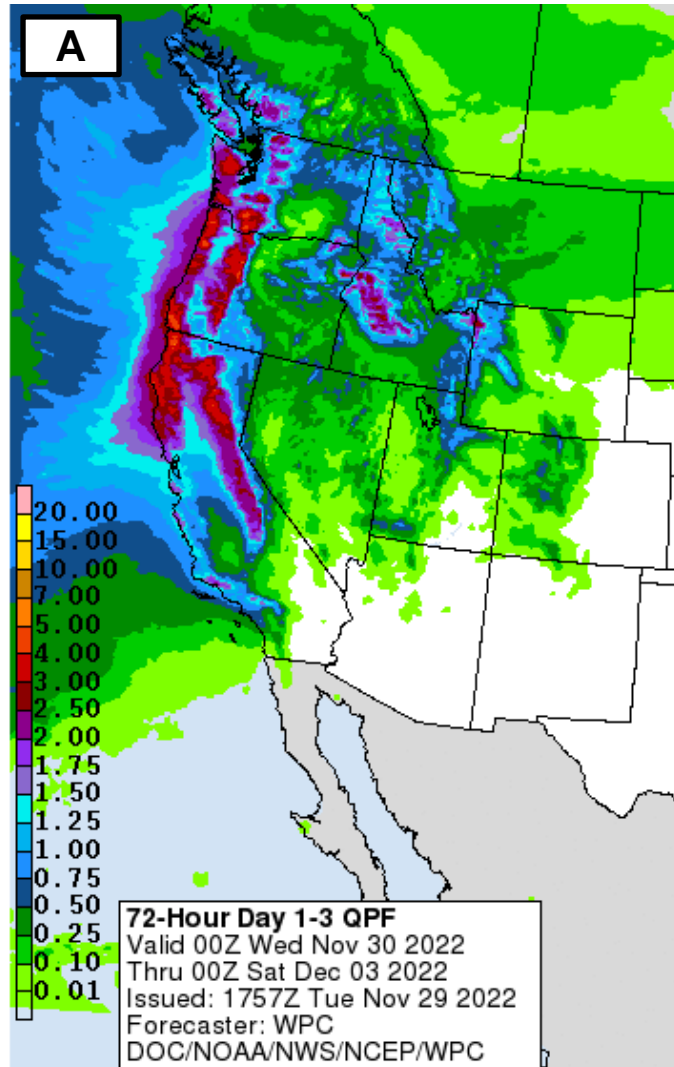
AR 1 AR 2 AR 3 AR 4 AR 5

Image created: 14 UTC 11/29/2022

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

# CW3E AR Outlook: 29 November 2022

## Weather Prediction Center – QPF



- Precipitation on 30 November–1 December will primarily fall in the Coast Ranges of Oregon and California and in the southern Cascades (Figure A)
- The AR period between 1–3 December will bring precipitation to the coastal ranges of California and the Sierras, primarily in the form of snowfall in the higher elevations (Figure A)
- The second low pressure system will produce precipitation in the coastal regions of Oregon and Northern California, with storm totals during this period between 2-3 inches in the mountains (Figure B)
- The WPC 5-day QPF total exceeds 7 inches for portions of Oregon and Northern California

