



Center for Western Weather  
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY  
AT UC SAN DIEGO

# CW3E Subseasonal Outlook: 6 November 2024

*Prepared by: C. Castellano, J. Wang, Z. Yang, M. DeFlorio, J. Kalansky*

UC San Diego



# CW3E Subseasonal Outlooks: Glossary & Context

- The outlooks are based on CW3E subseasonal forecast products that can be found here: [https://cw3e.ucsd.edu/s\\_and\\_s\\_forecasts/](https://cw3e.ucsd.edu/s_and_s_forecasts/)
- CW3E subseasonal (2–6 weeks lead time) atmospheric river, ridging, and circulation regime products use three different global ensemble prediction systems to create these products:
  - NCEP CFSv2 (US Model): Weeks 2–6
  - ECCO (Canadian Model): Weeks 2–3
  - ECMWF (European model): Weeks 2–6
- *On the following slides, the term confidence refers to the forecasters' interpretation of the magnitude of the anomalies, the level of ensemble agreement, and the skill of the products used to generate the forecasts. All the tools used are shown in the outlook presentation.*
- *The thresholds for below-normal, near-normal, and above-normal conditions are determined by forecast product and noted on each forecast product slide*

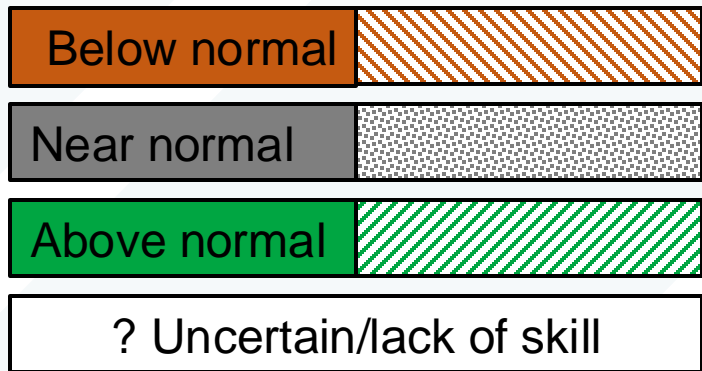
# Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

## Forecasts Initialized 4 Nov 2024

Region	Week 2 (12–18 Nov)				Week 3 (19–25 Nov)				Week 4 (26 Nov – 2 Dec)			
	NCEP <sup>3</sup>	ECCC <sup>1</sup>	ECMWF <sup>1,2</sup>	Multi-Model Forecast	NCEP <sup>3</sup>	ECCC <sup>1</sup>	ECMWF <sup>1,2</sup>	Multi-Model Forecast	NCEP <sup>3</sup>	ECCC <sup>1</sup>	ECMWF <sup>2</sup>	Multi-Model Forecast
WA/OR	Grey	Grey	White	Grey	Grey	Grey	White	Grey	Green	Green	White	Green
Northern CA	Grey	Grey	Orange	White	Grey	Grey	White	Grey	Green	Green	White	Green
Central CA	Grey	Grey	Brown	White	Grey	Grey	White	Grey	Green	Grey	White	White
Southern CA	Grey	Orange	Brown	Orange	Grey	Grey	White	Grey	Green	Grey	White	White

Higher Confidence | Lower Confidence



- Models lean towards below-normal precipitation (with low confidence) in Southern CA during Week 2; more uncertainty in Northern and Central CA
- Models lean towards near-normal precipitation (with low confidence) in CA during Week 3
- Models lean towards above-normal precipitation (with low confidence) in Northern CA during Week 4; more uncertainty in Central and Southern CA

### Subseasonal products included in this Outlook:

<sup>1</sup>CW3E/JPL Atmospheric River Activity Forecasts ([DeFlorio et al. 2019](#), [Zhang et al. 2023](#))

<sup>2</sup>CW3E/JPL Ridging Forecasts ([Gibson et al. 2020](#))

<sup>3</sup>IRI North American Weather Regime Forecasts ([Robertson et al. 2020](#))

# Summary

## MJO/QBO Conditions

- MJO convection is currently located over the Western Hemisphere (Phase 8); QBO is in the westerly phase
  - MJO in Phase 8 and westerly QBO during OND is associated with a high likelihood of below-normal AR activity and precipitation in Central CA at lag times of 2 weeks
- Models show uncertainty in MJO conditions during Weeks 1–2, with NCEP forecasting strong MJO convection over the Western Hemisphere/Africa (Phases 1&8), and ECMWF forecasting weak MJO convection
  - MJO in Phases 1&8 during OND is associated with an increased likelihood of wet extremes in Central and Southern CA at lag times of 1–4 weeks

## Week 2 forecasts (12–18 Nov):

- Models generally agree on below-normal AR activity in Southern CA, but disagree somewhat in Northern and Central CA
  - ECCO is forecasting near-normal AR activity in Northern and Central CA, but ECMWF is forecasting below-normal AR activity
- ECMWF ridging outlooks show high likelihood of above-normal West-ridge activity (dry conditions over Central and Southern CA) during Weeks 1–2
- IRI weather regime tool shows high likelihood of Pacific Ridge (near-normal precipitation in CA) during Week 2

# Summary

## **Week 3 Forecasts (19–25 Nov):**

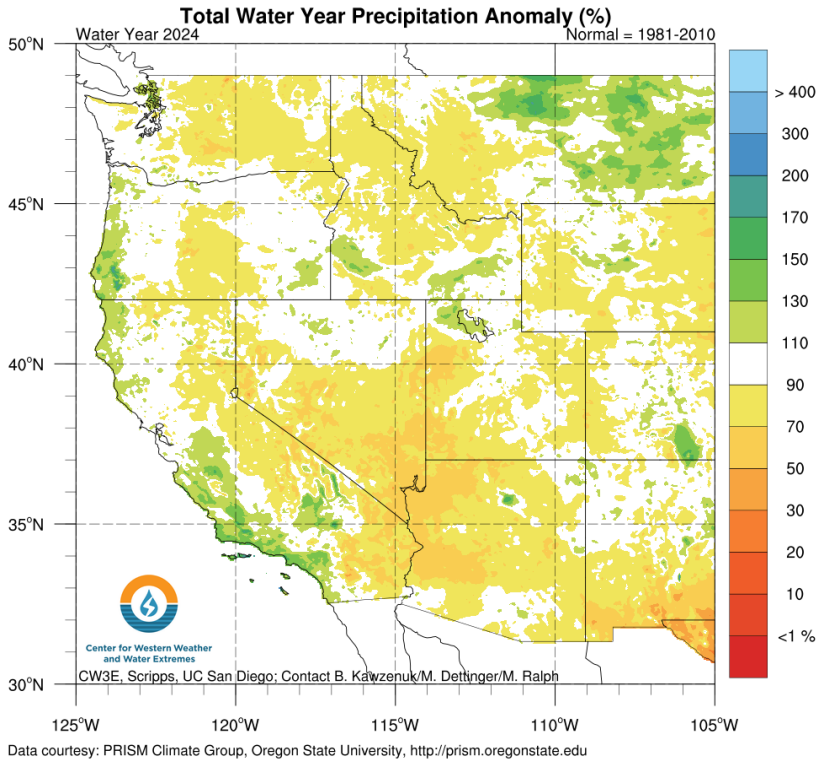
- Models agree on near-normal AR activity in Central and Southern CA during Week 3 (19–25 Nov), but disagree somewhat in Northern CA
  - ECCC is forecasting near-normal AR activity in Northern CA, but ECMWF is forecasting below-normal activity
- ECMWF shows potential for ridging activity near the US West Coast during Weeks 3–4, but there is uncertainty in the location of ridging activity
- IRI weather regime tool shows low-to-moderate likelihood of Pacific Ridge (near-normal precipitation in CA) during Week 3

