



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

CW3E Subseasonal Outlook: 26 November 2024

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UC San Diego



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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/
- 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*

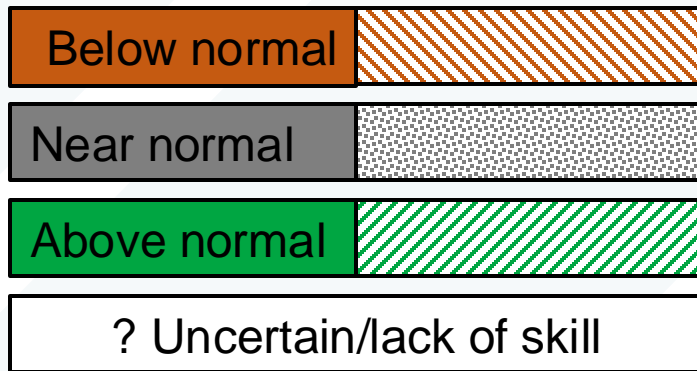
Summary: Subseasonal Precipitation Outlook by Model

This slide shows the CW3E synthesis of subseasonal products by model

Forecasts Initialized 25 Nov 2024

Region	Week 2 (2– 8 Dec)				Week 3 (9–15 Dec)				Week 4 (16–22 Dec)			
	NCEP ^{1,2,3}	ECCC ¹	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{1,2,3}	ECCC ¹	ECMWF ^{1,2}	Multi-Model Forecast	NCEP ^{1,2,3}	ECCC ¹	ECMWF ²	Multi-Model Forecast
WA/OR	Below normal	Above normal	?	?	Above normal	Above normal	?	Above normal	?	Above normal	Below normal	?
Northern CA	Below normal	Below normal	Below normal	Below normal	?	Near normal	?	?	?	Near normal	Below normal	?
Central CA	Below normal	Below normal	Below normal	Below normal	Below normal	Near normal	?	?	?	Near normal	Below normal	?
Southern CA	Below normal	Below normal	Below normal	Below normal	Below normal	Near normal	Below normal	Below normal	Below normal	Near normal	Below normal	?

Higher Confidence | Lower Confidence



- Models agree on below-normal precipitation over CA during Week 2
- Models lean towards below-normal precipitation (with low confidence) in Southern CA during Week 3; more uncertainty in Northern and Central CA
- Uncertainty in precipitation over CA during Week 4 due to poor agreement between products and models

Subseasonal products included in this Outlook:

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

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

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

Summary

MJO/QBO Conditions

- MJO convection is currently located over the Indian Ocean (Phase 3); QBO is in the westerly phase
 - MJO in Phase 3 and westerly QBO during OND is associated with a moderate likelihood (40-60% probability) of below-normal AR occurrence in all of CA during Weeks 3-4 (10–23 Dec)
- Models forecast MJO to propagate eastward to the Maritime Continent (Phases 4-5) in Weeks 1-2 (26 Nov-9 Dec)
 - MJO activity over the Maritime Continent during OND is associated with a statistically significant increase in wet extremes in CA at lag times of 2–4 weeks without considering QBO conditions

Week 2 forecasts (2– 8 Dec):

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

Summary

Week 3 Forecasts (9–15 Dec):

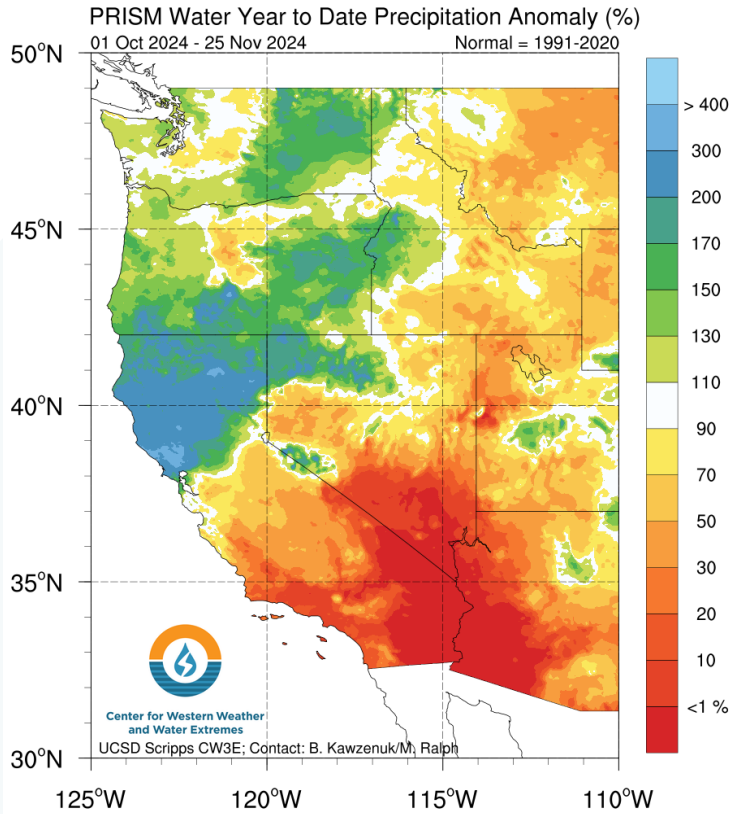
- Models disagree somewhat on AR activity in CA during Week 3
 - For Northern CA, NCEP is forecasting above-normal AR activity, ECCO and ECMWF are forecasting near-normal AR activity
 - For Central CA, NCEP is forecasting slightly above-normal AR activity, ECCO and ECMWF are forecasting near-normal AR activity
 - For Southern CA, NCEP and ECMWF are forecasting slightly below-normal AR activity, and ECCO is forecasting near-normal AR activity
- Uncertainty in the location of ridging activity near the US West Coast during Weeks 3–4
 - NCEP is forecasting a high likelihood of above-normal West-ridge activity
 - ECMWF is forecasting a moderate likelihood of above-normal North-ridge activity
- IRI weather regime tool shows low-to-moderate confidence in West Coast Ridge during Week 3

Weeks 4 Forecasts (16–22 Dec):

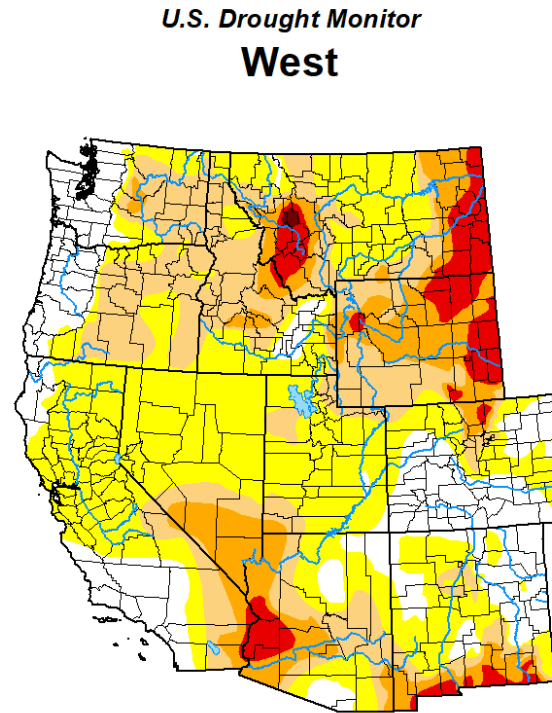
- Models generally agree on near-normal AR activity in Northern and Central CA during Week 4, but disagree somewhat on AR activity in Southern CA
 - For Southern CA, NCEP is predicting slightly below-normal AR activity, ECCO and ECMWF are predicting near-normal AR activity
- IRI weather regime tool shows high degree of uncertainty in regime type during Week 4

Hydrologic Summary

Precipitation



Drought Conditions



November 19, 2024
(Released Thursday, Nov. 21, 2024)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	19.56	80.44	40.91	18.03	5.81	0.10
Last Week 11-12-2024	17.35	82.65	43.17	18.70	5.28	0.11
3 Months Ago 08-20-2024	21.49	78.51	33.60	9.73	2.16	0.11
Start of Calendar Year 01-02-2024	51.19	48.81	25.08	13.17	4.67	0.66
Start of Water Year 10-01-2024	20.06	79.94	37.38	9.85	2.47	0.11
One Year Ago 11-21-2023	56.78	43.22	29.36	16.14	5.62	0.73

Intensity:

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

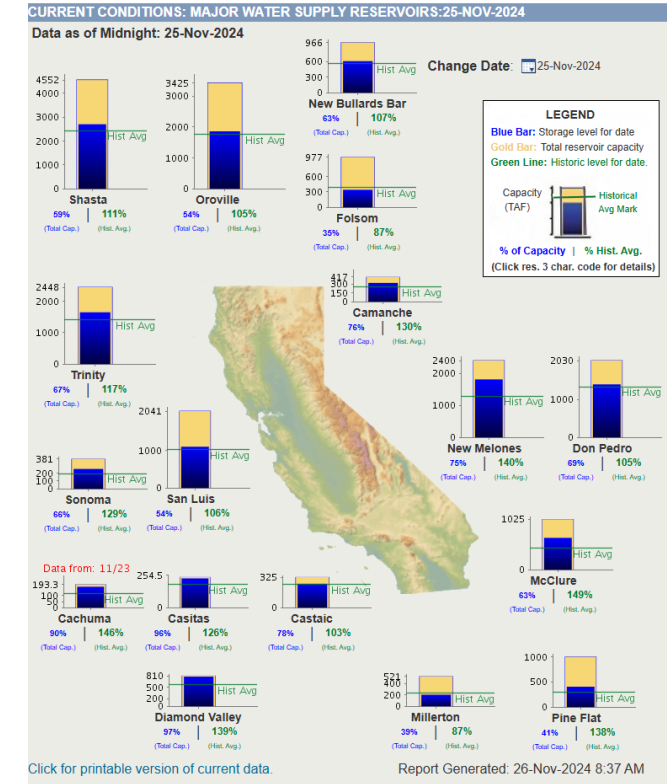
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