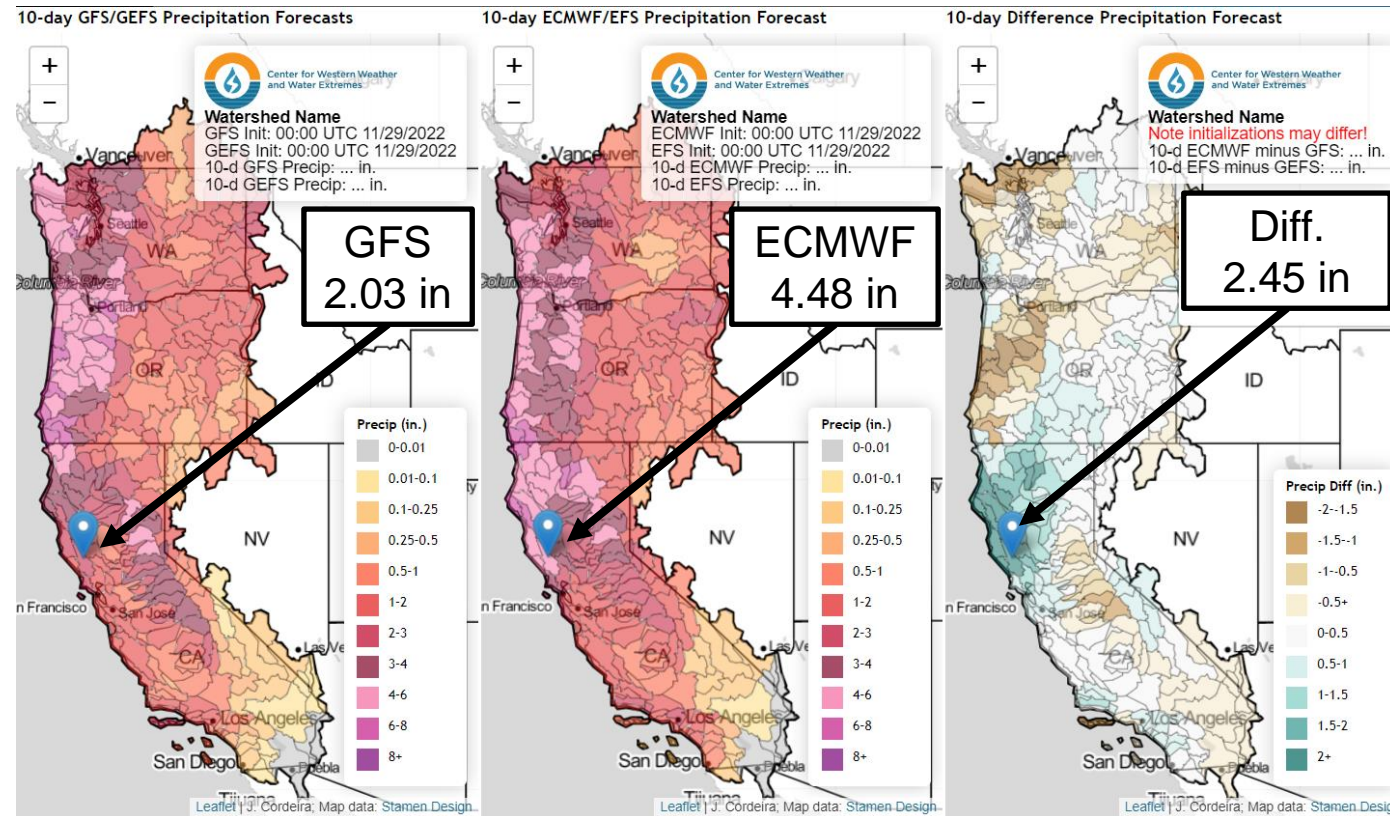
# CW3E AR Outlook: 29 November 2022

## Watershed Precipitation Forecasts (Russian River Highlighted Below)

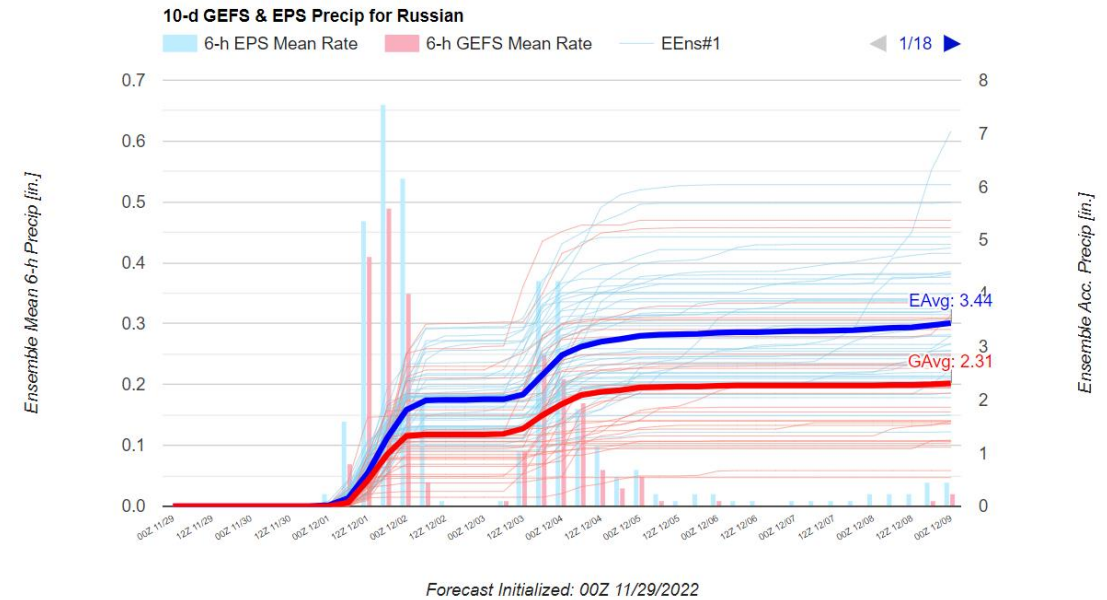
GFS

ECMWF

ECMWF - GFS



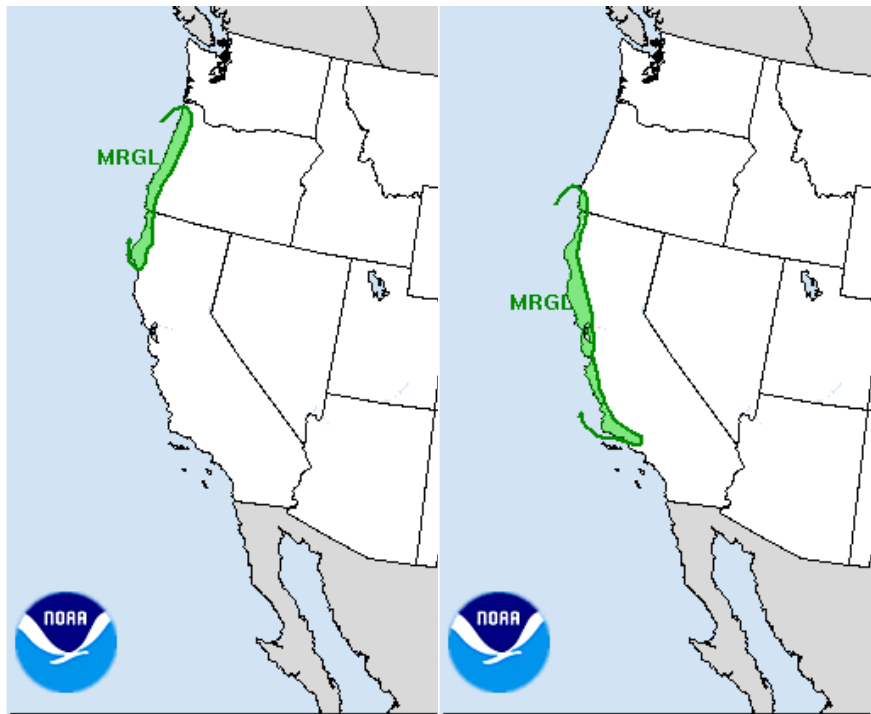
## 10-day GEFS & EPS Precipitation



- The 00Z deterministic ECMWF is forecasting higher precipitation totals in watersheds along the Coast Ranges of Northern California, with the ECMWF forecasting almost double the rainfall during this AR