## **Weeks 4 Forecasts (26 Nov – 2 Dec):**

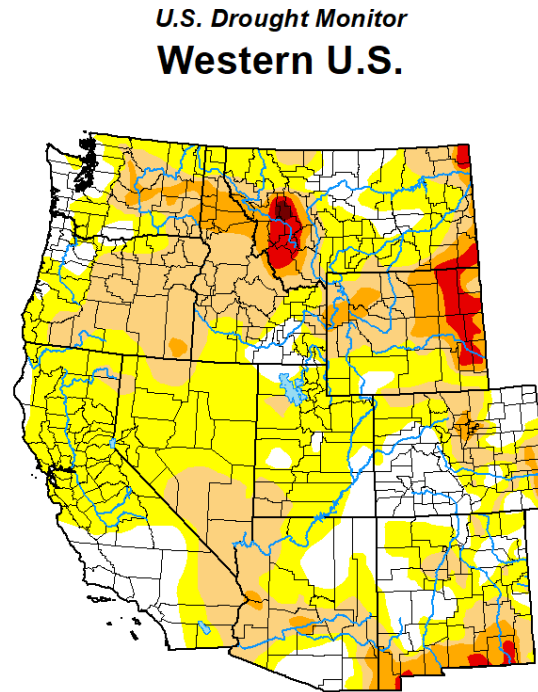
- Models agree on near-normal AR activity in Southern CA during Week 4 (26 Nov – 2 Dec), but disagree somewhat in Northern and Central CA
  - ECCC is forecasting above-normal AR activity in Northern and Central CA, but ECMWF is forecasting near-normal AR activity
- IRI weather regime tool shows low likelihood of Pacific Trough (wet conditions in CA) during Week 4

# Hydrologic Summary

## Precipitation



## Drought Conditions



**October 1, 2024**  
(Released Thursday, Oct. 3, 2024)  
Valid 8 a.m. EDT

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	20.06	79.94	37.38	9.85	2.47	0.11
<b>Last Week</b> 09-24-2024	20.16	79.84	36.37	9.15	2.14	0.11
<b>3 Months Ago</b> 07-02-2024	46.70	53.30	18.76	4.07	1.30	0.04
<b>Start of Calendar Year</b> 01-01-2024	51.19	48.81	25.08	13.17	4.67	0.66
<b>Start of Water Year</b> 09-26-2023	55.99	44.01	31.24	17.70	6.09	0.70
<b>One Year Ago</b> 10-03-2023	55.48	44.52	31.63	18.19	5.36	0.70

**Intensity:**

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

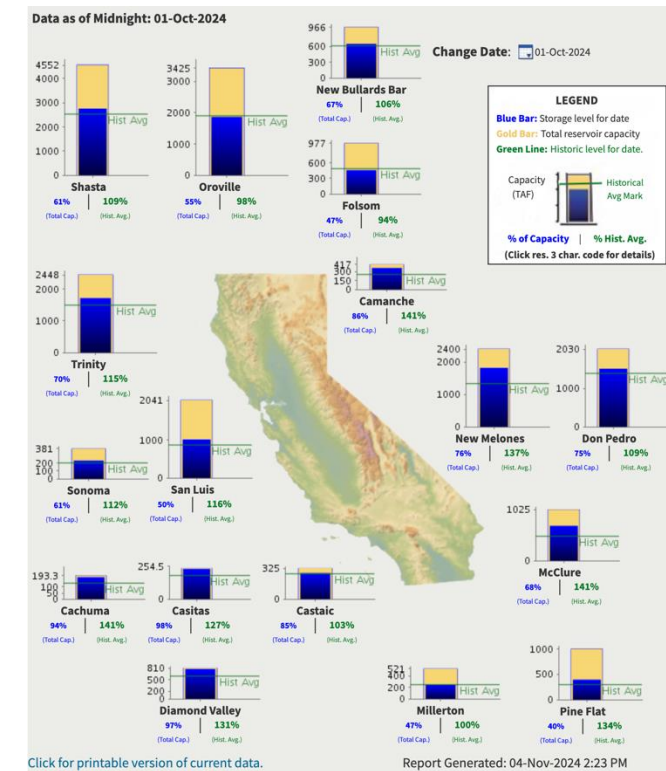
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

**Author:**  
Richard Tinker  
CPC/NOAA/NWS/INCEP

**Logos:** USDA, NDMC, NWS, DWR, DWR

[droughtmonitor.unl.edu](http://droughtmonitor.unl.edu)

## Reservoir Storage

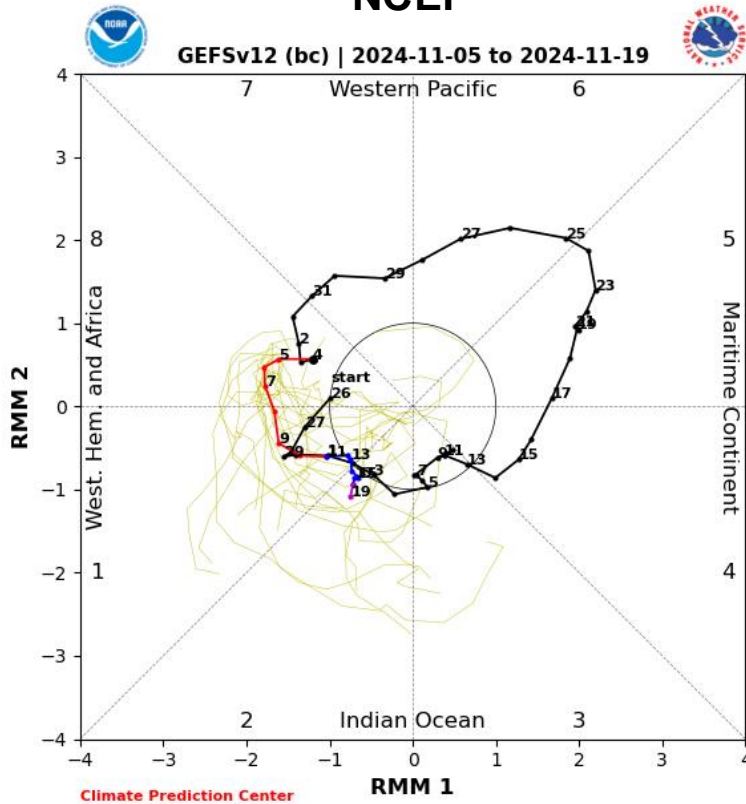


Source: California DWR

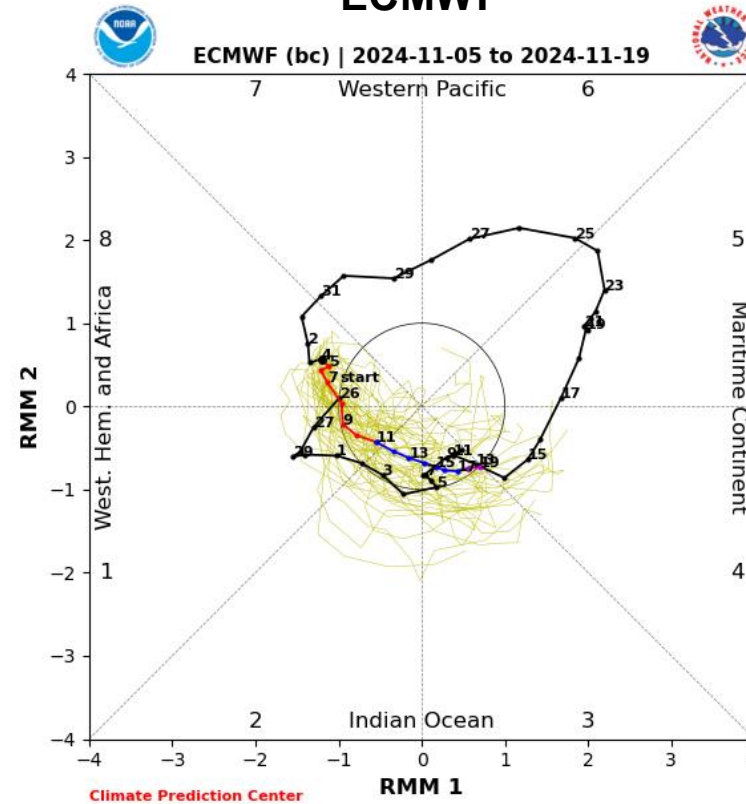
- Water Year (WY) 2024 precipitation was near-normal (within 30% of normal) over much of the US West Coast, except in portions of coastal Southern CA where precipitation exceeded 130% of normal
- By the start of WY 2025, abnormally dry conditions (D0) had developed over much of Northern and Central CA, with moderate drought (D1) in southeastern CA
- As of 1 Oct, most large reservoirs in CA were still operating at  $\geq 60\%$  storage capacity and near or above-normal storage