USDA NDAC NWS NARA

droughtmonitor.unl.edu

Reservoir Storage

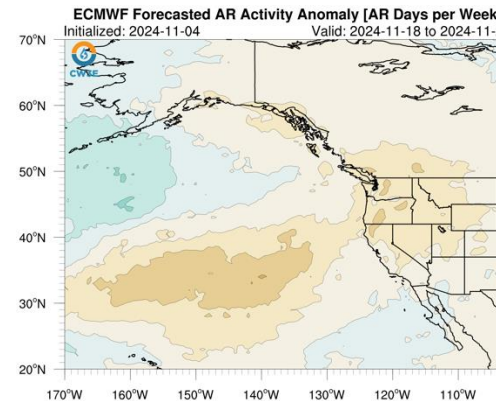
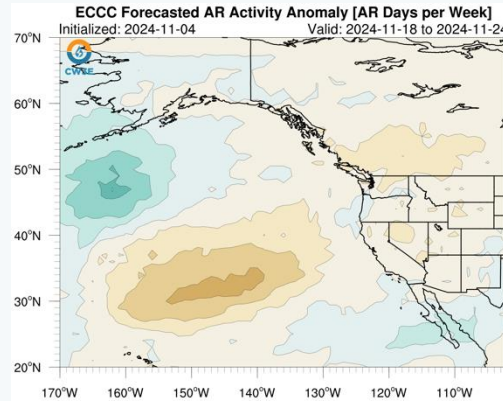
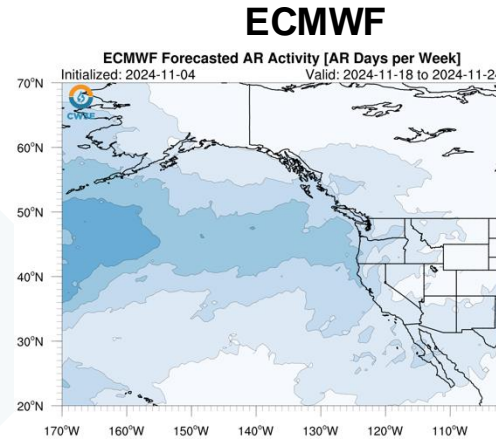
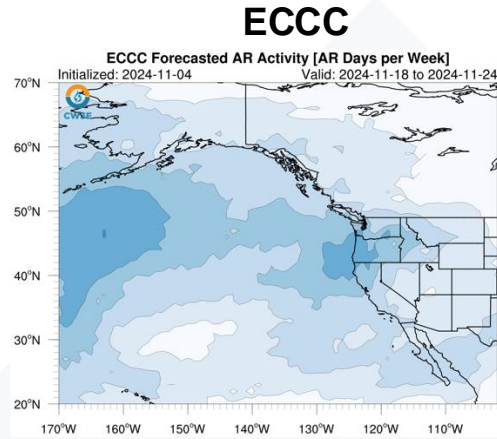


- As of 25 Nov, the recent strong AR brought water-year-to-date precipitation over Northern CA from below-normal to >200% above normal.
- WY-to-date precipitation is still running below normal (< 70% of normal) over Central and (<1% of normal) Southern CA
- The most recent drought monitor update (as of 19 Nov) is showing abnormally dry conditions (D0) over much of Northern and Central CA, and moderate drought-to-severe drought (D1–D2) in southeastern CA
- Most large reservoirs in CA are still operating at near or above-normal storage for this time of year

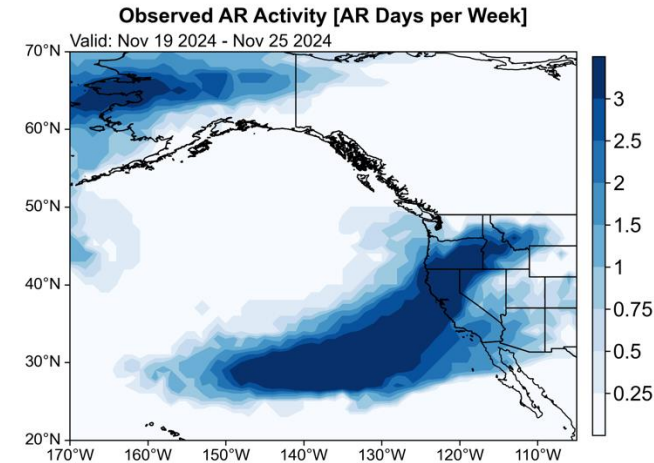
Looking Back: Week 3 AR Activity Forecasts

Forecasts Initialized 4 Nov 2024; Valid: 18 – 24 Nov 2024

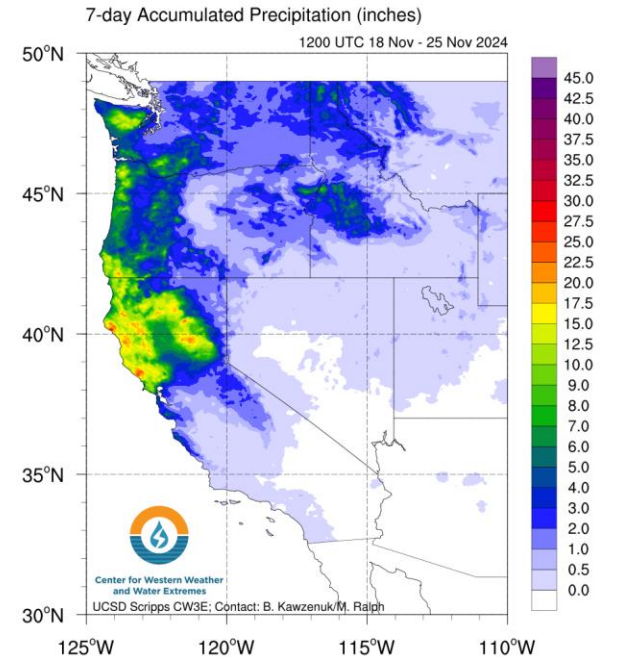
NCEP
unavailable



Observed (GFS Analysis)



Observed Precipitation



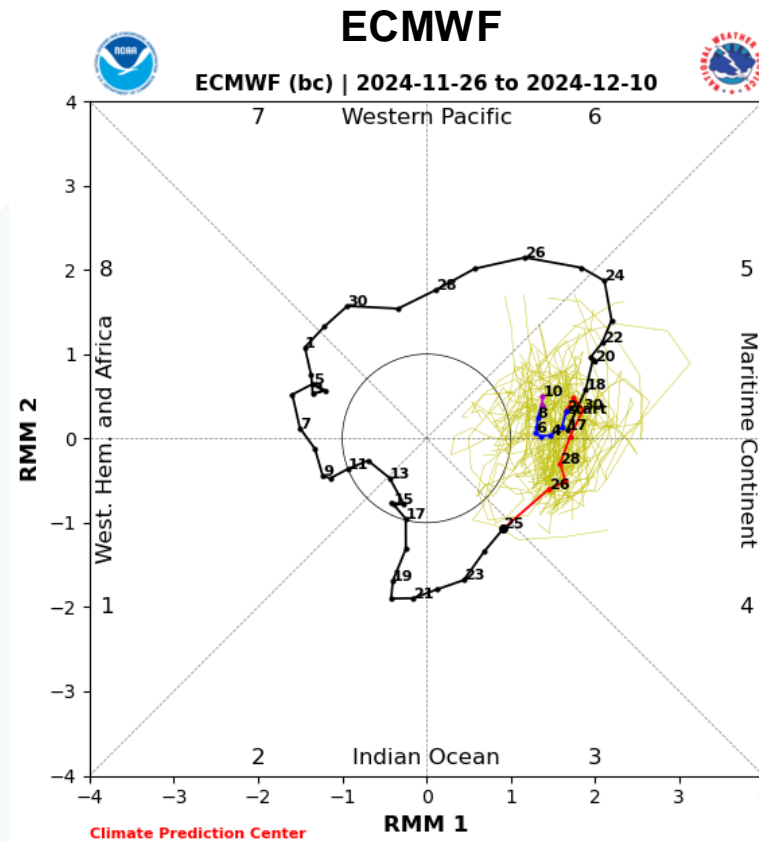
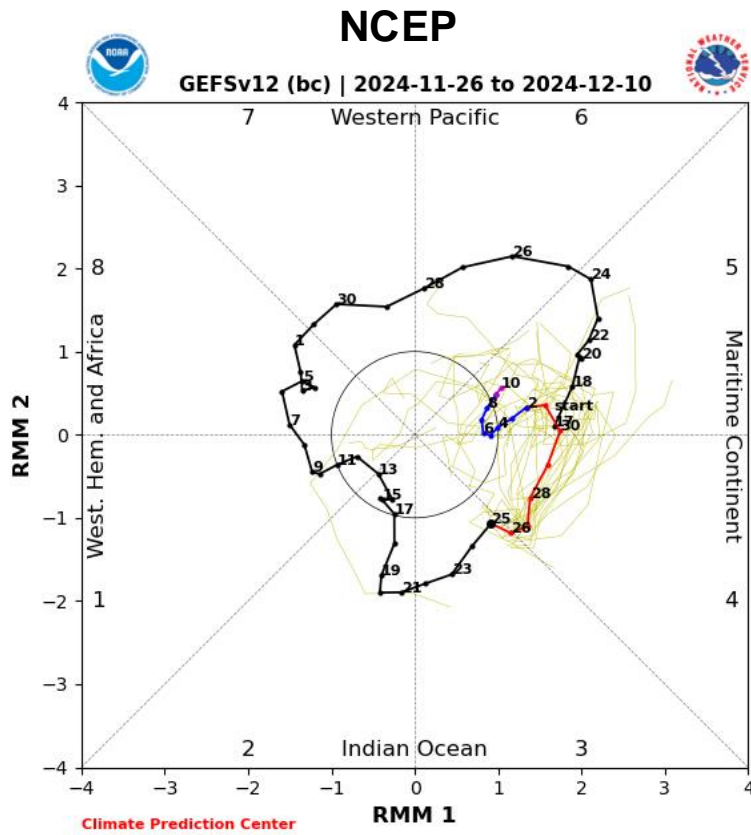
Shading: Fractional # of AR days forecast over a 7-day period (top) and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