- The two distinct storms are visible in the precipitation time series for the Russian River Watershed, with an initial period of precipitation associated with the AR followed by the second low-pressure system which will bring another round of precipitation to the region



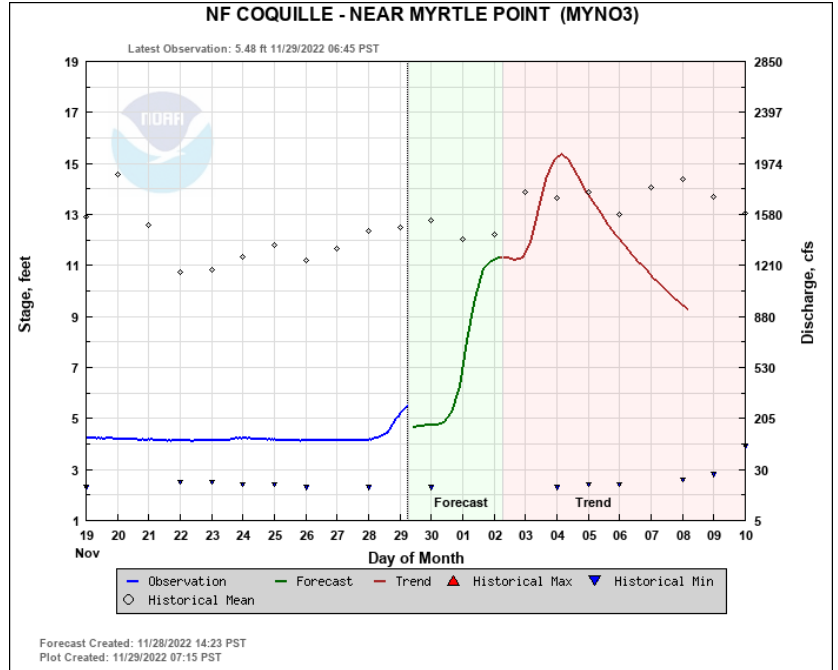
## WPC Excessive Rain Outlook and CNRFC Streamflow Forecast