# Dynamical Model MJO Forecasts (NCEP vs. ECMWF)

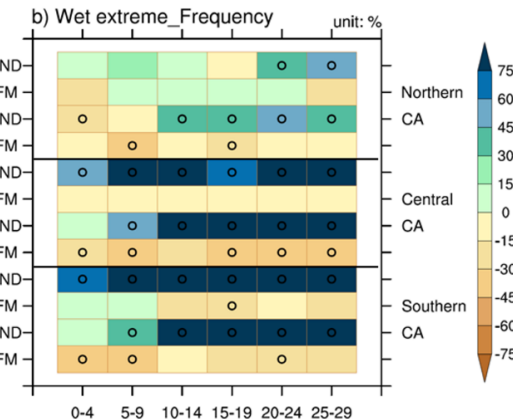
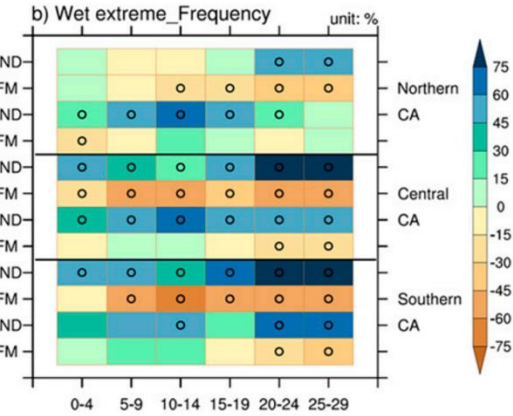
## NCEP



## ECMWF



Black: Last 40 days of observations (26 Sep – 4 Nov); Red: Week 1 (5–11 Nov) ensemble mean; Blue: Week 2 (12–18 Nov) ensemble mean; Yellow: Ensemble members

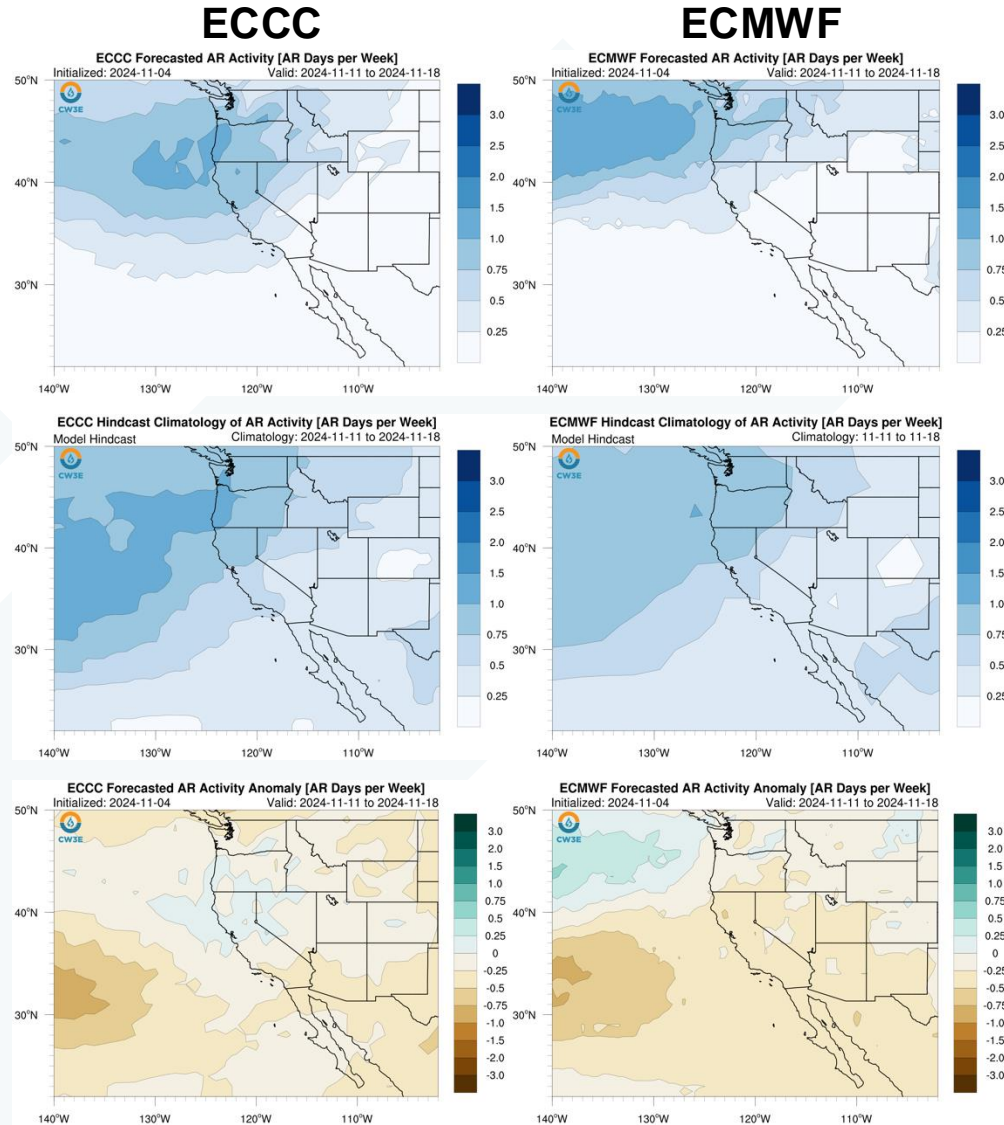


- MJO convection is currently located over the Western Hemisphere (Phase 8)
- NCEP is forecasting MJO convection to propagate eastward, potentially reaching the Indian Ocean (Phase 2) by Week 2
- ECMWF is forecasting MJO convection to weaken during Week 1 and remain weak through Week 2
- MJO activity over the Western Hemisphere and Africa (Phases 1&8) during OND is associated with a statistically significant decrease in wet extremes in Central and Southern CA at lag times of 1–4 weeks

# Subseasonal Outlooks: Week 2 AR Activity (ECCC vs. ECMWF)

Forecasts Initialized 4 Nov 2024

NCEP  
Unavailable



- ECCC is forecasting near-normal AR activity over Northern and Central CA, and slightly below-normal AR activity over Southern CA during Week 2 (11–18 Nov)
- ECMWF is forecasting slightly below-normal AR activity over all of CA

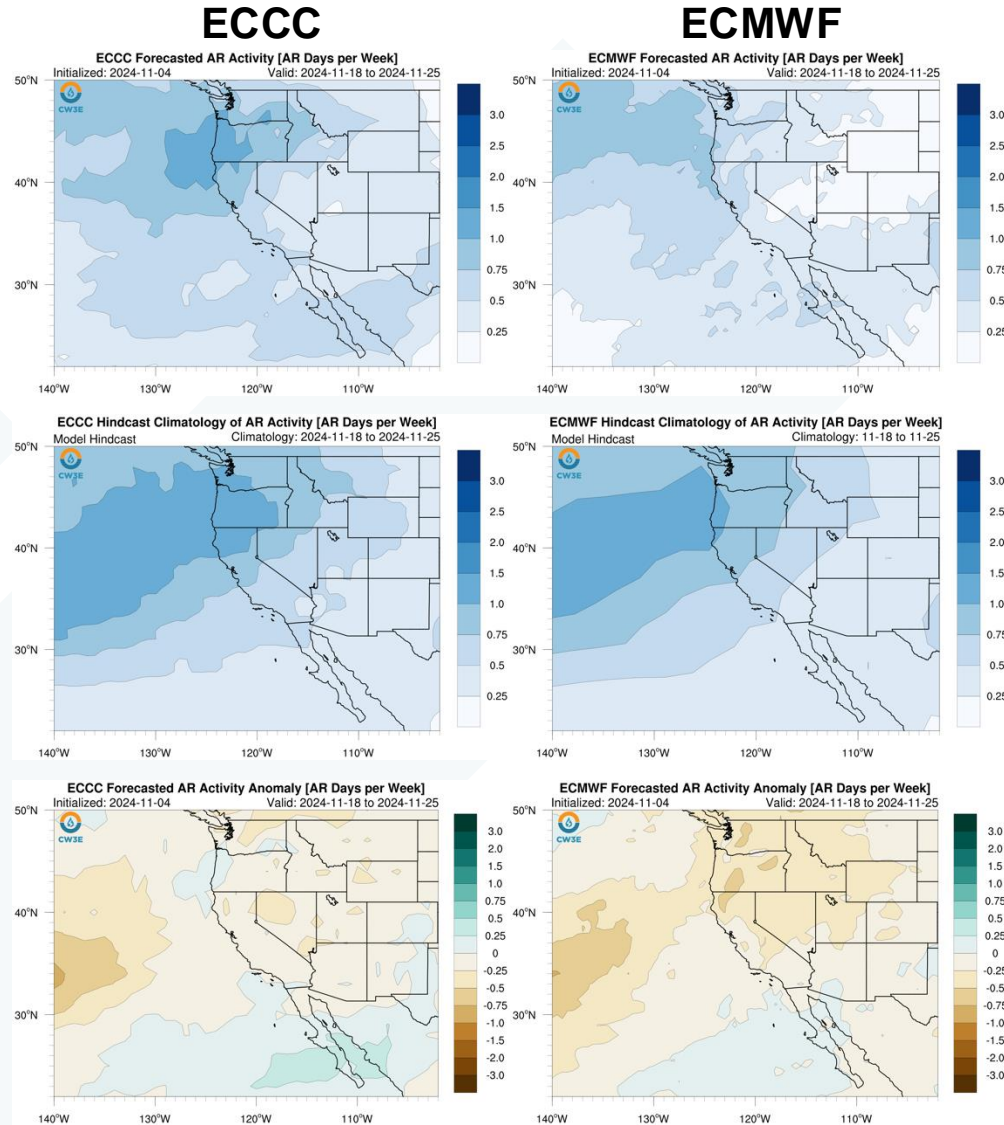
Models generally agree on below-normal AR activity in Southern Central CA during Week 2 (11–18 Nov), but disagree somewhat on AR activity in Northern and Central CA

Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

# Subseasonal Outlooks: Week 3 AR Activity (ECCC vs. ECMWF)

Forecasts Initialized 4 Nov 2024

NCEP  
Unavailable



- ECCC is forecasting near-normal AR activity over CA during Week 3 (18–25 Nov)
- ECMWF is forecasting slightly below-normal AR activity over Northern CA and near-normal AR activity over Central and Southern CA

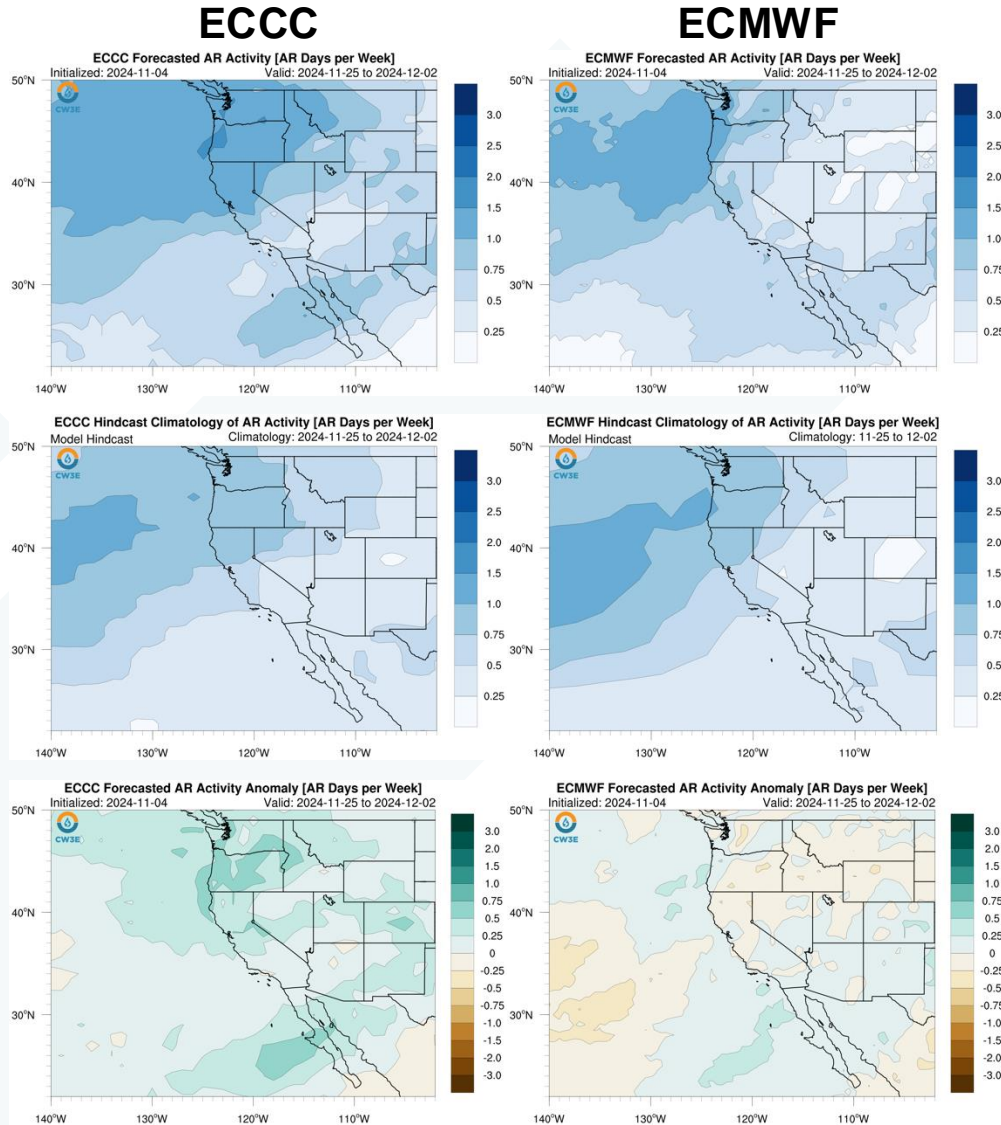
Models generally agree on near-normal AR activity in Central and Southern CA during Week 3 (18–25 Nov), but disagree somewhat on AR activity in Northern CA

Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

# Subseasonal Outlooks: Week 4 AR Activity (ECCC vs. ECMWF)

Forecasts Initialized 4 Nov 2024

NCEP  
Unavailable

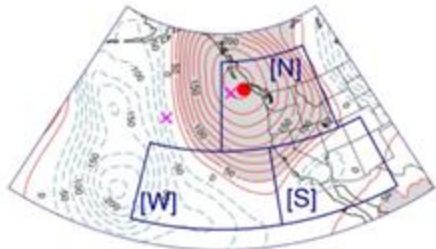


- ECCC is forecasting slightly above-normal AR activity in Northern and Central CA, and near-normal AR activity in Southern CA during Week 4 (25 Nov – 2 Dec)
- ECMWF is forecasting near-normal AR activity over all of CA

Models generally agree on near-normal AR activity in Southern CA during Week 4 (25 Nov – 2 Dec), but disagree somewhat on AR activity in Northern and Central CA

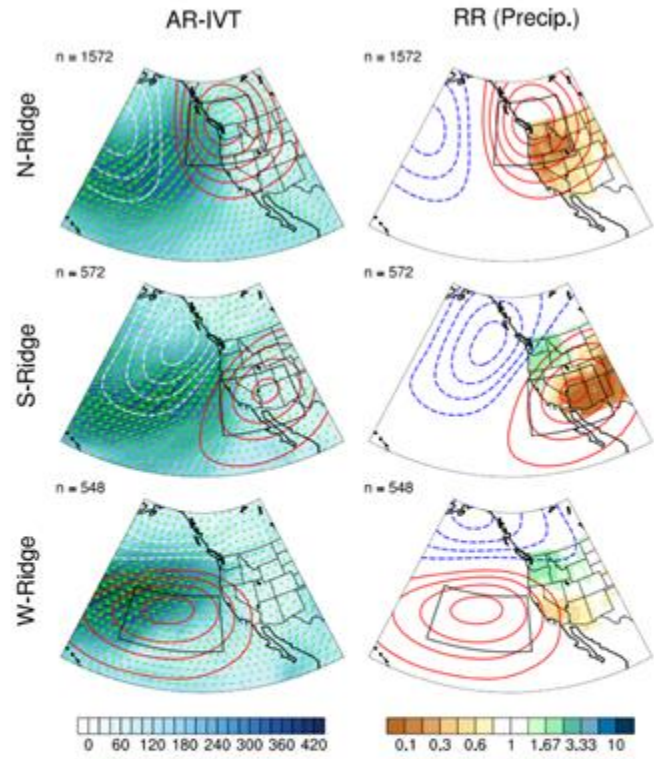
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

# Background Info: Subseasonal Ridging Outlooks



N = North Ridge  
S = South Ridge  
W = West Ridge

This slide contains background information about the three different ridge types in CW3E's subseasonal ridging outlook tool



- The North-Ridge type is typically associated with widespread dry conditions across the entire western US
- The South-Ridge type is typically associated with dry conditions in Southern CA and the Colorado River Basin and wet conditions in the Pacific Northwest
- The West-Ridge type is typically associated with dry conditions over Central and Southern CA and wet conditions over the Pacific Northwest

**How each ridge type typically influences precipitation**  
**Left:** Maps showing the average influence of each ridge type (red contours) on integrated vapor transport (IVT, blue shading indicates greater moisture transport, arrows indicate direction) during atmospheric river events  
**Right:** Maps showing the 'Relative Risk' (RR) of precipitation under each ridge type. Brown shading indicates a reduced chance of precipitation when ridging occurs. For example, a RR value of 0.2 indicates a 5-fold reduction in the likelihood of precipitation