- Both ECCC and ECMWF predicted some AR activity over the Northern Pacific
- Both models largely underestimated the inland penetration of AR activity over the western US
- A strong AR and low-pressure system produced >10 inches of precipitation over Northern CA during 20-23 Nov
- The AR also produced >5 inches of precipitation over western OR/WA and >2 inches of precipitation over Central CA

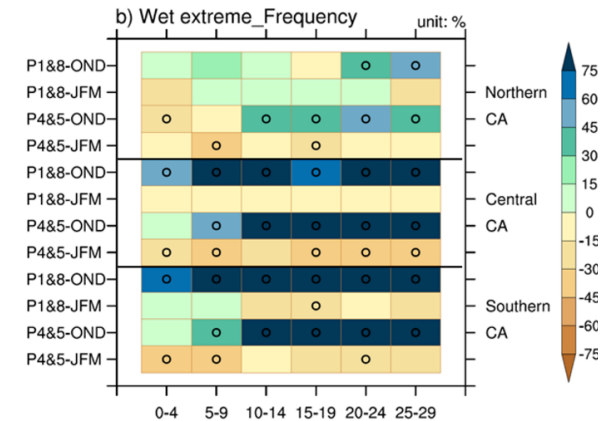
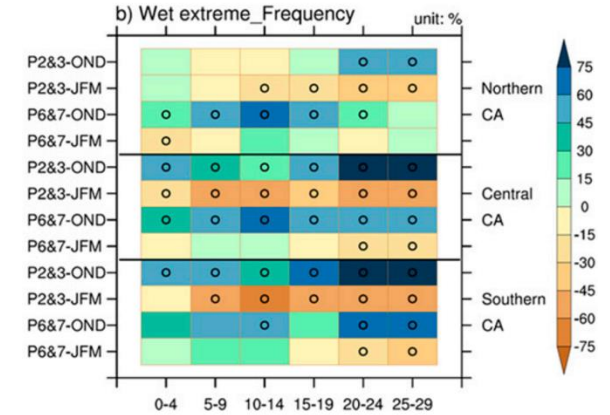


Center for Western Weather and Water Extremes
UCSD Scripps CW3E; Contact: B. Kawzenuk/M. Ralph

Dynamical Model MJO Forecasts (NCEP vs. ECMWF)



Black: Last 40 days of observations (17 Oct – 25 Nov); Red: Week 1 (26 Nov–2 Dec) ensemble mean; Blue: Week 2 (3– 9 Dec) ensemble mean; Yellow: Ensemble members



- MJO convection is currently located over the Indian Ocean (Phase 3)
- Both models are forecasting MJO convection to propagate eastward to the Maritime Continent (Phases 4&5) in the following two weeks (26 Nov-9 Dec).
- MJO remains strong in Weeks 1-2 forecasts in ECMWF but weakens in NCEP Week 2 forecast
- MJO activity over the Maritime Continent during OND is associated with a significant increase in wet extremes in CA at lag times of 2–4 weeks without considering QBO/ENSO conditions

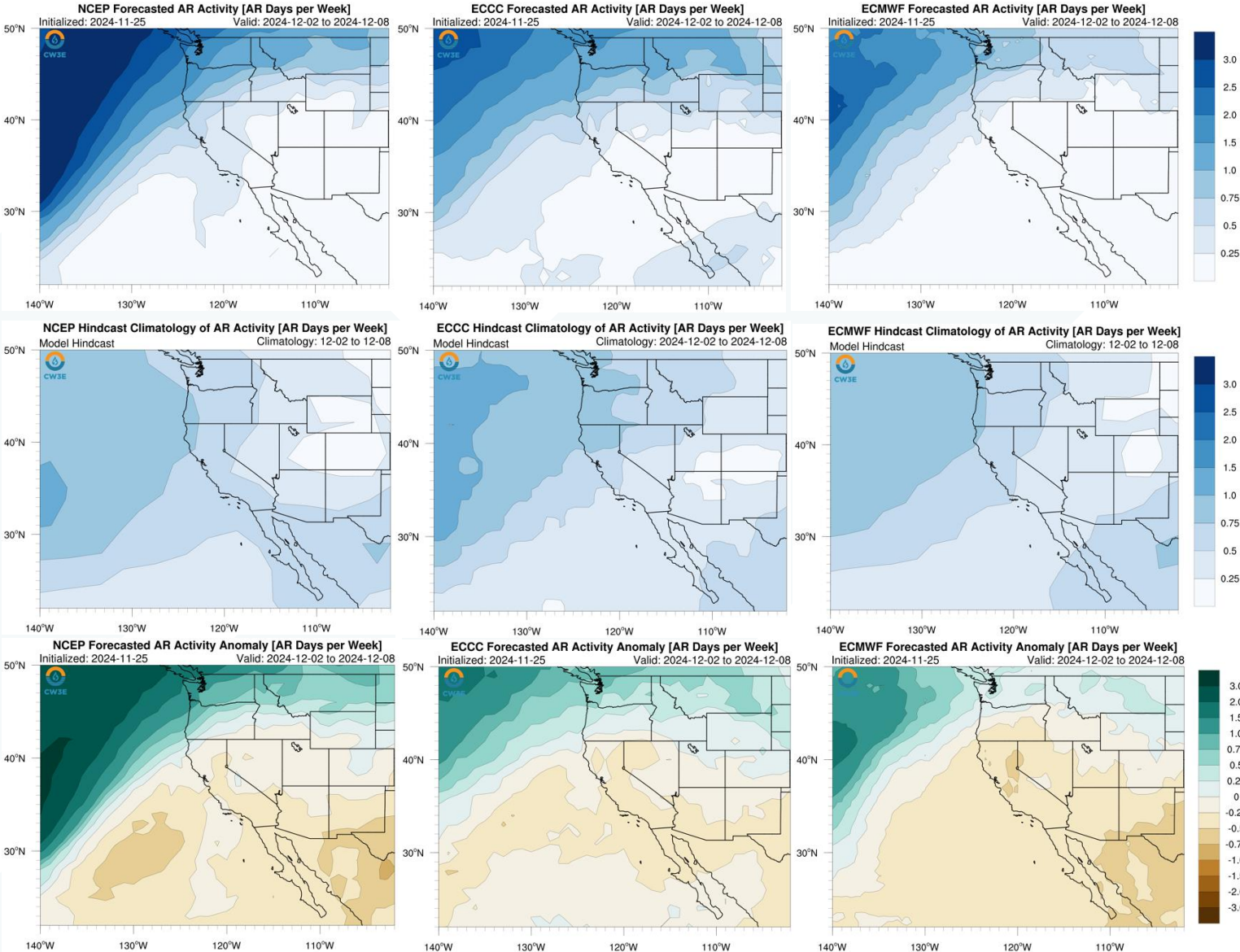
AR Activity Forecasts: Week 2 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 25 Nov 2024