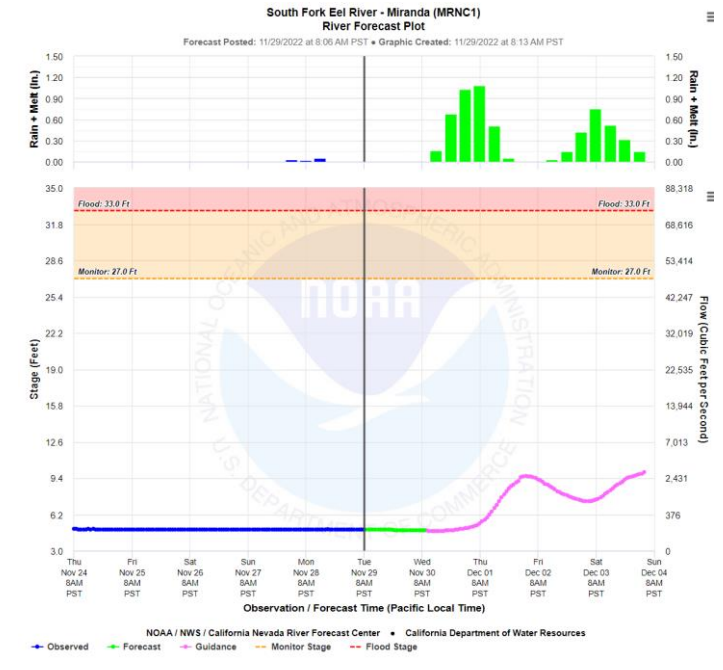
**Day 2 Excessive Rainfall Outlook**  
 Valid 12Z Wed Nov 30 2022  
 Thru 12Z Thu Dec 01 2022  
 Issued: 0821Z Tue Nov 29 2022  
 Forecaster: CAMPBELL  
 DOC/NOAA/NWS/NCEP/WPC

**Day 3 Excessive Rainfall Outlook**  
 Valid 12Z Thu Dec 01 2022  
 Thru 12Z Fri Dec 02 2022  
 Issued: 0825Z Tue Nov 29 2022  
 Forecaster: CAMPBELL  
 DOC/NOAA/NWS/NCEP/WPC