Contact: pgibson@ucsd.edu  
Reference: Gibson et al. (2020)  
Journal of Climate

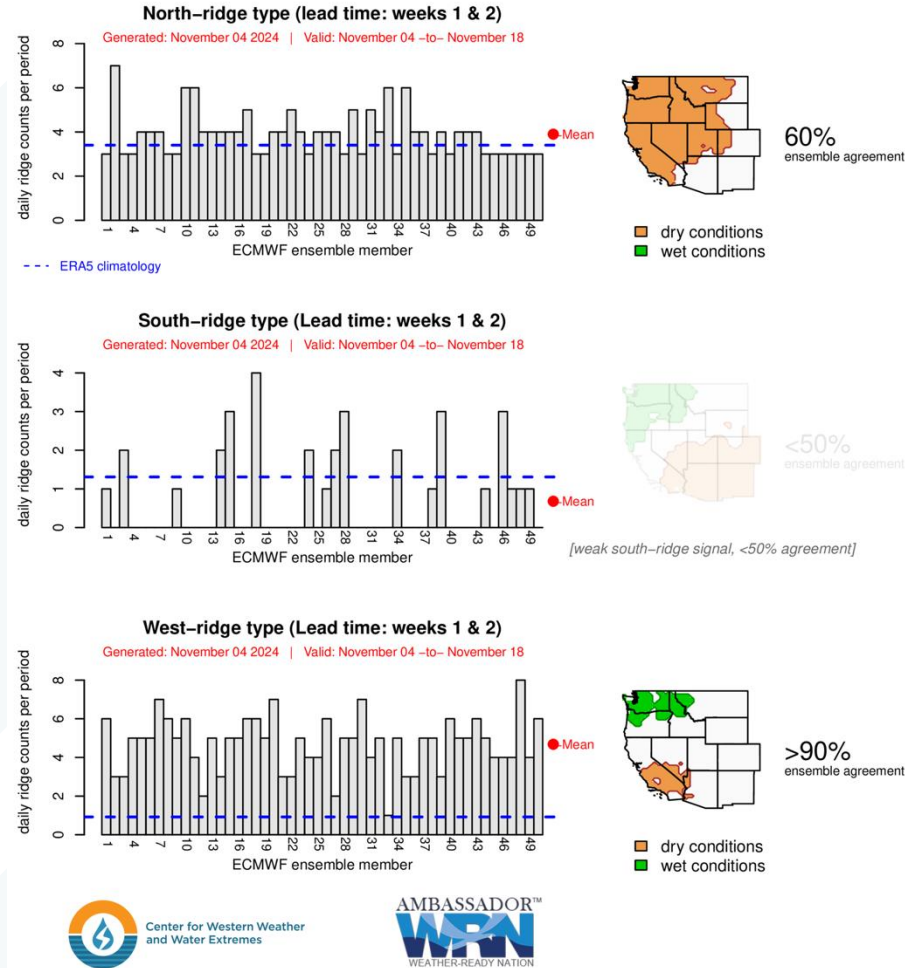
# Subseasonal Outlooks: Weeks 1–2 Ridging Forecasts (ECMWF)

Forecasts Initialized 4 Nov 2024

NCEP  
Unavailable

## ECMWF

### CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



- ECMWF is forecasting a very high likelihood (> 90% probability) of above-normal West-ridge activity during Weeks 1–2 (4–18 Nov)
- ECMWF is also forecasting a moderate likelihood (60% probability) of above-normal North-ridge activity

ECMWF is forecasting high likelihood of ridging activity west of CA during Weeks 1–2 (4–18 Nov)

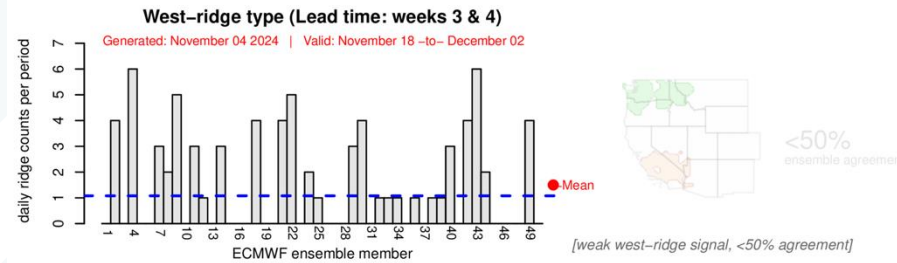
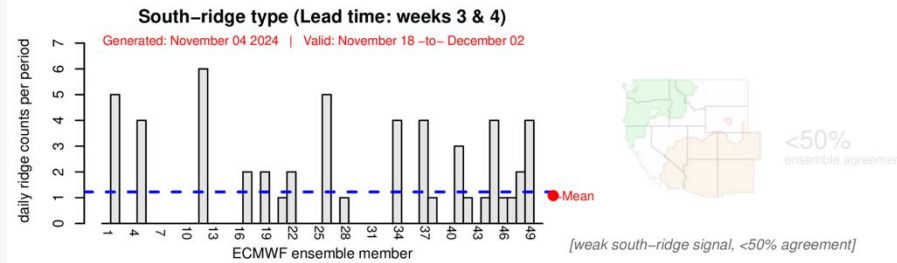
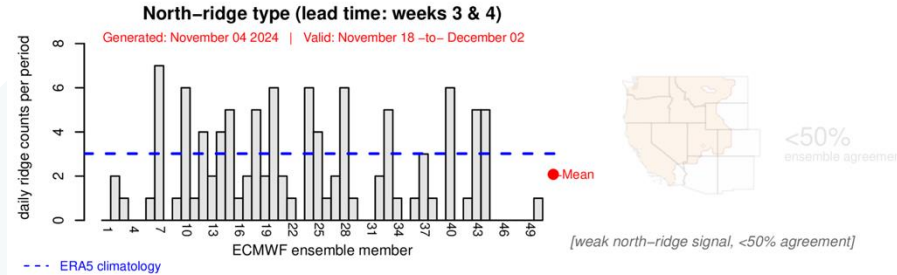
# Subseasonal Outlooks: Weeks 3–4 Ridging Forecasts (ECMWF)

Forecasts Initialized 4 Nov 2024

NCEP  
Unavailable

## ECMWF

### CW3E Subseasonal Ridging Forecast (Uses ECMWF model)

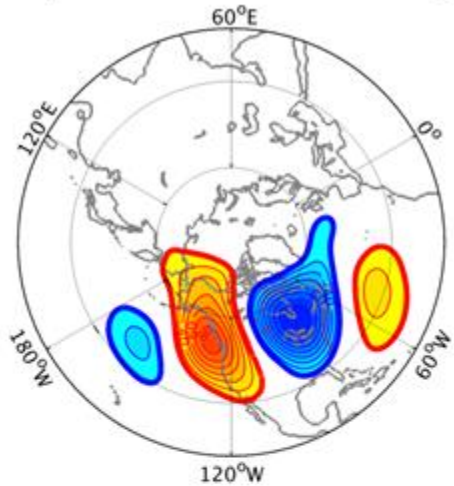


Uncertainty in location and frequency of ridging activity near US West Coast during Weeks 3–4 (18 Nov – 2 Dec)

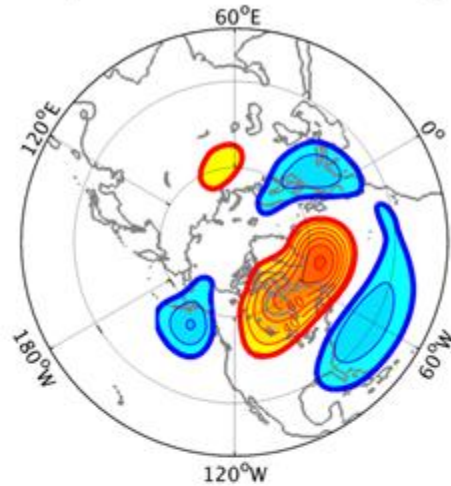
- ECMWF is showing potential for persistent ridging near the US West Coast during Weeks 3–4 (18 Nov – 2 Dec), but there is uncertainty in the location of ridging activity