NCEP

ECCC

ECMWF



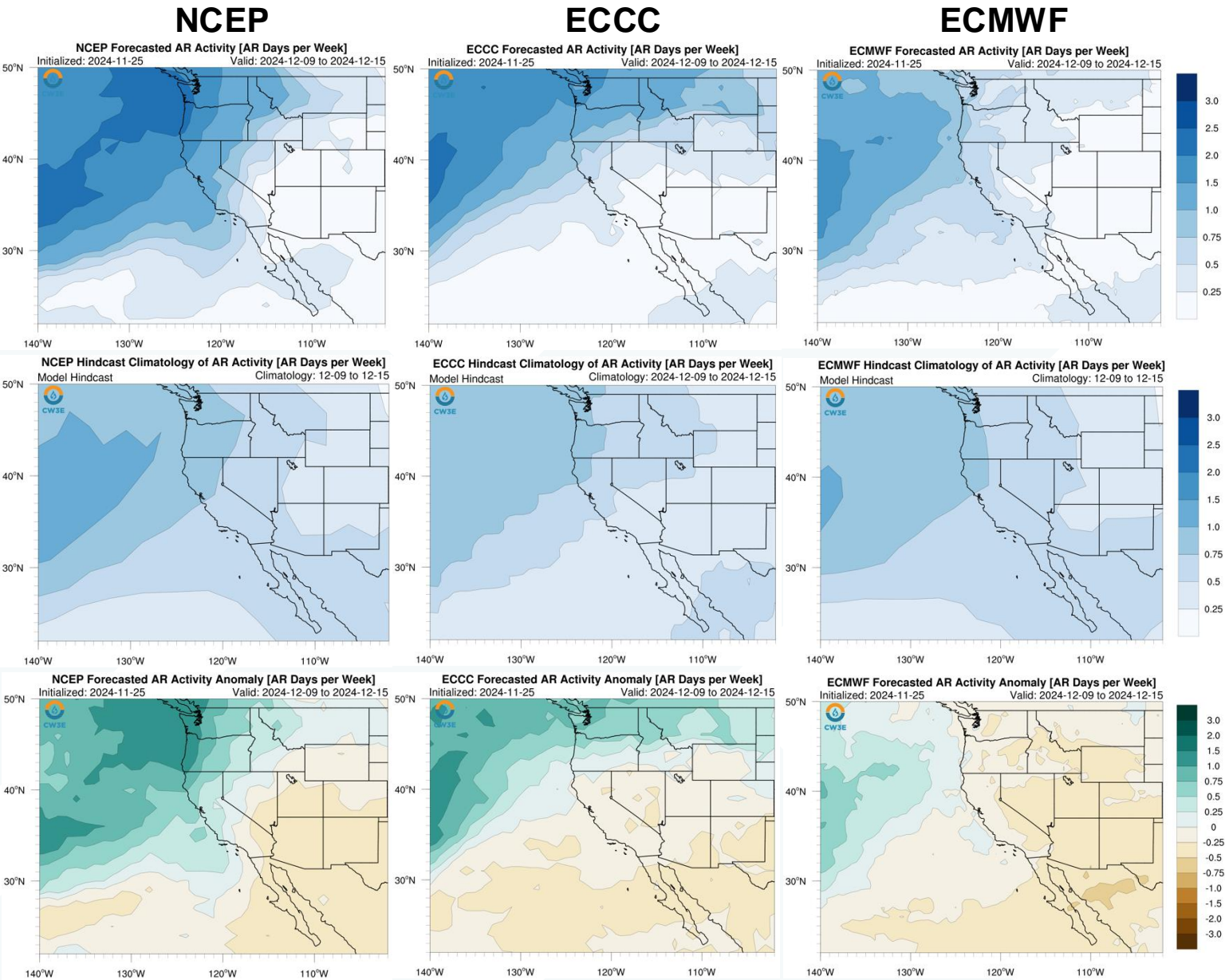
- All models are forecasting slightly below-normal AR activity over Central and Southern CA during Week 2 (2 – 8 Dec)
- ECCC and ECMWF are also forecasting slightly below-normal AR activity over Northern CA, and NCEP is forecasting near-normal AR activity

Models generally agree on slightly below-normal AR activity in Central and Southern CA during Week 2 (2 – 8 Dec), 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)

AR Activity Forecasts: Week 3 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 25 Nov 2024



- For Northern CA, NCEP is forecasting above-normal AR activity, ECCC and ECMWF are forecasting near-normal AR activity during Week 3 (9–15 Dec)
- For Central CA, NCEP is forecasting slightly above-normal AR activity, ECCC and ECMWF are forecasting near-normal AR activity
- For Southern CA, NCEP and ECMWF are forecasting slightly below-normal AR activity, and ECCC is forecasting near-normal AR activity

Models disagree somewhat on AR activity in CA during Week 3 (9–15 Dec)

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)

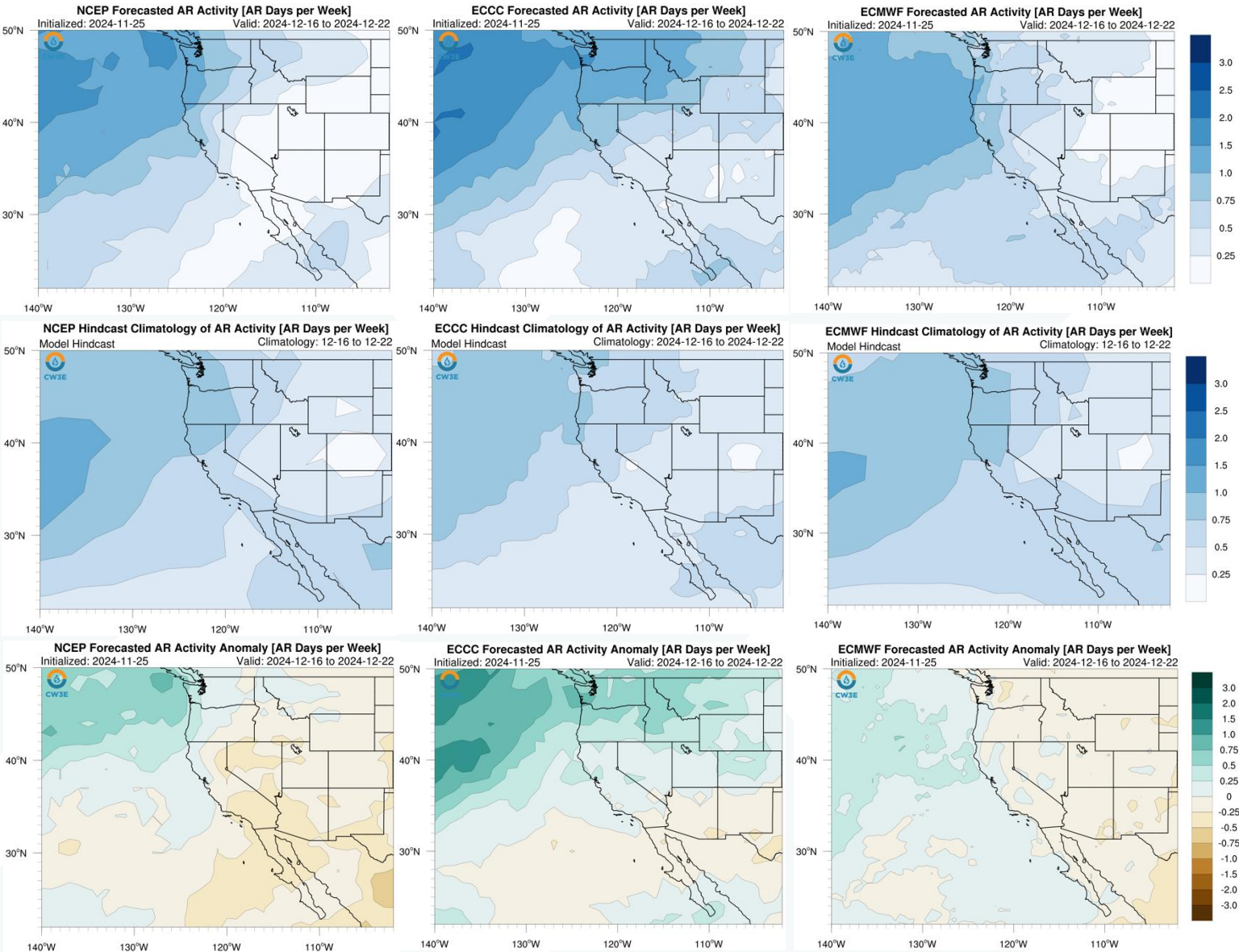
AR Activity Forecasts: Week 4 (NCEP vs. ECCC vs. ECMWF)

Forecasts Initialized 25 Nov 2024

NCEP

ECCC

ECMWF

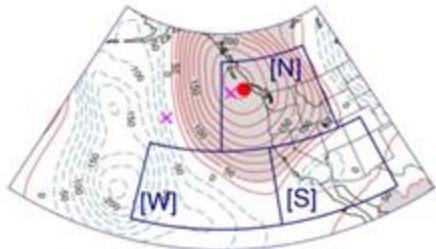


- All models are forecasting near-normal AR activity over Northern and Central CA during Week 4 (16–22 Dec)
- For Southern CA, NCEP is predicting slightly below-normal AR activity, ECCC and ECMWF are predicting near-normal AR activity

Models generally agree on near-normal AR activity in Northern and Central CA during Week 4 (16 – 22 Dec), but disagree somewhat on AR activity in Southern CA