### Southern Oregon



### Northern California

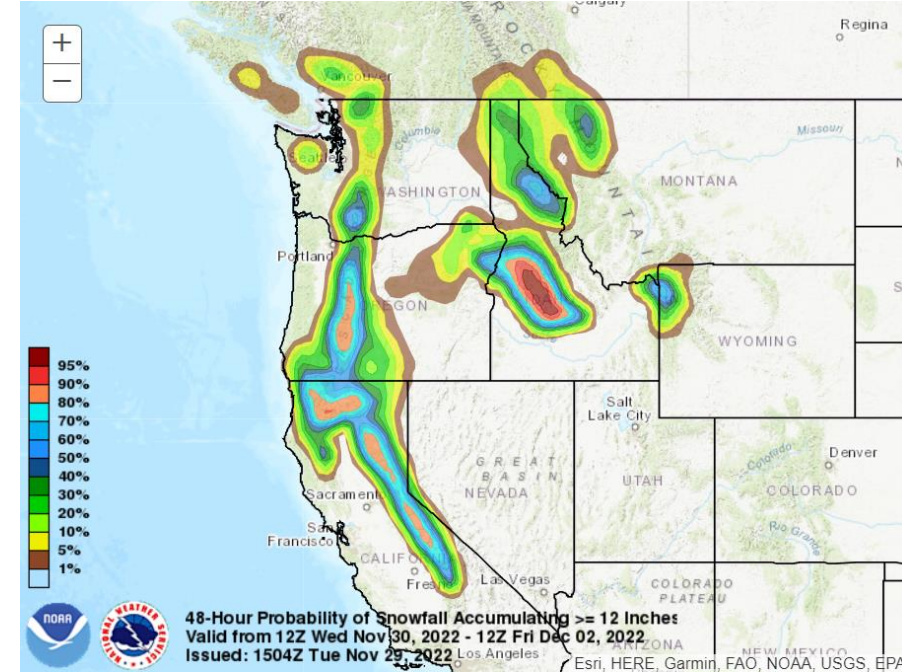
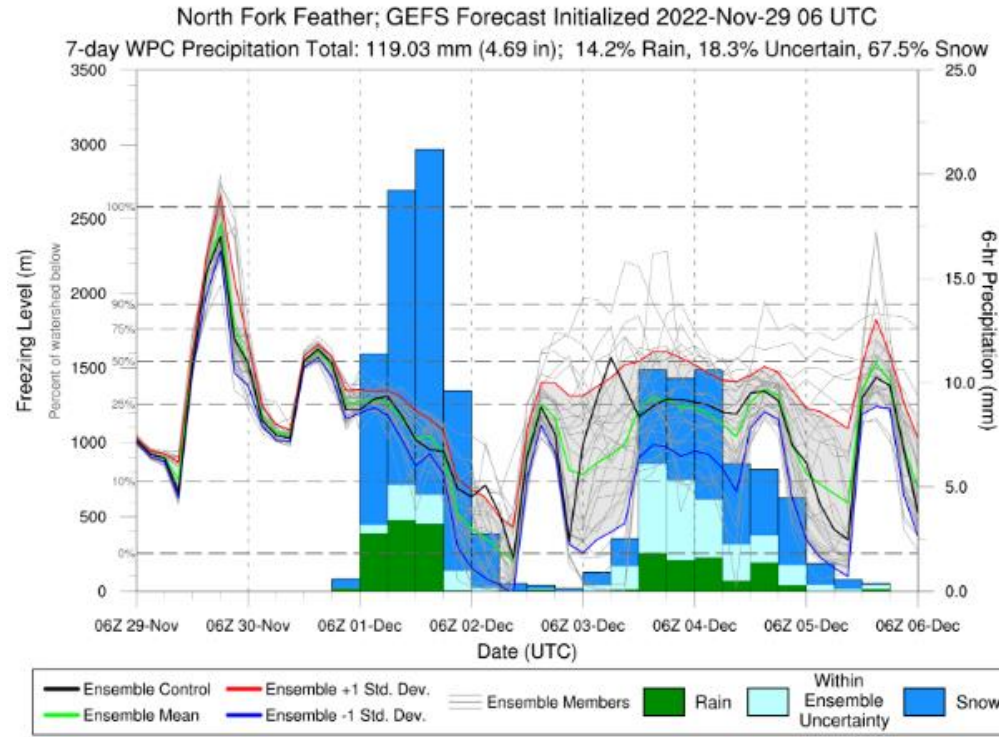
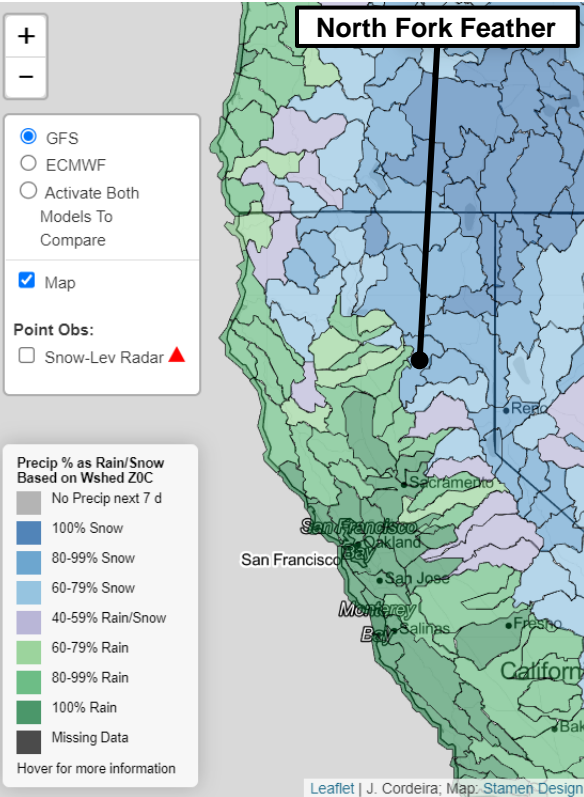