# Background Info: IRI Subseasonal Weather Regime Forecasts

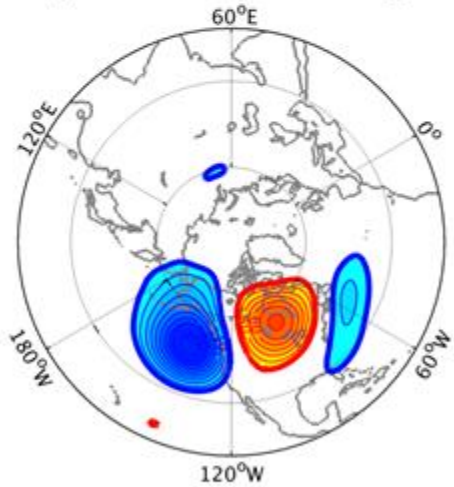
a) WR 1: West Coast Ridge



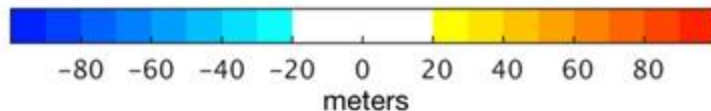
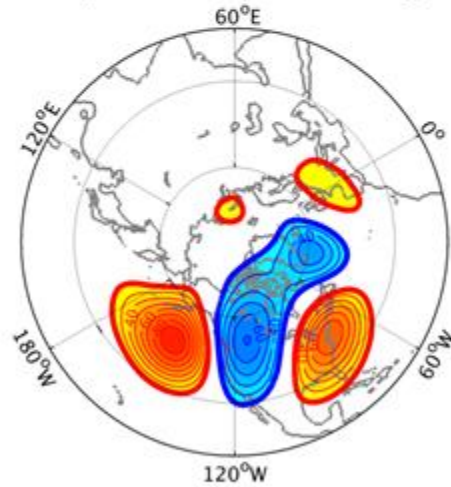
b) WR 2: Greenland High



c) WR 3: Pacific Trough



d) WR 4: Pacific Ridge



This slide contains background information about IRI's North American weather regime forecast product

- Four dominant weather regimes identified using cluster analysis on daily 500-hPa geopotential height anomalies from MERRA data (1981–2015)

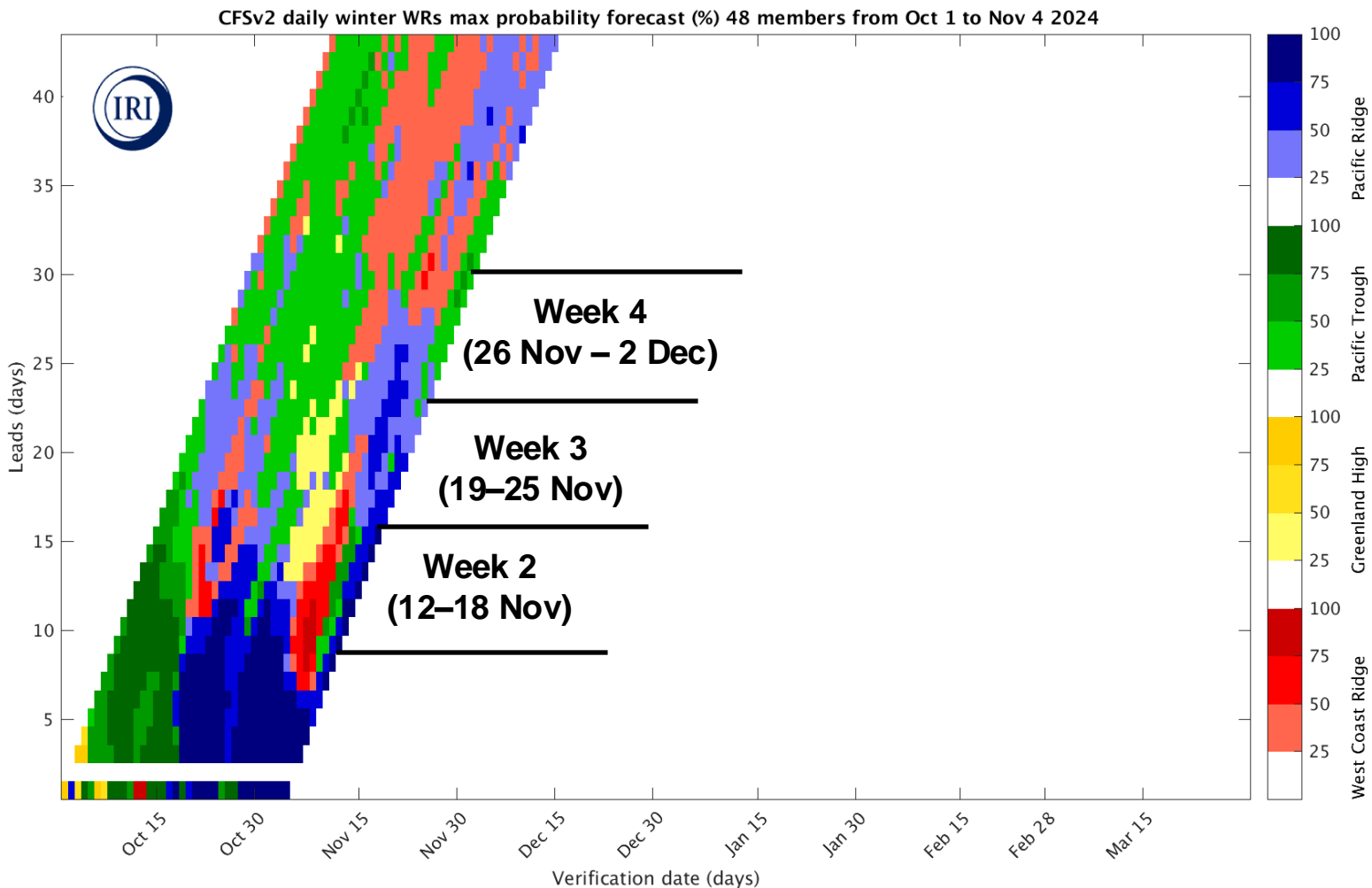
Reference: [Robertson et al. \(2020\)](#)

For more information about the forecast product:

<https://wiki.iri.columbia.edu/index.php?n=Climate.S2S-WRs>

# Subseasonal Outlooks: IRI North American Weather Regime Forecasts

**Forecast Initialized 4 Nov 2024**



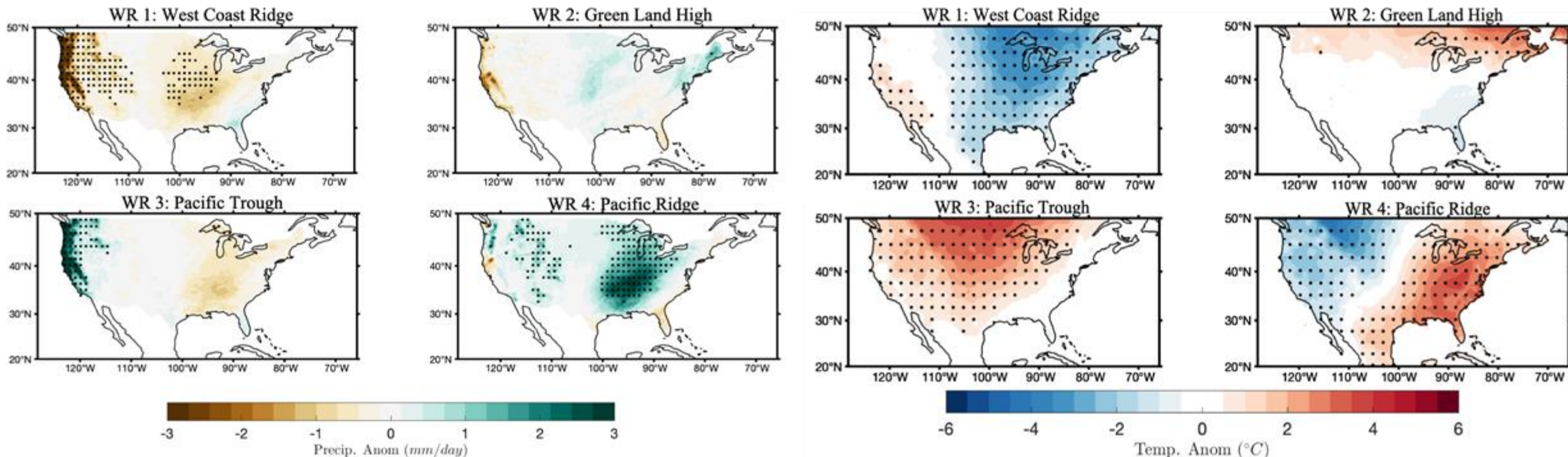
- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (> 75% ensemble agreement) of Pacific Ridge during Week 2 (12–18 Nov)
- Low to moderate likelihood (25–75% ensemble agreement) of Pacific Ridge continuing through the end of Week 3 (19–25 Nov)
- Possible transition to Pacific Trough during Week 4 (26 Nov – 2 Dec), but ensemble agreement is low (< 50%)

This graphic shows the which of the four North American weather regimes (different colors) is most likely to occur over the next 45 days. Darker (lighter) shading denotes higher (lower) probability of a particular regime. See the next slide for temperature/precipitation implications.