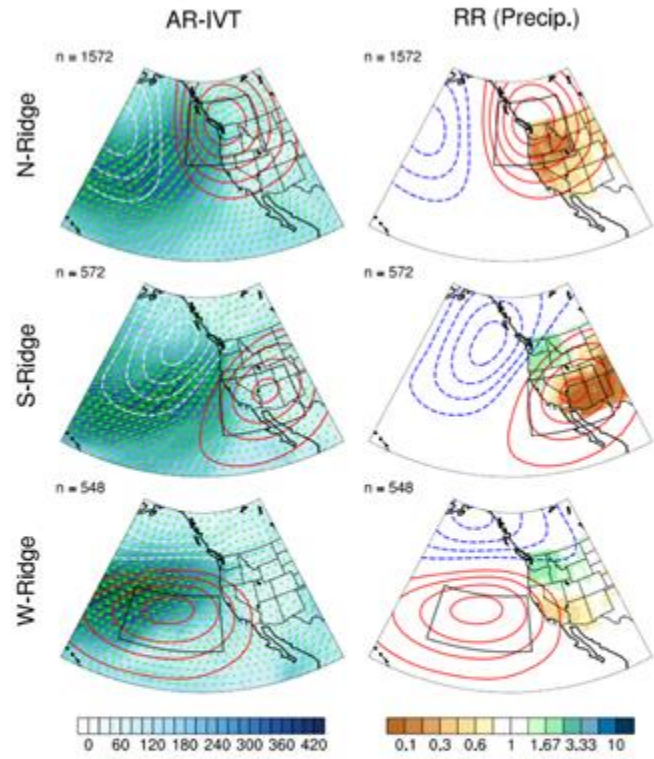
Shading: Fractional # of AR days forecast over a 7-day period (top), model climatology (middle), and forecast minus model climatology (bottom; green/blue = higher than climatology; brown = lower than climatology)

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

Ridging Forecasts: Weeks 1–2 (NCEP vs. ECMWF)

Forecasts Initialized 25 Nov 2024

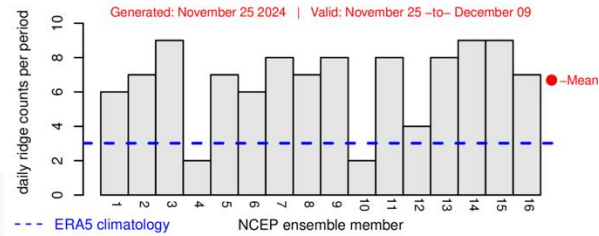
NCEP

CW3E Subseasonal Ridging Forecast

(Uses NCEP CFSv2 model)

North-ridge type (lead time: weeks 1 & 2)

Generated: November 25 2024 | Valid: November 25 –to– December 09



dry conditions
wet conditions

88%
ensemble agreement

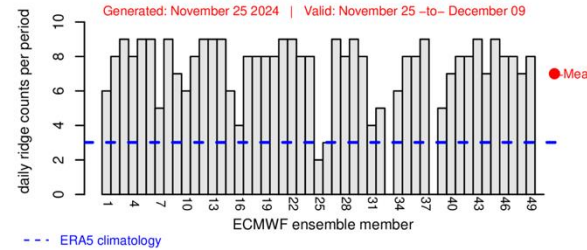
ECMWF

CW3E Subseasonal Ridging Forecast

(Uses ECMWF model)

North-ridge type (lead time: weeks 1 & 2)

Generated: November 25 2024 | Valid: November 25 –to– December 09

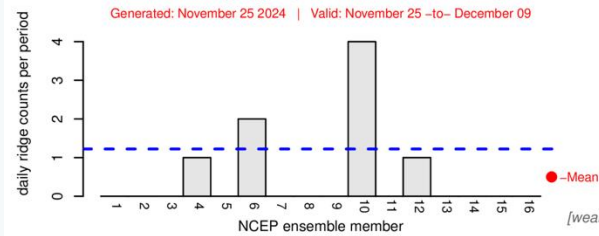


dry conditions
wet conditions

90%
ensemble agreement

South-ridge type (Lead time: weeks 1 & 2)

Generated: November 25 2024 | Valid: November 25 –to– December 09

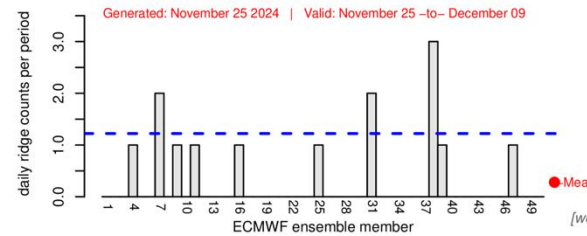


[weak south-ridge signal, <50% agreement]

<50%
ensemble agreement

South-ridge type (Lead time: weeks 1 & 2)

Generated: November 25 2024 | Valid: November 25 –to– December 09

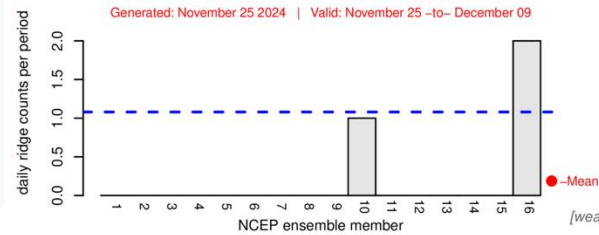


[weak south-ridge signal, <50% agreement]

<50%
ensemble agreement

West-ridge type (Lead time: weeks 1 & 2)

Generated: November 25 2024 | Valid: November 25 –to– December 09

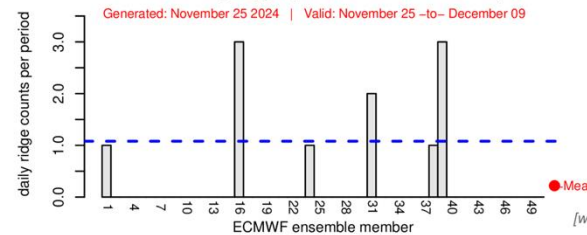


[weak west-ridge signal, <50% agreement]

<50%
ensemble agreement

West-ridge type (Lead time: weeks 1 & 2)

Generated: November 25 2024 | Valid: November 25 –to– December 09



[weak west-ridge signal, <50% agreement]

<50%
ensemble agreement

- NCEP and ECMWF are both forecasting a high likelihood (>85% ensemble agreement) of above-normal North-ridge activity during Weeks 1–2 (25 Nov – 9 Dec)
- Both models are also forecasting very low South-ridge and West-ridge activity



Models agree on high likelihood of above-normal North-ridge activity during Weeks 1–2 (25 Nov – 9 Dec)

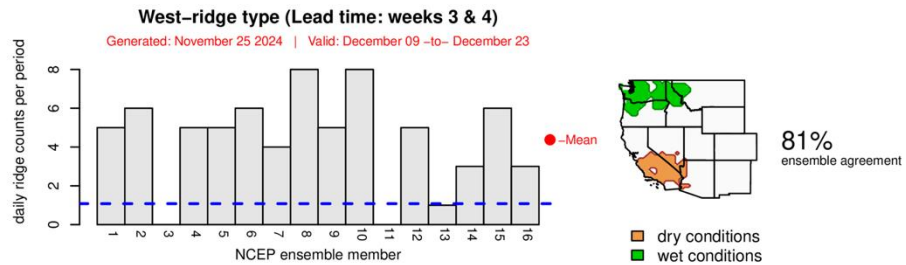
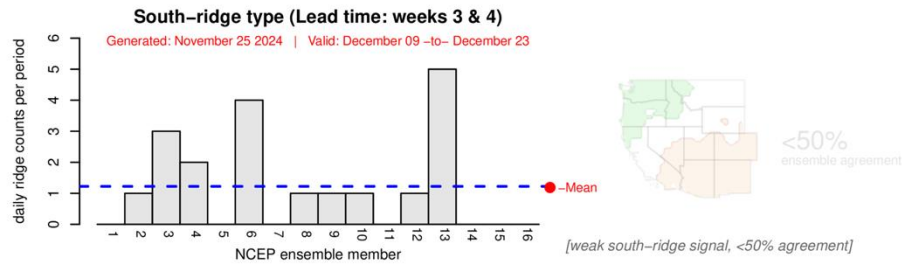
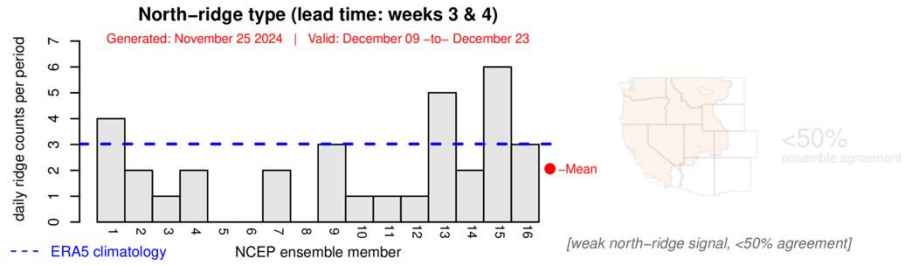


Ridging Forecasts: Weeks 3–4 (NCEP vs. ECMWF)