- The NWS WPC has forecast a marginal risk of excessive rainfall for a narrow region along the U.S. West Coast in association with the AR, highlighting the potential for orographically enhanced rain
- Both the California-Nevada and Northwest River Forecast Centers are forecasting significant rises for rivers in Northern California and Oregon, although these river levels are forecast to stay well below any action stages during this event

# CW3E AR Outlook: 29 November 2022

## Freezing Level and Snow Forecasts

## WPC 48-h Probability of Snowfall $\geq 12$ inches Valid 4 AM PT 30 Nov to 02 Dec



- Cold air associated with an upper-level trough moving down the coast will cause freezing levels in the Sierras and Northern CA to fall dramatically during the initial AR
- Significant snowfall is likely in the higher terrain of the Sierra Nevada, Klamath Mountains, and Cascades as well as the Sawtooth Range in Idaho
- Freezing levels are forecast to drop below 3,000 feet as the core of AR conditions moves through Central California

## Winter Storm Watch

National Weather Service | Medford

**Total Snow: 10 am Wed (11/30) – 4 pm Thurs (12/1)**

**A strong winter storm to impact the region Wednesday into Thursday.**

- Moderate to heavy snow above 2500 ft.
- Light snow possible down to 1500 ft early Thurs AM.
- Heaviest snow expected Wed eve – Thurs AM.
- Blowing snow E. of Cascades & Shasta Valley resulting in reduced visibilities.
- Strong winds with gusts 30 to 50 mph for Coast, Shasta Valley, E. of Cascades & across the terrain.

**Travel will be extremely difficult, if not impossible. If you must travel, bring the items below in your car's emergency kit!**

Car Winter Survival Kit Checklist		
<input type="checkbox"/> Flashlight & Extra Batteries	<input type="checkbox"/> Blankets/Sleeping Bag	<input type="checkbox"/> Extra Clothing Hats, Mittens, Parkas, Boots
<input type="checkbox"/> First Aid Kit	<input type="checkbox"/> Non-Perishable Food Granola Bars, Dried nuts, etc.	<input type="checkbox"/> Sand/Kitty Litter Used for Traction
<input type="checkbox"/> Snow Shovel	<input type="checkbox"/> Bottled Water	<input type="checkbox"/> Cell Phone & Charger
<input type="checkbox"/> Ice Scraper with Brush	<input type="checkbox"/> Booster Cables	<input type="checkbox"/> Flares/Triangles & other Bright Objects

Created: 7 pm 11/28/2022

## Snow Forecast

National Weather Service - Sacramento, CA  
weather.gov/sto  
Updated: Tuesday, November 29, 2022

**Impact**

- Chain controls and road closures
- Dangerous travel with possible travel delays

**Snow Levels**

- 2000'-3500' across Shasta County and southern Cascades; 3500'-5000' northern Sierra Nevada

**Timing**

- Wednesday night - early Friday

- National Weather Service offices across the western U.S. have begun issuing public guidance well ahead of this impactful winter storm
- NWS Medford highlighted snowfall totals up to 24 inches in the Klamath Mountains along the border of Oregon and California
- NWS Sacramento has forecast snowfall totals exceeding 36 inches over the northern Sierras, also highlighting the low freezing levels which accompany this storm
- NWS Hanford has forecast snowfall totals exceeding 12 inches for areas in the southern Sierras in association with this AR event

## Projected Precipitation for Thursday and Friday

Information as of Tuesday, November 29 at 5:23 AM

**4am Fri, Dec 02 Forecast**

**Total Precipitation**

**Accumulated Snowfall**

Hanford, CA WEATHER FORECAST OFFICE  
November 29, 2022

<http://www.weather.gov/hnx>