# Subseasonal Outlooks: IRI North American Weather Regime Forecasts

## Precipitation

## Temperature

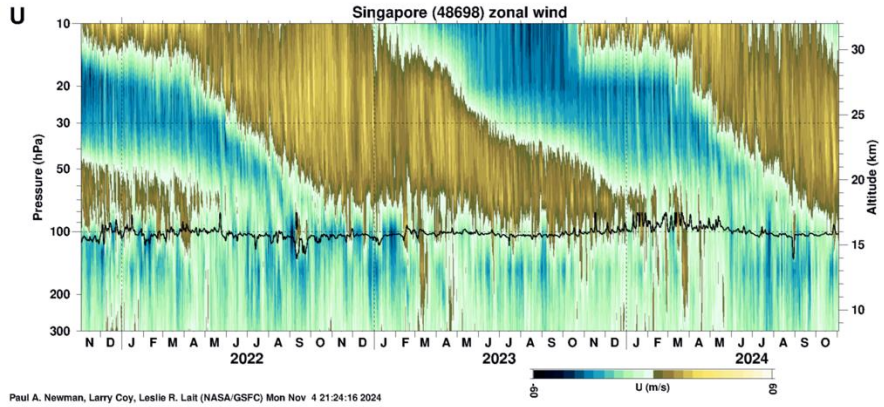


This graphic shows composite mean precipitation (left) and temperature (right) anomalies associated with each weather regime. Stippling (black dots) indicate statistically significant anomalies.

- Below-normal temperatures and near-normal precipitation predicted over CA during Week 2 (12–18 Nov) with high confidence in Pacific Ridge regime
- Below-normal temperatures and near-normal precipitation predicted over CA during Week 3 (19–25 Nov) with low-to-moderate confidence in Pacific Ridge regime
- Above-normal temperatures and precipitation predicted over CA during Week 4 (26 Nov – 2 Dec) with low confidence in Pacific Trough regime

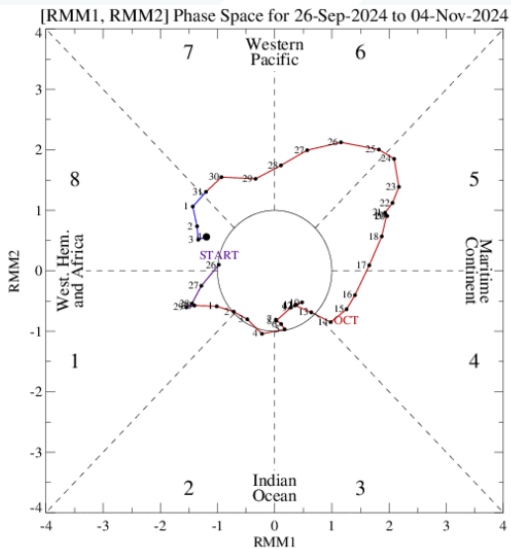
# Background Info: AR Activity and Precipitation Based on MJO and QBO

## QBO Conditions



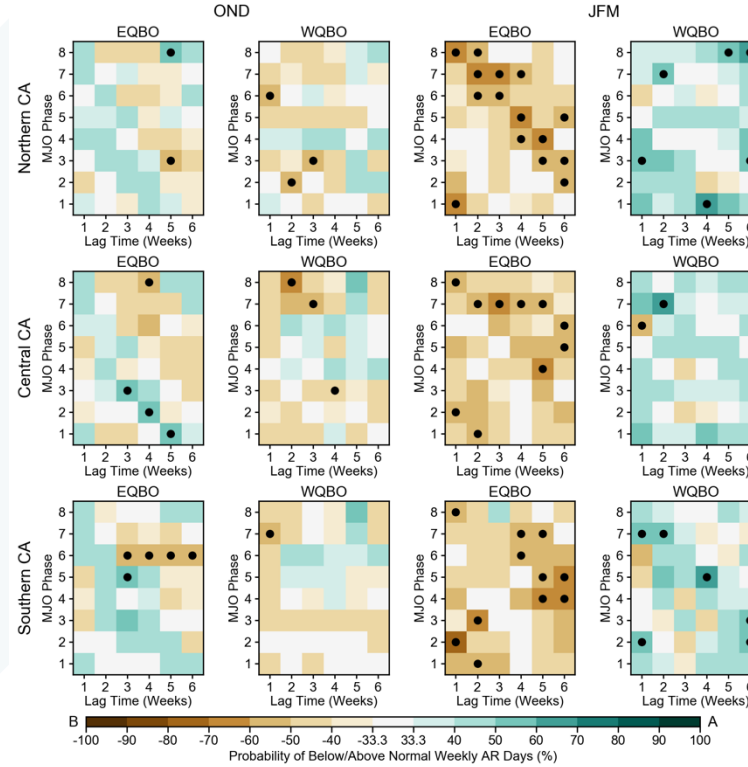
**QBO is in the westerly phase at 50-hPa**