Forecasts Initialized 25 Nov 2024

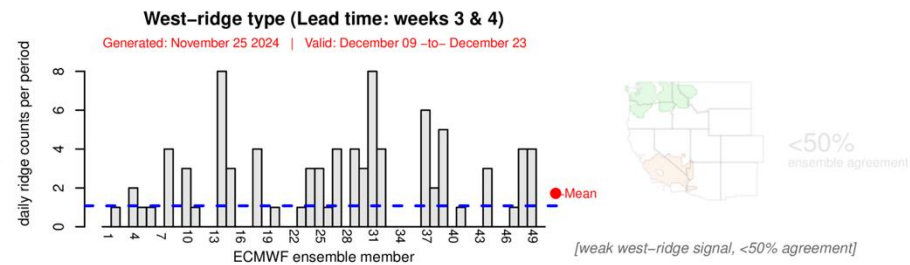
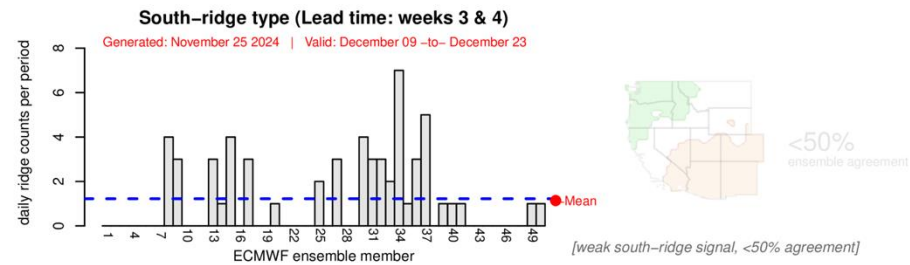
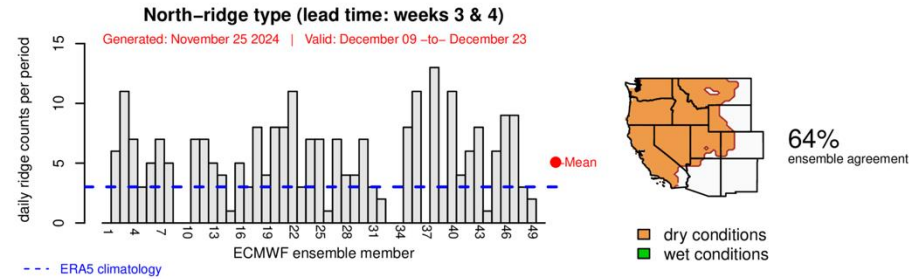
NCEP

CW3E Subseasonal Ridging Forecast (Uses NCEP CFSv2 model)



ECMWF

CW3E Subseasonal Ridging Forecast (Uses ECMWF model)



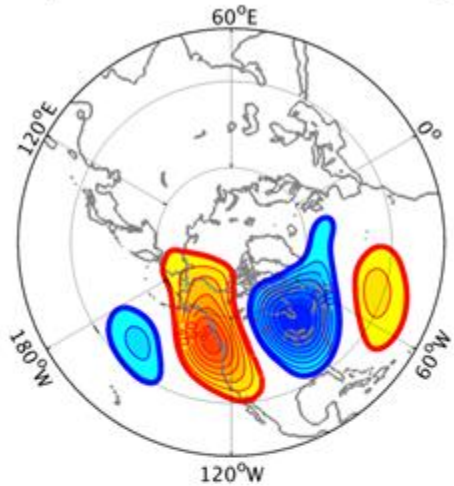
- NCEP is forecasting a high likelihood (81% ensemble agreement) of above-normal West-ridge activity during Weeks 3–4 (9– 23 Dec)
- ECMWF is forecasting a moderate likelihood (64% ensemble agreement) of above-normal North-ridge activity
- Both models are forecasting near-normal South-ridge type

Uncertainty in location of ridging activity near US West Coast during Weeks 3–4 (9–23 Dec)

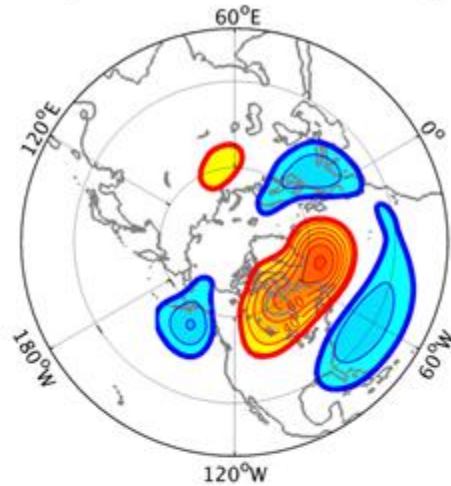


Background Info: IRI Subseasonal Weather Regime Forecasts

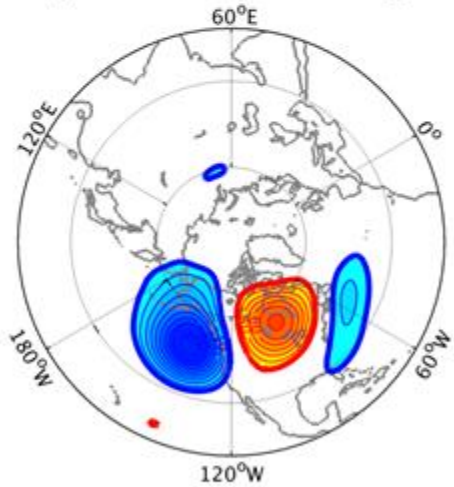
a) WR 1: West Coast Ridge



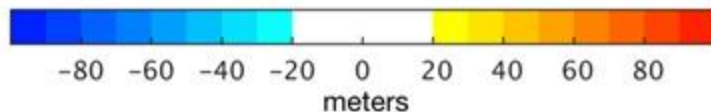
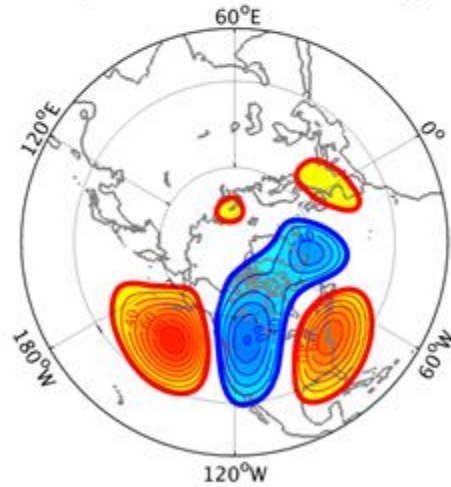
b) WR 2: Greenland High



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)

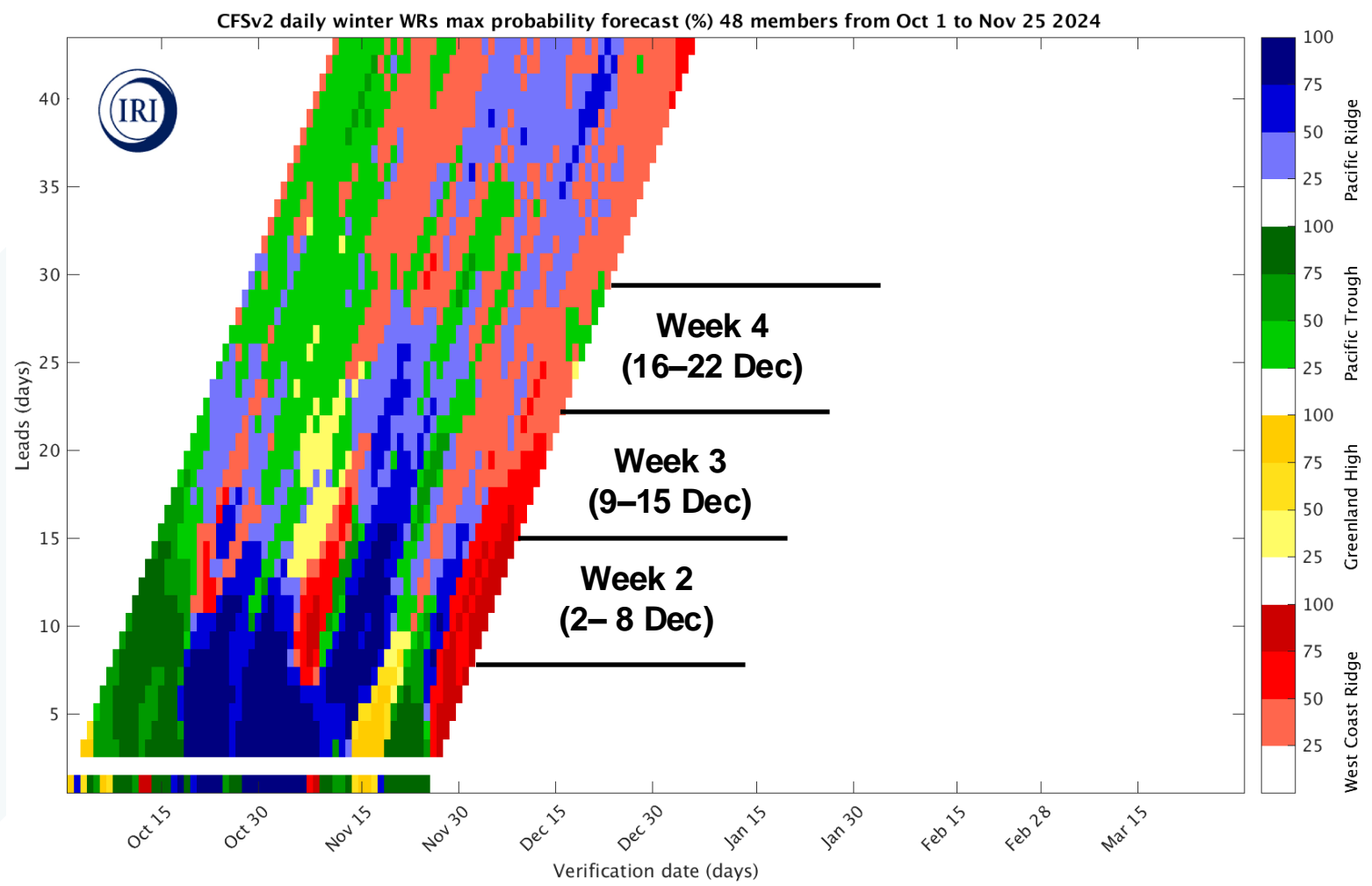
Reference: [Robertson et al. \(2020\)](#)

For more information about the forecast product:

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

IRI North American Weather Regime Forecasts

Forecast Initialized 25 Nov 2024



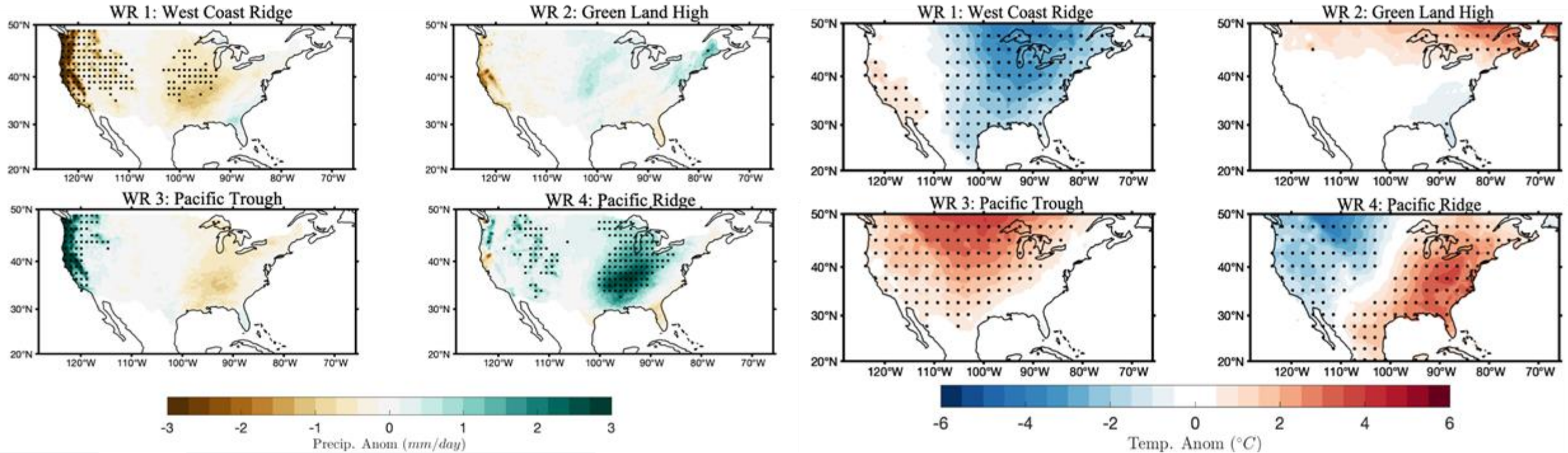
- Daily forecast out to 45-day lead time based on NCEP CFSv2 ensemble
- High likelihood (> 75% ensemble agreement) of West Coast Ridge during Week 2 (2– 8 Dec)
- Low-to-moderate likelihood (25-75% ensemble agreement) of persistent West Coast Ridge out to Week 3 (9– 15 Dec)
- Uncertain weather regime conditions in Week 4 (16-22 Dec)

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.

IRI North American Weather Regime Forecasts

Precipitation

Temperature

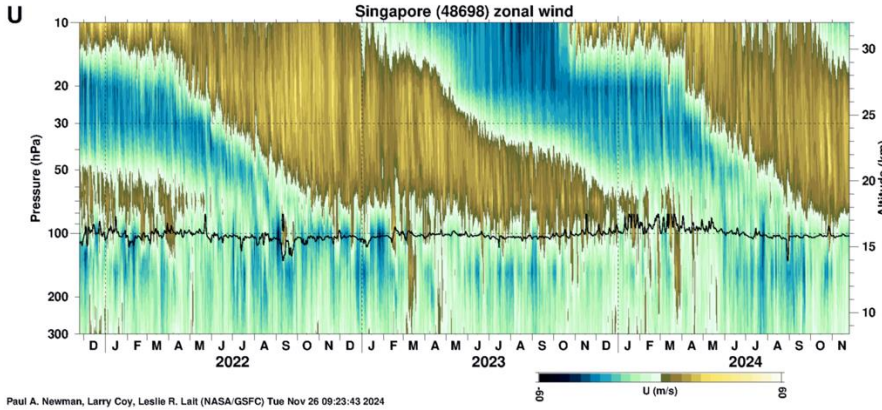


This graphic shows composite mean precipitation (left) and temperature (right) anomalies associated with each weather regime. Stippling (black dots) indicate statistically significant anomalies.

- Below-normal precipitation and above-normal temperature predicted over CA during Week 2 (2–8 Dec) with high confidence in West Coast Ridge regime
- Below-normal precipitation and above-normal temperature predicted to persist over CA during Week 3 (9–15 Dec) with low-to-moderate confidence in West Coast Ridge regime
- Uncertain temperature and precipitation conditions over CA during Week 4 (16–22 Dec)

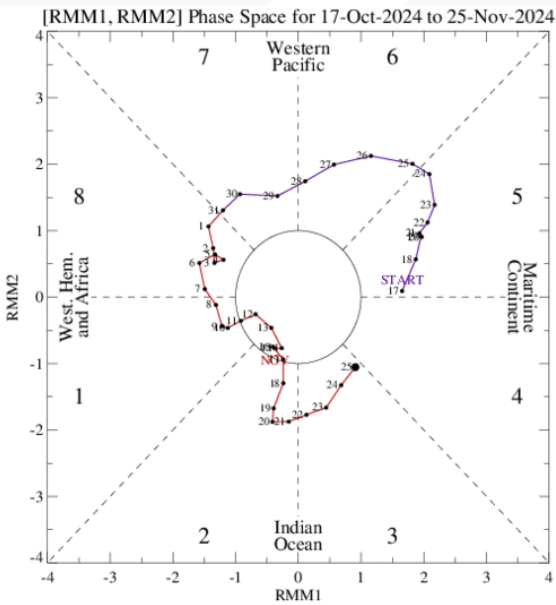
Background Info: AR Activity and Precipitation Based on MJO and QBO

QBO Conditions



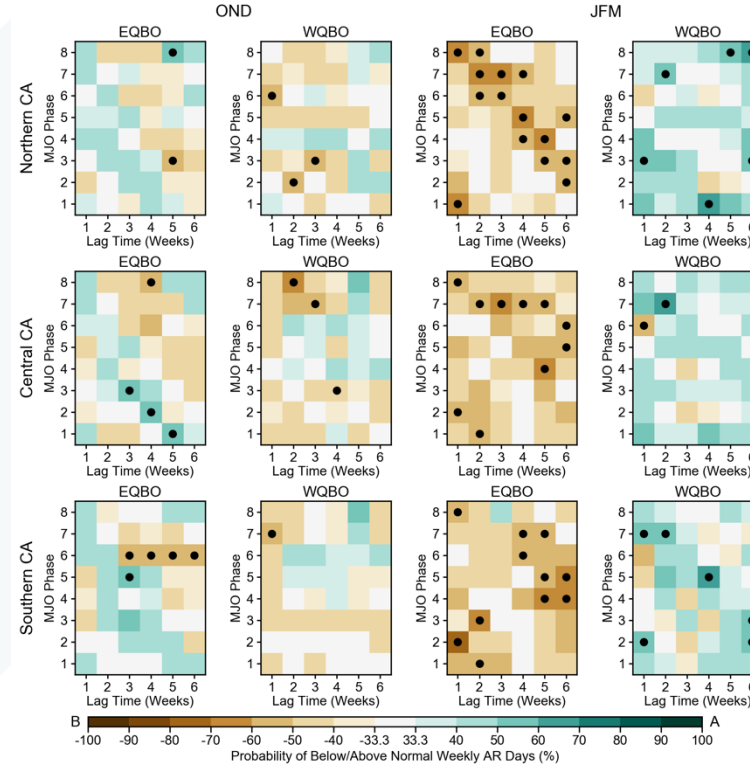
QBO is in the westerly phase at 50-hPa

MJO Conditions

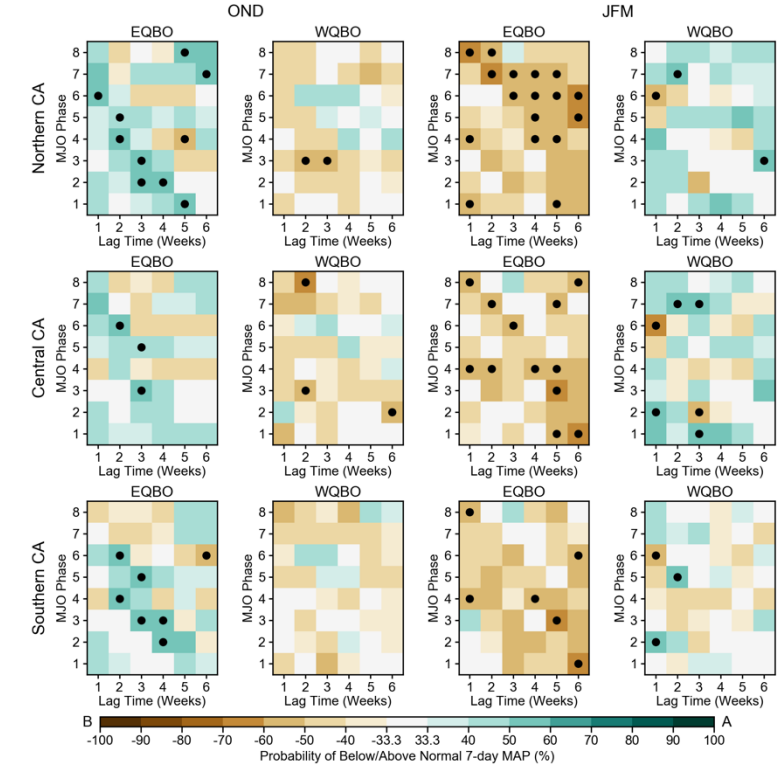


MJO convection is currently located over the Indian Ocean (Phase 3)