## MJO Conditions

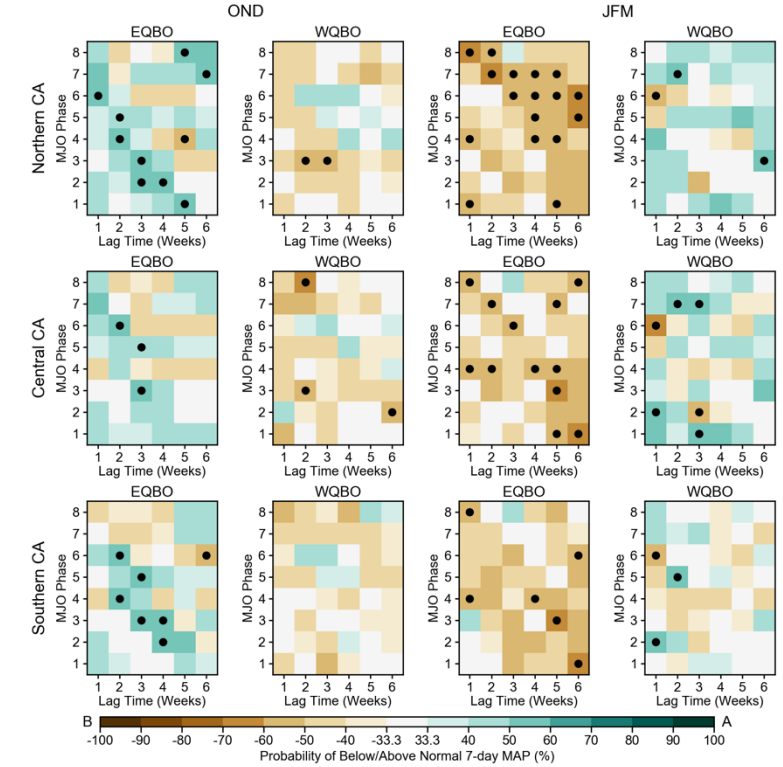


**MJO convection is currently located over the Western Hemisphere (Phase 8)**

## Probability of Above/Below-Normal AR Occurrence



## Probability of Above/Below-Normal Precipitation



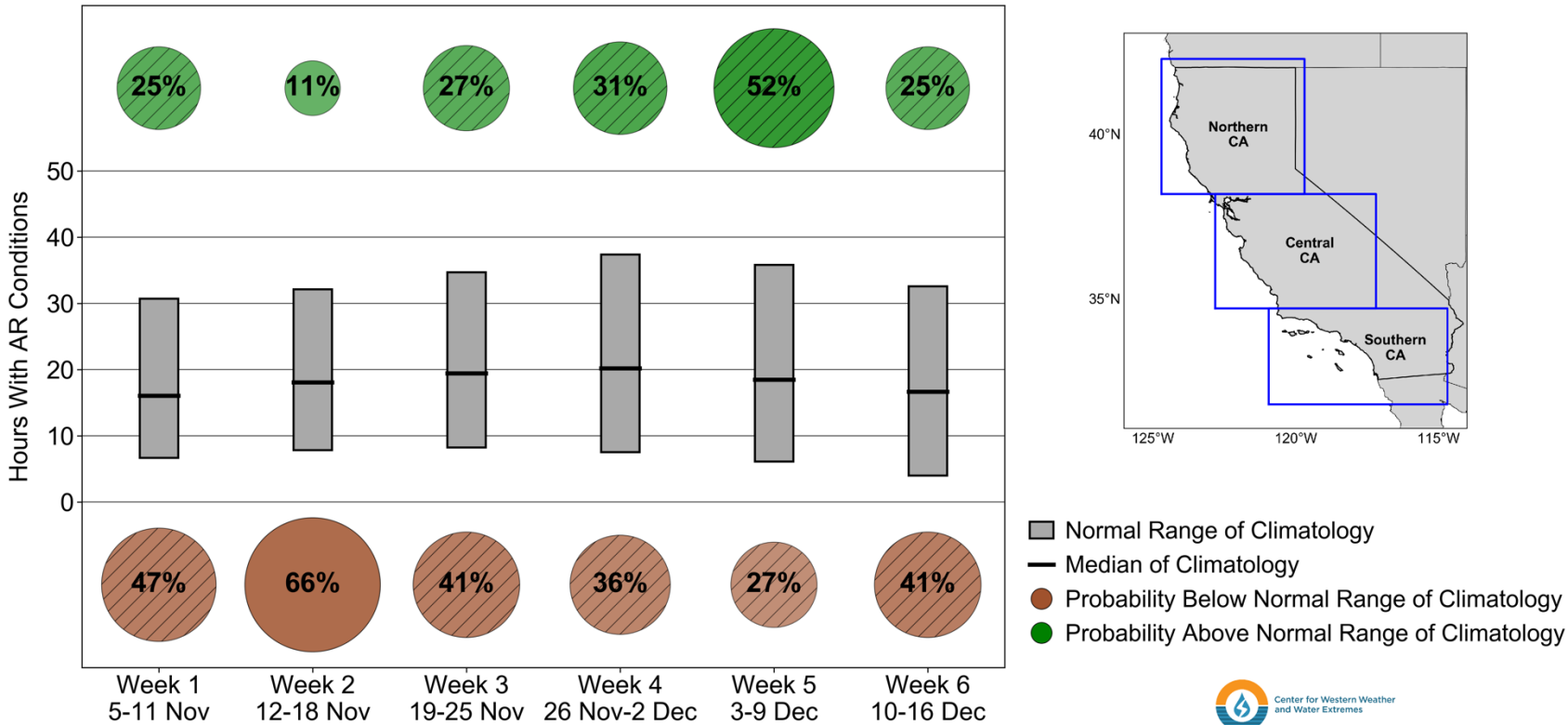
Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation during OND (left) and JFM (right) in Northern CA (top), Central CA (middle), and Southern CA (bottom). White squares indicate that the near-normal category has the highest probability. The black dots denote statistically significant probabilities of below- or above-normal conditions based on a bootstrapping analysis. Historical observations less (more) than the lower (upper) tercile of climatology (1981–2019 period) are considered below (above) normal.

# Subseasonal Outlooks: AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 4 Nov 2024

## AR Occurrence: Central CA

Central CA Subseasonal AR Occurrence Outlook  
Issued: 4 Nov 2024 MJO Phase 8 WQBO



- CW3E's probabilistic AR occurrence forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **High likelihood (> 50% probability) of below-normal AR occurrence in Central CA during Week 2 (12–18 Nov)**
- Moderate likelihood (> 40% probability) of below-normal AR occurrence in Northern and Southern CA during Week 2
- Moderate likelihood of below-normal AR occurrence in Northern and Central CA during Week 3 (19–25 Nov)



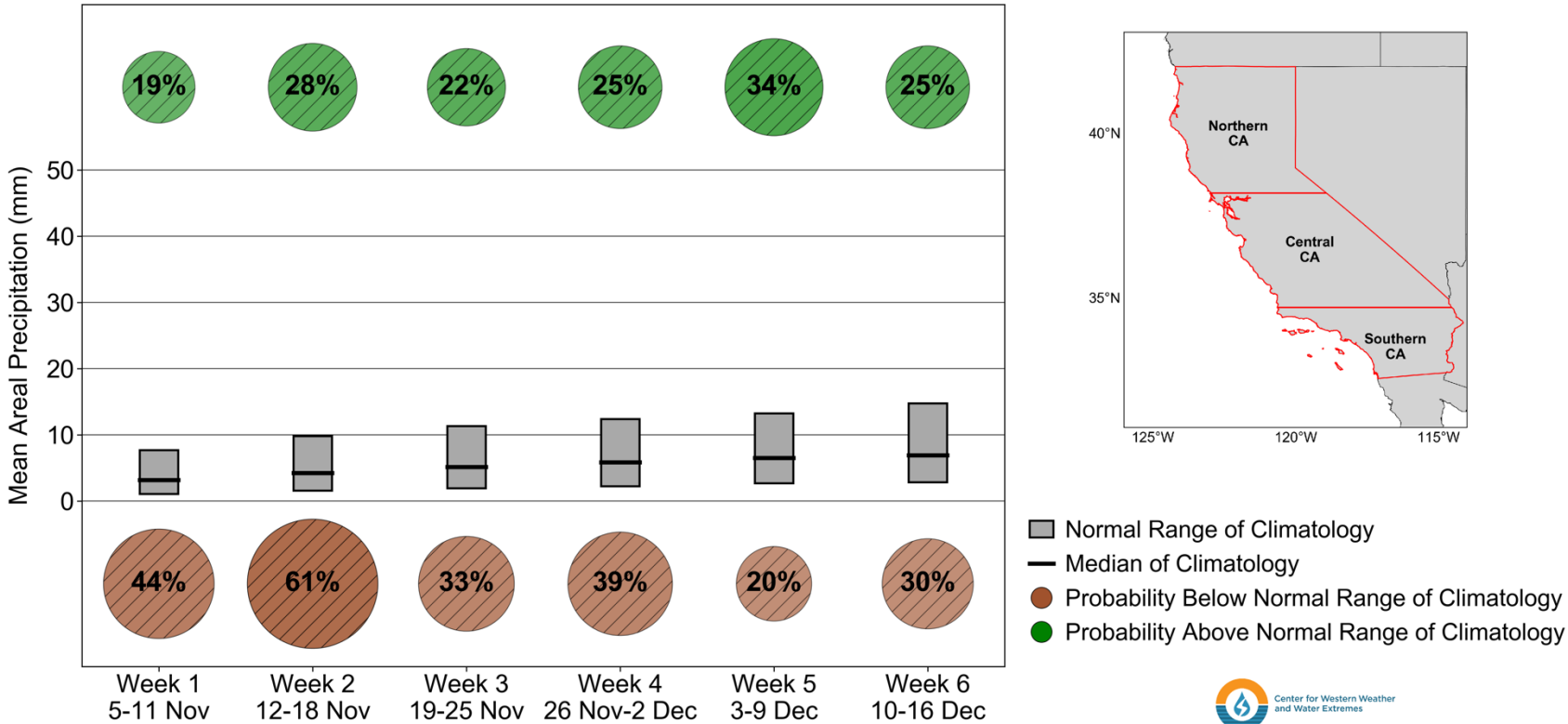
This product shows weekly probabilities of above-normal and below-normal AR occurrence in California. These probabilities are calculated for lead times of 1–6 weeks based on the current season (i.e., OND or JFM) and phases of the Madden-Julian Oscillation (MJO) and Quasi-biennial Oscillation (QBO). If MJO convection is weak or the QBO is in a neutral phase, no probabilities will be displayed. Circles without hatching denote periods with high confidence based on the hindcast skill assessment in [Castellano et al. \(2023\)](#)

# Subseasonal Outlooks: AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 4 Nov 2024

## Precipitation: Central CA

Central CA Subseasonal Precipitation Outlook  
 Issued: 4 Nov 2024 MJO Phase 8 WQBO



- CW3E’s probabilistic precipitation forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **High likelihood of below-normal precipitation in Central CA during Week 2 (12–18 Nov)**
- Moderate likelihood of below-normal precipitation in Northern CA and Southern CA during Week 2
- High likelihood of below-normal precipitation in Southern CA during Week 4 (26 Nov – 2 Dec)

This product shows weekly probabilities of above-normal and below-normal precipitation in California. These probabilities are calculated for lead times of 1–6 weeks based on the current season (i.e., OND or JFM) and phases of the Madden-Julian Oscillation (MJO) and Quasi-biennial Oscillation (QBO). If MJO convection is weak or the QBO is in a neutral phase, no probabilities will be displayed. Circles without hatching denote periods with high confidence based on the hindcast skill assessment in [Castellano et al. \(2023\)](#)