Probability of Above/Below-Normal AR Occurrence



Probability of Above/Below-Normal Precipitation



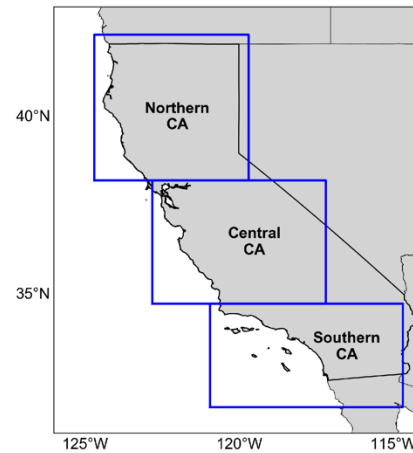
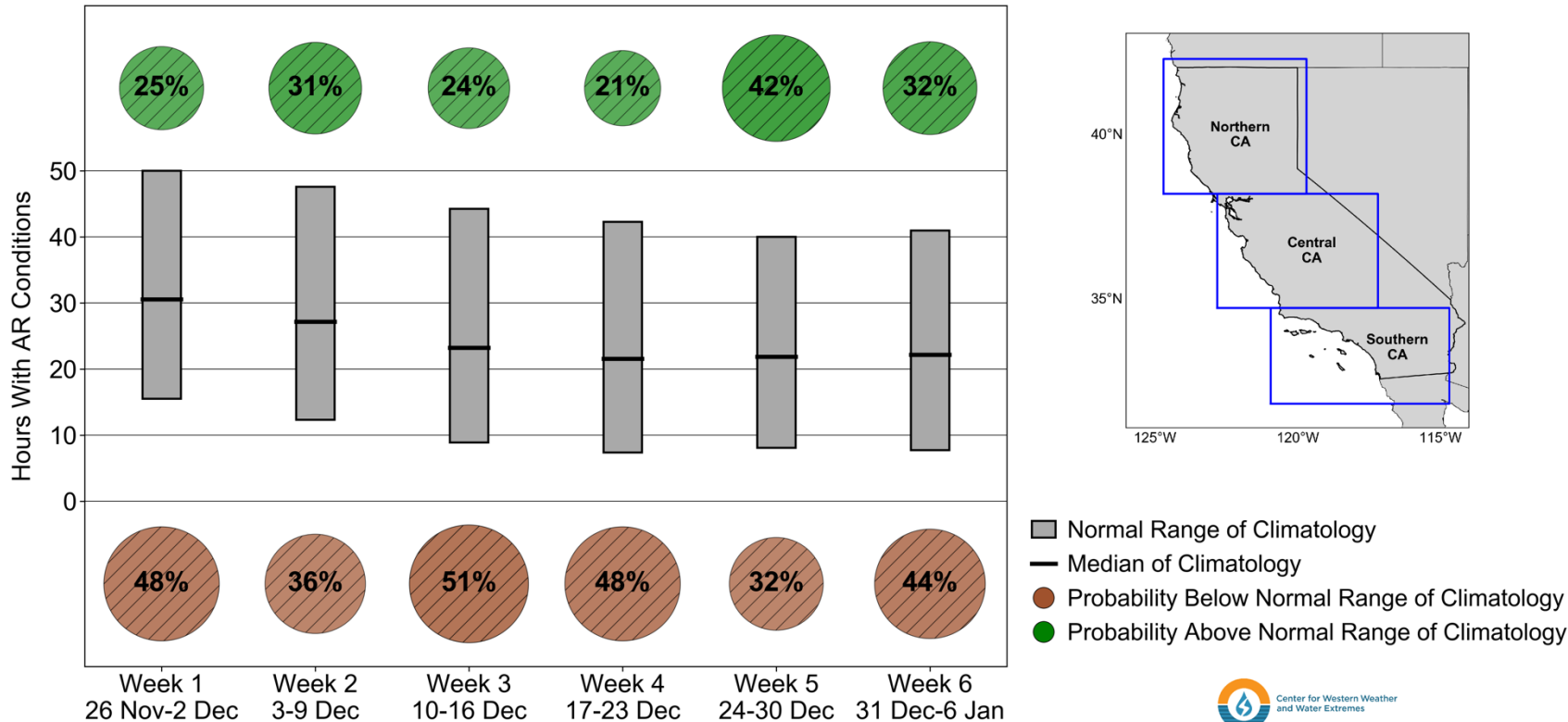
Probability matrices illustrating the weeks 1–6 lagged probability of below-normal (brown shading) or above-normal (green shading) AR occurrence and precipitation for all MJO/QBO phase configurations during OND (left) and JFM (right) in Northern CA (top), Central CA (middle), and Southern CA (bottom). 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.

AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 25 Nov 2024

AR Occurrence: Northern CA

Northern CA Subseasonal AR Occurrence Outlook
Issued: 25 Nov 2024 MJO Phase 3 WQBO



- CW3E's probabilistic AR occurrence forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **Moderate likelihood (40-60% probability) of below-normal AR occurrence in all of CA during Weeks 3-4 (10-23 Dec)**



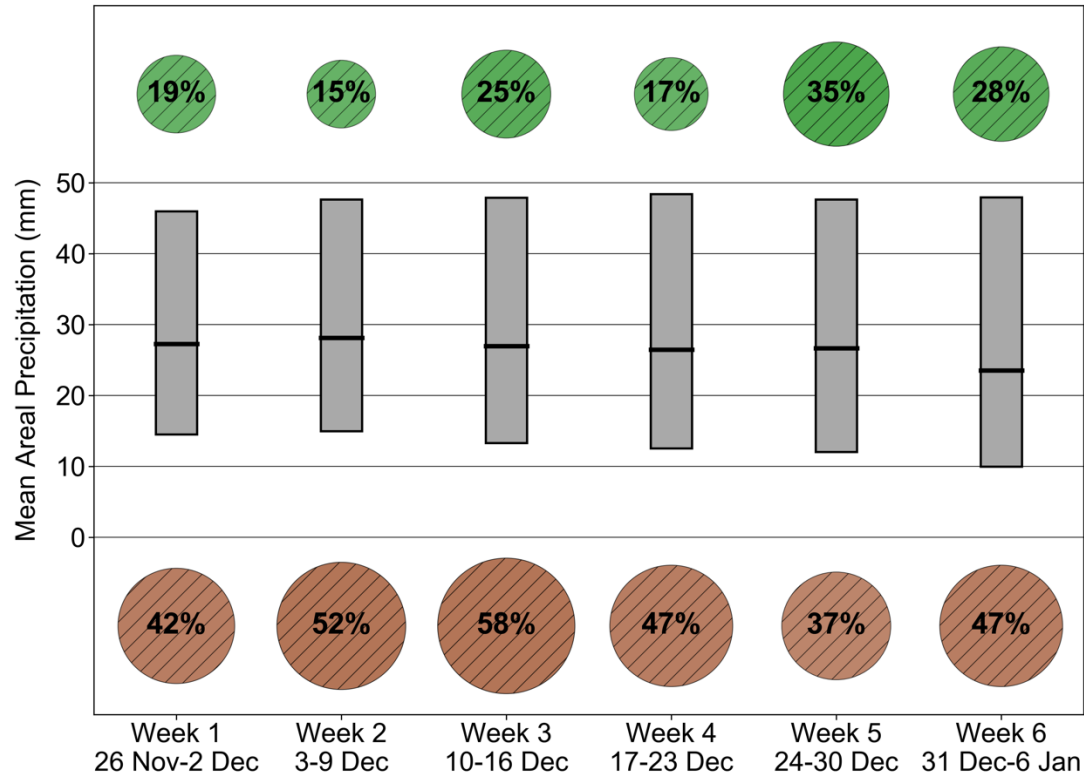
This product shows weekly probabilities of above-normal and below-normal AR occurrence in California. These probabilities are calculated for lead times of 1-6 weeks based on the current season (i.e., OND or JFM) and phases of the Madden-Julian Oscillation (MJO) and Quasi-biennial Oscillation (QBO). If 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. \(2023\)](#)

AR Activity and Precipitation Based on MJO and QBO

Forecasts Initialized 25 Nov 2024

Precipitation: Northern CA

Northern CA Subseasonal Precipitation Outlook
Issued: 25 Nov 2024 MJO Phase 3 WQBO



Normal Range of Climatology
 Median of Climatology
 Probability Below Normal Range of Climatology
 Probability Above Normal Range of Climatology



- CW3E’s probabilistic precipitation forecast based on current MJO and QBO conditions (see forecast for all regions [here](#))
- **Moderate likelihood (40-60% probability) of below-normal precipitation in Northern CA during Weeks 2-4 (3-23 Dec)**
- Moderate likelihood of below-normal precipitation in Central CA during Week 4 (17– 23 Dec)
- Moderate likelihood of below-normal precipitation in Southern CA during Week 2 (3-9 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. \(2023\)](#)

